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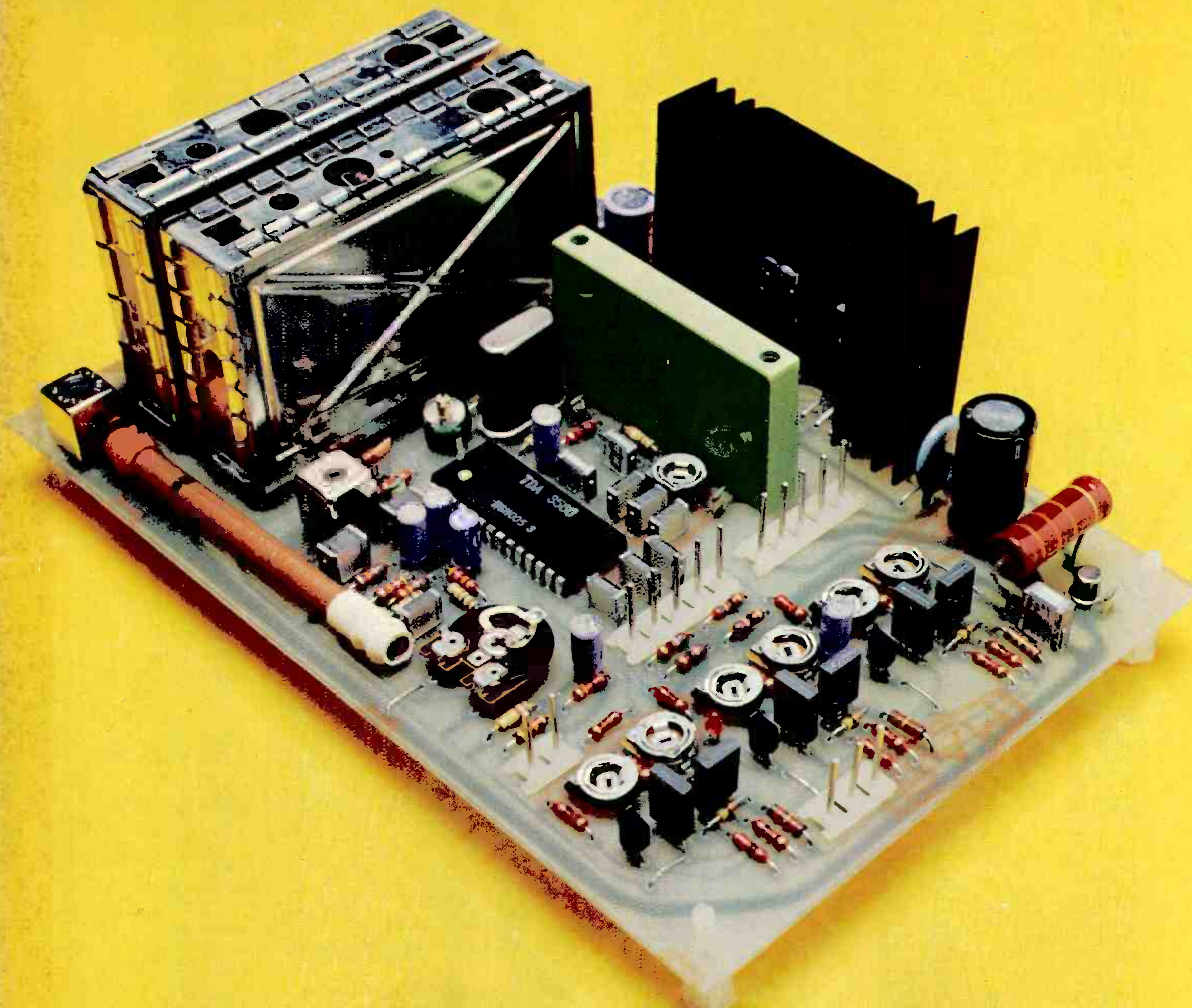

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TELEVISION

September 1980 **Vol. 30, No. 11** **Issue 359**

this month

OUR NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON SEPTEMBER 17

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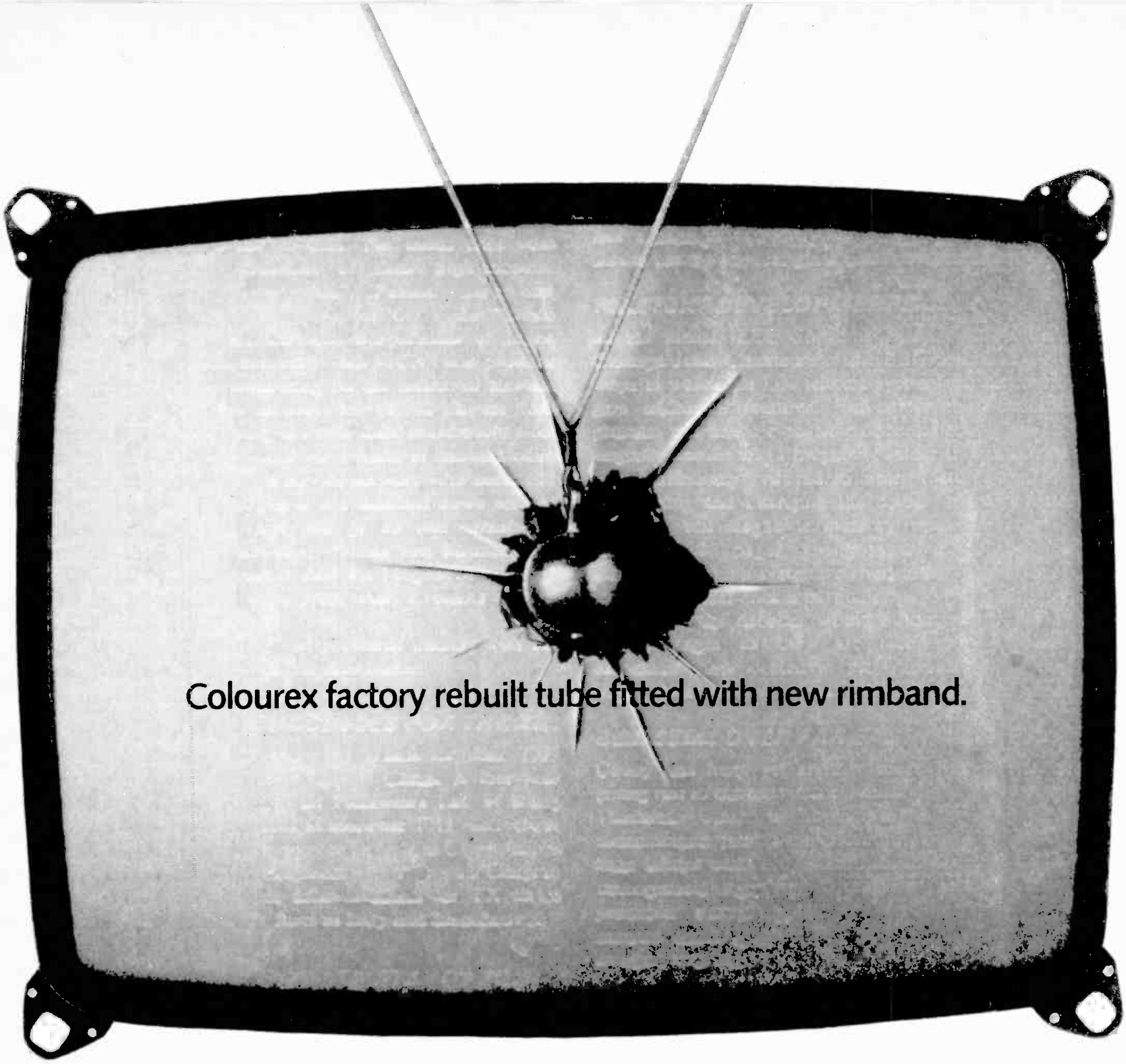
Colourex factory rebuilt tube fitted with new rimband.

TELEVISION

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Chill Winds

The much talked about recession is now here and likely to get worse. At least the consumer stands to gain initially, as manufacturers and distributors set about clearing stocks that are expensive to finance. It's been said that the present is an almost once in a lifetime opportunity for bargains, as half the shops in the high streets run extended sales and special offers come thick and fast. Those with spare cash could do worse than to avail themselves of the current opportunities, though people tend to save more as the economic climate worsens, making the situation that bit more difficult. The small retailer is certainly in an awkward position, as suppliers offer ever greater discounts and the high street discounters seize the opportunity.

The problems of UK manufacturing industry have been analysed over and over again. Will there be an indigenous car industry in five years time, or a textile industry in a couple of years time? Undoubtedly there will, but its form and size are not easy to foresee. What about TV and video? Well, we don't have a video manufacturing capacity, so that means TV setmaking. The industry is very fortunate in that the UK public's habit of set rental provides a very effective cushion against the worst recessionary effects. With rental, the cash flow continues and you can also keep the sets moving. The UK's TV industry could have been in as bad a position as certain other industries without the support of the rental system. Had people rented radio sets, we might still have been producing these in quantity.

The TV industry in the UK has on the whole been well managed. Labour relations are well above average for the manufacturing section, and despite low profits investment in up to date sets and production techniques has been maintained. Thorn set about designing a colour receiver that would be competitive world wide in their TX series, and the export successes already achieved are heartening. Selling TX9s to Hong Kong is an achievement indeed!

Those massive Japanese corporations nevertheless continue to scare the European industry. And how remarkably well they do! In their last half year reports, Toshiba announced profits increased by 112%, JVC up 120% and Sony a massive 342% increase. During the period, Sony managed to increase sales of TV sets by 52% and VTRs by 66·9%. Admittedly the recession had yet to bite, and the Yen exchange rate helped.

It's not all that easy to understand why Japanese firms do so well so consistently. We all know about dedicated workforces and workaholics, and that certainly helps. But the financial workings of Japanese industry are somewhat mysterious. If you generally work on low profit margins, the sorts of heady figures we quoted above can easily occur. You can work on low margins, relying on turnover, if interest rates are low, you have the support of the banks and the government, and know that your production lines will never be disrupted. With large scale production there'll be adequate funds for R and D work, and with reliable products your sales are likely to remain buoyant. One of the remarkable things nevertheless is the way in which the rest of the world seems to act as a successful sales force for the Japanese manufacturers!

Are there any lessons for the UK in all this? Looking back, governments here have constantly rocked the economic boat with stop-go and all that, but industry must also take its share of the blame for the situation today. One thing one recalls is the dotty devotion to badge engineering. The same cars were sold with half a dozen different brand names stuck on them, and the same happened with TV sets. Whether the idea was to appeal to the UK's notorious class consciousness or to keep redundant sales managers in jobs is difficult to say . . . The fact is that a Volvo has always been just that, as have Volkswagens, Datsuns, Sonys, Hitachis and so on. Spend the money on a reliable product that anyone can use the world over, rather than on craftily contrived status symbols.

So we've mismanaged our marketing, and successive governments have mismanaged the economy: what else? Oh yes, we've mismanaged our investment programmes. Remember the property boom? A fat lot of good that did anyone. Then we seem to hanker after grandiose projects of the Concorde variety. What would the money lavished on that sort of thing have achieved elsewhere? And then, dare we mention it, there's all that money spent on military hardware. Successive governments have overlooked the fact that the globe no longer has all those large pink areas. It's salutary to recall that the two most successful economies in recent times, W. Germany and Japan, devote a relatively small proportion of their resources to military purposes. Expecting sense in this field is probably asking rather much however.

Meanwhile, those of you with jobs can help yourselves to those special offers of Jap cameras and VCRs.

CORRECTIONS

The PL509 does not have its suppressor grid and cathode internally connected of course (page 423, June issue), but the suppressor grid resistor in the Kuba Florence nevertheless does burn up if a PL509 is fitted instead of a PL519 . . . Geoff Perrin's aerial mast (Oman) is 50ft, not 500ft.! (July, page 475.) And the correct model number for the Sony power unit and effects generator mentioned in *Video at the Shows* last month is HVS2000P. Its suggested retail price is £71·50 including VAT.

The Salora Ipsalo Circuit

George Wilding

TV DESIGNERS in recent years have paid a lot of attention to devising various ways of operating the line timebase and the power supply in tandem. After all, if you use a chopper to provide a regulated supply for a transistor line output stage, it's logical to switch the chopper transistor at line frequency. This in fact is a common enough arrangement nowadays. As far back as 1975, Thorn went a stage farther by integrating the two stages. As you all know, the famed Syclops circuit they adopted for the 9000 chassis used a single transistor as the chopper and line output switching device. It drove two transformers, the chopper transformer and the line output transformer.

At about the same time we noticed an interesting circuit suggested by Siemens. It was intended for use in large-screen monochrome receivers, and its advantages were the provision of mains isolation and low power consumption. We've never come across it in use, maybe because mains-isolated monochrome sets are rare birds indeed. The basic scheme is shown in Fig. 1, and as you can see this time we have one transformer and two transistors, the single transformer providing mains isolation in addition to being the line output/e.h.t. transformer.

The basic operation of this circuit is simple enough. Th1 is a wholly conventional thyristor rectifier producing a regulated h.t. supply. C1 is the h.t. reservoir capacitor, with R1 and C2 the h.t. smoothing components. R1 also senses the h.t. current, feedback from the junction of R1/C2 being taken to the control circuit to adjust the timing of the trigger pulses used to fire Th1. Transistor Tr1 is a self-oscillating chopper, driven by the flyback pulses applied to its base. When it switches on, energy is fed into the transformer via its collector winding. Those familiar with the Indesit T12 monochrome portable and the GEC 3133/3135 portables will immediately recognise this arrangement. The line output side is perfectly straightforward, with C3 smoothing the h.t. supply obtained at the top end of the line output transistor's collector winding. One thing you could call this circuit is "an inductive transfer system between the power supply and the line timebase". Which brings us to the new Salora G chassis.

Salora have adopted this basic approach and taken it some stages further for use in their new series G chassis, a mains/battery colour chassis designed to drive 90° PIL type tubes in sizes up to 22in. Low power consumption is obviously a prime requirement of a chassis that's to be able to do this, so the circuit we've briefly described is an attractive starting point. Salora call the circuit used in their G chassis "Ipsalo" – integrated power supply and line output. The power consumption figures achieved with the G chassis are certainly impressive – 38W with a 16in. tube and 45W with a 20 or 22in. tube, under normal viewing conditions.

The Ipsalo circuit is shown in greatly simplified form in Fig. 2. When operated from the mains, bridge rectifier BR1 will develop an h.t. supply of 300V across its reservoir capacitor C1. It won't do this however until Th1 is switched on. Th1 in fact is used for a totally different purpose from Th1 in Fig. 1. In this circuit both thyristors – Th1, and Th2 which replaces Tr1 in Fig. 1 – are switched at line frequency. Th1 is used as an electronic fuse, since with no drive the h.t. supply is removed. It also provides the slow-start action. Th2 provides the regulation.

Th2 is switched on during the line scan period, being switched off by the line flyback pulse which is coupled to it via the transformer. As Salora point out, this is a much more economical way of switching it off than the method used to switch off the scan thyristor in thyristor line output circuits. Th2 is in fact being used as a chopper, with the shunt diode D1 providing an efficiency diode action.

The scan/e.h.t. side of the circuit is entirely conventional. Energy saving is achieved since there is no electrical connection between the h.t. supply provided by the thyristors and the line output stage, power transference being via the magnetic fields produced by the current pulses flowing in winding 1-2 of the transformer. This minimises the dissipation in the set.

The control circuit that drives the thyristors is mainly contained in a 28-pin thick-film hybrid i.c. (type LF0015) developed and manufactured by Salora. In addition to driving the thyristors, it controls the soft-start, electronic fusing and voltage limiting functions.

Fig. 3 shows the mains isolation arrangements in greater detail. The drives to both thyristors are transformer coupled, while a further transformer (MM1) feeds a second bridge rectifier from which the start-up supplies are obtained. A further feed, via DB38, supplies a sample proportional to the mains voltage to the control circuit.

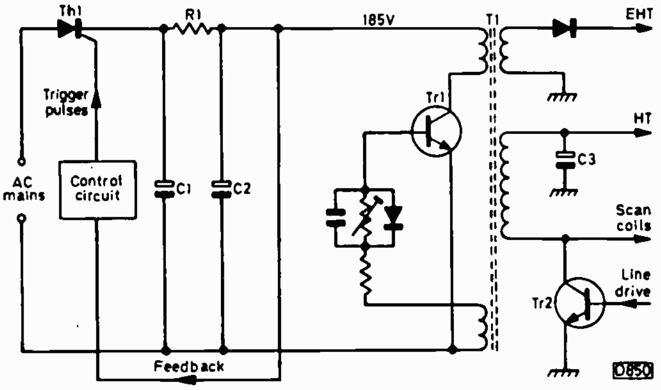

Fig. 1: Circuit suggested by Siemens for use in large-screen monochrome sets to give mains isolation and low power consumption.

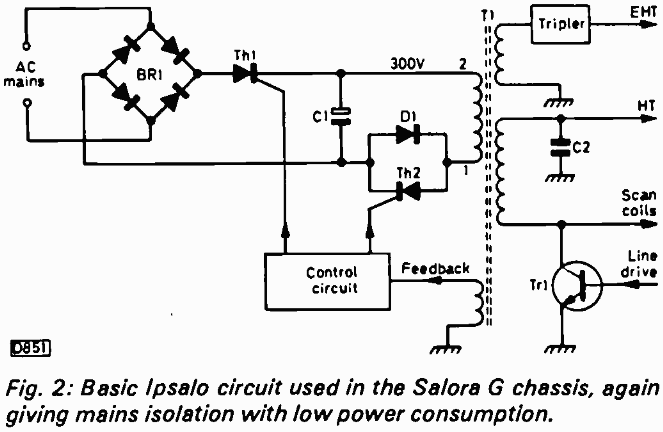

Fig. 2: Basic Ipsalo circuit used in the Salora G chassis, again giving mains isolation with low power consumption.

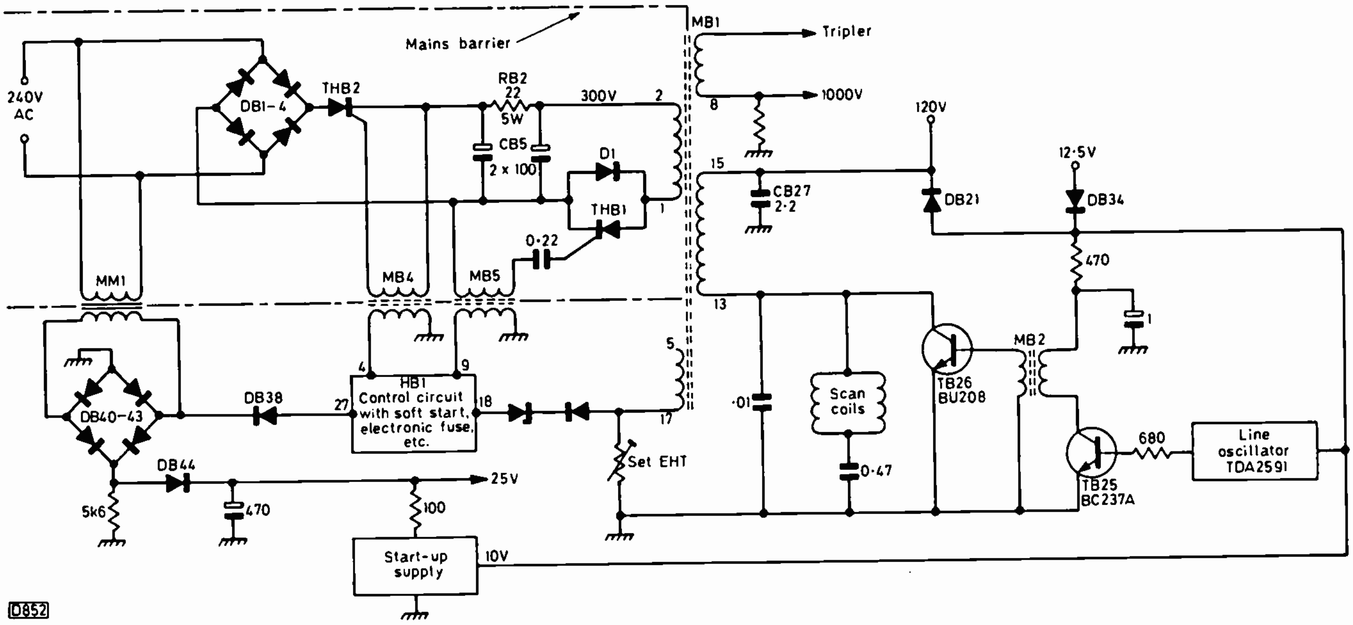

Fig. 3: The Ipsalo arrangement in greater detail, showing the mains barrier system and the start-up feeds.

The sample pulse for regulation purposes comes from winding 5-17 on the combined power supply/line output transformer. If the amplitude on the sample pulse rises, the switch-on time of the regulator thyristor THB1 is delayed, thus stabilising the width, the e.h.t. voltage and the various d.c. supplies obtained from the transformer.

The drive to THB2 is removed should the voltage on the 20V or 28V rails rise excessively, thus shutting down the receiver's supply. If the over-voltage condition is transient, the circuit starts up again quickly, restoring normal operation. If there's a definite fault condition however THB2 remains cut-off.■

Suffer Little Children

Les Lawry-Johns

I'M often accused of being hard on old ladies. This isn't true. The reason I seem to come into contact with so many of them is that I'm soft when it comes to charging them a realistic amount for the job. This is fatal, because the word gets around and before you can say Jack the Ripper you have a whole host of elderly female customers and precious little in the bank. It's children that have been giving me a hard time lately however.

I was feeling rather shattered the other afternoon, having left a house where they kept a horse in the same room as the TV ... Arriving at the vicarage I thought I'd be in for a quiet few minutes at least. No such luck.

The vicar's wife opened the door. "It's the black and white set in the kitchen. It blew up at lunchtime."

In the kitchen stood a good old, reliable 20in. Philips G20T300. "It keeps the children quiet at mealtimes" she said.

I suppose the fact that it was out of action explains why all hell was breaking loose as the two young children fought, with earsplitting screams, to get their hands in my toolbox. The little girl was about two and was the younger. This may have accounted for her ability to scream far louder than her brother who, being a year older, would have been the boss if his sister hadn't been gifted with a tremendous pair of lungs to offset the age difference. I immediately joined battle with the little girl and attempted to wrest the 4BA nutspinner from her. Both of them objected to this, and the screaming assumed 100dB proportions.

During this time their mother calmly stood and explained something to me. I haven't the faintest idea what it was, as all I could see was her mouth opening and closing. In the end I gained control of the nutspinner by giving the little girl my penlight torch. Her brother then wanted it.

I looked round for aid. There wasn't any. The vicar's wife had left me to it and was busy answering the phone. How she could hear anything above the tumult I just don't know.

I removed the set's back cover and put the screws on the table next to it. The little girl grabbed the screws and ran off, hotly pursued by her brother, to where their mother still chatted on the phone despite the screams as the girl tripped over and her brother tumbled on top of her. I decided to take a leaf out of the mother's book and ignored the noise.

The PCL82's cathode decoupler had exploded and deposited its innards all over the place. I presumed that this was due to the usual PCL82 trouble – it runs into grid current, burns out its cathode bias resistor and leaves the decoupling capacitor to take the strain of the high cathode voltage. So I carefully brushed out the area, fitted a new PCL82, and laid underneath the set to unsolder the resistor and capacitor. It was while I was in this vulnerable position that the little angels returned to look at the funny man stretched out under their set.

"Wha dat?" enquired the boy.

"I'm trying to mend your TV set" I confided.

"Wha dat?" he repeated. "When BANG!"

At this the little girl burst out crying and ran screaming to her mother. "Man make telly go bang." By this time I'd fitted the 470Ω resistor and was about to fit the electrolytic when the boy again said "when BANG". So I decided not to fit the capacitor until I'd checked the cathode voltage. I switched the set on and waited for the sound to come through, but the bias resistor started to smoke as the voltage across it soared over the 40V mark.

Scramble out to turn the set off. "Wha dat?" enquired the infant.

"Be quiet" I bullied as panic took over. The type of control grid coupling capacitor fitted in this chassis doesn't leak, so what else? I connected the meter to the control grid and switched on. Nothing till the PCL82 warmed up, then a very slight reading which vanished when I took out the valve. Faulty PCL82?

I just happened to have another, so in it went. The cathode resistor started to smoke again, something it hadn't done when the meter had been connected to the control grid. Wait a minute.

It was difficult to wait a minute, because both kids were now kicking up merry hell quarrelling about who was going to stand on my meter. I snatched up the meter and the tears flowed again. The vicar's wife picked up the little girl and her screams took on a new urgency. She didn't want to lose sight of the meter.

I gave up the battle and brought the set back to the peace and quiet of the shop where only grown ups shout and bawl about. In two minutes I'd found the cause of the trouble – a crack across the track from the control grid to the ferrite bead. This left the control grid floating. Having repaired this and fitted an electrolyic the cathode voltage remained just under 20V. We returned the set to the vicarage. "Wha dat" said the little boy . . .

Blue Angel

I love little girls. Well most of them. Except one that is. She was six years old and sat as quiet as a mouse. Good as gold she was. Sitting there whilst I repaired the Philips G11. It only wanted a new 0·91μF scan-correction capacitor. We always carry these with us and it was no trouble to fit. Before refitting the back cover I leaned over and switched the set on. Not a lot happened so I switched it off and it burst into life. A nice bright picture appeared, with normal sound. I reached for the back cover and the sound faded out. Put the back cover down and prepare to do battle. The sound then came up normal and stayed there. Glance over the top and find the brightness well down. As I looked on it came up brighter and brighter. Then the colour practically faded away to give a black and white picture.

Suddenly I knew it was time to finish with the whole game. It was all too much for a simple soul like me. I walked round to the front of the set and it was then that I saw the red light come on at the top right corner. The penny dropped, and I pointed a finger at the little angel who, to her credit, had sat there the whole time without appearing to move a muscle or even smile.

"You" I said. And she burst out laughing. "Wait till I tell dad. He said you were clever but I knew I could fool you." She had the remote control unit tucked up beside her and had moved only one finger to operate the brightness, colour and sound. It had merged perfectly with her dark blue dress. Horror.

Out of the Mouths . . .

I'd just finished the Pye hybrid set, after spending many hours patiently putting right a seemingly endless number of minor faults, most of which appeared to have resulted from eager little fingers rather than component failure, when this very small boy came in. He looked at a point about two feet over my head and addressed me.

"Have you done our telly?"

"Which one?"

"This one."

"Yes, I've just finished it. Are you going to take it?"

"My uncle will come for it when the little hand is on the six and the big hand is on the three. Have you done it properly this time?"

"If you didn't fiddle around with it so much it wouldn't need resetting every few months."

"I don't fiddle. My uncle fiddles when we go to bed at night, and when we wake up the telly doesn't work."

"I'll talk to your uncle when he comes for it."

I did, but it didn't do much good because he'd also been up on the roof and moved the aerial around. So when he got the set home he still couldn't get a clear picture. The result of this was that the small boy turned up next morning and looked at my left ear.

"You didn't do our set nicely."

"Yes I did. I did it very nicely."

"You come to our house and do it again because when I woke up this morning it wasn't very nice and my mother is not pleased." Eventually I did go to their house. The aerial was the only one in the road pointing north-west, where there's no transmitter.

Fooled Again

"Our set's gone wrong again" said the woman on the phone. "My husband brought it down to you a couple of months ago and the same thing's happened again. He can't bring it down this time. You'll have to come up." Roughly translated, this meant that the set had gone wrong, they wanted it repaired for nothing and they also wanted a house call for which they didn't want to pay.

For the life of me I couldn't remember a thing about the set. So I called at the house on the way back from another job. The set was a Decca 10 series one (hybrid colour chassis), so I could have done it. But I'd looked through the records for the last few months and couldn't find any mention of a Mr. Twister. I conserved my ammunition however until I'd found out just what was wrong.

The set appeared to be dead except for the tube heaters. This to me meant that the supply was present and there was probably an open-circuit in the heater chain. Checks showed that there was no h.t. either however. As a matter of fact there were no signs of life at all in the set – except at the on/off switch, and those tube heaters.

My mind went blank when I checked again at the mains transformer and found no life there at all. I was about to commit hari-kari when I noticed the heater isolating transformer, fitted so neatly that it escaped attention – so neatly fitted by me some two years earlier. So this was the "recent" repair.

I checked for h.t. shorts and couldn't find any, so I pressed in the thermal cut-out button. The valves then started to warm up. The sound hissed into life, and a nasty fizzing sound came from the right-hand side. I was just in time to see the tripler case arcing to chassis before the thermal trip cut out and the set went dead . . . except for the tube heaters of course.

I'd just finished fitting a new tripler unit when Mr. Twister arrived. I showed him the faulty unit.

"Ah yes, that's what you fitted last time."

"Oh no it bloodly wasn't."

I'd rather deal with kids.

Components for TV

Part 3 *Harold Peters*

WOUND COMPONENTS

COILS or, to use a better word, inductances are dying out in TV applications: soon only the deflection coils will remain. Until then however we shall have to live and work with the wound products to be found within a TV set, and because they are the bits that most people fight shy of we'll try to keep our text fairly simple – realising that Henry might well turn in his grave.

Coils can be classified by weight into heavy, medium and light items. The heavies comprise the scan coils, line output transformer, mains choke and the transformer used in the switch-mode power supply. You could also include the bench isolating transformer. Medium weight items include the line driver transformer, shift, linearity and width coils, convergence assemblies and the ident coil used in discrete component colour decoders. The featherweights consist of i.f. and tuner coils, chroma bandpass and delay compensators, r.f. chokes etc. – a more numerous collection to make up for their lack of bulk!

WIRE

They all use wire, and to understand them at all one golden rule about winding must be stated here and now: the more you bend a copper wire, the harder it is to wind it. So let's start by taking a look at copper wire and how it's made.

Insulated copper wire is made by drawing out a hot copper rod into a fine filament (see Fig. 12), coating it with an insulating varnish, and then putting it on to or in a drum for transit. For modern wires the insulant is polyurethane varnish.

Drawn copper wire is soft and pliant. Once bent however it becomes brittle and springy. In the pliant state it lays well when being wound. When it has become springy it's harder to lay evenly and tends to argue with the machine. Later, when the time comes to take the ends off, it tends to argue with the operator. Thus the best coils come from wire wound on large diameter spools that unspool without tension. Transferring wire from a big spool to little ones makes it more springy. In fact the wire that's been subjected to the least processing lays best. Brittle wire can be softened only by annealing with heat.

The basic method of drawing wire is to pass a hot copper rod through a series of dies of decreasing diameter. The wire gets longer and thinner all the time, and is eventually coated with the insulating varnish and spooled up. To do this without introducing springiness involves having a good long wire drawing area. If the manufacturer has not got the required space, he folds the process up – see Fig. 12(b) – by passing the wire around a series of increasing diameter pulleys instead, thus stretching it out. This will make it springy of course, so the wire needs to be annealed prior to spooling. A simple and reliable way to control this process is to use a varnish which discolours with heat, monitoring the shade of the finished wire. Wires made like this are usually of a marmalade colour. If it's necessary to colour code the wire, for example when the wire is to be used for bifilar windings, only straight drawn wire will do.

The after-treatment of wire may consist of lubrication or coating it with a second layer of insulation. If the latter is something like cellulose acetate, "bond" wire is produced. This can be treated after winding with acetone or by heating by means of a current passed through the wire, producing a solidified winding which needs no supporting former. Lubricated wires have a greasy look (like a worn LP) and a greasy feel. Their applications are limited, as the lubricant can in bulk production very soon clog up a winding machine, spoil the lay, or dry-joint the termination.

Stranded Wire

Wire is stranded to make it flexible. This property has little merit in winding however, because when you terminate a stranded wire by soldering it you make it into a single conductor again, just at the point where the wire usually breaks anyway. If on the other hand the individual strands are individually varnished to insulate them one from another, the resultant wire will have superior h.f. properties – because the total surface area of the wire is increased. As we should know, h.f. signals travel along the surface of wires. This unfortunately results in expensive wire which doesn't look too good when wound.

WINDINGS

There's a "chicken-egg" situation with respect to winding machines, bobbins and cores on the one hand and types of winding on the other – to understand the latter you are assumed to know a little about the former and vice versa. Windings are more interesting than the machines etc., so we'll begin with them.

Single-layer Windings

The single-layer winding (see Fig. 13) is the simplest of all windings – a few turns of wire on a plastic former with an adjustable dust core. Just the thing to put with one of our low K ceramics (see Part 2) to tune through the i.f. band.

The Q or circuit magnification ("goodness" if you prefer) is related to the diameter of the wire, and varies with the signal frequency – the higher the frequency, the closer the

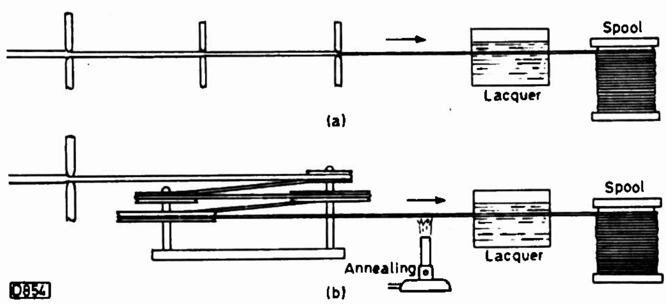

Fig. 12: Drawing wire. (a) From a copper rod, the wire is drawn through progressively thinner dies, then coated with insulant and spooled. (b) If space is limited, the wire is drawn by passing it around pulleys of increasing diameter. Because this bends the wire, it becomes springy and has to be annealed.

signal travels to the skin of the wire. As previously explained, you can increase the Q by using stranded insulated wire.

An iron dust core will change the inductance of a coil on a ratio of about 2:1. (A delay line driver coil will tune from 15μH to 8μH core in to core out.) Using a ferrite core in place of an iron dust core increases the ratio to 3:1, but the range of usable frequencies is limited to about 7MHz. The Q is normally stated at the frequency of use, as tuning varies the Q as well as the inductance.

A well designed coil will be on tune with the core halfway between the maximum and minimum settings – at this point the core should have its trimming slot flush with the top of the former/can. This condition permits maximum adjustability either way. To get the greatest tuning range, the core should be about half as long again as the winding. Maximum inductance then occurs when the core is protruding equally from the top and bottom of the winding. The tuning is likely to be sharp, but you can't have it all ways. To obtain a finer adjustment, space out the turns of wire along the former or reduce the Q by adding a damping resistor in the circuit or using a shorter core. Each of these techniques drastically reduces the tuning range.

There are often two tuning points on a coil – with the core coming out at the top or bottom. If the coil is mounted on a printed circuit board the top and bottom tuning points will each have a different Q. This is due to the damping effect of the copper tracks on the board – these behave like a shorted turn. In the lower position the core couples this shorted turn into the coil, damping its Q and increasing the leakage inductance.

Windings must be held rigidly on the former to prevent the inductance changing in use or when disturbed. To prevent movement you can fill the bobbin with wire, use bond wire, or apply an adhesive varnish. Avoid the temptation to make the winding rigid by binding it very tightly on the former. This is fraught with problems: expansion and contraction in use will loosen the winding in the end, and the wasp waist you've imparted to the coil former will certainly jam the core.

Non-tunable Windings

Non-tunable, single-layer windings are frequently used as chokes to decouple r.f. and i.f. stages. For economy they are usually self-supporting or wound directly on to a ferrite rod and fixed with glue or varnish. Quite a wide variation in tolerance was accepted with these types of coil until recent times – better control of core material now makes it possible to wind such coils repeatedly with consistent accuracy. As a result there are now several ranges of precision fixed inductors. They look just like carbon film resistors, use the same colour code (reading microhenries for ohms) and carry the same IEC range of standard values. So be careful, and don't be fooled! Their consistency permits their use in broadly tuned applications such as the chroma input, delay line output, and stagger tuned i.f.s.

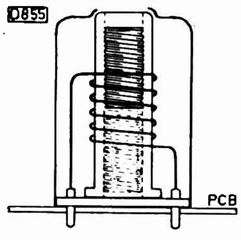

Fig. 13: A single-layer coil. The greatest tuning range is obtained when the core is one and a half times as long as the winding. Ideally, the coil should be on tune when the core is half-way into the winding – the top of the core is then usually flush with the top of the can. There will be a second tuning point at the bottom of the can: it may have a different Q because of the damping effect of the PCB.

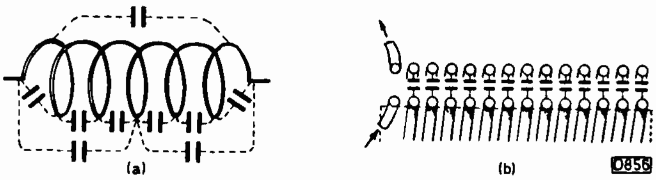

Fig. 14: (a) The self-capacitance of a single-layer coil – not a lot! (b) The self-capacitance of a layer winding – this time considerable.

Scramble Winding

The logical progression from a single-layer winding is to a scramble winding. In this the wire is allowed to pile up between the cheeks of a bobbin until the right number of turns has been put on. Although little conscious effort is applied to lay the wire evenly, it generally comes out level at the top, not bunched up at one cheek of the bobbin. The inductance of scramble windings is consistent with the number of turns, but the self-capacitance (see later) is variable and the possibility of short-circuited turns is high.

The latter occurs because of the pressure of the outer part of the winding on the turns lower down. Coil winders are aware of this problem of course, and carefully adjust the tension to produce consistently good windings. If you suspect shorted turns on a scramble winding, especially if the problem is intermittent, squeezing the winding during use (if safe) will cause visible detuning.

Self-capacitance

Just as a capacitor has a certain amount of inductance, so a winding has a certain amount of capacitance. The layer of varnish on the wire can be regarded as the dielectric, together with any air trapped in the coil: the surface of the wire is the plate. See Fig. 14.

In a single-layer coil the self-capacitance is small in relation to the inductance, but in scramble and multilayer coils the self-capacitance becomes disproportionately high. Laying the wire back on itself can result in the leadout being very close to the start of the winding. This gives a high self-capacitance. Various methods of reducing a winding's self-capacitance will be described later on.

Insulation

Also the voltage between adjacent turns becomes a hazard. For example, if an e.h.t. overwinding on a line output transformer had a "volts per turn" of around 20V (they usually contain 400 turns and give 8kV) and a scramble winding was used, it would be possible for two bits of the wire 80 turns apart to lay against each other. 80 turns at 20V per turn gives 1·6kV, which the insulation would have to withstand. It probably wouldn't. Flashover would occur, fusing the two wires together to produce a large number of short-circuit turns.

A "short-circuit turn", in case you're not familiar with this fault, absorbs much of the energy entering the coil, dissipating it in the bit of wire concerned in the form of heat

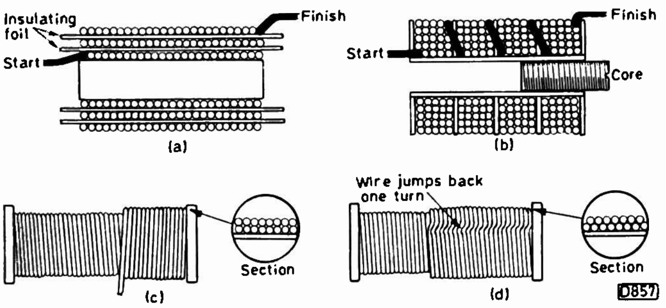

Fig. 15: Layer windings. (a) With insulation. (b) Toko style – by winding on a bobbin with many vertical cheeks, the inductance is maintained while the self-capacitance is reduced. (c) Layer winding without insulation. One layer lays from left to right, the next laying the other way: there's air between the layers and a chance of loose turns. (d) Orthocyclic winding. Subsequent layers drop into the spaces between the winding beneath: no air, no loose turns, and high inductance.

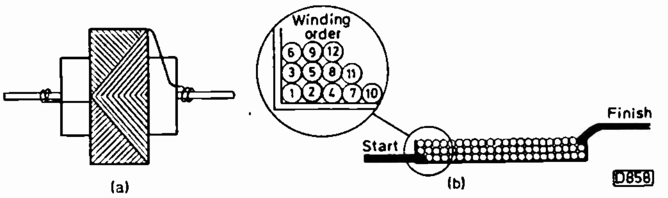

Fig. 16: (a) Wave-winding, the time-honoured method of reducing the self-capacitance of the winding: since no wire lays alongside another, there's little self-capacitance. (b) Semi-bank winding – using a slow traverse to get a "controlled scramble" effect. Wires lay alongside others at random, but the winding is very compact: the result is a coil a third the size of a wave-winding, with less self-capacitance.

(smoke, fire etc. . . .). Unless the wire is protected, the heat will eventually destroy the insulation of adjacent turns, spreading the damage throughout the winding.

In the e.h.t. overwinding example we've quoted there are 20V per turn, so if two adjacent turns short together they will have produced a secondary winding with an output of 20V and a resistance of say 1Ω. Ohm's law indicates that this combination will dissipate V^2/R or 400W – enough to catch the rest on fire.

Wire insulated with polyurethane varnish will withstand about 600V d.c., but it doesn't pay to rely solely on this. The varnish can crack when bent during winding, or there could be pinholes in the varnish caused by minute bubbles forming as the varnish is deposited.

Insulated-layer Windings

If voltage problems are likely to arise, scramble windings are out. Instead we need insulated-layer windings (see Fig. 15). These are universally found in line output transformers, switch-mode transformers, line driver transformers, and the like.

After winding the first layer, the winding machine stops and an interleaving layer of dielectric material – usually plastic film – is wrapped over the winding. The second layer is then wound back over the first. This process is repeated until the winding is finished. The type of interleaving material used must suit the voltage which will be encountered in the application, and allowance must be made for pulses, spikes, and spurious waveforms. The interleaving must extend the full width of the former, and the windings should start and stop dead above each other and well within the interleaving, otherwise the end turn will fall down and short to the winding below.

The self-capacitance of interleaved-layer windings is inherently high, but is much more consistent than a scramble winding. For this reason it's actually made use of in the modern diode-split type of line output transformer to provide the e.h.t. capacitors. A more recent variation in such transformers is to replace the wire with thin layers of metal foil. This gives even greater capacitance.

Where the self-capacitance must be kept low the thickness of the interleaving is increased. This puts more space into the winding, so its efficiency goes down, the leakage inductance goes up, and the power handling capability is small. In some line driver transformers the spacing is deliberately increased in order to avoid ringing effects on flyback transients.

Layer Winding – Toko Style

An alternative method of keeping the self-capacitance down is to wind the coil in vertical layers, using a moulded bobbin with many intermediate cheeks. Slots are provided to permit the wire to hop from one gap to the next, and the wire needs to be guided accurately, since hopping to and fro between cheeks is not part of the game. This technique gives better efficiency. The ubiquitous Toko coil – see Fig. 15(b) – is a good example of this type of winding.

Non-insulated Layer Windings

Where the turns per volt ratio is low, and insulation doesn't matter greatly, a winding can be layered without interleaving – see Fig. 15(c). The winding has to be tight and done on a machine with a traverse to ensure that it's evenly laid. Even so some air gets into the winding because if the wire travels from left to right on the bottom layer it will travel from right to left on the layer above. This will look like two threads in opposition, and there will form an air gap in between.

To get the most wire on to the bobbin, the upper layer can be dropped into the grooves of the layer beneath – see Fig. 15(d) – even if it seems to be going the wrong way. The upper wire "leans backwards" most of the time, and at one point in every turn it hops across from one groove into the next. This technique is called orthocyclic winding, and the skill in production lies in getting the point at which the wire hops over a turn to be a staggered progression throughout the entire winding. In this way very little air is trapped, and if the winding is then bonded an extremely efficient coil is produced. Orthocyclic windings are seldom found in TV, but there are applications in relay work and power transmission.

Reducing Self-capacitance

Since the early days of the crystal set the traditional way of reducing the self-capacitance of a winding has been to criss-cross successive layers of the coil over the ones beneath (see Fig. 16). In this way no one turn ever lays alongside another turn for any length. Wave-winding, or cross-winding as it's sometimes called, traditionally uses wire which has been covered with a layer of cloth (silk, cotton, or acetate). The purpose of the cloth is to roughen the surface of the wire so that it will "hang on" to the winding below and stay rigid despite the reciprocation of the wire guides laying it in.

Modern polyurethane wire is too slippery, unless you make it sticky by passing it through a resin (colophony) solution during winding. This is a messy business at the best of times, and the winding still ends up fairly bulky and as inefficient as if you used cloth-covered wire.

The simplest way of producing a low-capacitance winding is to "semi-bank" it as a layer winding with a slow traverse. As the wire moves across the bobbin it runs up and down, trying to make three layers at once. For a given inductance such a winding uses very little wire, has a very high Q, and incredibly has less self-capacitance than a wave-winding of similar inductance.

To make a good wave-winding requires careful setting up of the machine. Even then it's slow to produce, so it pays to question the need to wave-wind from the very beginning. The reason might be simply that it was the only way the designer could think of getting his wire to stay on a plain former. If this is the case, scramble-wind on to a bobbin with cheeks and save time and wire.

Bifilar Windings

You can't accurately make a small centre-tapped winding (the sort you need for the secondary of a delay line driver coil) by winding the same number of turns on top of a primary winding. It just doesn't balance. It's necessary to wind a bifilar coil (see Fig. 17). This consists of a pair of similar wires laid down side by side, with the centre tap made by joining the start of one winding to the finish of the other. Such a winding will be nicely balanced, with both sides of the tap having equal inductance – even with an adjusting core introduced through the centre.

For small quantity production, bifilar wire can be obtained. This is paired wire coated in dissimilar colours of varnish. Wire distinguished by using dissimilar conductors (e.g. plain and tinner copper) should not be used. It seldom balances at high frequencies.

In quantity production, two spools of dissimilar coloured wire are used. Care must be taken to terminate the windings correctly. It's so easy to take one winding forward to its terminating post, then take the other one backwards, thus producing a $19\frac{1}{2} + 20\frac{1}{2}$ turns coil where 20 + 20 was intended.

Printed Coils

Coils for i.f. and r.f. purposes can be printed on to the PCB in the form of a spiral (see Fig. 18). If an adjuster is needed, a screw-in core on a plastic former can pass through the middle. Otherwise the last turn can be extended by cutting out spokes with a sharp tool. Only low inductance values are practical, and although their inductance value is consistent the Q is variable due to the etching process altering the thickness of the conductors.

Winding Machines

Most enthusiasts wind their coils on an ordinary hand drill. They will be comforted to know that the principle of even the most advanced winding machine is no different. The extra refinements are: a device for de-reeling the wire from the supply spool; a friction pad to offer uniform tension to the wire during winding – often with a built-in tension gauge; wire guide pulleys to feed the wire vertically on to the winding; a traversing mechanism to move the wire correctly across the bobbin – it can be made to reciprocate during wave-winding; and a turns counter – programmable to stop the machine after a certain number of turns has gone on.

In the conventional winding machine just described the work is rotated and the wire feed stays comparatively still. In quantity production a different technique is often used. It's called "fly-winding": the bobbin stays still, the wire being spun round it on a rotating feed arm, rather like a lasso. This permits coil formers to be loaded on to a turret in a capstan winder, giving fully automated winding and terminating. Windings thus produced are no different from those produced conventionally – apart from bifilars. Here the two wires which make up the paired winding are fed in such a way that they cross over once every time the wire off the supply spool completes one turn. This gives an untidy look to the winding, but provided there are over 20 turns on the work it becomes an advantage rather than an impairment because the terminations become random, the self-capacitances are less, and the chance of making an unbalanced centre tap, as described above, is considerably reduced.

Degaussing coils need a winding technique all their own. Enthusiasts use a cycle wheel as a mandrel, professionals use machines as big as a room, fully automating the job. In between these extremes, some makers use a fly-winding technique.

There's even a machine that winds toroids, but we leave you to imagine how it does so.

Formers and Bobbins

The various modern thermoplastics chosen for use as coil formers and bobbins are selected for economy coupled with serviceability.

Polycarbonate is the base of most i.f. coil formers. It's white, translucent, pliant, and usually comes with a number of spines inside the tube into which the core cuts its own thread. In i.f. applications it doesn't need to be heat resistant. Its two main disadvantages are that it is pliant, and under great winding tension will "wasp-waist" and jam the core; and secondly very little sticks to it. Polycarbonate seldom comes with a moulded on baseplate: it's more often provided with a separate one of tagged laminate.

Where something better is needed, nylon is used. This is more shiny in appearance than polycarbonate and is much tougher. It's still quite pliant. Frequently pigmented black, it can be moulded to include a baseplate and tags. It's frequently found in mains and sound output transformers.

Where heat is involved glass filled nylon is used. This can be worked in a similar fashion to ordinary nylon, but looks, feels and is a lot tougher. To be found in convergence adjusters, shift chokes, line drivers, etc.

When used as a convergence adjustment, it's usual to thread the tube of the moulding for the core, using a multistart thread (three or four start) to permit very rapid

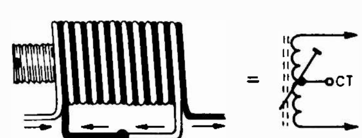

Fig. 17: Bifilar winding: to get a balanced, tunable centre-tapped winding, a pair of wires is wound and the start of one connected to the end of the other.

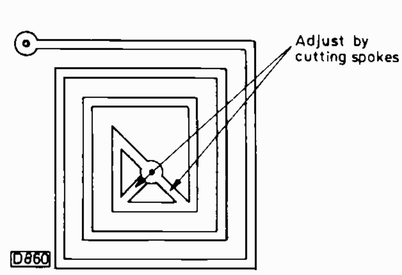

Fig. 18: A printed circuit coil.

movement of the core so that the movements on the raster are easier to observe.

Core Material

There's not been much change in the core material used for a number of years. For low frequencies soft iron laminates are used, for medium frequencies ferrite cores, and for high frequencies iron dust cores. The advances there have been in recent years are mostly in the process control of the magnetic material so that there's less waste and the finished windings have a more consistent inductance and Q.

The aim of a core is to improve the Q of the coil by raising L (sic!) without raising R. Because of this, the efficiency of the core material is important.

Losses

Core material suffers from two major losses. One is eddy current loss – when an electrical current is induced across the core itself from the winding. The other is hysterisis – the core material staying magnetised after a change of e.m.f. has caused a change of flux, so that energy is taken from the reverse change to demagnetise the core (see Fig. 19).

Eddy currents can be killed off by making the core material non-conductive. This is easy with ferrites and dust cores, as the ceramic binder is a good insulator anyway. Soft iron cores need laminating – that is to say, separating into thin vertical strips by means of thin layers of varnished paper, or even their own oxide layer. This makes the core continuous in the direction of the lines of force, but non-conductive crossways on, thus reducing any possible current flow.

Hysteresis only upsets a coil if the time taken to demagnetise the core is of the order of the frequency the thing is trying to handle. Soft iron laminates are o.k. for audio frequencies, ferrites are all right up to 7MHz, while iron dust cores should be used from there up.

Construction

Ferrite and dust cores can be moulded to almost any reasonable shape, and you can usually spot the difference between them as ferrites are more brittle and shiny, with sharp edges, whilst iron dust has a crumbly look and feel to it. The difference is about the same as between a cup and a flower pot. Soft iron laminates are traditionally offered in the form of stampings shaped in pairs as E and I, or T and U (see Fig. 20), and are best fitted by alternately staggering each E (U) to enter from either end of the core, fitting the I (T) to the other. In bulk production they are often bunched together for economy, but this more often than not leads to buzz problems. They must be securely clamped, and the last lamination must not be allowed to vibrate – by pushing a plastic wedge down the core, and/or by immersing in a varnish or resin.

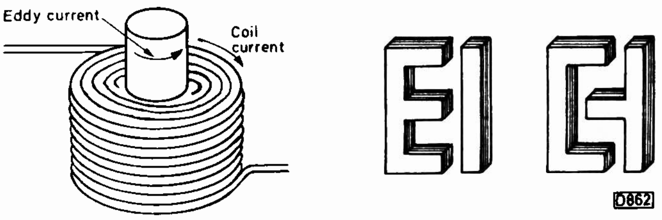

Fig. 20: Eddy currents. If the core is conductive, eddy currents will be induced, giving the effect of a shorted turn. Hence the need to laminate iron cores to reduce eddy current flow.

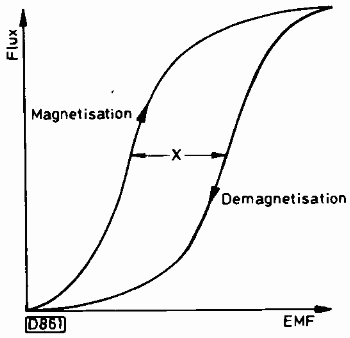

Fig. 19: Hysteresis: because of the time delay between the magnetisation and demagnetisation of the core material, there's an upper limit to the coil's frequency handling capability. The smaller the dimension X, the better the h.f. performance.

C cores will be found in modern sets. Instead of using stampings, the soft iron is supplied in strip form and wound around a mandrel which is exactly the size of the eventual bobbin. The whole is immersed in resin, which is cured while the core is held tight. When rock hard, the core is carefully cut in two, slipped over the wound bobbin, glued up and clamped together. As before there can be a buzz problem unless the job is done with care and precision.

Gapping

When C cores or ferrites are put round a bobbin to enclose the field a fantastic increase in inductance is possible. Because of variations in core material, grit in the gap or other manufacturing troubles, there can also be fantastic variations from one core's inductance to another.

If we settle for less inductance, we can make the winding consistent by leaving a gap in the joint. The gap itself must be precise, and must be the same every time. Spacings from 0·1mm to 1·0mm are common and are usually brought about by fitting a non-conducting shim of the required thickness in the gap. Conductive shims get hot with eddy currents.

A 'Z' shaped wire would do, but if you use insulating wire do not forget to allow for any varnish on it as this will be over the stated wire dimension.

Of recent years some leading coil makers have used glass beads for gapping. These are the same beads that you find on reflective number plates etc., but will have been graded into precise diameters. They are mixed into the glue used for uniting the two halves, and during the curing the joint is held under slight pressure. Any misshapen beads will be crushed by the clamping and the excess glue (usually an epoxy resin, like Araldite) will spread around the gap and set it solid.

When it comes to line output and scanning coils, there's a tendency for even the beaded glue joints to whistle away, sometimes at frequencies below the fundamental one. As these windings are usually clamped externally and do not rely on the jointing glue for rigidity, it's possible to use a flexible, rubbery, glue to hold the beads in the gap and to deaden the whistle somewhat.

A problem coil is the line linearity coil. This needs to be adjustable in manufacture. Once set correctly for your particular location however there's nothing to stop it being glued up to reduce whistle – you are unlikely to need to set it up again.

Standard Araldite is a fairly safe bet for all coil glueing. Rapid Araldite should be risked only if the coil is known to run cool. Linearity coils get very hot.

Teletopics

ELECTRONIC MOVIE MAKING

Portable video equipment is still a bulkier and more expensive option for the home movie maker than the traditional 8mm. camera, though once enthusiasts get used to using video equipment there's likely to be a decided shift away from photographic equipment: Mackintosh Consultants, in a report entitled "Home Video and Electronic Photography", estimate that sales of 8mm. cameras will decline by 50% over the next five years.

The thing that could accelerate this process is the advent of a combined, compact video camera/cassette recorder, so a prototype model unveiled by Sony recently in Tokyo is of particular interest. Sony call it a "video movie unit", and it's understood that other manufacturers, including BASF and Eumig in W. Germany, are working along similar lines. Sony's unit records on a compact cassette, using a solid-state image sensor (a CCD device). Since the cassette is non-standard, the idea would be to play it back via a "home editor" unit which would transfer the sound and vision signals on to any of the standard cassette formats now in use. This gives the added advantage of simple, instant editing.

Sony suggest that a further four-five years' development work will be required before the product is ready for launching on the market. They've extended an invitation to other manufacturers to start discussions on a common format for this type of equipment: let's hope that this time a joint system will emerge, with no more video wars.

GRANADA'S PORTABLE VIDEO SYSTEM

Meanwhile Granada TV Rental are offering a portable video system for short-term or normal rental through 21 of their branches. The equipment is of the JVC VHS type, including a portable colour video camera, lightweight portable VCR and separate tuner/timer unit. The battery gives an hour's operation, and can be recharged from the tuner/timer or from the mains via an optional adaptor. Further showrooms will be handling the equipment as supplies increase. The rental terms are £21·95 monthly for the recorder, £18·95 for the camera and £7·95 for the tuner/timer; or for a three-day period £30 for the recorder, £25 for the camera and £9.50 for the tuner/timer, with additional daily rental charges if required.

THE RCA VIDEODISC

In commenting on videodiscs last month we suggested that RCA had shown little interest in the European market to date. Preparations to market the system in Europe now seem to be getting under way however. At the recent US Consumer Electronics Show in Chicago it was announced that a joint venture has been set up to market the system in the German-speaking counties. In the UK the discs are to be handled by a joint venture between RCA Records (UK) and a subsidiary of the Associated Communications Corporation (previously ATV). Associated Communications Corporation recently took over Pye Records, and the joint venture will also be handling pre-recorded tapes and audio products.

RCA's videodisc player was on show at the Chicago exhibition, where it was also announced that the system is in future to be known as CED – "Capacitance Electronic Disc". The preview Model SFT100 measures 15·6 × 17 × 5·8in., weighs about 20lb, consumes some 30W and is compatible with any TV receiver sold in the USA. CBS and Zenith Radio Corporation have entered into agreements to produce and market CED equipment.

Several UK companies, including GEC, have been licenced to make players for CED videodiscs.

RECORDING SOUND ON LOCATION

JVC have come up with an interesting solution to the perennial problem of recording sound on location in a sensitive manner at the same time as the picture is being recorded. The omnidirectional built-in microphones used in video cameras are less than satisfactgory for this use! A highly directional rifle microphone can be employed, but this still doesn't allow the cameraman to adjust the area of sound coverage relative to the lens angle – when the zoom lens is set to a wide angle the microphone should have an almost omnidirectional response, changing to a highly directional response when the camera zooms into a tight shot.

JVC's answer, in a camera to be released later this year, is an electronic "zoom" microphone linked to the zoom lens. The microphone unit is mounted above the lens and contains three inserts, two facing forwards and one backwards. In the wide-angle mode all three are in use: as the lens angle narrows, the output from the rear-facing microphone is reduced while that from the other two units is increased. Anti-phase signal addition is used to obtain the maximum directional effect on the tightest camera angles. Four separate equaliser/attenuator units are employed. The cost of this additional feature will be around £50 – well worthwhile if it works.

LINEAR VCRs

BASF have decided to suspend work on their LVR machine, leaving this field to Toshiba who had working prototypes on display at the spring UK trade shows and at the Chicago US Consumer Electronics Show. According to BASF, currency changes made their LVR project uneconomic. It seems that the price of Toshiba's machine will be rather higher than previously expected: at around $1,100 in the USA it will be only marginally cheaper than VHS and Betamax machines.

SALORA G CHASSIS

We first mentioned the new Salora G TV chassis, with its very low power consumption, a couple of months ago. An article on page 586 describes the interesting power supply/line timebase system used, and we've now had an opportunity to study the full circuit. The signal circuits adopted are certainly capable of above average performance. Perhaps the most striking feature here is the use of separate vision and sound i.f. strips. The tuner feeds a BF199 i.f. preamplifier transistor which, in addition to driving a SAWF to form the vision i.f. response, provides a separate feed to the TDA2840 sound i.f. i.c. The latter is followed by a TDA120U 6MHz sound i.c. and a TDA2030 audio i.c., while on the vision side a TBA1440G provides the i.f. gain plus detection with a TDA120A for a.f.c. The single-chip decoder consists of a Mullard/Philips TDA3560 which drives class AB video output stages. The popular TDA1170 i.c. is used as the field timebase.

There's an elaborate tuning system, with a digital memory and automatic channel searching – also digital channel indication.

MORE OPTICAL VIDEODISC PLAYERS

Philips, who have been test marketing their VLP videodisc system in the USA for some 18 months now (under the Magnavox label), are rapidly extending the areas in which the players and discs are on sale. The initial sites were apparently selected "because of their high-income, technologically-aware populations". Pioneer have now entered the market with players for the same "Disco Vision" discs. Pioneer Electronics Corporation of Japan originally set up a joint company with MCA (who produce the discs) in 1977, concentrating on the industrial market. The latter activity led to an order for 10,000 players from General Motors for training use with their distributors sales force in the USA and Canada. As a result of this and other orders, Pioneer established a service network with some 120 centres. The new Pioneer player is a slimmed down version of their industrial one, and will go on sale initially in Syracuse, Madison (Wisconsin), Dallas and Minneapolis. The basic machine is cheaper than the Magnavox one, but comes out at much the same price when a remote control unit is added.

Magnavox report having had problems initially with the player, with interfacing, and with distribution.

FURTHER EXPORT SUCCESSES FOR THORN

Thorn have secured further export orders for their TX9 chassis, this time to Hong Kong and China. A four-year agreement has been signed with Promotors Ltd. of Hong Kong, who have been licenced to assemble TX9 receivers in Hong Kong and in a new factory to be built in China. Initial kits of components will be exported from Thorn's Gosport factory. This latest success follows orders for TX series chassis to be supplied in kit form to Italy and Scandinavia.

INTERNATIONAL VIEWDATA STANDARDS

Following recent meetings of the relevant CCITT (International Consultative Committee on Telephones and Telegraphs) study groups in Montreal, the UK's Prestel and the French Teletel viewdata systems have been adopted as recommended international standards. Senior Prestel managers presented papers at the meetings, and gave live demonstrations of the latest developments – picture Prestel, and a new British Telecom display technique known as DRCS (dynamically redefinable character set). The latter gives improved drawings and graphic displays at little extra cost, using an extra character store in the TV set along with sets of special-purpose characters which are stored in the system's central computer. When these characters are required, they are transferred from the computer to the set and held there until they are no longer needed.

MITSUBISHI JOIN BREMA

Mitsubishi Electric (UK) have been accepted as members of the British Radio and Electronic Equipment Manufacturers' Association. They join National (Matsushita), Sony and Toshiba as Japanese members with manufacturing plant in the UK.

NEW FAST DIODES REMOVE RFI PROBLEMS

Mullard have developed two new families of fast-recovery epitaxial diodes (types BYV27 and BYV28) designed to overcome interference and power loss problems in switch-mode power supply and similar circuits, for example line output stages. Traditionally, soft-recovery diodes have been used in such applications, the reverse current after switch off being reduced relatively slowly to avoid interference problems. A more attractive solution however is to design the diode so that there is minimal stored charge at switch-off – as with the new devices. This reduces turn-off losses and results in extremely low energy radiation. The new diodes use the popular glass bead encapsulation.

TELETEXT DEVELOPMENTS

At the recent IEEE Consumer Electronics conference in Chicago John Chambers of the BBC described the various ways in which the UK teletext system can be developed to give additional features. Full-colour, high-definition still pictures will become possible once the cost of much higher capacity memories (a megabyte rather than a kilobyte) has been sufficiently reduced. Simpler features include word underlining and changing the colour of every letter in a word. A one megabyte memory would be able to store around 1,000 pages, giving rapid access to pages and making possible a system referred to as "linked pages". The idea here is that once a particular page has been selected by the viewer the decoder would automatically file a set of related pages as they are received (by following a command incorporated in the transmission of the initial page), giving instant access to the related stored pages.

CONCERN OVER FAR EAST IMPORTS

Cheap sets from yet another source in the Far East are giving rise to concern in the industry. The source this time is Thailand, which is hoping to export some 200,000 monochrome sets to the UK during 1980-81 and is said to have labour costs only a tenth of those in the UK. A joint management-union report has been sent to the EEC. One particular worry is that imports from new Far Eastern sources could undermine voluntary restraint agreements reached with already established exporting countries.

STATION OPENINGS

The following relay stations are now in operation:

Ardentinny (Strathclyde) BBC-1 ch. 39, BBC-2 ch. 45, Scottish Television ch. 49, TV4 ch. 52.

Arrochar (Strathclyde) BBC-1 ch. 21, Scottish Television ch. 24, BBC-2 ch. 27, TV4 ch. 31.

Benagh (County Down) BBC-1 ch. 22, Ulster Television ch. 25, BBC-2 ch. 28, TV4 ch. 32.

Bowmore (Islay) BBC-1 ch. 39, TV4 ch. 42, BBC-2 ch. 45, Scottish Television ch. 49.

Brook Bottom (Manchester) BBC-1 ch. 58, Granada Television ch. 61, BBC-2 ch. 64, TV4 ch. 68.

Glengorm (Mull) Scottish Television ch. 48, BBC-2 ch. 52, TV4 ch. 54, BBC-1 ch. 56.

Glyn Ceiriog (Clwyd) TV4 ch. 54, BBC-Wales ch. 58, HTV-Wales ch. 61, BBC-2 ch. 64.

Llanbrynmair (Powys) BBC-Wales ch. 22, HTV-Wales ch. 25, BBC-2 ch. 28, TV4 ch. 32.

Marlow Bottom (Bucks) TV4 ch. 54, BBC-1 ch. 58, Thames/London Weekend Television ch. 61, BBC-2 ch. 64.

Pontfadog (Clwyd) BBC-Wales ch. 22, HTV-Wales ch. 25, BBC-2 ch. 28, TV4 ch. 32.

Port Ellen (Islay) BBC-1 ch. 22, Scottish Television ch. 25, BBC-2 ch. 28, TV4 ch. 32.

Rostrevor Forest (County Down) BBC-2 ch. 40, Ulster Television ch. 46, BBC-1 ch. 48, TV4 ch. 50.

Rothesay Town (Bute) BBC-1 ch. 55, Scottish Television ch. 59, BBC-2 ch. 62, TV4 ch. 65.

Seaham (Co. Durham) Tyne Tees Television ch. 41, BBC-2 ch. 44, TV4 ch. 47, BBC-1 ch. 51.

Stocksbridge (S. Yorks) TV4 ch. 54, BBC-1 ch. 58,

Yorkshire Television ch. 61, BBC-2 ch. 64.
Totley (Sheffield) BBC-1 ch. 39, TV4 ch. 42, BBC-2 ch. 45, Yorkshire Television ch. 49.
West Kirby (Merseyside) Granada Television ch. 24, BBC-2 ch. 27, TV4 ch. 31, BBC-1 ch. 34.
Whitehead (County Antrim) BBC-1 ch. 48, Ulster Television ch. 52, BBC-2 ch. 56, TV4 ch. 67.
The above transmissions are all vertically polarised.

New CTV Signals Board

Part 1

Luke Theodossiou

WHEN we embarked on our colour receiver project back in the autumn of 1978, one of the features promised was a single chip colour decoder. Unfortunately RCA did not go ahead with the i.c. we'd hoped to be able to use, so we adopted a Mullard two chip solution. One of the problems encountered with the original signals board was a certain amount of instability – mainly due to layout capacitance effects on the feedback paths to the TDA3500. Not all constructors experienced this, and it can be cured by good earthing practice and adding small shunt capacitors across the feedback loops.

When the idea of a colour portable design began to take shape, it became evident that the signals section would be almost identical to that required for our large screen project. We adopted a design suitable for both purposes therefore. Those constructors who have completed the large-screen project may find it worthwhile to update this by building the new signals board – since it provides noticeably better performance than the old board. Those attracted by the idea of a colour portable can have a head start, particularly if the large screen project is already running since this will enable you to set up and test the new board.

Design Considerations

The heart of the new board is obviously the single chip decoder. This is the Mullard TDA3560, which Thorn currently use in their TX10 chassis.

The i.c. has an extremely low peripheral component count, despite the fact that it offers direct RGB inputs (for teletext etc.) in the same way as the two chip set did. The RGB outputs from the i.c. don't require external feedback loops, simplifying the video output stages. It was decided to use the now classic class AB configuration, but with an additional small signal transistor which considerably improves the performance (more about this later).

The tuner we've chosen this time is a Telefunken unit which boasts higher gain (important for our portable project) and better image rejection performance than other similar units.

The i.f. module is the same size as the tuner unit, which is both convenient and aesthetically pleasing. It contains a preamplifier; a surface acoustic wave filter; a TDA2540 i.f. amplifier for generating a positive-going video signal for the decoder and a negative-going video signal for feeding to the sync separator; a 6MHz trap to remove the intercarrier sound signal from the video; and a TBA120U sound i.f. amplifier and detector. The unit is ready-built and prealigned, which makes life much easier for constructors without suitable instruments.

Unlike the original Philips modules, the new i.f. unit does not include the chroma filter and chroma trap (for removing the chrominance signal from the luminance channel). These are therefore external, and comprise L1, L2 and their associated components.

For the audio output stage we have chosen the SGS TDA2006V, a 5-pin i.c. which is capable of producing around 10W into 8 Ω. Again the number of peripheral components is kept to an absolute minimum.

The only remaining items are a +12V stabiliser, which uses the monolithic regulator 7812, and the +33V regulator for which the ubiquitous TAA550 is used.

Circuit Description

Fig. 1 shows the complete circuit diagram of the board. The tuner and i.f. module, together with constructional details and the setting up procedure, will be given next month. In this issue we shall deal with the remaining circuitry, starting with the colour decoder.

The Decoder

A 1V pk-pk positive-going composite video signal emanates from pin 6 of the i.f. module, at low impedance. This is split into the luminance and chrominance paths via R7 and R9 respectively. Resistor R7 matches the impedance of the luminance delay line so that the delay line "sees" 1k Ω. Similarly, R8 correctly terminates the delay line to minimise reflections and distortions. Capacitor C9 together with coil L1 form a series resonance circuit at the colour subcarrier frequency (4·43MHz). When at resonance, the effective impedance of the circuit is very low. In conjunction with R7, it forms an attenuator which removes the colour information from the luminance channel, thus avoiding patterning on the screen.

The parallel resonant circuit consisting of L2 and C11 forms a bandpass circuit in conjunction with R9, and allows only the chrominance information to pass to the i.c. via C12.

A block diagram of the decoder i.c. (TDA3560) is shown in Fig. 2. A good way of describing the functions performed by the i.c. and at the same time looking at the peripheral components is to describe the function of each pin.

Pin 1: +12V supply. The current taken by the i.c. is around 85mA.

Pin 2: Control voltage for ident. Capacitor C16 enables detection of the ident signal. During normal (colour) operation the voltage at this pin is typically +4·7V, dropping to +2·4V when a monochrome transmission is being received.

Pin 3: Chroma input. For correct operation within the a.c.c. range, the chroma input signal should be between 55mV and 1·1V pk-pk (25mV-500mV pk-pk burst).

Pin 4: A.C.C. detector reference. This pin is decoupled by C18 and the voltage under all conditions is +4·6V.

Pin 5: A.C.C. control voltage. A.C.C. is obtained by synchronous detection of the burst signal followed by a peak detector. Good noise immunity is obtained in this way, and when a weak signal is being received there is no colour change.

Pin 6: Colour control. The control range is 50dB and the control voltage is 2V to 4V. A potential divider is formed by R20 and R22 and the pin is decoupled by C30. Resistor R21 is connected to the wiper of the colour control. The voltage at G1 varies from 0V to +12V, setting the voltage on pin 6 between +2V and +4V. When the colour killer is activated, the pin is internally pulled low and no chroma signal is applied to the demodulators. When this pin is connected to +12V, the colour killer is overruled to enable the oscillator frequency to be adjusted.

Pin 7: Contrast control. The control range is 17dB for a control voltage of between +2 to +4V. When the voltage at this pin is less than 1V, the output signal is suppressed. If any of the outputs goes higher than 9V, the peak-white limiter circuit is activated and reduces the output signals via the contrast control by discharging C23 via an internal current sink.

Pin 8: Sandcastle and field blanking input. Blanking of the output signals is effected when the voltage at this pin is between +2V and +6·5V. The burst gate and clamping circuits are activated when the voltage is higher than +7·5V.

Pin 9: Video data switching. When the voltage is between +1V and +2V, the internal RGB signals are switched off and the inserted signals are applied to the output amplifiers. The switching times are less than 20ns to avoid colour fringeing on the data signals.

Pin 10: Luminance input. The input signal should be around 0·45V pk-pk.

Pin 11: Brightness control. By varying the voltage on this pin, the black level of the output signals can be changed.

Pins 12, 14 and 16: RGB outputs. Nominal output is 5V black to white. The blanking level is always +2V.

Pins 13, 15 and 17: RGB inputs. The input signals are a.c. coupled via C26, C27 and C28. The amplitude should be 1V pk-pk.

Pins 18, 19 and 20: Black-level clamp capacitors. These are C20, C21 and C22 respectively.

Pins 21 and 22: U and V inputs. The input signal is automatically fixed at the required level by means of the burst phase detector and a.c.c. generator. As the burst (applied differentially to these pins) is kept constant by the

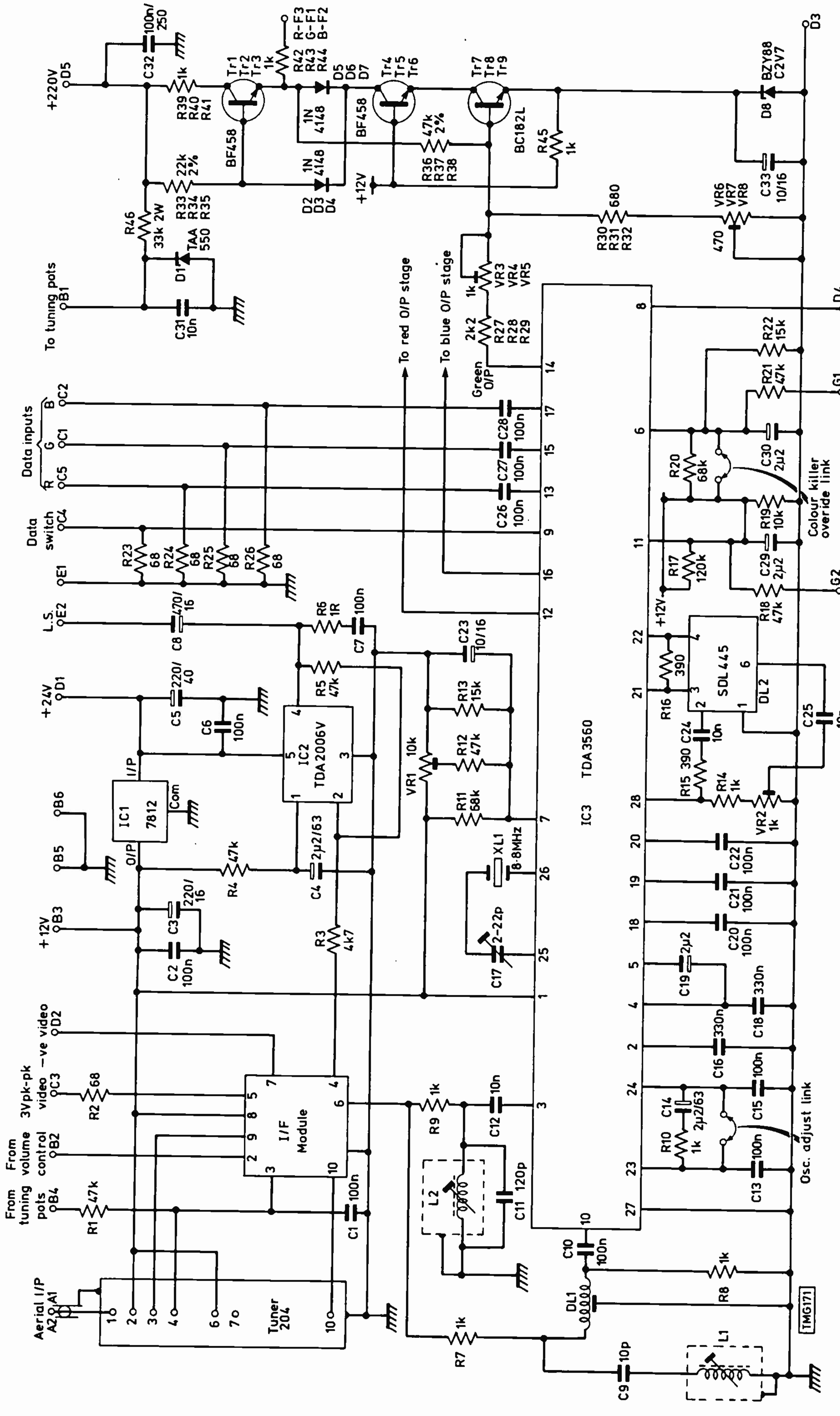

Fig. 1: Circuit diagram of the new signals panel, which can be used in the large-screen colour receiver project or the forthcoming colour portable project.

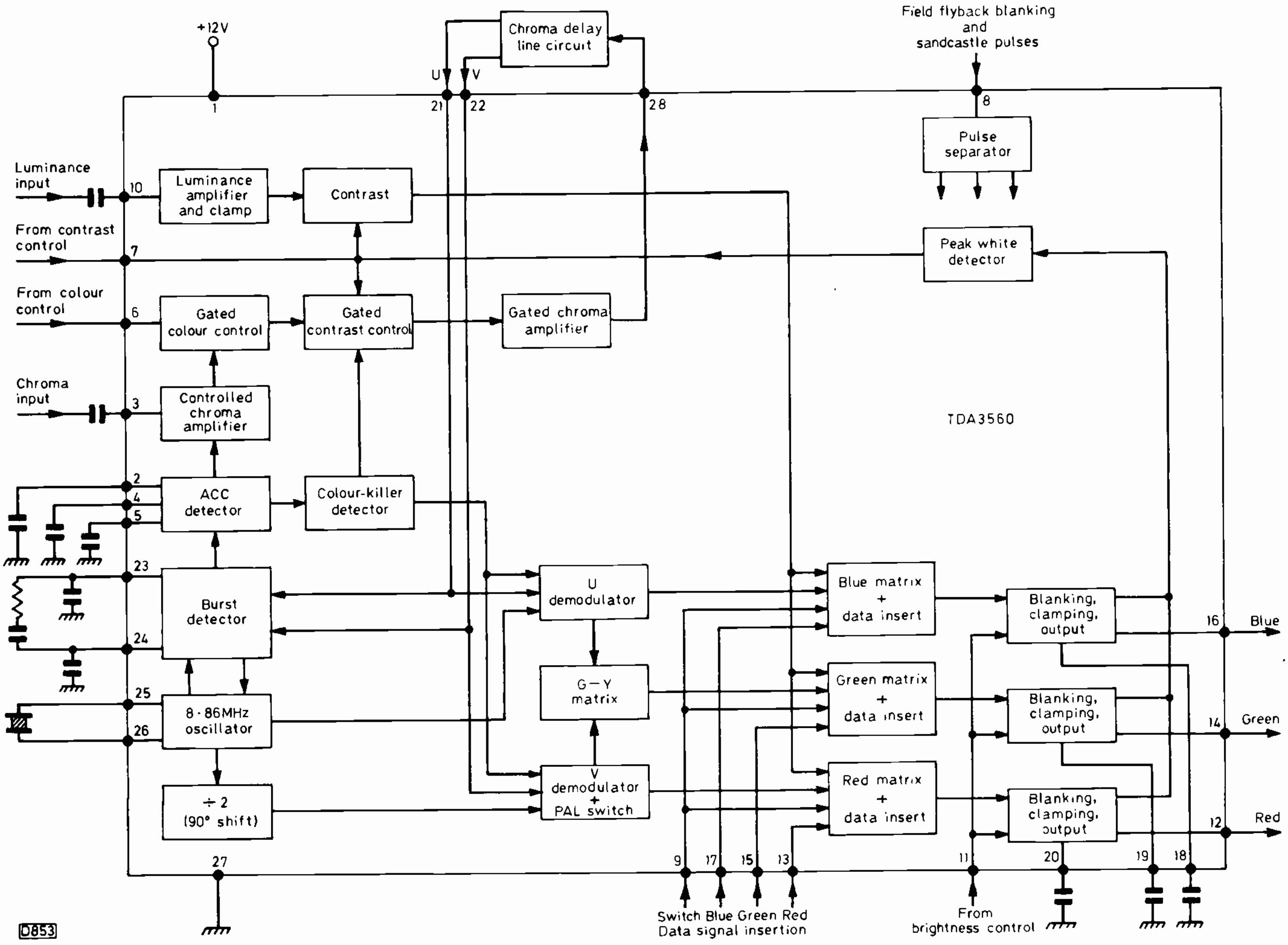

Fig. 2: Simplified block diagram of the TDA3560 decoder i.c.

a.c.c., the colour-difference signals automatically have the correct value. Resistor R16 damps the output coil inside the chroma delay line.

Pins 23 and 24: Burst phase detector outputs. The output of the burst phase detector is filtered by C13 and C15 and controls the reference oscillator. Optimum catching range is obtained by the time-constant set by R10 and C14.

Pins 25 and 26: Reference oscillator. The crystal XL1, in series with C17, determines the frequency. A frequency counter connected to pin 25 enables the frequency to be correctly set up.

Pin 27: Earth.

Pin 28: Chroma amplifier output. This is applied to pin 2 of the chroma delay line via R15 and C24, and to the centre tap of the delay line output transformer (integral with the delay line) via R14, VR2 and C25. The setting of VR2 determines the level of the undelayed signal mixed with the delayed signal.

Video Output Stages

We've described the operation and merits of class AB video output stages several times, so here we'll concentrate on the departure from the basic configuration by the inclusion in our design of Tr7, 8 and 9.

These transistors form cascode circuits with Tr4, 5 and 6 respectively. The base of the upper transistor in the cascode is tied to +12V, therefore its emitter will sit at +11·4V. The lower transistor is thus operated at an emitter to collector voltage of 11·4V minus the zener voltage (2·7V), i.e. 8·7V. This mode of operation has several advantages. First of all the Miller effect is minimised. The bandwidth is therefore increased without the need for capacitive compensation. Secondly, since the gain of a small-signal transistor such as the BC182L is considerably higher than that of the usual video output types, the stability of the output voltage against supply voltage variations is much improved, while crossover distortion is suppressed because of a higher feedback factor. Thirdly, as the dissipation in the lower transistor is very low, it doesn't affect the output voltage since the transistor doesn't warm up (with a consequent change in its base-emitter forward bias voltage). All this contributes to a very substantial improvement on the original design, the results of which can be easily seen on the screen.

Audio Output

The TDA2006V audio output i.c. is operated in the inverting (virtual earth) mode. The audio signal from pin 4 of the i.f. module is applied to the inverting (−ve) input of the i.c. at pin 2. Feedback is taken to the same pin from the output via R5. The closed-loop gain of the system is the feedback resistor value divided by the source impedance (in our particular case this equals 1·1kΩ plus the value of the input resistor R3). The gain of the stage is therefore set at about 10 times.

The non-inverting input of the i.c. is referenced to +12V via R4 and decoupled by C4. This sets the quiescent output voltage at +12V, i.e. half the supply voltage. The network R6 and C7 prevents oscillations due to the inductive component of the speaker's impedance.

Servicing ASA Hybrid CTVs

P. Cole

SETS fitted with the ASA hybrid colour chassis were imported by a Bristol firm during the early 70s colour boom period. There were two models, the 22in. CT5003 (A56-120X tube) and the 26in. CT5004 (A66-120X). They were manufactured in Finland, and the circuitry used is capable of giving above average performance.

The only i.c. in the set is the TAA550 (or ZTK33) tuning voltage stabiliser, discrete transistor circuitry being used throughout the i.f. strip and the decoder and RGB output stages. A PCL86 is used in the audio stages, a tertiary winding on the audio output transformer being used to provide negative feedback to the cathode of the triode section of the valve. This latter stage includes a.f. muting during the warm-up period, i.e. until the boost line has been established. There are three unusual aspects to the c.r.t. drive circuitry: the transistor R, G and B output stages drive the c.r.t.'s grids, while the common cathode circuit is used for beam limiting and switch-off spot suppression. We'll return to these latter features later.

The line timebase employs a PCF802, PL509 and PY500A (see the simplified circuit shown in Fig. 1), the tripler being either a TVK31 or a TM25-6W6. The only unusual feature of the line output stage is the use of an ECC81 triode in the width/e.h.t. stabilising circuit. The conventional VDR (see Fig. 1) is complemented by the ECC81 which conducts when the positive-going line flyback pulse appears at C307. The ECC81's cathode is held at a fixed voltage by the zener diode D45, its grid sensing the h.t. voltage via R384 and the boost voltage via R386. As a result, it produces at its anode a negative voltage, proportional to the h.t. and boost voltages, to bias the line output valve. P28 should be set for 23kV e.h.t. or 950-970V on the boost rail. The VDR is included to prevent the e.h.t. rising above 27kV in the event of failure of the ECC81 valve. The other section of the valve acts as the field flyback blanking pulse amplifier. The line and field flyback blanking pulses are mixed at the anode of this valve, clipped by diode D54 and then fed to the c.r.t.'s first anodes.

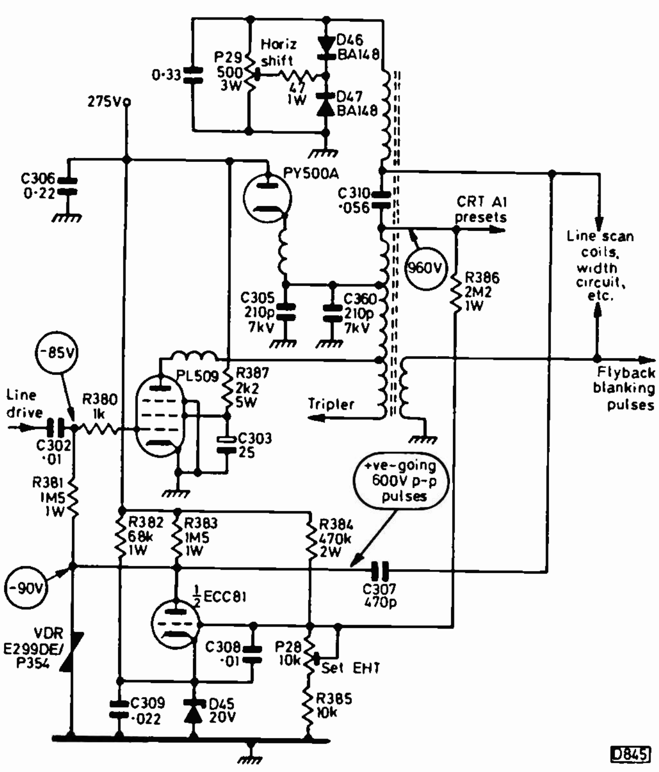

Fig. 1: Simplified circuit of the line output stage. Width/e.h.t. stabilisation is effected by the ECC81 triode, with the VDR providing protection in the event of failure of the triode. The negative control bias is developed by the pulse coupling capacitor C307 when the ECC81 conducts.

The sync circuitry is quite elaborate. The sync separator itself is T14 (BC158) on the signals panel. This is followed by the sync pulse clipper T43 (BC178) which feeds the field sync pulse amplifier T44 (BC147) and a small ringing transformer which couples the line sync pulses to the flywheel line sync discriminator circuit.

The final two valves in the set form the field timebase. First is another ECC81. One section of this acts as a blocking oscilator, the second section forming a waveform shaping/driver stage. As you'd expect, a PL508 is used in the field output stage.

The power supply circuit is shown in Fig. 2. The only thing that might cause some confusion here is the use of three separate heater circuits. The ECC81 in parallel with the c.r.t.'s heaters is the e.h.t. regulator/pulse amplifier one.

To some common faults then. Valves and c.r.t. alight but no results will probably mean that R344 or R345 has gone open-circuit. The resistor concerned may simply have felt like doing so, or alternatively one of the BY127 diodes in the h.t. bridge rectifier citcuit may have gone short-circuit. A blown mains fuse probably means a short-circuit BY127 diode, although I did once find the protection capacitor C314 short-circuit.

When the l.t. bridge rectifier D41 goes short-circuit, either the 0·5A fuse blows or, if an incorrectly rated fuse has been fitted, the mains transformer burns out. I mention this latter point because I've come across quite a few of these sets with a 2·5AT fuse fitted in this position. This can result in the mains transformer burning away quite merrily for some time before the set is switched off.

The l.t. bridge also goes open-circuit. The result is an unmodulated white raster. The same result occurs when R353 goes open-circuit.

No sound or picture with the PL508, PL509 and PY500A glowing excessively means a heater-cathode short in one of these valves. It's best to replace all three. Why no sound? Remember the muting arrangement mentioned earlier.

No e.h.t. with cool valves in the line output stage probably means that either the PL509's screen grid feed resistor R387 is open-circuit or there's no h.t. supply to the line output stage due to R349 having sprung open.

No e.h.t. with the valves in the line output stage overheating is normally due to one of four things: (1) the boost capacitor C310 short-circuit; (2) the tripler short-circuit (it can be replaced with a Phab universal type); (3) the line output transformer shorting to the core; (4) lack of line drive. In the latter event check whether the PCF802's anode load resistor R374 (33kΩ) is open-circuit.

In the event of lack of width, first try new PL509 and PY500A valves and then check the following: the print behind the line output transformer burns out; dry-jointed

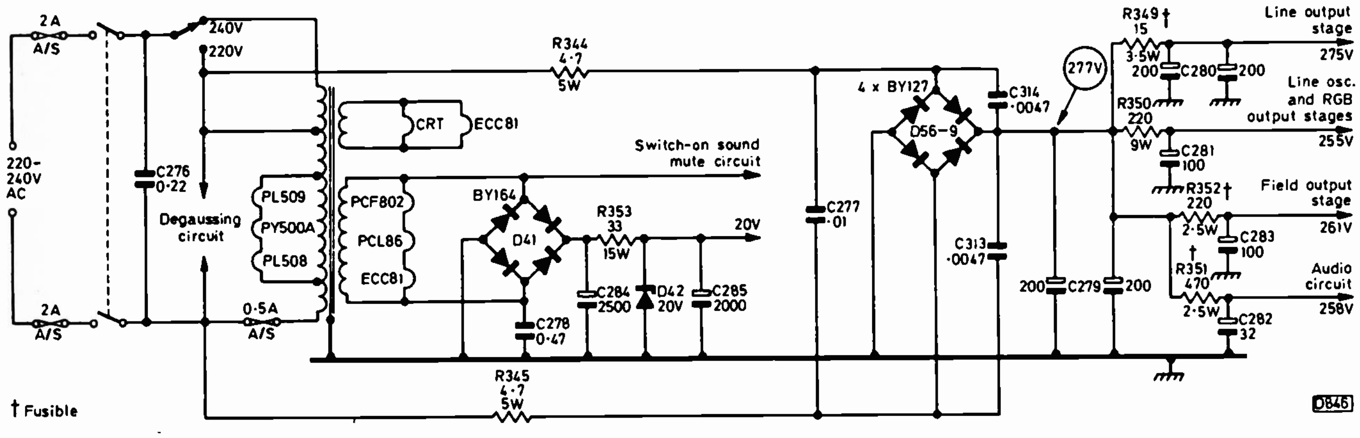

Fig. 2: Power supply circuitry. Note that the mains fuses are on the live side of the on/off switch.

connection(s) to the transformer; replace the transformer if it's burnt right up through the winding.

In the event of excessive width, check R386 and the ECC81 which may have lost emission.

Poor focus may be due to R421 (40MΩ) or R420 (30MΩ) changing value (they are in series with the focus control), a defective tripler, or sometimes the focus control (P31, 10MΩ) leaking to chassis. If the correct control is not available an Erie unit can be used with R420/1 left out of circuit.

Field collapse with the sound o.k. can be due to several things: the valves – PL508 and ECC81; the vertical shift control P27 (22Ω) going open-circuit (thus open-circuiting the PL508's cathode); the blocking oscillator transformer M09 (low or varying ECC81 anode voltage); or R401 (1·5MΩ) in the blocking oscillator's timing circuit increasing in value – in this case applying the meter to the ECC81's grid (pin 2) will open out the field scan. Field collapse with no sound occurs when R404 (270kΩ, 2W) goes open-circuit – no sound because this removes the boost supply to the height control and the sound mute circuit.

Lack of height with cramping occurs when R404 goes high-resistance or the ECC81 looses emission.

The top folded over half way down the screen is due to a faulty field blocking oscillator transformer. Top foldover with cramping is caused by C332 (0·022µF) going short-circuit – this capacitor is mounted on the field output transformer, across the secondary winding (pins 7 and 9).

Since the ECC81 valve in the line output stage screening can amplifies the field flyback blanking pulses, lack of flyback blanking will be the result when this valve looses emission – or the relevant anode load resistor R423 (510kΩ, 1W) goes open-circuit.

Lack of brightness is generally caused by R336 (56kΩ, 1W) going high in value or open-circuit. This resistor links the high voltage end of the c.r.t.'s first anode presets to the boost rail.

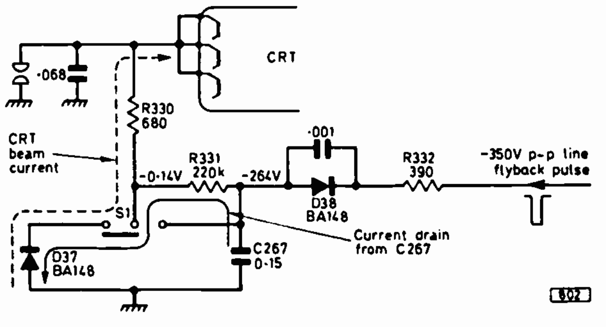

Fig. 3: The c.r.t.'s cathodes are strapped together and used for beam limiting and switch-off spot suppression.

If the picture goes negative at high brightness levels, check the blanking diode D9 in the luminance channel (goes open-circuit) and the setting of P3 (a.g.c. preset) and P45 (luminance amplifier bias). The former is set by connecting an oscilloscope to point 30 (junction of R256/R267/C250) and adjusting the potentiometer so that there's no clipping of the field sync pulses even when the contrast and brightness controls are at maximum. P45 is similarly adjusted for no white clipping. If the waveform at point 14 (pin 5 of vision detector can Ke 21-11) is not then at 2·5V ± 0·5V peak-to-peak, repeat the adjustment of P3.

Sound faults are usually due to the PCL86 valve. The man's a genius! Here's another one though. The sound output transformer sometimes shorts between its primary and feedback windings, with the result that the h.t. feed resistor R351 overheats. This can be misleading.

The signal and decoder stages are fairly trouble free apart from intermittent or complete loss or colour due to a fault in the colour-killer circuit. Replacing T21 and T22 (BC182) usually cures this.

For an intermittent bright red, blue or green raster, check for dry-joints at the appropriate output transistor or a dirty drive preset (P16/17/18).

Tuning drift or intermittent loss of signals is more often than not caused by the pushbutton unit. I've successfully refurbished some of these by applying electroconductive paint to the print connectors – a replacement unit is very costly (approximately £20 at the time of writing). The TAA550 tuning voltage stabiliser seems to be fairly reliable. The ELC1043 (ELC2000S in some sets) varicap tuner can be responsible for all kinds of faults from drift to a white unmodulated raster.

To summarise then. Most of the faults are straightforward, though the absence of sound due to a timebase fault could confuse someone not familiar with the chassis.

Finally the beam limiter/switch-off spot suppressor circuit (see Fig. 3). This operates as follows. –350V peak-peak pulses are fed via R332 to the cathode of D38, which produces a –264V supply across its reservoir capacitor C267. This biases D37 on, and with no beam current a bleed current of 1·3mA flows via R331 and D37 to chassis. The c.r.t.'s cathode currents also flow via D37, but in the opposite direction to the bleed current. When the beam current reaches 1·3mA, D37 cuts off to provide the beam limiting action. The inclusion of switch-off spot suppression is unusual in a colour set but is simple to arrange with this circuit. S1 is ganged to the mains on/off switch, so that when the latter is switched to off S1 disconnects D37 and instead shorts out R331. With –264V at its cathodes, the c.r.t. rapidly discharges the e.h.t. ■

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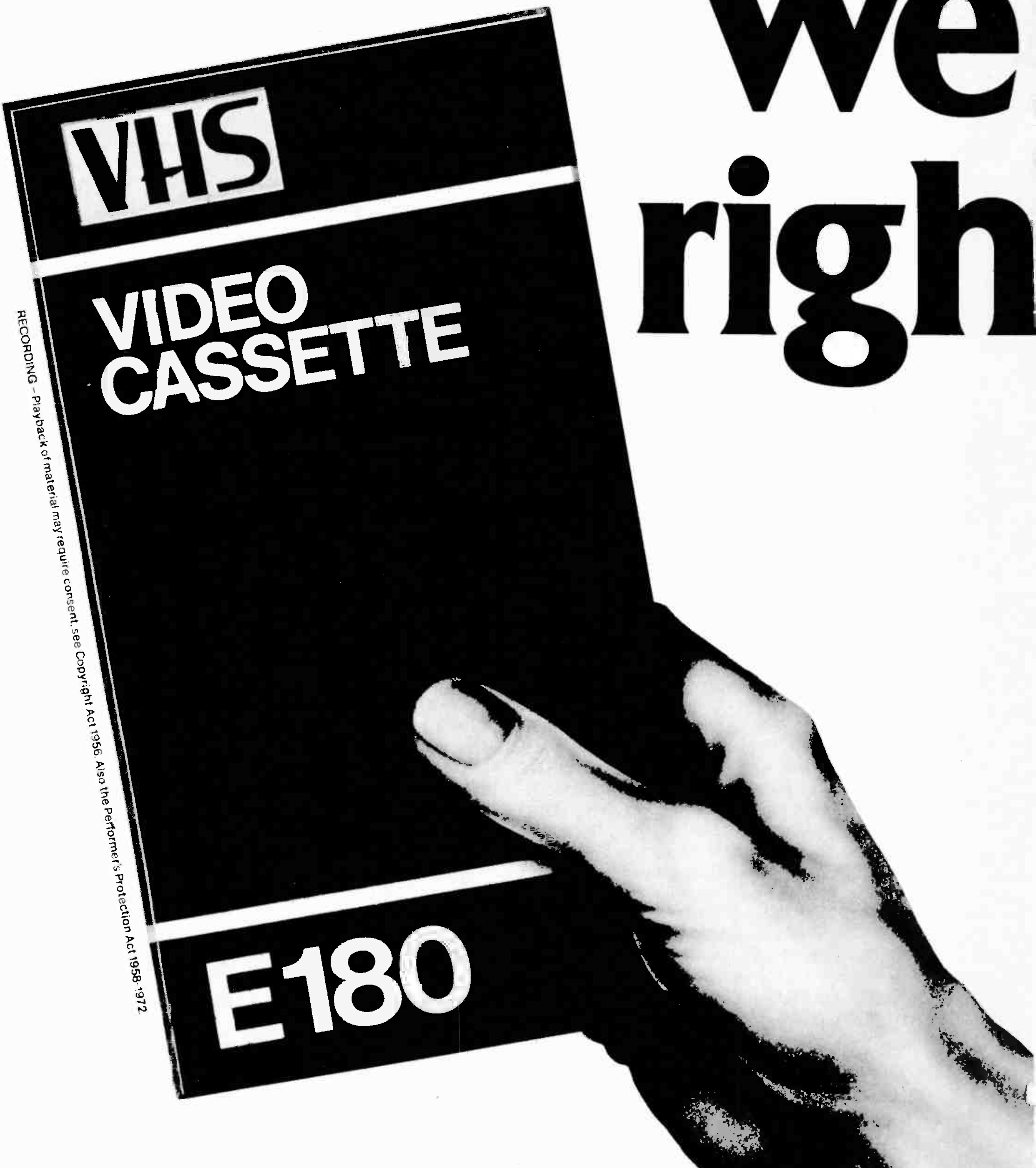

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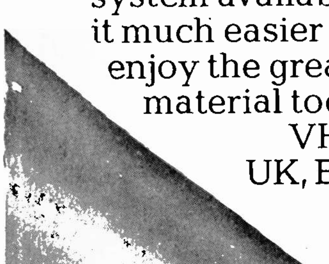

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Long-distance Television

Roger Bunney

ALTHOUGH there were some days with no SpE signals at all, there was a generally high level of SpE activity from mid-June to the end of the first week in July. For most of us, DX viewing is somewhat random, with the result that many major openings are probably missed. Brian Fitch (Scarborough) seems to be able to spend a lot of time "on the air" however, and his logs make envious reading indeed. He seems to have noted SpE activity at various times of the day on nearly all days during the period under review. My own log is as follows.

16/6/80 NRK (Norway) chs. E2, 3, 4; SR (Sweden) E2; YLE (Finland) E3; ORF (Austria) E2a; TVP (Poland) R1; CST (Czechoslovakia) R1.

17/6/80 Unidentified programmes on ch. E2.

18/6/80 Evening football, chs. E2, 3, 4; RAI (Italy) ch. IA. Hugh Cocks and David Martin reported sustained signals from Jordan on ch. E3 from 1800 onwards on this date.

19/6/80 TSS (USSR) R1, 2; NRK E2; RAI IA; RTVE (Spain) E2, 3; also many unidentified signals. Garry Smith (Derby) reports reception of TVR (Rumania) ch. R2 at 0800.

21/6/80 TSS R1.

27/6/80, NRK E2, 3, 4; SR E2, 3, 4.

28/6/80 NRK E2, 3, 4; YLE E3.

29/6/80 TSS R1, 2, 3; TVP R1, 2; JRT (Yugoslavia) E4; RAI IA, IB; also suspected Jordan ch. E3 (news programme with Arab content). An E3 test pattern consisting of black squares was observed at 1935–2000 and is reported to have been seen elsewhere at 1800. An Italian "free" station is suspected.

30/6/80 TSS R1 twice; CST R1; plus unidentified signals.

4/7/80 TSS R1 twice; TVP R1, 2; MTV (Hungary) R1; SR E2, 3, 4; NRK E2, 3, 4; RAI IA, IB.

7/7/80 TSS R1, 2. Correspondents reported receiving many Scandinavian stations during a long opening.

Tropospheric conditions have been indifferent (matching the weather!), while the last F2 reception was reported on June 8th (Gwelo, Zimbabwe ch. E2, at high levels).

Jim Maden, who was active in Cyprus in the 60s, has written to say that he's resumed the hobby once more, this time in South Africa. After investing in an up-market Wolsey Band I Cosmos amplifier, he received startling F2/TE results on June 3rd. From early afternoon the screen was abruptly filled with Gwelo ch. E2 plus RTVE E2, the UK chs. B1 and 2 and TF1 (French first chain). Even ch. R1 was "murky"! The opening lasted for about two hours.

Keith Hamer (Derby) reports good SpE conditions, particularly interesting being his reception of ORF chs. E2a and E3 on June 19th. The latter signal was from a low-power relay. On the same afternoon he received strong signals, in colour, from Iceland (RUV) on ch. E4.

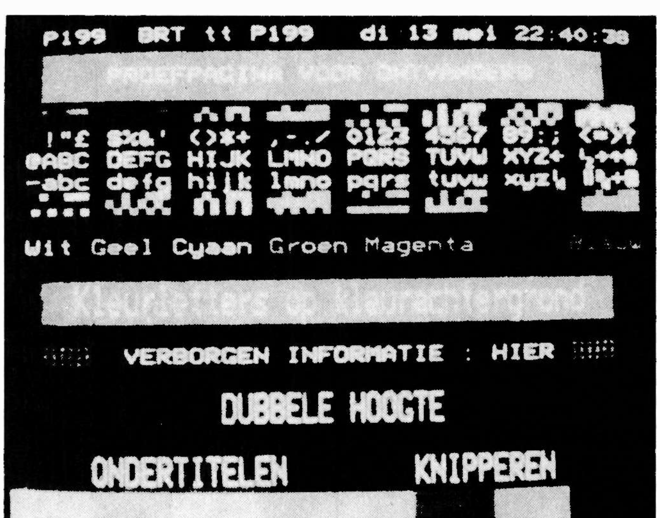
Ray Davies (Norwich) received Jordan ch. E4 on June 6th, the NCT Italian "free" station on ch. E3 on the 19th and, unusually, observed the TSS ch. R1 close down with the 0249 test pattern at 2345BST. Since Moscow is two hours ahead of the UK time, this is strange.

Ryn Muntjewerff (Holland) reports an opening between 1603–1709GMT on June 30th during which he saw two Arabic stations on ch. E3. The first and stronger was showing a programme with diplomas being presented; the second had US cartoons with Arabic subtitles. I suspect that the former was Jordan ch. E3 while the second could be from the Aramco HZ22 station at Dhahran.

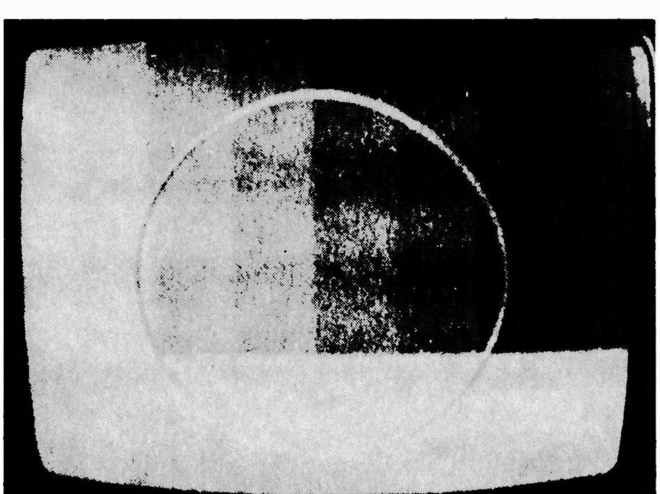
News Items

Lebanon: The two programme companies have been absorbed into a single government supervised company, though alternative programming is still in operation. The ch. E2 and E4 outlets have been reactivated, and there's talk of higher power transmitters in the future. This is ideal for long-hop SpE propagation to the UK!

UK: Discussions have been reported between Thorn–EMI,



Teletext DX – the Belgian test page 199 received by Michael Roberts in Chelmsford. Michael has received similar quality teletext transmissions from Holland.



The "mystery" test pattern queried by several readers – it's an RTVE (Spain) regional test pattern. This shot comes from Graham Barker (Leeds) – signal on ch. E3.

British Aerospace and a Swiss publishing group on a plan to beam a satellite, English language programme to the European land mass. The idea would be to use one of the Swiss channel allocations (22, 26, 30, 34 and 38 at 19°W), with transmissions at 12GHz.
Australia: The weekday ethnic TV service starts on October 28th. At the weekends there's to be a community TV service called "Public Broadcasting Association".
China: There are now three TV channels in Peking, with a fourth expected to be added during the next two years.

From our Correspondents . . .

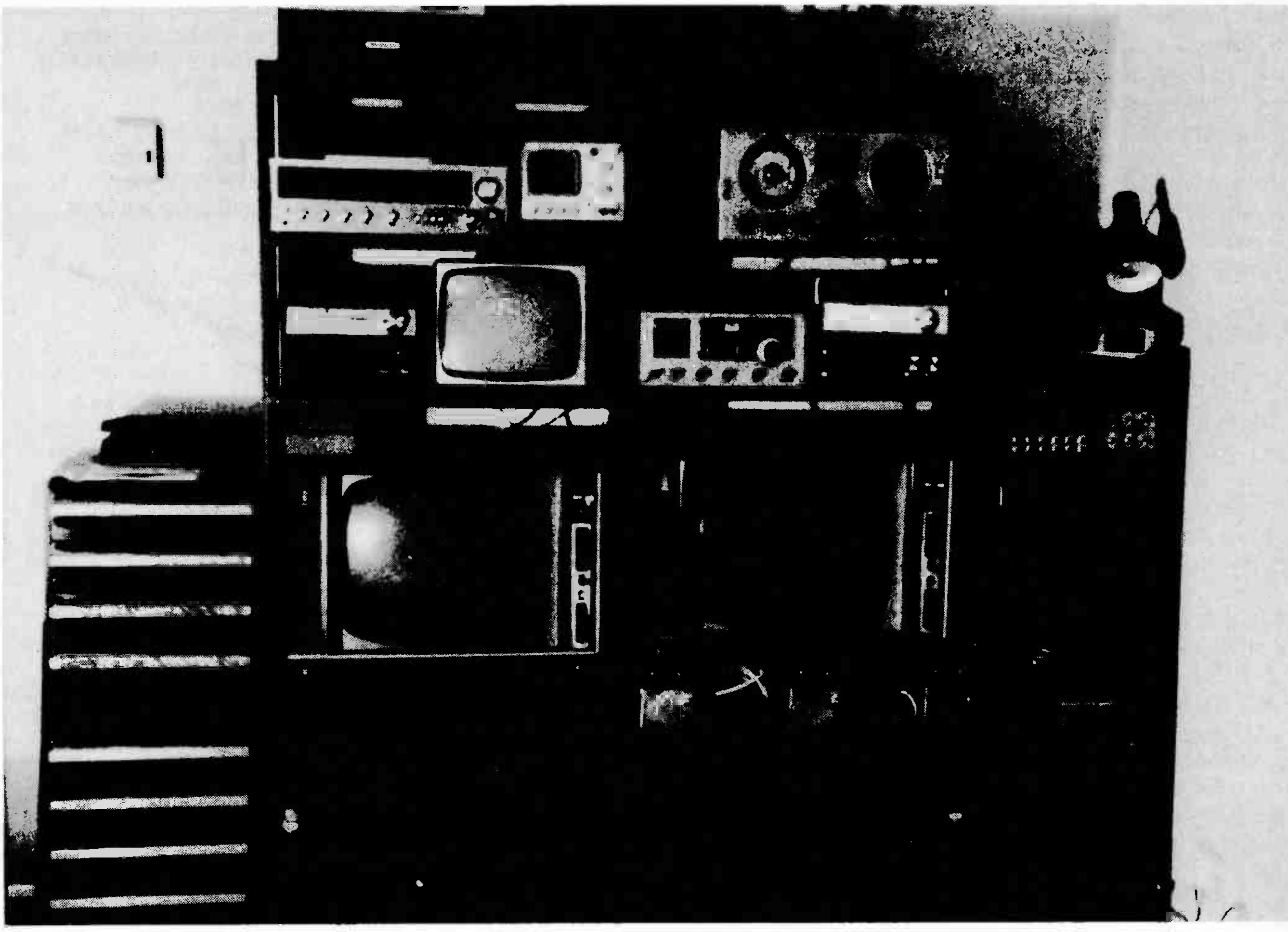
Once again a hefty post bag! Michael Roberts (Chelmsford) has been experimenting with DX teletext reception and has sent us a glorious colour photo of the BRT (Belgian) test page (199), received at u.h.f. He's received similar quality teletext transmissions from Holland.

Several readers have queried reception of a mystery test pattern (see photo). We can confirm that this is an RTVE regional test transmission.

Keith Hamer and Garry Smith have been on holiday in Switzerland, and whilst there took the opportunity to use a recently acquired Plustron colour set to monitor the various channels used by Italian "free" TV stations. They received many channels during their stay at Lugano, including two Campione based outlets, Tric Campione and RTV Excelsior. The test pattern resembled the Fubk one, but with a checkered band along the top of the rectangle and an identification below the centre. The programmes are apparently mainly rubbish, while RTV has distorted sound. Test patterns and music were transmitted throughout the night, RTV closing at dawn. During a day trip to Venice, with a visit to a local TV shop, several interesting patterns were received, including Tele Monte Carlo at some 200 miles (the PM5544 pattern with "TMC 2" identification). There are 460 Italian "free" stations at present, and to prevent piracy RAI now include the identification "RAI" (I've seen this, at the top right-hand side). Broadcasting in Italy seems to have gone mad.

Thomas E. King (PO Box 140, Kensington, NSW 2033, Australia) collects recordings of air checks (station identifications), both radio and TV. He's collected many while making overseas visits. He'd like to hear from those with similar interests in other parts of the world, with a view to trading identifications.

The Albanian ch. IC test card, received in Holland on 7/6/80 by Ryn Muntjewerff.

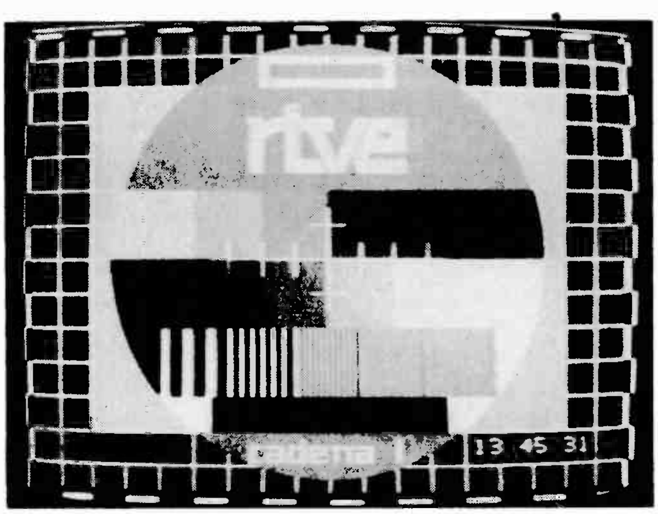


The domestic end of Roger's DX-TV receiving installation, as rearranged last winter.

Finally, I've heard that Leslie Green (Scunthorpe) has again been in hospital for a serious operation. I'm sure readers will join me in wishing him all the best.

DX–TV Receiving Installation

During the winter months earlier this year I completely rearranged the layout of my receiving equipment, with a view to increasing efficiency and also fitting the equipment into the domestic scene harmoniously – space in my typical modern terrace house is rather limited, and the equipment has to reside in the living room. After taking various measurements, I decided to purchase a free-standing MFI wall unit plus a couple of strong bedside cabinets. The unit came in kit form, enabling me to make various modifications during construction. The results are shown in the accompanying photo. The receiver on the right is mounted on a shelf to give a 3in. gap beneath, with the tuner units in front. The gap is convenient for the cabling required. A 4in. space is left above the receivers to make it easy to get at the sets and to ensure a good air flow – the sets use valves of course!



RTVE Madrid ch. E2, received by Andrew Tett (Surbiton) on a modified Thorn 1400 chassis.

Flexibility in use means being able to change over aerials/amplifiers/filters easily, and this is where the bedside cupboards come in. The backs were removed, and a metal cable trunking tray fitted. The amplifiers etc. are bolted to this, ensuring rigidity and thorough earthing (I use amplifiers with diecast housings) via common earth wiring to the domestic mains earth. Connections are made via the coaxial patchfield on the shelf above the cupboard – more diecast boxes, with Belling-Lee surface-mounting coaxial sockets. You may think that this type of cable patching will result in losses, but in practice any losses are negligible. It's wise however to fit simple tin screening between each connection inside each diecast box, in order to avoid stray coupling between adjacent cables at the socket junctions. Individual mains switching to each amplifier is incorporated in the upper cabinet, which also contains the connections and power supplies for the masthead amplifiers.

Perhaps other enthusiasts would like to send details/photographs of their installations.

Servicing the Beovision 3400 Series

Part 3

Eugene Trundle

The Line Timebase

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

NS Raster Correction

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

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

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

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

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

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

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

Convergence

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

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

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

Hardware

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

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

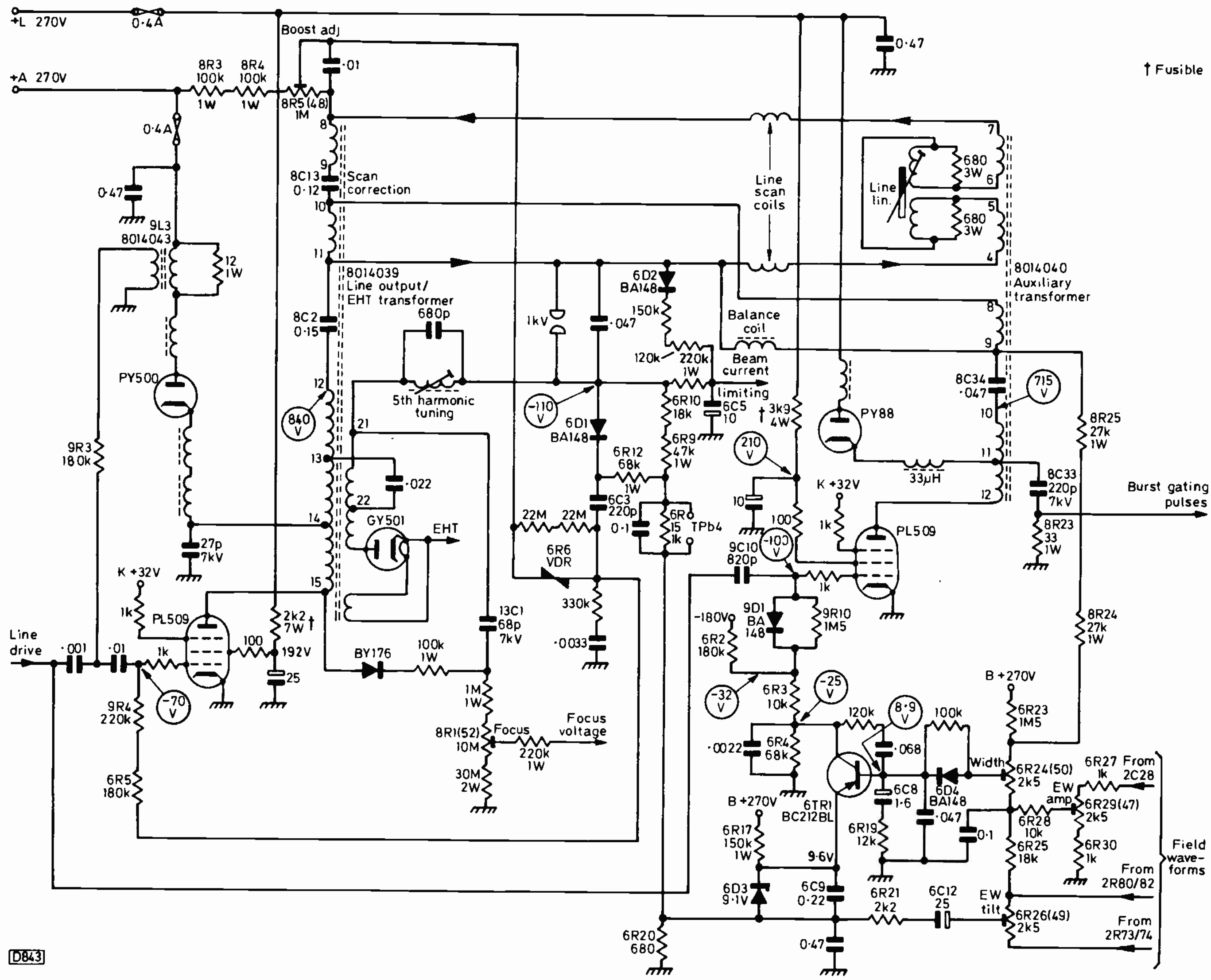


Fig. 3: Simplified circuit of the "double" line output stage used in the 3400 chassis. The voltage across 6C5 should be −1·1V.

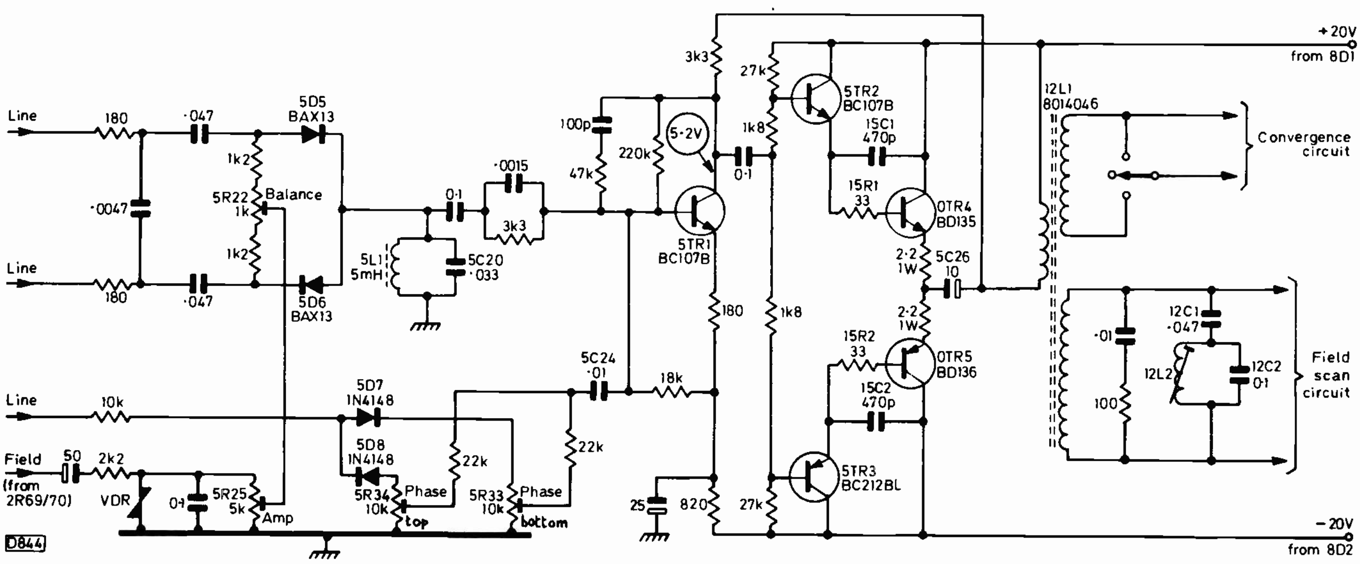


Fig. 4: The NS raster correction circuit, which gives rise to a fair number of the faults on these sets.

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

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

The Great Optical Illusion

Malcolm Burrell

THE Science Museum's TV exhibition "The Great Optical Illusion" opened back in March, the basic theme being to chart the technical development of TV during its first fifty years – since Baird first started regular experimental transmissions. I visited the South Kensington exhibition recently and was enthralled. It's on till September 28th, so as this issue of *Television* is due for publication on August 20th you've still some five weeks left to pay a visit. I feel it's well worth the effort. Admission is free, and the opening times are 10·00–17·45 weekdays and 14·30–17·45 on Sundays.

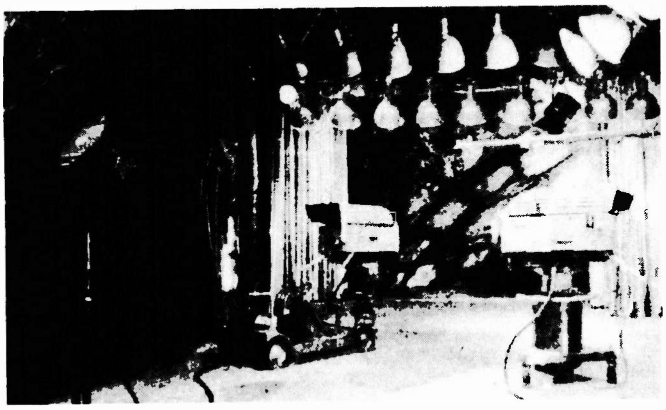
Early Receivers

One of the things I particularly wanted to see was the sets of 1936, when the BBC's TV service was inaugurated, in operation. There was a 15in. Baird model of the time, looking rather like an old radiogram with a glass top where a mirror reflected forwards a bright, slightly defocused picture. In another setting close by, a Pye Model 817 was displaying a tiny but very sharp picture from a BBC demonstration film of the period.

Two sets made to sell at vastly different prices! The Baird set with its almost three foot long c.r.t., front silvered mirror and tall cabinet sold for 85 guineas in 1937. Its price was later reduced to 55gns. By the end of 1937, when the TV service had been running for a year, fewer than 2,000 sets had been sold. So manufacturers made efforts to produce cheaper sets. The Pye 817, with its 5in. c.r.t. that gave a 4 × 3⅞in. picture, is an example, dating from 1938. It was a table model that provided a low-level sound output for feeding to the gram sockets of an existing radio receiver, and sold for 23gns. It was giving much the steadier picture of the two sets however.

Cameras

Standing opposite was an EMI type 1015 camera, measuring roughly 18 × 14 × 10in. This was the famous Emitron camera, the foundation stone of all-electronic TV – the first electronic eye you could say. In fact it did resemble the human eye, consisting of a 10in. diameter glass bulb that contained the photosensitive target, and a long stalk in which the electron gun resided. Two wide-angle lenses were fitted, with focusing by means of a knurled knob on the front of the camera. One lens provided the image for the tube, the other projecting an inverted image on to a ground glass screen inside a rectangular housing at the side of the camera – the viewfinder. Particularly interesting was the use of miniature B8H valves in the head amplifier, wedged inside the beautifully constructed metalwork beneath the tube.



Studio A at Alexandra Palace during the mid 50s, with experimental colour (NTSC) cameras operating on 405 lines.

What a contrast with the grotesque, balding head of the ventriloquist's dummy, perched on a piece of rough timber attached to a decaying Nipkow disc – one of Baird's original, 10ft. long mechanical TV apparatus. He was working with very limited finances of course. It was in 1926 that Baird first demonstrated 30-line TV pictures publicly, and a separate exhibit enables you to see the flickering, low-definition pictures on a skeleton Baird televisor or a strategically placed c.r.t. monitor. Recognisable shapes can be seen, but the discomfort of the performers of the time is all too understandable.

Another camera on view is fitted with the CPS Emitron tube, and was first used to televise the wedding of Princess Elizabeth and Prince Philip in 1947. The CPS Emitron was one of the few orthicon-type tubes to go into production. The camera itself is larger than the earlier Emitron one, with a four-lens turret and electronic viewfinder. Close by is the slightly more compact Marconi Mk. I camera: it uses the 3in. image orthicon tube developed by RCA.

Post-war Sets

As the strains of Adelle Dixon, Helen MacKay and Leslie Mitchell fade in the corner, the fanfare of *Television Newsreel*, now more associated with advertisements for Fiat motor cars, begins in another. A beautifully restored Bush TV22 demonstrates the excellent pictures these sets of the early 50s produced – while a bright, slightly softer image is to be seen on a 20in. Philips 1700A projection receiver.

Three non-operational Pye sets enable one to compare the styling of receivers from 1946, when the TV service re-opened after the war, onwards. The B16T of 1946 still used mains-generated e.h.t. to power its 9in. tube, the whole lot being housed in a rather bulky table cabinet. A more compact 9in. model, the B18T, dating from 1948, shows the reduction in size (and weight!) made possible by the adoption of line flyback e.h.t. The one on show is fitted with a magnifying lens.

The 14in. Model V4 dates from about 1954 and features a tinted implosion screen giving improved contrast, edge controls, a sloping speaker panel, and a number of circuit features – black-level correction, flywheel line sync, and automatic picture control (a.g.c.) as Pye called it. The subsequent VT4 featured a thirteen-position incremental tuner for Bands I and III.

Videotape

On the videotape side an enormous Ampex VR1000 using 2in. tape can be compared with various Sony machines using 1in. and ¾in. tape. A recent compact Baird (JVC/Thorn) VHS machine is dwarfed by all. Few 405-line videotape recordings have survived, but an excellent 17in. Peto Scott monitor was showing extracts from some 1958 tapes of ABC's production of *Women in Love*. This was the first programme where the tape was edited – literally by cutting! The picture quality was very good however, even in comparison with the 625-line programmes of today.

Studio Equipment

Also on view here is a Moy telerecording camera. Until Ampex developed their first commercial tape machine, the only method of recording TV images was to photograph them. This resulted in a considerable loss of picture quality.

Whilst children enjoyed rolling on a board placed before a concealed EMI colour camera, their friends could watch them superimposed on a videotaped background of aerial views: two short programmes at another exhibit explain the technicalities of such special effects. The first, from the BBC training department, describes colour separation overlay – chroma key to everyone outside the BBC. Performers are placed against a blue background which is filled in by the picture from another camera. This makes it possible to combine live action with models or photographs. The second programme, made by The Moving Picture Company, briefly outlines the use of a digital field store in the Quantel effects unit, which makes artificial zoom effects, pictures within pictures, tumbling pictures and other effects possible.

The Cintel twin-lens flying-spot telecine machine, designed by T. C. Nutall in 1946-7, remained in production until 1975. Large enough to fill a small cottage, 350 of them were sold throughout the world. The specimen present was purchased by the BBC in 1958, subsequently transistorised and modified for colour. It remained in service until 1979.

From the days when Europe was only dreaming of colour comes a Marconi BD848 three-tube colour camera. It measured almost 4ft. in length and used 3in. image orthicon tubes, needing about three times the scene illumination required by a modern colour camera. Two of these majestic creatures graced studio A at Alexandra Palace in the mid 50s, during the early experiments with NTSC colour on 405 lines.

And Yet More

Historical contrasts in projection TV are provided by a Decca 1000 receiver of 1953, struggling to illuminate a 5ft. diagonal screen, and the startlingly bright display provided by a Grundig 9000 unit.

Finally, amongst the teletext and TV games items, a Philips VLP disc player lay sleeping in its glass case. Outside the exhibition area however there were periodic demonstrations of the player (under the Magnavox banner). The discs, on the 525-line NTSC system, gave impressive results on an American Magnavox receiver. Once activated, the disc takes a few seconds to reach its optimum playing speed of 1,500 r.p.m., the screen being blank: the screen then suddenly flickers to life, with very stable pictures as the laser tracks across the disc in search of the required programme item. Frame freeze, and slow or fast forwards or backwards playing are all stable.

The multitude of cameras, receivers, c.r.t.s and other equipment assembled at this exhibition makes it essential viewing for anyone deeply interested in TV. Most of the important items in the development of the technology, from the mirror-drum scanner to the digital TV standards converter, are on show – with much of the equipment in operation. Sadly, many of the older cameras are non-operational: just as the nearby pumping engines need steam to live, so these cameras need the lifeblood of a technical, pioneering crew struggling to get a programme on the air! ■

Rebuilt Tubes

Vivian Capel

THERE are many colour TV bargains about at present. Sets in poor condition can usually be brought up to a reasonable standard of performance given time and patience. The big question is the state of the tube. A new tube can cost more than the price of the set, thus taking the gilt off the gingerbread. One may get a set with a tube in good condition, but the really cheap sets tend to have tubes whose emission is failing. Many tubes may have been boosted to give a reasonable picture – for a while. A solution to this problem is to fit a rebuilt tube.

Many people feel dubious about rebuilt tubes however, especially when it comes to colour. There is certainly some variation in the quality of rebuilt tubes from different sources – and indeed some variation in the techniques used in reprocessing them. Let's start by considering some history.

History

In the early days of TV the only option was a new tube. Then some enterprising firms started to open up old tubes and replace the gun – provided the phosphor screen was all right (it's usually good for at least a second life). The result was a much cheaper alternative to a new tube. While some rebuilt tubes were very good, others unfortunately were poor, with faults such as astigmatism, poor focus, poor emission, and early failure. The worst reprocessors became notorious in the trade and in time disappeared. Others whose tubes were just passable survived by selling at rock bottom prices to back-street repairers. So fitting a rebuilt tube came to be considered as something of a risk.

In due course the tube makers themselves decided to start rebuilding tubes – the Mullard Lumenar range for example. These tubes were more expensive than those from independent rebuilders, but at least you knew you had a good quality product.

The supply situation thus became three-tiered – new tube, maker's rebuild and independent rebuild, in descending order of cost. While the price of an independently rebuilt tube may be attractive, what are the chances of getting a dud one? The problems that beset the monochrome tube rebuilders pale into insignificance when compared to colour. With rebuilt colour tubes you can get grey-scale tracking problems due to mismatched guns, deformed shadowmasks, purity problems and others.

To find out more on this subject I went along to the Supervision factory at Wickwar, Gloucestershire and spent a day looking around, tracing the course taken by a tube from the time it comes in as scrap glass to the time it's packed ready to leave as a rebuilt tube. I wanted in particular to check up on quality control, and must say I left considerably the wiser for the experience.

Initial Tests

The tests start early, since you can't accept just any old tube for rebuilding. The incoming tube is first rigged to display a raster and the purity checked. If good purity cannot be obtained, the tube is rejected. The screen is also examined for missing dots. Tubes that cannot be run due to an open-circuit heater or some other fault of this type are generally scrapped, though if the tube looks as if it might be a good one it may be sent for rebuilding at the risk of later rejection. Another preliminary test is for air in the tube. This will also lead to rejection, since the phosphor can be damaged if exposed to air for longer than 48 hours.

Rebuilding Procedure

The first step is to clean the outside of the tube, at the same time marking the orientation of the old gun on the tube flare – usually this is with the blue gun towards the e.h.t. connector cavity. Air must next be let in, but only very slowly, otherwise the phosphor screen will be damaged and the tube contaminated. So a fine hole is drilled in the tube neck, opposite the gun support, using a pin-sized tungsten drill. It then takes about a quarter of an hour to exhaust the vacuum. From now on there's less than 48 hours to complete the job if the phosphor is to be preserved, so most tubes go through the rebuilding process within a working day.

To remove the old neck, a line is inscribed using a diamond tool. The neck is then severed by a hot-wire loop. The interior of the neck stub left is then cleaned with acetone and a brush that looks like a pipecleaner, and dried with warm air.

As the basis of the new neck, a length of glass tubing is welded on to the stub. The tube is longer than needed, the excess being removed when the new gun is in position. After this the tubes are stored face upwards ready to receive the new gun, overhead electric heaters warming the faceplates to avoid too rapid a temperature change when the tubes are later put into the furnace for pumping.

The guns used are made by one of the top US firms. Positioning the gun assembly in the tube neck is a very critical business, especially with Toshiba tubes. The firm has designed its own micro-alignment jig, which measures the distance between the gun and the faceplate to very fine limits. The gun assembly comes mounted on a glass disc which carries the pins and a thin glass tube through which evacuation takes place. Once the gun is positioned, the base is welded on, using a vertical stand with rotating gas jets. The excess length of tubing drops away. Rapid cooling has to be avoided, otherwise the glass disc may crack around the pins. So the tube is placed in an annealing stand where the temperature is gradually brought down to 275°C. This takes some fifteen minutes. The temperature of the faceplate is then further increased by another spell in the racks under the heaters.

Pumping

The performance and life of a tube depends greatly upon the thoroughness of the evacuation. A perfect vacuum is impossible, so the tube builder aims to get it as high as he can. Cold pumping with a single pump will produce quite a good vacuum, but to get that little extra which makes all the difference to the results obtained quite elaborate methods are required.

Heating the tube in an oven expands the air and improves the vacuum obtained, so each tube is evacuated (pumped) while heated to 385°C in an individual oven. This procedure takes four hours – during which the air is being continuously pumped out of the tube, using two pumps in series to give improved pumping efficiency. The vacuum in the evacuation tube attached to the base is frequently checked by using a high-voltage probe that produces visible ionisation. The pumps themselves are regularly removed for pen-and-gauge tests.

Before the tube is placed in one of the firm's 18 ovens, a block connector is fitted to its base. This enables heater current to be applied for cathode conversion. The connector also contains a heating element to melt the evacuation tube and seal it once pumping has been completed.

Cathode Conversion

Conversion (cathode activation) is brought about by heating the cathode in as near a perfect vacuum as possible, at particular temperatures and for precisely controlled times. These vary for different guns. A typical activation schedule is 6·3V on the heater for one minute followed by 8·5V for one and a half minutes. The effect of this process is to change the cathode coating chemically to barium oxide. Some gas is liberated in the process, so pumping continues for a further ten minutes before the tube is finally sealed. During conversion the oven temperature is reduced to 200°C.

Gettering

Most of the small amount of gas remaining is then removed by firing the getter. This is a magnesium ring which is attached to the gun assembly. With some rebuilt tubes the getter is fired just inside the tube neck. This is an easy operation, as it's done by placing the tube neck in a tank coil and positioning the neck so that the getter lies within the coil. A half kilowatt of r.f. (470kHz) is then applied to the coil.

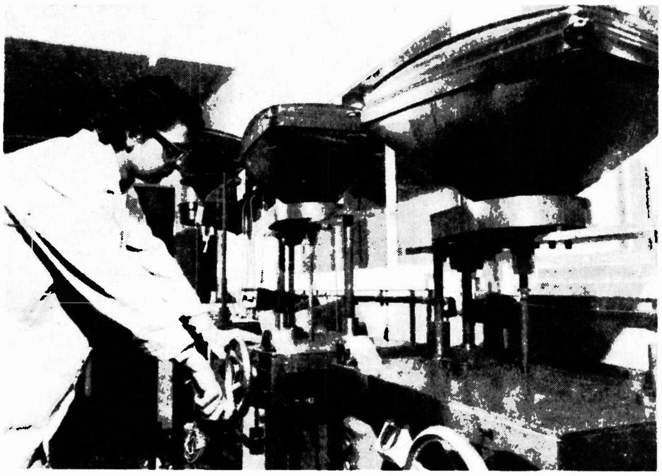
For maximum effectiveness however the best place to fire the getter is in the bowl of the tube – hence Supervision use "antenna" getters. These are mounted on the end of a long, flexible arm that extends from the gun assembly into the bowl. Firing poses a problem however. The tank coil must be close to the getter, otherwise the getter may not fire or may only partially fire. An unfired getter can actually liberate gas during normal tube use, making matters worse rather than better. It appears that it's not uncommon to find unfired getters when an old tube from a different source is dismantled. The difficulty is that the Aquadag coating conceals the position of the getter.

To overcome this problem, Supervision use a proximity detector probe to locate the position of the getter accurately, the position being marked on the outside. A special pancake-shaped tank coil is then applied to the marked position and the r.f. switched on. Gettering is carried out in a darkened booth so that the tell-tale orange flare can be seen reflected in the clear glass next to the faceplate.

Polishing and Sparking Off

The tube is then conveyed to the polishing bay, where any faceplate scratches are polished out, and the first coat of fresh Aquadag is applied.

From here it goes on to be sparked off. The purpose of this is to remove from the guns any dust that may have been picked up before insertion in the neck of the tube. The tube is placed in a lead-lined compartment, to prevent



Cleaning and drying the interior of the neck stub after removal of the old neck/gun assembly.

X-ray radiation, and all gun electrodes are connected to earth. An e.h.t. lead is fitted to the final anode cavity, and e.h.t. is then applied, starting at 10kV and increasing to 60kV in 10kV steps.

Ageing

The tube must next be aged. Like conversion, this is done by applying voltages for strictly controlled times according to the sequence prescribed for the particular type of gun. One sequence for example is 7V on the heater for five minutes, 11·5V for 1·5 minutes, 7V for 5 minutes again and finally 9V for 25 minutes, with h.t. on the anodes.

Testing

After the final coating of Aquadag has been applied, tube testing starts. All three guns are emission tested. The gun manufacturers stipulate 1·8mA as the minimum for a pass, but anything below 2·2mA is rejected. Most tubes give 3mA or more. If you've ever had trouble getting good grey-scale tracking with a replacement tube, the next test will be of interest. This is to compare the balance between the three guns. The maximum difference laid down by the makers is 0·8mA. At Supervision no more than 10% (about 0·3mA for most tubes) is allowed.

Each tube is individually picture tested, which came as rather a surprise. There are test bays for each type of tube, with the necessary video drive, scan coils and convergence components. Testing includes purity, brightness and focus checks as well as convergence. At the same time the shadowmask is examined for dirt and the screen for missing dots.

Failure in any of these tests means rejection. Rejects with minor faults are sold as seconds, with the imperfection clearly marked. If the defect would materially affect performance however the tube is scrapped.

In addition, some tubes are selected for life tests. These are run for 48 days in two-hour cycles – 72 minutes on, followed by 48 minutes off. The measured emission must then be at least 80% of the initial figure. This test simulates a 3½ year life when used for the national average viewing period of 18 hours a week.

Banding

One factor that hasn't been mentioned is removal of the rimband and fitting a new one after pumping. Is this necessary? Some say yes, others no. It adds to the cost of course. Supervision have the equipment to include this feature in their tube rebuilding procedure, and provide rebanded tubes when an order specifies this.

The Original Question

So back to our starting point, whether to fit a rebuilt tube? In performance there is little to choose between a properly processed rebuilt tube and a new one. Certainly those I saw on life test at Supervision were indistinguishable from new ones. What about life expectancy? This is slightly less than for a new tube. The reason for this is that before new tubes and the rebuilds from some tube makers are fully evacuated the grid and the anodes are "bombed", i.e. subjected to r.f. heating similar to that used for gettering. As a result the electrodes glow red for some twenty minutes, driving out any gas trapped in the metal. Rebuilt tubes from independent rebuilders are not treated in this way at present, which means that impurities in the electrode structure may be liberated during a tube's life, forming small but significant amounts of gas during the later part of its life. Bearing in mind the substantial price difference however, and the fact that the set itself may have passed beyond economic repair in the meantime, a regunned tube from a reliable rebuilder is well worth considering.■

Letters

DECCA MS2000/MS2400 SERIES

In the May *Service Bureau* the problem of a white line down the centre of the screen in a Decca monochrome set (Model MS2400) was mentioned. The reply suggested that the fault was line collapse. It's more likely to have been line cramp at the centre of the screen however. I've had this fault many times in the past on these sets. It's usually caused by resistor trouble in the line multivibrator stage – check the grid leak resistor R130 (680kΩ) which goes high in value. If necessary, also check the associated resistors in the potential divider network across the h.t. line – R139 (330kΩ) and R140 (56kΩ).

I hope the following fault notes, collected over many years servicing these sets (MS2000/MS2400), may be of help to other readers:

Cogging, pulling and streaking: D205 (1N4148) video d.c. restorer diode leaky.
Sound goes off after several hours: Check the sound output transistor Tr201 (MJE340) for being loose on its heatsink.
Low gain vision: First i.f. amplifier transistor Tr3 (AF106) in the tuner unit short-circuit base-to-emitter. The AF139 is a suitable replacement.
Low sound: Check for 11V at pin 14 of the MC1351P intercarrier sound i.c. If low check the 12V zener diode D206 (a BZX61C12 is suitable here).
No video, sound weak: Last i.f. transformer primary winding L208 open-circuit.
Distorted sound and buzzing: Quadrature coil L207 open-circuit.
No sound or raster, but e.h.t. o.k.: H.T. feed resistor R203 (400Ω, 5W) on i.f panel open-circuit. Check for h.t. shorts.
A.G.C. instability: Faulty a.g.c. reservoir capacitor C245 (1μF tantalum).
Overloading (contrast control inoperative): C245 short-circuit.
Vision instability: C226 (0·005μF) which decouples the screen grid of the final i.f. amplifier valve low in value.
Low vision i.f. gain: C215 (0·005μF) which decouples the screen grid of the first i.f. amplifier valve leaky.
Low contrast and flashing: C215 leaky.
Excessive brightness plus picture pulling: C241 (0·003μF) which provides frequency compensation in the cathode circuit of the video output valve short-circuit.
Cogging: C240 (200μF) which decouples the video output valve's cathode open-circuit.
Weak field sync with slight video smear: C240 low in value.
Patterning and sound-on-vision effect: C233 (0·01μF) across the primary winding of the sound output transformer open-circuit.
Field collapse: Field output transformer secondary winding open-circuit or the cross-coupling capacitor C115 (0·003μF) leaky.
Lack of height: High-resistance screened lead to field scan coils.
Hum on field, slight hum on line: Shorted turns on the h.t. smoothing choke CH1.
Line oscillator dead: Cross-coupling capacitor C120 (500pF) leaky.
Incorrect line speed: C114 (800pF) which couples pulses from the line oscillator to the line sync discriminator pentode leaky.
Line tearing: C113 (1μF) in the flywheel sync filter circuit open-circuit.
Line cramping at screen centre: R130 high-resistance, check also the values of R139/R140. The value of the oscillator cross-coupling capacitor C116 (25pF) is also critical if foldover at the centre is to be avoided. Use only the correct type of capacitor – 5% polystyrene (Suflex).

A common fault is to find that C122 (2μF electrolytic) has exploded. It decouples the boost supply to the height control and is on the timebase board. Make sure that all the pieces of electrolyte foil have been removed from around the base of the line oscillator valve, otherwise some very distressing line faults will be countered. To prevent the new capacitor suffering the same fate, replace the associated feed resistor R157 (680kΩ) with a 1W type. This action should be taken whenever one of these sets is serviced.

These sets are a good few years old but are still worth refurbishing. They have a smart, modern appearance, and you're not likely to come across one with many of the faults listed above.

Alan Shaw,
Bolton, Lancs.

Editorial note: Many thanks indeed for this helpful information. The full circuit for these sets appeared in our February (receiver circuits) and March (timebases/power supply) 1974 issues.

INTERESTING VCR FAULT

David Matthewson's article on VCR Muting Systems in the June issue brought to mind an interesting fault I had not long since on a Sony U-matic VO1810 VCR. The machine was in the workshop for routine service, and is in use continuously in the "repeat" mode for eight hours a day. In fact it's one of a number of machines in similar use, so it's normally quite easy for us to assess what's required – most of the faults are due to mechanical wear of course. We could well have missed this particular fault however, since the machines are used for playback only.

All worn mechanical items were replaced, and the standard alignment tape produced a perfect picture. I then made a recording, but on switching to playback there was no output at all. When the newly recorded section came to an end however, back came the video. Some brief checks were carried out – to ensure that r.f. was reaching the video heads and that control track pulses were being fed to the control head. All seemed o.k. I next removed the tape and tried playing it back on another machine. This time success, and the mystery deepened. The faulty machine would play a reference tape and would record, and its recordings could be played back on another machine – but it didn't seem to like its own tapes back!

After a fair amount of head scratching, I discovered that when the machine was playing back a known good tape the control track pulses were coming off the tape but were of very slightly low amplitude and mis-shapen. Now muting on the VO1810 is affected by the control pulses, or rather the lack of them. Another quick check with the scope, while recording, showed that the control pulses were at the correct level – up to control head. Inspecting the combined audio/control head revealed all. The gap was visible with the naked eye, though surprisingly the audio section was o.k.

On high-quality audio recorders the playback head sometimes has a slightly narrower gap than the record head, but in this case we had what amounted to the reverse condition, with the result that the head could not read its own laid-down slightly imperfect control pulses.

Replacement followed by a quick line-up proved the theory.

D. R. Stone,
London, E17.

SIMULATING A VARIAC

Malcolm Burrell seems to have made rather hard work of simulating a variac in his article on the Sony set (June issue). A single transformer will do. Connect the live side of the mains supply to tag 6 (0V) and the neutral side to tag 1 (250V), taking the 100V a.c. output from pins 1-5.

R. J. Nunn,
Diss, Norfolk.

MORE ON RESISTORS

May I say how interesting and enjoyable I found Harold Peters' article on resistors in the June issue. A few additional points may be of interest.

As Harold Peters says, carbon composition resistors were reliable and seldom failed unless overloaded. But they did drift, or rather wander in value, especially if subjected to considerable temperature cycling. Besides the painted style and those in ceramic tubes, some were moulded in a brown or black plastic – the Allen-Bradley resistors that came in during the war were in this style and were highly regarded. In parallel with carbon composition types, there was the Dubilier metallised resistor. Cynics said these were made of a glass tube and puff of smoke – but as they were accepted for inter-services use as grade 2 resistors along with carbon composition types they must have been satisfactory.

There were carbon film resistors (also called cracked- or pyrolitic-carbon) resistors long before the arrival of the cheap, mass-produced types we've known for the last ten years or so, though they were rather too expensive for use in domestic equipment. They appeared towards the end of the war and were generally called high-stabs, with 5, 2 and 1% tolerance ratings. Come to think of it they must have been available elsewhere earlier – I've seen 1939-40 vintage Avometers with high-stabs bearing the well known SH monogram of Siemens-Halske. It often surprises engineers used to resistance values up to only 10MΩ or so to find that carbon film resistors are available with values up to tens of thousands of megohms. I once used a pair of very high value in a demonstration oscillator, to give a period of several hours. Resistors of the order of 1,000MΩ are useful as the feedback resistor in picoammeters and of course in the measurement of e.h.t. voltages.

The advent of the metal-oxide resistor some twenty years ago resulted in the rapid decline in the use of carbon film high-stabs with values of 1MΩ or below. The metal-oxide resistor is virtually standard in military, industrial and laboratory equipment. Different manufacturers use different manufacturing techniques. In one well known brand, Electrosil, tin oxide is deposited on very stable glass developed by the Corning glass company.

More than the other types referred to, carbon composition resistors produce excessive noise. When there's no applied potential difference, or only small signal voltages, the noise contributed by the resistor is just the irreducible thermal (Johnson) noise – so in this case substituting a different type of resistor will give no noise reduction.

There's a better quality carbon potentiometer – the moulded carbon type. It's smoother in operation, and generally more reliable and longer lasting. The Morganite types are marked in their own peculiar manner: the first two figures are the first two figures of the value, the third indicates the number of remaining noughts and the last two figures the percentage of total value at 50% rotation – thus 10410 means 100kΩ log.

Wirewound potentiometers can also have a non-linear or tapered law. Except in very expensive ones this is effected by changing the gauge of the resistance wire at certain points along the track. Three gauges of wire are used, giving a characteristic made up of three straight lines. The shape that was shown in Fig. 2 is I believe known as the wine-glass shape.

E. F. Good,
Darlington, Co. Durham.

DON'T FORGET THE WIRE!

An interesting problem came our way recently – failure of a Ferguson Movie Star colour portable (early version) to operate on battery. The set worked all right in the workshop, so we blamed the customer's battery. When we returned the set however it refused to work – even with our own battery. What we initially overlooked was that we'd not operated the set in the workshop using the customer's battery lead but one lying around in the stores. It turned out that when the customer had bought the set a battery lead had not been available, so he'd made one up using 2A speaker wire. This was totally inadequate of course for passing the 8A required by the set, and the voltage drop along the wire was sufficient for the set to shut down. This serves to show that although the resistance of wire is usually ignored there are times when it can be quite significant – apart from the fire danger!

D. Snelling,
Clayhanger,
Brownhills.

Service Bureau

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RANK A823 CHASSIS

The picture broke up, and to restore line sync the oscillator coil's core had to be set so that it's only about two turns in. A few days before this trouble started, the neon on the timebase panel lit, cutting off the e.h.t. The overvoltage protection control had to be turned down to get the e.h.t. back.

The overvoltage circuit trips when the h.t. is excessive. 8RV1 (set e.h.t.) should be set so that the voltage at the h.t. fuse 8F3 is approximately 200V. If the h.t. voltage cannot be reduced sufficiently, check the control transistor 8VT1, zener diode 8D2, the control (8RV1) and the values of 8R6 (in series with the control) and 8R9 (feedback). If the h.t. is in order but the neon still strikes, disconnect the collector of the protection transistor 5VT3 as a check – the circuit can trip due to a defective neon or 5VT3 being leaky. Once these points have been attended to and the h.t. has been set up correctly, if the oscillator is still not functioning properly suspect capacitor trouble in the line oscillator stage – the tuning capacitors 5C17/18/20 will need to be checked, also if necessary the decoupler 5C14, 5C7 associated with the ringing circuit and the flywheel sync discriminator diodes 5D2/3.

DECCA HYBRID CTV

The problem with one of these "Bradford" sets is as follows. When the receiver is tuned off station, the first half of the scan is dark with no snow while the second half is normal, i.e. with snow. As a station is tuned in, the dark area reduces to an inch or two at the left-hand side, but the picture is always progressively brighter towards the right-hand side. Changing the line output stage valves has had no effect.

First check C434 (100μF) which decouples the cathode of the line output valve – this point affects the video via the beam limiting arrangement. If the set is the earlier 10 series, check if necessary C272 (0·0015μF) which feeds the line flyback blanking pulses to the c.r.t. The relevant capacitor on the 30 series is C219 (0·05μF) on the decoder panel. It's just possible that the boost capacitor C436 (0·22μF) is faulty, though this is unlikely.

THORN 3500 CHASSIS

About half an hour after the set has been switched on, purple bands appear across the top and bottom of the picture, with some loss of line sync in these bands. After a while the colour goes completely and the line hold gets worse. Occasionally the colour will return sporadically in parts or all over the picture, then going again.

This is typical of burst gate timing drift, the clue being the line oscillator drift – this shifts the flyback pulse, delaying the gating pulse so that the burst signal is reduced or lost. First adjust the line oscillator circuit therefore. This is done by removing the sync pulse feed – short the test point on the main chassis (lower at the left-hand side viewed from the front) to earth – then set the line hold control to the mid-position and tune the line oscillator coil for a stationary or nearly stationary picture. After doing this you may find that the fault has been cured. If drift is still present however the flywheel sync discriminator diodes, the reactance transistor and the electrolytics hereabouts, also possibly the oscillator tuning components, will have to be checked.

SONY KV1800UB

The trouble with this set was a 5in. wide picture, due to the line oscillator running at the wrong speed. Replacing the line oscillator transistors Q509/510 cured the fault, but we found that the originals were type 2SC1363 instead of type 2SC1364 as specified in the manual. Is there any significance? Three days later the cut out operated, due to the series regulator transistor Q902 going short-circuit. This is type 2SD96A. Is there a substitute?

The 2SC1363 and 2SC1364 are similar enough for Sony to use either in the Q509/510 positions. Though Sony would no doubt be filled with horror, we've found that a BC171B will generally do as a substitute. Q902 is more difficult, being a high-dissipation device – the correct type should really be fitted here. We're surprised however that the circuit breaker trips when Q902 shorts, and suggest you check the mica washer on it and also the converter (Q802) and line output (Q801A and Q801B) transistors.

RANK A823A CHASSIS

After the set's been on for about an hour, if the picture has a large white or near white area the field splits for a second or two, about two inches down from the top, then returns to normal. The problem then becomes worse until the picture remains split in two, with a one inch black band across the middle, the field sometimes rolling very slowly.

If you're lucky, all that's required is slight adjustment of the field hold control 5RV1. If adjusting this fails to cure the trouble, the following are suspect: the interlace diode 5D4, 5R14 (560kΩ) which biases the base of the sync separator transistor, 5R20 (1MΩ) in the field sync coupling network, the sync separator transistor 5VT2, and 5C18 (47μF) which decouples the supply to the field oscillator circuit. We've listed these in order of likelihood.

DECCA GYPSY

From new there was slight foldover at the top of the raster (apparent only after the set had warmed up). Then the raster went completely, due to the line output transistor going short-circuit. A replacement restored the raster, but the top foldover subsequently got worse. Checking with freezer failed to find anything wrong in the field timebase, but on touching Tr9 (one of the field output stage transistors) the field collapsed. On removing my finger there was some picture, but only four inches high and with terrible foldover at the top and bottom. Since then I've replaced all the transistors in the field timebase, but the problem remains.

Top foldover on this portable is usually caused by leakage in D7 (BA157), which is in series with the field output stage and switches off to enable the flyback action to take place, or in the field scan coupling capacitor C57 (220μF). If these are in order, and the d.c. voltages in the field timebase are reasonably correct, the likelihood is that there are shorting turns in the scan coils.

THORN 1500 CHASSIS

For the first hour and a half the set works well, then the bottom of the picture starts to jump and subsequently the whole field keeps closing in to a horizontal line for a few seconds before opening out again. Half an hour later the picture becomes steady again. A new PCL805 field output valve has failed to produce any improvement.

We suggest you check the condition of the two 18kΩ resistors R101/2 in the coupling circuit between the output pentode and the triode section of the valve. The symptoms you describe are consistent with one of these resistors being defective.

TANDBERG CTV2–2

The mains fuse blew and on examination we found the following components in the power supply faulty: the chopper transistor Q977, the trigger thyristor Q976, the control transistor Q975, and the 160V rectifier D985. These were replaced, but when the set was switched on the sound and vision lasted for only about thirty seconds before the mains fuse again blew. Any ideas?

The 160V line supplies the line output stage. The first thing to check therefore is the BU108 (BU208) line output transistor, which can be responsible for sudden failure of Q977. Chopper transistor failure unfortunately usually means failure of the thyristor and control transistor as well: all must be replaced at the same time. Other things that can cause sudden failure of Q977 are the mains bridge rectifier diodes D976–9 if type 1N4005 (replace with BY127s), dry-joints (not easily visible) on the power supply transformer T975, and D992/Q981 if there are signs of distress in R998. The latter components are fitted in later production only: Q981 is an over-voltage crowbar thyristor connected to the 160V line, D992 is the reference zener diode that fires it, while R998 (10Ω) is in series with Q981.

THORN 2000 CHASSIS

The fault on this set is no e.h.t. The trouble seems to be in the e.h.t. regulator circuit, as the driver transistor VT5 heats up quickly, also R11 in its feed circuit, then R1 on the power supply panel springs open (as it should do). On testing the regulator transistor itself (VT6) I find that there are low-resistance readings across all the junctions. It's type D1693, but I can't find any trace of this device. Can you also suggest an alternative for the e.h.t. generator transistor VT7 (type R1038)?

It seems that leakage in VT6 is the root of the trouble. A good substitute is the 2N3055 which is readily available. The R2008 or R2008B used in the 3000 series chassis can be used to replace the R1038. The driver VT5 can be replaced by an E1222. It would also be worth checking C2 (140μF) which decouples R11.

ITT VC300 CHASSIS

The trouble with this portable is a hum bar, which moves up the screen, and a wavy picture. I've replaced the bridge rectifier, using BY127 diodes, also the transistors in the l.t. regulator circuit. The l.t. rail is correct at 11V, the current is 1·7A as quoted in the manual, and the set works normally when used with a car battery. The BY127s and the mains transformer run hot.

The current rating of the BY127 doesn't approach the 1·7A which this circuit demands. Even the original bridge rectifier used in the chassis proved not man enough, being replaced by a different ITT approved and supplied alternative. It's essential to use either this or high-current, low-voltage rectifiers such as the 6A types marketed by RS Components. The ITT part number for the recommended bridge is 12547. Occasionally the cause of hum is the reservoir capacitor C14 (4,700μF – there are two of them if the set is a 15in. model).

RANK A823AV CHASSIS

The trouble is tuning drift on all channels, always slight and towards the l.f. end of the scale. A normal picture can be obtained for 10–40 minutes (at the h.f. end of the scale only) but then slowly drifts off station, leaving the sound but no picture, just patterning with weak sync. I've changed the TAA550 regulator i.c. and the diodes in the a.f.c. circuit. Also the touch tuner refuses to hold on, reverting to "one" if any channel is not on station.

There seem to be two faults here. We suspect the touch tune unit for the "jumping to one" trouble – possibly the number one neon. The varicap tuner itself is the first suspect for the drift problem, though the tuner control unit is not above suspicion. The latter can be checked by rigging up a 22 or 25kΩ potentiometer in place of the tuning potentiometer bank in the set.

DECCA 30 SERIES CHASSIS

The trouble with this set is intermittent loss of height. The picture will suddenly close in, at the top and bottom, then return to normal – the test/teletext signals are seen at the top when the raster collapses. Sometimes there's a sort of "threatening" action before the collapse suddenly occurs. The picture may then return to normal for a considerable time.

This fault on these sets is usually attributable to a dud spot on the height control potentiometer, in which case replacement is the only sure cure. If the height control is o.k., check for dry-joints on the panel and particularly the seating of plug/socket PT/A on the timebase board.

THORN 8000 CHASSIS

The only things we've had to do to this set in the past have been to replace the line output transistor and the f.e.t. d.c. amplifier in the reference oscillator control loop. Now however we get horizontal yellowish lines across the raster for about three minutes after switching on, then the screen is filled with lines as though field and line sync are lost. The picture appears a minute or so later, and is generally satisfactory for the rest of the evening.

If both field and line hold are lost, the suspect is the tantalum capacitor C196 (3·3μF) on the signals panel. This couples the video signal to the buffer amplifier which in turn feeds the sync separator. If line hold only is affected, check the BA154 flywheel sync discriminator diodes W405/6 – by substitution, since they can cause trouble even if an ohmmeter test suggests that they are all right. Adjust the line oscillator coil L405 (line hold) if these diodes have to be replaced.

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TELEVISION SEPT. 1980

RANK A816 CHASSIS

The initial trouble was excessive width. While checking the voltages around the line driver transistor 3VT17 however the BU105/01 line output transistor went short-circuit. A replacement went the same way, so I changed the line output transformer and the SN76533N line oscillator i.c. This produced scan for a few seconds, then puff! the new line output transistor went again. Any ideas? It's costing a bomb in BU105s.

We feel that the first suspect is the flyback tuning capacitor 3C61 (2,200pF). Other things we'd do before switching on again are to check the value of the current stabilising resistor 3R103 (1·8Ω), which is in series with the base of the line output transistor, and disconnect the TV20 e.h.t. rectifier to clear this of suspicion. We assume that the resistors (3R118, 3R117 and 3R113) in series with the h.t. feed to the line output stage have not been tampered with.

BUSH CTV25

The set is one of the later ones, with an e.h.t. multiplier. Unfortunately the multiplier has failed and replacements seem difficult to find. It's a quadrupler, made up from separate rectifier sticks. Can these be replaced, and if so what with?

Diode types BY182, BY184 and BY176 are all suitable for use in this application.

TEST CASE

213

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.

The symptoms on an ITT colour set fitted with the CVC20 solid-state chassis were no colour and very low contrast. The job was taken on by a small local servicing firm that occassionally uses the services of an experienced engineer as a consultant, and this particular set was eventually referred to him. The firm's technicians had tried fitting a replacement decoder/video panel without success, but had discovered that the control voltages fed to this panel from the contrast and colour controls were low. The 12V supply to the control panel was present and correct, so suspicion was directed to the beam limiter circuit (see Fig. 1).

So as not to waste any time, the two transistors involved, T1 and T2, were replaced. The picture was still flat and milky however. These two transistors are normally cut off, being intended to switch on and pull down the contrast and colour control voltages only when the e.h.t. current flowing to chassis through R20 exceeds the bleed current flowing via R20 and R23 – with D3 clamping the voltage at the junction of R19/20/23 to –0·6V when the beam limiter circuit comes into operation.

The consultant was acquainted with all this, and decided to check the diode and the values of the resistors with his Avo. These turned out to be in order, and he started to wonder whether there was maybe a tripler fault. Voltage readings were next taken – and a strange set of circumstances was revealed! The voltage at the emitter of T1 was correct at 4·5V (zero beam current), while the voltage at the base of this transistor was found to be 1·8V. Though this was not correct, it nevertheless suggested that T1 was cut off, as it should be. The voltage at the collector of T1 was found to be markedly lower than it should have been however, while T2 was hard on. Shorting the base and emitter of either transistor to switch it off restored normal contrast and colour.

The consultant turned to another piece of test gear and quickly snipped out the offending component. What was it and what had happened to it? See next month for the answer and another test case item (about a VCR, so there!).

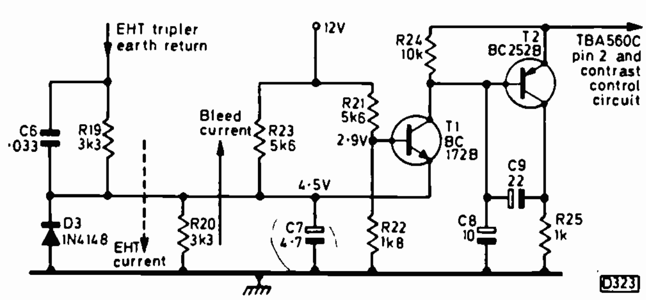

Fig. 1: Beam limiter circuit used in the ITT CVC20 chassis. R23 changed to 10kΩ, R22 to 910Ω and R25 to 470Ω in later production sets.

SOLUTION TO TEST CASE 212
– page 564 last month –

The fact that disconnecting the heater chain in the VC200 chassis mentioned last month removed the hum on line scan symptom meant that the heater supply just had to be the source of the offending hum modulation on the raster. The line output valve's control grid circuit is quite a high-impedance one, and it became obvious to the engineer that this was the point of hum injection when he managed to reduce the severity of the symptom by artificially lowering the circuit impedance at this point.

Close inspection of the printed panel (it's made of SRBP material) with the PL504's valveholder removed revealed charring in this area. The conclusion then was that the trouble was due to leakage across the surface of the board beneath the valveholder. Although no leakage could be measured with a Megger, the fault was completely cured by isolating the print tracks and valveholder pins associated with the heater and line drive feeds (pins 1, 2, 4 and 5) and wiring them up with PVC covered wire instead. After this rather tricky operation the raster was rock steady. It was fortunate for Mrs. Williams that her set was on rental, otherwise her bank balance would have taken rather a heavy blow in labour charges!

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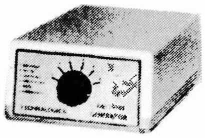

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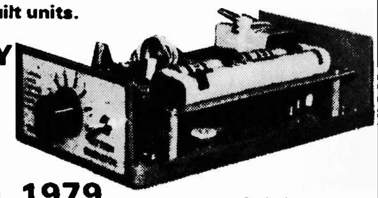

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CPG6RF KIT £42.55 BUILT £63.25 – Both above combined.

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The Office of Fair Trading have agreed that the notice of the Mail Order Protection Scheme to appear in periodicals carrying mail order advertising should appear as follows:—

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Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfill orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch, as this may be needed.

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Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

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Long Leads £1.00 each
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Repair your old 5 and 3 sticks **at a Fraction of the Cost.**
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Fit our **C.R.T. Isolating Transformer.** Ideal for HTR./Cath. Shorts. 200-220-240 inputs. 750-900 MA outputs with thermal cutout. Made for **Thorn 4000** C.T.V. but works O.K. on other sets.
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20Ω 16W, 91Ω 10W, 13Ω 11W.
10 of any one type £1.20
10 of each type £3.00
2·2k fusible, vertical mounting
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4,500μF 35V cans 80p each
R.B.M.100μF + 32μF + 32μF 300V

Avoid Lethal Shocks 50p each
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Spillages, Floor Sweepings, Cosmetic Imperfects etc.
All mixed up. Factory clearance.
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Polyester C280's (Liquorice Allsorts)
100 mixed £2. 1000 mixed £12
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Our Transistor Packs are even better than before! **100 NEW AND MARKED TRANSISTORS** including BC238, ME0412, BF274, BC148, BC182L, BC338 and, or other similar types. A random analysis of these packs yeilded between 98 and 106 transistors of 17 to 20 different types with an average total retail value of £14 – £16. **OUR PRICE ONLY £4.95**
200 transistors as above but including BD131, 2N3055, AC128, BFY50, BC154, BF394, BC184L, etc.
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(ALL NEW AND FULLY GUARANTEED)

(Prices include VAT at 15%)

Discount to Trade Post and Packing 85p

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Z146 A640 dual std mono	8.50
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*Please state printed circuit or wired version

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0.047mfd	26p.	0.22mfd	42p.
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1.0mfd (Three wire type)	45p.		

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0.1mfd	28p.	0.47mfd	54p.

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4700pF	28p.
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P. E. WHITE

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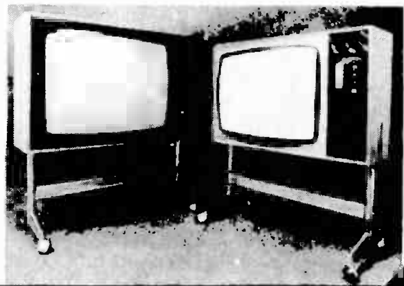

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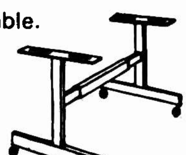

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ECC82	10	5
PCF80	15	8
PCF802	10	5
PCL82	12	6
PCL84	15	8
PCL85/805	15	8
PCL86	12	6
PFL200	15	8
PL36	20	10
PL504	20	10
PL508	30	15
PL509	80	25
PL519	90	40
PY500	40	19
PY800/81/801	15	8
PY801/88	15	8
30FL1/2	25	12
PL802	£1.20	

Please add 10p per valve p. & p. for orders under £2.00.

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Tube prices + V.A.T.

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22"	A56 – 120×	**£30.00** + VAT
25"	A63 – 120×	**£32.00** + VAT
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CURRENT PRICE LIST

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A49-120X, A51-110X	**£30**	A51-161	**£40**
A56-120X, A56-140X	**£33**	A56-500X, 560HB22	**£43**
A63-120X, A66-120X	**£36**	A66-500X	**£46**
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Prices are based on a type for type exchange tube suitable for reprocessing.

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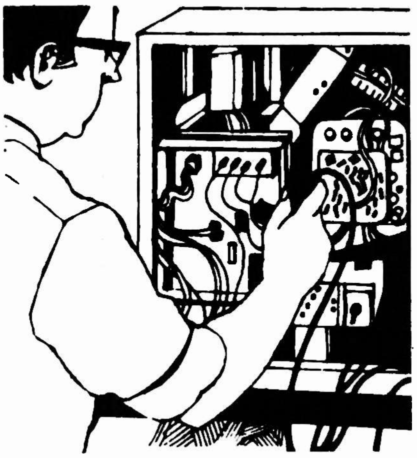

SETS & COMPONENTS

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Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser to check both prices and availability of goods before ordering from non-current issues of the magazine.

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5p each	47/63V	5p each

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220/450V	40p	.0047/1,500V	8p
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