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TELEVISION

April 1977

Vol. 27, No. 6
Issue 318

CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", Fleetway House, Farringdon Street, London EC4A 4AD. All other correspondence should be addressed to the Editor, "Television", Fleetway House, Farringdon Street, London EC4A 4AD.

BINDERS AND INDEXES
Binders (£2.10) and Indexes (45p) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. Prices include postage and VAT.

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We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.
Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved".

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V2415D
V2415S
V2415SS
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V2417S
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V2423

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17TG100u	19TG170a ...	21TG106u
17TG102u	all models to	21TG107u
17TG106u	19TG179a	21TG109u
17TG200u	G19T210a	
17TG300u	G19T211a	23TG111a ...
17TG320u	G19T212a	all models to
	G19T214a	23TG164a
19TG108u ...	G19T215a	
all models to		23TG170a ...
19TG164a	G20T230a ...	all models to
	all models to	23TG176a
	G20T328	
		G24T230a ...
	21TG100u	all models to
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31F	43F	59	68	83	94	150	170
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TELEVISION

PRICEY PARTS

It's a sad fact that in the specialised and complex business of TV repair there is little choice when it comes to obtaining many of the more expensive replacement parts required. All too often we cannot shop around and take our custom elsewhere when substantial price increases are announced. For the housewife, sausages might do instead of fish fingers, but if we need a TBA920, a TBA950 certainly won't do! The situation was brought home to us recently when we were told by a national valve distributor that the PL509 line output valve had virtually ceased to exist so far as valve manufacturers are concerned. In their wisdom they have decided no longer to make the PL509 – but to make the PL519 available instead. The announcement comes at virtually the same time as the cessation of production of hybrid colour receivers by the setmakers. But no one's used a PL81 in a new set in years, yet this valve is still readily available cheaply enough. The PL519 is a beefier and better device than the PL509 – it was originally designed for use in 110° hybrid sets – but how many dealers or customers are likely to feel that an up-rated line output valve is required in a set designed to use the PL509? Like it or not, they will have to use the PL519 now or go without TV, and the point is that in the last price list we have quoting both types the cost of the PL509 retail to the customer was £2·70 while the retail price of the PL519 was £4·70! Despite the fact that setmakers are no longer in the market for PL509s, the fact is that this had been the standard line output valve for use in 90° colour sets for almost ten years, so the demand will inevitably be appreciable for some years to come. Who's decided then that every time one packs up you've got to pay an extra £2 willynilly?

A similar situation arises with devices which are obsolete, such as the OC series of germanium transistors, or for some reason in short supply, like the PL802 luminance output pentode whose current retail price is no less than £3·25. You may be able to modify a transistor circuit to use more modern devices, but there's not a lot you can do about a PL802.

There are also anomalies which are hard to understand when it comes to service charges and spare parts prices charged by setmakers. If the multiband tuner in a Bang and Olufsen colour receiver has to be returned for repair on an exchange basis the current net charge (to the trade) is £15·25. Yet a tuner which is almost identical electrically and mechanically, used in Decca dual-standard sets, comes at about a third of this price. Line output transformers are not renowned for their reliability: if yours fails, what you will have to stump up depends very much on where it has been obtained. We find that similar line output transformers for hybrid single-standard colour receivers vary in price by as much as 80%. Strangely, it seems to be the more expensive line output transformers that fail most frequently. The number of Decca and ITT hybrid colour receiver line output transformers we've had to replace over the past couple of years can be counted on the fingers of one hand – and that certainly can't be said of another make!

When it comes to Continental and Scandinavian sets, many of which were imported during the boom years around 1972-3, staggering spare parts prices can be encountered. In the trade magazine *Electrical and Radio Trader*, line output transformers for German Combi colour sets, admittedly a rather rare breed, are listed at a cool £35 each – not including the dealer's mark up.

No doubt manufacturers and distributors will be able to present a good case for the prices of the spares and services they provide. But in some cases it seems that exploitation, in others sheer inefficiency, play a part. One thing is certain however. The unfortunate owner of a Combi colour set, whether a member of the public or a rental dealer, would never have guessed when he bought his set that its line output transformer would one day cost five times as much as his neighbour's, while no one would have expected the cost of a line output valve to almost double overnight.

CORRECTION

TV PATTERN GENERATOR

The transistor types shown in Fig. 3 on page 129 of the January 1977 issue were incorrectly quoted as 2N3704 for Tr2 and 2N3706 for Tr3. These should read 2N3904 and 2N3906 respectively. Note that these were also incorrectly specified in the components list on page 128.

teletopics

INTERNATIONAL TRADING

US TV manufacturers are experiencing increased competition from imports: during the first nine months last year a third of the colour set supply and seventy per cent of the monochrome supply consisted of imports – there had been a marked increase in colour set imports. It's interesting to compare the situation with the UK, where rather over half the monochrome set supply was imported though colour set imports were kept down to roughly fifteen per cent. There is no doubt that, as with shipbuilding (and cars?), a certain country has laid down grossly excessive production capacity in recent years.

MORE IN-LINE GUN TUBES

The four remaining US colour c.r.t. manufacturers, RCA, GE, Sylvania and Zenith, are all now producing self-converging, in-line gun colour c.r.t.s – and all have gone their own way. RCA's PIL tube has been in production for several years and is in use world wide. Both Thorn (9000 series chassis) and ITT (CVC20 chassis) use it in the UK. GE's tube is a 25in. one with a conventional shadowmask and phosphor dot screen. Zenith are claiming the biggest recent breakthrough with their 100° deflection, 19 in. slotted mask Chromacolour tube. This uses a new glassware system, developed in conjunction with Corning and said to provide appreciable cost savings, but the main technical interest is in its patented "EFL" gun structure. This has a tripotential focus system with four instead of the usual two electron lens elements. Thus focusing takes place over a longer distance, giving a 60 per cent smaller spot size. The result is a sharper picture with improved colour highlight detail. Zenith seem anxious to offer the design to other c.r.t. manufacturers under licence. Sylvania have announced that they will be producing 100° slotted mask tubes with tripotential focusing, and RCA have decided to adopt tripotential focusing for their 25in., 90° PIL tubes. No other manufacturer has adopted the Zenith/Corning glass system which is understood to be bulkier than conventional colour c.r.t. glassware. Mullard comment that they do not foresee adapting the new focusing system for use in their 20AX tubes. They point out that the design of focusing systems is a matter of compromise between various performance requirements, some of which conflict: while the longer tripotential lens offers some improvement in central area focusing it does so at the expense of a larger deterioration in focus quality from the centre to the edges of the picture.

There is no doubt that the main problem with in-line gun tubes is in getting good focus over the picture area. Different tubemakers have adopted different compromise solutions to the problem. Whether the vast majority of viewers, who never examine picture quality all that closely, would notice the differences seems rather doubtful to us however. For most of the time the viewer observes the centre area of the screen where the problem is not so great. In fact problems such as this – and complaints about convergence – seem to arise mainly during the tennis season, when the eye is being constantly directed towards the picture edges!

FLAT PANEL DISPLAYS

The latest issue of the Royal Television Society's Journal contains an extremely interesting account of recent work on the development of flat-panel TV display devices, both monochrome and colour. The conclusions don't give much hope for any appearance of these in commercial sets in the foreseeable future however – in fact it's said that major breakthroughs will be needed before even prototype panels suitable for domestic viewing can be developed.

There are three basic approaches to producing a flat-panel display – to use arrays of light-emitting diodes, liquid crystal cells or plasma cells. LEDs seem to be the obvious approach – semiconductor diode arrays have already been used successfully in cameras – but they suffer from inadequate brightness and colour ranges. Liquid crystals act basically as light filters which can be modulated to provide varying brightness, and don't seem to be serious contenders in this field. The vast majority of the work reported in fact has been done on plasma (ionised gas) displays. These consist of large numbers of discharge tubes – think of an array consisting of a vast number of miniature fluorescent tubes. About half a million would be required to provide a 625-line picture with adequate resolution, at least two individual connections to each cell being necessary. The advantage of using plasma cells is that they can be readily adopted to produce the required primary colours: this is done by using the ultraviolet radiation produced by the discharge to activate suitable phosphors to give the appropriate coloured light outputs.

The complications of such arrays seem rather daunting however. The cells are connected in rows and columns, with the drive voltage applied to each cell in turn. But it's not just a matter of turning the cells on one after another. Some form of modulation has to be used in order to obtain various contrast levels – a grey scale in other words. Also some form of memory is required in order to maintain the

appropriate discharge between the times when the individual cells are "scanned". The receiver itself is considerably complicated since the video signal has first to be converted into a digital form suitable for driving the panel. A major disadvantage is the operating temperature of some of the more successful plasma panels – 70°-90°C. This means that considerable insulation is necessary, and brings with it the problem that the warm up time would be about half an hour unless extra power was applied during the warm up period. Even then the warm up time is unlikely to be less than ten minutes.

Quite a lot of work is being done on flat-panel TV display devices, almost entirely in Japan and the US. Nine new experimental devices were announced during 1974-5. But the time when such things will form part of the domestic TV scene still seems a very long way off.

VIDEO

Despite its failure to make any headway in its home (German) market, the TED videodisc system is to be introduced on the Japanese market. Two Japanese manufacturers, Sanyo and General, have been licensed to produce TED videodisc players to the NTSC system. Test marketing is also expected in the US before long, where 1977 is also the target date for the introduction of the Philips and RCA videodisc systems. All videodisc systems to date have been for playback only, but a professor at Toronto University has put forward suggestions for home recording on videodiscs, using the laser/optical approach developed by Philips. His proposal is based on the use of a plastic disc material on which recordings could be made using a relatively low-power laser – in fact only 2mW, just twice the power of the laser used in the Philips' system to scan the records for playback.

It's still a very open question as to whether discs or tape will become the accepted medium for domestic video. Sony say they expect that the main area of growth in home electronics over the next few years will lie in videotape recording. They sold an astonishing 100,000 colour VCRs last year and anticipate selling a quarter of a million units this year.

LABGEAR'S TELETEXT DECODER

Labgear are at present producing their Teletext decoder, Model 7026, at the rate of some 200 a month. This is an aerial socket type adaptor which is simply connected between the aerial downlead and the set's aerial socket. It is understood to be being retailed at a price in the region of £390-395 including VAT.

TRANSMITTER NEWS

The following transmitters are now in operation:

Bressay (Shetlands) ITV (Grampian Television) channel 25. Receiving aerial group A. Vertical polarisation. Maximum e.r.p. 10kW. To extend the service from the Orkneys to the Shetlands, a distance of over 100 miles, too far for either a rebroadcast link or a direct microwave link, a special link station has been built on Fair Isle roughly midway between the Orkneys and Shetlands.

Cambret Hill (Wigtown, Scotland) ITV channel 41 (Border Television), BBC-1 channel 44, BBC-2 channel 51. Receiving aerial group B.

Channel Islands – the BBC's Fremont Point (BBC-2 channel 44, BBC-1 channel 51) and Les Touillets (BBC-2 channel 48, BBC-1 channel 56) stations are in operation. A group B aerial is required for the former, a group C/D aerial for the latter. Polarisation is horizontal in both cases.

Dallington Park (Northampton) ITV channel 56 (Anglia Television), BBC-2 channel 62, BBC-1 channel 66. Receiving aerial group C/D.

Ffestiniog (Gwynedd) BBC-Wales channel 22, BBC-2 channel 28. Receiving aerial group A.

Fodderty (Scotland) BBC-1 channel 57, ITV channel 60 (Grampian Television), BBC-2 channel 63. Receiving aerial group C/D.

Llanidloes BBC-Wales channel 22, BBC-2 channel 28. Receiving aerial group A.

Poole (Dorset) BBC-1 channel 57, BBC-2 channel 63. Receiving aerial group C/D.

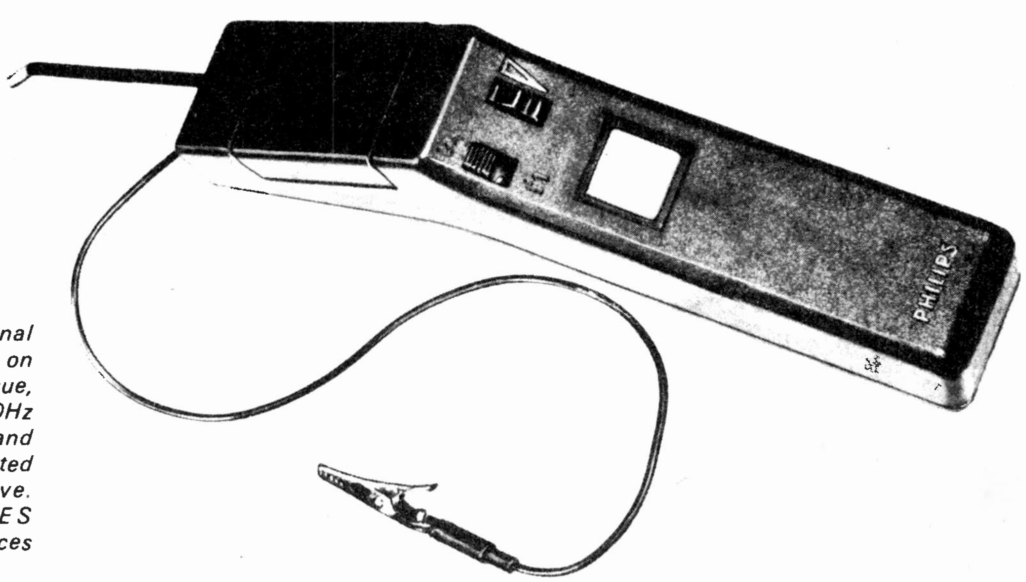
Rothesay (Strathclyde) BBC-1 (Scotland) channel 22, ITV channel 25 (Scottish Television), BBC-2 channel 28. Receiving aerial group A.

Wooburn (Nr. High Wycombe, Bucks) BBC-1 channel 49, BBC-2 channel 52, ITV channel 56 (London programmes). Receiving aerial group C/D.

Polarisation is vertical unless otherwise stated.

POCKET STATION GUIDE

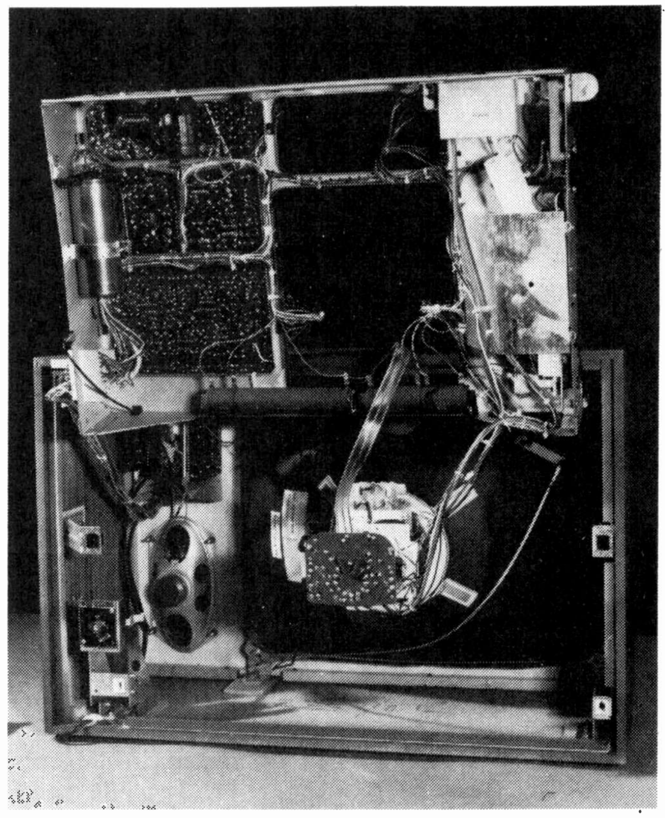
The IBA have published a new (January 1977) edition of their excellent pocket guide to transmitting stations. For a copy apply to the Engineering Information Service, IBA, Crawley Court, Winchester, Hants SO21 2QA.



The Philips SIM212 signal injector, which was reviewed on page 192 of the February issue, provides test signals at 300Hz (squarewave), 4·43MHz and 6MHz, the latter two modulated by the 300Hz squarewave. Available through CES (Combined Electronic Services Ltd.).

The Decca 80 Chassis

Barry F. Pamplin



Rear view with the chassis hinged upwards. Note the clean layout – reminiscent of monochrome chassis.

THE Decca "Bradford" chassis in its various versions – the 10 and 30 series – proved itself to be a popular and reliable design over the years following its introduction in 1970. With production figures approaching the 900,000 mark however it was clearly time to produce a successor which would take into account the technical developments over those seven years. This successor is the 80 series chassis – and its larger screen variant the 100 series chassis. Sets fitted with the 80 chassis have been available since early 1976: the 100 chassis has been released only recently, though export versions have been available for some months.

Two major advances since the early 1970s have had a marked influence on TV receiver design. First, the increasing number of analogue i.c.s specifically designed for use in TV receivers. And secondly the development of in-line gun colour tubes with their much simplified convergence systems. Both these have played an important role in the development of the new Decca chassis.

In these articles the circuitry and construction of the chassis will be described, along with fault diagnosis procedures and those stock faults which have come to light so far. We shall deal mainly with the 80 chassis, bringing in the

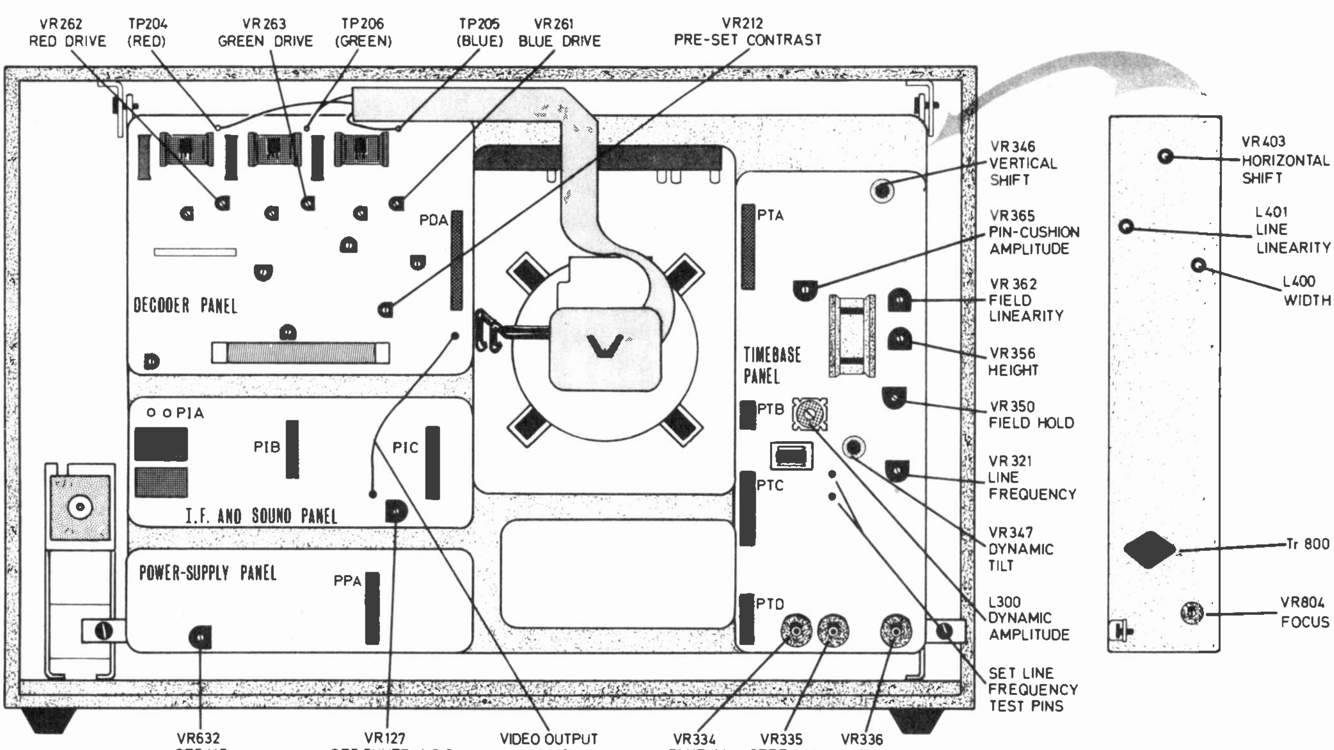


Fig. 1: Rear chassis view, showing positions of the preset controls.

differences found in the 100 chassis towards the end. The 80 chassis is designed around the 90° Toshiba SSI tube while the 100 chassis is fitted with the Mullard/Philips 110° 20AX tube. The differences are to be found in the timebases and the convergence sections therefore, the signal circuits and the power supply being virtually the same.

Layout

Like the Bradford chassis, the 80 series has been designed for easy service accessibility. The basic layout is shown in Fig. 1. The chassis is hinged at the top and can be swung through 180° so that the presets on the printed panels can be adjusted whilst viewing the front of the set. At first sight this arrangement may seem precarious, but because of the design of the hinge brackets the whole assembly is surprisingly stable. Indeed the whole weight of the cabinet and tube can be pivoted backwards by pulling on the top edge of the chassis framework! Unlike the Bradford chassis, which is full of sharp edges and corners, the 80 series has a nice "feel" in the mechanical sense. Because of the power supply arrangement however it has the drawback of always being at half mains potential above earth. Thus any servicing should be done on a bench fitted with an isolating transformer.

The "works" are arranged on five printed circuit panels, four of which can be seen in Fig. 1. The fifth panel, containing the line output stage, is mounted behind the timebase panel.

There are two c.r.t. sizes with the 80 chassis, 18in. and 20in. The Toshiba SSI tubes feature in-line guns, vertical phosphor stripes and a high degree of preconvergence. A high-impedance line scanning yoke is used to minimise the power requirements of the line output stage, and because of the preconvergence of the tube (tubes with in-line guns need no convergence correction in the vertical direction) the number of dynamic convergence controls is reduced from the 12 required with delta-gun tubes to only three – two to overlay the red and green and blue verticals at the sides of the screen, and one to cancel crossover errors along the centre horizontal line. The substitution of a small permanent magnet assembly on the tube in place of the conventional convergence yoke gives the whole interior a distinctly "monochrome" look.

All the panels on the framework can be easily removed for servicing or replacement, and the whole framework can be lifted out of the cabinet and stood on the bench. This is achieved by hinging the chassis upwards 90° from its normal position and sliding it off its top hinges.

The main chassis is designed to be used in a variety of models with different tuner and front panel arrangements. It can also be used with a remote ultrasonic transmitter unit which provides volume control and sequential channel changing "from the arm chair".

The current range of models includes the CR0801 (18in. with varicap tuner), the CT0802 (20in. with varicap tuner) and the CT0812, a "de-luxe" 20in. version with touch tuning.

Standard Tuner

The circuit arrangement of the standard tuner is shown in Fig. 2. It's conventional and causes little trouble apart from some cases of drifting or low gain. The 12V supply for the tuner is fed to pins 4 and 8 via the decoupling circuit L2/C2. A.G.C. from the i.f. panel is fed to pin 2 via the decoupling circuit L1/C1 whilst a.f.c. is fed to pin 5 via R2/VDR1. The use of a VDR in this position may look a bit odd: its purpose is to counteract the non-linear potential/frequency response of the varicap diodes and thus provide a more level a.f.c. action over the full tuning range.

The tuning voltage is derived from the main 165V h.t. supply, via resistors R4/R5 and the TAA550 stabiliser IC1. This provides a nominal 33V which is applied to the switched tuning potentiometers via the decoupling network R3/C4 which eliminates the low-frequency noise produced by the stabiliser. The output from the tuning potentiometers is fed to pin 5 of the tuner, in parallel with the a.f.c. signal, R1/C3 providing the necessary decoupling.

Tuner faults are usually easy to diagnose since they give rise to well defined symptoms of low gain or tuning drift. The former is almost always due to the front end transistor or, occasionally, the aerial isolator. The latter is caused either by a defective stabiliser (IC1) or a defective tuner unit. One or two cases of intermittent and noisy tuner operation have been traced to intermittent leaks in the decouplers C3 and C1.

Touch Tuner

The circuit of the touch tuner is shown in Fig. 3. The tuner circuit proper is similar to that described in the previous section, with the addition of a preset control VR3 which alters the voltage fed to the tuning potentiometers to enable the tuning scale to be calibrated correctly. There is also an additional transistor Tr1 connected as an emitter-follower between the output of the tuning potentiometers and the varicap tuner.

The touch tuning circuits are based on six pairs of pnp/npn transistor bistable circuits with LED indicators to show which channel has been selected. All the channels use similar circuits with the exceptions that channel one is modified to ensure that this channel is always selected when the set is first switched on, while channel six is arranged to provide switching of the flywheel sync circuit time-constant to make the set suitable for use with a domestic videotape recorder or other locally generated signal source which requires the line sync circuits to follow rapid fluctuations in the timing of the line sync pulses.

When the set is first switched on the potential at PTUE3 is zero and the bistables are all off. Capacitors C12/C13 commence to charge from the 37V line via R16. Eventually the junction of the two capacitors attains a high enough potential to bias on Tr703 via R12. This transistor turns on and by virtue of the d.c. coupling via R720 causes Tr702 to turn on as well. Thus both transistors are locked on and current passes through the LED LD701. The bottom end of the tuning potentiometer VR703 associated with channel one is connected to chassis when Tr703 conducts: thus diode D703 connected to its slider becomes forward biased and the potential present at that point passes to the base of the tuning transistor Tr1.

Now consider what happens when the touch button for channel two is bridged. The base of Tr704 is then connected to a negative supply which is obtained by rectifying the line pulses present at the cathode of D3. The supply is connected via R15/C11 and R14. Since Tr704 is a pnp device, the effect of this is to turn it on, pulling down the voltage on the line to which D704 is connected – i.e. from PTUE3. This line is normally about 2·5V above chassis. The holding current of the channel one bistable is thus reduced and it turns off. At the same time transistor Tr705 is switched on because of the coupling between Tr704 and Tr705, and LD702 lights.

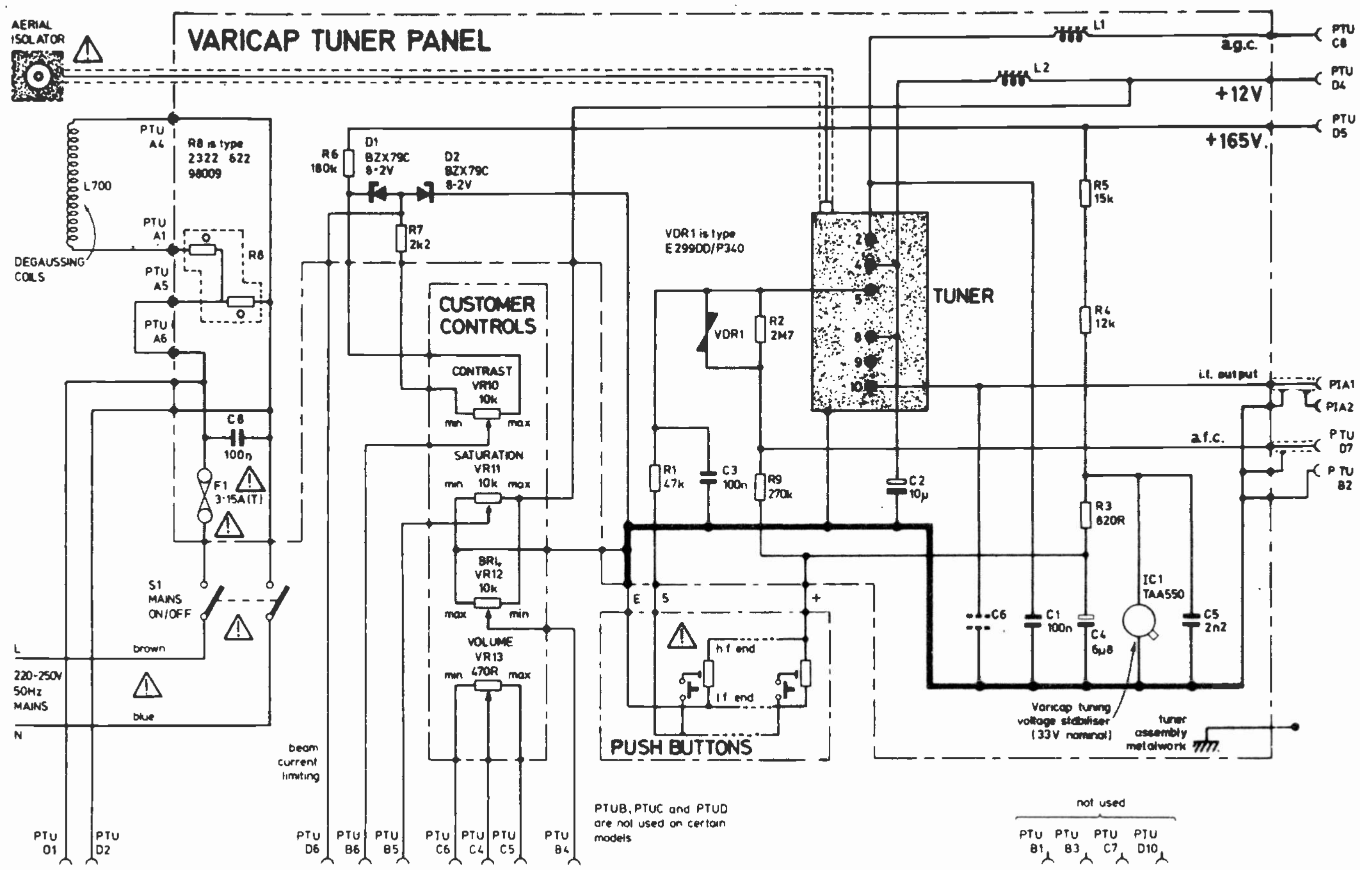


Fig. 2: Circuit diagram of the varicap tuner panel, the control panel and the push-button unit. Note that the mains fuse and mains filter capacitor (C8) are mounted on the varicap tuner panel.

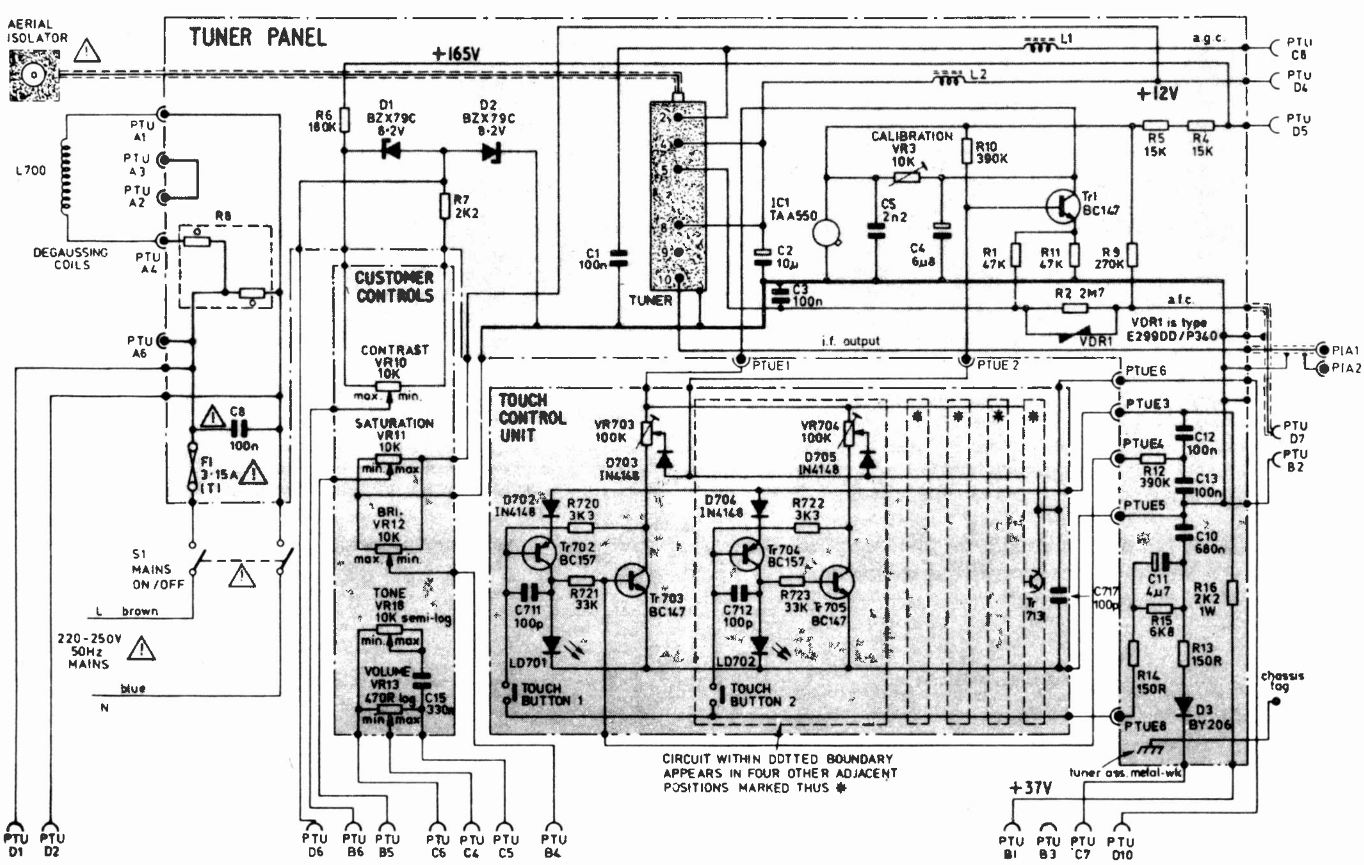


Fig. 3: Circuit of the varicap tuner panel, control panel and touch tuning system used in Model 20CT0812. The transistor pairs Tr702/Tr703 etc. act as regenerative switches for channel selection. When another channel is selected by connecting the base of the appropriate transistor to the negative rail produced by D3, the previously conducting transistors switch off due to the momentary lowering of the voltage on the 2·5V rail (at PTUE3).

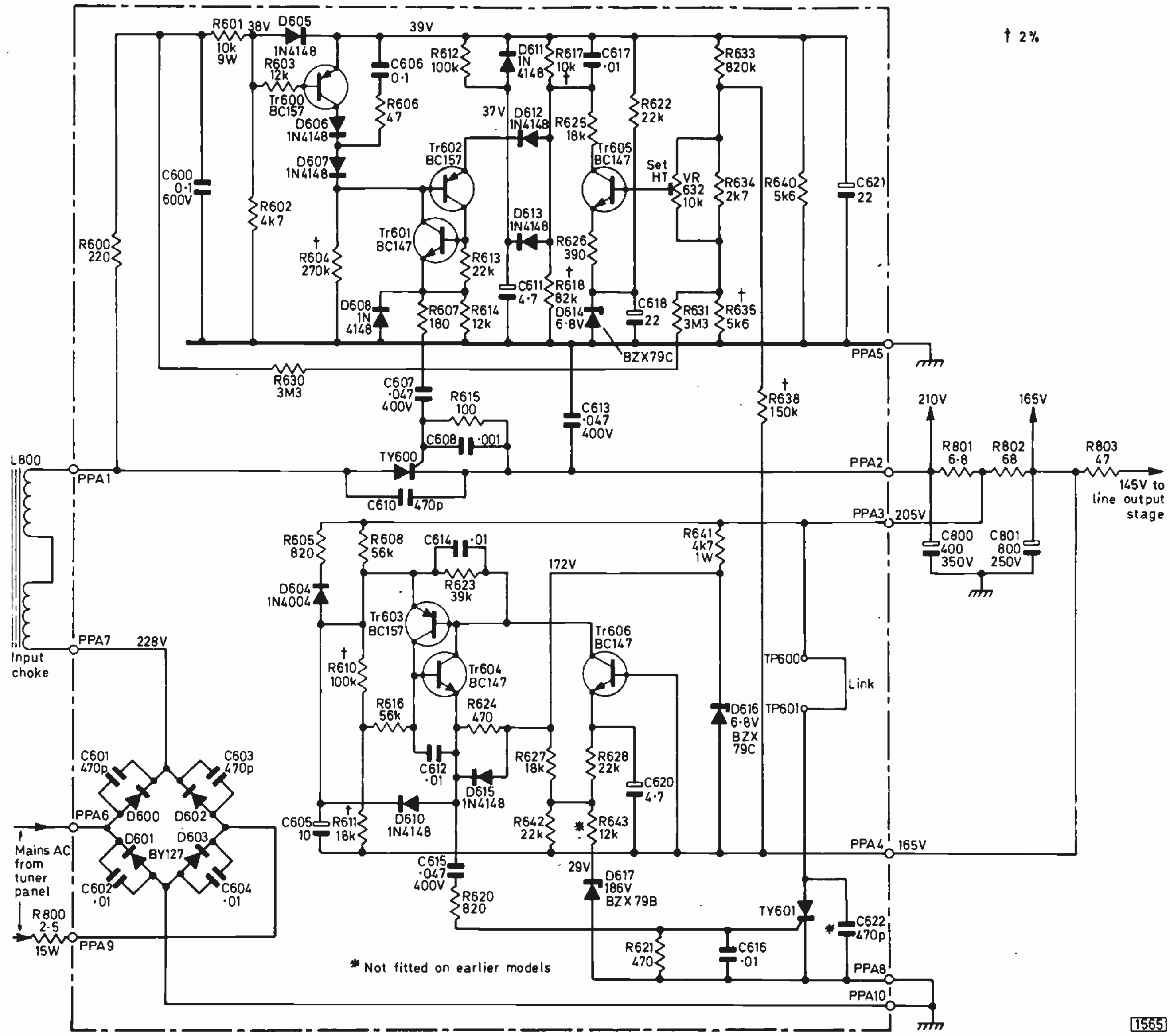


Fig. 4: Circuit diagram of the power supply system.

One feature of the circuit is that the simultaneous operation of two of the touch buttons will bring two channels into operation at the same time. This is easily corrected however by simply selecting a third channel which will then switch off the other two.

Power Supplies

There are two power supplies in the receiver. First a mains derived supply which provides a stabilised 210V line for the RGB output stages and a stabilised 165V supply for the line driver/output stages and the varicap tuning supply. Secondly a line output stage derived 37V supply which is used in conjunction with various subsidiary stabilisers to feed all the other circuits.

The mains derived supply (Fig. 4) incorporates non-resetting trip circuits which fire a crowbar thyristor and blow the mains fuse in the event of excessive h.t. voltage or current. The line timebase derived supply is fed via a fusible 1Ω resistor which opens under excess current conditions.

The tendency in modern television sets for the power supply circuitry to become more and more complicated whilst every other department becomes a collection of insect like black blocks is well exemplified by this chassis. In order to understand the operation of the power unit we will consider first the stabiliser and then the protection circuits.

Voltage Regulation

Because of the profusion of components involved it is as well to try and get an overall idea of the general scheme of things before going into detail. Fig. 5 shows the stabiliser in block schematic form. The incoming mains supply is applied to a diode bridge whose negative output is

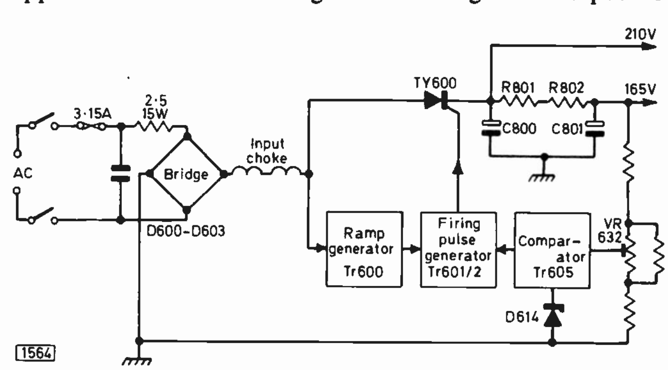


Fig. 5: Block diagram of the voltage stabiliser.

connected to chassis. *This means that at all times the chassis is around 125V above earth.* The positive output of the bridge, consisting of 100Hz pulses, is applied to the anode of thyristor TY600. This device is switched on for a greater or smaller part of each cycle depending upon whether the stabiliser calls for more or less output. It feeds a conventional *RC* smoothing and reservoir circuit (C800, R801, R802, C801).

The pulses to fire the thyristor are generated from the 100Hz signal by the ramp generator circuit, the phase of the pulses being controlled by a comparator circuit which compares a fraction of the 165V h.t. voltage with the fixed voltage across zener diode D614 and uses the resulting error signal to arrange the firing pulse to turn the thyristor on earlier or later in each cycle.

Returning now to Fig. 4, the positive output from the mains bridge rectifier is fed via the current limiting choke L800 to the thyristor and also, via R600, R601 and D605 to C621. The peak potential across this capacitor is limited to about 39V because of the potential divider effect of R601 and R640. It is used as the h.t. line for the control circuits.

The values of these components are chosen so that D605 conducts during most of each cycle, apart that is from the two periods at the beginning and end of the cycle when the voltage approaches zero. During these periods the diode is reverse biased and switches off. When this happens transistor Tr600, whose base-emitter junction is in parallel with D605, turns on and discharges C606 which had previously charged to 39V via R604, D607 and R606. This process repeats itself every cycle and in consequence a 100Hz negative-going ramp waveform appears on the bottom plate of C606.

This signal is used to drive the pulse generator circuit — Tr601/Tr602. These two transistors are coupled together in a loop so that by regenerative action they both turn on fully when the base potential (ramp voltage) on Tr602 exceeds its emitter voltage (set by the comparator circuit). When Tr601 turns on, its emitter goes positive and the resulting pulse is coupled to the gate of TY600 via C607.

The comparator transistor Tr605 simply compares its base voltage, which is provided by a potential divider (R638, R634/VR632 and R635) connected across the 165V h.t. rail, with its emitter voltage which is set by the 6·8V zener diode D614. It thus develops across its collector load resistor R617 a voltage proportional to the difference between its base and emitter voltages. Since the collector of Tr605 is connected to the emitter of TR602 via D612 it follows that the comparator will control the point on each ramp when the Tr601/Tr602 combination will turn on and fire the thyristor. Components C611 and D613 provide a delay at switch on so that the h.t. line builds up in an orderly fashion, D611 discharging C611 at switch off.

Loop Stability

Control circuits of this sort have to be carefully designed to ensure that the loop does not go unstable and cause hunting or other unwanted swings in the output. Knowing which components are used for loop stabilisation is most important when fault finding, and they will now be dealt with in some detail.

An important consideration in all phase controlled thyristor power supplies is to ensure that under conditions of low input voltage or high current drain the trigger circuit does not try to turn the thyristor on so early in the cycle that its cathode voltage, i.e. the voltage across the reservoir capacitor, is higher than its anode voltage. If this was to happen the thyristor would not turn on and the circuit would start operating with the thyristor missing every second or third cycle. The key component which prevents this happening in the 80 series circuit is R618. It limits the positive potential which appears at the emitter of Tr602 even if Tr605 goes open-circuit. The importance of replacing this resistor, the associated resistor R617 and the ramp timing components C606 and R604 with close-tolerance high-stability units cannot be over emphasised if stable operation is to be obtained.

The other components concerned with overall loop stability are resistors R630 and R631. They inject into the base of Tr605 a current proportional to the mains voltage, thus enabling the comparator to "anticipate" changes in output voltage caused by changes in mains voltage. Beyond this however they have an important function in stabilising the circuit by modifying the trigger time/control voltage transfer characteristic of the control circuit to compensate for the non-linearity of the output voltage/trigger time transfer characteristic of the thyristor . . . what on earth have I written!! The point is that small changes in the triggering time have a much greater effect on the output voltage at different times during the cycle. Why? Simply because sinewaves have a high *dv/dt* (rate of change of voltage with time) at the beginning and end of a cycle, while as the sinewave flattens out at its peak the *dv/dt* decreases. To overcome this effect it is necessary to "modulate" the trigger circuit with a half sinewave: this is done by Tr605 amplifying the half sinewave delivered to it via R630/R631.

What, you may ask, is the purpose of all this abstrusion (can you think of a better way of turning abstruse into a noun?). Simply this – these two resistors are 3·3MΩ, and we all know what happens to very high value resistors with time. So my prediction for 1980 is: if your four year old 80 series chassis is suffering from unstable width, height, brightness or anything else, try changing R630/R631.

Protection Circuits

So much for the stabiliser. We will now turn our attention to the protection circuits.

The "heart" of the protection circuit is the crowbar thyristor TY601 which is triggered into conduction in the event of an overload, blowing the mains fuse F1 without further ado. There are two over-voltage sensing circuits. One senses the h.t. current by monitoring the voltage across R802 while the other monitors the h.t. voltage across the smoothing capacitor C801. In each case a zener diode is used as a reference. The voltage across R802 is used to power the protection circuits.

We will consider over-current protection first. The voltage across R802 is applied to the 6·8V zener diode D616 via the series resistor R641, this stabilised voltage feeding the emitter of Tr604. The potential across R802 is also "potted down" by the divider network R608, R610 and R611, the potential at the junction of R610/R611 feeding the base of Tr604. The values of these resistors are such that with the normal voltage across R802 Tr604 is biased off. If the current rises by more than 50 per cent however, the base voltage on Tr604 turns this device on, Tr603 turns on by regenerative action, and the emitter of Tr604 goes positive to provide a turn on pulse via C615 to fire the thyristor.

The over-voltage sensor is the 186V zener diode D617. With the nominal h.t. of 165V this device is non-conducting and the emitter voltage of Tr606 is fixed by the potential divider R627/R642 across the stabilised 6·8V supply generated by D616. Thus Tr606 is switched off. Any voltage rise above 186V will turn D617 on, causing Tr606

to draw current and bias on Tr603. Regenerative action as before provides a pulse to fire the crowbar thyristor.

Because of the drastic nature of the crowbar action – in viewers' terms it means that a service visit is required – it's important that it operates only on "solid" faults and not, for example, every time the c.r.t. flashes over. To ensure that this condition is achieved a number of components have been added to the basic circuit. An *RC* network R623/C614 is connected between the base and emitter of Tr603, a similar capacitor (C612) is connected between the base and emitter of Tr604 and two additional diodes are incorporated, D610 and D615. Additional components fitted to later panels for the same purpose are C622 across TY601 and R643 in series with D617.

Fault Finding

So much for the operation of the power supply circuits, now on to the troubles. We will deal first with the approach if the set is found to have an open-circuit mains fuse. First of all check for short-circuits in the mains filter capacitor C8, the diode bridge D600 – D603, TY600 and the main smoothing blocks C800 and C801. If all seems well here the next step is to deactivate the crowbar by removing the link between test points TP600 and TP601 at the top right hand corner of the power panel and connect between these points a 240V 15W pigmy lamp. This has two functions: it limits the crowbar current to a level below that which will blow the mains fuse, and it provides a visual indication that the crowbar is operating. Connect a voltmeter across the 165V h.t. line, replace the fuse and switch on.

If the set now works all right the fault was probably either the fuse itself or a transient overload condition which has cleared.

If the crowbar lamp lights then either there is an over-voltage or over-current condition or a fault in the protection circuit. A quick check is to remove the link coupling the droppers R802 and R803 to isolate the line output stage, which is the usual cause of excessive h.t. current.

If the crowbar lamp still lights there is a fault in the stabiliser or the trip circuits. If it does not light and the h.t. rail is correct then there is a fault in the line output stage.

Cases of persistent tripping are usually caused by one of the thyristors going short-circuit or leaky. A quick check on the crowbar thyristor is to remove its gate feed resistor R620 from the panel. If the crowbar still trips then TY601 is certainly faulty.

Another approach to the problem of deciding whether the tripping is being initiated by over-voltage or excess current is to remove Tr606 from the panel. This will inhibit the crowbar action due to excessive voltage.

Intermittent false tripping is a nasty symptom to deal with. The components most likely to be responsible are again the two thyristors, but the slow-down capacitors C620 and C605 are worth attention as well. Also check the loop stabilisation components mentioned earlier, and the e.h.t. tripler by substitution.

Very low or non-existent h.t. voltage is generally the result of failure of one of the following: R800, the diode bridge D600/D603, TY600, Tr600-Tr602 or D612.

A word of warning about the regenerative switching pairs Tr601/Tr602 and Tr603/Tr604. If there is any doubt about these devices change both the pnp and the associated npn one at the same time, and don't rely on meter checks to tell you whether the device is in order. The transistors cost only pennies, but unless this advice is heeded hours of time can be wasted.

CONTINUED NEXT MONTH

Scope Tubes

Phosphor

WHILST the average oscilloscope tube is much simpler than say the Trinitron colour receiver tube there are nevertheless a number of features which can confuse anyone thinking of acquiring a tube around which to build an oscilloscope. The purpose of this article is to explain the main features of scope tubes. To do so, it's helpful to go back through history and take a look at c.r.t. developments.

Back in 1897 Braun made a primitive c.r.t. primarily for research on the electron and its behaviour. His tube – see Fig. 1 – had a field emission (i.e. cold) cathode, an anode, a perforated diaphragm and a fluorescent screen. No one at the time seems to have asked how the electrons arriving at the screen got back to the cathode: if they don't, the screen will acquire a greater and greater negative charge as the electrons pile up and ultimately no more electrons will land since they will be repelled. The modern tube has a conductive screen which is connected to the final anode and thence, via the e.h.t. power supply, to the cathode. Some very early tubes were also constructed in this way, but for many years tubes worked without conductive screens. The answer to this conundrum is that the screen emits secondary electrons when bombarded. These cross the vacuum and reach the final anode. If a secondary electron is emitted for each electron arriving in the beam, a balance is struck and the beam continues to activate the screen. For this to happen, the screen must reach a potential such that the velocity of the electron beam is sufficient. For Willemite, the common early screen material, the arrival velocity must lie between 500V and 6·5kV – velocity is proportional to voltage, and it is more convenient to work in voltage so long as the velocity is well below that of light. Early tubes with isolated screens were constructed to operate in this range.

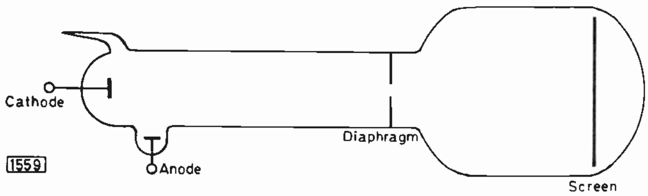


Fig. 1: Braun's tube of 1897.

Focusing

Since electrons repel each other a small spot would not have been obtained even if Braun's diaphragm had only a very small hole in it. Magnetic focusing was developed at a very early date, but for oscilloscope tubes it was more convenient to use gas focusing. A trace of gas was left in the c.r.t. This ionised as a result of collision with the beam of electrons. The ionised gas counteracted the negative space charge around the electrons, with the result that the electrons in the beam converged, thus providing a form of focusing. If the beam is deflected rapidly however the much heavier ion beam is left behind and in consequence the spot is defocused. As understanding grew, the focusing action of the curved lines of an electrostatic field was appreciated and, since it was cheaper than magnetic focusing, and without the speed limitation of gas focusing, came to be universally used for scope tubes.

Deflection

Electrostatic deflection was preferred since it's much easier to develop a voltage waveform across a nearly perfect capacitor – the deflection plates and the vacuum between – than a current waveform through a coil containing inductance, resistance and stray capacitance. The waveform is linear, as required in a device used to examine and measure waveforms. The same conditions don't apply in a television receiver: the signal is applied to the grid or cathode to modulate the beam, deflection is not particularly rapid and linearity is much less important. The development of television resulted in an enormous boost to scope tube development however, both directly and through the need for a servicing instrument which could display the waveforms in a receiver.

Post Deflection Acceleration

Progress in the electronics industry led to the need for increased deflection speed – in order to be able to display high frequency waveforms – and increased intensity – since a fast moving waveform arriving at low velocity will not give a viewable trace. This meant the need for a higher accelerating voltage. The higher the accelerating voltage however the greater the voltage required to deflect the beam. The answer to this was to move the final anode to the screen side of the deflection plates, so that the electron beam was deflected while relatively slow moving.

The first p.d.a. (post deflection acceleration) tubes had a band of aquadag next to the screen – see Fig. 2(a). This however had the unfortunate effect of forming an electron lens which compressed the deflection. Next to be tried was a series of bands between the deflection plates and the screen, each operated at a successively higher voltage. Then came a high-resistance (40MΩ) spiral which filled the tube wall between the plates and the screen, distributing the acceleration gradually. With the latter approach, shown in Fig. 2(b), e.h.t. voltages in the 10kV region were common.

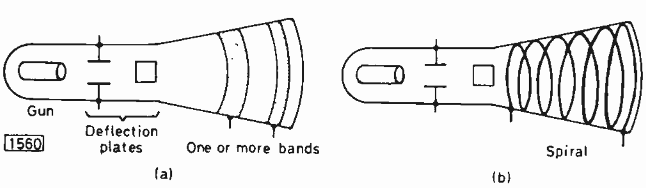


Fig. 2: Post deflection acceleration systems.

Even the spiral p.d.a. tube had some deflection compression however, and to reduce this a mesh, shaped so as to cancel the converging lens effect, was introduced between the plates and the spiral (sometimes called a helix). The mesh intercepts some of the electrons however, thus reducing the brightness. This is overcome by running the tube at say 14kV. The deflection compression also reduces the spot size, so that the mesh p.d.a. tube has a larger spot than the simple spiral p.d.a. tube. There is also some loss of contrast due to the mesh scattering electrons. A "geometry control electrode" – see later – gives a compromise between raster shape and background illumination.

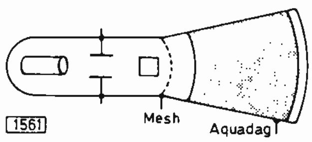


Fig. 3: Single p.d.a. band tube giving scan magnification.

One step backwards was the introduction of a tube with a mesh and one p.d.a. band only. This, see Fig. 3, gave a diverging lens and scan magnification of up to two times. These tubes were not popular however.

Brightness Control

In 1903, a year before Fleming patented the thermionic diode, Wehnelt found that a heated filament coated with calcium oxide (lime) was a far better emitter of cathode rays than the field emitters used till then. Hot cathode tubes appeared – with the brightness controlled by varying the filament temperature! Wehnelt had also discovered the controlling effect of a cylinder surrounding the cathode, but once again did not exploit it. Television c.r.t. use resurrected the grid, but for the oscilloscope user there is a complication. The potential between the cathode and the deflection plates is about 1kV in most tubes, while to facilitate direct connection, when required, to the work being examined the plate potential in early scopes was earth. Deflection amplifiers were a.c. coupled because valve d.c. amplifiers are troublesome. The cathode was at about 1kV below earth therefore and good insulation for the brightness control, which varies the grid voltage, was essential: d.c. coupling of a signal to the grid was impossible. The advent of solid-state deflection amplifiers did little to improve the situation: the mean plate potentials went from earth to around 50V, with d.c. coupling throughout the amplifier, and the cathode would now be at minus 950V, which is no great improvement.

Blanking

But this is not television, so why should we want to apply a signal to the control grid? With the advent of triggered timebases, waveforms occupying only a hundredth of the repetition interval or less (one television line per field for example) could be displayed across the screen. But during the remaining 99 hundredths of the repetition time the spot will be stationary at one end of the screen, where it will cause damage. Biasing the grid off to cut off the beam is the obvious solution, but if the grid is at 1kV below earth, a.c. coupling is necessary and there will be trouble if long blanked or unblanked times are involved. One way out is to use a bistable circuit, a.c. triggered from the timebase, to blank or unblank the trace, and now optocouplers are available. All the complexity can be avoided however if the tubemaker includes a miniature deflection system which operates at the same mean potential as the plates and is included in the gun assembly,

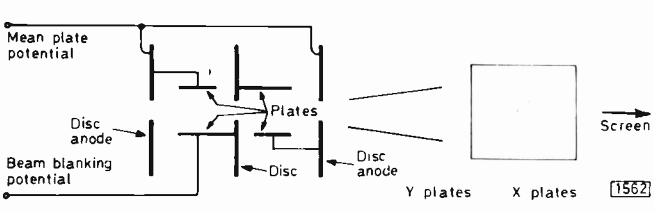


Fig. 4: Beam blanking system.

just before the last gun anode prior to the plates – see Fig. 4. This provides beam blanking by deflecting the beam so that it does not pass through the hole in the next anode, thus extinguishing the spot. Some 50V either above or below the mean plate potential is required. This arrangement, besides allowing either polarity for blanking, ensures that the spot is undeflected as well as blanked. This electrode is not intended to be used as a brightness control.

Developments

Not much has happened to the deflection plates since Braun's time. Cossor made a double-beam tube just before the war with a splitter plate between the two Y (vertical deflection) plates. They also made tubes designed so that the deflection voltages were applied to one of each pair of plates only. Doing this gave rise to a form of distortion which would turn a square raster into a trapezium, but with valve amplifiers it was a desirable goal since at least one valve in each output stage was saved. Today push-pull deflection is easily obtained and most tubes would suffer from trapezium distortion if asymmetrical deflection was applied.

Obtaining a double trace is today more easily done by electronic switching than by the use of split Y plates or double guns.

The display speed is limited by the speed at which the electrons pass through the deflection system: if the deflection changes sign during the transit of the electrons there will be little deflection at this frequency. Since p.d.a. reduces the electron speed through the deflection system it only makes matters worse in this respect. To overcome this, tubes were made with delay line deflection systems so that the deflection was slowed down to keep in step with the electrons. The delay lines used had low impedance, matching coaxial cables. This gave a bandwidth of up to 500MHz. Considerable power was required to develop the deflection voltage across the low-impedance line however.

In modern tubes the deflection system is surrounded by shields, three being the record number. Varying the voltage on one of them affects the trace geometry: with a blank raster displayed, the electrode enables a square rather than a barrel or pincushion shaped raster to be obtained. Another shield corrects astigmatism, or inability to focus the spot into a circle instead of an oval. Apart from manufacturing tolerances, astigmatism is caused by a difference in the mean potentials of the two sets of deflection plates. This difference is difficult to avoid with d.c. coupled amplifiers, and the astigmatism control electrode provides an easy solution to the problem.

Some mesh p.d.a. tubes have a third shield which affects the background illumination produced by electrons scattered by the mesh. This is done at the expense of poor geometry, and a compromise setting between this electrode's voltage and that of the geometry one for the best display has to be found.

All three shields are operated within about 100V of the first anode voltage. Since they draw no current, high-resistance potentiometers can be used to supply them.

Aluminising the screen increased the light output and provided screen conductivity. Willemite was replaced by materials with different colours and greater resistance to burning. Green is still retained for general purpose scopes because the eye is most sensitive to this colour while photographic emulsions no longer require blue. A long afterglow can be had if required: the commonly used phosphor for this purpose flashes up blue and afterglows

– continued on page 317

Use of the Barograph as an Aid in Forecasting DX Openings

R. A. Ham, FRAS

IT'S well known – or should be – that weather conditions affect reception. So a device, the barograph, that records the prevailing conditions by giving a continuous record of atmospheric pressure is an invaluable aid to assessing the likelihood of long-distance reception. I installed a barograph back in 1962, and for the past fourteen years have accumulated an extensive record of the atmospheric pressure changes which have taken place in southern England.

Operation of the Barograph

A barograph is basically a mechanically strengthened barometer with a pen arm attached to trace the information it gathers on a calibrated paper chart which is rotated in seven days by a clockwork motor. The chart is calibrated from 28 to 31in. (the readings are relative to a column of mercury) and the seven day length (Monday to Sunday) is time marked at two hour intervals. The highest pressure I have recorded to date is 30·8in. (in December 1970) and the lowest 28·7in. (in November 1965). The usual variations are between 29·4 and 30·4in. however, well within the range of the instrument. A barograph is reliable and the only maintenance required is to keep the pen clean and filled with ink and to wind the clock motor weekly when the new chart is fitted.

Weather Patterns

The user can learn from a barograph a great deal about the prevailing trends in the local weather pattern. If it's raining for example and the pressure is still falling this means that the rain will continue for a few more hours. If the pressure is beginning to rise however the rain should stop shortly. When the pressure is high and steady in the summer months it should be warm and dry – cold and dry in the wintertime. A barograph responds to tiny pressure changes and it is surprising the number of small variations that can take place daily, even during a settled period. After about six months the user will be familiar with the machine and will find it and its records a valuable tool in the radio room.

Tropospheric Openings

Since originally installing a barograph I have been relating pressure changes to the tropospheric openings which increase the normal range of v.h.f. and u.h.f. radio and television signals. The general rule that has emerged is as follows: *When the atmospheric pressure is above 30in. and then rises further, a tropospheric opening can be expected around the time that the pressure starts to fall again.* As an example, see Fig. 1.

This fall in pressure is telling us that the prevailing anticyclone is on the move and that in consequence a change in tropospheric conditions is taking place. The troposphere is the first ten miles of atmosphere above the earth's surface: it's the home of the earth's weather and of course the birthplace of the thunderstorms that interfere with the reception of both radio and television signals.

The propagation of radio signals above say 80MHz is affected by the prevailing tropospheric conditions. Thus a barograph, or alternatively a hand plot – see Fig. 2(a) – can be used to provide an early warning of a tropospheric opening.

The FM Band

From the evidence I have collected over the years it seems that the f.m. broadcast band (88-108MHz) is the most vulnerable when a suitable pressure change is taking place. Frequently, strong signals from continental broadcast stations are heard between 95-100MHz a few hours before the pressure drops, and once the actual fall begins and the opening proper gets under way the continental stations can be heard from 88-100MHz, often with equal strength to the BBC stations.

For observations in this band I use an Eddystone Model 770R receiver fed from a horizontal dipole. At my location at Storrington, Sussex (200ft. a.s.l. on the north face of the South Downs) an average of between 10-15 continental stations is heard during an opening. The record so far is 38 between 88-100MHz on October 28th 1975 during a big tropospheric disturbance – see Fig. 2(b). This memorable event began in Band II during the morning of October 23rd and ended at around 0800 GMT on the 29th. As the pressure rose from 30·2in. on the 23rd to its maximum of 30·4in. and then fell back to 30·15in. on the 29th (see Figs. 2 and 3) the opening rose from 88MHz to above 1GHz.

Band III

In Band III I monitor the signal from the IBA Lichfield transmitter (ch. 8, 189MHz), using a standard 405-line television receiver fed from a vertical dipole. The transmitter is 150 miles north west of Storrington and Band III must open up for a good signal to appear via the dipole. During the

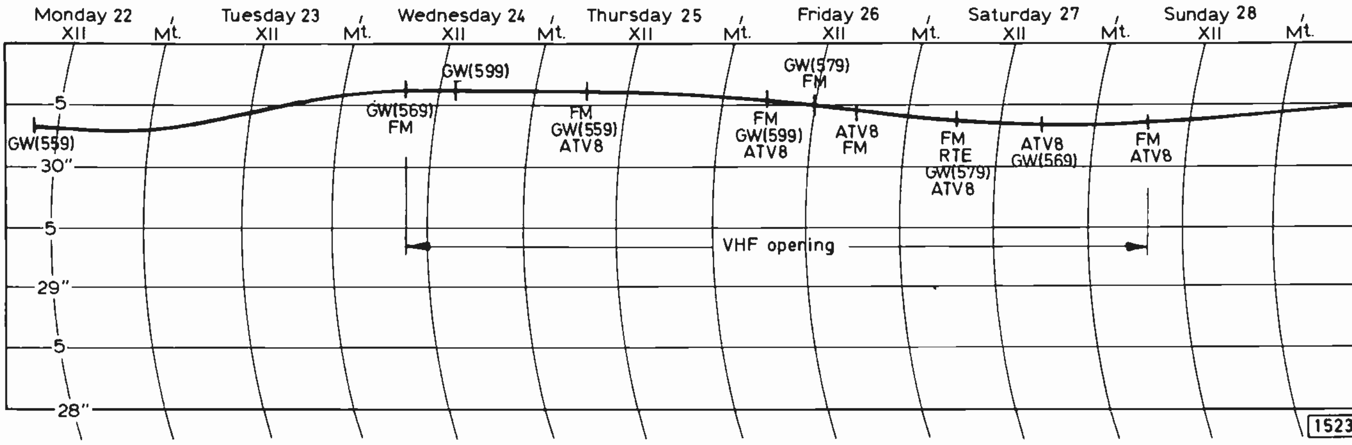


Fig. 1: Barograph chart for the week 22nd-28th October 1973, showing the v.h.f. opening which started on the 24th. The signals noted on the chart are as follows. GW is the GB3GW Swansea beacon, in each instance followed by the signal strength conditions using the RST (readability, strength, tone) code. FM indicates that Band II is open. ATV8 indicates picture received on channel 8 (189MHz). RTE indicates reception of Radio Telefis Eireann in Band II.

Day	Pressure noon	Pressure midnight
23	30·2"	30·15"
24	30·2"	30·3"
25	30·4"	30·4"
26	30·4"	30·4"
27	30·4"	30·4"
28	30·4"*	30·3"
29	30·25"	30·15"

* Peak

(a)

Day	FM	2m beacon	ATV8	UHF TV1	70cm beacon
23	6	—	✓	—	—
24	9	GB3DM	✓	—	—
25	23	GB3DM GB3GW	✓	✓	—
26	18	GB3DM GB3GW	✓	✓	GB3SC GB3GEC
27	36	GB3DM GB3GW	✓	✓	GB3SC GB3GEC
28	38	GB3DM GB3GW	✓	✓	GB3SC GB3GEC
29	8	—	—	—	GB3SC GB3GEC

(b) 1524

Fig. 2: (a) Hand plot of pressure readings at noon and midnight during the October 1975 opening. (b) Progress chart as the opening extended the range of v.h.f. and u.h.f. signals received.

October 1975 opening a strong picture was received every day, often suffering from co-channel interference.

The UHF Bands

The u.h.f. bands did not open up until the 25th. On that evening the BBC issued a warning to viewers about the interference. On the 26th the RSGB beacon at Sutton Coldfield (GB3SC, 432·89MHz) became audible in Sussex and continued to present a strong signal until the end of the opening.

My u.h.f. television receiver is fed from a two-element (dipole plus reflector) array. A single dipole is used with the 70cm convertor. For propagation studies – as opposed to DX-TV – high-gain aerials must not be used since the observer does not want to "encourage" the distant signals he is using as a standard. Once the existence of a tropospheric opening is known however the big aerials can be used to follow one's own particular interest.

Summary

Although I've given only two examples of the association between atmospheric pressure and tropospheric openings in this brief article many more have been observed over the years. Apart from the common factor of pressure change, each opening has differed in that reports of DX signals received throughout the UK have varied considerably.

A tropospheric disturbance may last for several days, during which time the normal range of a v.h.f. or u.h.f. signal may be multiplied by ten, so causing interference to other systems that have been allocated the same or a similar frequency. In severe cases it's a question of "one man's meat is another's poison"! While TV viewers are complaining about those nasty criss-cross lines on their screens, radio enthusiasts are taking advantage of the situation to receive rare long-distance signals and establish new records.

Final Word

I hope that enough information has been given to encourage DXers to use a barograph. As a result you may catch that short, sharp opening – and make a contribution to Roger Bunney's regular column. ■

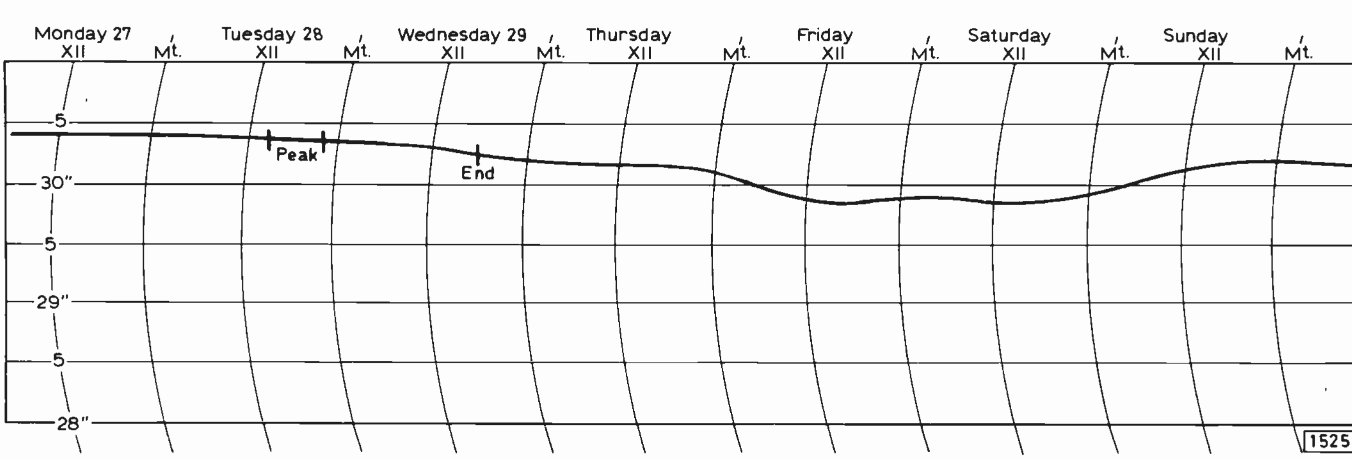
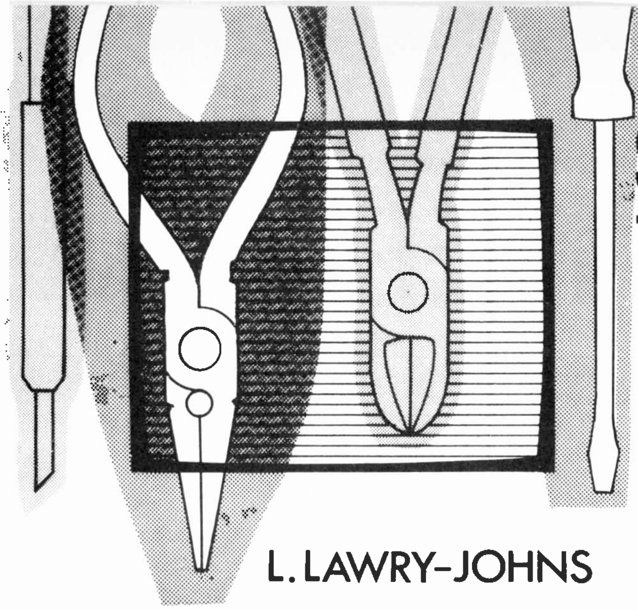


Fig. 3: Barograph chart for the week 27th October-2nd November 1975, showing the peak (28th October) in the opening.



SERVICING TELEVISION RECEIVERS

Have You Noticed . . . ?

L. LAWRY-JOHNS

THERE'VE been some odd things going on lately, I can tell you. It may be coincidence, but on the other hand there may be sinister forces at work lurking around unseen; determined to drive us to drink (more than usual that is). No wonder old Ken sits there with his barley wines trying to summon up the courage to face the next day. Me? I'm on hot brandies with chasers so that I don't lay awake at night with the worry of it all.

Purple Picture

Take this last week for instance. Three Thorn 3500 series chassis, each with the same trouble, no green."Me picture's gone purple and we think it's the picture valve." A quick check on the convergence panel showed plenty of life on the red and blue first anode controls but not a lot on the green one due to leakage through the associated switch (S702). Making a nice neat cut through the print immediately beneath the switch (as we didn't have a replacement with us) restored the green voltage and a smile to the faces of the enthralled spectators. "Do I owe you anything for that?" enquired the head of the house. "When we have fitted the switch" we reassured him.

The next call was a repeat performance, only the name on the set being different. Well, well, we said. Three days later the same thing. Well, well, well, we said.

Now you may say there's nothing funny about that, those switches are always leaking. Maybe so but why the green one? The voltage there is no higher than on the other switches, to impose a greater strain, but I haven't had to replace a red or blue switch up to the present. All right, you have. But green has always been my unlucky colour, except for the other day that is.

A Broken Set

Now settle back and listen to this one. The 'phone rang the other morning and a young woman's voice asked us to come and estimate the cost of repairing her set which she'd dropped. As it was covered by her household policy she had got in touch with the insurers who had advised her to approach us (there's fame for you!) for an estimate. We duly made the call and were amazed to find that the set was a large HMV Colourmaster weighing about as much as she did if not more – and with an empty space where the tube should be! "You were carrying that", we stammered. She said she was and everything would have been all right if she hadn't caught her foot in the carpet and let the set fall forward so that the face of the tube hit the edge of a heavy coffee table and imploded, hurling thousands of bits of sharp glass all over the place. How she had survived with nothing more than a slight cut on the wrist and an ache in the back where she'd fallen is quite beyond our comprehension.

After congratulating her on being the luckiest person of the year we picked the set up (now considerably lighter) and brought it in for examination. Clearing up the pieces of glass still in the set took some time and the neck of the tube was still in the scanning assembly. It soon became evident that apart from a little patching up of the tube base assembly a replacement tube would be the only expensive item necessary. We duly fitted this and everything fell into place quite nicely (sic) except that on test the picture kept flashing up green.... Ah yes, it was a 3500 chassis. On this occasion however the problem turned out to be a poor contact in the collector load resistive element which is part of a group of three in a common housing and heatsink at the rear of the lower panel. As it happened, this was not due to the accident but had been showing up on odd occasions previously and a man had called to fix it some time back.

You may think from all this that we only deal with Thorn sets, or at least have trouble only with these. This is a long way from being so but faulty sets do tend to come in groups – had you noticed?

Tuning Drift

Talking about Thorn sets, what about these 9000 series models? When they are good they are very very good, but when they are bad they are horrid. Properly spoilt my Christmas one did. Having put it right three times in a few days, we brought it in and put out an 8800 in its place. Damn me if that didn't play up with tuning drift after a few hours – a new voltage stabiliser i.c. and small electrolytic on the tuning board put that right, but one's patience can wear a little thin at times with these sets straight out of the box.

Hybrid Receiver Line Oscillators

Leaving Thorn alone for a moment, have you noticed how the hybrid colour sets – like Pye, Decca and the older GEC and Bush ones – are giving more trouble with the

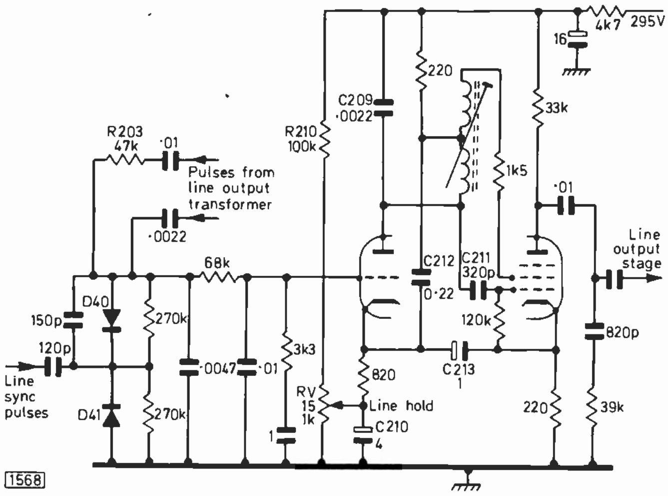


Fig. 1: A typical PCF802 line oscillator circuit – this one from the Pye hybrid colour chassis.

small electrolytics now? We've always had the occasional spot of bother in the PCF802 line oscillator stage, and the polystyrene capacitors here have come in for a fair bit of (justified) criticism. A typical PCF802 circuit is shown in Fig. 1. As time goes on however we are finding these less troublesome and now pounce on the little electrolytics of between 1μF and 4μF. These can cause a number of different symptoms ranging from complete stoppages (PL509 red hot) to erratic hold or a white line or kink down the centre of the picture with lack of width. Here again you can be fooled. All capacitors can be innocent of all charges (men have been shot for better jokes than that Les) and the culprit turns out to be a resistor.

On Pye group models (Ekco, Invicta, Dynatron etc.) it pays to look at the 47kΩ reference pulse feedback resistor R203 (see Fig. 1) which on the 697 chassis with the vertical right side panel is about two thirds of the way down on the left centre and can best be seen (without hinging the panel down) with a torch directed down to the left of the transformer. If the colours are plain to see (nice yellow, mauve and orange) the resistor is unlikely to be at fault, but if the colours are indistinct turf it out. If it's not causing trouble this time it soon will be.

Another resistor which is mucking about a bit lately is the 100kΩ R210 in series with the line hold control. It's right down the bottom and you have to hinge the panel down for this one. In actual fact it can go right down to about 10kΩ, the effect being to make the setting of the line hold very critical, giving the impression of poor sync and casting suspicion on the above mentioned 47kΩ resistor, the sync diodes, capacitors and what have you.

Some Common Troubles

Whilst on the subject of these Pye group sets it may be worthwhile for the benefit of newer readers to recap on a few of the more common faults. These remarks will generally apply whether the right side power supply and line timebase is on a chassis or on a vertical panel.

Probably the most common fault is failure of the 0·1μF 1kV smoothing capacitor C224 (see Fig. 2) which shorts to chassis, thus causing some distress to the series resistor R227 (100kΩ) which feeds boost line voltage to the c.r.t. first anode potentiometers. Several things can happen as a result, depending upon whether the set was switched off as soon as the picture disappeared and smoke was seen to be rising, or the set was left on, perhaps unattended, and the resistor cooked up and became a dead short thus causing a howl of anguish from the PY500 until relieved by the supply fuse popping off.

Once again, if there is a vertical panel, look about a third of the way down the centre to where the 100kΩ resistor should be and see how the poor dear looks. If clean your fault is elsewhere. If it's a charred mass or has dropped out, replace the capacitor leading off to the right and then the resistor, check the PY500, and if necessary the 2·5A supply fuse (anti-surge).

Note that this fuse and the associated tracks are live, at mains potential, when the set has been switched off by means of the front switch – see Fig. 3. One of the effects of this is that a little bit of a burn up occurs at the top of the panel, the severity depending upon the rating of the supply plug fuse. This should not be more than 5A, but all too often a 13A fuse is fitted and this is a lot of current for the tracks to bear. A clean up job is often necessary when a short has occurred between tracks, or the (0.2μF) filter capacitor on the rear of the on/off switch shorts as it has a habit of doing on these as well as most other sets.

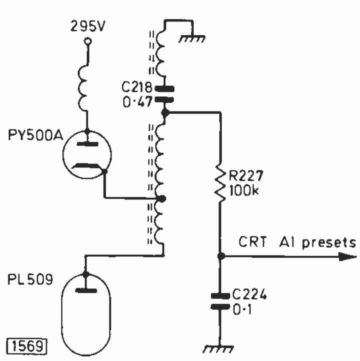
Another persistent trouble spot is the colour-difference amplifier panel. This is the one with the three PCL84 and one PL802 valve on it. The picture can go darker due to the PL802 failing (also check the beam limiter circuitry) and the colours can change due to the PCL84 valves wearing at different rates (and, you're not going to believe this, it's nearly always the green one . . . there he goes again, he must be potty). The trouble however is that the valves are not always responsible for the queer things that do happen. Over a period of time the heat from the valves affects the panel and the tracks underneath, including the earthing springs. All sorts of funny things then happen to the colour.

If you don't want to fit a new panel, carefully cut away the parts of the plastic which are discoloured and remake the tracks – which may be cracked. The long term answer is to remove the existing valve holders and fit stand off types which dissipate the heat better.

Pye 713 Chassis

Later Pye group models present different problems.

Some time ago Pye brought out a nice looking 18in. colour set which has since been adapted for use in several models including the Philips 570. New standards of reliability were and are claimed. By and large these claims are justified, and the set is certainly more reliable than the hybrid ones. We've had quite a few in with the same trouble however. This shows up as lack of gain, looking as though the aerial is inefficient or there is a fault in the tuner or in the selectors – and indeed there often is. But on several



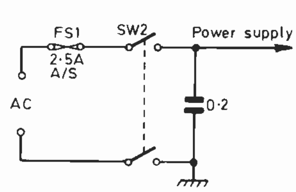


Fig. 2 (left): A common line output stage fault in the Pye hybrid colour chassis.

Fig. 3 (above): Note that the fuse is on the mains side of the on/off switch on this chassis.

occasions we have found the fault to be in the i.f. module. The makers' describe this as the "i.f. filter and gain module". It's located on the lower left panel behind the tuner unit, and is contained in a metal box measuring some 3½ by 2¼in., or 90 by 65mm. if you prefer metric. Whilst it's possible to service this unit by simply removing its cover once the panel has been withdrawn, we prefer to remove the solder from the pegs on the panel and take the unit out.

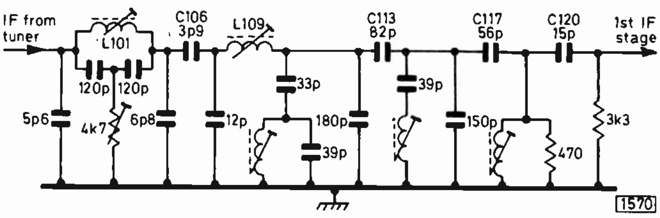


Fig. 4: The i.f. bandpass shaping filter in the Pye 713 – and related – solid-state chassis (18in.).

There are three transistors in the unit, but they are rarely at fault. The trouble seems to originate during assembly. Some of the tracks are on one side of the panel, and some on the other. Thus some components have to contact on both sides. It will be observed that the capacitors have a coating which extends some way down the leads. If they are pushed in too far, the coating will prevent good contact with the solder. The answer is to apply the iron to the reverse side and ease the capacitor slightly upwards. Finally make a general check on the soldering at the coil ends (the coils are printed on the panel). Then pop the thing back in. The suspect capacitors are C106, C113, C117, and C120, and the suspect coils L101 and L109 (see Fig. 4).

It's also a good idea to check the setting of R515 (h.t. control) to ensure that there is 155V at the junction of FS541/R531. The h.t. tends to creep about a bit after a period.

An Undeserved Headache

We have had our share of the later ITT colour sets in for service but these have usually been run of the mill jobs such as shorted ceramic capacitors in the line output stage etc. We have had very little trouble with the earlier CVC1 and CVC2 chassis. One in particular recently gave us quite a headache which we neither expected nor deserved however. The original trouble was quite straightforward, smoke from the e.h.t. tripler. Replacing this restored the e.h.t. and a raster, but this was too bright. There was no trace of a signal on the screen, and the sound was only just audible. Oh dear, we said. I think it was that anyway. We could see the connection between a bright raster and a fault in the luminance amplifier, but we couldn't see quite how this might have knocked out the sound signals. We put this question off for a while and concentrated on the bright raster.

Having located the luminance output transistor on its own little panel on the rear left side it didn't take long to find that as expected it was short-circuit. Replacement didn't help matters a great deal except that the voltages on the transistor returned to something like normal. We moved back down the line therefore, this time under the chassis, and found the next transistor also short-circuit. To cut a long story short replacement of this didn't do very much either so we moved back to the a.g.c. circuit and found a couple of transistors here faulty as well. The signals then came back to normal but we had long since concluded that the tripler must have failed in a mighty peculiar way to have played such havoc all along the line. Anyway I don't think this is likely to happen to you. Agreed?

Faulty Fuses

Now you might think that there's not a lot to say about fuses. Like me however you may have noticed that the fuse is not such a go/no go device as it is intended to be. We have had several instances lately where we have been led up a long garden path chasing heaven knows what only to find that the ticking, tripping and intermittent operation stops when a particular fuse is finally replaced. This applies not only to protection circuits and the like but to supply plug fuses of the 3A and 5A variety as well.

You may say that it is hard to think of a protection circuit where a fuse could do this, but we have just left a Philips 320 series receiver where the 1A fuse in the feed from the line output transformer to the l.t. rectifier read perfectly when we checked it and as we have had trouble with dry-joints from the line output transformer to the print causing this effect in this chassis we were more inclined to follow this line. Eventually however we were led back to the fuse holder again and this time found voltage at one end (albeit low) but not at the other. So there.

Television sets are not the only gadgets to suffer. A succession of hairdryers, vacuum cleaners etc. has prompted us to replace the fuse instead of merely checking it on an ohmmeter. Nuff said.

Problems with Presets

Another thing which seems to be happening more and more, to us at any rate, is the irritating habit of small preset controls intermittently making poor contact with their lead outs. This is easily recognised when the control is in the a.g.c. circuit for example (e.g. the Bush TV181S series). But what happens when one which sets a colour-difference signal level in a decoder i.c. plays about, and does so only occasionally? A fine old dance before this one was nailed, believe me. Our example was the decoder in the Philips 570 chassis, preset R403 (2·2kΩ). Much the same set up is found in other models using the Mullard three i.c. decoder. It was in the green channel of course . . . well you know my luck by now.

If the things went open-circuit when they wanted to be troublesome it wouldn't be so bad, but they seem to go

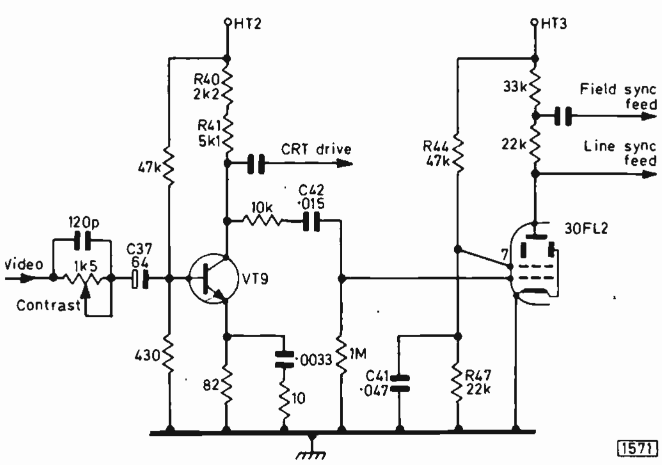


Fig. 5: The video output and sync separator stages in the Thorn 1500 monochrome chassis.

slightly high resistance at one end or the wiper and the resultant change in control voltage is very slight but certainly sufficient for the eye to detect on the screen.

Don't Rely on Stock (Faults, that is)

We all tend to pounce on particular items when faced with symptoms which regularly crop up. Look at our old friend the Thorn 1500 series chassis. Its wide distribution over many years means that a fair precentage of monochrome sets needing service are fitted with this chassis. There are several stock faults which crop up so often that one can be forgiven assuming one or two things.

One of the most common of these faults is weak sync, where the picture cannot be held. Practically every time it is R44 (47kΩ screen grid feed resistor to the sync separator – see Fig. 5) which is obviously too small for the job. In goes a larger 47kΩ resistor and there is usually no more trouble on that score.

Recently however we've had one or two sets where this action restored sync for a limited period only, and investigation has shown that the voltage is again low at pin 7 although the 47kΩ resistor is in order. Although C41 could be reasonably suspected, in fact the trouble has proved to be R47 falling in value, presumably due to the sudden restoration of full current once R44 had been restored to its correct value, thus imposing the "last straw" on the back of the 22kΩ resistor.

Quite a lot of these sets have come in lately with a very weak and light picture, due to the collector load resistors (R40, R41) in the video output stage changing value. The fault can also be due to the transistor itself, or the 64μF base coupling capacitor C37 or indeed a faulty contrast control. But all these points can be checked in a few minutes, so it's not really worth shouting about. If we get enough requests we will do another full article on the 1500, but it's been covered so many times now that everyone should be happy to service these sets blindfold.

Shattered Mains Fuses

Now before we go, just one last "have you noticed?". We get quite a few Bush colour sets of the CTV182S series in with shattered supply fuses. This is normally due to the mains filter capacitor or the thyristor rectifier (BT106 – or 16172 RCA type with TO66 encapsulation). We have found however that it pays to swing up the convergence board and have a look at the front end of the main electrolytics. There is a 47kΩ resistor wired across one of the 600μF electrolytics and this has a habit of dropping its value quicker than a whatsit drops its dodahs. It naturally presents a charred appearance having done this disgraceful thing, and so it should.

LETTERS

BECOMING A "SERVICE SPECIALIST"

George Wilding's article on *Becoming a "Service Specialist"* (February) contains several points which I would challenge. The advice not to get a shop is common sense I suppose, since the guy wants to be a technician rather than a salesman. But getting yourself known by means of advertisements is dubious advice and very expensive. Also, advertising that you do the repairs in the house is unlawful unless you do so in all cases (otherwise it would be an offence under the Trades Descriptions Act).

The key to getting business is mentioned in the article – in the comment that many "shop competitors ... in fact are not really interested in extra service work". This is a fact of commercial life that enables the would be free-lance service engineer to get started. Let him keep his advertising expenses in his pocket and instead pay a call on all the small and medium sized TV shops within ten miles of his house. If he can convince the proprietors that he can actually mend sets, and offers a commission of say £2 on each job passed to him, he will soon have enough work to keep him fully occupied – without the need to renovate bangers as a pastime. He will also be sure of his money and not have any of the troubles associated with being a "complete stranger".

George Wilding's comments on customer relations miss the main point on this subject. What customers want to know is how much it is going to cost them. They want to know this at the earliest possible moment, and they don't want to be charged for being told. Generally they don't have the slightest interest in what's gone wrong, but need reassurance on the fact that they are doing the right thing in having it repaired. The essence of successful customer relations is to forget about TV servicing and talk to the customer about each and every subject he or she raises. Make it a rule to spend fifteen minutes during the service call just chatting and looking unconcerned. Above all, don't put on the "specialist" act: people with broken down tellys don't want professional mystique, they want the set mended with the minimum of fuss and the maximum of good cheer. – **Barry F. Pamplin** *(Preston, Lancs.).*

Editorial comment: Whether you try working through existing local firms or completely independently probably depends on your personality and on local conditions – what's suitable in a small village and a city high street can be very different matters. We know servicemen who have very successfully followed both approaches. Those who lack the confidence to "go it alone" may well find Barry's suggestions a safer course to adopt.

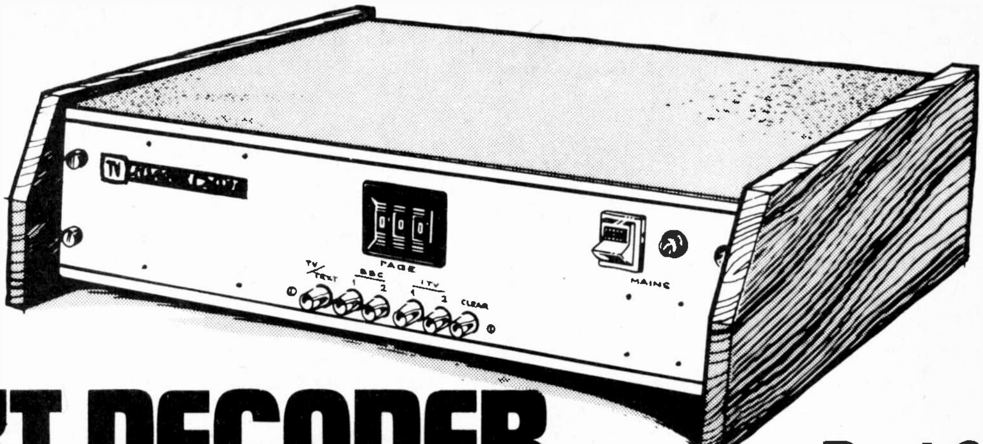
OPEN-CIRCUIT CAPACITOR BLOWS FUSE!

N. Lyons' letter on the peculiarities of the Philips 320 chassis reminded me of one I encountered last year. On switching the set on, a just about normal picture appeared before the mains fuse blew. Monitoring the over-voltage neon showed that it was striking at least 10V below the normal h.t. rail voltage. So the neon was disconnected – and the BU205 line output transistor promptly gave up the ghost. Here we have it I thought, and fitted a replacement - only to have the mixture as before, with this time the 33Ω h.t. filter resistor failing. This was replaced with a higher rated one and I was then called away for a while. On my return I found that it had melted its joints and fallen off.

That did it. I took a hard look at the picture, and noticed slight traces of hum. The fault was that the reservoir section of the h.t. filter electrolytic can was open-circuit. The resultant much increased ripple current had been responsible for the resistor failure, the a.c. peaks firing the neon. – **W. E. Harrison** *(Windsor, Berks).*

THE

TELETEXT DECODER



Part 2

Steve A. MONEY T. Eng.(C E I)

IN contrast to the relatively simple power supply section described last month we are now going to examine the input logic board which is perhaps the most complex of the four circuit boards in the unit. The basic function of the input logic is to decode the Teletext data and select the required page for display.

Fig. 1 shows a block diagram of the input logic whilst Fig. 2 gives the complete circuit diagram.

Before going on to describe the actual construction of the board an account will be given of the functions of the various circuits making up the input logic system.

Teletext Signal Gate

One of the first requirements of the input logic is that it must be able to select the two lines of text data from the rest of the video signal. This ensures that the decoder does not attempt to interpret the picture video signals as data, which would result in a somewhat garbled display on the screen.

To achieve this we need line and field synchronising pulses from the receiver section. The line pulses are fed through one section of the 7408 gate IC2 which has positive feedback applied to ensure rapid switching. This gate is used to clean up the line sync pulses and to reduce the effects of noise which could produce a jittery display.

The field sync pulse triggers one section of the 74221 dual monostable circuit IC4. When IC4b is triggered its $\overline{Q}$ output goes to 0 and is used to hold the second monostable IC4a and flip-flop IC3a in the reset condition. The timing components are chosen so that the time delay will end, and IC4b will reset, sometime during line 16 (or line 329 in odd fields) of the field scan. This is the line immediately before the two lines of Teletext data.

When IC4b has timed out, the reset signal to IC4a and IC3a will be removed and the second monostable circuit is then triggered by the leading edge of the next line sync pulse at the start of line 17 (330). The delay time of the second monostable IC4a is arranged to be just under two line periods and it will provide the gate signals to select the two lines of Teletext data.

Flip-flop IC3a is triggered by the trailing edge of the same line sync pulse and, when set, the Q output of this flip-flop is used to inhibit any further triggering of the monostable IC4a until the next field sync pulse occurs. This ensures that only two lines from each field can be selected. If at some later date the number of lines used for Teletext data is increased this can be catered for by changing the timing components for the two monostables.

Data Signal Format

We saw last month that each line of Teletext data is divided into 45 sections each of which contains a group of eight pulses representing either a character of text or a control code. These groups of pulses are called data "words" and the pattern for the first three of every data line is shown in Fig. 3.

Effectively, a data word is divided into eight equal segments each containing one "bit" of data which may have the value 1 or 0 depending upon the signal level during the bit period. If the level is about zero the bit is a 0 whilst if the level is high, at about +4V to +5V, the bit is a 1.

When a string of bits which are all at the same level follow one another the signal level stays at either 0 or 1 for the required number of bit times. Although this reduces the bandwidth of the signal it does present some problems in decoding since the timing of the bits now has to be identified by the decoder.

To achieve bit detection a clock pulse train must be generated in the decoder so that a pulse is produced roughly half way through each bit period to allow the state of the bit to be determined. In order to synchronise this clock with the data signals the first two data words are made up of alternate 1 and 0 bits as shown in Fig. 3.

During the rest of the data line the bit clock is maintained in synchronism with the data by making use of the data transitions between the two logic levels to show where the edges of the bit periods are. The data coding is arranged to produce at least one change in the logic level during every word period. In this decoder the bit clock generator is located in the receiver section and will be described in a later article.

Word Synchronisation

Before it can be used, the received data must be converted from a serial stream of data bits into a parallel stream of data words where the eight bits of the word are fed out simultaneously on eight separate wires. This is achieved by using the 74164 eight stage shift register IC6.

The shift register simply consists of eight flip-flops connected so that when a clock pulse is applied each stage takes up the state of the next earlier one in the chain. Thus a pattern of eight data bits will move along the register by one

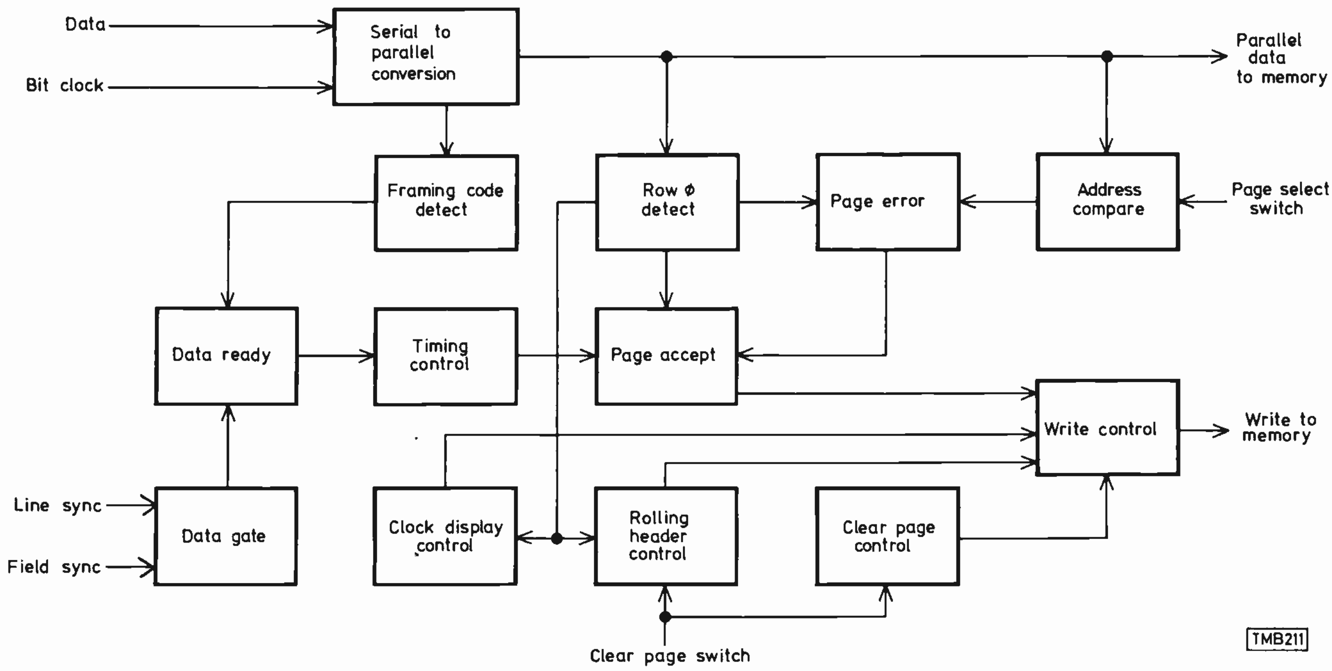


Fig. 1. Block diagram of the input logic. Individual section functions are explained in the text.

stage following the arrival of each clock pulse. The eight stages will thus contain the states of the last eight bits received, and since there is an output for each stage this gives a parallel output of the eight bits.

At this point we need a timing reference to tell us when each complete word is lined up in the 74164, since this will occur only once in every eight clock pulses. A special pattern of bits called the Framing code performs this function and is contained in the third word of every line of Teletext data. This word contains the bit pattern 11100100 as shown in Fig. 3. When this pattern is first detected in a row of data we know that a proper data word is set up in the 74164 and that the following data words will appear at intervals of eight clock pulses from that time.

To detect the Framing code, those outputs of the 74164 which should be at 0 if the word is correctly lined up are inverted and gated with the other outputs of the register. These signals are then fed to the eight inputs of a 7430 NAND gate IC11. Now when the Framing code is present in the 74164 all eight inputs of the 7430 will be at 1 and its output will go to 0. For all other conditions the 7430 output will be at 1.

The output from the 7430 is inverted and used to clock flip-flop IC3b. The D input of this flip-flop is fed from the monostable IC4a and will be at 1 only during the two Teletext data lines. Thus if a Framing code is detected at the beginning of a data line it will cause IC3b to be set, indicating that data is ready for decoding. Framing codes detected on any other scan lines will merely leave the flip-flop in its reset condition. When IC3b is set, its $\overline{Q}$ goes to 0 and drives the Preset input to latch the flip-flop into the set condition until the end of the line. At the end of the data line the flip-flop is reset by either the line sync pulse or an End of Line pulse from the memory circuits.

When flip-flop IC3b is set by the detected Framing code it releases the reset line on the 7493 divide-by-eight counter IC7 which then starts to count off bit clock times. After every eighth clock pulse the counter produces a word clock pulse which is used to transfer the data in parallel from the outputs of the 74164 IC6 to the two four bit data latches IC13 and IC14. The data for the current word will now remain on the outputs of IC13 and IC14 until the next word is ready for transfer. Thus the data words will appear sequentially on the eight data bus lines DB1 to DB8.

Address Codes

Before we get to the text character codes there are still two more control words to be dealt with. Words four and five of each data line contain the magazine address and a row address which tells the decoder where to place the row of text in the display.

Unlike the character codes, only four of the eight bits in the address words are used to carry information. The other four bits are used for error protection purposes. By using appropriate logic circuits any errors in the address word can be detected and sometimes corrected.

Fig. 4 shows the layout of the magazine and row address words, with the bit patterns shown representing row 11 in magazine number 6. It will be seen that the address information is carried on bits 2, 4, 6 and 8 of each word, whilst the odd numbered bits are used for the protection coding. The addresses are coded in simple binary code, with the least significant (units) digit first.

Eight magazines are allowed for and these require a three bit binary address to give numbers from 0 (binary 000) to 7 (binary 111). For the row address five bits are needed, since there are 24 rows of text. The fourth address bit in the magazine word is used to provide the least significant row address bit.

For the memory circuits, the five row address bits must be presented simultaneously. This requires a latch to hold the row address bit from the magazine word until the rest of the row address becomes available. Flip-flop IC21a performs this function. Its data input is fed from bit 8 of the parallel data, and it is clocked when the magazine address word appears on the data outputs so that it stores the least significant row address bit for the rest of the data line period.

In order to detect the address codes a timing register comprising IC8 and IC9 is used. These two devices are set up to produce a long shift register. When the Framing code is detected, a single 1 bit is injected into the first stage of this timing shift register. When each word clock occurs and data

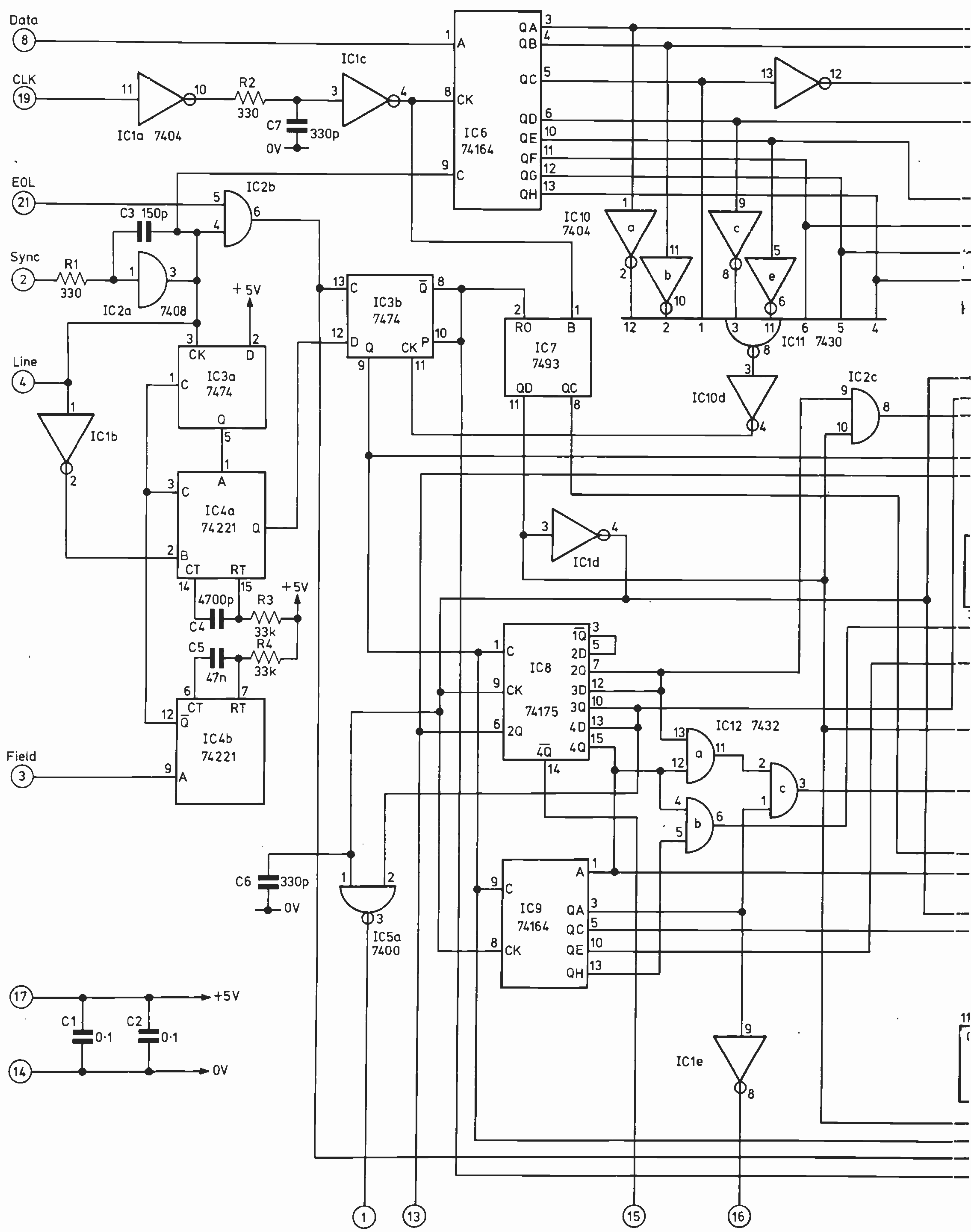
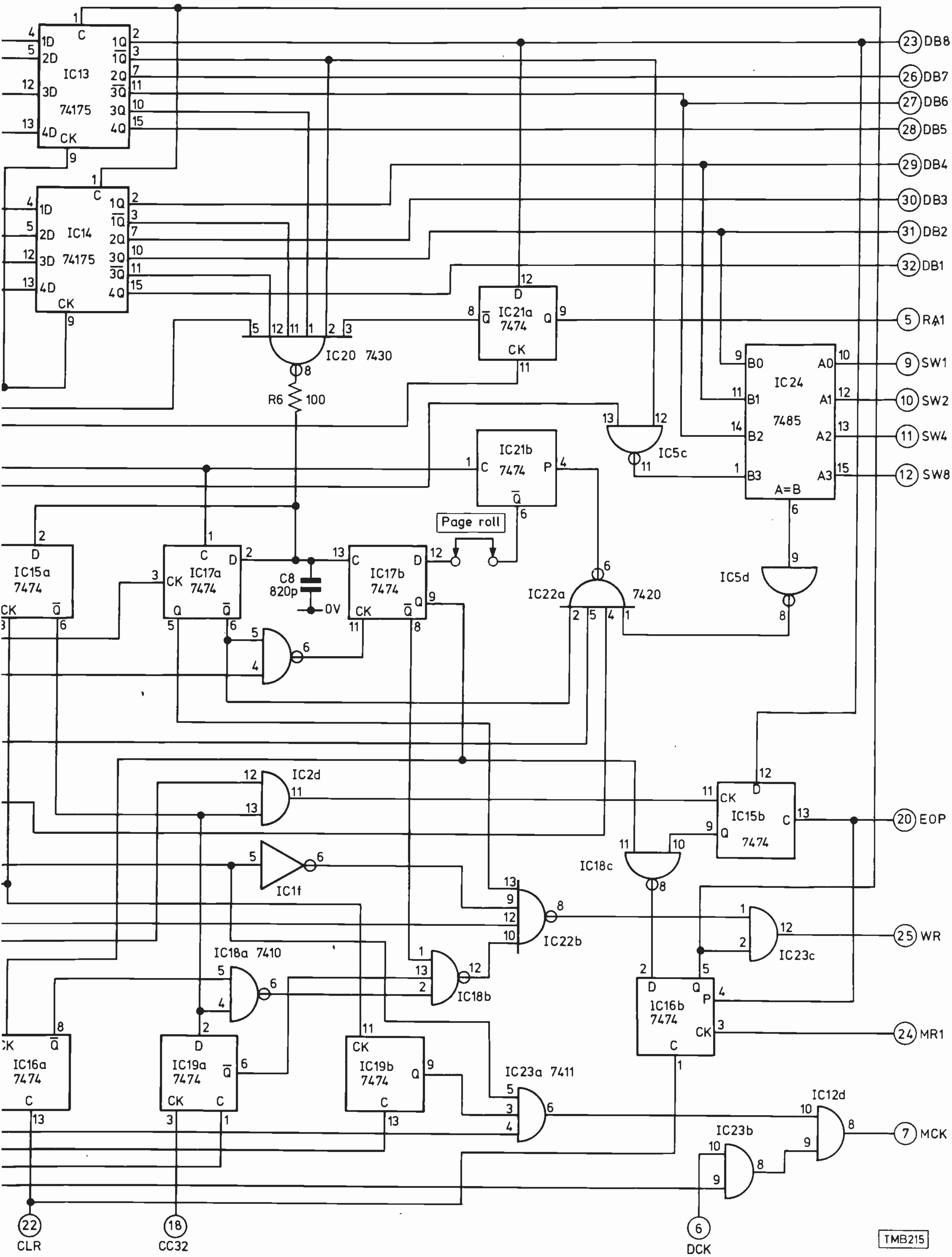


Fig. 2. Circuit diagram of the input logic. Encircled numbe



rs refer to connections made through the edge connector.

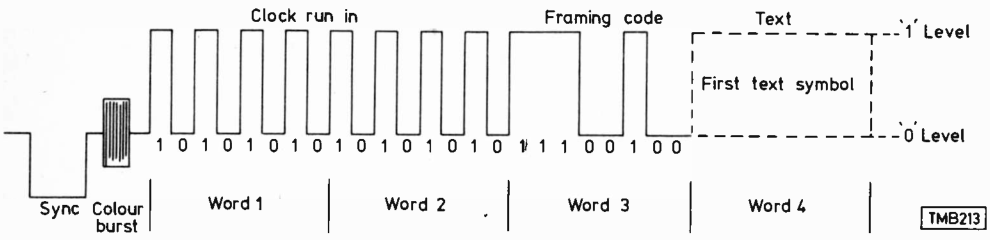


Fig 3. Data sync "words".

is transferred to the data output lines the 1 in the timing register is moved along by one stage. Thus at any time one of the outputs of the shift register will be at 1 whilst the others are at 0, and the position of the 1 in the register will indicate which data word is present on the output latches IC13 and IC14.

When the magazine address is on the output lines, the 1 in the timing register will be at output 2Q of IC8. By gating this output with the word clock in IC2c the row address bit of this word can be clocked into flip-flop IC21a.

One word time later the 1 state will have moved to 3Q in IC8 and the complete row address will then be ready for transfer to the memory control circuits. Gate 5a uses output 3Q and the word clock to produce a pulse to control the loading of the row address to the memory system.

Page Addresses

Unlike the magazine and row address codes the page address is transmitted only during the first row of each page of text. The first eight character positions in this row are not used for text but contain page address, time and control codes. As a result only 32 characters, instead of 40, are displayed in the header row at the top of the page.

Like the magazine and row address codes, the page, time and control codes in the header row use only bits 2, 4, 6 and 8 for information, the remaining bits being used for error protection. The layout of these extra address words in the header row is shown in Fig. 5. The address words are arranged in sequence, with the least significant first so that page units are followed by page tens and in the time codes the minutes are first with tens of hours coming last.

Page Detection

To select a particular page for display the received magazine and page codes must be compared with the page number selected on the front panel switch. When the two agree, the required page is being received and the data must be accepted, stored and displayed on the screen.

In this decoder all page number checking is carried out during the reception of the header row. Since no error protection is included, only bits 2, 4, 6 and 8 of the page and magazine address words are used. The time codes are ignored completely.

The first requirement in page detection is to select the header row, which has the address code 00000. By gating together the inverted outputs for bits 2, 4, 6, 8 and the $\bar{Q}$ output of the row address RA1 flip-flop when the row address word is on the output lines, we can detect the row address 00000 showing that the row being received is the header row. This function is carried out by the 7430 gate IC20. A timing pulse from 3Q of the timing register IC8 is also fed to the input of this gate to ensure that it can respond only when the row address data is present. If the row address is 00000 the output of IC20 goes to 0. All other row addresses will give a 1 output.

Flip-flop IC17a has its D input fed from the row 0 detection gate via a resistor/capacitor delay network. When the next word is transferred to the output lines, the flip-flop is clocked and takes up the state of the row 0 detector gate. The flip-flop is reset at the start of all lines, and if the header row is being received it will stay reset after the clock pulse. On other rows it will be set by the clock pulse. This flip-flop activates the page comparison circuits when the header row is being received.

Comparison of the selected and received page numbers is carried out in the 7485 four bit comparator IC24. The received data is applied to the four B inputs of this device, whilst the corresponding four bit signals from the page selector switch are fed to the A inputs. When the A and B input signals are identical a 1 output appears on pin 6, whereas any mismatch produces a 0 output.

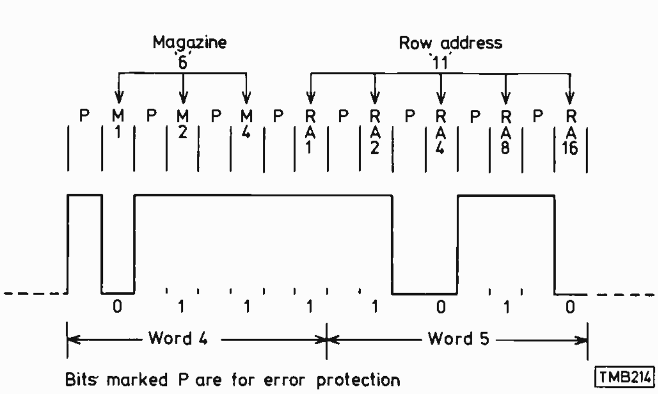


Fig. 4. Magazine and Row address "words".

★ Components list for Input Logic Card

Integrated Circuits:

IC1	7404
IC2	7408
IC3	7474
IC4	74221
IC5	7400
IC6	74164
IC7	7493
IC8	74175
IC9	74164
IC10	7404
IC11	7430
IC12	7432
IC13	74175
IC14	74175
IC15	7474
IC16	7474
IC17	7474
IC18	7410
IC19	7474
IC20	7430
IC21	7474
IC22	7420
IC23	7411
IC24	7485

Resistors:
(all are ¼W carbon film ±5%)

R1	330Ω
R2	330Ω
R3	33kΩ
R4	33kΩ
R5	100Ω
R6	100Ω

Capacitors:

C1	0·1μF disc ceramic
C2	0·1μF disc ceramic
C3	150pF polystyrene
C4	4700pF polystyrene
C5	47nF polyester
C6	330pF polystyrene
C7	330pF polystyrene
C8	820pF polystyrene

Miscellaneous:
Printed circuit board reference no. D011
Soldercon sockets for Page Roll link

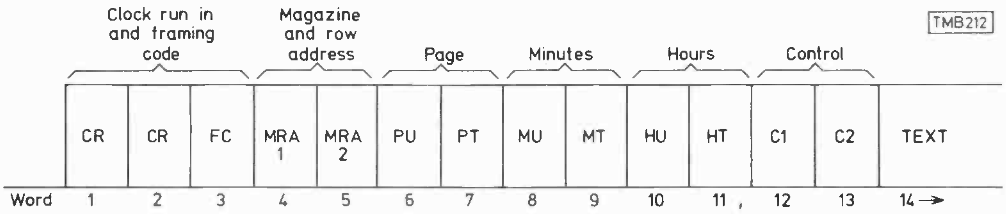


Fig. 5. Header Row address "words".

To save logic and reduce the number of wires from the switch, the signals to the 7485 are multiplexed. A pulse from the timing register energises the magazine section of the switch when the magazine address word is present on the output lines. The magazine code and switch signal are then compared and the inverted output from IC24 is fed via gate IC22a to the Page Error flip-flop IC21b. If no match occurs, IC21b will be set to indicate a page error. During the page units and page tens word times, the corresponding sections of the switch are selected by pulses from the timing register and these codes are compared. Here again if an error occurs the Page Error flip-flop will be set.

At the end of the Tens of Hours word, a timing pulse from the IC9 Qe output is used to clock the Page Accept flip-flop IC17b which will then take up the state of the $\overline{Q}$ output of the Page Error flip-flop. If the correct page has been detected, the Error flip-flop will not be set and the Page Accept flip-flop will be set by the clock pulse. Once set, the Page Accept flip-flop opens the write control circuits to allow the data to be written into the memory and later be displayed. If a mismatch had been detected in either the magazine or page codes, the Page Accept flip-flop would be reset and the following data would be rejected.

To ensure that the error signals from the comparator are passed through gate IC22a only during the magazine and page code periods, the appropriate timing pulses are gated together in the OR gates IC12a, b and c and applied to one of the inputs of IC22a.

For setting up purposes a link labelled Page Roll is included between the Page Error flip-flop and the Page Accept flip-flop. When this link is removed, the checking of page numbers is suppressed and every page of data is accepted for display. This produces a display in which the pages appear to roll down the screen one after another, and is used to simplify the setting of the bit clock and data level setting in the receiver section.

Flip-flop IC17a is used to control the write signals to the memory so that the address codes are not written into the memory and hence not displayed on the screen. This flip-flop is clocked after the Row Address word and again at the end of the second control code of the header row. During the header row, the first 13 words are suppressed. During other rows the flip-flop allows writing after the first five words.

Next month we shall complete the logic description by looking at the Rolling Header, Clear Page and Time Display circuits, and describe the actual construction of the card.

TO BE CONTINUED

Timebase Faults: Baird 620/640 Chassis

John Law

THE Baird 620/640 series used an all valve dual-standard monochrome chassis produced by Radio Rentals prior to their becoming part of the Thorn group. The sets have given good value for money in terms of trouble-free service over the years and there is plenty of life in them yet. In fact as second sets they can be a good buy and invaluable when the colour set breaks down yet again. Model numbers include the 622, 624, 626, 628, 630, 632, 640, 642, 644, 646 and 648 – a collection of 19 and 23in. models.

Sync Circuit

The timebase circuitry is shown in Fig. 1, including the sync separator valve V8. The field sync pulses are fed via C224 to the integrating circuit R173/C227, while the line sync pulses are coupled to the flywheel line sync circuit via C105. C110 couples line flyback pulses to the line sync discriminator circuit. These are integrated by R83/C106, the diodes X4/X5 producing across C109 a correction voltage dependent on the phase relationship between the line sync pulses and the line flyback pulses. This voltage is filtered by R84/C111/R85/C112 and used to bias the grid of the cathode-coupled line multivibrator V9, whose basic frequency is set by L40 in conjunction with the hold controls R92/R93.

Line Timebase

The line oscillator's output is coupled via C121 to the grid of the line output valve V9. Bias for this is provided by the VDR width stabilisation circuit which operates as follows. Line flyback pulses are fed to the VDR by C126. As a result of the VDR's action, a negative potential is developed at the junction C126/R100. This is offset by a positive voltage from the boost line via the width control R101. The line output stage follows normal practice, with V11 the boost diode, C129 the boost reservoir capacitor, V12 the e.h.t. rectifier and C127/C128 the scan-correction capacitors.

Field Timebase

Returning to the field timebase, the interlace diode X10 is held forward biased via R172/R173/R175 in the absence of a field sync pulse. The negative-going field sync pulses reverse bias it and cut off the field output pentode to initiate the flyback. The field output pentode and the associated triode section of the PCL805 are connected as an anode/grid cross-coupled multivibrator. The field charging capacitor is C238 which charges from the boost rail via R195 when the triode is non-conducting during the forward scan. R186 acts as the height control, with its bottom end returned to the field linearity feedback loop. When the pentode cuts off during the flyback, the positive-going pulse at its anode is applied via C229 and R174 to the anode of the interlace diode X10 to switch it on again.

No Picture

Since the line whistle is so much more audible on 405 lines, it helps to switch to 405 when tackling the no picture condition. Alternatively a meter showing a healthy negative voltage at the control grid of the PL504 is proof enough that line drive is present and the circuit operating.

Suppose we switch on and can hear no line whistle however. If the screen remains unilluminated when the brightness control is turned up, look for a glowing anode or screen grid in the PL504 or a glowing anode in the PY88. These signs of stress indicate lack of drive from the oscillator and a quick check at the control grid of the PL504 will confirm this – by failing to record a negative voltage. Don't panic: in many cases the cause is simply failure of the ECC82 line oscillator valve, and a replacement will cure the fault. If a new valve makes no difference, follow up by trying replacement of the PL504, PY88 and DY86. It's unlikely that all three valves will be faulty: it could just be shorted turns on the line output transformer, but let's not be gloomy.

If the line whistle can be clearly heard but there is no raster check whether the DY86 is alight. If it is there should be e.h.t. at the top cap and around 400V at pin 3 (focus electrode) of the c.r.t. The c.r.t. cathode voltage (pin 7) should vary between zero and 100V as the brightness control is operated. If the voltage here does not vary, check the video signal coupling capacitor C132 which could be leaky.

Drive at the control grid of the PL504 but cold output stage valves means that the PL504's screen grid feed resistor R97 is open-circuit. Before replacing it, check whether the associated decoupler C122 is leaky or short-circuit.

Oscillation and drive but a dead DY86 may be due to its heater being open-circuit or, occasionally, the series resistor R107 in the valve base being open. This can be confirmed by touching the glass of the DY86 with a screwdriver blade: a bluish glow should appear around the blade.

The position can be more tricky when there is weak line oscillation but no raster. Check whether the DY86's heater is alight. If not, remove the boost diode's top cap. The line whistle may then change frequency and take on a harsher note. In this case the PY88 has an internal short and replacing it will cure the fault. Should the whistle increase in strength and sound fairly normal the boost capacitor C129 is short-circuit. An $0{\cdot}22\mu$F type rated at 1kV is a suitable replacement.

The line oscillator circuit can be killed by failure of one of the flywheel sync discriminator diodes X4/X5. Check by connecting a multimeter switched to read ohms across each diode in turn. With the black lead connected to the diode's anode and the red lead to its cathode a reading should be obtained: on reversing the leads a much higher reading

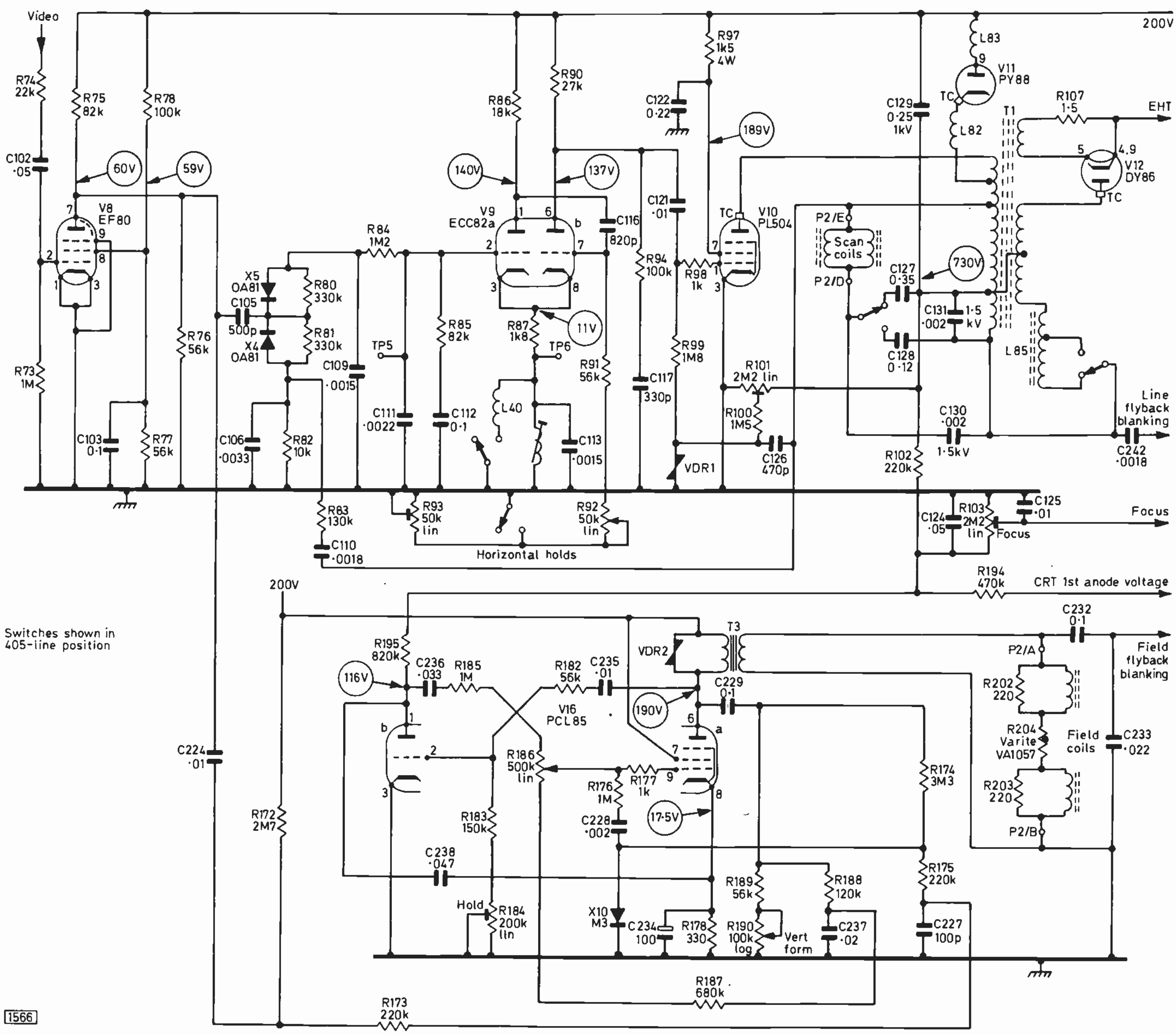


Fig. 1: Field and line timebase circuits, Baird 620/640 Chassis.

should be obtained. Comparing the readings with those obtained from a good new diode will confirm the condition of the old one. The actual resistance value is not important, as long as the ratio between the forward and reverse readings is about ten to one. A matched pair of BA144 gold-bonded silicon diodes make ideal replacements. Before replacing them however check the pulse feedback components C110 and R83. The capacitor can leak, upsetting the line hold; or it can go short-circuit with a resultant burn up and damage to the diodes – this stops the oscillator. If in doubt, replace the capacitor before fitting new diodes. The resistor can change value, either upsetting or destroying the line sync or stopping the oscillator.

Dry-joints around the line oscillator coil terminals for no apparent reason after years of normal operation can occur to disable the oscillator. Careful cleaning and a spot of flux before resoldering should cure this. C116 and C113 can become leaky, and the hold control potentiometers can go open-circuit to kill the oscillator.

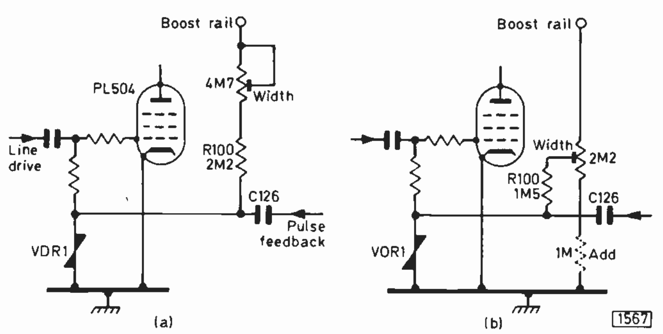


Fig. 2: Modification in later production to increase the range of the width control. (a) Original circuit. (b) Modification. Add a 1MΩ resistor as shown to prevent the width potentiometer burning out.

Lack of Width

A narrow picture and other width faults were common when these sets were new, and a circuit modification was introduced – see Fig. 2. The weak component is the miniature preset width potentiometer which has a habit of changing value over the years. In the arrangement shown at (b) the control is connected between the boost rail and chassis: if its value drops after a time the result can be a nasty burn up. With this arrangement, connecting a 1MΩ

– continued on page 325

Test Report: Philips Desoldering Tool

E. Trundle

SINCE printed circuits first appeared, the problem of removing components for test or replacement has given birth to several strange appliances for easing the task. The first contender was the unwieldy aspirated soldering iron. This had a special hollow bit and a foot-pump or air-line to create suction to remove the solder from the joint. The contraption was neither simple nor foolproof. It was soon joined by a range of special bits, rather like a cowboy's branding irons. These were designed to heat the several pins of a multi-tagged component simultaneously, and could be had in several sizes – typically to match DIL i.c. packages. The soldering iron was often hard put to muster sufficient heat for effective desoldering, and the device was physically awkward and totally inflexible.

More efficient tools had to come, and the arrival of the spring-plunger type of solder remover was a great advance. These operate like a bicycle pump in reverse, sucking the molten solder through a nylon nozzle when the spring is released by pressing a button. They are not cheap, and sometimes suffer from jamming and clogging, but can release any type of tagged component.

The most effective alternative is desoldering braid, which is a woven copper wick impregnated with flux and resin. As far as we are concerned this makes the plunger type virtually redundant, and it is hard to imagine that a more effective solder remover is possible. We were intrigued, and a bit sceptical, therefore when we heard that a new desoldering device was about to be released by Philips.

Desoldering Action

The gadget consists of a pencil-like shaft with a hollow and very thin-walled tube at each end, giving a choice of two diameters. Certain metals have a natural aversion to solder – as most of us have discovered by now – and the business ends of this tool are made of such a metal. The idea is that the most suitable end (diameter-wise) is selected and pushed over the end of the protruding component lead. The joint is then heated while the tool is rotated and pushed inwards, the rotating action being maintained as the heat is removed. Once the solder has frozen, the tool is withdrawn, leaving the component lead desoldered.

Tests

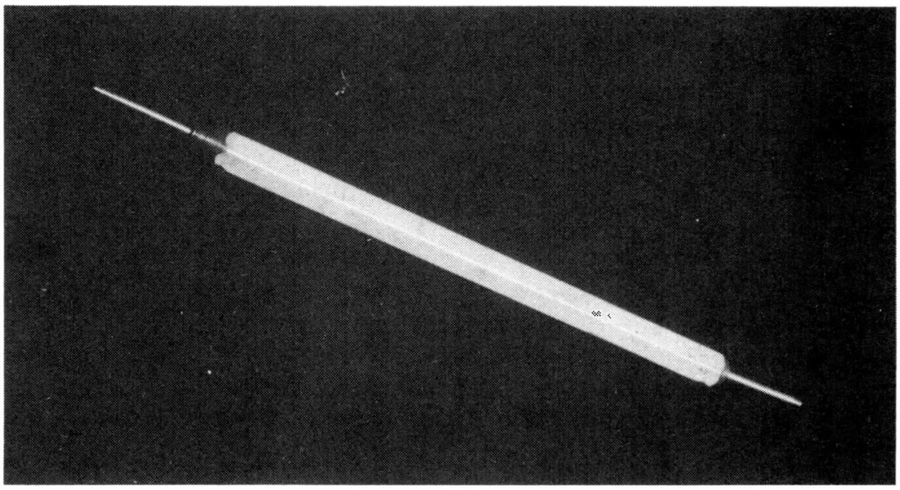
The tool was tested on all types of printed circuit boards, from line output transformer removal in TV sets to desoldering $\frac{1}{8}$W resistors from calculator-type panel assemblies. Our first conclusion was that it complemented braid rather than displaced it. Certain types of joint cannot be tackled at all with the Philips tool, mainly those involving large or rectangular section tags, such as those on field output transformers and valveholders, or consisting of a printed tongue which pushes through the panel at right-angles, as do some i.f. transformers and printed inductors. The tool was best with components such as varicap tuners and line output transformers with rigid tags: these literally fall away from the board when fully desoldered. The operation is more efficient when the panel hole is large enough to enable the tool to pass right through the panel, but in most cases effective desoldering was achieved when the component leg fitted tightly in the panel hole so that the tool nozzle butted the print surface. This occasionally led to the formation of a bead of solder on the lead however, preventing removal of the component.

A difficult situation arises because certain manufacturers bend tags over before soldering them during production. The use of braid often results in some bond remaining between the tag and the print, causing tearing of the print when the part is removed. We found the hollow ends of the Philips tool strong enough to bend such offending tags straight during the desoldering process, a great advantage.

It is important to bear in mind that the tool does not actually collect any solder, but leaves it, devoid of flux, sitting round the hole. To avoid dry-joints therefore it is important to use plenty of flux-cored solder when fitting the replacement part.

Conclusion

Two pounds buy little these days, and by the look of it this tool should last long enough to justify its expense. It has a useful place alongside desoldering braid in the armoury of the service technician.



The new Philips desoldering aid.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

UNDOUBTEDLY the talking point of January 1977 has been the quite incredible Quadrantids meteor shower opening during January 3rd. Signals were at times so strong and prolonged that more than one DXer mistook the activity for a Sporadic E opening! Both TSS (USSR) and TVP (Poland) were noted in Band III on chs. R6 and R8 respectively. Other Band III signals came from CST (Czechoslovakia), ORF (Austria), NRK (Norway) and SR (Sweden).

My own monitoring on that day was mainly during the pre-1000 period but I can certainly confirm that strong and lively signals abounded throughout the Band I spectrum. During the afternoon I visited David Martin (Shaftesbury) and witnessed an unusual phenomenon – the ch. E3 signal from Liege (Belgium) flicking in and out via MS at an unusually short skip distance. Subsequently James Burton-Stewart reported receiving this signal at the same time.

The Tropospherics improved here on the 8th, with various French u.h.f. signals, while towards the end of the month a mid-day SpE opening provided reception (suspected) of NRK with two signals floating on ch. E2. These signals were the well-known PM5544 pattern but with a three letter identification in the lower rectangle. Briefly then reception here consisted – apart from the above – solely of MS (Meteor Shower) signals.

Readers will by now be familiar with the continuing saga of the interference problems I am experiencing from a nearby computer installation. I have now heard from the manufacturers who admit that the equipment radiates and are working on the problem with a view to circuit redesign. Apparently screening the apparatus tends to produce undesirable side effects! In the meantime they are to assist my activities with a view to reducing the interference by installing a new aerial system which I am currently designing. Hopefully this will ease the problem until the firm concerned can modify the equipment satisfactorily. It does seem that daylight can at last be seen at the end of the tunnel, though it is an unfortunate reflection that the efforts of a solicitor had to be called upon.

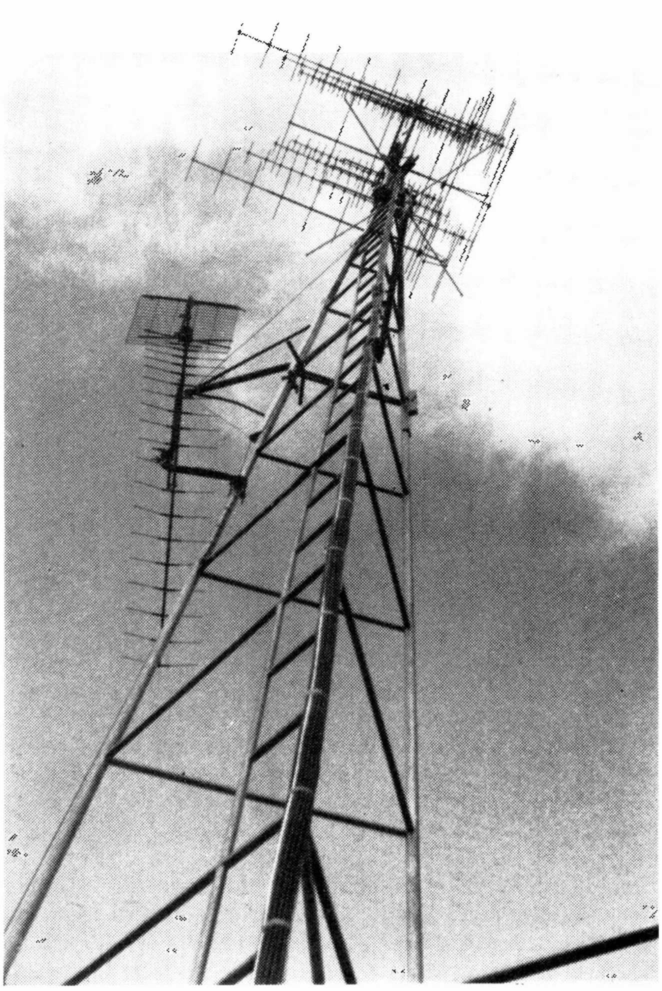
News Items

Iceland: Iceland (RUV) is understood to be transmitting colour programmes using the PAL system, though there's been no official confirmation. This would explain the sighting of the PM5544 test card from RUV in East Anglia last Summer.

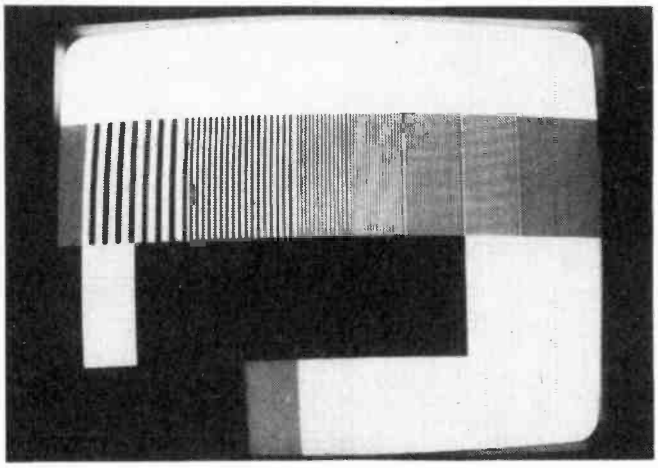
Eire: Establishment of RTE's second Network (RTE-2) has been postponed. It had been hoped to commence the service towards the winter of 1977. The reason is the current economic situation. Pending a government review of the situation in 1978, RTE will continue with development plans for the future network.

USSR: Unofficial reports suggest that the USSR may decide to abandon the SECAM colour system in favour of the PAL system. If the USSR does change to PAL – and if such a change takes place it is likely to happen before the next Olympics in Moscow – it would seem to follow that the other OIRT members would adopt PAL. At this stage I have no further definite news. For a longer review of the subject see the *New Scientist* dated January 6th 1977. Brian Fitch tells us that a new TV centre is to be built in Moscow for the Olympic Games.

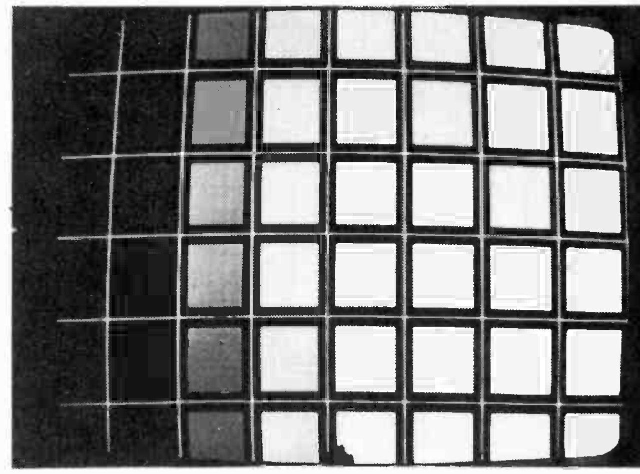
Italy: Following the legalisation of a number of "free" radio and TV stations a somewhat chaotic situation seems to be



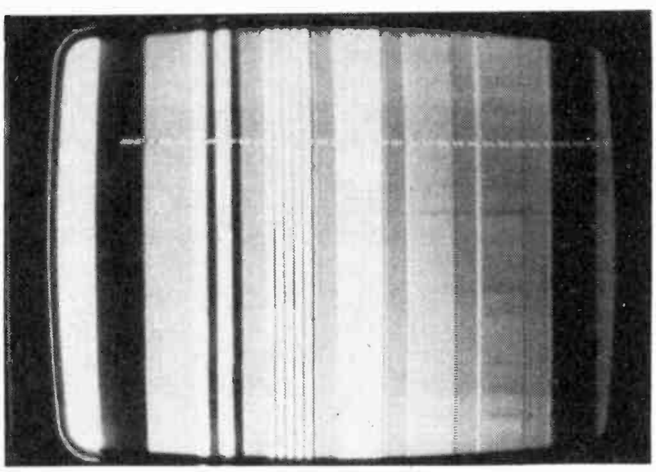
Ryn Muntjewerff's DX-TV aerial installation (Holland). For details see the February column, page 215.



1. The monochrome test pattern at present being used by the three French networks.



2. The convergence crosshatch pattern, with half-tones, used by the three French networks.



3. The frequency test pattern used by the three French networks.

4. Test card used used by the Teletna (Sicily) private (free) television station – on channel E60.

5. Test pattern used by Tele Altomilanese, Milan. Channels used are E59 and E69, the latter on mount Penice.

6. Identification card used by Tele Altomilanese.

Photos 1-3 courtesy Pierre Godou (Rennes, France). Photos 4-5 courtesy Michele Dolci (Bergamo, Italy).

developing. Brian Fitch reports that 65 private TV stations are now operating in Italy, with several foreign networks operating repeaters. Both Austria and Malta are apparently beaming programmes into the country. Michele Dolci tells us that the private stations are now operating in Band V: he estimates that there must be at least 100 such stations in operation. He has four local stations at Bergamo, the latest of which seems to transmit simple test patterns only! Michele has sent us a number of off-air shots, some of which are shown this month.

Iran: A second TV network (NIRTV-2) has begun colour transmissions but for the present the service is restricted to the area around the capital, Teheran. SECAM is being used. To assist in covering the more remote areas of the country a

system of balloons (not unlike those planned for Nigeria) is to be employed. One such balloon is already in operation, giving a service area of about 140 miles radius.
Iraq: Iran's neighbour is also extending its TV network. A recent order has been placed for Japanese TV transmitters. Iraq began colour transmissions in June 1976.
India: We understand that India plans to make extensive use of satellites over the next few years. The USSR is to launch India's second satellite, which adds to the speculation that the Russians will allow India to use the Ekran satellite series for domestic TV transmissions.

For Sale

James Burton-Stewart has been making improvements to his receiving installation and as a result has for disposal a Schrader VR12/01 u.h.f. varicap amplifier with indoor control unit. It's in brand new condition and to go "to a good DX home"! I reviewed this device some while ago in the column. If anyone is interested, James can be contacted directly at Field Cottage, Great Horwood, Nr. Milton Keynes, MK17 0RA.

TV Receivers

In the years I've been writing this column I've often received the query "where can I buy a foreign standard TV?". It usually comes from those interested mainly in Summertime Sporadic E and wishing to receive both sound and vision using the full i.f. bandwidth of the receiver, or from those lacking the confidence to convert a UK receiver themselves. One firm that can help is Portatel Conversions Ltd. The company has supplied Sony receivers to a number of DX enthusiasts. Its normal business is converting UK sets for overseas use or vice versa. This work is generally done with PAL receivers: the cost for fitting a v.h.f./u.h.f. tuner, band switching and sound realignment is £57 plus VAT. They also modify monochrome sets.

More important is the fact that they are now importing a Swedish receiver (12 or 17in.) for system B/G (5·5MHz). For an additional sum these sets can be supplied switchable for the 5·5MHz and 6MHz intercarrier frequencies. In due course further modifications for system L (French u.h.f.) are to be introduced. Yet another service provided is realignment to system D (6·5MHz), and consideration is being given to providing receiving equipment for the DX fraternity. I feel that these services are worthy of mention and although I have not personally had any dealings would be interested to hear about others' experiences.

Bad News!

From time to time we have to report bad news. It seems that the ch. E2 BRT transmitter in Belgium is to be closed, that Lopik ch. E4, one of the original Dutch transmitters, will close at the end of 1978, and that the NDR ch. E2 outlet at Steinkimmen will also close at end 1978. This trend is likely to continue, due partly to the Sporadic E interference from which most Band I service areas suffer. Fortunately, there are areas which will need to continue to rely on Band I due to the terrain and the vast stretches of countryside which have to be covered. The trend to closure of Band I will be felt mainly in Western Europe.

From Our Correspondents

A new DX enthusiast, Anthony Harris (Fareham), has written to tell us of his successes during the recent Quadrantids meteor shower. He reports problems with excessive local channel breakthrough and overload due to the use of an upconverter feeding a wideband receiver. Notch filters are being made to alleviate the problem and should enable the Rowridge ch. B3 sound and vision signals to be filtered out, thus clearing the ch. E2-4 spectrum. For Band I Anthony is using a wideband Band I array from R. Smith Aerials (Luton) and for u.h.f. a Wolsey Colour King.

John Lees has moved to an apparently excellent location at Winstone near Cirencester, at 800 feet a.s.l. shelving away to the East and S. East. Unfortunately problems are experienced from a local communications transmitter. One hopes that this too can be "notched"!

Robert Copeman (Sydney, Australia) has written to tell us of a novel way of TV-DXing – reception from a moving train! Using a Ranger 5in. portable TV, he has logged various trop signals and, possibly a new record, logged the New Zealand TV1 network ch. 1 Te Aroha transmitter and Hedgehope simultaneously whilst on the move at distances of over 1,500 miles! Strange to relate, these SpE signals didn't fade even with the train passing through cuttings, when the trop signals did fade. We hope to receive some shots of this remarkable reception shortly.

In a recent letter Clive Athowe reports that Lille is now transmitting the first chain programmes on ch. E27.

SCOPE TUBES

– continued from page 299

yellow. Orange is used for very long afterglow radar tubes and does not affect night vision as much as other colours do. A storage tube is made for "once in a lifetime" events and the cumulative construction of displays, but this is beyond the present article.

As the stability of amplifiers and timebase generators increased it became possible to calibrate scopes and to measure rather than simply observe – the purpose of the earliest scopes. Parallax is avoided if the graticule is incorporated in the screen, but the tubemakers found that they could not align the deflection system with the graticule with an acceptable degree of accuracy. To overcome this, a trace rotation coil wound around the neck of the tube between the deflection system and the screen enables the vertical and horizontal deflections to be aligned with the lines of the graticule. Some tubes require a further rotation coil or a group of permanent magnets around the Y plate region to ensure that the vertical and horizontal deflections are at right angles to one another.

Summary

The above account of scope tube differences is not exhaustive but does cover the main variations in commonly available tubes. It should help to resolve the choices offered to the home constructor. Wartime surplus tubes should not be rejected out of hand as long as the vacuum is good, though the sensitivities leave something to be desired. I have a Cossor 09J double-beam tube of prewar vintage still soldiering on in a 339 scope and the vacuum is still good. A wartime variant of the Osram 4081A, but with a p.d.a. band, is also still hard and refutes the claim by foreigners to have discovered p.d.a. after the war. Wehnelt probably tried it but never developed it! ■

Servicing the Beovision 2600/3000/3200 Chassis

Part 2

Keith Cummins

HAVING dealt with the operation of the receiver circuits last month it's logical for us next to turn to the decoder, which is on the main chassis. This part of the circuit is particularly interesting since some unusual techniques are employed.

Decoder Circuitry

The output from Tr20 on the receiver chassis passes via P/S3-4 and a coaxial cable link to the 100pF capacitor C87. A positive-going gating pulse from the line output transformer is introduced via R97 and is clamped to 12V amplitude by diode D100. On arrival of the pulse D88a conducts, placing a forward bias determined by the potential divider network R88/R93 on the base of Tr34. In consequence Tr34 is switched on only during the colour burst period.

The burst signal is then applied to Tr37, the final burst amplifier, and also, in attenuated form, to the base of Tr35 which turns on during the positive half cycles to an extent determined by the amplitude of the bursts. The output at the collector of Tr35 is smoothed and applied to the base of the d.c. amplifier Tr36. The output from this stage is the a.c.c. potential which is fed back to the base of Tr16 on the receiver chassis via P/S3-6.

The output from the final burst amplifier Tr37 is applied to the burst phase discriminator. Unlike the majority of receivers, the route of the feedback signal from the crystal oscillator to the discriminator is quite devious. The output from the discriminator consists of a d.c. control bias which directly controls the two varicap diodes D126 and D128 which form the variable control capacitance in series with the crystal. Because the burst phase comparison is carried out at high level, no d.c. amplification is needed and drift is minimal.

A 7·8kHz ripple signal from the discriminator provides PAL phase identification, and we shall deal with this in more detail later.

Tr38 is the reference oscillator transistor. It employs emitter feedback, using capacitors C136 and C138 as tapping elements across the basic tuned circuit. The output from the collector of Tr38 is taken via a 90° phase shift network to the buffer amplifier Tr32. This drives the resonant transformer feeding the B—Y phase demodulator circuit. A feed from this transformer is taken via the phase shift network R61-L62 to Tr31 which provides the feedback signal for the burst phase discriminator. So the loop is complete.

Loose coupling via capacitor C77 provides the majority of the 90° phase shift needed between the B—Y and R—Y demodulation axes. 180° PAL phase switching is achieved by introducing the diode ring modulator (can 8010058) in the path of the R—Y reference signal. A final amplifier (Tr33) provides the subcarrier drive for the R—Y demodulator.

A 60V supply is employed for the majority of the stages just described. It will be realised therefore that the signal amplitudes are high by comparison with most decoders. The outputs from the synchronous detectors are large enough to drive the colour-difference output stages directly, without further amplification.

The foregoing remarks indicate that the peak collector voltages, remembering that the r.f. signal is superimposed upon the d.c. supply rail, can be as high as 90V. The BF110 transistors do fail, and should be replaced by BF178s.

The chroma signal, at a level set by the colour intensity (saturation) control, enters the decoder via P/S 2-7 and is applied to the base of the PAL delay line driver Tr26. This stage operates in the reverse manner to the burst amplifier. That is, it operates normally *except* during the clamping period of the colour-difference output stages, so that a true black level reference is obtained at all the colour-difference outputs. The blanking pulse is introduced via R1.

The delayed signal from the PAL delay line is added to the direct signal in a resistive matrix (close tolerance resistors R21 and R22) and by this means phase errors are cancelled and the B—Y and R—Y chroma components separated from each other in the normal way. The outputs are taken via the emitter-followers Tr27 and Tr28 to the twin output stages (Tr29 and Tr30) which drive the synchronous demodulators. The forward bias for these stages is derived from the colour-killer circuit, so that in the absence of the 7·8kHz ripple signal (identifying a colour signal) the emitter-followers and their subsequent d.c. coupled amplifiers are turned off. A differential gain control acting on the two chroma outputs provides a tint adjustment.

The 7.8kHz ripple signal from the burst phase detector is amplified by Tr40. The associated tuned circuit is excited by the signal, so that a 7·8kHz sinewave appears when a colour signal is received. This sinewave is rectified by diode D147 to provide a d.c. voltage which turns on Tr39, the colour killer transistor, so providing the turn-on bias for the chroma stages referred to earlier. The signal also switches in the 4.43MHz trap circuit in the luminance path.

Tr41 is fed from a tapping on the 7.8kHz tuned circuit and produces positive pulses at its collector. These are applied to the PAL bistable (Tr42 and Tr43) via diode D164. If the bistable is in the wrong phase, the pulse will stall it for a line so that it is then correct. Once it's in the correct phase, diode D164 is always reverse biased. Thus a noisy ident signal cannot degrade the PAL switching performance.

The receiver is fitted with a colour defeating switch (SW1) which interrupts the forward bias feed to the chroma circuits. The colour killer can be over-ridden for test purposes by linking across TPj2.

When correctly set up the decoder is capable of giving exceptionally good performance. The high-level r.f. operation referred to results in very linear decoding, since little gain is required after demodulation of the colour signals. Consequently a colour picture of great subtlety can be achieved.

The pentode sections of three ECL84 valves are used as the colour-difference output stages. Each valve also

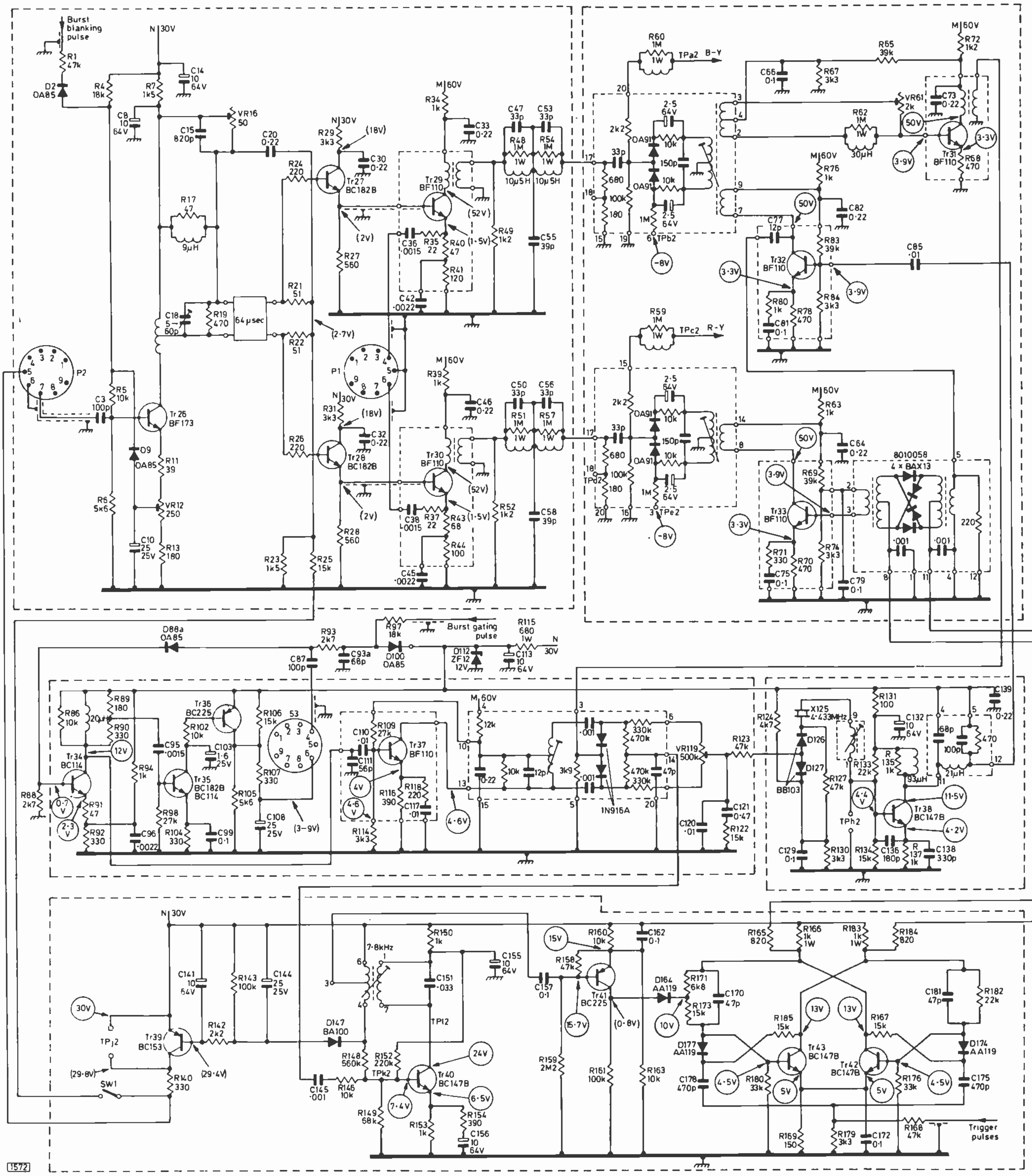


Fig. 3: Circuit diagram of the decoder: for the CDA output stages see Fig. 4.

contains a triode section. Two of these are used in the flyback blanking circuit which we will deal with later. The third triode is unused.

The B–Y and R–Y output stages are basically similar, though the gain of the B–Y output stage is higher (remember that the levels of the colour-difference signals are attenuated by factors R–Y/1.14 and B–Y/2·03 at the transmitter; the receiver has to equalise these levels). Careful optimising of the frequency and transient response in the stages is achieved by the use of frequency-dependent decoupling at both the cathodes and the screen grids, while inductive equalisation is employed in the anode circuits. The circuits are very elaborate compared with most receivers, one unusual technique being the provision of output drive controls which are ganged with the preset luminance drive potentiometers for blue and green. Thus when the luminance signal drive to either the blue or green gun is increased, the colour-difference signal (B–Y or G–Y) is also increased in proportion. This makes setting-up the c.r.t. drives a very simple procedure.

The R–Y output stage employs variable cathode feedback (VR218) to enable the gain to be precisely adjusted. The G–Y signal is derived by taking the appropriate proportions of the B–Y and R–Y signals from the anodes of their respective output valves via a resistive matrix to the grid of the G–Y output valve. Since the transmission weighting factors have already been compensated for, the G–Y signal may be expressed as $G-Y = -[0.51(R-Y) + 0.186(B-Y)]$. The resistive matrix attenuates the signal to a level which the G–Y output stage restores to that required – along with the required 180° phase inversion (denoted by the minus sign outside the square brackets above). Potentiometer VR206 provides a final adjustment of the –(G–Y) level from the matrix.

Note that the anode circuit of the B–Y output stage is fed from a 290V supply, while the other two stages, which need less gain, are fed from the 245V line. The main anode load resistor is 15kΩ for B–Y (R201) and 12kΩ for G–Y and R–Y (R209 and R235).

The signals from the three colour-difference output stages are conveyed via capacitors C189, C226 and C234 to the appropriate picture tube grids. The cathodes of the tube are driven with the luminance (Y) signal, so that matrixing within the tube itself yields $(B-Y) + Y = B$, $(G-Y) + Y = G$ and $(R-Y) + Y = R$. Thus the tube guns are driven in proportion to the original blue, green and red signals derived from the camera.

Clamping and Beam Limiting

While d.c. coupling is used in the luminance path in order to preserve the black level, clamping is required at the tube grids because of the use of a.c. coupling in the colour-difference paths. Eight diode valves are employed for this purpose, in the form of four double diodes. During the forward line scan the diodes do not conduct and the tube grids are d.c.-wise effectively open, with the colour-difference signals applied as described above. During the line flyback, symmetrical pulses are applied to the anodes and cathodes of the clamp diodes which conduct as series pairs. The four diode anode-cathode junctions are thereby all connected together for the duration of the clamping pulse. Three clamp pairs are connected to the three tube grids, while the fourth connects to a 100V reference level. Thus the grids are clamped to 100V during the line flyback. This voltage is normally stable, but is connected to a beam limiting circuit so that the grid voltages are lowered if a very large luminance drive occurs. This circuit operates through the action of diode D67 (BA148) which monitors the luminance output valve's anode voltage level and conveys any excessive negative excursions to the clamp circuit via VDR69.

This circuit arrangement is very reliable, and only very rarely is it necessary to change a clamp diode. On the odd occasion when a fault does develop in the clamps it has always shown up in the same way. The screen slowly floods with a predominance of the colour associated with the defective clamp.

Luminance Output Stage

We come next to the luminance output stage. Earlier we traced the path of the luminance signal to the point where it could be applied to the control grid of the output valve. This signal is introduced to the main chassis via P/S2-4 and stands on a d.c. level of 5.2V. This voltage is offset in a resistive divider network by the application of negative bias from two sources. In consequence the nominal d.c. voltage at the control grid of the 12HG7 is zero. The two negative sources are (a) the brightness control and (b) a compensating network to keep the brightness constant over reasonable fluctuations of the mains voltage (these affect the emission of the 12HG7). The brightness control bias is derived from the –225V supply produced by the stabilised line timebase, while the compensating bias is derived from the mains power section.

High-frequency components of the luminance signal are passed by capacitor C52 to the control grid of the 12HG7. Frequency-compensation components are included in both the anode and cathode circuits of the luminance output stage. Variable Y drive to the blue and green cathodes is available as mentioned earlier when dealing with the colour-difference output stages, while a two-position tapping is provided for adjustment of the red drive. This is normally set at maximum. (Note that a corresponding tapping is available at the R–Y output also: if necessary these two should be adjusted together.)

Service Switch

A service switch is provided for setting up the gun extinction points. This switches out the luminance input to the drive potentiometer bridge network. A separate section of the switch interrupts the screen grid supply to the field output valve, so disabling the field timebase and collapsing the field. A further section disconnects one leg of the balanced static convergence voltage, thus ensuring that the three guns produce separate lines on the screen for setting up.

This final section of the switch can become dirty through lack of use, with the result that it remains open when switching back to normal. A dreadfully misconverged picture results, so it's worth cleaning the switch before diving into the convergence section of the receiver.

Common Faults

A flickering picture may be caused by a defective 12HG7; tapping the valve will soon indicate if this is the case. The valve has no equivalent and should be replaced by the genuine type. Fluctuating brilliance, sometimes accompanied by sync disturbances, is often caused by variations in the 12V supply to the luminance (Tr4-Tr7) and sync (Tr8-Tr11) stages. The 12V zener diode on the receiver chassis (fed from the 30V rail via R92) is the culprit in this case. A component of at least 1W rating should be used as a replacement. Streaking can be caused by a defective capacitor in the luminance output stage. The culprit is C65 (10μF).

Power Supplies

The a.c. mains supply is taken via the switch on the volume control through P/S2 to the power supply section of the main chassis. For 240V working a 6.8Ω 23W resistor is added in series with the feed to the main rectifiers and the series heater chain. While the power supply's reliability would seem to be good on 220V continental inputs it is not so good on 240V. This is because of the increased peak inverse voltage applied to the rectifiers, a level which is not reduced proportionally by the dropper resistor since only the valve heaters are being fed when the rectifiers are reverse biased.

Rectifiers periodically fail by going short-circuit. This usually blows the 6·8Ω resistor open-circuit. Sometimes it is blown apart completely, which makes diagnosis simple. Reliability is improved by increasing the value of the 6·8Ω resistor to 8·2Ω.

No thermistor is used in the series heater chain, and quite a surge occurs on the heaters when the set is switched on. This can sometimes blow the heater of the PY500 or the PY88. A thermistor can be added in series with the heater

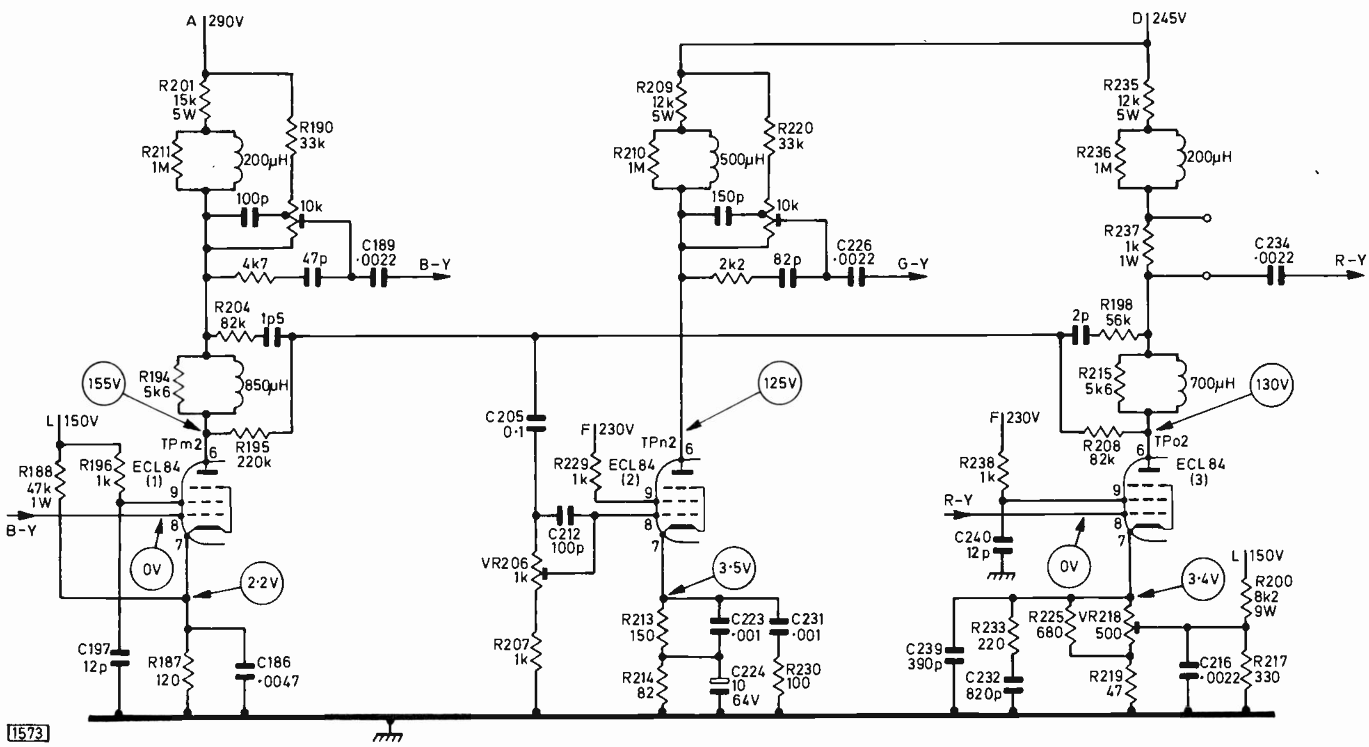


Fig. 4: Circuit of the colour-difference output stages. The associated clamps will be shown next month.

chain if desired, the value of the 47Ω resistor R5 being reduced in proportion. It will be gathered that both a series and a parallel heater system are used. The series chain consists of valves PY500, PL509, PY88, PL504, PCC85, PL508, ECC81, PL84 and PCF802. The parallel heaters are the picture tube itself, 12HG7, the four EAA91 clamp diodes and the three ECL84 colour-difference output stages. They are fed from a winding on the mains transformer and are protected by a 6A fuse which can sometimes fail for no obvious reason. Replacement or re-wiring the fuse will effect a cure.

Several positive h.t. supply rails are provided. The mains transformer, which feeds the parallel heaters and stabilised low-voltage supply rail, employs its primary as an autotransformer to provide, with half-wave rectification (D29), a 290V supply rail (A) for the luminance output stage. Another diode (D8) provides a 270V supply (B) for the e.h.t. generator. All the other h.t. supplies, C 255V, E 235V, F 230V, G 225V, H 210V, J 200V, K 200V and L 150V are derived from a single rectifier (D9) and a network of smoothing resistors and capacitors.

A tapping on the mains transformer primary also feeds rectifier D25 which provides 60V (M) for the decoder, after smoothing. A 40V secondary winding on the transformer feeds rectifier bridge D33, and a stabilised 30V supply (N) is derived from the stabiliser circuit Tr45, Tr46 and Tr47. Zener diode D40 provides the reference voltage for the stabiliser. Tr45 is the error amplifier while Tr46 and Tr47 form the driver and output section which is in series on the negative side of the supply. Tr44 is an over-current limiter. The stabilised 30V rail feeds the transistors employed in the timebases, the PAL switch, part of the decoder, the i.f. strip, the sync separator and the chroma amplifiers.

A conventional auto-degaussing circuit is employed, the degaussing coils plugging on to a panel adjacent to the majority of the smoothing resistors. This section of the receiver is placed above the line timebase and e.h.t. generator can, wherein reside the PL509, PY500, PL504, PY88 and PCC85 valves. It will be seen that this area of the receiver becomes very hot indeed, and indeed in some cases has caused the receiver back to buckle. The plastic plug on the degaussing coils can sometimes crumble away in the presence of so much heat, whereupon the 470Ω resistor R45 burns out. Should this occur it is best to solder the leads from the coils directly to the panel.

The mains rectifiers are also mounted on this same panel, and as a result they become very hot. This does little to improve reliability, and if the rectifiers fail we have frequently replaced one by two in series to ease the strain. Radiospares REC53A diodes seem to be best, in preference to BY127 types.

The primary tapping on the mains transformer also feeds a circuit (D31, C37) providing a negative supply of −88V. This is used to provide bias for the d.c. balancing of the field output stage, and is also used as the reference for the brightness stabilisation of the luminance output stage, referred to earlier. Little power is involved in this circuit, which is consequently very reliable.

Most of the dropping or smoothing resistors in the power supply are of the fusible type. Looking for one that is "sprung" may save quite a lot of diagnostic time.

Audio Output Stage Faults

The PL84 audio output valve can sometimes run into grid current which in most cases will cause its cathode resistor R92 to trip. On some occasions however we have known the excessive anode current to trip out the 200V (K) supply instead. This silences the sound, but also removes the screen grid supply to the luminance output valve, causing the picture to fail as well. In either case, replacing the PL84 and resetting the trip resistor will restore matters to normal. As heavy negative feedback is employed in the audio system, obvious sound distortion may not occur prior to such a fault. If any doubt is felt concerning the PL84, remake the trip and connect a voltmeter to pin 2 of the valve. If the valve is defective, a positive voltage relative to chassis will build up as the valve warms over a period of a few minutes.

CONTINUED NEXT MONTH

Gun Microphones for TV

Vivian Capel

ONE of the basic requirements for most television work is that the microphone must be kept out of camera shot. In some cases it doesn't matter – for example for interviews or news reading – but for most entertainment purposes, especially drama, it is strictly taboo for the microphone to put in an appearance. This applies equally whether the shots are outdoors on location or indoors in the studio.

Obviously this gives rise to problems. While the microphone can be mounted on a long boom to bring it as close as possible, and for close-ups this can be quite near, for medium and long shots it has to be at quite some distance.

Microphone Output

The output from a microphone falls in proportion to the square of the distance. Thus to move out three times the initial distance from an actor will result in the output dropping to a ninth of its previous level. There is an increase of the same order when moving in for a close-up. The sound recordist must be on his toes all the time therefore if he is not going to grossly overload the tape or lose the sound altogether. Automatic level control circuits can help, but they have vices which considerably reduce their desirability.

Taking into account the longest distance and therefore the weakest signal likely to be obtained, it is necessary to ensure that the microphone used is capable of giving an adequate output and that the recorder input circuits have sufficient gain. Although a low-sensitivity microphone could be used with high-gain amplifier circuits this gives a poor signal-to-noise ratio. Capacitor microphones are generally used by the professionals and these give a high output.

Reverberation

It may seem that provided the microphone is of high sensitivity and that there is enough gain in the recorder circuits the microphone can be at virtually any distance. This is not the case however because of the ratio of wanted to unwanted sound. When televising indoors, reflected sound reaches the microphone from the walls and the ceiling – reverberation as it is called – as well as directly from the sound source. A small amount of reverberation is desirable as it adds life and body to the resulting sound – without it the reproduction sounds lifeless and thin. If there is too much reverberation however speech sounds muddled and indistinct: there is a hollow effect as though the subject is speaking at the end of a long passage.

Wherever a microphone is positioned in an enclosed area the reverberation will be roughly the same (there will be subtle differences in frequency and phase in various positions but we can ignore these for the present purposes). The reason for this uniformity is that there are so many reflections and so many different paths of various lengths that the overall average of sound level at any given time after the original sound has ceased will be much the same anywhere in the room.

With the direct sound however things are different. As we have seen this decreases with the square of the distance. So comparing a remote with a nearby microphone position, we have the same amount of reverberation but a greatly reduced level of direct sound (see Fig. 1). Thus the ratio of reverberation to direct sound decreases with microphone distance. In addition there will be pickup of various extraneous noises such as camera movements, script rustling, etc, though these can be controlled to some extent.

This then is the real problem. In professional television studios acoustic treatment is employed to deaden the sound and thus reduce the reverberation. With amateur television this may not be possible – also for professionals where location interior work is involved. This is the reason why film or telerecordings of interior scenes where the speech is particularly difficult to follow are sometimes seen.

Excessive reverberation is not a problem when shooting outdoors since there are few reflections. Too much ambient noise presents a similar problem however. Distant traffic, air movements and a host of other noise sources combine to give a general "mush". This is not usually noticed by ear, especially in a "quiet" country location, but when emphasised by a combination of a too distant microphone and high-gain amplification it can be quite obtrusive.

Pressure-Gradient Microphones

Much of this can be greatly reduced by the use of a directional microphone, that is one which rejects sounds coming from directions other than the wanted one. The simplest form of directional unit is the pressure-gradient type (see Fig. 2). With an ordinary microphone where the sound pressure actuates only the front of the diaphragm, the rear being completely sealed off, sound pressures generated by sound waves arriving from all directions produce some diaphragm movement and therefore an electrical signal. With a pressure-gradient unit there is some limited access to the rear of the diaphragm – through vents in the side of the instrument – giving a form of acoustic resistance. Sounds arriving from the sides exert pressure on both the back and front surfaces of the diaphragm. Partial cancellation is thus obtained – it is not complete however because of the restricted access to the rear. Sounds arriving from the front exert a much greater pressure on the front surface of the diaphragm than on the rear surface, thus giving maximum output. When plotted on a circular graph the effect looks approximately heart-shaped, which is why it is usually referred to as a cardioid response – see Fig. 3(a).

If the acoustic resistance is reduced so that sounds entering the side vents exert a greater force on the rear surface of the diaphragm there will be greater side cancellation and hence a narrower forward acceptance angle. While this is an improvement it means that sounds coming from behind affect the rear of the diaphragm more than the front, increasing the output from behind. The result is that the polar response has a small negative rear lobe. This type of response is termed super or hypercardioid – Fig. 3(b).

Sound Power Concentration

The overall rejection ratio of sounds from all directions compared to those arriving from the front is known as the *sound power concentration*, sometimes referred to as the

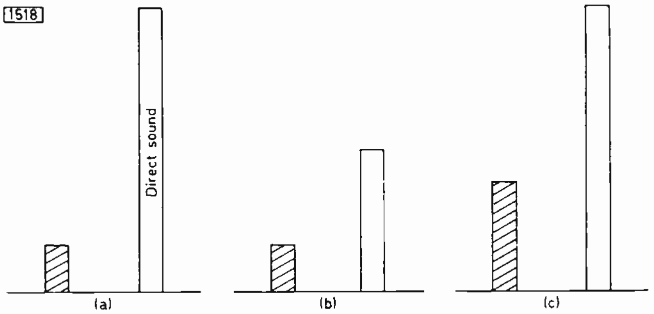


Fig. 1: (a) Proportion of direct to reflected sound (shaded column) for a normal microphone position. (b) When the microphone is at some distance the direct sound is reduced but the reverberation stays the same. (c) Increasing the gain to bring up the direct sound increases the reverberation as well.

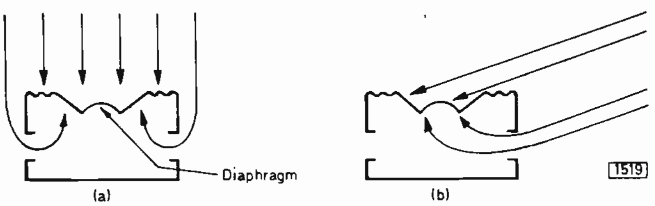


Fig. 2: Principle of the pressure-gradient microphone. Sound pressure is applied to both the front and the back of the diaphragm. (a) With sound approaching from the front, there is little pressure from behind and the pressure gradient is greatest. (b) Sound approaching from the side exerts similar pressure to the front and the rear of the diaphragm: the pressure gradient is low and the result is partial cancellation and reduced output.

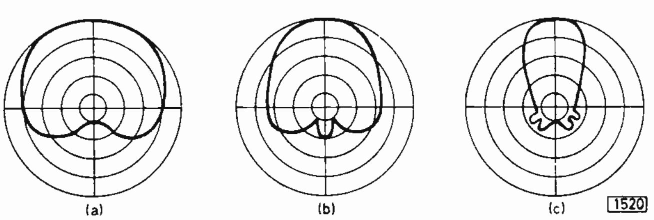


Fig. 3: Microphone polar response patterns. (a) Typical cardioid response at 1kHz. (b) Hypercardioid response. (c) The lobe response of a gun microphone.

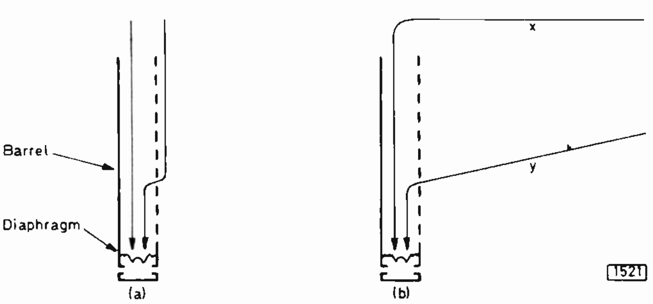


Fig. 4: Principle of the gun microphone. (a) Sounds from in front enter the front and the sides of the interference tube, arriving in phase at the diaphragm so as to reinforce each other. (b) With a sound arriving from the side, the path X from the front of the tube is longer than the path Y of the same sound entering the side of the tube. When the difference in path lengths equals a half wavelength of the sound, there will be cancellation. Numerous holes ensure that this relationship exists for all frequencies within the range of the microphone.

gamma. In the case of a good cardioid this is three and the hypercardioid four. The extra distance that this enables the microphone to be used when compared to an omnidirectional microphone which has the same direct/reverberation sound pickup ratio is the square-root of the sound power concentration. Thus a cardioid can be used at about 1·75 times the distance and a hypercardioid at about twice the distance.

This is a useful gain but further improvement would clearly be welcome, especially for longer shots where the microphone must be farther away from the sound source in order to stay out of camera range. It might be mentioned here though that a natural psychoacoustical effect works in favour of the film maker and television producer. When we see a close-up we expect sound with little or no reverberation: this is what a fairly close microphone placing provides. For longer shots a higher proportion of reverberation will give the "distant" effect which the ear expects. Sound level differences are also compensated to some extent by the fact that in close-ups the speech is generally at a lower voice level while with longer shots the actors are required to speak in heightened tones.

The Gun Microphone

Even so a microphone with a greater directivity than the hypercardioid would be useful, hence the common use by professionals of the gun microphone. This instrument operates on the interference principle: it looks simple, but there is rather more to it than meets the eye. The barrel (see Fig. 4) consists of a long tube, usually about 2ft in length though some are shorter, with a series of holes or vents along one side. The diaphragm is mounted at the rear end of the tube.

Sounds coming from the front enter the end of the tube and travel down it to the diaphragm. They also enter via the side vents. Since there is virtually no difference between the lengths of the paths such sounds travel they arrive at the diaphragm in phase. In the case of sound coming from the side however the path lengths will differ. As shown in Fig. 4(b) a side sound X entering the tube at the end will travel twice the distance along the tube as the same sound Y entering a vent half way along the tube. When the difference in path lengths is half a wavelength cancellation occurs. By having a large number of holes or vents along the side of the tube, each producing cancellation at one particular frequency, a wide band of frequencies over a large part of the audio range is covered. It's true that sounds at all frequencies enter the various vents – we can't channel each frequency into its own vent – but this doesn't materially affect the operation as the leading and lagging components of sound entering ahead of and behind the "proper" vent at each frequency largely balance out.

The polar response obtained is a narrow forward lobe. It's frequency conscious however, the device being more effective at the higher frequencies. A typical sound power concentration figure is from about 9·5 at 1kHz up to 17·5 at 10kHz. It's at the lower frequencies that the deficiencies become apparent. The lowest frequency at which the interference effect can operate is determined by the length of the tube: for a 24in. tube it's between 100-200Hz. There are vents behind the diaphragm as well as along the tube so that at low frequencies there is cancellation on the pressure-gradient principle. But at low frequencies the directivity is no better than that of a hypercardioid microphone.

The overall average sound power concentration is about 10, giving an operational distance for equivalent direct/reverberant sound of just over three times that of a non-directional unit or just over half as long again as that of the hypercardioid device. This is not spectacular but is still useful. In practical terms a gun microphone at 7ft will have the same acoustics as a non-directional type at 2ft or a

– continued on page 325

CRT Booster

A. Denham

THE circuit of the c.r.t. booster I constructed a couple of years ago is shown in Fig. 1. It's easy to build and operate, and uses components which most TV engineers will have to hand. Since the circuit is directly coupled to the mains supply it is important to observe "live chassis" precautions.

There are innumerable suitable transformers on the market. Note however that for use with colour tubes around 7·5V at 1A is required. Most field output transformers will give up to 30V and will stand 1A for a few minutes at a time. The values of R3 and R4 – for monochrome and colour tubes respectively – are calculated to provide the correct heater voltage on load.

The mains rectifier D1 produces around 300V across its reservoir capacitor C1. This is applied to the c.r.t.'s grid via the pygmy bulb LP1. The cathode and one side of the heater are connected to the neutral side of the mains supply. The other side of the heater supply is taken from the secondary of the transformer via S2 and the diode dropper D2, then via R3 or R4.

To work out the values of R3 and R4 proceed as follows. Taking first the case of a colour tube, whose heaters represent a resistance of about 7Ω, load the transformer and diode dropper D2 with a 6·8Ω 10W dummy load resistor (see Fig. 2) and measure the voltage V across the load. This should be about 5V d.c. – unless you use a moving-iron meter which will measure the true a.c. voltage. The value of resistor required is then given by:

$$R4 = \frac{V-5}{0{\cdot}9}\ \Omega.$$

Use the same method to find the value of R3, this time loading the supply with a 22Ω 5W resistor and using the formula:

$$R3 = \frac{V-5}{0{\cdot}3}\ \Omega.$$

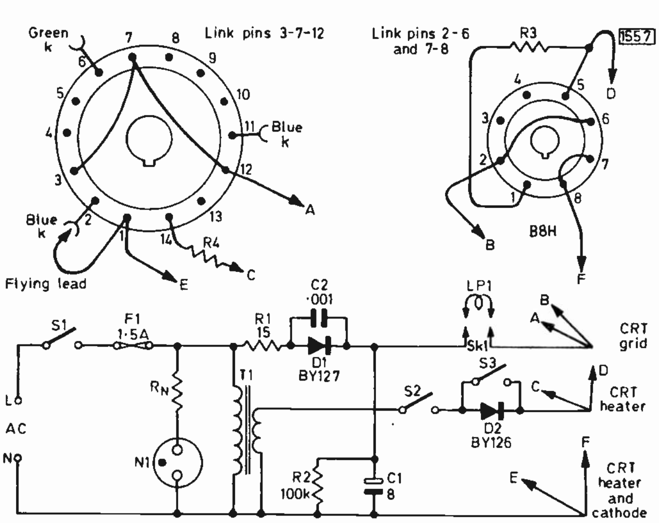


Fig. 1: Circuit diagram and c.r.t. base connections.

I have used several field output transformers successfully. With the one out of the GEC dual-standard monochrome chassis and diode D2 in circuit R3 worked out at 21Ω and R4 was not required. With the one out of the Bush TV125 series and the diode, R3 again worked out at 21Ω and R4 at 1·8Ω. The transformer used in the Philips G6 chassis has not been tried but this has two separate high-resistance windings and with the mains applied to one around 200V is obtained across the other. The entire booster circuit can be supplied from the secondary therefore, giving the added advantage of mains isolation.

With colour tubes the operating procedure is as follows. First select an individual gun by connecting the flying lead to one of the small sockets at the cathode pins on the c.r.t. base. Open S2 and S3, then close S1. If sparks are seen in the c.r.t. neck and LP1 flashes, a grid-cathode leak is being cleared. Next close S2 and watch the c.r.t. heater light up. If the gun is not beyond reclaim the lamp will flash and then come on brightly. Open S2 and allow the heater to cool. Repeat this process until LP1 comes on gradually – any tendency to flash straight on means that the process is incomplete. If the bulb will not light, close both S2 and S3. This increases the heater voltage by around 75%. Do not leave S3 closed once the bulb has lit up. The tube will usually respond quite well once the boosting process has started. Repeat the process with the other two guns.

Note that tubes may flash over for a while whilst in normal use after this process has been carried out.

With monochrome tubes use the B8H base and apply the same procedure as for colour tubes. Tapping the c.r.t. neck may help to start reluctant tubes.

Since there is nothing critical about the layout constructional details are left to the builder. Some may prefer switches to the use of flying leads while transformers vary in size as do bulb holders.

A similar unit has been in use for over a year in a workshop where I worked and has had a 90% success rate, certainly on 90° colour tubes, though 110° ones – especially Valvo and Telefunken – don't boost too well.

All the tubes I have processed have remained reasonable for at least six months, though this only postpones their inevitable demise. Some lasted for as long as two years after processing on an earlier booster. Tube boosting really does do wonders for a dull picture. ■

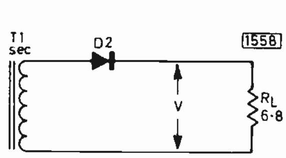


Fig. 2: Finding the value of R4, which is added in series with D2 and the load to make V approximately 5V.

★ Components list

C1	8μF 400V electrolytic	D2	BY126, 1N4004 etc.
C2	0·001μF 1kV, to BS415	T1	See text
R1	15Ω 5W	Sk1	Bayonet socket
R2	100kΩ 1W	LP1	15W 240V pygmy bulb
R3, R4	See text	F1	1·5A anti-surge
D1	BY127, BY238, 1N4007 etc.	S1-3	SPST toggle switches
		RN/N1	Mains neon (RN 220kΩ)
			Plus 14-pin and 8-pin (B8H) bases etc.

GUN MICROPHONES

– continued from page 323

hypercardioid type at 4ft. Those extra few feet can make a big difference to the man controlling the boom.

An important factor in using a gun microphone is that it must be accurately lined up on the sound source. Being highly directional, there is less tolerance to being off axis than with other types. For example, a cardioid unit can be 90° off axis before the output drops to 6dB below normal pickup between the frequencies 1-2kHz. For a hypercardioid, the angle becomes 75° while the 24in. gun unit has a 6dB acceptance angle of only 45° or less.

A drop of only a few dB will lose some of the advantages of the gun. Actors moving about the set can easily step right outside the main acceptance angle, or at least suffer a noticeable drop in volume. A remotely controlled swivel head is therefore essential on the boom, and the operator must be alert to follow the speaker's movements.

As the directivity falls off at the lower frequencies the pick up of incidental and reverberant sound will be greater at these frequencies. Some improvement can be made by l.f. attenuation. The greater the attenuation, the better the overall direct/reverberation ratio, but too much will obviously make the resulting reproduction thin. A small amount gives slightly better rejection of ambient sound without audibly affecting the tone quality.

Though seemingly simple in construction gun microphones are expensive. They usually consist of either an integrated unit – interference tube plus transducer – or a tube supplied separately to fit a particular microphone. In either case the transducer is usually of the professional capacitor type. This is one reason for the costliness, but the tube itself can be over £50.

As a result amateurs tend to view the gun microphone as a desirable but rather too costly acquisition. One model that may be of interest however is the AKG D900. This is a full-length 25in. gun, but with a moving-coil transducer. Although not cheap, it's considerably less costly than a capacitor unit. It also includes a three-position bass-cut switch which as we have seen can be useful for this application.

To get a smooth, resonance free response with maximum directivity the dimensions of the holes, their spacing etc. become critical. There is always room for experimentation however and if successful a home-made unit will save a goodly sum of money. A tube could be made up to fit on the end of an existing hypercardioid or cardioid microphone. Care would have to be taken not to cover the existing rear vents by whatever mounting method may be devised – otherwise the microphone would revert to non-directional characteristics at low frequencies.

The problem is that holes cannot be moved or altered once drilled. An experimental prototype could be made by cutting a slot about $\frac{1}{8}$in. wide along a tube, to within an inch of one end. This could be covered with a strip of softer metal – such as zinc – and drilled with experimental holes. Several strips with different hole configurations could be made, and each one tried over the slot to see which gives the best results. A strip of ordinary perforated zinc would in fact make a good starting point. Finally either the best strip could be permanently secured in place or another tube could be drilled using the successful strip as a template.

Although probably not as good as a commercial unit, such a tube should be an improvement over the straight hypercardioid and thus worth the experiment. ■

BAIRD 620/640 CHASSIS

– continued from page 313

resistor in series with the earthy end of the control will prevent the trouble.

The other main cause of lack of width is low-emission valves, mainly the PL504. In stubborn cases check the values of the other resistors in the width circuit.

Failure on One System

Normal operation on one system but not the other is often caused by dirty or corroded contacts on the system change switch. Clean the contacts individually with a Boot's "cotton bud" dipped in methylated spirits, then treat with Servisol. Failure of one of the switched capacitors is another possibility.

Poor Line Sync

A tendency to line slip and poor sync is often due to trouble around the PCL84 video output stage, or to loss of capacitance in the main smoothing block. Otherwise, for line hold troubles try a new ECC82, check the flywheel sync diodes and, as previously mentioned, the pulse feedback components R83 and C110.

Field Collapse

Perhaps the most common field timebase fault is collapse of the raster to a single horizontal line across the screen. In most cases this can be cleared by simply replacing the PCL805. More serious is when the field output transformer has an open-circuit primary winding. Check by taking voltage measurements at the valve base. If the winding is open-circuit there will be the normal 190V or so at pin 7 (screen grid) but no or a low voltage (via VDR2) at pin 6 (anode).

Lack of Height

Lack of height can be due to several things. First try a new PCL805. Then check the value of the focus potentiometer R103 which can fall in value thus reducing the boost voltage. Next check the value of R195 which can go high. Finally check the charging capacitor C238 which can become leaky.

Field Roll

Field roll with the control at one end of its track can be due to C235 being defective, R183 changing value or the hold control itself. Weak locking will occur when the interlace diode X10 breaks down. Also check the value of the sync separator's screen grid feed resistors R78/R77 and the video output pentode's cathode decoupling electrolytic C93 (500μF).

Field Linearity Faults

Field linearity problems are often caused by defects in the miniature preset potentiometers. Replacement is the best answer, though treating with Servisol may do the job.

Bottom compression of the raster is generally due to the output pentode's cathode decoupling capacitor C234 loosing capacitance. Alternatively a defective valve can result in the bias resistor R178 changing value.

There are still a lot of these sets around. If they have been looked after, a clean up and check over will give them a new lease of life. ■

Service Notebook

G.R.WILDING

Varicap Tuner Troubles

WE'VE had a spate of varicap tuner troubles recently. The first call was to a Decca hybrid colour receiver which had a weak, grainy picture and a very low saturation level. As the aerial was in a notorious local "black spot" we spent some time checking the connections and comparing the results with those from the test aerial we always carry in the car boot. Since virtually nothing could be obtained via the latter no matter where it was held we concluded that the customer's aerial was probably in order. On subsequently changing the tuner really good results were obtained. From the customer's comments it seemed that the tuner had been fading off gradually over a long period.

The second fault was on a 20in. Pye monochrome set. This gave quite good results on BBC-1 and ITV, but on tuning any push-button higher to get BBC-2 the background noise increased to produce a "mush" with no suggestion of the wanted channel. It appeared that one or more of the tuner's transistors – most likely the mixer – was failing to operate at the higher local BBC-2 channel frequency, which is near the top end of the band. Once again tuner replacement restored normal results.

The third example was provided by an ITT colour set which gave fairly good BBC-1 and ITV reception, though marred occasionally by momentary gain/tuning variations. On BBC-2 however this latter effect was so pronounced and occurred so often that it was not worthwhile watching this channel. The trouble was present whichever channel selector was tried, so in view of the previous trouble with the Pye set a replacement tuner was tried. This made no difference however. Clearly the fault was in the push-button assembly, which contains the selector isolating diodes etc. Dismantling this assembly, a simple job, brought us to a riveted paxolin panel. As this and the points on the assembly to which it is secured can be easily split or cracked we decided to take advantage of ITT's repair/exchange service for the whole assembly. The charge (trade of course) was £3·60 plus packing and carriage at 37p and VAT at 49p, making a total of £4·46, which is very reasonable. Perfect results were obtained on refitting the returned assembly.

No Picture

The owner of a set fitted with the Pye 697 hybrid chassis complained that for some time he had heard a sparking noise when he switched the set off but as the picture was all right he hadn't worried about it. While watching the previous evening however, the picture had suddenly gone off, the sound remaining, and a slight wisp of smoke had come from the back of the set. Our first action therefore was to see whether there were any burnt resistors – the 100kΩ resistor R227 which feeds the c.r.t. first anode presets often falls in value to a few kilohms, virtually connecting the associated 0·1μF decoupling capacitor C224 between pin 6 of the line output transformer and chassis – this eliminates the line output. Another resistor which regularly gives trouble in this chassis is R203 (47kΩ) which feeds line flyback pulses to the flywheel line sync discriminator circuit. This falls in value or gets completely burnt up, but usually results in loss of line lock. All resistors seemed to be in order however, though the smell from the chassis certainly suggested carbon resistor failure. As there was no measurable short anywhere and the 0·47μF boost capacitor was o.k. the only thing we could do was to switch on and see what happened.

Perfect sound came on, but as soon as the PL509 and PY500A line output stage valves warmed up there was a distinct wisp of smoke from the vicinity of the line output transformer. After disconnecting the chassis completely, brown discolouration was found on the metal support close to the lead from the tripler. Closer examination showed that this lead was cracked, so that sparking had been taking place between the damaged section and the metal support bracket. Fortunately it was possible to cut off the damaged part of the lead and re-route the shortened section. We then noticed that the right-hand edge of the insulating panel on the top of the line output transformer was also discoloured, the carbonisation here providing a conductive path for the high voltage between the large, anti-corona soldering points 10 and 11 – associated with the connections to the tripler – on the panel. We scraped the carbonised edge away and smoothed off with a nail file. Then, on reconnecting the chassis and switching on, normal results were obtained.

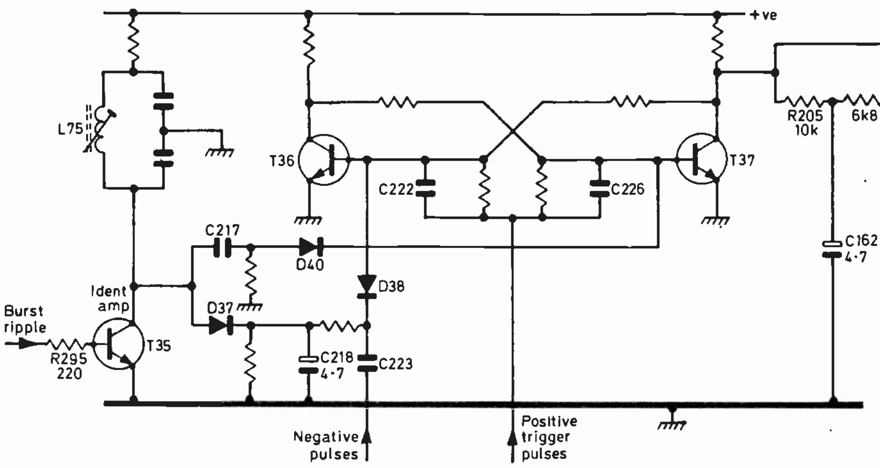
Undoubtedly the arcing from the defective tripler lead to the metal support bracket had produced the carbonisation initially, after which tracking across the edge of the panel had increased the deposit.

Intermittent Colour

Intermittent colour was the problem on an ITT set fitted with the CVC8 chassis. The colour sync was perfect, so we decided that the fault was probably in the chrominance channel rather than the reference oscillator/burst section of the decoder. On lowering the hinged chassis, our first move was to check the voltage across capacitor C162 (see Fig. 1). This smooths the colour-killer turn-on bias which is applied to the base of the delay line driver transistor. The voltage was normal at just under 7V on colour, but fell to almost zero when the colour dropped out.

The colour-killer arrangement used in this chassis is somewhat unusual. The squarewave developed at the collector of one of the bistable transistors, T37, is smoothed by R205/C162 to provide the turn-on bias for colour operation. On monochrome, the negative pulses fed via D38 to T36 switch it off, in turn saturating T37 to prevent the development of the turn-on bias. On colour D37 rectifies the ident signal appearing at the collector of T35, the positive potential thus developed across C218 reverse biasing D38 so that the negative-going pulses no longer reach the base of T36 and the normal line by line bistable switching starts.

In view of this it seemed likely that there was a fault in



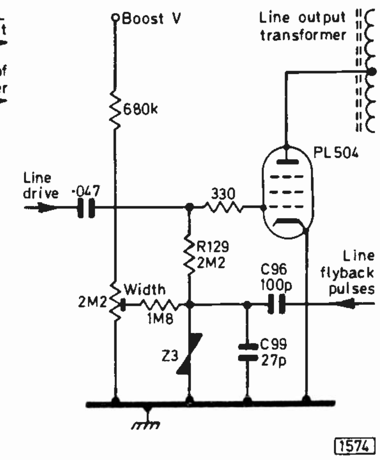


Fig. 1 (left): The colour-killer turn-on bias in the ITT CVC5 – CVC9 series of chassis is obtained from the collector of T37, one of the transistors in the PAL switch bistable circuit. R205/C162 smooth the squarewave appearing at the collector of T37 during colour operation. On monochrome T36 is biased off while T37 is biased on from the collector of T36: in consequence T37's collector voltage remains at near chassis potential and C162 remains discharged. Circuit shown simplified.

Fig. 2 (right): Thorn 1500 chassis line output pentode control grid circuit.

either the bistable circuit or the ident amplifier stage. After checking the diodes in the area we discovered that the fault could sometimes be instigated or cleared by moving the hinged chassis, and on further investigation we found that the resistor (R295) in series with the base of the ident amplifier transistor was dry-jointed. Resoldering produced a complete cure, but we then discovered that the ident coil, L75, had drifted well off tune. This is adjusted by connecting a high-resistance meter across C218 and tuning for maximum voltage, usually about 11V.

Thorn 1500 Chassis Faults

The raster on a set fitted with the Thorn 1500 monochrome chassis was of insufficient width, with the sides curved inwards like severe EW pincushion distortion. Usually of course insufficient width, whether caused by a low-emission line output valve or an increased value resistor in the width stabilising circuit, does not affect the outline of the raster sides. As the hum level was normal, the possibility of heater-cathode leakage in one of the line timebase valves was considered. Changing the valves made no difference however, while advancing the width control, which was already set at nearly maximum, gave very little increase in width. Since the high-value resistors in width stabilising circuits so often give trouble we decided to start checking them. As soon as the positive-test prod of the meter was connected to the junction of Z3/R129/C99 (see Fig. 2) however, and *before* the negative lead was connected to chassis, the sides of the raster straightened up and full width was restored. Evidently hand-capacitance via the test prod was shunting C99, and on replacing this component a normal raster was obtained.

Sound but no raster on another of these sets was found to be due to the fusible resistor R124, which is in series with the HT1 and HT3 lines to the line timebase and the sync circuits, being open. There was no short across these rails, so R124 was resoldered and the set switched on. A normal picture developed, but as these fusible resistors rarely open unless subjected to an overload condition the set was given a test run. After some minutes we found that tapping the PY801 boost diode resulted in occasional internal sparking, so we replaced this valve and as no other fault condition was apparent returned the set to its owner.

Next day another phone call was received to say that the same fault had occurred. Once again we found that R124 was open, though no fault condition could be traced. The PL504 line output valve was replaced in case it was shorting intermittently, and to be on the safe side the 180pF 8kV line output transformer tuning capacitor was changed although it looked all right – high-voltage disc capacitors sometimes break down when the ambient temperature gets high. After more than an hour's test run the screen again went blank, due to R124 opening once more. This time we replaced the 30FL2 valve, whose triode section is the line blocking oscillator, and since then there has been no recurrence of the trouble. Line oscillators sometimes fail to oscillate, or will do so only when the set is switched off and on again rapidly, but this is the first time we have come across one which worked perfectly for an hour or more before failing.

In another recent case with one of these chassis we had to spend some time trying to find the cause of intermittent loss of line hold. The culprit turned out to be the 0·01μF capacitor C48 which decouples the slider of the line hold control.

No Sound or Field Scan

The picture on a Pye hybrid colour set fitted with the 693 chassis had collapsed to a thin horizontal line, along with loss of sound. The simultaneous appearance of these two faults clearly pointed to an l.t. rail failure rather than to separate sound and field faults. The only fuse in these sets is in the mains input circuit, while the four positive and three negative l.t. rails are all derived from a single bridge rectifier unit (D51) which is fed from a centre-tapped secondary winding on the mains transformer. While checking, we noticed from the smell that the transformer was overheating, due it turned out to a short in the bridge rectifier. We decided to replace this with four separate diodes, and on switching on normal results were obtained – with the transformer seemingly unaffected by the short-term overload.

Weak Sync

A dual-standard Philips monochrome receiver had weak line and field sync, placing immediate suspicion on the sync separator section of the PFL200 video/sync valve. A replacement made no difference so the next step was to check the anode and, in particular, the screen grid voltage.

Since there was a degree of sync, it was likely that the fault was due to low-amplitude sync pulses produced as a result of incorrect screen grid voltage. Although it was possible to get the test prod on to pin 4 (anode), where a near normal reading was obtained, we couldn't be certain whether the zero voltage reading obtained when checking at pin 3 (screen grid) was due to a fault or the fact that the test prod wasn't quite making contact. Not having the manual with us, the process of identifying the feed resistor could have taken time: so the valve was removed in order to make the test at the valveholder socket. The boost diode was also removed since it's the first valve in the heater chain – if this is not done, or the heater leads of the removed valve linked across with either a shorting link or a low-value wire-wound resistor, the heater-cathode insulation of all the valves on the live side of the one removed would be subject to excessive voltage. There was found to be ample screen grid voltage, which seemed to destroy the supposition that the trouble was due to the sync separator receiving inadequate or zero screen grid voltage during operation. Measuring the screen grid voltage in this way made it possible to quickly identify the feed resistor however – the one with the same voltage at one end as at pin 3 of the valveholder of course. On replacing the valve and switching on again almost zero voltage was found at the feed end of this resistor, which on checking was found to have risen in value from 680kΩ (Philips 210 chassis) to a few megohms. The valve's screen grid current had resulted in almost the entire h.t. voltage being dropped across this resistor during normal operation. With the valve removed however, the 50μA passed by the meter had resulted in only a small voltage drop across the resistor, the rest being developed across the meter's internal resistance.

No Picture

There was no picture on a set fitted with the ITT CVC8 chassis, due to the fuse in series with the h.t. supply to the line output stage having blown. There was no short-circuit across the rail and chassis, but there was across our next testing point – between the cathode top cap of the PY500A boost diode and chassis. As anticipated, disconnecting the lead to the top cap left the short unaltered and our next step was to connect the meter across the large 1kV working 0·47μF capacitor by the line output transformer. This of course is the boost capacitor, and is returned to chassis via a winding on the line output transformer and the horizontal shift control. It turned out to be completely short-circuit. Normal results were restored by replacing it, the fuse and the PY500A – it's always as well to replace the PY500A when the boost capacitor has shorted to provide a low-impedance path from its cathode to chassis, since this may well have strained it – especially if the fuse is over rated.

Dark Picture

The owner of an Ekco Model CT122 (Pye 697 chassis) complained that while watching the previous evening the picture had gradually got darker and darker until it became unwatchable. On switching off, three large coloured spots had appeared on the screen and then gradually faded away. When we switched on, a reasonable picture appeared, but even with the brilliance control fully advanced it was much too dark. The picture size and focus were about normal, so the e.h.t. could be assumed to be within tolerance and the fault due to an over-biased c.r.t. – as a result of excessive cathode voltage or inadequate grid voltage – or to the c.r.t.'s first anode supply being low. Since this hybrid chassis uses colour-difference c.r.t. drive, the most likely cause of the trouble was simply that the PL802 luminance output valve was not passing sufficient current. The valve was found to be in order, while shorting its cathode to chassis – as a quick check on the flyback blanking circuit in series with its cathode – had no effect. Excessive c.r.t. bias could be due to a defect affecting the three clamp triodes in its control grid circuits, but the voltage across the clamp voltage smoothing electrolytic was normal, as were the voltages at the anodes of the clamps.

At this point a distinct smell of carbon resistor burning was noticed, and was traced to the 100kΩ resistor R227 on the vertical line timebase/power supply panel. This resistor is part of the *RC* filter between the boost rail and the c.r.t. first anode presets, and the trouble was found to be due to a leak in the associated 0·1μF capacitor (C224) – the leak increased as the capacitor's temperature increased. Replacing both components and readjusting the presets resulted in a first class picture.

No Signals

The symptoms with a Thorn monochrome set fitted with the 1500 chassis were normal raster but neither picture nor sound. Since the sound signal is taken from the collector of the video driver stage, the fault clearly lay in either this stage or before it – but after the tuner since there was no screen noise or speaker hiss. The first check was to ensure that the l.t. supply – which is obtained from the earthy end of the heater chain – was present and correct, and next to check the voltages in the video driver and the preceding stages in the i.f. strip. There are four i.f. amplifier transistors, and the trouble was found to be in the first two stages since the emitter, base and collector voltages of both transistors were all roughly the same at around 11V, indicating that both were saturated. The control voltage from the a.g.c. amplifier is applied to the base of the second i.f. amplifier transistor, which in turn supplies the base bias for the first i.f. amplifier transistor from its emitter. It was likely therefore that the fault was in the a.g.c. section, and the a.g.c. amplifier's collector voltage was found to be about 11V instead of the correct figure of 0·4V. The cause of this high voltage was that the a.g.c. amplifier transistor was virtually open-circuit at its base-emitter junction. Changing this transistor restored normal working voltages in all the three stages concerned and of course normal picture and sound.

Very Dark Picture

We were called to see a 405-line portable fitted with the Thorn 980 chassis. The fault was normal sound but a very dark picture, only the highlights being visible even with the brightness control at maximum. With this type of fault the first action should be to check tube base voltages, and on doing so the cathode, grid and first anode were all found to be at zero. The drive is a.c. coupled to the cathode, whose d.c. voltage is set by the brightness control, the grid being used for flyback blanking. Zero voltages at the grid and cathode were to be expected therefore, since with the brightness control set to maximum its slider would be at the chassis end of the control. The trouble was obviously due to the lack of first anode voltage, and on checking the 3·9MΩ feed resistor R95 was found to be open-circuit. A replacement resulted in a first class picture. Without bias and with no first anode voltage only the negative-going swings of the video signal had been able to produce slight beam current.

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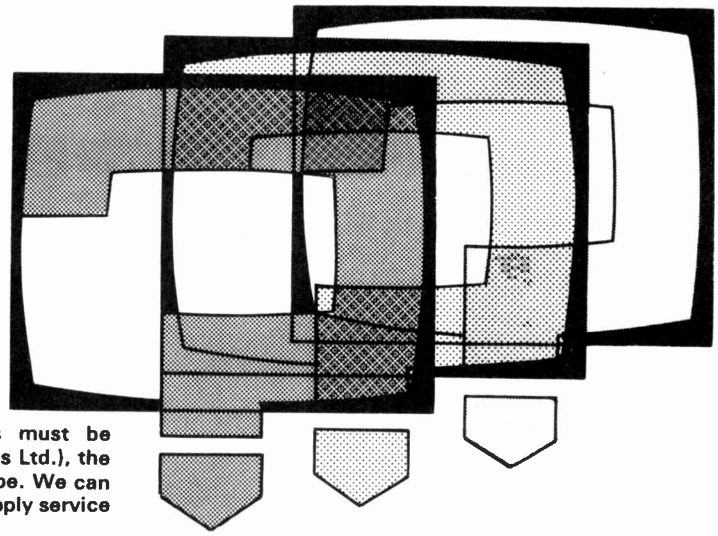

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ITT CK505

We are having difficulty tracing the cause of intermittent colour drop-out on this set. Any suggestions would be welcome.

This symptom is typical of early production of these chassis. It's commonly caused by dry-joints on the print side of the decoder printed panel. There is a transverse screening strut running across the print adjacent to the service switch S501/2. This strut earths two "lands" on the printed pattern, and poor jointing occurs here. The rest of the decoder is not above suspicion for dry-joints however. (ITT CVC20 chassis.)

PYE CT152

The fault on this set consists of a horizontal curtain effect fading down from the top of the screen. It's not always present on all channels.

The problem is due to the a.g.c. amplifier ringing, and can usually be cured by replacing the 50μF electrolytic capacitor C46A which decouples its base. It can also often be cured by swapping over C46A and C45 (0·22μF) which decouples the collector of the a.g.c. amplifier. (Pye 691 and subsequent hybrid chassis.)

ULTRA 6649

This set seems to be working well except for the fact that the picture lacks contrast. Can this be cured without going to great expense?

First check the 6F28 video output valve. If changing this makes no difference, note the effect of turning up the contrast. If this turns the picture silky on highlights – instead of making the whites whiter – suspect the tube of losing emission. If the picture merely remains grey, check the high value resistors in series with the sliders of the two (405/625) contrast controls. These are R4 (5·6MΩ) and R7 (3·9MΩ) respectively. Further checks should include R14 (39kΩ) which feeds the screen grid of the 6F29/EF183 first i.f. amplifier valve, the valve itself and the second i.f. amplifier valve (30FL14/PCF808). (Thorn 1400 chassis.)

PERDIO PORTARAMA

I came across this old portable while clearing a shop of ex-rental sets. After some work on the switching system, sound and a good picture were obtained, but neither the line nor the field could be locked for more than a second or two. After replacing the OC44 sync separator transistor good line lock was obtained but the field locking is still easily upset and the picture starts to roll slowly. When field lock is achieved there is quite often field judder.

In addition to the field hold control VR402 there is another control (VR103, 5kΩ) which sets the field sync level. The field sync pulses pass to the slider of this control via D114 (Y25) which is the chief suspect. It would be an idea to check the electrolytic C116 (160μF) which is the a.g.c. reservoir capacitor.

MARCONIPHONE 4715

The trouble here was that the brightness faded away. The voltage across R907 in the beam limiter circuit is too high – 2·5V instead of 1·3V. Varying the beam limiter control R903 will bring the picture back but does not reduce the voltage across R907. The set is operating normally otherwise.

The line scan current is returned to chassis via R907 which thus monitors the conditions in the line output stage. Your problem is symptomatic of excessive line output stage loading. The following are suspect: shorting turns in the blocking choke L504; leakage in the c.r.t. first anode rectifier W505 or its associated reservoir C523; a leaky e.h.t. tripler; shorting turns in either the line output or the e.h.t. transformer. Disconnect each of these in turn while monitoring the voltage across R907. The voltage will drop to about 1V when the faulty component is disconnected. Check that R907 itself hasn't increased in value. Although it's a wire wound component, this has been known to happen. (Thorn 3500 chassis.)

PYE CT200

The first problem to develop was that on a monochrome transmission red, green and blue dots would keep appearing on the screen, then fading away. Now when the set is switched on the picture appears covered with coloured grainy dots – as if a poor transmission is being received.

The symptoms suggest faulty colour-killer action on the decoder board. We suggest checking the setting of the a.c.c. line. There should be 1V on colour and 4V on monochrome at pin 9 of the TBA540Q i.c. If the voltage is low on monochrome, adjust the set a.c.c. control R391 until 4V is obtained. (Pye 713 chassis.)

EKCO T525

There is no raster on this set, with the PL504 line output valve getting red hot due to lack of drive from the ECC82 line oscillator. There is no sign of cooking anywhere however.

The ECC82 is a blocking oscillator with the other half a d.c. amplifier to apply flywheel sync control. Try a new valve then suspect capacitors. The coupling capacitor to the line output stage (C111, 0·047μF) and the charging capacitor (C110, 390pF) both go leaky from time to time. The only other relevant components are the timing capacitor C109 (820pF) and the blocking oscillator transformer. (Pye 368 chassis.)

DECCA CTV19

The trouble with this set is a green cast on the right-hand side of the screen – the colour is normal on the left-hand side. I have checked several components around the G – Y output valve but there don't seem to be any obvious defects.

Make sure that the purity is satisfactory – check on the red field – then concentrate on the G – Y clamp stage – the triode section of the G – Y PCL84. Check the coupling capacitor C652 (620pF) and the 10MΩ anode resistor R675. Confirm that the clamp pulse is reaching pin 1. The trouble can also be due to the pentode's anode load resistor R674 (12kΩ).

ULTRA 6714

There is a click and the sound disappears, leaving a good picture, when the set has been on for about three-quarters of an hour. Switching the set off and on again restores everything to normal for a short time. If the volume control is set at a very low position however the set continues for hours without losing the sound.

The fault is not uncommon on this chassis – but the answer is never twice the same! We suggest you check by substitution the three electrolytics associated with the audio amplifier transistor VT401. These are C401, C402 and C407. If the fault persists, any one of the four transistors VT401-VT404 in the audio section could be responsible, though we'd check the driver VT402 first. Gentle use of heat from a hair-dryer, plus an aerosol freezer, may help narrow the field of search. (Thorn 3500 chassis.)

PHILIPS 19TG158A

Occasionally there is bending at the top 1¼in. of the screen. Another trouble is curved verticals which are there continuously.

Check the ECC82 flywheel line sync valve (V403) and the video and sync separator circuits, starting with the 10MΩ resistor connected to pin 7 of the ECL80 sync separator. A strong possibility is R402 (27kΩ) which feeds pin 1 of the ECC82 (V403).

PYE CT200

The trouble with this set is a loud hum after it's been operating for a short time.

The hum suggests detuning of one of the sound coils. There are two in the input to the TBA750Q intercarrier sound i.c., also the quadrature coil. A dry-joint could be responsible, so try resoldering around the TBA750Q and its associated circuits. (Pye 713 chassis.)

ITT CK600

This set has stopped working – following a small amount of smoke. Both the line output stage valves light up brightly, but I can't see any signs of burnt resistors anywhere.

The distress in the line output stage is due to lack of drive from the PCF802 line oscillator. If its pentode section cathode resistor R406 (5·6kΩ) is burnt, replace this and the valve. If the tuning capacitors C294/C295 and the quadrature feedback capacitor C291 are of the polystyrene (see-through) type they are suspect. Other possibles are the oscillator feedback coupling capacitor C293 (330pF) and the oscillator coil. Disconnect the line output valve's screen grid feed resistor R421 (2·2kΩ) while investigating the line oscillator – this will prevent damage to the line output stage. When drive is restored there will be a negative voltage at pin 1 (control grid) of the line output valve. (ITT CVC5 chassis.)

PHILIPS 19TG170A

There is an odd fault here. The picture and sound seem to be all right at low volume settings but when the volume control is turned up to about half way the sound is choked off almost completely and the picture suddenly shrinks by about an inch all round. On turning the volume control down again the picture and sound return to normal.

The trouble seems to be due to leakage in C228 which couples the anode of the triode section of the PCL82 audio valve to the control grid of the pentode section. The effect on the picture is due to the fact that the triode anode is fed from the boost rail. You could use an 0·01μF replacement, but make sure it's rated at 350V or so. (Philips Style 70 series.)

HITACHI CNP192

When receiving a colour transmission there is a high-pitched whistle from the speaker, even when the colour control is at minimum. The whistle is not present on monochrome.

We assume that the high-pitched whistle is the ident signal (7·8kHz) since this is developed only during colour reception. It would appear to be getting into the audio section due to defective smoothing and/or decoupling in the supply to the ident or the audio circuits. We'd be suspicious of C527 (100μF) which decouples the 12V supply to the two ident stages TR26/TR27 and, in the sound section, C407 (470μF) which decouples the 10·7V supply to pin 5 of the intercarrier sound i.c. and C411 (1μF) which decouples the volume control circuit. Another possibility is C561 (22μF) across which the colour turn-on bias is developed.

FERGUSON 3658

After the set has come on the picture will usually either go off again instantly or gradually drift off. All that is necessary to restore the picture is to depress any one of the three piano-key channel selectors. Once the picture has been restored it remains on for the rest of the evening. It's sometimes necessary to press the keys more than once.

Once you have removed the tuner and its cover you will observe a number of spring washers which contact with the tuning spindle. These usually have a covering of grease which will have to be removed. We always remove the springs completely, using a large soldering iron, to ensure that all traces of grease are removed. Clean off and refit the springs. (Thorn 1400 chassis.)

DYNATRON CTV10A

After about an hour there is crackling on sound accompanied by quite severe ringing on sharp-edged images – especially on bright scenes. Some herringbone patterning is also evident.

The symptoms indicate failure of one of the ceramic decoupling capacitors in the i.f. strip. Try bridging each in turn with a good one during the fault condition. (Pye 691 chassis.)

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

A Ferguson receiver fitted with the Thorn 8000 colour chassis was investigated for excessive horizontal scan. The complaint was that detail at the sides of the picture was not visible. This was verified on a test card, the line scan having increased to the extent that at least half an inch of the picture was off the screen. There is no width control, the picture size tracking with the e.h.t. voltage as set by the stabilised power supply.

It was thus concluded that the trouble must lie somewhere in the h.t. supply circuit. An e.h.t. voltmeter was not at hand, so it was decided to try adjusting the set e.h.t. preset R725 in the power supply section. Note that this preset is factory sealed and under normal circumstances it should not be adjusted. One reason for this is that incorrect adjustment could strain the line output transistor and lead to its failure. It was found however that a very slight adjustment restored the line scan to normal, and all appeared to be well.

After several weeks of normal operation the receiver was returned with the complaint of "picture flutter". We discovered that the effect could be cleared by a very slight readjustment to R725. In fact there was a definite threshold point where the flutter would start or stop. This was not apparent previously.

The obvious course was to investigate the power supply circuit in more detail. The chassis uses a thyristor rectifier whose trigger point varies depending on the effective load, i.e. the current taken by the receiver. For accurate adjustment of the preset R725 the arrangement shown in Fig. 1 should be used in connection with an Avo Model 8 to

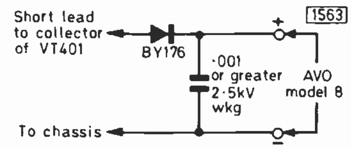

Fig. 1: Method of adjusting R725 to obtain the correct e.h.t., using an Avo Model 8 on its 2·5kV range.

measure the peak voltage at the collector of the line output transistor (VT401). The scheme is to adjust R725 for an absolute maximum of 1·4kV on the Avo, with a locked raster.

It was found that for this reading the preset was pretty well at the end of its travel, the picture then fluttering. What was the most likely cause of this trouble? See next month's Television for the solution and for a further item in the Test Case series.

SOLUTION TO TEST CASE 171
(Page 273 last month)

The clues to the whereabouts of the trouble were the excessive amplitude of the pulses provided by the line output transformer pulse winding, the excessive voltage at the cathode of the PL509 line output valve, and the fact that the symptoms were affected by altering the setting of the beam limiter preset control. The abnormally high PL509 cathode voltage indicated that the valve was not being biased correctly, and one or two tests in its control grid circuit soon brought to light the cause of the trouble.

There is the usual v.d.r. width stabilising arrangement in the valve's control grid circuit, the negative voltage produced by the v.d.r. being offset by the positive potential obtained from the width controls. The positive potential from these controls – the dealer and factory preset width controls – is fed via two 270kΩ resistors (R415h and R416h) which are connected in series. These had broken down with the result that there was excessive positive potential applied to the valve's control grid, i.e. inadequate bias. The abnormally high PL509 current accounted for the incorrect cathode voltage and pulse amplitudes. It also meant that as soon as a good vision signal was tuned in the beam limiter came into action, removing the screen illumination.

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TELEVISION APR. 1977

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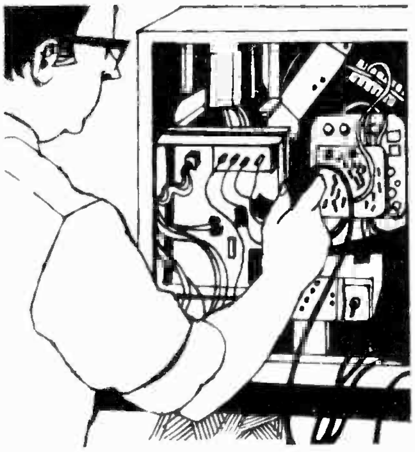

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