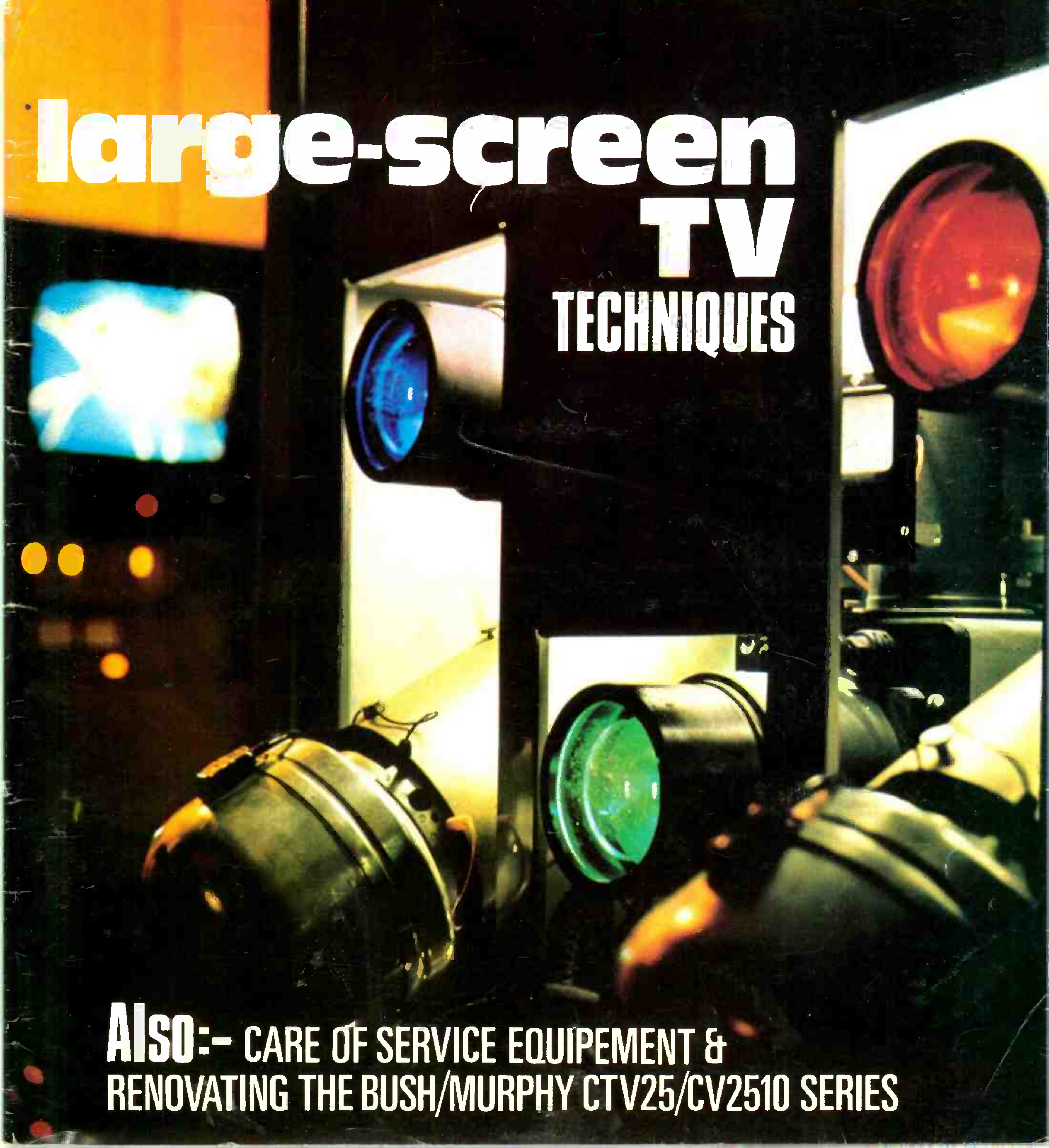
TELEVISION

20p

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

1972 NOVEMBER



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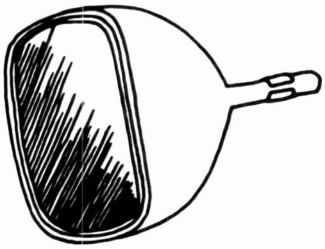

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19″	£5·00	24″	£9·00	25″	£27·50
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1S5	·22	30C17	·76	EAF42	·50	EM80	·38	PCL82	·30	UABC80	·32
1T4	·16	30C18	·58	EB91	·10	EM81	·38	PCL83	·57	UAF42	·50
3S4	·26	30F5	·64	EBC33	·40	EM84	·32	PCL84	·34	UBC41	·45
3V4	·47	30FL1	·65	EBC41	·49	EM87	·50	PCL85	·38	UBF80	·34
5U4G	·31	30FL12	·69	EBC81	·30	EY51	·36	PCL86	·38	UBF89	·32
5V4G	·35	30FL14	·68	EBC90	·22	EY86	·29	PCL88	·68	UCC84	·32
5Y3GT	·34	30L1	·29	EBF80	·32	EY87	·29	PCL800	·89	UCC85	·35
5Z4G	·35	30L15	·70	EBF83	·39	EZ40	·39	PCL805	·38	UCF80	·32
6/30L2	·54	30L17	·67	EBF89	·29	EZ41	·39	PENA4	·77	UCH42	·58
6AL5	·11	30P4	·65	ECC81	·17	EZ80	·21	PEN36C	·70	UCH81	·30
6AM6	·13	30P12	·69	ECC82	·20	EZ81	·22	PFL200	·52	UCL82	·32
6AQ5	·22	30P19	·65	ECC83	·35	EZ90	·25	PL36	·49	UCL83	·55
6AT6	·20	30PL1	·60	ECC85	·34	GZ30	·34	PL81	·44	UF41	·52
6AU6	·20	30PL13	·89	ECC804	·54	GZ32	·40	PL81A	·47	UF89	·30
6BA6	·20	30PL14	·65	ECF80	·31	KT41	·77	PL82	·31	UL41	·53
6BE6	·21	35L6GT	·45	ECF82	·26	KT61	·55	PL83	·33	UL84	·30
6BJ6	·41	35W4	·25	ECH35	·55	KT66	·78	PL84	·30	UM84	·22
6BW7	·50	35Z4GT	·25	ECH42	·59	LN319	·63	PL500	·63	UY41	·39
6F14	·40	50CD6G	·68	ECH81	·29	LN329	·72	PL504	·63	UY85	·25
6F23	·68	807	·49	ECH83	·38	LN339	·63	PM84	·33	VP4B	·77
6F25	·53	AC/VP2	·77	ECH84	·35	N78	·87	PX25	·95	W77	·43
6J7G	·24	B349	·65	ECL80	·35	P61	·40	PY32	·52	Z77	·22
6K7G	·12	B729	·62	ECL82	·29	PABC80	·34	PY33	·52	**Transistors**	
6K8G	·17	CCH35	·67	ECL86	·35	PC86	·47	PY81	·25	AC107	·17
6Q7G	·35	CY31	·30	EF39	·38	PC88	·47	PY82	·25	AC127	·18
6SL7GT	·30	DAF91	·22	EF41	·57	PC96	·42	PY83	·26	AD140	·37
6SN7GT	·30	DAF96	·36	EF80	·23	PC97	·36	PY88	·33	AF115	·20
6V6G	·28	DF91	·16	EF85	·28	PC900	·29	PY800	·34	AF116	·20
6V6GT	·28	DF96	·36	EF86	·30	PCC84	·29	PY801	·34	AF117	·20
6X4	·23	DH77	·20	EF89	·26	PCC85	·23	R19	·30	AF125	·17
6X5GT	·28	DK32	·33	EF91	·13	PCC88	·38	R20	·70	AF127	·17
10P13	·53	DK91	·28	EF92	·27	PCC89	·43	U25	·73	OC26	·25
12AT7	·17	DK92	·50	EF98	·65	PCC189	·48	U26	·70	OC44	·12
12AU7	·20	DK96	·45	EF183	·28	PCC805	·70	U47	·73	OC45	·12
12AX7	·22	DL35	·40	EF184	·31	PCF80	·28	U49	·70	OC71	·12
19BG6G	·75	DL92	·26	EH90	·34	PCF82	·33	U52	·31	OC72	·12
20F2	·67	DL94	·47	EL33	·55	PCF86	·46	U78	·24	OC75	·12
				EL34	·45	PCF800	·58	U191	·68	OC81	·12
20P3	·75	DL96	·38	EL41	·54	PCF801	·28	U193	·42	OC81D	·12
25L6GT	·19	DY86	·24	EL84	·23	PCF802	·40	U251	·64	OC82	·12
25U4GT	·57	DY87	·24	EL90	·26	PCF805	·58	U301	·38	OC82D	·12
30C1	·28	DY802	·33	EL95	·33	PCF806	·56	U329	·66	OC170	·23

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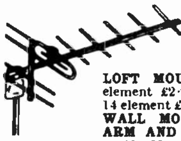

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EF85	12½p	PCF80	7½p	PY33	22½p
EF183	12½p	PCC89	12½p	U191	17½p
EF184	12½p	PCL85	22½p	6F23	17½p
EY86	17½p	PCL82	17½p	30PL1	22½p
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AF170	25p
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BA155	10p
BA163	90p
BAX12	12p
BAW63	36p
BAW65	36p
BAW67	35p
BB105	37p
BBY20	37p
BC107	10p
BC107B	12p
BC108	10p
BC108A	10p
BC108C	15p
BC109	12p
BC113	15p
BC116	20p
BC117	20p
BC119	30p
BC121	25p
BC125B	25p
BC136	20p
BC137	20p
BC139	25p
BC142	21p
BC143	23p
BC147	12p
BC148	10p
BC149	12p
BC152	20p
BC153	20p
BC157	15p
BC158	12p
BC159	15p
BC170	15p
BC171	15p
BC171A	17p
BC177	20p
BC177B	23p
BC178B	16p
BC179	20p
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BC214L	15p
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2N919	45p
2N920	42p
2N1302	17p
2N1304	21p
2N1306	24p
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TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

VOL 23 No 1
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NOVEMBER 1972

EVER DIMINISHING SPIRALS?

A surprise announcement from Philips has been that of their new VLP (Video Long Playing) system, a method of recording audio and video (colour) signals on an LP-type record for playback through an ordinary domestic television set. Since Philips do not expect this system to be commercially available for a few years it is rather early to forecast the likely cost to the customer: the only guide is the Philips' prediction that VLP will considerably reduce the cost of audio-visual programmes in some fields.

Although the basic technical details make very interesting reading nevertheless we are, in our sceptical editorial mind, reluctant to hail this new development as the answer to our prayers. Since Ampex came up with the first commercial videotape recording system in 1956 we have been anticipating the day when such facilities would be available at reasonable cost to the ordinary viewer. .

The first attempt to bring video recording to the home market was made in the UK in 1964. Due to various factors which need not be dwelt upon here this brave attempt was abortive. From then on it has been, to use TV soap opera terms, "a continuing story" of hopes alternately raised and shattered. Even on the industrial scene audio-visual equipment has not been without its troubles—the latest casualty has been the EVR system which was launched with great fanfares but now seems doomed to oblivion.

One of the drawbacks to EVR was that it was a playback-only system. In our view this appears to be a major disadvantage of the new VLP disc system. It may well be that Philips will find some way of bringing down the cost of the hardware to make it acceptable for domestic use, while the software should certainly be comparatively inexpensive. But until a system comes along which combines playback and recording facilities and is within the right price bracket we do not see large sales to domestic users. We have the feeling that "this is where we came in" and that the dream of home video recording is still progressing in ever diminishing circles (or spirals).

W. N. STEVENS—*Editor*

Cover: Our photograph this month shows the control room and Eidophor large-screen colour television projector at the surgery department of the Medical School in Heidelberg, Germany. It was kindly supplied by Philips of Eindhoven, Holland.

THIS MONTH

THE NEXT ISSUE DATED DECEMBER WILL BE PUBLISHED NOVEMBER 20

TELETOPICS

TV TOUCH-TUNING IC

With the filing of a patent application covering the use of m.o.s. devices for television and radio channel selection and indication a World "first" is claimed by the UK firm Emihus Microcomponents Ltd. of Weybridge, Surrey. The patent relates to a specially developed m.o.s.-technology integrated circuit which Emihus is already producing in development quantities. The ETT6016 touch-tuner as the i.c. is designated is intended to replace mechanical push-button TV tuner mechanisms. It provides a sensing system which operates in conjunction with a finger-touch plate, a switching arrangement to control a varicap tuner and in addition outputs to operate channel indicating neon lamps. The sensing system comprises a very high-impedance circuit which is effectively shorted out by the resistance of a finger placed across the external touch plate. One side of the touch plate is connected to the sensing input of the i.c. and the other to a positive voltage which may be d.c. or a.c. When the touch plate is operated the channels are stepped through in sequence: the selected channel latches on and the appropriate indicator lights. The i.c. operates from a standard 33V varicap tuner supply and enables up to eight channels to be selected. Remote control can be applied to the system if required.

SERVICE EXTENSIONS

The BBC-1 and BBC-2 services from the **Ridge Hill** (Herefordshire) main station are now in operation, BBC-1 on channel 22 and BBC-2 on channel 28 (receiving aerial group A). The first "phase two" IBA main station is also now in operation, **Angus** north of Dundee, with Grampian Television programmes on channel 60 (receiving aerial group C). All these transmissions are horizontally polarised.

The following relay services are now in operation:
West Runton (Norfolk) BBC-1 channel 33 (aerial group A).
Fenham (Newcastle-upon-Tyne) BBC-1 channel 27 (aerial group A).
Bath BBC-1 channel 22 (aerial group A).
Maesteg BBC-Wales channel 22 and BBC-2 channel 28 (aerial group A).
Salisbury Southern Television channel 60 (aerial group C).
Haslingden (Lancashire) Granada channel 23 (aerial group A).
All these transmissions are vertically polarised.

Experimental local cable TV services are to operate in **Sheffield, Swindon, Bristol** and **Wellingborough.** The Minister of Posts and Telecommunications has announced that licences will be granted to British Relay (Sheffield), Rediffusion (Bristol), Wellingborough Traders Television Relay Ltd. (Wellingborough) and Radio Rentals in conjunction with EMI Ltd. (Swindon) to operate these services. These four services complete the selection of experimental local TV operations which are to run until July 1976.

ELECTRONIC TEST CARD DETAILS

The basic design details of the now widely used Philips PM5544 electronic colour test card are shown this month in Fig. 1. This card is now being used by Radio Telefis Eireann (to whom thanks for our information) and has been used for short experimental periods by the BBC and IBA. One advantage of using an electronic card is that the pattern can be generated and inserted at the transmitter, freeing the network lines for other purposes. The card enables rather more tests to be carried out than Test Card F.

The background crosshatch pattern and centre circle provide linearity and geometry checks, the crosshatch pattern also serving as a dynamic convergence check. Within the circle the top black rectangle provides an l.f. response check, the narrow vertical black line on the white background beneath giving a check on reflections which show as images to the right. The 75% amplitude 250kHz squarewave beneath this provides a check on receiver transient response and in conjunction with the EBU colour bars below can be used to check and adjust the colour signal matrixing. The horizontal centre line consisting of two scans, one in each field, serves as a check on interlace (errors show as a difference in width between this line and the crosshatch pattern lines) and with the vertical centre line provides a check on static convergence. Beneath this are definition and grey-scale blocks, then the identification area and at the bottom a centre red area on yellow which shows up any chrominance/luminance signal delay error: the edges of the red area should be in line with the vertical crosshatch pattern lines beneath. The information outside the centre circle to the left and right enables the decoder alignment to be checked and adjusted.

VIDEOPLAYER SYSTEMS

A couple of years ago there appeared to be four competing systems that held out the possibility of videoplayback—in colour—for domestic purposes: the videocassette recorder (VCR) system using mag-

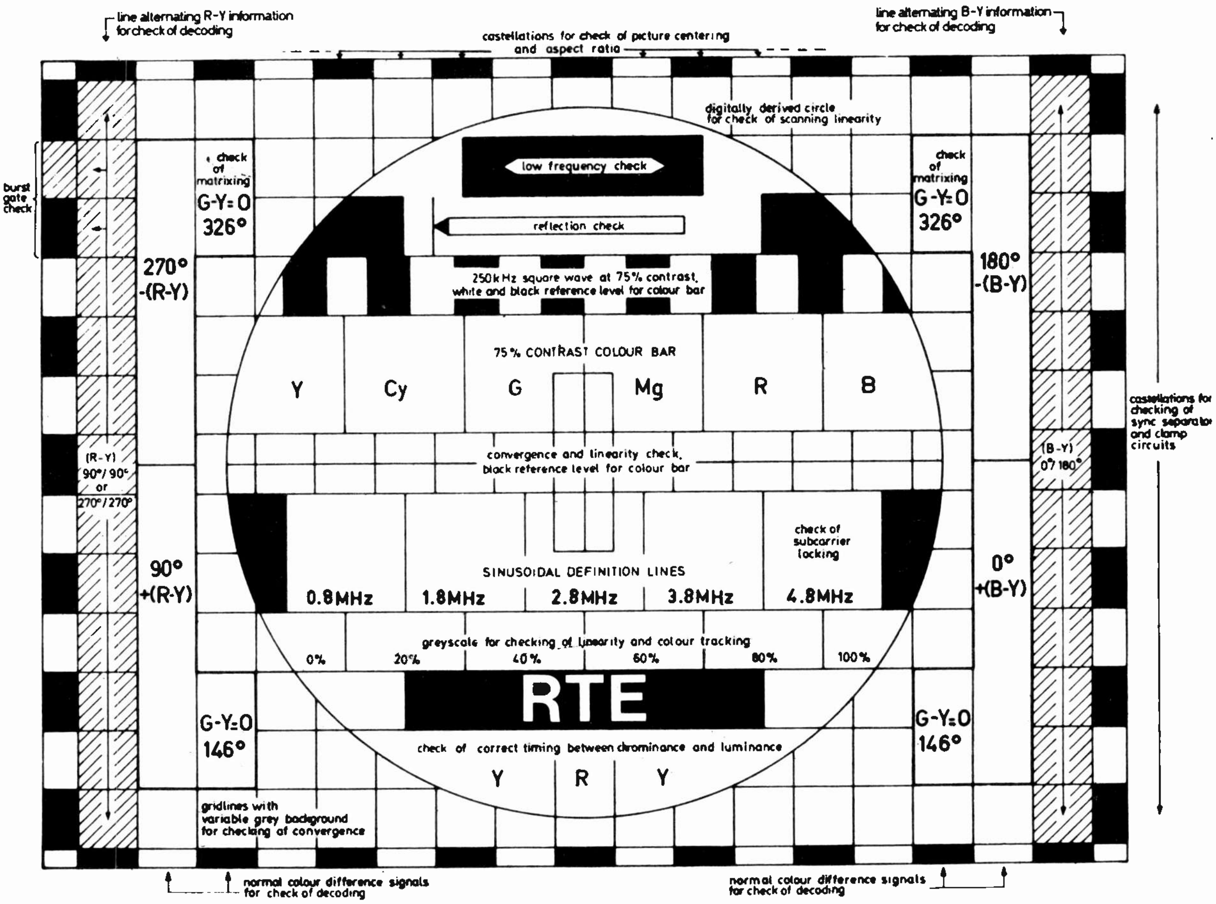


Fig. 1: Design details of the Philips PM5544 colour test card. A photograph was shown on page 418, July.

netic tape and pioneered by Philips, the electronic video recording (EVR) system in which the video signal is stored on film, the Teldec videodisc system developed by Decca and Telefunken and the first RCA Selectavision system in which the video signal is stored as a holographic image on cheap film. The latter system still seems to be very much in the experimental stage with a development period of several years quoted (RCA are also now working on VCR systems) and with the recent news that the programme to produce EVR players at the Plymouth Rank-Bush-Murphy plant has been abandoned the field for the immediate future seems to be left to Teldec and the Philips VCR system. There has not been much news about Teldec recently: the problem is not that of putting video information on to disc and replaying it but of devising a mechanism that will give a reasonable playing time. There is on the other hand a steady trickle of information which suggests that the Philips VCR system is about to establish itself as the standard videorecording technique for domestic and specialist—educational and commercial—use. Thorn announced some time ago that they had taken out an option to produce VCR machines to the Philips standard and the latest news is that they are producing these machines, mainly at present for educational and business use, at the rate of 100-200 a week. With a further recent announcement that GEC is interested in producing VCR machines there seems little doubt as to the way things are going. But now Philips have surprised all by developing a light-spot scanned video disc.

ERRORS : SEPTEMBER ISSUE

There was an error in the crosshatch and dot generator article which was our September issue cover feature: R4 was shown in the circuit and the components list as 56Ω: its correct value is 560Ω. The generator will function with R4 56Ω but on many sets there will be a tendency for field slip in the receiver. The correct value is supplied in the kit from Bi-Pre-Pak but those constructors assembling their own components should check this point. In the Colour Receiver project all presets were specified in the components list as vertical mounting types: as the board photograph showed R349 should be a horizontal mounting type: the correct type is supplied in Component-Pack 10 but those assembling their own components should note this. On the timebase board layout D8 is shown connected the wrong way round. The line output valve screen feed resistor R351 must be a 6W type. Several readers have queried the pin connections of the 2N5492 transistor: they are shown correctly in Figs. 1 and 2 (some data books show the pins viewed from the underside).

large-screen TV TECHNIQUES

I. R. SINCLAIR

FOR addicts of TV techniques one of the highlights of the EXPO 70 display was the demonstration of large-screen projection colour television. This was unusual nowadays in using mechanical scanning, and unique in using gas lasers as the light source (each laser was quoted as giving a *light* wattage of 15W output—compare with the 2mW output of the gas lasers now used for teaching laser optics in technical colleges).

CRT Projection Systems

Projection TV is of course not new and several systems have been used over the years. One of the most popular projection techniques for monochrome displays has been to use a high-intensity c.r.t. in conjunction with a Schmidt optical system. Tubes working at up to 100kV e.h.t. and dissipating several hundred watts at the screen have been built and used for this purpose and are still obtainable. The screen has to be made of heat resisting glass while the remainder of the tube envelope (apart from the base) is made of metal, heavily finned so that a fan can be used to keep the whole tube cool (Fig. 1).

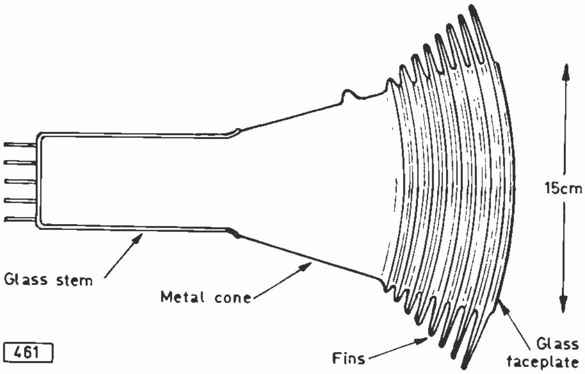


Fig. 1: Cross-section of a typical projection c.r.t.

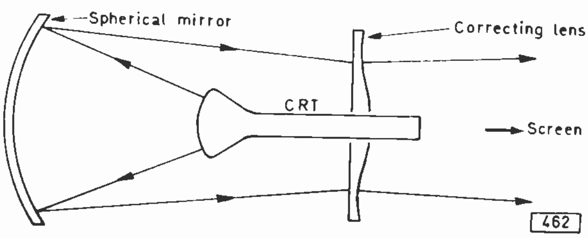


Fig. 2: Basic Schmidt optical system for projection television.

The basic Schmidt optical system for large-screen displays is shown in Fig. 2. The high-intensity tube is mounted coaxially with and facing a spherical mirror which is the main focusing element. The raster is reflcted back from the mirror through a correcting lens which eliminates the distortion introduced by mirror and then passes to the screen. "Spot wobble" —imparting to the beam a high-frequency vertical oscillatory motion—is sometimes employed to increase the brightness and eliminate the line structure of the picture.

Eidophors

A projection system that has been used with considerable success is the Eidophor which was pioneered by Philips. In fact colour Eidophors—see cover photograph for example—are currently available and the main disadvantage is simply that of cost. There have been various types of Eidophor but all have in common the use of an oil film which is distorted so as to alter the brightness of the light either reflected from it or beamed through it.

In modern Eidophors the oil film is scanned in a vacuum by an electron beam which distorts the surface of the film through electrostatic action. The basic arrangement is shown in Fig. 3. Light from the light source is focused on to a mirror-grid system which reflects the light towards a concave mirror on the surface of which is the thin film of oil. This oil film is scanned by the beam from the electron gun. In the absence of an electron beam the light is reflected from the oil film back to the mirror-grid system and does not therefore reach the main lens. As the beam scans the oil film its surface is distorted and in consequence light is deflected and passes through the mirror-grid and the main lens to the screen. The video signal modulates the electron beam to produce a picture on the screen: the greater the distortion of the oil film at a given point the greater the amount of light deflected from that point towards the screen. The colour version uses three electron beams with three separate primary-colour light sources, the outputs being superimposed to give the colour display. The time-constant of the oil film deformation decay has to be carefully controlled: if it is too fast there is loss of brightness and contrast while if it is too slow the image is smeared.

A simplified system is under development by RCA but has not yet reached the stage of being marketed. This employs an extremely thin metal mirror in

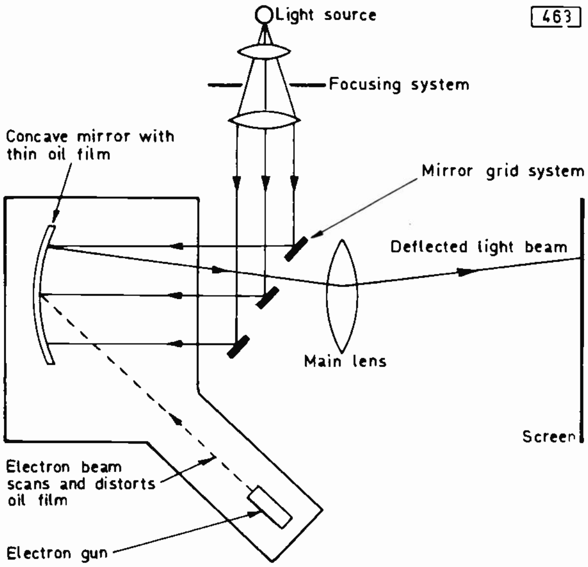


Fig. 3: Principle of the Eidophor in which an oil film is scanned by an electron beam, the resulting disturbance to the surface of the oil film determining the amount of light deflected through the mirror-grid system on to the screen.

place of the oil film but apart from this uses the same basic set-up.

An earlier form of Eidophor used mechanical scanning—with servo techniques to maintain synchronisation—and a unique "light valve" to modulate the beam of light from the light source. The light valve consisted basically of a cell containing water covered with a film of transparent oil. An ultrasonic transducer immersed in the water was driven at a frequency of around 10MHz so that a ripple pattern appeared on the surface of the oil film. The wavelength of this ripple pattern was very short—a few hundredths of a millimeter—and its effect was to alter the amount of light which passed through from the water to the oil. This it did because of *total internal reflection*, an effect which requires some explanation.

Suppose we have a glass block with a light source inside. If the path of a light ray from the source to the surface is traced we find that unless it approaches the surface at exactly right angles it will change direction as it passes from the glass to the air. The change of direction is always such that the ray is deflected towards the glass (Fig. 4) and as there is a law connecting the angles the degree of bending can be predicted. At some particular angle of approach the ray coming from the glass into the air will be deflected so much that it runs along the surface of the glass. The angle at which this happens is called the *critical angle* and its value is a constant for any pair of substances such as glass and air. A ray which approaches the glass-air surface at more than the critical angle will be *reflected* at the surface: this is what is meant by total internal reflection. The result in our ripple system is that some or all of the light passing through the "valve" will be reflected back. If the ripple amplitude is small the amount of light reflected will be small while if the ripple amplitude is large the amount of light reflected

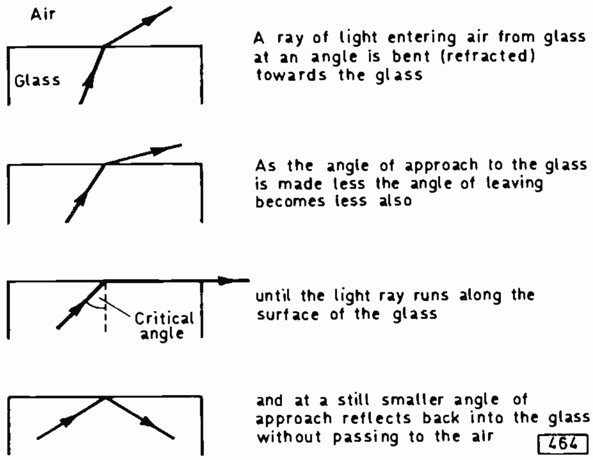


Fig. 4: Total internal reflection.

will be large (Fig. 5). Such a device can be used as a light valve to modulate a beam of light for TV purposes if the ripple frequency is modulated by the video signal.

The practical difficulties are considerable. Fast response can only be obtained if very little movement takes place. Thus the oil film must be very thin. This in turn causes cooling problems, for with several kW of illumination being controlled in this way the oil temperature rises rapidly. Then the scanning has to be delayed relative to the video signal because the ripples move at the speed of sound rather than the speed of light.

Mechanical Projection Problems

We can see then that mechanical projection systems involve numerous problems. The design of an effective monochrome system is difficult enough: adding colour increases the problems considerably. For a mechanical projection system we require three basic items and each introduces its own set of difficulties. First we need a light source. This must be able to provide an intense light beam since it will be focused on to a small spot area which is then scanned over a large area: there are enormous losses in the scanning process while the light which strikes the viewer's eye is only a small amount of that reflected from the screen. The second requirement and problem is the scanning arrangement: mechanical systems such as rotating mirrors are diffi-

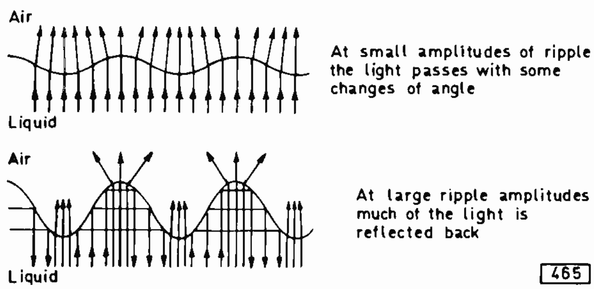


Fig. 5: Effect of ripples on the surface of a liquid when light is passing from the liquid to air.

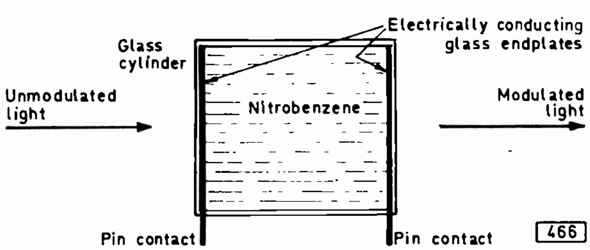


Fig. 6: Principle of the Kerr cell. The end plates are made of glass coated with a transparent conducting material such as stannous chloride so that an electric field can be applied between them.

cult to synchronise, especially if some form of flywheel sync is to be used, since mechanical systems cannot be varied in speed as easily and quickly as an electron beam. The third difficulty is finding a method of modulating the light source with the video signal. For this purpose we can use a material which is normally transparent but which becomes opaque when a voltage or magnetic field is applied to it. The light valve just described is a similar arrangement.

The Kerr Cell

A further device which has been successfully used in the past as a light valve and modulator is the Kerr cell. The principle of this is based on the action of charged substances in an electric field. If we have a rod charged as a dipole, that is with a positive charge at one end and a negative one at the other, it will if free to do so turn so as to line up with an electric field—just as a compass needle lines up with a magnetic field. The molecules of many substances carry a permanent "dipole" charge and when in addition they are of disc shape so that when turned side on to a light beam they will pass most of it while when facing a beam they will prevent it passing then we have the basis of a light valve. This in fact is the principle of the Kerr cell (Fig. 6) which has been extensively used as a "shutter" for high-speed photography. The substance used is nitrobenzine which is normally almost transparent but becomes opaque when a high electric field is applied.

Mechanical Scanning

As far as domestic receivers are concerned mechanical scanning is a dim memory. The technique is still used for large-screen displays however and is now well developed. The great problem of mechanical scanning in the early days was synchronisation. Modern servo techniques have made this less of a worry.

The most successful systems have been based on the mirror drum or the rotating prism. If a ray of light strikes a mirror it is reflected at the same angle but in the opposite sense (Fig. 7). Thus if the mirror is rotated about an axis at right angles to the beam of light the reflected ray will also rotate—at twice the speed of the mirror. If the mirror consists of a four-sided block the beam can be reflected from one side of the block on to a screen at the same side of the block. When the block is rotated the reflected beam scans the screen and with a scanning rate of 15,625Hz we need a block speed of 15,625/4 revolutions per second, nearly a million r.p.m. Such a speed is not impossible (with air turbines) but is not exactly desirable. By using a mirror drum with many more sides or a many-sided prism the rate of rotation can be brought down to the more manageable region of 14,500 r.p.m. which is easily attainable using an electric motor. We have an advantage here over electronic scanning: any sync system we use will literally be a flywheel system!

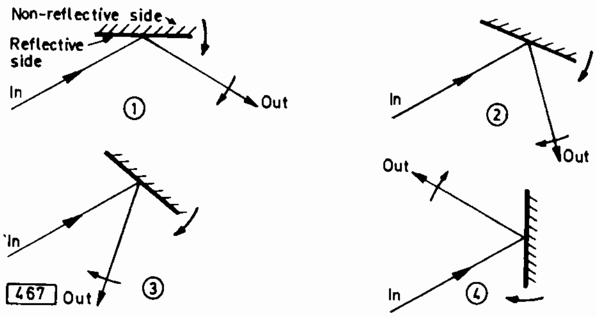


Fig. 7: How a light beam is made to scan by being reflected from a rotating mirror. 1-4 show the effect with the mirror rotating clockwise. As the mirror turns the reflection is turned through twice the angle turned by the mirror. In this illustration the mirror has turned through 90° while the reflection has turned through 180°.

Synchronisation

At the time when rotating-mirror scanning systems were first employed scanning standards of only 30 lines meant that low speeds could be used with synchronisation effected by using synchronous motors for both the transmitter and receiver along with a phase-shift network at the receiver to ensure that the scans started at the same time. These simple methods are inapplicable at modern scanning rates because the mechanical lag due to the inertia of the moving parts is too great compared to the time of one scan. Some other method of synchronisation must therefore be devised. One very successful method is to use a phototransistor to detect the ray of light which forms the start of each scan: the output from this phototransistor consists of a pulse train which is compared with the received sync pulse frequency in a phase discriminator whose output is a voltage proportional to the time difference between the two sets of pulses. This voltage is amplified and used to control the speed of the motor driving the drum (Fig. 8). With thyristors controlling the speed of series-wound motors a large and rapid response is obtained.

Laser Light

The light systems used in the past for large-screen TV displays have employed tungsten filament, Xenon discharge or more recently quartz-iodine lamps at the wattages prevailing. The Osaka display was unique in using gas lasers for the three light sources and the Faraday Effect for modulation. Gas lasers produce light from the passage of electric current through a gas in a similar way to a fluorescent light. Unlike the better known ruby-rod lasers, gas lasers can easily give a continuous (as distinct from a

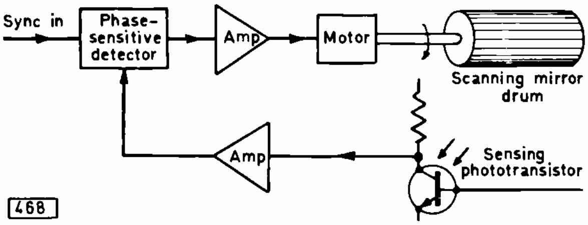


Fig. 8: Servo system for synchronising a scanning mirror drum.

pulsed) output. The principle is as follows:

When a voltage is applied between electrodes in a gas at low pressure charged particles—which are always present because of radioactive bombardment and also because of collisions between fast gas molecules—are accelerated. At normal air pressure such particles cannot easily move to a charged plate as they continually collide with the gas atoms: also as the atoms are comparatively close the charged particles cannot reach a high average speed. At a lower pressure however a charged particle attracted by an oppositely charged plate can accelerate to such a speed that it will break up any atom it hits, forming more charged particles. The result is an avalanche effect with the newly created charged particles accelerating in turn and causing further breaking up until the whole gas consists of charged particles. The gas can then conduct current. It is however the reverse effect—the recombination of oppositely charged particles—that produces a light output when an electric current is passed through a gas at low pressure. Separating the charged particles that make up an atom requires energy and this we supply in the form of a voltage. When particles recombine this energy is given out in the form of light, the colour of the light depending on the amount of energy given out in each recombination while the number of recombinations per second determines the brightness of the light.

The light given out in each recombination is not simply one cycle of wave but a large number of cycles whose amplitude gradually falls off (Fig. 9). The recombining particles behave as high Q oscillators whose output is down to almost a quarter of its original amplitude after some ten million cycles

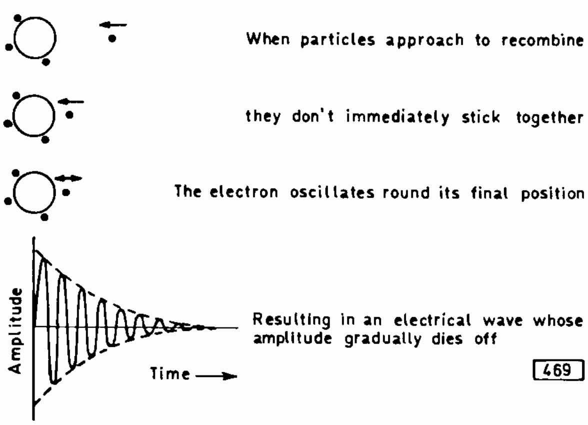


Fig. 9: The light given off when particles recombine consists of an oscillation which gradually dies away.

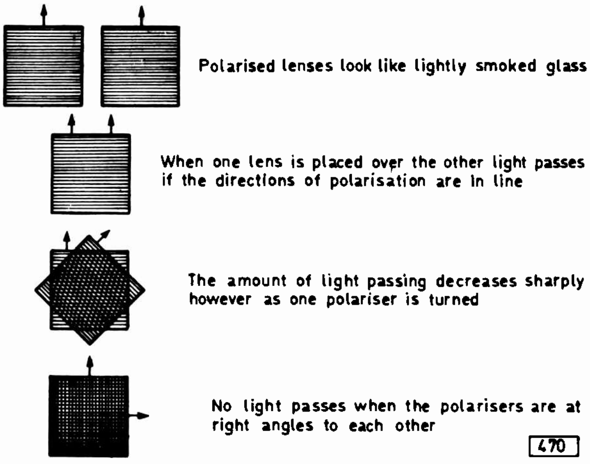
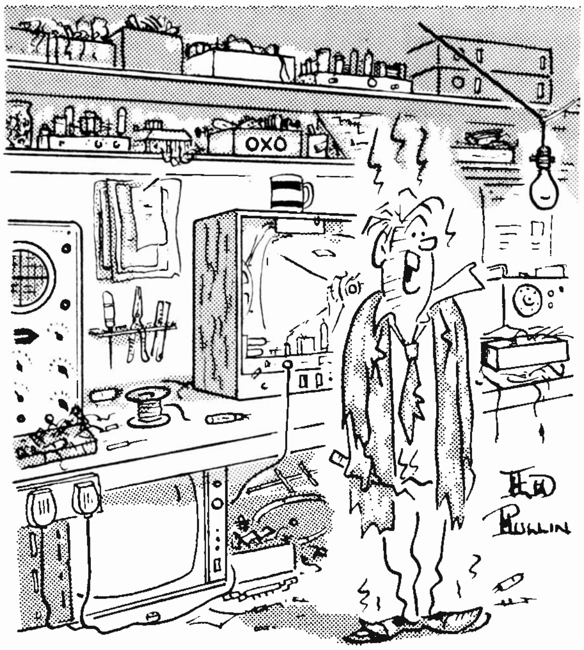


Fig. 10: The effect of polarised glass lenses on light transmission.

of oscillation. This might seem a fair number of oscillations for an r.f. oscillator but as the frequency of a light wave is around 10^{15}Hz ten million cycles is only a very brief nanosecond flash of light. Each recombination causes another flash but there will be no definite phase relationship between the flashes. If however we could persuade each pair of recombining particles to give up its energy in phase with a pulse of light moving at a rate of some 30cm. per nanosecond along the tube then the output would consist of a very large pulse of unusually concentrated light. This is what is meant by laser effect and the way in which this result is obtained is by making the gas discharge tube a resonant cavity for light of the wavelength produced by the recombination action. In a microwave tube this is done by making the cavity a precise number of wavelengths long. The same technique is used for the laser cavity: if the ends of the tube are semireflecting and they are spaced a precise number of light wavelengths apart laser action is achieved—the technology involved implies the ability to set and measure distances to within a fraction of a light wavelength, around a thousandth of a millimetre. With this arrangement a beam of light travels to and fro inside the tube and the pairs of charged particles in giving up energy contribute to the beam in phase. Any oscillations which are not in phase or which cause beams not accurately parallel to the axis of the tube soon die out since they are not kept in phase by reflection at the ends. If one of the ends of the tube is not a perfect reflector but passes about 1% of the light reaching it an output can be taken from the laser. This is a continuous output whose phase changes only comparatively slowly: it is a *coherent* laser beam.

Polarisation

Everyone must at some time have seen polarising sunglasses. When a small piece of the same material is held in front of one lens (see Fig. 10) the amount of light passing through the combination depends on the angle through which one piece is turned compared to the other. This remarkable effect, due to what is called *plane polarisation,* was first observed in 1699 in natural crystals. The polarisation of a



"I traced it chief!"

wave is the direction of its oscillating electric field; the magnetic field is at right angles to this and is of less importance to us. The polarisation of light waves reaching us from the sun is random—unless they have been reflected from a sheet of water which absorbs waves whose electric field is at right angles to the surface. If ordinary light waves are passed through a slit in a metal plate we find that only those waves polarised with their electric field in the direction of the slit pass through. Materials which act as slits for light waves and which select a definite direction of polarisation are available and are called polarising materials.

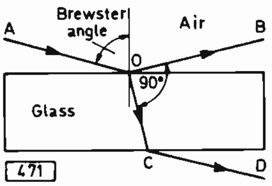


Fig. 11: The Brewster Angle. A ray of light AO striking the glass causes both a reflected beam OB and a refracted beam OC. If these two beams are at 90° to each other both are strongly polarised. The angle at which this happens is called the Brewster Angle.

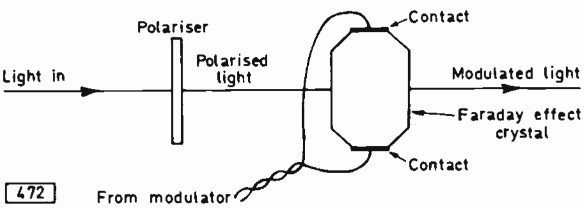


Fig. 12: Modulation using the Faraday Effect.

Light can be quite efficiently polarised by refection from a glass surface without using any such materials if the reflection is at a certain angle (the Brewster angle)—see Fig. 11. When the reflected and the refracted beams at a glass surface are at right angles to each other both are strongly polarised. Thus if we arrange a piece of glass (Brewster Window) outside a laser tube we should expect to obtain strongly polarised laser light.

The Faraday Effect

Polarised light can be of considerable use. Many substances have the ability to twist the plane of polarisation of light and this characteristic has been extensively exploited by chemists as a means of analysis. Far more important for our purpose however is the discovery made by Faraday in the middle of the last century that certain crystals which twist the plane of polarisation of a beam of plane polarised light will alter the angle of twist when a magnetic field is applied to them. It was later found that an electric field was equally effective with some materials. This effect depends on altering the atomic orientation inside the crystal and can be carried out in a very short time, short enough for modulation by a video signal at the highest frequencies used to far.

If we project a beam of polarised light through such a crystal—see Fig. 12—to which we apply modulation to alter the plane of polarisation the result will be a modulated light output. This gives us then another method of modulating a light beam by a video signal.

The Osaka Display

The Osaka display mentioned at the beginning used mechanical scanning, laser light sources and Faraday-effect modulators. Such methods are unlikely to be applied to domestic receivers but it is likely that they will be further developed for large-screen TV displays.

Developments

Work is being done for example on methods of scanning laser beams using solid-state techniques. For several transparent crystals the refractive index, which represents the change of direction of a light ray refracted through the material, changes quite markedly when an electric field is applied. It should be possible therefore to scan a beam by refracting it through such a crystal while applying a sawtooth field to the crystal. There are however several snags. The change of refractive index with voltage is very small so that huge voltages are required; the change is by no means linear so that the waveform for a linear scan is nothing like a sawtooth; and the crystals which seem most promising so far are not very transparent so that a lot of light gets wasted as heat. This provides nevertheless a possible means of breaking away from mechanical scanning and making all-electronic large-screen television without an electron beam a possibility for the first time.

At the present time however the Eidophor and c.r.t. projection systems remain the established methods of high-quality large-screen TV. ■

THE 'TELEVISION' COLOUR RECEIVER PART 8

CONVERGENCE Circuitry

WE take the opportunity this month to complete the description of the scan side of the receiver—principally the line and field dynamic convergence systems and also the e.h.t. and focus circuits which we did not quite reach when describing the timebase module. We are doing this because arrangements are still being made to ensure a sufficient supply of components for the convergence panel: constructional details will follow next month.

The line output transformer used in the project is the Mullard type AT2055 or an equivalent made to the same specifications.

Advantages of Voltage Multiplication

The first generation of UK manufactured colour receivers used a line output transformer which produced a voltage pulse of full amplitude for half-wave rectification and application to the final anode of the picture tube. To obtain adequate e.h.t. stabilisation a shunt regulator valve was connected across the feed to the tube. The size of the e.h.t. overwinding necessary to produce the required 25kV in this way is very large while the capacitance introduced makes it extremely difficult to apply third harmonic tuning. Without precise tuning there would of course be the probability of a ring occurring in the active line time. It is also difficult to control precisely the e.h.t. voltage level given by different samples of transformer with this arrangement.

The very large voltage pulse introduces its own problems. As it exists physically across the transformer the insulation must be substantial—with resultant increase in cost. The pulse is also present across the shunt regulator valve so this too is an extremely expensive component. X-rays will be emitted from the e.h.t. rectifier and shunt regulator so the screening of this circuit must provide the required safety factor. The screening becomes a further problem because with the heat developed by the line output stage—up to 120 watts with this type of circuit—the screening must be arranged for adequate ventilation.

Voltage multiplication reduces the amplitude of the pulse required from the e.h.t. overwinding and in consequence a smaller overwinding can be used. Also there is no X-ray production and less danger of flashover in the transformer area. With a voltage tripler the pulse required is quite small while the components in the tripler itself will be understressed.

With the reduced transformer insulation requirements it would be possible to wind the overwinding directly on top of the transformer and dispense completely with third harmonic tuning—there being no chance of ringing because the leakage inductance between the windings would be extremely small. The regulation necessary for a colour picture tube is however quite high (the maximum permitted voltage on a 25kV picture tube for example is 27.5kV) and this technique would therefore still require the use of some form of voltage regulator. To avoid the need for a regulator fifth harmonic tuning can be employed: this effectively "flattens" the top of the e.h.t. pulse and thus introduces a degree of stabilisation. However in order to create sufficient leakage inductance for tuning, the overwind must be on a separate limb of the transformer. This provides a secondary advantage in that the effects of poor fifth harmonic tuning will apply more to the output from the overwinding than the transformer primary: transformer production spreads can then be quite high without ringing being visible on the raster, further lowering production costs.

Line Output Transformer Circuit

The line output transformer circuit is shown in Fig. 3. The anode of the line output valve feeds pin 8 of the transformer (through 4R) and the overwinding is from pin 11 to pin 12 to which the tripler module is directly connected. The tuning capacitor C601 and boost reservoir capacitor C602 are connected directly across the line output transformer and will be supplied in a later Component-Pack.

The tripler is of the standard form in which the action consists of adding pulse voltages across the circuit capacitors. In order to control the e.h.t. voltage magnitude an additional voltage pulse can be added to or subtracted from the main circuit path. This is applied through R605 the end of which is connected to one of three points on the transformer: connected to tag 3 (chassis) the e.h.t. is unaltered; connected to tag 4 (where there is a +750V pulse) the e.h.t. is *reduced* by that amount; connected to tag 1 (where there is a −750V pulse) the e.h.t. is *increased* by that amount. There is therefore a spread of 1.5kV in e.h.t. available by changing taps and great care must be taken in using them.

Focus Supply

The focus potential is also derived from the tripler circuit. There are several ways in which this can be done. A potential divider can be connected at the first stage of the tripler or at its output—i.e. at about 9 or 25kV—and the circuit of the potential divider can vary. The better position for the divider is at the output point where the focus and e.h.t. voltages track closely together to produce optimum results. This is a costly arrangement however and tapping the first stage of the tripler is an economic compromise.

It is usual to employ a v.d.r. in this position with limiting resistors of several megohms at either side to prevent overvoltage and overcurrent on the v.d.r. and to prevent the focus voltage being accidentally set to either very high or very low proportions. A slider on the v.d.r. rod surface takes off the required focus voltage. Such a v.d.r. is not the cheapest component and it has to be mounted in a special carriage with a variable control. Instead we are using a new product from Erie—a thick-film potentiometer assembly.

V.D.R.s are used in this position more because they provide a suitably constructed potentiometer than because any use is made of their voltage-dependent characteristics. The Erie assembly consists of a potentiometer in a neat package with a control knob and no worries about protecting the user against the live ends of the assembly. A test point is provided for monitoring the focus and e.h.t. potentials although we much prefer for e.h.t. readings to use a special e.h.t. meter (such as the one described on page 368 of the June issue of TELEVISION) or alternatively an adaptor probe with a multimeter. It is important in the latter case that the probe used is designed for the particular multimeter being used. Sources of supply of the electrical components used in the meter featured in the June issue are listed at the end of this article.

Convergence Requirements

We are concerned here with only dynamic convergence and the associated circuitry. The most important requirement is that the deflection coil arrangements are as little affected as possible by the removal from the scan output stages of suitable waveforms for producing the convergence waveforms needed. In addition it is desirable that the linearity, picture shift, width and height adjustments have only a minimal effect on convergence. Whilst it is impossible to achieve the latter perfectly it is nevertheless possible to achieve a condition in which a reasonable amount of adjustment of the scan presets can be made without having to reset the dynamic convergence.

An additional requirement of the scan circuits is to correct for *pincushion* distortion. We will look at this first.

Pincushion Distortion Correction

The design of the deflection coils could be made something of a compromise between the requirements of spot diameter and linear deflection, the deflection coils having—particularly at the edges and corners of the screen—an appreciable effect on spot focusing. Spot quality however is regarded as being of major importance in colour work—much more so than in monochrome—since the overall standard of resolution is already relatively low because of the shadowmask: any compromise in spot quality produces seriously degraded pictures.

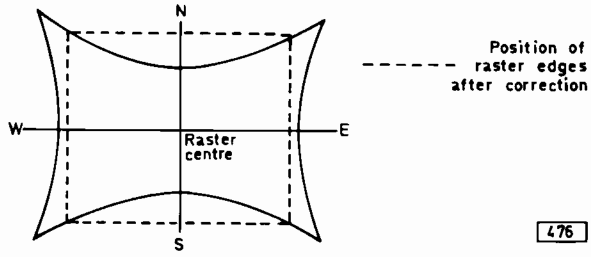


Fig. 1: Shadowmask tube pincushion distortion

Designing the scan coils for optimum spot focusing however produces pincushion distortion. The form this takes is shown—exaggeratedly—in Fig. 1. It is convenient to refer to the error in line terms as E–W distortion and that in the field direction as N–S distortion. With a 90° picture tube the N–S distortion amounts to some 3% of the raster height while the E–W distortion amounts to some 2% of the raster width.

The presence of the metal shadowmask and the external magnetic screening mask makes it impossible to use external magnets to correct these distortions. Thus the waveforms fed to the deflection coils must be predistorted and to avoid interference to the convergence circuitry and picture purity the predistortions must leave the centre of the raster undisturbed: the predistortion at the centre must be zero therefore in both the line and field directions.

To correct the E–W distortion the line scan at the top and bottom of the raster must be *reduced* and this reduction must *decrease* progressively towards the centre E–W line. This calls for the line scanning to be modulated by a parabolic waveform at field rate.

To correct the N–S distortion the field scan at the left and right of the raster could be reduced, this reduction becoming progressively less towards the N–S centre line. Alternatively and more conveniently the height at the N–S centre can be increased, with this increase decreasing progressively to the left and the right of the centre line. For this we require a parabolic waveform at line rate on the field scan.

Transductor Action

Modulation of both scan waveforms simultaneously can be obtained by using a transductor designed for this purpose. The basic arrangement of the transductor is shown in Fig. 2. The ferrite core is shaped to produce the correct magnetic effects. The field scan waveform passes through winding A (in fact for correct magnitude this consists of two windings in parallel) while windings B and C are in parallel with the line scan coils. These last two windings are connected in series opposition.

The field scan waveform sets up a flux in the core from the centre limb of the transductor as indicated. By itself this flux has no effect because any voltage induced in winding B is cancelled by that induced in winding C. The line scan waveforms passed through windings B and C produce a flux that is circulatory around the outer limb. Whenever there is some flux in the centre limb—i.e. whenever the field scan is not at zero deflection—the two sets of flux interact.

With the polarities shown the fluxes in the left-hand limb will tend to cancel while those in the right-hand limb will tend to add: the proportion of addition or subtraction depends on the point during the field and line scans at any instant.

On the side of flux addition the limb tends to go into saturation. This reduces the impedance of the saturated winding and hence of course the total shunt impedance across the line deflection coils. Thus more of the line scan current is routed away from the scan coils. On the opposite sense of the field scan the other limb will be saturated instead and there will be a similar loading across the line scan coils producing as in the former case—and maximised at the beginning and end of the field scan—a reduction in the line scan. The field waveform applied to the centre limb is basically a sawtooth, so the change in the line scanning does not automatically follow the required parabolic law. In fact the law of permeability of the ferrite chosen and the shape and volume of the core dictate the parabolic law required. All this is of course the E–W correction.

As well as this effect of the field on the line scan, the saturation of one limb means that inductive action cannot occur there. The other, non-saturated limb is still inductively active however and induction takes place there between the line and field circuits. The capacitor C408 across the field windings integrates the line information as it appears in the field circuit so that it is of suitable parabolic form for N–S correction. Note that the degree of induction increases as the other limb becomes more saturated —i.e. at the extremes of the field scan.

Because line scan current is shunted from the line deflection coils instead of being routed in series with them the N–S pincushion correction amplitude achieved in this way is insufficient. It is increased by peaking, using the high-Q resonant circuit formed by the integrating capacitor C408 and the inductor L408. This inductor is called N–S phase because small changes off the resonant frequency created by alteration of its setting shift the position or the phase of the correction on the raster. It is set so that both sides of the raster are affected equally and this can be quite critical. For this reason the coil must be mounted in a position relatively unaffected by extraneous magnetic fields. The resonant circuit's effect on the line modulation amplitude will be determined by the Q of the tuned circuit: as this is always too high the circuit is damped by the variable resistor R423 which is given the title N–S amplitude.

Line Scan Circuit

The perfect waveform for deriving the line convergence waveforms is the line scan current itself and the best way of using this is to connect the dynamic line convergence circuit in series with the scan coils. As can be seen from Fig. 3 the line scan waveform is taken from tag 4 on the line output transformer; the return path is through the complete set of line convergence coils down to earth. Affecting the current passing through the coils are the blue lateral and blue lateral amplitude coils while the rest of the dynamic line convergence circuitry shunts various parts of the line convergence coils to give the required correction effects. Any change in the basic line deflection—such as width—immediately affects all the convergence waveforms

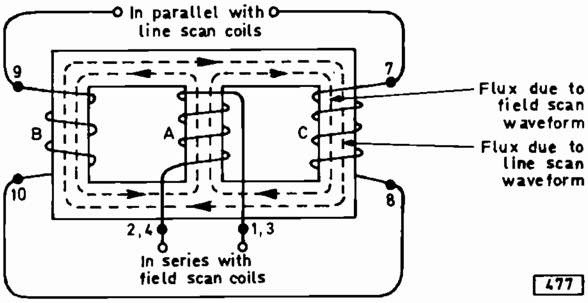


Fig. 2: Basic arrangement of the pincushion distortion correction transductor.

in a similar way so the tracking between the scan presets and the convergence is fairly good.

Note that the "bottom end" of the deflection coil winding on the line output transformer is the winding from 4 to 3. The "centre section" (1-2) is isolated from this so that the deflection coils are balanced about earth. This is always done to prevent unnecessary electrostatic effects around the tube neck. There is also no danger of the convergence components being raised to some hundreds of volts above chassis when they are connected to the earthy side of winding 1-2.

The d.c. necessary to give variation of line position—i.e. line shift—has already been described (see September): it is fed via L401 to the "top end" of the line deflection coils. L401 prevents line-frequency signals passing back to the d.c. shift potentiometer and is generally known as the centring choke. The return path for the d.c. is through 4-3 on the line output transformer. The d.c. is not directly prevented from flowing through the transductor but the impedance of this circuit path is made higher than the correct path by including R422. The d.c. cannot flow into the convergence circuitry because of C404.

Linearity Correction

This latter component is also the S-correction capacitor and in a colour receiver the type of component used in this position must be very carefully chosen. The value of 0·68μF is for 22in. (56cm.) tubes and while it should in theory be changed for other tube sizes we have found that in practice the range of pincushion and convergence adjustment available make this unnecessary.

In series with the S-correction capacitor is the line linearity coil L403: this is of the movable magnet type and provides a fair range of adjustment. Its affects are partly damped by the shunt resistor R413.

Line Coil Balance

Between the two halves of the line deflection coils and effectively in series with each is the centre-tapped inductor L402. This affects the balance of current flowing through the two halves of the scan coils so that the symmetry is altered. This does not affect the blue beam because of the centre position of the blue gun in the vertical plane. It is thus labelled R-G line symmetry. As neither the red nor the green gun lies on the horizontal centre line its effect will not be to give a true "see-saw" but will instead tend to be parabolic along the centre line. The control is of most use at the corners of the raster.

Blue Lateral Correction

The blue lateral coil L404 is in series with the scan waveform. The necessity for dynamic blue lateral correction will depend considerably on the tolerances of the tube, the radial convergence coils and the deflection coils. With some unfortunate combinations a large degree of correction in either phase may be necessary. To provide for this the balance of the coil itself is alterable and the phase can be changed by reversing plugs P401 and P402 into the opposite pair of sockets. The amount of current flowing through the blue lateral coil is controlled by the shunt coil L405 (blue lateral amplitude). A change in the correction can be made by changing the tap on the coil, using P403. This shunt component is made inductive because it is still effectively part of the line scan waveform series path.

Radial Line Convergence

The amplitude of the current flowing through the blue radial coil (the uppermost radial line convergence coil in Fig. 3) is altered by the shunt resistive path R414 and R415. R414 limits the minimum resistance that can be placed across the coil. For true blue radial adjustment however the current should be parabolic and this is achieved by the additional path across the amplitude control circuit: some integration is provided by C406 but additional treatment is needed because the waveform would otherwise be closer to a pure sinusoid. The additional treatment is the creation and addition of some second harmonic content which is produced by the resonant circuit C405 and L406. The latter is variable so that the precise shaping needed can be set up. The amount of current allowed to flow through this additional shaping circuit is controlled by R421 which is therefore called the blue line tilt control.

The red/green convergence is altered in total by the amount of current that flows through both sets of radial convergence coils by alteration of R418 (therefore called R-G line amplitude). Again a limiting resistor (R419) is included in series. Only partial integration is needed with C407 to produce the correct sawtooth correction waveform through the radial coils. Additional integration can be provided by L407 if this is needed and the necessary balance is set by R420 (R-G line tilt) which makes L407 either a series or parallel component to the radial coils. The balance between the red and green sections of the radial coils is simply set by the R-G line difference control R416.

Changes in red/green dynamic convergence tend to change the static convergence at the centre of the screen. It would be extremely tiresome to have to readjust the static convergence after each small dynamic convergence change and to prevent this the voltage across the pairs of coils is d.c. restored by D401. It has become conventional in these circuits to use an AC128 transistor as the diode with its base and emitter strapped together. The time-constant of the d.c. restoration is fixed by the series resistor R417 and the value of 8.2Ω gives minimum static convergence movement with a complete swing of the dynamic convergence controls.

Field Dynamic Convergence Circuitry

In addition to N-S pincushion correction we must also provide a field shift control using a d.c. source and field convergence adjustments.

An R-G field symmetry control (similar to that in the line circuit) is connected between the field deflection coils. The d.c. shift potential is added at this point, tapped from the potential divider chain R424, R425 and R426. The d.c. path is through the transductor/R423, then the field deflection coils to the centre point between the two field output transistors: as this point is nominally at HT/2, i.e. 20V, small alterations of the field shift control around its centre point provide positive or negative voltage differences across the field deflection coils.

The feed to the field convergence circuitry is through C409. This is of large value to allow the passage of the 50Hz components whilst still acting as a d.c. block. The scanning waveform therefore appears across R430 and R431. A proportion is tapped off for the R-G circuit, while C410 acts as integrator to produce a parabolic waveform in the path via R433. The proportions of the two convergence waveforms—sawtooth and parabola—are mixed by the R-G field tilt control R434 and fed through the red and green coils. An additional balance potentiometer called the R-G field difference control (R432) is provided to vary the proportions through the red/green coils.

The field blue convergence coils need a mixture of sawtooth and a differential component: the latter is obtained by differentiation, using C411. The proportions of the two waveforms are mixed by R429 (blue field tilt). The amount of combined waveform fed through the blue convergence coils is then adjusted by the blue field amplitude control R428. It is possible for the differential component to be either larger or smaller than the sawtooth component used and the polarity of the voltage across C411 may reverse with movement of R429: C411 must therefore be a reversible electrolytic.

Diode D402 (again an AC128 with its emitter and base strapped together) d.c. restores the R-G convergence movements.

Component Suppliers

Component suppliers for the e.h.t. meter described in the June issue:

3 off 180MΩ Welwyn 2% type F44TU (updated version of F44F) resistors, £4.90 including postage, from East Cornwall Components, PO Box 4, Saltash, Cornwall, PL12 4AL.

1 off 0-50μA panel meter (SEW type MR38P), £2.23 including postage, from A. Marshall & Son Ltd., 28 Cricklewood Broadway, London NW2.

A number of readers have enquired about the tuner unit: the Mullard ELC1043 varicap tuner unit available from Manor Supplies (172 West End Lane, London NW6) is the recommended tuner for normal u.h.f. installations in the UK.

Corrections: See page 7.

NEXT MONTH: CONVERGENCE BOARD CONSTRUCTION

The value of C404 should be 0·68μF not 0·47μF.

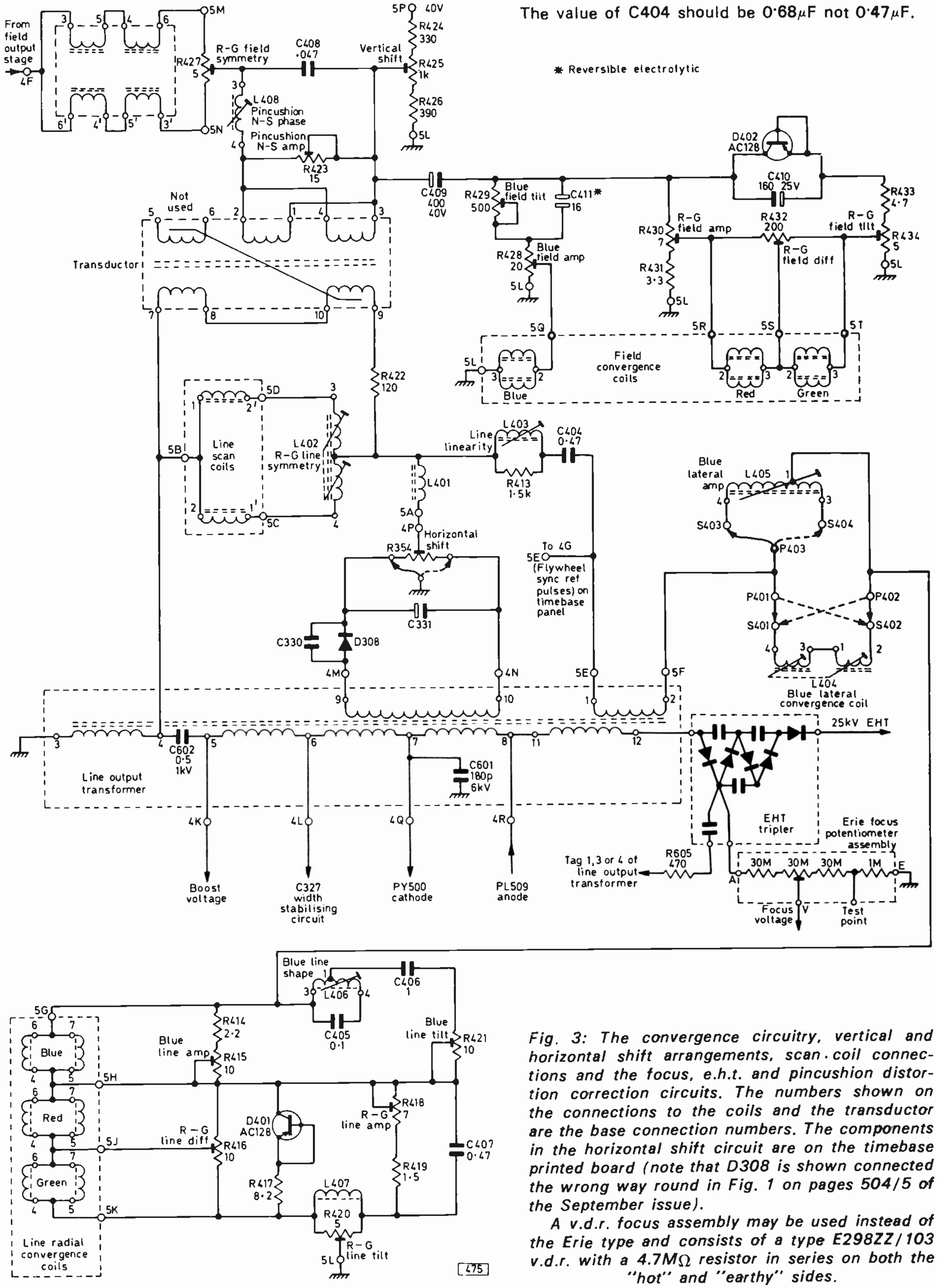


Fig. 3: The convergence circuitry, vertical and horizontal shift arrangements, scan-coil connections and the focus, e.h.t. and pincushion distortion correction circuits. The numbers shown on the connections to the coils and the transductor are the base connection numbers. The components in the horizontal shift circuit are on the timebase printed board (note that D308 is shown connected the wrong way round in Fig. 1 on pages 504/5 of the September issue).

A v.d.r. focus assembly may be used instead of the Erie type and consists of a type E298ZZ/103 v.d.r. with a 4.7MΩ resistor in series on both the "hot" and "earthy" sides.

SERVICING television receivers

L. LAWRY-JOHNS

BUSH TV141, TV148 SERIES—cont.

Whenever one of these sets comes in for service always check the fitting of the line linearity coil 3L7. This tends to break away from its print on the panel and the resultant arcing can cause untold damage to the whole panel. Resolder the base, pushing the coil well in so that the rather short pegs get a good purchase into the print. Check the condition of the 4·7kΩ shunt resistor 3R28 and replace if necessary.

Further up on the right-hand side sits the block of three diodes 3MR1/2/3. These are not reliable and can cause all sorts of trouble from a complete cessation of line timebase working to unreliable line and field locking. Fitting three separate diodes (type BA144 or similar, for example) doesn't take long and is well worthwhile. The polarity is marked on the block to be removed or can be sorted out from the circuit.

Some receivers are fitted with a PL504 in place of the PL36 and a DY802 in place of the DY87.

The Field Timebase

Field timebase faults experienced will include total loss of field scan (showing only a white line across the screen), incorrect locking, poor linearity (mainly at the bottom), and lack of height. Whilst the PCL85 (PCL805) is often responsible for any of these faults there are many occasions when it is not.

Capacitor 3C52 may be found on the panel or slung under the field output transformer. It often shorts producing the symptom of no field scan (white line). The replacement shoud be rated at 1·5kV or at a minimum 1kV.

Where this capacitor and the PCL85 are not at fault it will often be found that a crack in one of the printed board tracks is causing the trouble.

It is difficult to say where the crack or cracks will be but most often they occur at the valve base or at the controls. The use of a voltmeter will quickly show where the voltages are and where they are not. For example a high voltage may be found at 3R39 but not at pin 1 of the valve base, or at pin 8 but not at 3R47. Alternatively with the set off an ohmmeter can be used to test the continuity of the tracks. The golden rule of all servicing should however be followed: first get the voltages right and nearly all else will follow as night follows day.

A component which is often overlooked is the screen feed resistor 3R69. This can change value or become variable, causing poor linearity and varying hold. Poor linearity, bottom compression and similar faults should however direct attention to the PCL85 and to 3C35 (500μF) which regularly goes open-circuit. Also check the value of 3R47 which is often damaged by a faulty PCL85. The value of this resistor has a profound effect on the linearity of the picture: generally speaking bottom compression is the result when it falls in value while top compression is the result when it goes high-resistance.

Poor interlace should direct attention to 3MR3

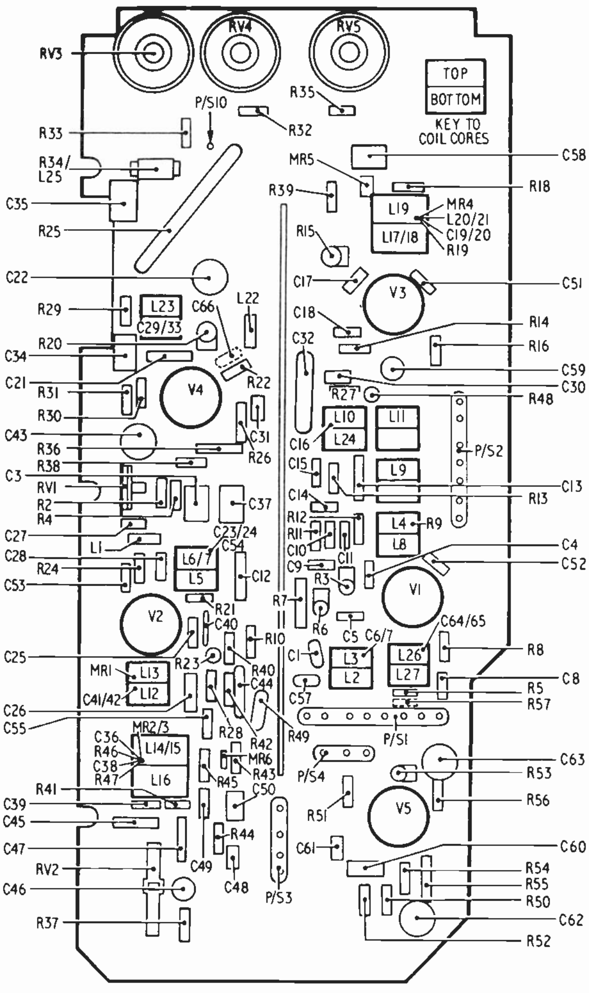


Fig. 4: I.F. unit component layout.

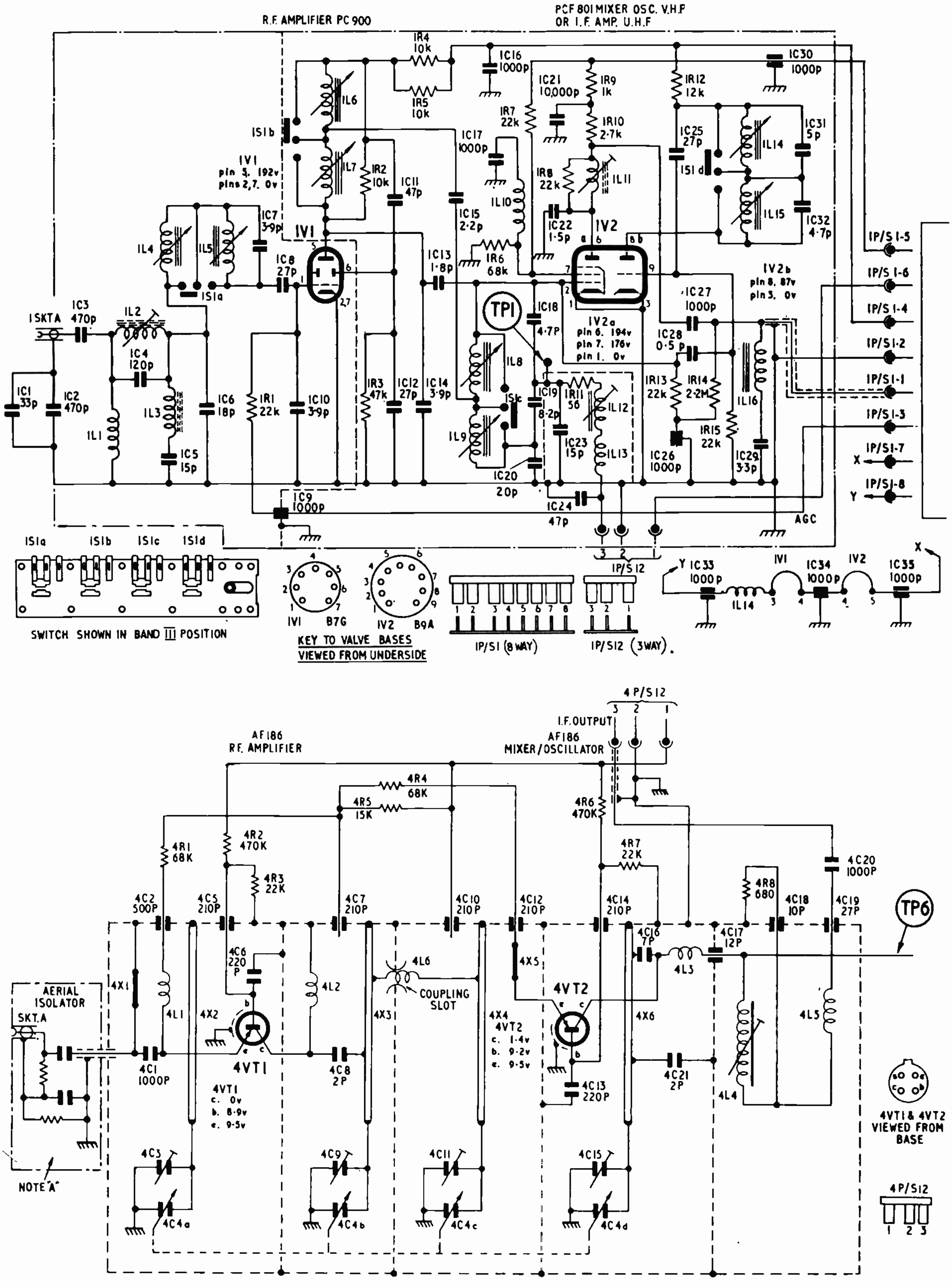


Fig. 5. Circuits of the v.h.f. tuner unit (top) and u.h.f. tuner unit (bottom).

and in stubborn cases an improvement may be obtained by changing 3R65 from 2.2MΩ to 220kΩ as in the later TV161U series.

The Video Stage

The video valve is a PFL200. This can give rise to many and varied fault symptoms ranging from poor or no sync (half the valve is used as the sync separator) to weak contrast, waving picture, excessive brightness or no picture at all.

Having said this however we must point out that defects due to a faulty PFL200 are much less common than they used to be: in other words the valve nowadays is more reliable. We find in fact that the electrolytic capacitors associated with the valve are more likely to give trouble than the valve itself.

The symptom of no sync (picture lock both vertically and horizontally being unobtainable) must first direct attention to the heater circuit diode (supply rectifier) 3SR2. As mentioned earlier this rectifier is likely to short thus causing excess heater current. To call attention to this state of affairs the screen grid (pin 3) of the sync separator section of the PFL200 is fed from the heater line (P/S2-6, point B on the circuit). Thus if the rectifier shorts the line becomes a.c. and the screen grid feed is no longer present as 2C43 conducts. Sudden loss of sync must therefore be looked upon as a possible power supply fault and the set should not be run until the diode has been checked. In passing it is amazing how many people are prepared to let the set run with this fault present "just to hear the rest of the programme".

If the diode is behaving itself and the heater current is normal lack of sync can well be due to 2C43 being open-circuit (or shorted) or the PFL200 being defective. Poor sync on 625 lines only can be due to the video section and again the valve and small electrolytics should be checked. A kinky picture on 625 only can also be due to a faulty electrolytic (2C22) or to excessive contrast. Also check 2MR5 for this fault.

If the brilliance control still operates excessive brilliance may be due to the PFL200 or to an associated component. The possibility of a faulty tube must also be considered. When the brilliance control has no effect however it will often be found that the control itself is at fault. This 250kΩ control is wired from h.t. to chassis with the slider taken to the cathode circuit of the tube. As the control usually goes open-circuit at the h.t. end the tube cathode is left at chassis potential and the symptom of maximum brightness results. If on the other hand the control goes open-circuit at the chassis end the result is no illumination on the screen at all. Once again, take your voltage readings first!

The IF Stages

A definite trouble spot in the i.f. strip is 2R15 the 3·3kΩ anode feed resistor of the EF184 (2V3) vision i.f. amplifier. It can change value on its own account or be damaged by a short, which is a common occurrence, in the EF184. If the valve has shorted it is necessary to check 2R15 as this could be left in circuit to cause trouble at a later date. 2V3 can also cause trouble by losing emission. When this happens the lack of gain in this stage causes a reduction in a.g.c. with the result of overloading in the early stages. The symptoms are persistent vision buzz on sound and sound interference with the picture. The same symptoms can result from a leak in the EF183 (2V1) cancelling out the a.g.c.

To sum up fault-finding on the i.f. strip: Check the valves first, then the resistors and decoupling capacitors. Check for poor connections and then check the smaller electrolytic capacitors. Always check the panel for cracks.

The sound output stage doesn't give a lot of trouble—mainly the PCL82 itself will be found at fault. This of course means that when the valve is replaced its bias resistors 2R54 and 2R55 must be checked.

The other weak links must include the multi plug and socket connectors: there is a tendency for the insulation of the strips to break down, mainly on the right-hand side. A degree of burning is sometimes caused by this type of breakdown with consequent damage to the surrounding circuit.

Hum on sound should direct attention to the HT3 smoothing electrolytic 3C44.

The Tuner Units

The v.h.f. tuner is of the conventional Bush type with sliding contacts which require cleaning from time to time and a plastic tuning wand with metal sleeves which seems to break so easily inside the coils. A new wand can be fitted or a small coil spring such as is found in a retractable ballpoint pen may be pushed inside to keep the wand in the correct position. Secure the end of the spring with a short piece of braiding soldered across the opening. This tip was passed on to us by a reader some time ago and has proved most effective.

The first point we must make about the u.h.f. tuner is a caution. For heaven's sake don't be tempted to spray the inside with cleaning fluid. The effect of this on the closely spaced tuning vanes is to virtually short them across.

As usual the first stage transistor (AF186) is the one which is most often responsible for a weak and grainy picture: replacement requires a good deal of care.

SAFETY

The recent case of a child electrocuted by holding simultaneously the metal leg of a TV receiver and a metal pipe attached to an adjoining wall emphasises the need to ensure that TV set installations are electrically safe. In particular wood screws should not be driven into the cabinet unless the setmaker has made provision for this and even then care is necessary not to use oversize screws which could come into contact with the set's internal chassis/metalwork: the leg of the set in the case quoted was live because a screw holding a leg fixing bracket was touching the chassis inside. BREMA comment that it is a useful safety precaution each time a set is installed or serviced to check that there is no electrical continuity between any exposed metalwork and either of the mains plug connector pins when the set is switched on.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

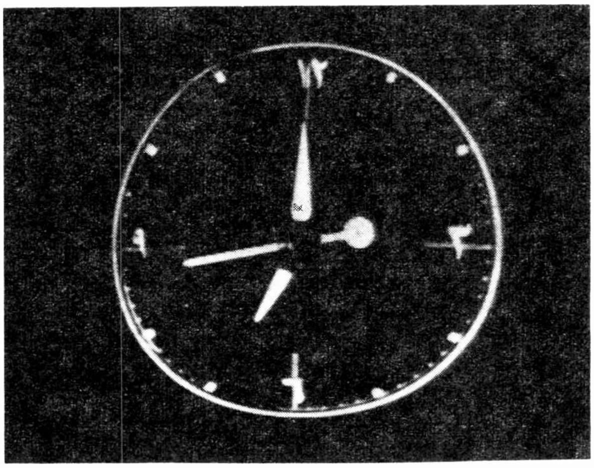
AUGUST brought about a decline in Sporadic E propagation though this was only to be expected. To compensate this time there has been a considerable increase in reception via Tropospherics—caused by very slow-moving high-pressure weather systems over the UK for much of the month. News is beginning to trickle in about Auroral activity as well. There was a large Aurora on June 17th—which I missed—and apparently further activity towards the end of July/early August. Unfortunately I was at the time dismantling/packing aerials prior to moving and missed out for a second time! No reports have come in so far of television reception via this or the earlier Aurora—should they do so however we will mention them. My own log for the period is:

1/8/72 RUV (Iceland) E4; various unidentified signals via SpE; DFF (East Germany) E4.
2/8/72 Unidentified signals via SpE.
3/8/72 MT (Hungary) R1, R2; ORF (Austria) E2a—all SpE.
6/8/72 TSS (USSR) R1—SpE; BRT (Belgium) E2—trops.
7/8/72 TSS R1—SpE.
9/8/72 SR (Sweden) E2; RTP (Portugal) E2; also unidentified signals—all SpE.
10/8/72 CST (Czechoslovakia) R1—SpE.
11/8/72 BRT E2—trops.
12/8/72 RAI (Italy) IB; NRK (Norway) E4; ORF E2a; TSS R1; plus unidentified signals—all SpE.
13/8/72 TVE (Spain) E2; SR E2; MT R2; also unidentified signals—all SpE.
14/8/72 SR E2—SpE.
15/8/72 RAI IA—SpE.
17/8/72 MT R2; ORF E2a; JRT (Yugoslavia) E4; WG (West Germany) E2; SR E2; RAI IA. IB; also unidentified signals—all SpE.
19/8/72 DFF E4—MS (Meteor Shower); BRT E2—trops.
21/8/72 DFF E4—MS.
22/8/72 BRT E2; NOS (Holland) E4—both trops; also unidentified programmes E2, 3, 4 via SpE.
24/8/72 CST R1—MS.
26/8/72 DFF E4; CST R1—both MS; BRT E2.
27/8/72 WG E2; ORF E2a—both MS; BRT E2—trops.
28/8/72 ORF E2a; SR E2; Switzerland E4; TSS R2—all SpE; BRT E2—trops.

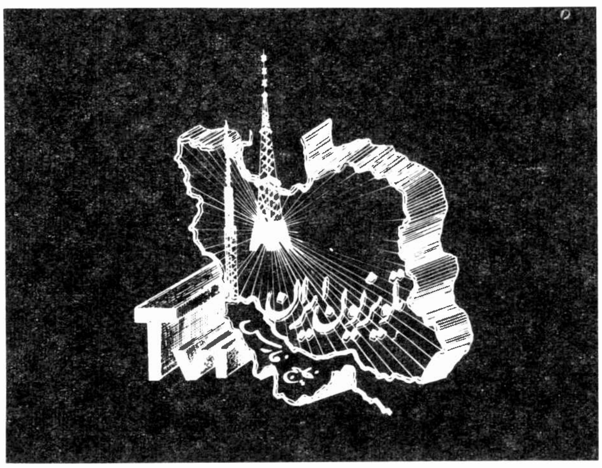
As already mentioned I have been rather preoccupied recently with a change of location. For this reason I have since August 6th been active with only the wideband Band I dipole recently featured in these pages but from results as noted above it seems to work quite well. I have of course missed out on the improved Tropospherics which have enhanced signal reception at Band III and u.h.f. across much of central Europe. West German u.h.f. has been noted as far inland as Derby (ch. E29 on August 12th). We have too a report from a Dutch reader that improved trops have brought in for him West Germany. East Germany, France and England. The letter dated August 14th states that the BBC and W. German transmitters were coming in "bright and clear for most days of the week".

We have previously noted that Swiss TV is radiating the old type test card carrying the letter G identification from the La Dôle (French Network) ch.E4 transmitter. A photograph just arrived from the Europese Testbeeldjagers shows the SWF type card from this transmitter with the La Dôle identification: this shot is unique since the card was only seen on one day—on other days the alternative version has always been transmitted.

Recent changes in EBU listings include the return of the ch.E3 Port Said transmitter though whether this is actually in operation is still not certain. A letter from George Sharples in Malta mentions that on June 11th with his aerial beamed 100° East he received on ch.E3 a news programme carrying the identification NSH and underneath USIS: the identification was in the upper left-hand corner of the screen with a male news reader central. As the signal was via Tropospherics it could very well be from Egypt. In passing Jordan was noted using the Philips electronic card type PM5540 (Data Panel No. 3)—this is only one step removed from the rather too familiar PM5544!—and Turkish TV (TRT) was noted on ch.E5 carrying the EBU bar with the identification TRT. The transmitter was likely to be Istanbul (100kW) since the Ankara transmitter is given as only 5kW e.r.p. Even so the Istanbul-Malta path is some 860

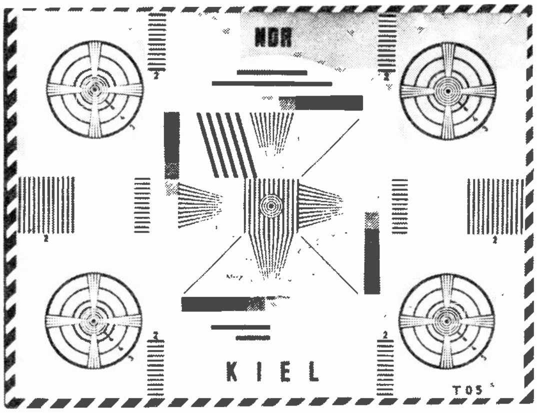


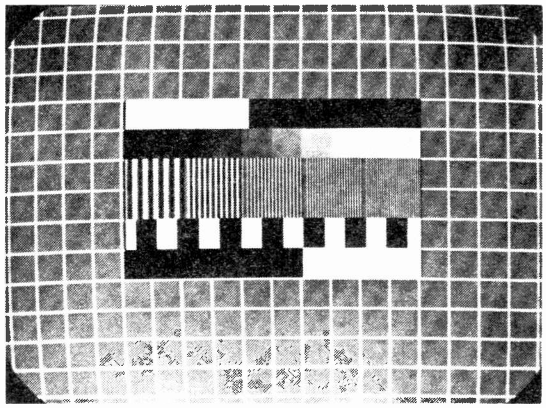
Clock used by Libyan TV.



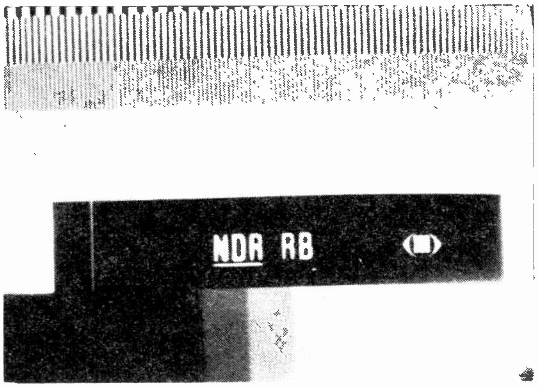
Iranian TV1 Network station identification.

DATA PANEL 16—2nd series **WEST GERMANY—2**

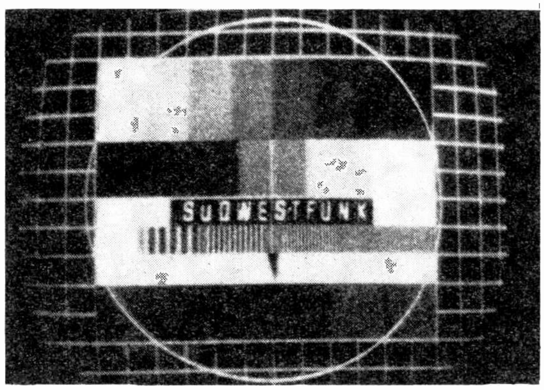




Test cards used by NDR (Norddeutscher Rundfunk): 1st chain left, 3rd chain right.



Modified EBU pattern used by the NDR 3rd chain and Radio Bremen.



The SWF (Sudwestfunk) 1st and 3rd chain test card.

Photographs this month courtesy Europese Testbeeldjagers and Peter van der Kramer.

miles—much of it across sea—quite nice reception!

Keith Hamer (Derby) has commented on the recent confusion between BRT/RTB (Belgium) and Yugoslavia: his successful identifications of news programmes —JRT Zagreb have a news programme *RTB TV Vesti* while the RTV Ljubljana news programme is called *TV Obzornik*—should help with this problem. Drifting to the East, to Hungary, the RETMA card has been noted on occasions carrying the identification MT in the upper portion: this is indeed encouraging since there is some confusion over the card which TVP (Poland) also use. Up to now we have usually noted the MT version with small white figures and the TVP with black. I am keeping a much closer lookout for this reported variation!

A recent report suggested the possibility of a Rumanian second network and a letter just in mentions that ch.R2 has been received with an identification slide Televiziunea Romana. Between the two words (displaced vertically) was a large figure 2, lines radiating from this giving the appearance of a star.

Our Italian contact Michele Dolci has kindly sent a number of photographs from which we have selected two for inclusion this month. A clock as used by Libyan TV commences our series of clocks in a somewhat exotic manner. Another "exotic" illustrates the striking and distinctive identification slide of the Iranian TV1 network—there are two Band I transmitters in operation, Tehran 4kW and Abadan 10kW, both on ch.E3. Iran has been received in Cyprus via Sporadic E but there have been no reports of its reception in the UK lately!

Reception via Aurora

Although it may seem that we are closing the stable door after the horse has bolted it nevertheless seems appropriate that the mechanism of Aurora should be discussed—in preparation for the next event! An Aurora is most likely to occur during periods of high solar activity when there is every likelihood of a large Solar flare. When such an eruption occurs charged particles from the flare spiral towards the Earth arriving about a day later. These particles are affected by the various radiation belts surrounding the Earth and activity is concentrated around the Earth's magnetic poles, resulting in an Aurora which disrupts short-wave communications (due to Ionospheric/magnetic storms in the D, E and F layers) and produces various visual effects in the sky towards the North—aptly called the Northern Lights.

The Aurora produces a reflecting sheet which tends to lie in a vertical plane. The result of this is signal reflection at v.h.f. Since the reflecting sheet lies to the North it follows that reflected signals will arrive from that general direction though the signals received may originate from transmitters to the East or West of the receiving site since the signal when leaving the transmitter travels North, is reflected and then returns South. If the Solar flare is extremely large it may persist for some 27 days resulting in a second Aurora when the Sun has rotated. There is a tendency for Auroras to occur in April or October (the Equinoxes) when the Sun's North or South pole tilts towards the Earth. Signals propagated by Aurora have a characteristic hum effect which makes vision reception difficult. Often two phases occur in an Aurora, one in the afternoon and a later one during the evening/night time period. Frequencies up to 200MHz can be affected by Auroral reflection.

West German Television

Continuing our coverage of the West German television system we will detail this month the various companies, locations of main studios and other items of interest.

Norddeutscher Rundfunk—NDR: The 1st Network uses the Telefunken card and the 3rd Network the ZDF/SWF card without the white circle. The main studio centre is at Hamburg. All NDR-3 transmitters radiate a station identification at each half hour—usually the coat of arms from the town/village where the transmitter is located. The NDR, Radio Bremen and Sender Freies Berlin produce a common 3rd programme—NDR-3.

West Deutscher Rundfunk—WDR: The 1st Network uses the Telefunken card with a colour bar superimposed across the lower half (this may be omitted). The identification WDR appears upper centre and the first letter of the transmitter name at the centre bottom. These are as follows: KL Kleve; L Landenberg; TW Teutoburger Wald; KN Köln; M Munster; N Nordhelle; A Aachen. The 3rd Network has now largely discontinued the "old electronic card" (with the circular central portion as with RUV Iceland), using the card shown last month instead. The main studio centre is at Köln. WDR-3 transmitters usually radiate an identification slide on each half hour.

Sudwestfunk—SWF: Naturally the SWF type card is used but the identification contained within often changes—lately SWF Badn 1 for the 1st Network. The 3rd Network also uses this card but the inscriptions differ at times—lately SWF Badn 3. The main studio centre is at Baden-Baden. The 3rd Network has a common programme produced by Sudwestfunk, Suddeutscher Rundfunk and Saarlandischer Rundfunk.

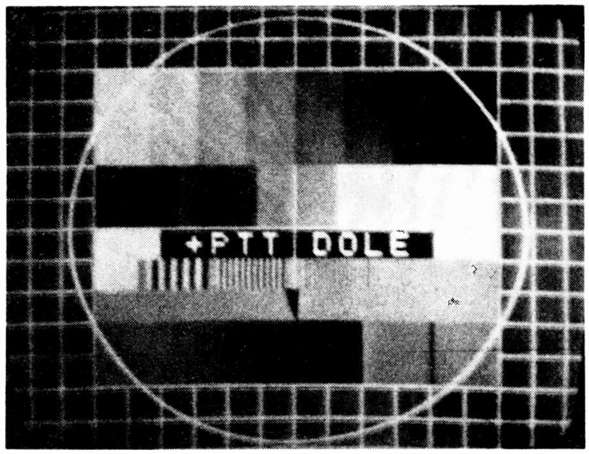
Heissischer Rundfunk—HR: The 1st Network uses the SWF/ZDF and at times the Telefunken card, the former carrying the identification hr1 Frankfurt. The 3rd Network uses the distinctive electronic card as for NDR-3, with no identification. The main studio centre is at Frankfurt.

Bayerischer Rundfunk—BR: The 1st Network uses the SWF/ZDF card with inscription br1 München. At times the Telefunken card is used and the transmitter will include its name at the bottom, e.g. Grünten. BR-3 is similar to the 1st Network although the electronic card is in greater use. The studio centre is at München.

Radio Bremen—RB: The 1st Network uses the SWF/ZDF card; the 3rd Network a similar one but without the circle. The 3rd Network operates as for NDR-3 as above. The studio centre is at Bremen.

Zweites Deutches Fernsehen—ZDF: The 2nd Network uses both versions of the SWF/ZDF card, i.e. with or without identification but with the circle. Officially identification is shown each half hour; however practice differs somewhat! The most likely times to see the identification are 0600-0745 and 1130-1200GMT and after the close. The main studio centre is at Mainz.

Information on Sender Freies Berlin; Saarlandischer Rundfunk and Suddeutscher Rundfunk has unfortunately not arrived but we hope to include this next time. Our grateful thanks to the Europese Testbeeldjagers/Peter van der Kramer for passing on the above.



Variations on a theme—French Network test card from La Dôle Switzerland.

From our Correspondents

A great number of letters has arrived this month! A new enthusiast Charles Oliver has been in contact with Hugh Cocks of Mayfield and by all accounts things have been busy at Charles's home at Bean near Dartford Kent. A Ferguson Model 606T has been modified to 625 lines and signals have been well received using an H array. Signals during July seem to have originated from South/South East since Charles mentions TVE, JRT, RAI and several unidentified ones. One of these has been identified as Lopik ch.E4 via Tropospherics. Incidentally we are always pleased to assist with identification problems but please send full details—date, time, channel, duration of signal, propagation mode and details of received image. If of a test pattern or identification slide a sketch often tells more than the most descriptive of paragraphs!

Geoffrey Chapman of Blandford reports that the mysterious CS U 01 Czechoslovak pattern on ch. R2 apparently carries the letters LTU. Keith Hamer visited Switzerland this summer (with Garry Smith) and comments on what he saw: the SWF/ZDF card is in use daily on the German network with the identification PTT SRG 1; it is used daily on the Italian network with PTT TSI 1; the French network uses the "old card" with the letter G (Geneva) apart from the one exception noted earlier.

Dave Bunyan of Sittingbourne Kent reports on a most successful season. Of particular interest has been his use of an up-converter (discussed in the August column). His work with a Teleng unit on Bands I and II (TV) resulted in "a great deal of success"—a group A preamplifier overcame the insertion loss. USSR was received in Band II on several occasions, together with various f.m. services at present operating around the 70MHz region in Eastern Europe. Dave's log indicates that signals for the month from July 9th came from all points of the compass!

Footnote

We are expecting the start of transmissions from CLT-Luxembourg ch.E21 and the ORTF-3 u.h.f. chain, Lille being the one most likely to be noted first. When operating at u.h.f. please bear this in mind and let us know as soon as anything is seen.

a look at Imported SETS.....

Polish UNITRA Series

H.K.HILLS

A FEW months ago we took a look at the Russian Temp 7 series of monochrome receivers which are being imported and sold on the UK market in fair numbers: we found some quite unusual circuit techniques compared to normal UK practice. With the Polish produced Unitra series of 19 and 20in. monochrome receivers which are also at present being distributed in the UK we find a chassis that is much more akin to what we have come to expect in a TV receiver: even the valve types, with one minor exception, are those to which we are accustomed. The chassis does however have a few features in common with its Russian counterpart: in particular a high-gain three-stage i.f. strip, a similar video amplifier/gated a.g.c. circuit, and by UK standards at any rate an elaborate sync separator circuit. Four transistors are used, our old friends the BF180 and BF181 in the u.h.f. tuner and a couple of pnp transistors, type AF428, in the two-stage intercarrier sound strip. A total of 12 valves is employed, the unusual one being an EAA91 double diode which is used as the flywheel line sync discriminator.

Power Supply Circuit

The valve heaters are a.c. fed and as the power supply circuit has one or two unusual features it is shown in Fig. 1. The primary of the low-impedance transformer in the circuit feeds the heaters and is in series with the usual dropper resistors and thermistor while the secondary is connected as a choke in series with the rectified h.t. feed. The phasing of the windings is such that the a.c. flowing in the primary cancels the ripple in the half-wave rectified h.t. supply. The h.t. then goes via separate smoothing/decoupling *RC* filters to five h.t. rails and from one of these a v.d.r. stabilised l.t. rail is taken to feed the tuner (the emitters of the transistors in the intercarrier sound channel are fed from one of the h.t. rails via high-value resistors).

Video Amplifier

In any television receiver chassis the design of the video output stage is of particular interest. This together with the closely linked a.g.c. circuit is shown in Fig. 2. D.C. coupling is used from the anode of the vision detector diode right through to the cathode of the c.r.t., thereby preserving the black level. The anode load of the video output pentode consists of R126 and R127 with DI101 and L17 providing h.f. boost—the latter is unusual in that it can be adjusted. C160 and L16 form a trap tuned to 6MHz to prevent the intercarrier sound signal reaching the c.r.t. cathode.

There are two contrast controls, a front-mounted user potentiometer which directly regulates the bias applied to the video output pentode and a rear-mounted preset which sets the bias applied to the a.g.c. triode. Both these controls affect the a.g.c. level therefore. The bias applied to the a.g.c. triode is in addition affected by a "grey-level" preset. As can be seen from the circuit the vision detector load resistor R159 is returned via R114 and R113 to the slider of the main contrast control R602: thus as a result of the d.c. coupling between the detector and the output pentode the negative-going detector output (with the sync pulses representing peak *negative* signal amplitude) is superimposed on the positive bias tapped from the slider of the contrast control.

Separate feeds, for noise-cancellation purposes as we shall see, are taken to the sync separator stage from the grid and anode circuits of the video output anode. The 6MHz intercarrier sound signal is tapped from the video output pentode anode while the drive to the a.g.c. triode is taken from its cathode circuit.

Brightness Control System

A most unusual feature is that the h.t. supply for the brightness control, which sets the c.r.t. grid voltage, is taken from the video output pentode anode: R129/C522/C518 filter out the video component so that the h.t. to the brightness control repre-

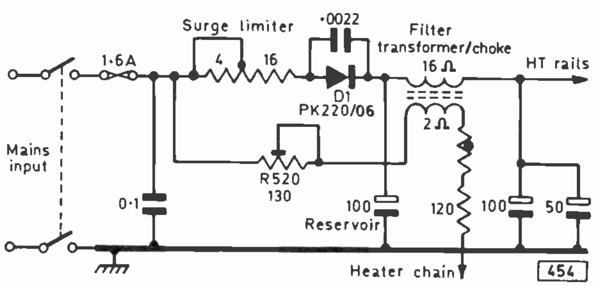


Fig. 1: An unusual feature of the power supply circuit is the low-impedance filter transformer/choke.

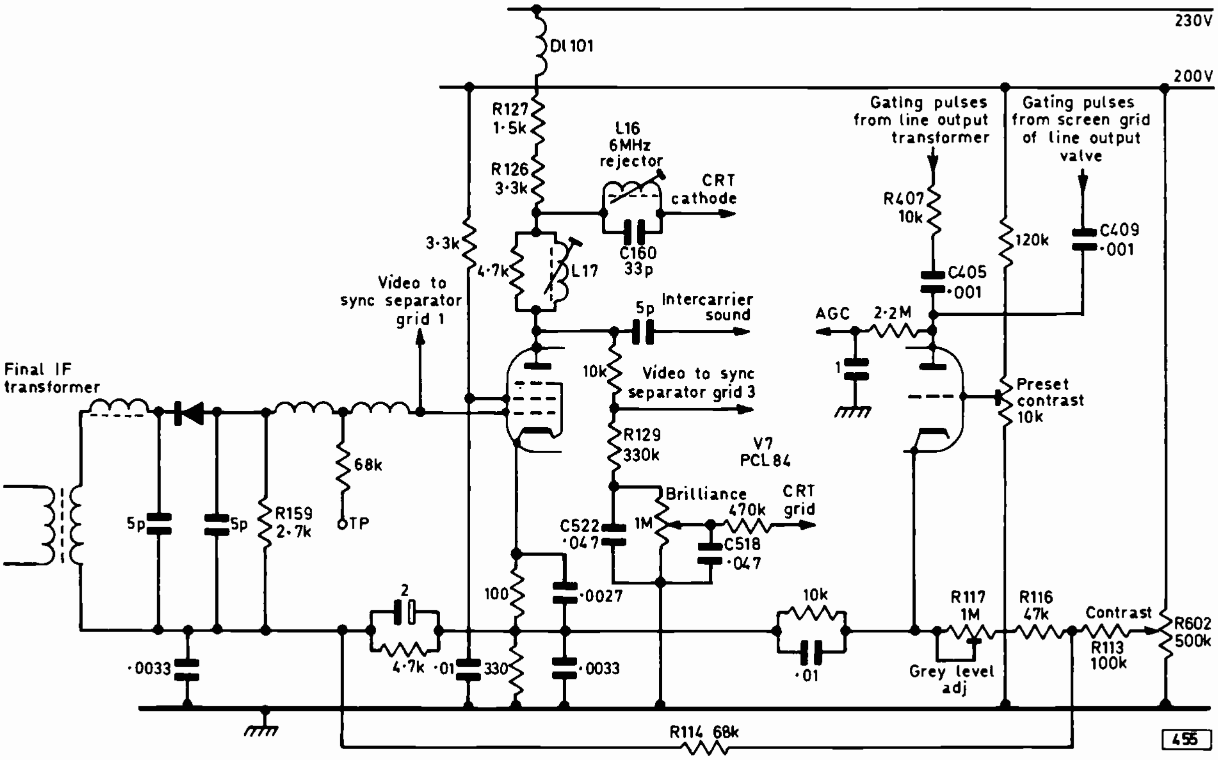


Fig. 2: The video amplifier and gated sync-tip a.g.c. circuits.

sents the mean PCL84 pentode anode voltage level. Thus on sustained, predominantly dark scenes the voltage applied to the brightness control increases, slightly raising the overall brightness level, while on mainly bright scenes the opposite occurs. The net effect is to improve the tonal balance.

Gating the AGC Triode

The a.g.c. triode is gated on by line flyback pulses which are applied to its anode—there is no other anode supply. As these pulses coincide with the sync pulses whose amplitude is a true measure of the signal strength the result is an a.g.c. potential which is independent of changes in picture content. There are two flyback pulse feeds to the triode anode, the main one being from a tapping on the line output transformer. The second pulse feed is from the screen grid of the line output valve: the purpose of this is to enable the a.g.c. circuit to come into operation during the warm-up period before the boost diode starts to conduct.

AGC Circuit Action

It will be seen from the circuit (Fig. 2) that the video signal with negative-going sync pulses is applied to the cathode of the a.g.c. triode: there is also a d.c. potential related to the setting of the main contrast control present, tapped off via R116 and the grey-scale preset R117. The triode's grid voltage is set by the preset contrast control. The triode conducts when the flyback pulses appear at its anode, via C405 and R407 from the line output transformer and/or via C409 from the screen grid of the PL500 line output valve. The more the triode conducts during these instants the more these positive-going anode pulses are "shorted out", resulting in an increased mean *negative* potential being developed at its anode as the capacitors charge up. The negative anode voltage can range up to −25V on very strong signals and is applied via the usual filtering components to the first and second i.f. amplifiers (both type EF183). A.G.C. is not applied to the tuner unit.

Sync Separation

One of the main disadvantages of negatively-modulated transmissions is that random noise pulses are of the same polarity as the sync pulses. For this reason flywheel line sync circuits are generally used in 625-line receivers. The flywheel line sync circuit employed in this chassis operates in conjunction with a sinewave line oscillator of the now well-known variety except that it uses a PCF82. Push-pull reference signal feeds are taken to the flywheel sync discriminator, a preset control being provided so that the symmetry of the feeds can be balanced. This still leaves problems with field synchronisation of course since a field oscillator can easily be tripped by a strong noise pulse occurring just before the termination of its scan: this is where a noise-cancelled sync separator is a great advantage.

Noise Cancelling

The noise-cancelled sync separator circuit, using an ECH84 triode-heptode valve, is shown in Fig. 3. The heptode section provides the noise-cancelling action. The video signal with positive-going sync pulses is

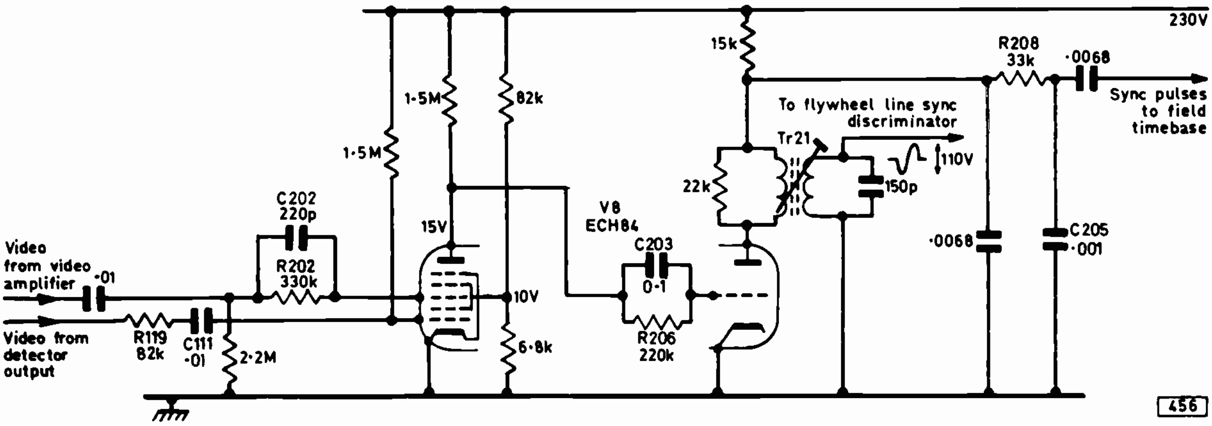


Fig. 3: The ECH84 sync separator circuit: noise cancellation is effected in the heptode section.

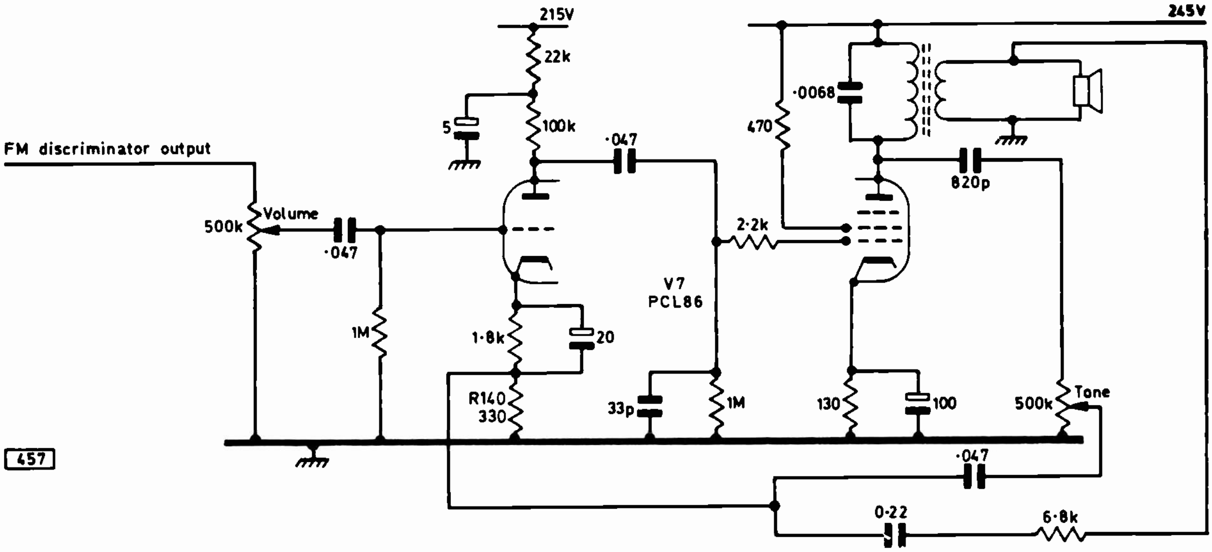


Fig. 4: The PCL86 audio amplifier with its negative feedback loop incorporating a tone control.

fed from the pentode anode of the PCL84 to the second control grid (g3) of the heptode. The usual negative bias is developed at this grid, and this bias together with the low anode and screen grid voltages holds the anode current at a very low value during the picture information content of each line. The positive-going sync pulses then drive the valve into full conduction. Noise pulses would of course do likewise but their effect is minimised by the time-constant of R202/C202 which absorb short-duration noise spikes. The first control grid is fed with opposite polarity (negative-going sync pulses) video signal at much lower amplitude from the grid circuit of the video output pentode (via R119 and C111). The sync pulses in this feed will tend to reduce the valve's conduction but their effect will be much less than that of the noise spikes since these are effectively removed from the other feed by the *RC* combination R202/C202. We thus obtain at the heptode anode a relatively noise-free sync pulse output of 24V peak-to-peak and this is fed via C203/R206 to the grid of the triode section which provides at its anode sharp, positive-going sync pulses. R208 and C205 integrate the field sync pulses which are then applied to a conventional PCL805 field timebase circuit. The line sync pulses are developed across the secondary winding of the transformer Tr21 and are fed to the junction of the EAA91 flywheel sync discriminator diodes.

Line Output Stage

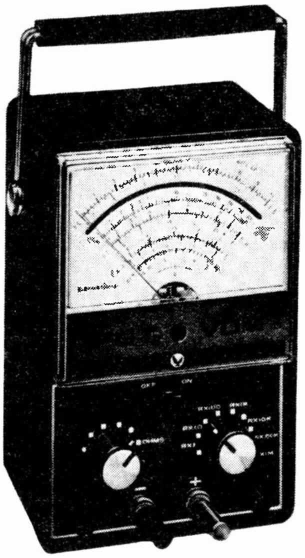
The line output stage follows conventional practice, with a feedback e.h.t. stabilising loop employing a v.d.r. to set the line output valve bias.

Audio Amplifier

The audio amplifier uses a PCL86 and is shown in Fig. 4. Negative feedback from the secondary of the output transformer and the anode of the output pentode is applied across the undecoupled resistor R140 in the cathode lead of the triode. A tone control is incorporated in one of these loops.

All in all this appears to be a well-made and highly sensitive chassis.

TV TEST REPORT



E. M. BRISTOL

THE EAGLE K-200 FET VOLTMETER

VALVE voltmeters have long been used where an instrument with a very high input impedance which has negligible effect on the circuit under test is required. They have the drawbacks however of needing a mains supply and a warm-up period while some models require critical adjustment and are temperamental in operation. Thus although invaluable for certain measurements they have not proved suitable for day-to-day servicing in place of the normal multirange meter.

The use of field effect transistors (f.e.t.s) with their high input impedance makes possible a transistorized instrument free from mains supplies and valve warm-up delays: the Eagle K-200 is an example of this type of test meter. It consists of a wide-range a.c. amplifier, detector and d.c. differential amplifier employing three f.e.t.s and four diodes, plus an 80μA meter.

First of all its ranges. For d.c. voltages there are eight ranges from 0·3V full scale to 1,000V. The scale markings permit a reading of 0·01V on the lowest range. The a.c. voltage ranges are the same for r.m.s. values but there is also a peak-to-peak a.c. scale which gives readings of from 0–0·84V to 2,800V in eight ranges. The current ranges, both d.c. and a.c., are from 30μA full scale to 300mA in eight ranges. Both voltage and current ranges (except the a.c. peak-to-peak range) are in successive steps of 1 and 3, 10 and 30 etc. The resistance ranges are from 0–500Ω to 0–500MΩ in seven stages: the scale is calibrated in the lowest range (10Ω centre scale) and each range is ten times the one below it. Lastly there is a decibel scale reading directly from −15 to +2dB: 0dB is taken as the standard reference of 1mW at 600Ω or 0·775V. The 1V a.c. range is used for this and the range can be extended by either the ×3 or ×10 ranges—the ×10 one is easier as this just adds 20dB to the reading for each power of 10.

On the d.c. and resistance ranges the accuracy is quoted as ±3% while for the a.c. ranges the accuracy is quoted as ±4%. The input resistance is 10MΩ on all voltage ranges which is the same as a conventional 20kΩ/V meter on its 500V range. Thus a conventional meter on its higher ranges—1,000V or more—offers a higher impedance. For the lower ranges however the relatively high input impedance can be very useful. One advantage is that the a.c. voltage ranges have a frequency response up to 3MHz. Thus for television work the meter can be used as a signal tracer to follow the path of the video from the detector to the c.r.t.

Another useful feature is the provision of a centre zero mark on the scale: the pointer can be set to this and the instrument used for polarity comparisons and discriminator alignment. A position on the function switch enables the polarity on all the d.c. voltage ranges to be reversed: this is helpful as it makes it unnecessary to change over the leads or prods and clips when different polarity voltages have to be read in succession.

A very important feature of any meter is the layout and general readability of its scale. Other good design features will be pointless if there is any possibility of ambiguity here. The scale on this instrument has eight different sets of calibrations yet they are all quite legible and once one is familiar with the meter there should be little chance of the scale being misread. The top line, printed in black, is for direct voltages and currents: the ×1 calibrations are above and the ×3 calibrations below the line. Next come the anti-parallax mirror and then the resistance scale. This is also black and is particularly clear with subdivisions in thinner lines than the main ones. Underneath this is the a.c. voltage and current scale which is easily identified as it is printed in red. The ×1 and ×3 calibrations are above and below the line respectively as with the d.c. scale. Below this is the peak-to-peak a.c. scale, also in red. Finally the lowest scale, printed in black to distinguish it from those above, is the decibel scale which is calibrated in ½dBs. The longest scale is some 4in. in length.

The controls are little different from those of a conventional multirange meter. The two main ones have round knobs with coarse milled edges for good finger grip and raised pointers. There are also pointers set in the satin-finish silver discs in the knob faces. The left-hand control is the function switch and polarity changeover. Just one point with this, the d.c. voltage and the resistance positions which are the most frequently used ranges are set at extreme opposite ends of the six-position switch: it would be more convenient to have them adjacent, though the arrangement used may have been adopted on purpose so that the less often used positions in the middle are kept clean by being continually switched through. The right-hand knob selects the range. Resistance inscriptions are white while the voltage and current markings are black: this helps to make things clear! There is only one fault I find with these: the *lowest* resistance position is the same as the *second* lowest current and voltage position. While this in itself may be a little confusing matters are made worse by the fact that the inscription for the resistance range is ambiguously situated between these two switch positions.

The on/off switch is a small thumb-operated slider between and above the two main controls. It has a centre position which gives a reading of the internal battery voltage. As one has to go through this to reach the on position a check on battery voltage is made each time the instrument is switched on. There is a mark on the scale above which the needle should go to indicate a serviceable battery. When in the on position a small red area on the switch is exposed. This however is rather too small to be sufficiently eye-catching. Now an ordinary multimeter does not of course have to be switched off. So if you are used to using one of these for bench work the chances are that you will leave this meter on inadvertently. I did this several times during the few months the meter was being given its workshop test.

The other two controls have small knobs in the left- and right-hand bottom corners of the panel. These are the zero and ohms adjusters. The zero adjuster is used to bring the pointer to the zero mark before taking a reading: this in fact has been one of the main snags with many valve voltmeters in the past as the setting is often critical and varies from one range to the next. The Eagle K-200 scores well on this point: the setting is not at all critical and holds good for all ranges except the lowest resistance range where a slight readjustment is needed. The setting also remains constant over a period of use, only occasionally requiring alteration. Indeed in this respect the meter can be treated almost as though it is a normal multirange meter.

The ohms adjustment is something we are all familiar with on conventional instruments. Adjustment is usually needed on going from one range to another—unless separate adjusters are provided for each range. On this meter the ohms adjustment holds good for every range so this eliminates the nuisance of continual resetting when measuring resistors of widely differing values.

The resistance scale is different from conventional meters in that it reads the opposite way, zero being at the left and maximum resistance at the right—the same as for voltage readings. This is more rational but takes a little getting used to. Setting up is also rather different: first of all the leads are shorted and the zero adjuster set for zero reading (we usually do this with the ohms adjuster on ordinary meters), then the ohms adjuster is set for open-circuit conditions to get the needle on the infinity mark. Although confusing at first I soon got used to this by remembering that the left-hand knob adjusts for the left-hand scale limit while the right-hand knob adjusts for the right-hand limit. And as already mentioned adjustments are rarely needed during a session of use.

The test lead is connected to raised sockets at the bottom of the control panel via two banana plugs. It consists of a single insulated screened length of cable some 3ft. long. The earth lead is brought out of the live banana plug at the meter end and out of the test prod at the other. It is terminated with a crocodile clip. At the test end it is just over 12in. long which means that the measuring points cannot be more than 12in. apart. Fresh chassis connections must therefore be made when going from one part of a receiver to another. I felt that this would be troublesome when working but found in practice that the disadvantage was slight. The use of a screened lead undoubtedly adds to the stability of the instrument. Many valve voltmeters give spurious readings when the prods are in free air and thus also when contacting a point that is open-circuit. This is not the case here: the pointer remained steadily on zero when not taking a measurement.

The instrument is housed in a metal container with black-crackle finish; the handle is chrome with a black plastic finger-piece ribbed underneath to prevent slipping; the scale is raised and is enclosed in clear plastic all around; the colour of the recessed control-panel is an unusual grey with the lettering in black and white. The overall effect is very smart. One note of warning though. The case is obviously intended to be stood vertically since there are four raised areas on the bottom intended as feet. Many engineers however prefer to operate their meters horizontally to give greater physical stability and easier reading. The two dome-headed screws at the back are only partly countersunk so if the instrument is used in the home do not lay it down on a polished surface! I would recommend sticking a set of four circular pads that can be obtained for the purpose from Radiospares on the back. The internal construction is quite sound, the printed panels are solidly made and low-loss material is used where necessary for the switch wafers.

In use the instrument is stable and almost as convenient as a conventional multirange meter—though with the facilities of a valve voltmeter of course. The meter movement itself is beautifully damped, the pointer rising quickly to the reading without any overshoot. The ranges are generally adequate, the resistance range being particularly good with its ×10 steps up to 500MΩ. The maximum current range of 300mA however I thought rather too low: there are many applications such as checking the current of output transistors where a higher range is desirable.

One point of relevance in television servicing is that a d.c. voltage with any trace of spiky a.c. waveform on it gives a wildly inaccurate reading. I tried to measure the boost voltages on different television receivers—from 700–900V—on the 1,000V range and the needle went well off the end of the scale. This however was the only example of spurious or inaccurate results: compared with a highly accurate standard meter all readings were very close, well within the accuracy tolerances quoted.

There are no fuses or trips to protect the meter in the event of overload but for all the voltage ranges these seem unnecessary as the instrument is claimed to stand up to 1,000V overload on the 0·3V d.c. range and 600V a.c. on the 0·3V a.c. range. This is an excellent feature since sooner or later an overload will be inadvertently applied and fuses and trips can be a nuisance. There is no protection on the resistance range should this be accidentally applied to a voltage source however so extra care is necessary when taking resistance measurements in a faulty set.

The batteries used to power the K-200 are one U11 and two type PP3. The U11 is a medium 1·5V torch cell and the PP3s (which are connected in series) are 9V small transistor radio batteries. Herein lies the most serious criticism of this instrument: the PP3s supplied lasted only two or three weeks of regular bench use in the workshop. Current drain is not large, around 5mA, but PP3s have a very small capacity and for test equipment one really needs something that is going to last a fair time without the bother and expense of replacement. One can stretch the life by remembering to switch off after every reading but when troubleshooting in defective equipment where readings are interspersed with

—continued on page 37

COLOUR RECEIVER CIRCUITS

VERTICAL SHIFT AND LINE OSCILLATOR TECHNIQUES

GORDON J. KING

In a monochrone receiver picture shift is achieved by means of a permanent magnet system on the tube neck. This system cannot be used with colour tubes however since the shift field would tend to destroy both the purity and convergence. Instead d.c. is passed through the field and line scan coils to provide vertical and horizontal shift. The d.c. source impedance needs to be isolated from the scanning current to prevent undue damping or alternatively the d.c. has to be applied in series with the scanning current. Early monochrome receivers employed a similar method of picture shift—before the advent of the permanent magnet shift control.

One method of vertical shift is shown in Fig. 1 and this arrangement, sometimes with slight variation in detail, is often found in receivers using a valve field output stage. T1 is the field output transformer and the primary (A) is connected to the h.t. supply via the 100Ω variable resistor which constitutes the shift preset. Current flowing from the valve anode through this resistor produces a voltage across the resistor of value depending on the setting of the slider. Since the resistor is heavily decoupled by the 4,000μF electrolytic the 50Hz scanning current in the primary circuit is hardly affected by the presence of the resistor. The voltage drop across the resistor reduces the voltage swing slightly but in practice this is only of the order of some 2V or so.

Winding B on T1 produces the scanning current in the usual manner and this passes through the low impedance of the shift network, R1, which is in parallel with the coils of the pincushion distortion correction transductor, thermistor TH1 and the field scanning coils. Thus the d.c. resulting from the charge of the 4,000μF electrolytic is introduced in series with the scanning current. The degree of vertical shift depends of course on the setting of the 100Ω resistor and since the current can in this way be changed in only one direction a pair of links is provided to enable the direction of current flow to be altered if necessary so that accurate picture centring can be achieved.

The voltage dependent resistor in shunt with T1 primary merely limits the flyback voltage peaks in the normal manner while the thermistor TH1 compensates for increase in temperature of the scanning coils.

Failure of the electrolytic capacitor in this type of circuit will tend to inhibit the amplitude of the field scan, a point worth bearing in mind.

An alternative arrangement used with valve field timebases obtains the d.c. shift from the cathode circuit of the field output valve. This is fairly easy when the dead side of the field scan coils can be connected direct to an earthy signal circuit. The arrangement is used in Bang and Olufsen receivers, a simplified circuit being shown in Fig. 2. The vertical shift preset has a tapping which is returned to chassis through R1 at the centre of its track. Thus in the centre position cathode current flows to chassis direct through R1. The two outside tags of the preset are effectively across the field scanning coils so that when the slider is moved from track centre in one direction d.c. flows through the coils one way while when the slider is moved from track centre the other way the direction of d.c. flow is reversed. This is a better scheme than that shown in Fig. 1 since it makes it possible to shift the picture up or down without the need for the current reversing links.

A very similar arrangement is used in the recent Finnish ASA receivers, Models CT5003 and CT5004. It is also employed by Grundig.

Receivers with transistor field timebases have to adopt a different approach and one example, used in the recent BRC 8500 chassis, is shown in Fig. 3. Field scanning current is delivered by the complementary output transistors Tr1/Tr2 to the field scan coils via the symmetry preset, the a.c. circuit being com-

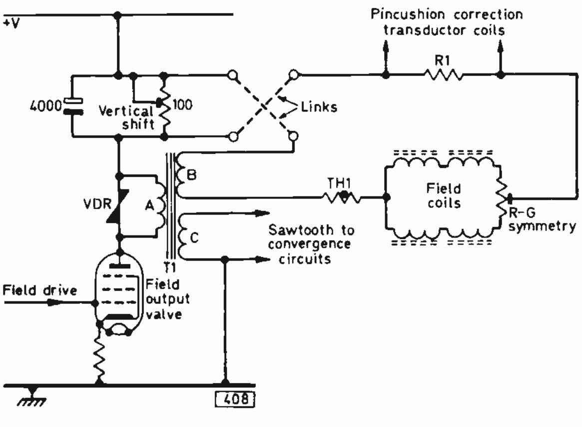


Fig. 1: The usual vertical shift control system used in sets with a valve field output stage.

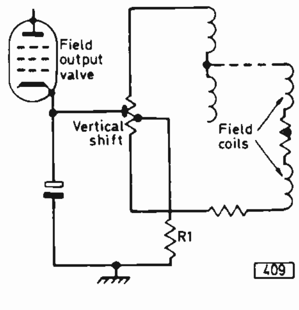


Fig. 2: Method of using the cathode current of the field output valve to provide vertical shift control (simplified circuit). This technique is used in several chassis imported from the Continent.

pleted through the 160μF electrolytic and 8.2Ω resistor to chassis. The shift preset is across the power supply and from the d.c. point of view the circuit can be regarded as a bridge. The bridge is balanced, and hence no d.c. flows through the scan coils, when the preset is at its centre position. Moving the slider either side of centre results in an increasing d.c. through the scan coils, the direction of the current depending on which side of centre the slider is moved.

Most receivers with transistor field output stages employ this arrangement or a variation of it, though the actual d.c. circuit is not always easy to follow because of the complexity of complete circuit diagrams—the d.c. path may for example be in part through the field convergence circuits.

Similar shift circuits are used in the line timebases but owing to the high-amplitude flyback voltages and other factors (associated with the line frequency) the precise method of control and the circuitry employed may differ from that used in the field timebase. We shall be looking at horizontal shift circuits later: first we must take a look at some basic colour receiver line timebase circuits.

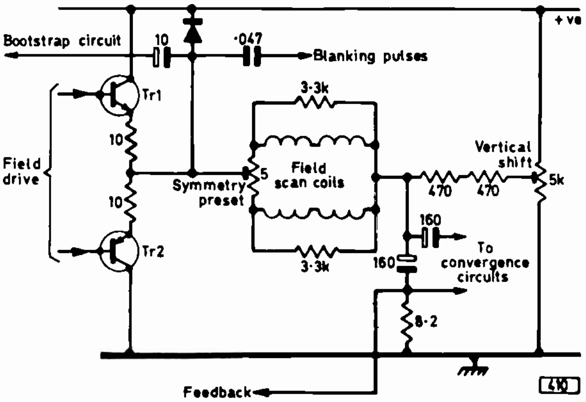


Fig. 3: Transistor field output circuit (simplified) used in the BRC 8000/8500 chassis, showing the shift control system.

Line Oscillator Circuits

Most second generation colour receivers with valve line timebases, including the tail end of the dual-standard species, employ a form of sinewave line oscillator controlled by a valve reactance stage. Such a circuit is used in the Dynatron CTV1, CTV1CH and CTV2 group of models which are fitted with the Pye 691 chassis and is shown in Fig. 4.

The line oscillator proper consists of the pentode section of the PCF802 (V1B) which is arranged in a screen-coupled configuration with the line drive signal for the output stage taken from its anode circuit. The oscillatory circuit consists of L36A/B tuned partly by C209 and partly by the capacitive reactance reflected from the triode section V1A. The capacitive part of the oscillatory circuit can thus be regarded as C209 in shunt with V1A reactance (since both capacitive components are effectively across the windings). Oscillation is sustained by feedback from the screen to the control grid of V1B via R216, the oscillatory circuit and C211.

When the circuit is oscillating a sinewave is developed across R211 and this signal is coupled to V1A cathode by C212. The phasing is such that the sinusoidal *current* passed by V1A leads the sinusoidal *voltage* at its anode by approximately 90 degrees, and since this is exactly the effect provided by a capacitor V1A appears to the oscillatory circuit as a shunt capacitance. Now the degree of capacitance so reflected is a function of the gain of V1A, and since this can be adjusted by varying the voltage on the control grid it follows that by changing the grid bias there is also a change in the frequency of the sinewave. It will be seen that the line hold control is arranged so as to vary the potential between the grid and cathode of V1A: thus a change in frequency is produced by varying the setting of this control. Frequency control is also provided by the output from the phase detector which consists of diodes D40 and D41 at the left-hand side of the circuit.

One input to the phase detector consists of negative-going line sync pulses applied through C203. Another input is a sample signal from a tapping on the line output transformer fed in through C204 and R203. These components integrate the sample signal to yield a reference waveform of some 25V p—p, and to optimise the phasing a second input from a separate winding on the line output transformer is applied through C202. Both these line signals consist of negative-going pulses. The phasing signal coupled in by C202 serves to modify the steepness of the negative-going edge of the composite reference

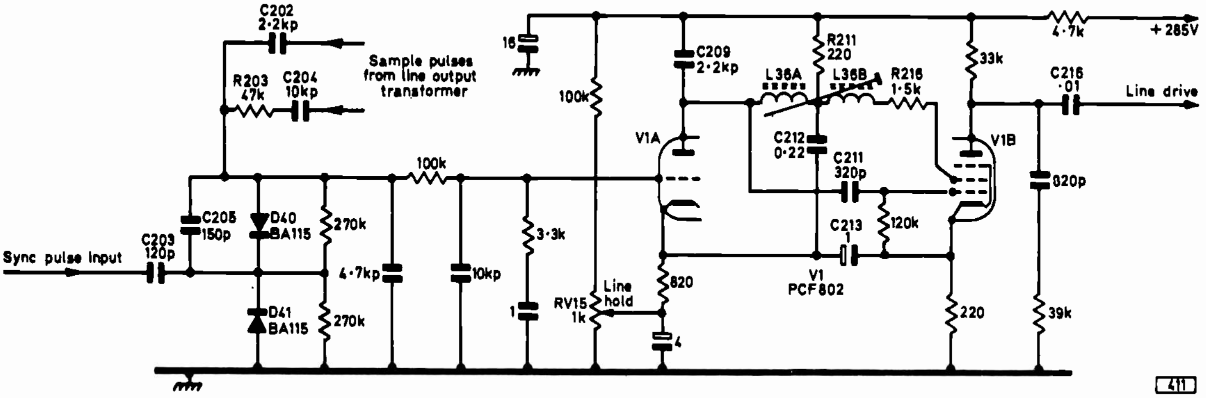


Fig. 4: Typical valve sinewave line oscillator circuit with flywheel synchronisation.

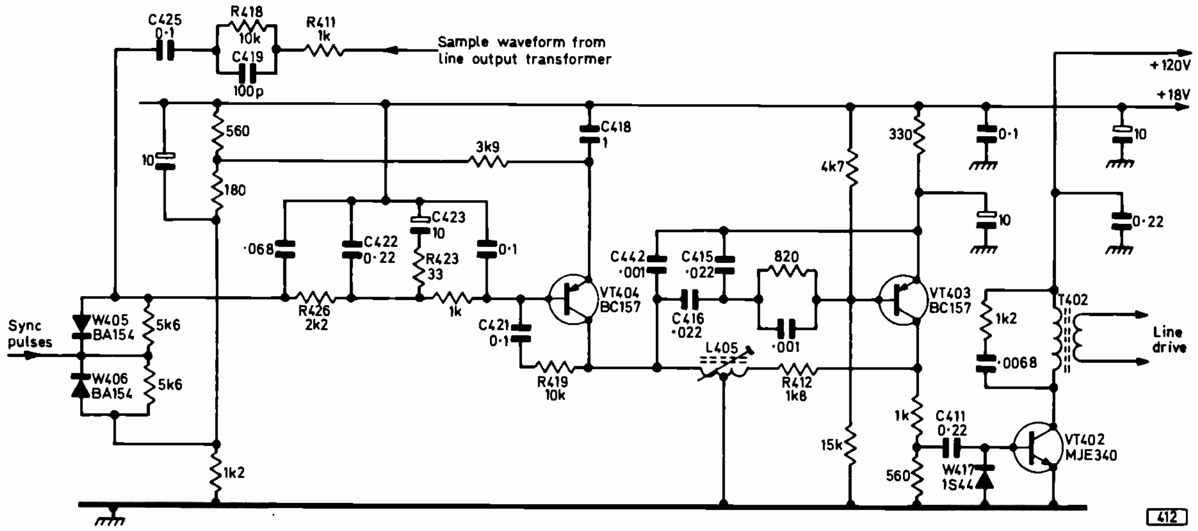


Fig. 5: The flywheel controlled transistor sinewave line oscillator and line driver stages used in the BRC 8000/8500 chassis.

waveform, thereby ensuring that the picture when correctly synchronised is placed horizontally in the centre of the raster.

The phase detector output alters when the frequency and hence the phase of the sample or reference signal differs from the nominal phase of the line sync pulses. The resultant positive- or negative-going d.c. output—depending on the sense of the phase change—is coupled via the filter circuit to V1A grid, automatically changing the frequency and phase of the oscillator signal until correct locking is achieved. There is of course only a limited pull-in range so it is necessary to preset the approximate frequency/phase conditions by means of the line hold control. Capacitor C205 is connected across D40 to ensure that the least unbalance occurs when the line sync pulses are weak, distorted or absent.

The positive feedback from V1B cathode to V1A cathode via C213 minimises the damping across the oscillatory circuit so that the drive waveform at V1B anode is of sufficient amplitude fully to drive the line output stage. This feedback also gives the drive waveform a fast negative edge to operate the output stage correctly.

The filter between the phase detector and V1A grid has a relatively long time-constant so that the oscillator does not fall immediately out of sync in the event of momentary failure of the sync pulses or if the sync pulses are affected by noise or interference.

Receivers with transistor line timebases use a solid-state equivalent of the reactance flywheel controlled sync system just described. One such chassis is the BRC 8000/8500 and the circuit of the line generator used in this chassis is shown in Fig. 5. Diodes W405 and W406 form the phase detector, VT404 the reactance stage, VT403 the oscillator and VT402 the driver stage.

Negative-going sync pulses are fed to the junction of W405 and W406 while a sample of the line output waveform is also applied to the detector through R411/R418/C419/C425 from the line output transformer. When the phase of the sample signal is coincident with that of the line sync pulses there is no output from the phase detector. When there is a phase difference however the diodes give a d.c. output which is communicated to the base of the reactance stage via the filter network consisting of R426/C422/R423/C423.

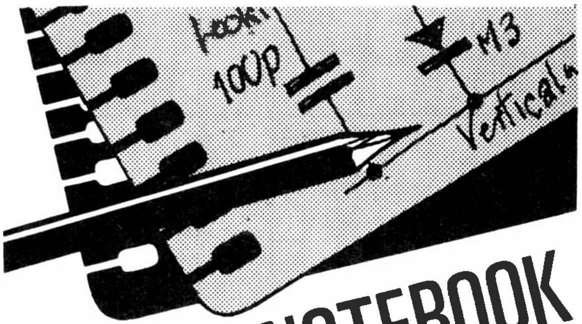
As in the valve circuit the reactance stage is effectively in shunt with the oscillatory circuit but in this circuit the reactance is inductive—that is, the current lags the voltage by 90 degrees. The oscillatory circuit consists of L405, resonated by C415/C416/C442, and the inductive reactance provided by VT404 which is connected across the tuned circuit via C418. Oscillation is sustained by feedback from VT403 collector via the inductor and capacitance tap (C416/C415) back to its base: R412 stabilises the feedback current.

As with the valve circuit a change in the reactance stage bias alters its reactance. The potential from the phase detector is coupled direct to VT404 base to complete the phase correcting loop. There is no line hold control as such, the initial operating frequency being established by adjusting the core in L405. This is done with a shorting link connected from W405 anode to W406 anode, the adjustment then being made until the picture is as steady as possible under zero sync input. The sync is restored by removing the short and the picture then locks solidly on the screen. Correct quadrature operation of the reactance stage is obtained by phase retarded feedback from collector to base via R419 and C421.

The line driver transistor VT402 is fed from the oscillator via C411 and because this removes the d.c. component of the waveform the restoration diode W417 is necessary. The line drive waveform consists of a series of pulses which result from the oscillator having a fixed conduction period of about 26μs. The drive is developed across T402 primary and is fed from the secondary to the line output transistor as a switching signal.

The next instalment will look at some line output stage circuits, including the methods used for horizontal shift, after which we shall be investigating field and line convergence circuits.

TO BE CONTINUED



SERVICE NOTEBOOK

G. R. WILDING

Lack of Height with Top Foldover

Insufficient height with a pronounced foldover at the top of the raster was the complaint on a fairly recent single-standard hybrid Bush receiver (Model TV181S). This fault is rare as insufficient height is generally either without any foldover or even bad linearity (caused by value increase in one or more of the resistors supplying h.t. to the anode of the field generator) or with severe cramping or foldover at the bottom (caused by a defective output pentode plus decreased value cathode resistor and shunting electrolytic). A new PCL805 not surprisingly failed to make any difference. The voltages everywhere were up to standard, there were no breaks in the tracks of the two linearity controls, and the primary and secondary windings of the output transformer had the scheduled d.c. resistances.

As the voltages were normal, the likelihood of a leaky coupling capacitor was ruled out so we commenced checking the values of the resistors. As none of them showed much sign of discolouration we weren't unduly surprised when all proved to be well within tolerance. Our next move therefore was to stab equivalents or near equivalents across each of the capacitors and on so shunting 3C15 (Fig. 1) the 2,200pF capacitor in the grid circuit of the pentode section the height was restored excessively. On removing the original and replacing it with one of similar value normal height without the top foldover was obtained.

In another of these receivers we found that intermittent field collapse was due to a defective 3C11 which shorted the grid circuit of the PCL805 triode to chassis.

Weak Volume

There was weak volume on a colour receiver fitted with the BRC 3000 chassis though the quality was fairly good. Tests on the sound panel showed all voltages to be correct and shunting an equivalent across the 0·047μF audio coupling capacitor connected from the volume control slider to the base of the first a.f. amplifier stage made no improvement. Our next move therefore was to check the two type BA130 discriminator diodes (Fig. 2). Both were ok however as also was the electrolytic C163. We next found that the volume could be considerably improved—though not to the normal level—by realigning the secondary of the i.f. transformer feeding the discriminator diodes. This suggested—as drift was not the cause—that the two series-connected 180pF capacitors across the secondary were of reduced capacitance. On replacing these two components and realigning the secondary normal volume and tone were restored.

Insufficient Width

There was insufficient width on a set fitted with the ITT VC200 single-standard chassis and as replacing the PL504 failed to have any significant effect we made a bee line for the high-value resistors associated with the v.d.r. width stabilising circuit—in receivers of all makes these have a tendency to increase in value so that they do not sufficiently offset the valve's self-produced negative grid bias. There are three possibles in this chassis, R159 (10MΩ), R153 (1MΩ) and R154 (also 1MΩ), all connected in series between a boost potential tapping point on the line output transformer and the 0·01μF pentode grid coupling capacitor. As expected it was the 10MΩ resistor that had increased in value—to

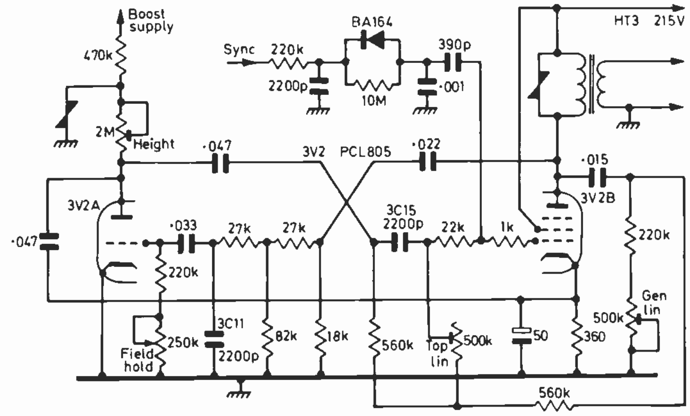


Fig. 1: The field timebase circuit used in the Bush TV181S/Murphy V2016S single-standard monochrome series.

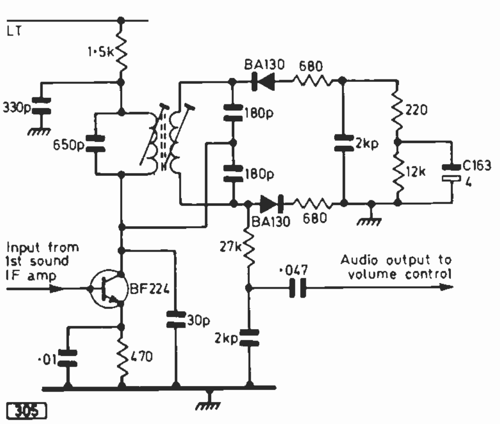


Fig. 2: Sound discriminator circuit used in the BRC 3000 colour chassis.

well over 13MΩ—and though of 1W rating the manufacturers recommend that it is replaced with two series-connected 1W types, of 4·7MΩ and 5·6MΩ.

No Colour, Excessive Brightness

THERE was no colour and an excessive brightness level in a colour set fitted with the BRC 3000 chassis—the symptoms were reported to have developed simultaneously. As the cause of total loss of colour is usually easily found we decided to concentrate on this. Our first action was to over-ride the colour-killer action by connecting an 82kΩ resistor from the junction of the two capacitors connected across the ident coil L303 to chassis. This ensured that the PAL switch driver stage VT307 was conducting—the chrominance channel turn-on bias on this chassis is derived from the PAL switch circuit—and resulted in the appearance of colour but without colour sync. This showed that the trouble must be to do with the burst channel since the burst gate and amplifier stages must be operating normally if the reference oscillator a.p.c. loop and the ident amplifier are to come into action. A scope test at the collector of the ident amplifier revealed that there was no output from this stage instead of the usual 10V sinewave and a further scope test showed that there was no burst signal at the collector of the burst amplifier stage. The burst gate stage which precedes this is gated by pulses fed to it from the emitter of the polarity splitter transistor VT308 and scope tests then showed that there was a complete absence of pulses at both the emitter and the base of the polarity splitter transistor. The pulses are derived from the line timebase so attention was next directed to the line timebase board.

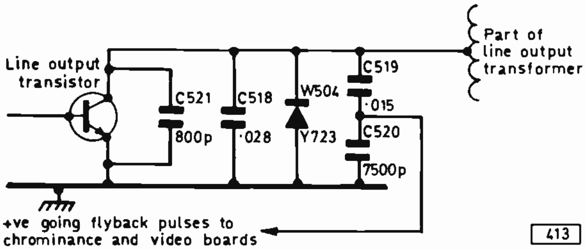
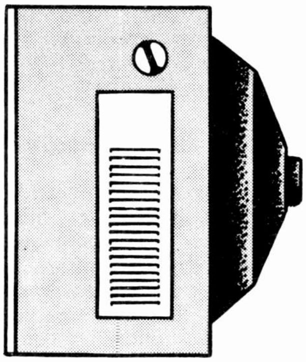


Fig. 3: Part of the BRC 3000 chassis line output circuit: a faulty C520 can cause various troubles.

As shown in Fig. 3 the pulses are taken from the junction of the two capacitors C519 and C520. These series connected capacitors are shunted by C518, C521 and diode W504 and clearly these three components were above suspicion since if any of them had been short-circuit the collector of the line output transistor would have been shorted to chassis blowing the timebase and sound fuse. Meter tests showed that C520 was completely shorted, removing the pulse feed. After replacing this capacitor the pulse feed to the polarity splitter transistor was restored so that the burst gate came into action and a normal colour picture was obtained. These pulses from the line output stage are also fed to the video board where they are used to operate the black-level clamping system. Thus replacement of C520 also resulted in the brilliance level returning to normal.

Renovating the RENTALS



CALEB BRADLEY BSc

8 BUSH/MURPHY CTV25/CV2510

THE Bush CTV25 and the similar Murphy CV2510 ("Colour 25") are among the best looking dual-standard colour sets now available on the ex-rental market—we used one of them to demonstrate the crosshatch generator on the September cover. They are 25in. tube models and come in light and dark wood cabinets fitted with double doors. Wood legs can be fitted. Other models using the same chassis are the Bush CTV162 and CTV167 and the Murphy CV1912 and CV2511: but do not confuse with the similarly numbered Decca CTV25 which we covered in July and August.

The chassis is a hybrid one using valves in the timebase, luminance and colour output stages and transistors everywhere else. It has passed through several modifications: in the final Mk. III version the valve e.h.t. rectifier and associated large line output transformer e.h.t. overwinding were replaced by a solid-state multiplier although the PD500 valve shunt stabiliser remained. Apart from a few weak points we shall mention it is quite a reliable chassis and certainly worth reconditioning. The information we give applies mainly to the later Mk. II versions but will be found useful for the Mk. I and Mk. III. Accessibility is quite good.

Separable Assemblies

The i.f., decoder and luminance/colour-difference boards are mounted on a steel frame which can be removed from the set when various plugs and sockets and earth straps have been disconnected. Similarly the power supply and timebase units can be easily removed. Note however that the timebase and scan coils used in Mk. III sets are not interchangeable with those used in earlier sets. It can be tricky to get the i.f./decoder/luminance or the timebase frames back into the cabinet as a rear flange has to slide into a tight groove: be careful about using force since a wire may be trapped in the groove.

Tuner

The integrated u.h.f./v.h.f. tuner is similar to that used on Bush/Murphy monochrome sets and has the same steam age pushbuttons which operate with about the same delicacy as railway points. Also you can't tell which button *is* pressed. Nevertheless the mechanism is reliable except that the button inner ridges which should grip the flats on the tuner spindles can wear away so that the button cannot be tuned. A reasonable cure is to pack the button to make a force fit on the spindle so that the button is permanently tuneable.

Each button is set to v.h.f./405 or u.h.f./625 by a metal plate fitted under it. To adjust the plates the tuner must be removed as follows. Remove the fibre back, reaching inside to unclip from it the aerial sockets. Unplug the leads from the tuner to the i.f. board and power supply and unclamp one end of the tuner earthing braid. Remove two bolts holding the tuner bracket to the side of the cabinet and carefully withdraw the tuner, trying not to drop the push-buttons or the springs behind them. Each of the plates can be inserted either way up: the system stamped on the upper side is the operational one

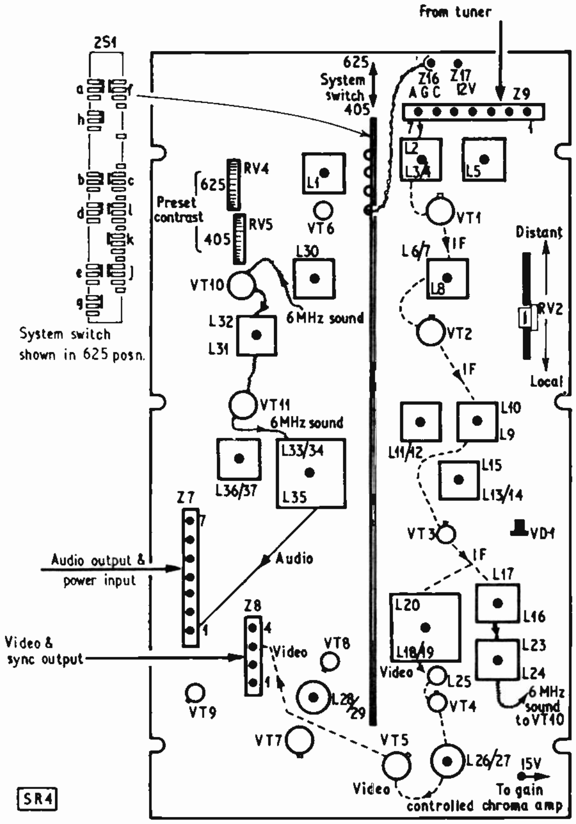


Fig. 1: I.F. board layout. All components are prefixed 2, e.g. 2L1, 2L2 etc. The signal paths shown apply to 625-line operation.

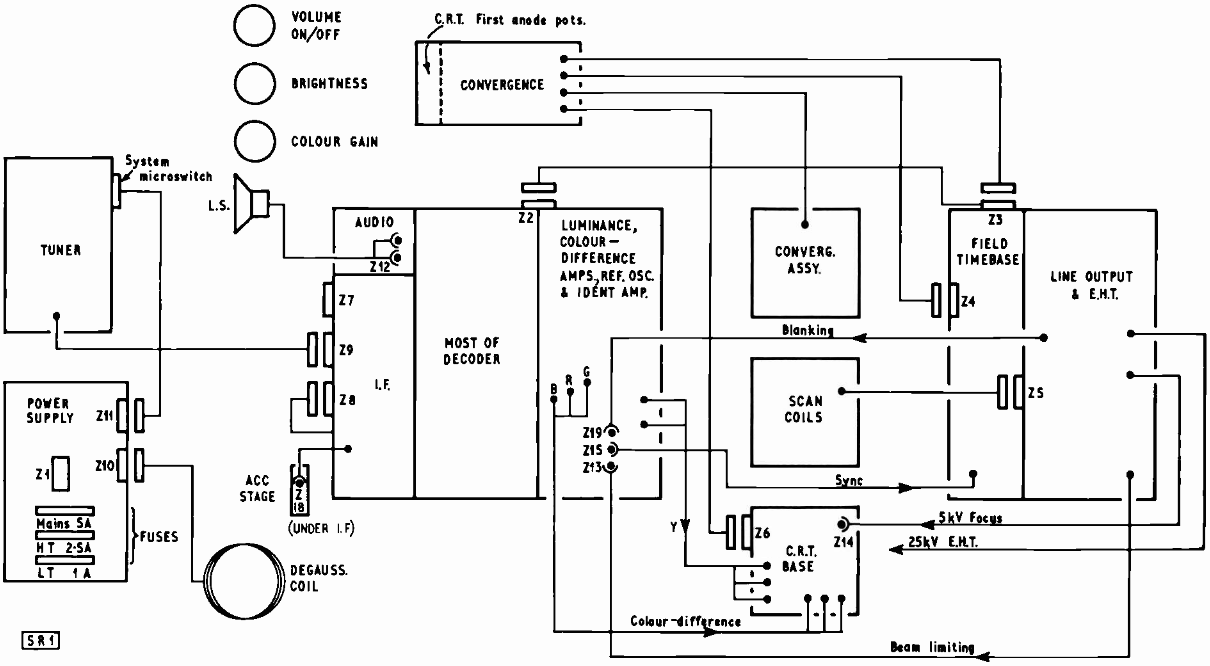


Fig. 2: Interconnections between the various assemblies.

for the button. Besides the normal selection of Band I 405 (BBC-1), Band III 405 (IBA) and u.h.f. 625 there are plates for v.h.f. 625 wired systems. Normally one wants to set all the buttons to u.h.f. 625. Do not despair if there are not as many u.h.f. 625 plates as buttons since for single-standard use it is only necessary to fit one plate and the rest can be thrown away.

Inspection of the tuner mechanism will show how the standards switching is achieved. Each plate has two "arms". The length of one arm selects the v.h.f. or u.h.f. section of the tuner by operating a slide switch. The other arm indirectly operates a bowden cable to set the i.f. board system switch to 405 or 625 and also works a microswitch which supplies mains voltage to the solenoid which operates the timebase 405/625 switch. Since the live connections to the microswitch are rather exposed on top of the tuner it is a good idea to unplug the twisted red/yellow lead to the power supply if standards switching is not required. Incidentally it is possible to arrange the microswitch to operate an aerial relay if one wishes to receive two IBA transmitters on separate aerials. You would have to bodge the plates appropriately.

If the picture is weak and noisy check the aerial sockets before suspecting the r.f. transistors (BF180 for u.h.f., AF180 for v.h.f.). Careless removal of the fibre back can break connections inside the sockets which are held together by two Phillips screws.

I.F. Board

There is little trouble with the i.f. board. This is a pity almost since it is the most accessible board in the set! The layout is shown in Fig. 1. Note the two contrast controls RV4 and RV5: set these carefully since there is no viewer contrast control. If contrast is excessive the beam limiting feedback from the line output stage to the luminance amplifier reduces the picture brightness. The slider of the local/distant control RV2 can be left at distant (uppermost) unless this causes sound/vision cross modulation on a strong signal. In a fringe area it is worth experimenting with this preset for the best signal-noise ratio. Note that the a.g.c. flying lead should be clipped to the *left-hand* pin (Z16): the alternative pin Z17 carries 12V which will stop any signal coming through and give a blank screen—useful for setting up the grey scale.

Occasionally transistors fail, particularly VT1. The correct d.c. voltages are shown in Table 1. The readings are approximate and were measured with a 20kΩ/V meter on 625—they vary slightly on 405.

Table 1: I.F. strip voltage data.

Transistor	*Type*	*Collector V*	*Base V*	*Emitter V*
VT1	AF181	3	11	12
VT2	AF179	2	12	12.5
VT3	BF173	14	4	3
VT4	BF115	11	2	1.5
VT5	BF178	62	8.5	8
VT6	OC45	13	14	14
VT7	BF178	80	62	61
VT8	BC108	15	7	5
VT9	BC187	2	15	15
VT10	AF115	4	10.5	11
VT11	AF115	4	10.5	11

Intercarrier buzz on 625 sound can be dealt with by trimming the cores in the 6MHz sound path shown in Fig. 1. Intermittent sound has been caused by poor contacts at Z7. The video output is from an emitter-follower (VT5 on 625) which can burn out if the output gets shorted to chassis. Watch out for the 400μF electrolytic C78 at the top of the board (15V rail smoother): it is rather vulnerable and may break away from the board causing a

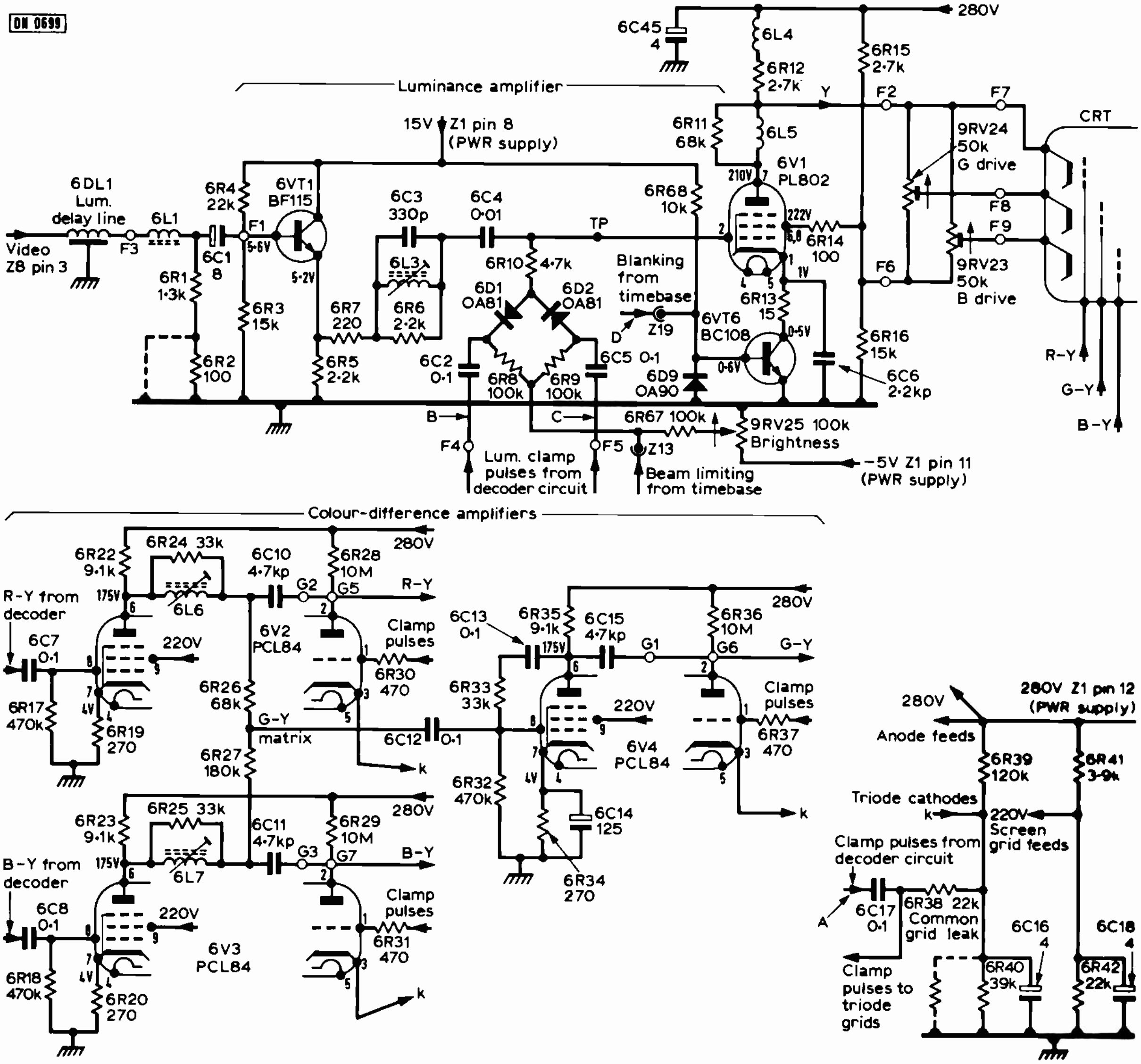


Fig. 3: Circuit of the colour-difference amplifiers and the luminance channel.

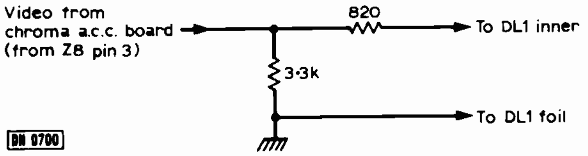


Fig. 4: Later models have these two resistors at the luminance delay line input to improve the luminance/colour registration.

smeary picture. Both this and the 100μF electrolytic C79 can go short-circuit pulling the 15V line down to a couple of volts.

Loss of both line and field sync resulting in an uncontrollable mess on the screen is commonly due to the 1μF electrolytic C51 which feeds the base of the sync separator VT9 going open-circuit.

There are three i.f. stages, VT1, VT2 and VT3, and two sound i.f. stages VT10 and VT11. VT4 is a video preamplifier and on 625 the output is taken from the emitter-follower VT5. Drive for the a.g.c. system is provided by VT7, with VT6 the a.g.c. amplifier. On 405 the video passes via VT5 and VT7 to a separate emitter-follower VT8.

Colour-Difference and Luminance Amplifier Board

The circuit of the luminance amplifier and colour-difference board, excluding the reference oscillator section which will be included with the decoder circuit, is shown in Fig. 3. The flyback blanking transistor 6VT6 often fails giving no luminance or flyback lines on the picture depending on whether it goes open- or short-circuit. (Older sets do not have 6VT6, blanking being done at 6V1 grid.) The high dissipation anode and screen resistors 6R12 and 6R15

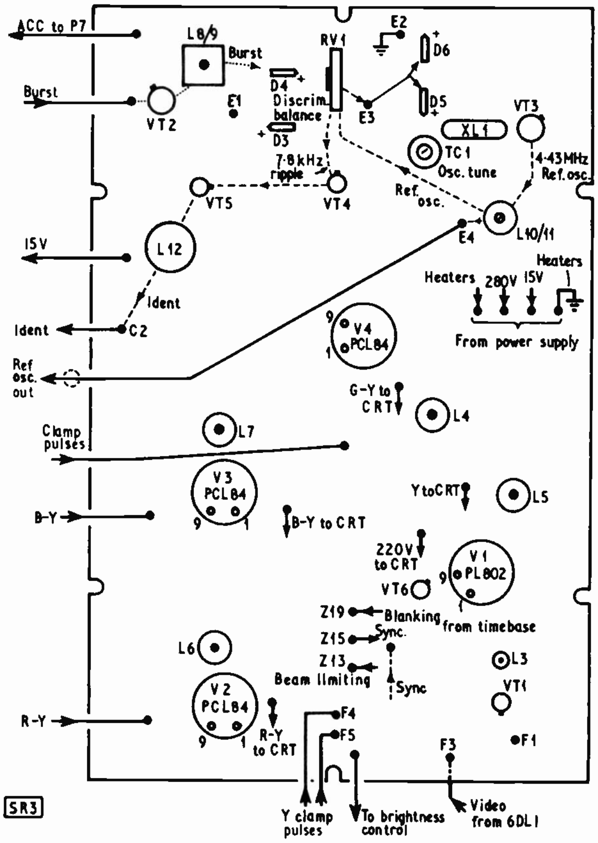


Fig. 5: Layout of the colour-difference and luminance board. Part of the decoder circuit is also on this board. All components are prefixed 6.

sometimes fail as one might expect from monochrome experience, the only teaser being that one still gets a smeary sort of picture if 6L5, 6R12 or 6L4 goes open-circuit since the valve continues to act as a triode with the screen resistor 6R15 as the load!

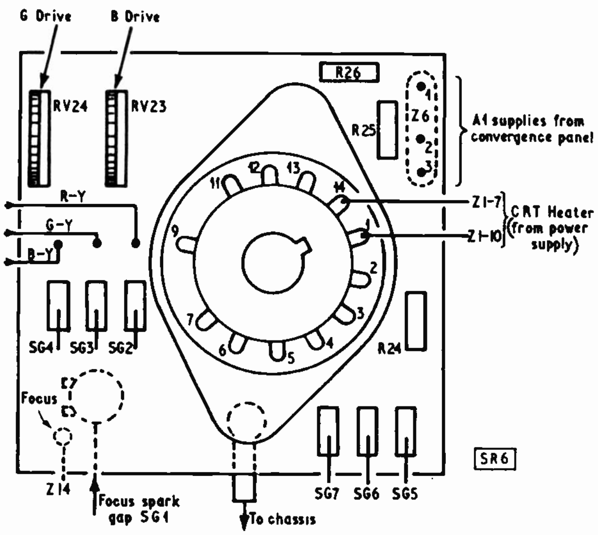


Fig. 6: CRT base board. Components are prefixed 9.

The G and B drive controls are mounted on the c.r.t. base (Fig. 6) and should be adjusted for neutral *whites* in the picture.

The luminance delay line is under the decoder board and feeds video through 6L1 and 6C1 to the preamplifier 6VT1: suspect 6C1 if luminance is intermittent.

On later sets there is a modification which seems to improve the luminance/colour registration when incorporated on earlier sets and is easy to try. Simply add the two resistors shown in Fig. 4 at the input to 6DL1 coming off the gain-controlled chrominance amplifier board.

The luminance clamp is interesting. At the start of each line simultaneous negative and positive clamp pulses from the decoder circuit turn on 6D1 and 6D2 respectively. This clamps the video black level at 6V1 grid to a negative voltage set by the brightness control. Since there is no grid leak as such 6C4 maintains the black level over the rest of the line. Unstable brightness can be due to faulty diodes 6D1/2 (silicon diodes make a sturdier replacement than germanium ones) while irreducible brightness is commonly due to a failure of the −5V supply to the brightness control. Excessive c.r.t. beam current is prevented by a negative beam limiting voltage from the line timebase; this part of the circuit is not usually a source of faults.

The colour-difference amplifiers are generally reliable. Note however the common screen grid resistor 6R41. The only colour-difference signal gain controls are the R−Y and B−Y presets 5RV2 and 5RV5 on the decoder board—some models have only one of these. The G−Y matrixing (6R26/27) and gain are fixed.

At the start of each line the triode sections of the colour-difference valves clamp the c.r.t. grids to the voltage set by 6R39/40. Note the long time-constants 6C10/6R28 etc. which ensure that the clamped level persists throughout the line. A problem one runs into when interchanging these boards between sets is that different models have different values for 6R40 and it may be necessary to change this to correct over- or under-brightness.

NEXT MONTH: THE DECODER

TEST REPORT

—continued from page 28

component substitutions and circuit diagram consultations switching off each time can be a nuisance —or be completely forgotten. But if this is neglected it can mean that the meter is left switched on for considerable periods. Added to this is the danger previously mentioned of failing to switch off at the end of a job or even overnight. A remote switch on the probe similar to some tape recorder microphone switches would be a good idea here I think. Alternatively, larger capacity batteries such as the PP7 would make frequent switching off unnecessary: room could be made inside the case with a little rearrangement of the components.

There it is then: a meter with many good features but as with most items of equipment a few snags. Apart from the battery life however the snags are minor ones and are more than balanced by the facilities the meter offers. The price is £40 retail and is subject to normal trade discounts.

NEXT REPORT: LABGEAR SIGNAL-STRENGTH METER

Workshop HINTS

by VIVIAN CAPEL

TAKING CARE OF TEST EQUIPMENT

A LOT of test equipment these days is transistorised and can therefore be conveniently operated from dry batteries. This means that there is one less lead to be concerned with, warm-up times are eliminated and the equipment can be used in the field without the fuss or changing mains plugs or carrying an array of adaptors.

There is however a debit side. Batteries do not last forever, periodic changes are necessary and in a busy workshop such changes may easily be neglected or forgotten. The results of an overdue change are first impaired or inaccurate operation while the battery voltage is below the minimum value specified by the makers of the equipment and secondly if the battery is left in when exhausted the all too familiar leakage and corrosion effects with perhaps major damage to the equipment.

It is a fact of workshop life that some items of test equipment—bought with great enthusiasm as to their prospective usefulness—somehow never get the use that was envisaged: they lie on the workshop shelves gathering dust and are only occasionally put into service. It may not be that they are ineffective, just that the need for them is not as frequent as was anticipated. These are the items that particularly have to be watched if battery operated as it is so easy for the batteries to be left in long after they should have been removed.

Extending Battery Life

Battery life with such instruments can be considerably extended by making use of one characteristic of the present generation of dry batteries: small, short discharges at not too long separated intervals will maintain the battery in a healthy state over quite a long period—far longer than if it is not used at all. This may seem contrary to the expectation that an unused battery would last longer than one that is used but is nevertheless true. It explains why meter batteries which are subject to low discharges of short duration quite frequently seem to go on for protracted periods while spare torch batteries stored from one winter to the next are often well down and practically useless when eventually fitted.

This being so it is a good plan once in a while—say once a month—to switch on all transistorised test instruments for ten minutes, especially equipment that is not often used. If this is done at a set time, say the first of the month or the first working day thereafter, it will not be forgotten.

Regular Battery Replacement

While this practice prolongs battery life it will not make the battery everlasting. So we are still left with the problem of replacing the battery before performance deteriorates or worse happens. A good way of providing a reminder is to fix a label giving the date of the last replacement somewhere on the outside of the test instrument. This could be a stick-on label on the base or a tie-on label on the handle. This method is better than inscribing the battery itself as with the latter procedure the instrument must be opened to check the date and this will just as likely be forgotten as making a voltage check.

The average length of life to be expected from a battery depends on the capacity of the battery, the current drain of the equipment, the frequency of use and the length of time it is used on each occasion. Some of these factors vary but it will be found that on average the life of each battery will be much the same as its predecessor. Hence the previous dates on the label will indicate roughly when the next replacement is due. Some instruments—such as transistor "valve" voltmeters—have built-in checks for internal battery voltage so it is hardly necessary to use a label as a reminder with these. Also instruments that are used privately rather than in a workshop are likely to have a much more variable battery life so that replacement by date is not so practical. Whether you are an amateur experimenter or work in a busy service department however it is as well to have some arrangement for looking after the batteries.

Erratic Meter Readings

The conventional volt/ohmmeter which is the engineer's main standby uses batteries for the resistance range and these generally last for a considerable time. This can however be a mixed blessing. Complaints are often heard of erratic behaviour on the lowest resistance range: the pointer is set to zero but does not stay put and takes up various positions making adjustment difficult or impossible. In desperation the engineer will often select a higher range that appears to be more stable even though the scale is rather cramped for the resistance he wishes to measure. In many cases the trouble can be traced to the battery contacts. If the battery is rarely changed oxide may form on these introducing a resistance of variable nature. Removing the battery and cleaning both the battery terminal and the contact strip—finishing off with a smear of silicone grease—will in many cases cure this annoying fault. There are other possible causes however. Poor contacts between the test leads and the meter sockets may be responsible, though this is less likely because of the frequent movement between them as the leads are removed and refitted. An intermittent break in the leads themselves or in one of them is another possibility: the wire ends at the point of the break may be just touching, resulting in a contact of varying resistance. This may make little difference when measuring voltage but shows up on the low-resistance range.

A further cause can be the resistance adjuster which may be either dirty or worn. This can be cleaned in the usual manner. If the adjuster is at fault the symptoms will be that a stable reading can be obtained (although off the zero scale marking) at some settings but not at others, with matters aggravated when the control is touched or moved. If these are not the symptoms the trouble is more likely to be in the places previously mentioned—especially the battery contacts.

Once again then there is a case for a regular routine: remove and clean the batteries and contacts every so often. This is better than waiting for the trouble to crop up—invariably at an inconvenient moment!

Precautions against Accidents

It pays to take care of all test equipment, the multirange meter in particular as it is so important to the engineer's daily work. From time to time nearly every workshop has its casualties but many of them could be avoided if more care was taken and certain routine precautions observed. It is not uncommon for example to see a meter laying on the edge of the workbench with its test leads dangling over the edge. It only needs someone to pass closely by, perhaps carrying a set and not noticing the danger, for the leads to get caught up and the meter pulled off. To prevent this the meter test leads should never be allowed to dangle over the edge of the bench. Park them so as to offer the minimum hazard: they can be coiled loosely on the bench itself or wound over the top of the instrument and around it so that it is lying within the coiled leads. The clip used for the chassis connection is especially likely to get caught up. It should be clipped to the leather carrying handle if the meter possesses one. Failing this it can be clipped sideways (not with the teeth biting the lead) on to the meter end of the lead. Care must be taken not to let the loop thus formed dangle and provide another hazard. The ideal from the safety angle is to detach the leads completely and store them elsewhere but as the instrument is in such frequent use this is rather inconvenient.

Accidents frequently occur as a result of a meter being perched in a precarious position. Quite apart from the leads and the hazard they present the edge of the bench is far from the ideal position to leave a test instrument. Equipment should be placed well back toward the rear (if there is a rear wall) when not in use, and brought forward as necessary to make test readings. If the bench is positioned with its side to the wall the meter should be parked near the side wall.

When working on some older console TV sets or on radiograms the engineer has sometimes to adopt awkward positions in order to get at the works. Meters then have to be placed where they can be seen which is not always the safest position. The likelihood of accidental damage to the meter can be lessened by placing it as near the floor as possible and putting a blanket or something soft underneath so that if the worst happens and the meter topples it has a soft landing!

Overloads

Not all damage inflicted on test equipment is mechanical. Electrical overloading accounts for a fair proportion of accidents. Most meters are equipped with overload protection devices such as fuses or velocity trips and these are invaluable—without them the casualty rate would be far higher than it is. Effective as these are however they cannot give 100 per cent protection. It is best to think of the meter as being unprotected and to take precautions against overloading.

The first precaution is always to leave the meter switched to a high-voltage range when not in use. This is the range which is used most anyway so it is the one most likely to be needed next time the meter is required. If this is done then if the instrument is picked up and used in a hurry without checking the range it will be safe. The meter should never be left switched to the resistance range: not only is this one of the most vulnerable to overload damage but there is also the possibility of the leads shorting together and running down the internal battery.

Even though you have acquired the habit of leaving the meter on a high-voltage range always check the range before using the meter again. Never assume that it is still on that range. You may have forgotten to switch it round after using it or someone else may have used it. The check-before-use habit provides a second line of defence.

One must be especially careful when actually trouble-shooting. The meter is often used on resistance and voltage ranges alternately as various checks are made and while deep in thought as to the fault and its symptoms it is very easy to forget that the meter is on the wrong range. The only safeguard is to practise the check-before-use procedure at all times, really making a habit of it. Never apply the prod to a circuit without a glance at the range switch: it will pay off in terms of long meter life.

Shock and Vibration

When a meter is to be subjected to shock and vibration, for example when sent through the post or another delivery channel, it should not only be adequately packed to prevent damage to the case but the movement itself should be protected by magnetic damping. Switch the meter to the lowest direct current range (if it is a multirange instrument) and short the terminals together with a piece of wire. By doing this any movement of the pointer caused by shock will generate an e.m.f. which will cause current to flow through the shorting wire: this will set up a magnetic field in the bobbin which will interact with the meter magnet to oppose the original motion and thereby damp it. Some manufacturers send out panel instruments protected in this way.

It would not be a bad idea to do something along these lines to meters used for outside service work. The leads could be shorted by connecting the chassis clip to the test prod and the meter switched to the low direct current range. This unfortunately represents a potential hazard as the meter may be used to measure high voltage without checking the range—with disastrous results! Thus the value of one safety precaution is negated if another is overlooked. The ideal answer would be for meter manufacturers to include a transit position on the range switch to open-circuit the test lead terminals but put a short across the meter movement. I have not seen this done in any commercially made multirange meter but if some maker would take the hint the result would be a very useful meter for outside service work.

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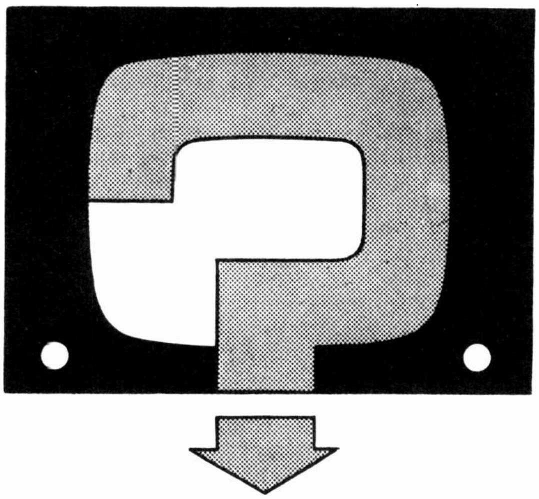

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PHILIPS 1796U

The trouble with this set is lack of height. With the height control at maximum there is still a gap of about 1½in. at the top and bottom of the screen. The h.t. rectifier, boost diode and field timebase valves have been renewed without improvement. Though lacking in height the picture is quite good. —T. Cheeseman (Romford).

We suggest you try fitting a 1MΩ resistor in series with the chassis end of the focus control. The reason for this is that the control tends to change value, thus dropping the voltage available at the height control (boost line). The control could of course be replaced if it is the cause of the trouble. Check the value of the 680kΩ resistor from the height control to the anode of the field oscillator if necessary, also C83 (0·027μF) which decouples the boost line to the h.t. rail.

PYE V110

We have had difficulty with picture rolling with this set after it has been on for about half an hour. Changing the field timebase valves does not improve matters. Now we have no picture at all: the PL81 line output valve is glowing red but cools down when the top cap is removed from the PY81. There is a strong whistle, indicating that the line oscillator is working. The line timebase valves and the boost capacitor have been replaced.—P. Hammerson (Aberdeen).

For the field fault check C74 (470pF) in the field interlace circuit. This may be open-circuit. For the line fault check the PL81 screen grid resistor R106 (2·7kΩ 1W).

GEC BT456DST

Operation on 405 lines is OK but on 625 lines there is lack of width (2-3in. at each side of the screen) together with foldover on the left. The boost voltage on 625 lines is down—about 580V—with the set boost control at maximum. The timebase valves have been replaced, also the S-correction capacitor on 625 lines.—S. Carruthers (Newhaven).

Lack of width on 625 lines combined with foldover such as you describe usually indicates a defective line output transformer, the 625-line overwind having developed a fault.

INVICTA 638

When the set is switched on there is no picture or raster. The line whistle is absent, the e.h.t. rectifier does not light up and the PL81 overheats. When the aerial is removed however the PL81 returns to normal, the line whistle is audible and a narrow, wavy raster is obtained. On reconnecting the aerial the previous conditions return.—R. Grade (Boston).

The line oscillator is a free-running type but when the line sync pulses are applied it stops oscillating. The probable cause of the trouble is the flywheel line sync circuit and we suspect the discriminator diodes. These are marked V17 on the circuit and are type D3-2-1Y. Replace them with two separate ones if you prefer, e.g. two BA144 silicon diodes. If this does not clear the trouble check the diode load resistors R86 and R87, the filter resistor R90 and feed resistor R92. There is a small chance that the line output transformer is faulty: if it is the PL81 will no longer overheat when its top cap is removed.

GEC BT448

There is bottom compression and top expansion and the picture expands and contracts in the vertical plane. The field timebase valve (which gets very hot after about ten minutes) and its cathode components have been replaced. Also after about a quarter of an hour the width decreases by about an inch each side: the boost diode and the h.t. and e.h.t. rectifiers have been replaced but this fault persists.—H. Gardner (Cambridge).

The field timebase valve seems to be incorrectly biased and as you have replaced the cathode components we suspect that the coupler C131 (0·1μF) is leaky. The field output pentode cathode voltage (pin 2 of the 30PL14) should be 17·6V. For the low width check the 30P19 line output valve and its grid leak resistor R106 (470kΩ), then check its screen grid voltage (102V at pin 4) and if necessary the screen grid resistor (R103, 3·9kΩ). It is of course possible that a fault has developed in the line output transformer.

BUSH TV191D

The picture on 625 lines is grainy and there is vision-on-sound. The aerial has been adjusted and a preamplifier tried but with no improvement. Operation on 405 lines is all right but the a.g.c. delay control has no effect on either system. Switches and plug connections have all been cleaned and checked. —J. Major (Leicester).

We suggest you first check the operating conditions of 2VT1 (BF167) the first i.f. transistor. The emitter voltage is the most significant reading and should be 3·3V. If there is no voltage across the emitter resistor 2R9 the transistor is likely to be at fault. Then check the r.f. amplifier transistor (BF180) in the u.h.f. tuner: this is likely to be the cause of the poor performance on 625 lines.

SOBELL 1019

After about 3-3½ hours the line hold fails, the picture breaking up. The 405 line hold control P9 is at the limit of its travel and I am wondering whether adjusting the sinewave oscillator coil (L65) will make it possible to get stable line hold with P9. Replacing the PCF802 oscillator valve makes it impossible to lock the picture at all.—F. Crayford (Huyton).

A *small* adjustment to L65 core may make it possible to restore line lock. However the fault is more likely to be due to a defective tuning capacitor—check C167 (1·5kpF), C168 (2·2kpF) and C169 (3kpF)—or change of value of the common cathode resistor R122 (560Ω). We suggest you replace these components and then adjust L65 for lock on 405 lines with P9 set to mid-travel.

DECCA DM4/C

The sound quality is poor. It is best at low volume settings but there is considerable distortion when the volume control is advanced. The sound is reasonably clear only when the volume control setting is such that the sound is barely audible. The contrast and fine tuning controls make no difference to the problem.—G. Sutcliffe (Scarborough).

Early versions of the DM4/C used a PCL83 audio output valve, later versions a PCL82. Whichever is used replace it and check the cathode bias resistor which could well have changed value. Use a 270Ω resistor if in doubt. If the valve is not the cause of the trouble check the 0.01μF capacitor which is connected between pin 6 of the sound detector/interference limiter EB91 and the top end of the volume control.

PYE V700A

The troubles with this set are poor contrast, poor field lock and the fact that the bottom of the picture creeps up slowly to about 2in. from the bottom of the screen (this takes about 15 minutes). The picture shrinkage and poor field lock seem to be linked. All likely valves have been replaced and the cathode components of the field output pentode checked and found to be up to standard.—D. Reese (Wembley).

The field trouble is commonly due on this chassis to the 50μF electrolytic (C47) on the sync panel. Your weak signal is likely to be due to a low vision detector diode (V9 CG64).

FERGUSON 743T

The sound and width are OK on this transistor portable mains/battery set but the height is only about an inch. The height, linearity and hold controls all produce some effect on the screen, suggesting that most of the field timebase circuit is operating correctly. The OC26 field output transistor, also the oscillator transistor, have been replaced.—H. McClasky (Perth).

The set uses a conventional transistor blocking oscillator followed by a driver d.c. coupled to the output transistor: unfortunately the trouble could lie anywhere in these three stages and will probably have to be traced by taking voltage readings. We are however inclined to suspect the 500μF electrolytic (C167) which is connected between the two halves of the field deflection coils. It would also be as well to check the field charging capacitors: these are the electrolytics C121 (8μF) and C122 (25μF).

PHILIPS 23TG175A

There is vision-on-sound which cannot be tuned out by adjusting the fine tuner. Resetting the sound discriminator balance control doesn't improve matters either. The trouble is experienced on 625 lines only and is particularly pronounced on captions.—R. Grampian (Totness).

We feel that the trouble is due to the ratio detector transformer L208/L210/L211 being out of tune but you should also check the ratio detector diodes (the OA79s in the transformer can) and the associated 4μF electrolytic C219.

SOBELL 1010

There are horizontal bars across the screen which vary with the sound. On the sound side there is buzzing, particularly when captions are displayed: this can be varied by adjusting the tuning but cannot be eliminated. The trouble is present on all channels. All valves have been checked and found to be in order.—B. Hall (Rugby).

You will find a 32μF electrolytic capacitor (C93) beside the PFL200 valve. This electrolytic decouples the supply to the video amplifier screen grid and the anode of the EH90 sound detector/amplifier valve. Replacing it should cure both fault conditions.

FERGUSON 3601

This set is fitted with the BRC/Thorn 850 convertible chassis and has had very little use. There is however trouble with the line hold. When switched on from cold the line hold control has to be adjusted then after a few minutes the picture slips out of sync and the control has to be readjusted. This occurs several times before the picture finally becomes stable and remains so till switched off. The line oscillator and sync separator valves have been replaced and there are no signs of discoloured resistors.—S. Haynes (York).

We suggest you replace the line blocking oscillator grid circuit timing components: these are C82 250pF and R94 220kΩ. If the set has been converted and the trouble persists check the flywheel sync diodes on the conversion panel.

BUSH TV105

The problem is field judder—about a 1in. jump. The judder can be stopped by adjusting the height control so that the picture is closed up, or made less of a nuisance by opening the picture out. Thinking that the height control might be the cause of the trouble I have checked and cleaned this but the problem remains. The judder, after being removed by adjusting the height control, can be brought back by altering the linearity control settings. All the valves in the field timebase have been changed.—F. Olderton (Perrivale).

The problem is due to a defective capacitor and we suspect C82 (0.02μF) in the field linearity feedback loop—connected between the two linearity controls. Change this, then if necessary check the field charging capacitor C84 (0.05μF).

HMV 2643

There is normal sound but no line whistle or e.h.t. All valves are glowing and those in the line timebase have been replaced.—T. Cribbins (Peterborough).

There is a separate h.t. feed to the line output stage in this chassis, the feed resistor being R115 (950Ω). We suggest you check this resistor as it is likely to be open-circuit: it is the nearest upstanding resistor to the field hold control. This diagnosis assumes that there is no overheating in the line output stage: if there is check the h.t. feed resistor R46 (5.6kΩ) to the line oscillator stage.

PHILIPS 19TG142A

The fault with this set is poor focus, the focus control having no effect at all on the picture. A new tube has been fitted without solving the problem.—R. Brownlow (Durham).

The focus control itself (R112 500kΩ) is the most likely cause of the trouble. Check it and also the 470kΩ resistor (R111) in series with it and the 220kΩ resistor (R449) feeding the first anode (pin 3) of the c.r.t. Particular attention should be paid to the width of the picture, noting any variation that occurs as the brilliance control is advanced: if there is little if any change it can be assumed that the line output and e.h.t. stages are in order.

BUSH TV128

The original fault we had with this set was no picture: this was found to be the result of 3C42 which decouples the boost feed to the tube first anode shorting and after replacement the set worked well for a few days. Then the fault of excessive brightness with poor contrast developed. We examined the resistors in the video amplifier circuit, replacing the anode load and the screen and cathode resistors, but the fault persists.—J. Appleby (Ware).

We feel the trouble will probably be solved by replacing the PCF80 video amplifier valve. The triode section of this acts as video cathode-follower driving the tube: thus low emission will lead to low cathode voltage and excessive tube brightness.

SOBELL T178

The trouble with this set is sound on vision which we have been unable to tune out by adjusting the rejector. The local oscillator has been adjusted and the h.t. and smoothing seem to be OK.—J. Grant (Dunstable).

We suggest you replace C38 (0.1μF) which decouples the a.g.c. line. There are two rejectors, L5 which also serves to tap off the signal to the sound i.f. amplifier and L6. They will be found on either side of V4 (EF80) and should be set for minimum vision at 38.15MHz.

MARCONIPHONE 4612

There are two pictures divided horizontally, the bottom one having lots of thin white horizontal lines on it. The PCL85 field timebase valve has been checked and found to be OK.—H. Cloverdale (Burton).

Just behind the PCL85 you will find an 0.003μF capacitor (C79) which is rated at 1.2kV working. This is the feedback capacitor from the pentode anode to the grid circuit of the triode section of the valve. It is the first but not the only suspect. Also check the 100μF pentode cathode decoupler (C89) and the resistor in series with the field hold control (R98 470kΩ).

SOBELL 1033

Line and field slip were experienced on 625 lines but this was cured by replacing the 2000μF and 1000μF electrolytics which smooth the 20V rail. Now however there is a ghost to the right of figures etc. —white after black and the reverse—the ghost being about 1½in. away on 625 lines, rather less on 405. Several faint ones follow the main, pronounced one. A further problem is vertical striations on the left-hand side of the picture. The picture quality is otherwise good.—D. Mason (Rochdale).

The ghosting you are experiencing is typical of an aerial fault and we suggest you check the downlead as well as the aerial positioning. We do not suspect a set fault as you say the picture quality is otherwise good. For the striations first of all suspect the line ouput valve screen grid decoupler (C227, 0·22μF), then the line output transformer.

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TELEVISION NOVEMBER 1972

TEST CASE

119

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

? *A GEC Model 2047 suffered from intermittent failure of both sound and vision, the vision symptom resulting from a collapse of e.h.t. voltage. Since both sound and vision were affected the technician's first move was to check the main h.t. rail voltage under the fault condition. This proved to be fairly normal however. Further voltage checks then revealed that under the fault condition the supply to a section of the sound channel was lacking.*

It was decided to concentrate on the vision failure and on making checks in the line timebase it was soon discovered that while line drive was being applied to the output valve the output stage appeared to "block", cutting off the e.h.t. supply. The line output valve was not unduly hot but when a 20,000Ω/volt meter switched to the 100V range was connected between its control grid and chassis both sound and vision returned, the raster carrying a fair amount of horizontal distortion however.

The circuit was consulted and it was not long afterwards that the technician had the set working correctly. Why were the sound and vision faults related and what component was most likely to be responsible for the trouble? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 118

Page 571 (last month)

The d.c. supply for the line output valve passes through the conducting efficiency diode and since the line output valve continued to pass anode current with the top cap of the PY800 efficiency diode removed it was obvious to the technician that an alternative d.c. route had been created by the fault condition.

One such route is via a shorted boost reservoir capacitor. An insulation check on this component was the first test made but the capacitor was in order. Study of the circuit around the line output transformer revealed only one other alternative route —between two isolated windings on the line output transformer. Disconnecting the windings and making a simple insulation test between them proved that this was indeed where the fault lay. Line output transformer replacement cured the trouble.

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