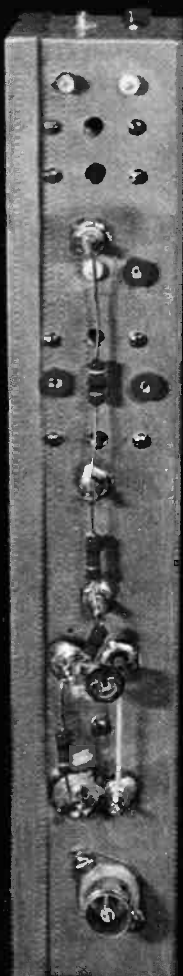
PRACTICAL

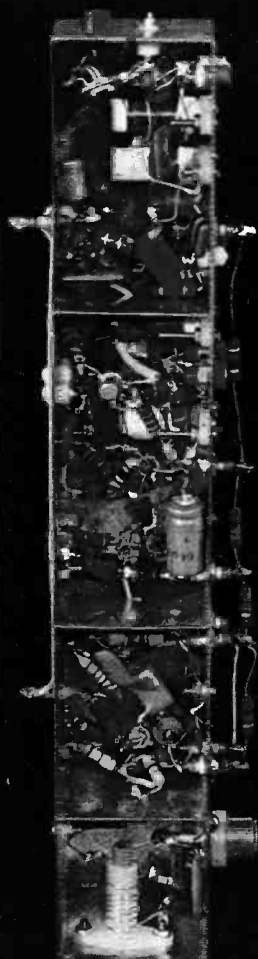
TELEVISION

3/6

SEPTEMBER 1970

IF





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BURST AND ACC CIRCUITS • TUBES FOR COLOUR TV

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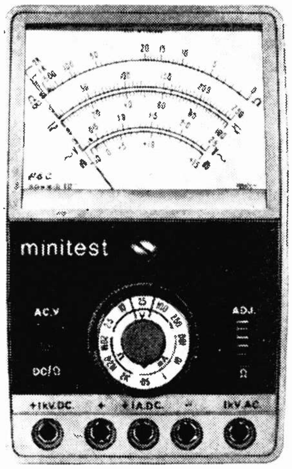

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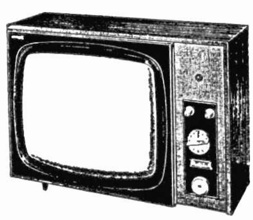

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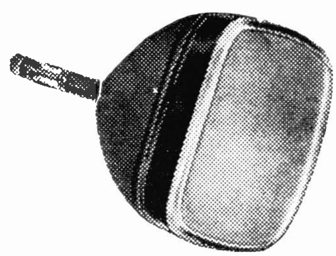

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DpF96	8/3	EL34	9/9	PL82	7/3	6AV6	6/6
DF91	9/–	EL41	10/–	PL83	10/3	6BA6	9/6
DF96	9/–	EL81	9/6	PL84	8/3	6BE6	12/–
DK91	11/6	EL84	7/9	PL500	16/6	6BR7	15/–
DK96	11/6	EM81	11/6	PL504	17/–	6BR8	19/–
DL92	7/6	EM84/7	12/9	PL505	29/–	6BW6	16/6
DL94	7/6	EY51	7/6	PL508	20/–	6BW7	13/9
DL96	9/3	EY86/7	7/9	PL509	30/9	6CD6G	28/–
DY86/7	8/–	EZ40/1	7/6	PL802	17/3	6V6G	8/–
DY802	8/6	EZ80	6/6	PL805	17/3	6X4	7/6
EABC80	10/6	EZ81	5/9	PY32	10/–	6X5	9/6
EBC33	11/–	GY501	14/6	PY33	10/9	12AU6	15/–
EBC41	9/6	GZ30	9/6	PY81	8/3	12BA6	9/6
EBC81	6/6	GZ32/4	11/9	PY800	8/3	12BE6	12/–
EBC90	9/6	GZ33/7	16/3	PY801	8/3	12BH7	14/–
EBF80	8/–	KT66	25/6	PY82	7/–	35W4	9/6
EBF83	8/–	KT88	32/6	PY83	10/–	50C5	12/6
EBF89	8/–	N37	15/6	PY88	8/3	50CD6G	28/–
EB91	5/3	N339	25/6	PY500	20/–	6F23	15/6
ECC81	8/–	PC86/8	10/3	PZ30	16/–	6F24/5	12/6
ECC82/3	8/6	PC900	10/3	R19	13/–	6F26	8/3
ECC84/5	8/6	PC95	7/3	R20	15/–	6F28	11/6
ECC88	11/–	PC97	8/3	UABC80	10/6	6/30L2	15/6
E88CC	12/6	PCC84	9/3	UBF89	8/–	10F1	15/–
ECF80/2	9/6	PCC85	8/6	UBC41	9/9	10F18	10/–
ECF86	11/–	PCC88	14/–	UCC85	9/3	10P13	16/–
ECH35	13/6	PCC89	12/3	UCH42	13/9	10P14	19/–
ECH42	13/3	PCC189	12/3	UCH81	10/9	20P4	20/–
ECH81	10/3	PCF80	10/3	UCL82	10/3	30C1	10/3
ECH83	8/–	PCF82	10/6	UCL83	12/3	30C15	13/9
ECH84	9/6	PCF84	9/6	UF41/2	11/–	30C17	15/9
ECLL800	20/–	PCF86	12/3	UF80/5	7/6	30C18	13/6
ECL80	8/–	PCF200/1	16/3	UF89	8/3	30F5	16/6
ECL82	9/9	PCF801	12/3	UL41	11/6	30FL1	12/9
ECL83	11/6	PCF802	12/3	UL84	11/–	30FL12	17/6
ECL86	9/9	PCF805	13/–	UM80/4	9/–	30FL14	13/6
EF39	10/6	PCF806	12/3	UY41	8/–	30L1	9/3
EF80	8/–	PCF808	13/6	UY85	6/9	30L15	15/3
EF83	10/–	PCH200	11/6	U25	15/–	30L17	14/6
EF85	8/3	PCL82	10/3	U26	15/–	30P12	15/6
EF86	13/3	PCL83	12/3	U191	14/6	30PL1	12/9
EF89	8/–	PCL84	10/3	U193	8/3	30P4MR	20/–
EF91	8/6	PCL85	10/6	U301	17/–	30P19	12/9
EF92	10/–	PCL86	10/3	W729	11/–	30PL13	18/6
EF93	9/6	PD500	30/6	Z759	24/6	30PL14	18/6
EF94	15/6	PFL200	14/9	5Y3	8/6	30PL15	18/6
EF95	12/6	PL36	12/9	5Z4	9/6		
EF183	11/3	PL38	18/–	6U4	15/–		

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AC127	4/9	BC118	7/9	BF22A	9/6	2N3055	15/–
AC128	4/6	BC134	11/6	NKT125	5/9	2N3392	5/–
AC176	7/4	BC147	5/8	NKT281	4/–	2N3702	5/6
ACY17	6/–	BC148	4/4	NUT401	17/6	2N3705	4/6
ACY20	6/–	BC152	5/6	OC25	9/6	2N3711	4/9
AD149	11/8	BC175	5/6	OC44	5/6	2N3819	9/–
AD161	6/9	BC187	5/8	OC45	5/4	2N3826	6/–
AD162	6/9	BC213L	5/4	OC71	4/4	2N4062	4/6
AF114	4/8	BDY20	30/6	OC72	5/4	2N4289	4/6
AF115	4/8	BFY50	5/–	OC77	5/6		
AF116	4/9	BFX84	7/–	OC78	5/–		
AF117	4/6	BFX29	7/6	OC81	4/–		
AF118	12/–	BF115	5/6	OC81D	4/–	**RECTIFIERS**	
AF126	4/8	BF117	9/6	(GET113)		BY126	4/4
AF127	4/8	BF163	7/–	OC84	5/–	BY127	5/–
AF139	8/8	BF167	6/–	OC169	4/8		
AF178	9/–	BF173	7/–	OC171	6/–		
AF179	9/–	BF178	7/–	OC200	6/6	**DIODES**	
AF180	12/4	BF180	8/–	OC202	9/6	AA119	2/–
AF181	9/4	BF181	8/–	OC203	6/6	OA47	1/9
AF186	13/4	BF182	8/–	OCP71	12/6	OA79	1/10
AF239	8/6	BF184	5/–	P346A	4/6	OA81	1/10
BC107A	5/–	BF194	5/–	2N456A	17/6	OA91	2/–
BC108B	4/6	BF197	6/4	2N697	5/10	OA202	2/–
BC109C	5/–	BF200	7/4	2N698	10/6	BZY88	
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	CME1703	£6.12.0	£4.12.6
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AW47-91 }			
	CME1901	£7.13.4	£5. 7.6
A47-14W }	CME1902	£7.13.4	£5. 7.6
	CME1903	£7.13.4	£5. 7.6
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A47-13W	CME1906	£10. 5.6	£8.10.0
A47-11W	CME1905	£8.17.3	£7. 0.0
A47-26W	CME1905	£8.17.3	£7.15.0
A47-26W/R	CME1913R	£9. 6.8	
A50-120W/R	CME2013	£10.17.0	
AW53-80		£8.18.8	£6. 5.0
AW53-88	CME2101	£8.18.8	£6. 5.0
AW59-90 }	CME2303	£9.11.8	£7. 4.0
AW59-91 }			
A59-15W }	CME2301	£9.11.8	£7. 4.0
	CME2302		
	CME2303		
A59-11W	CME2305		
A59-13W	CME2306	£13.13.0	£10.19.6
A59-16W	CME2306	£13.13.0	£10.19.6
A59-23W	CME2305	£12.12.0	£10.10.0
A59-23W/R		£12.12.0	£10.10.0
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PRACTICAL TELEVISION

VOL 20 No 12
ISSUE 240

SEPTEMBER 1970

FACE LIFT

NEXT month we enter our 21st year of publication since the magazine was re-established after the war, and will be introducing a slight modification to our cover styling. "Practical" will be dropped and a by-line added — "SERVICING — CONSTRUCTION — COLOUR — DEVELOPMENTS" — to emphasise the main coverage of the magazine at this point in time.

No great changes will take place *inside* the magazine, which will still retain its practical approach. Over the last year the amount of space devoted to construction has been increased and we intend to keep this up; a colour receiver is at present under development for example. We also intend to maintain our comprehensive coverage of servicing subjects, with the emphasis on day-to-day practical matters.

So why alter the title? Well, we live in a changing world, and it is necessary from time to time to adjust our "image" to reflect more accurately the range of subjects that progress in television forces us to cover.

"Practical Television" today somehow conjures up visions of the era before u.h.f., colour, printed circuits, ICs and even transistors had become commonplace. To keep readers abreast of what is going on and the problems likely to be faced, it is necessary to tackle ever more complex subjects and to delve deeper into them. This will be done in our traditional way — presenting technicalities in a straightforward manner that can be easily followed but without skating over the difficult bits that just confuse if ignored.

So we've decided on a slight face lift, if only to be seen to be keeping up with events as well as actually doing so! We will continue to serve our existing readers, while doing our best to encourage newcomers and appeal to the increasing number of people concerned in one way or another with the technical side of television.

W. N. STEVENS, *Editor*

THIS MONTH

THE NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED SEPTEMBER 18

TELETOPICS

NOW VIDEODISCS!

The recording of television programmes on discs for replay on a teleplayer feeding a standard TV set is the latest development in the recorded video field. The new development has been unveiled by AEG-Telefunken and Decca, whose jointly-controlled subsidiary Teldec is responsible for this breakthrough. The technical achievement that makes the system possible is the development of a high-density disc storage system in which 10 grooves are the equivalent in thickness to a human hair. This increases the disc information storage capacity by about 100 times in comparison with a normal audio LP record. The player is expected to cost between £50 and £100, and the discs something of the order of 25s. The present playing time is 12 minutes but an autochanger unit to provide longer programme times is being developed. The discs and players are expected to be available commercially in about two years' time, first in black-and-white and later in colour. It is claimed that the grooves in the disc are virtually indestructible.

The videodisc is made of cheap, flexible plastic foil with a groove width of about 8μm. and depth of 0.5-1μm., giving 100-140 grooves per millimetre. The discs are produced from film which is scanned frame by frame and the playing speed is 1,500 r.p.m., the disc resting on a thin air cushion which stabilises the disc movement to within 50μm. The special playing needle is sensitive to pressure rather than, as in a standard audio pickup, movement, an impression receiver being used to measure this pressure accurately. Movement of the pickup head is controlled by a drive unit and mechanical pulley which draws the head smoothly across the disc by means of a tensioned cable.

The horizontal definition is about 250 lines with a 3MHz bandwidth and the sound is recorded on the single track by using the sound-on-sync principle. Frequency modulation is used for the video signal, the hill-and-dale recording technique being used. The ceramic pick-up provides an output of about 2mV.

Operating the videodisc player is child's play!

NEW FROM THE SETMAKERS

Two new chassis and a number of portable models this month. From **Decca** come Models CS1910 and CS2213 fitted with a new single-standard colour chassis which Decca call the Bradford chassis. This features RGB drive, a.f.c. and an integrated circuit sound channel. A new black-and-white chassis has been introduced by **STC-ITT,** the VC200, and is a departure for this organisation in using printed circuitry. The chassis is so far used in two **KB** models, the SV042 20in. model (£70.10.0d.) and the SV142 24in. model (£78.10.0d.). Other features of the chassis are the use of a selenium e.h.t. rectifier and etched-foil inductors in the wideband i.f. coupling circuits.

Sony have introduced a 7in. model, the TV7-20UK. This single-standard model covers channels 21-69 and can be operated from the mains or a 12V battery. It is fitted with a loop aerial, anti-glare tinted screen, weighs 8lb 13oz and has a recommended price of £73.15.0d. **Sanyo** have introduced a 5in. model, the 5-TC1, at just over £70. This will operate from the mains or nickel-cadmium rechargeable batteries.

The brand name **Philco** reappears from the Ford subsidiary Philco International Ltd., 42 Leicester Square, London WC2H 7LR, who have introduced a 12in. single-standard portable called the "Tommy". This can be operated from an a.c. mains supply, 12V car battery or rechargeable battery pack (optional extra) and costs 89 guineas. It is available in a red, teak or white wooden cabinet with tinted laminated glass filter screen.

LATEST TRANSMITTERS

The BBC-2 u.h.f. service from **Hannington** (Hants) started on June 13th on channel 45 with horizontal polarisation (group E receiving aerial). The BBC Wales TV service from the **Llanelli** relay station started on June 8th on channel 3 with vertical polarisation. The station serves Llanelli, Llwynhendy and Felin-foel. The BBC has placed orders for the start of work on u.h.f. relay stations at **Maesteg** (Glamorgan) and **Bethesda.**

US AND JAPANESE COLOUR

The US Magnavox Co. has recently announced sharp reductions in the prices of their 14 and 23in. colour models and there is speculation as to whether this might be the beginning of a price-cutting war that could seriously affect the substantial exports of Japanese colour sets to the US. It is also understood that some US manufacturers are planning to have their colour sets assembled in Formosa. With the prospect of unfavourable trading conditions in the US, Japanese manufacturers are taking steps to increase their home sales and exports to W. Europe. Sharp and Matsushita are reported to be making PAL-type sets while Hitachi have begun negotiations with the PAL system basic patent holders Telefunken.

A HELP TO DXers !

Budapest is to get a new television tower which will form the first link in a colour television network covering the whole country. Five main stations will be able to transmit three programmes simultaneously. Experimental colour transmissions commenced in May 1968, using the SECAM system.

PHILIPS VCR SYSTEM

The video cassette recording system developed by Philips will be introduced to the market in late 1971 and will be capable of recording and reproducing both full colour and monochrome TV programmes via any domestic receiver, using a video recorder and ½in. magnetic tape. Agreement has been reached with AEG-Telefunken, Blaupunkt, Grundig, Loewe-Opta and Zanussi to adopt the Philips system as a standard for video cassette recording. Talks with other manufacturers are going on.

RCA EXPERIMENTAL PROJECTION TV

A new type of TV projection unit has been developed by RCA Laboratories, although considerable research to raise the performance level still remains to be done. The projector is greatly simplified in comparison with present high-quality projection units. The basic elements of the new projector are a special metal mirror which is scanned by an electron beam carrying the video information, and a light source (500W bulb) which projects the mirror deformations resulting from the action of the scanning beam as an enlarged picture on to a film screen for viewing. In the system used at present the electron beam scans a thin oil film: this system is complex and, at about 30,000 dollars a projector, costly.

The main feature of the new unit is the extremely thin (0.2-0.6 microns) metal mirror which can be electrostatically deformed at television speeds. The mirror is 5cm. square and is mounted about 5 microns away from a glass substrate. The deformations of the mirror result from the electrostatic charge built up on the glass substrate by the action of the scanning beam. This charge attracts the metal mirror, on to which the light source is focused. The projected image from the metal mirror consists of the reflections from the deformation points, the amount of deformation determining the contrast at each part of the picture. Light reflection from undeformed parts of the mirror is prevented from reaching the screen.

A critical part of the process is the time required for the mirror deformations to return to normal. This is determined by the length of time the glass substrate retains its electrostatic charge: too fast a decay time causes loss of contrast and brightness in the projected picture while too slow a decay time causes smearing of the image.

ELECTRONIC ZOOM

EMI Varian have introduced two gated zoom image intensifier tubes, with 80mm. input and either 25 or 40mm. output depending on model. They are designed to amplify low light level scenes which are focused on to a fibre-optic faceplate. The variable magnification (zoom) feature is accomplished electronically instead of mechanically and enables either the entire or 25 or 40mm. (depending on model) of the input image to be displayed on the output screen. The gating feature enables the tube to be used pulsed for automatic brightness control, range gating, high-speed photography and stroboscopic purposes.

NEW EMI CAMERA FOR ETV

EMI have introduced a new television camera, type 2004, aimed primarily at the educational CCTV market and costing about £2,000. The camera offers most of the facilities found in more expensive studio-type cameras and will enable EMI to offer a reasonably inexpensive "packaged system", based on the Sony equipment which they market, providing a professional standard installation. A lead-oxide or standard vidicon or Plumbicon tube can be fitted, and the four-position lens turret accommodates studio or C mount fixed-focus lenses or a zoom lens.

TV DELIVERIES AND TRADE NEWS

Another 30,000 colour sets were delivered to the trade during April. This compares with 6,000 colour sets delivered in the same month last year. Monochrome set deliveries were at 118,000 slightly down, but the total number of sets delivered was 13% up compared with April 1969. It appears that colour set deliveries are leading a minor boom in the TV trade just now.

The Pye/Philips servicing organisation Combined Electronic Services has opened a new branch to cover South Wales for the first time. The address is 25A Severn Road, Canton, Cardiff CF1 9DZ, telephone number 0222 45014.

Hitachi products, previously distributed by Lee Products, will in future be handled by a new company Hitachi Sales UK Ltd.

DANSETTE AGAIN

A new range of record players and radio receivers is to appear shortly under the Dansette brand name, which has been bought by the Rank-Bush-Murphy group. The old Dansette company was wound up at the end of 1969.

electronic video recording

PAUL SILVERHAY

A BRIEF description of the electronic video recording (EVR) system was given last month. It is basically a film process using an unconventional method of exposure, and a conversion system for producing television pictures and sound. In this article we will go into the processes involved in far greater detail.

The EVR film is 8·75mm. wide and within this width are contained two visual channels, two magnetic audio tracks and a synchronising track. The film is not sprocketed. An example of the film is shown in Fig. 1 and each track provides a maximum programme timing of 30 minutes.

As any photographic enthusiast will know, 8mm. film is not the kind of stock you would use for high-quality reproduction. As far as television is concerned, the occasional amateur cinephotographer who happens on a big news story has his 8mm. film reproduced on TV in almost unrecognisable form as a result of complex processing. The quality losses involved with 8mm. film are due to the camera action—uneven pull-throughs, light losses, poor lens qualities—and the film which has a fairly large grain size, limiting to quite a low value the possible resolution and signal-to-noise ratio.

For the EVR system to be an economic proposition two such tracks are recorded on film stock of about the same size. Obviously the processing systems used and the film itself must be rather different if any kind of watchable picture at all is to be produced. The EVR system can therefore be broken up into three basic sections—the film used and the making of the film master, the production of multiple copies from the master, and the *tele-player* (the name given to the conversion equipment which produces from the film a television signal suitable for feeding to a normal TV receiver).

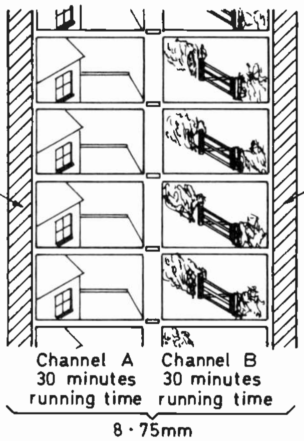


Fig. 1: Layout of monochrome EVR film. A one-hour cartridge has some 180,000 frames each of which can be studied individually.

The Film Master

It has been possible for some years to produce fine-grain film for optical use. It has however been very unsensitive and this has limited its use. Film which has a low sensitivity to light has however a correspondingly high sensitivity to electron beams, because of the large amount of energy they contain. The use of electron beams for the exposure of the EVR film has therefore been adopted, using an electron-beam recorder. The film used has been developed by Ilford and has a grain size about 1/10th that in the finest grain optical film—using silver halide crystals.

The electron-beam recorder (EBR) enables full advantage to be taken of these fine-grain films. The EBR consists basically of an electron gun with the film stock passing in front of its final anode. The electron beam is modulated by the video signal to be recorded being applied to the modulating anode of the recorder. The arrangement is shown in Fig. 2. The film has to pass through the EBR in a vacuum and to allow quick loading of new film stock it is desirable that the film supply and take-ups are in a low-vacuum chamber. The film therefore passes through a progressive increase and decrease in vacuum between reels.

The video signal for the EBR can be taken from any standard source—1 or 2in. videotape, 16mm. or 35mm. film (through telecine) or live studio video. The input section of the EBR contains several stages of processing which predistort the linearity of the signal (i.e. alter its gamma) to correct for the non-linearity of several stages in the system and to give some improvement in the signal-to-noise ratio. The signal also has h.f. pre-emphasis applied to compensate for certain losses later. This makes the design of the player easier. Typical spot size of the electron beam in an EBR is about 0·0004in. and this gives a possible resolution of 1,000 lines.

To make the system a little more economical the master film is twice the required width. After exposing one copy of both tracks of the video, the EBR steps across and repeats the exposure on the other half of the master. The synchronising signals are also laid down on the film at this stage by a short exposure at the beginning of each frame and in the centre of the tracks. Because of the bombardment of electrons the film picks up a considerable static charge and to allow this to discharge the film is made with a relatively high conductivity. Errors in beam writing or in the positioning of synchronising signals at this stage must be minimised as they affect the stability of the final pictures from the teleplayer.

The EBR film master has the two visual tracks laid on it with the centre synchronising track. The audio tracks are not yet present. These are added on the magnetic sound tracks of the print copies. The print copies are made in a high-speed multiple copying machine (up to 200ft./minute). The film master is looped to produce continuous copies of the film in the printer. Up to 1,000 copies can be produced from each half of the negative. The two sound tracks are also laid and the timing between sound and vision is ascertained by the use of two "start" sync points—one put on the EBR negative and one on the original sound recording. Leaving the addition of sound to this later stage allows one master film to be produced and any number of different sound tracks, e.g. different languages, to be used.

Figure 3 shows the basic arrangement of the printer. The stock from the printer is developed, spliced into 8·75mm. strips and cut into the individual lengths of film, normally 750 feet. These are then spooled into the EVR cartridges. The cartridges are of 7in. diameter and the film is provided with a plastic leader which seals the film within the cartridge. It is then almost completely dust-proof and the player has a self-threading system which "grabs" the leader and pulls it through the transport system. This ensures that the film never has to be touched by hand.

Colour EVR

The system as described so far provides monochrome EVR films. But EVR also lends itself to

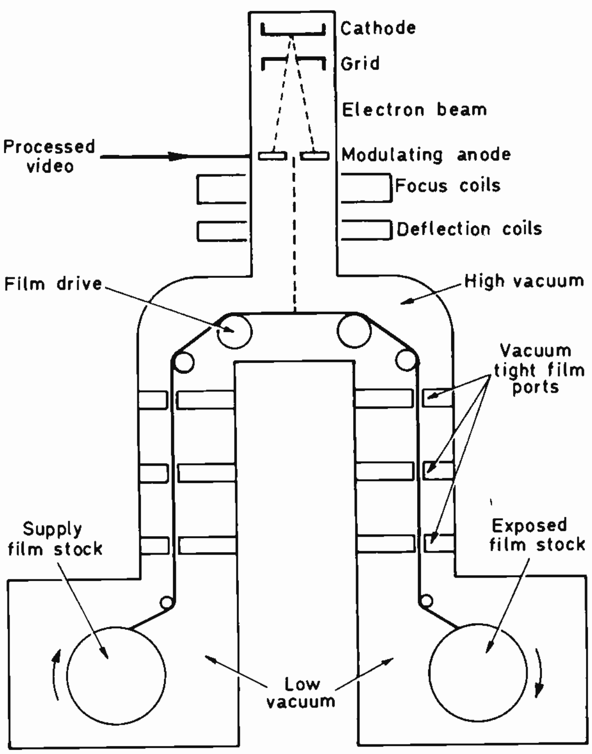


Fig. 2: Electron-beam recorder.

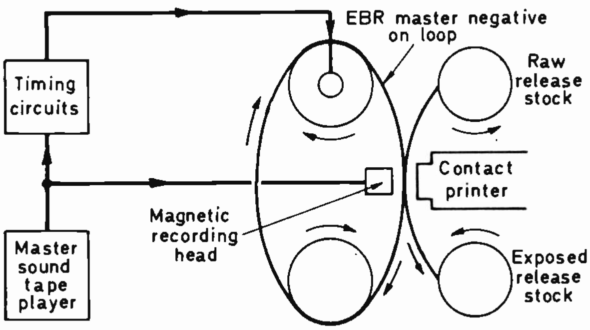


Fig. 3: High-speed EVR printer arrangement.

colour. For colour use the two tracks of visual information are both required, one track carrying the luminance information and the other the chrominance information. The chrominance information is coded and the subcarrier frequency is unimportant as it can never interfere with the monochrome signal. Thus the film needs only to be monochrome stock, so keeping down the cartridge costs. What it does cut down on of course is the programme duration, which will be a maximum of 30 minutes of colour compared to the 1 hour of black-and-white. To look at, the colour EVR film has the monochrome images on the left track and the encoded colour on the right track, the coded colour having the appearance of many vertical lines down the frame.

1.8MHz has been chosen as the EVR subcarrier frequency and because the subcarrier is suppressed a "burst" of some kind is required for demodulation or for conversion to a PAL signal. This is achieved by using a 0.9MHz pilot tone superimposed on the chroma track. This signal can then be used to regenerate the 1.8MHz subcarrier in the teleplayer.

The EVR Teleplayer

A colour teleplayer is shown in block diagram form in Fig. 6. The first machines to be sold will be monochrome versions of this arrangement and it will then be necessary to plug in four or five printed circuit boards to convert it for colour operation.

The conversion of the film images to vision signals is undertaken using the flying-spot principle (Fig. 4). An unmodulated raster is displayed on a c.r.t. screen on one side of the film. The light from the raster is focused onto and passes through the EVR film, and the changes in light level are picked up by a photomultiplier tube. As the raster is produced by a beam spot scanning the c.r.t. phosphor, the video signal from the photomultiplier is in time with the scan. The synchronising pulses used to lock the raster can therefore also be used to add

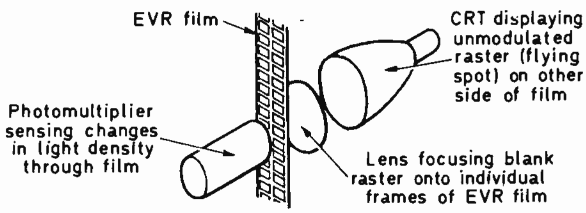


Fig. 4: Principle of flying-spot scanning.

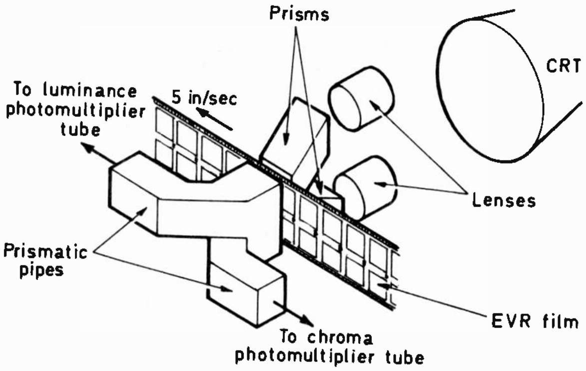


Fig. 5: Optical system in an EVR teleplayer.

to the video to form a composite signal. The flying-spot raster is displayed on a 3in. c.r.t. which has been specially developed with a P16 phosphor, and although of high quality it is relatively low cost.

To allow a simple, continuous motion of the film, 50 fields per second are recorded on it. The frame size is 0.10in. high and 0.13in. wide.

The light from the c.r.t. passes through two separate lens-prism systems to focus on each of the tracks of the EVR film. The light outputs are then taken through prismatic pipes—a convenient method of turning the light through a right-angle and moving the image plane—feeding the input plates of the photomultiplier tubes. The arrangement is shown in Fig. 5.

The design of the two small lenses used to focus the raster on to the two tracks is important. This is the only truly optical arrangement in the whole EVR process. If the lenses are not set up in exactly the right positions or if they have slightly different characteristics, poor registration between the luminance and chrominance signals will result.

The average c.r.t. display brightness is continuously monitored by a photosensitive resistor. This provides a feedback signal to control the beam current of the c.r.t. to maintain a constant brightness level. As the tube ages the feedback circuit increases the beam current from about 10μA to about 80μA, prolonging the effective life of the tube.

The output from each nine-stage photomultiplier tube (PMT) is fed to similar video amplifier channels. Here set-up gain, clamping and fixed gain are provided. The outputs of these amplifiers are switched by a four-position track selector switch with positions off, colour, A and B. In the off position both chains are left open-circuit. In the A or B positions one output is connected through the rest of the luminance/video stages. These positions are for use with monochrome EVR films, so that either track A or B can be viewed. In either case the output from the track not being used is left open-circuit. In the colour position of the switch track A is connected to the luminance chain and track B is taken off to the colour processing chain. This corresponds to the track layout on colour EVR film.

The luminance chain is straightforward. The signal passes through the standard luminance delay line, is amplified and is white-compressed to correct the gamma. The coded chroma signal is also finally gamma-corrected at its peak level and the inevitable pedestal caused by scanning is removed. After amplification the EVR chroma signal passes to the colour translator.

The EVR chroma signal is filtered into two parts. One filter rejects the pilot signal and allows the chroma information to pass, the other filter rejecting the chroma and allowing the 0.9MHz pilot tone to pass.

The pilot tone is amplified and doubled in frequency to reconstitute the original 1.8MHz subcarrier of the system. This subcarrier is then mixed with a 4.43MHz (PAL subcarrier) signal from a crystal oscillator. The upper frequency resultant of this mixing, 6.23MHz, is chosen by means of a tuned amplifier and the output is taken through the chroma killer to the 180° PAL switch which alternates the phase of the signal with each line of information. If no 6.23MHz signal is present there is no output from the chroma killer and the colour circuitry is dead. This prevents unwanted beats of colour on a monochrome picture.

The chroma signal path itself comprises—from the filter point—amplification and then delay, and the signal is then mixed with the 6.23MHz signal derived from the pilot chain. The products of this mixing contain the chroma information around a 4.43MHz subcarrier with PAL action included. This output is then selected by a tuned amplifier at 4.43MHz and mixed with the luminance signal.

Also produced in the pilot chain is the burst for the colour signal. This is also derived from the internal 4.43MHz crystal oscillator. The sinusoidal 4.43MHz signal is fed through a variable phase-shifter circuit to provide some control over colour hue and is then gated with burst flag pulses so that bursts of subcarrier are allowed through at the right timing. There is no need for the 4.43MHz oscillator to be phase locked to any signal from the film because it is used both for burst and subcarrier generation. The phase relationship between the two is therefore always correct. Additionally, any error in the frequency/phase of the subcarrier off the film due to speed or processing errors is automatically taken up within the loop of the pilot tone/chroma circuitry.

The burst killer cuts off the burst feed if the 6.23MHz signal is not present—in other words if there is no chroma information on the EVR film. As with the chroma subcarrier feed, the burst must be phase shifted line-by-line to produce a PAL burst before being added to the other components of the signal. This is done by the 90° PAL switch, which gives the $\pm 45°$ burst signal phase change from line to line required in the PAL system in order to obtain an ident signal in the receiver's decoder.

To complete the video processing, the luminance and chroma signals are added and the resultant video signal blanked to remove between-line and between-field noise. A second adder circuit then adds the syncs and burst to the waveform to produce a completely standard, composite PAL colour signal.

Two outputs are provided. One is a direct video signal for feeding picture monitors and the second is from the v.h.f. modulator which provides an r.f. signal for applying to the aerial input of a television receiver. It should be noted that at this time this is a 625-line signal modulated at v.h.f. The receiver used must therefore be capable of the 625-line/v.h.f. operation used in relay systems.

Two separate magnetic sound heads pick off the two sound tracks from the EVR film. Each output

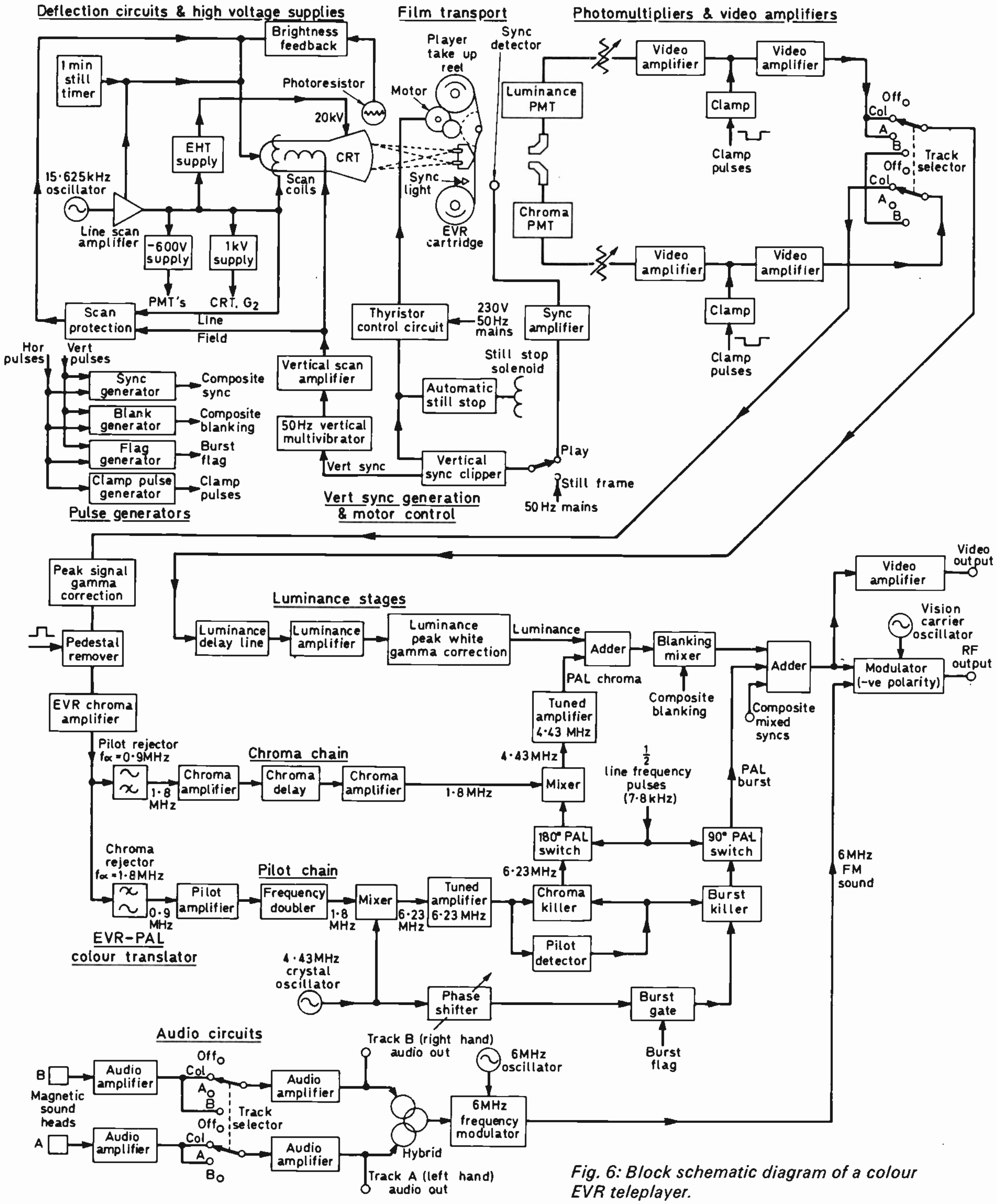


Fig. 6: Block schematic diagram of a colour EVR teleplayer.

is preamplified before being fed to the track selector switch. As with the video section of this switch three possible output combinations are possible—track A sound, track B sound or colour. In positions A or B the output from the switch is fed through a further stage of audio amplification and the resultant is available either as an audio output for supplying extra amplifiers and loudspeakers or as the input to the f.m. part of the r.f. modulator to complete the formation of the r.f. signal. A hybrid transformer is used to feed the A and B signals to the 6MHz modulator whilst keeping them isolated from each other.

In the colour position there is the possibility of stereo sound with the left-channel recorded on track A and the right-channel recorded on track B of the

EVR film. The outputs of the audio amplifiers can then be taken to a stereo amplifier and a pair of loudspeakers Until television sound is stereo—and such a thing seems inevitable with time—the two channels must give a single input to the modulator.

For colour EVR films which have only mono sound or which have different language sound on each track, track A or track B must be selected.

Synchronisation

A small incandescent light shines through the centre of the EVR film (the sync light) and an output from a photocell (the sync detector) occurs every time a sync mark appears in the film (i.e. once per frame). The pulse output is amplified and then clipped so that noise at the extremities of the pulses is removed. The pulses, which correspond to vertical sync pulses, drive a 50Hz multivibrator whose output is amplified to drive the field scan coils of the c.r.t. A second output from the clipper circuit is used in a phase comparator system, with the mains input as the reference signal, to control the motor drive of the film transport. This is achieved by using a thyristor phase control circuit. The effect of the circuit is to lock the drive motor accurately and quickly to the 50Hz mains to prevent frame slip.

Line synchronising is obtained from an internal 15·625kHz oscillator. The output from this is amplified and drives the line scan coils. Feeds are also taken off, as in a television receiver, to derive the higher voltage supplies—20kV for the c.r.t. final anode, 1kV for the c.r.t. focusing grid and a −600V supply for the dynodes of the photomultipliers. The horizontal blanking pulses for c.r.t. beam cut-off during the line blanking time are also taken from the horizontal amplifier.

Feeds from the line and field coils are taken to a control circuit known as scan protection—similar to those fitted to camera channels. Failure of either the line or field scans is detected and the c.r.t. beam cut off. This prevents scan burns on the c.r.t. if either line or field or both scans collapse.

Still Framing

The movement of the film transport mechanism can be arrested at any time and a single frame examined. A knob on the front of the teleplayer allows the film to be manually moved forwards or backwards to select a particular frame so that individual material can be examined. This is particularly valuable for educational EVR films.

To get a full picture on still frame it is necessary to collapse the c.r.t. raster to about 1in. by 1in. from its normal 2in. (frame) by 1in. (line) size and the field sync must be derived from the 50Hz mains supply as the film is not producing field sync pulses when it is stationary.

The facility also exists for automatic still framing by adding extra sync pulses to the EVR film. This might take the form of a counting sequence or a particular pulse code. The auto-stop detector would operate the still stop solenoid (equivalent to the solenoid-operated pause controls fitted to some audio tape decks). The still frame might be held for up to a minute before the film runs on again. Automatic still framing might be valuable in certain types of programmed learning films.

The channel frequency of the v.h.f. modulator is variable so that it can be set up on a channel not being used for normal off-air reception in a particular locality.

The sound tracks for the film are laid on the reverse side. They stand off from the film surface so that when the film is wound in its cartridge the sound tracks support the wind. The picture surfaces never touch and an even wind is obtained. The mechanical movement in the film transport mechanism also avoids the film surfaces, only the sound tracks ever being brought against a roller. All this care inevitably extends the life of the cartridge.

The resolution capabilities of the EVR system are as good as a good-quality vidicon camera. This has been shown in demonstrations. Whether the performance from production cassettes and teleplayers will match the demonstration performance must remain to be seen. Cartridges should be in full production by the end of this year when teleplayer production should also begin.

Future Developments

Apart from the c.r.t. and photomultiplier tubes the whole teleplayer is solid-state. It is to be expected that integrated circuits will be employed in later versions. The obvious positions for these would be in the colour processing circuits, the audio chain, the pulse circuits and the basic video chain. A less obvious application may be in the r.f. modulator: i.c.s for such use do exist. Production teleplayers will have a u.h.f. modulator instead of a v.h.f. one because of the dominance of single-standard u.h.f.-only receivers.

EVR gives good-quality pictures and sound (the film speed is 5in. per second) but an even higher quality is foretold for broadcast EVR (BEVR). The same basic principles are used but in a more sophisticated manner. Performance, which should equal 2in. videotape or 35mm. film, will suit the professional user.

Because of the different mains frequency in the US (60Hz), American EVR cassettes cannot be used in European teleplayers. This means that the EVR Partnership's film production plant at Basildon will supply only the European market. This will limit the number of cartridges available to the user slightly but it gives the advantage that Europe can modify the EVR standards if it seems that there are any advantages in doing so.

The biggest development in the EVR scene could be the completion of the development of a new film stock—Diazo film—which offers even greater resolution, is producible at lower cost and is thinner (extending the possible programme time of a cartridge).

The basic circuitry and ideas used in the EVR teleplayer are not unfamiliar to the colour TV service engineer. It is therefore to be hoped that maintenance and repairs of teleplayers will pass into the hands of suitable dealers. The EVR teleplayers will be manufactured in this country (under non-exclusive licence from the EVR Partnership) by the Bush-Murphy division of Rank and will be marketed by Rank Audio-Visual Ltd. ■

G. R. WILDING

THE chroma signal in the NTSC and PAL systems is transmitted with the subcarrier suppressed and for this reason a reference oscillator, or subcarrier regenerator as it is sometimes called, is necessary in a colour receiver's decoder—the section of the receiver where the chroma signal is processed. For correct colour reproduction the reference oscillator in the receiver must by synchronised in frequency and phase with the subcarrier oscillator at the transmitter. To make this possible 10Hz of the transmitter's chroma subcarrier signal, which in the UK colour system is at 4·43MHz, are transmitted once each line, during the back porch period immediately following the line sync pulse. This 10Hz of subcarrier on the back porch is called the burst signal. The functions of the burst stages in the decoder are to separate the burst signal from the composite (i.e. chroma plus burst) chroma waveform and amplify it to a suitable level for presentation to the phase detector circuit which develops a control potential to keep the receiver's reference oscillator in phase with the subcarrier. The burst channel is shown in block schematic form in Fig. 1.

Burst Channel

A burst gate circuit is used to separate the burst signal from the composite chroma signal. This circuit is usually off, i.e. non-conducting, but is switched on by a suitably timed pulse once each line to allow the burst signal to pass through to the phase detector. There is considerable variation in detail between various models, and it is for example quite common to find that the gated stage follows the main stage of burst signal amplification. The separated and amplified burst signal is also generally rectified and used as an automatic chroma control (a.c.c.) source to control the gain of the first chroma amplifier stage. Automatic gain control of the chroma signal strength is necessary for two reasons, first to ensure that the required colour level is kept constant irrespective of reception fluctuations and/or variations in fine tuner setting and secondly to maintain constant burst signal amplitude which contributes to good a.p.c. discriminator action.

The chroma feed to the burst gating circuitry is usually taken from a point after the first chroma stage while the a.c.c. bias is usually applied to the first chroma amplifier. As the two sections of the decoder are so closely interrelated they are both shown in Technichart No. 2. The circuitry shown here is that used in the ITT-STC-KB colour chassis and is a representative example of modern practice.

As the burst signal comprises only 10Hz of the 4·43MHz subcarrier, lasting only about 2·5μsec, its gating must be done very accurately. This is achieved by using suitably timed and shaped pulses derived from the sync circuits or the line output stage. In many chassis, as in our example, the pulse from the sync separator or line output stage is not used direct but is fed to a burst gate pulse generator stage. This incorporates a ringing circuit which produces an oscillation whose overswing is accurately timed to give the required burst gating action.

Burst Gate Generator

As the overall circuit operation is fairly involved, we shall divide it into three sections. First there is the burst gate generator Tr3. This is forward biased by R14 from the 15V positive rail so that it is normally conductive, collector current flowing through the transformer primary L4. A strong negative-going pulse from the sync pulse amplifier stage is applied to Tr3 base once each line. This instantaneously cuts Tr3 off. The oscillatory circuit L4, C12 then rings since Tr3 is cut off but as the current flowing in L4 cannot cease instantaneously it charges C12. A sharp positive-going pulse is generated, with a negative-going following overswing. The waveform induced in the secondary L5 is a negative-going pulse with positive-going overswing. This is applied to the base of the other-

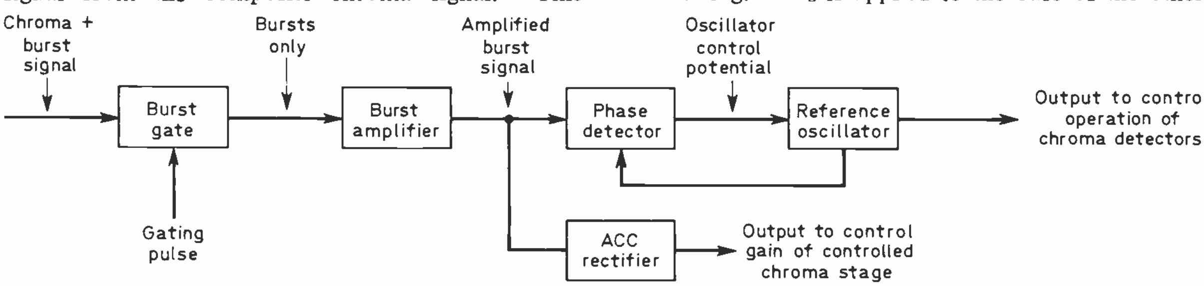


Fig. 1: Block diagram of the burst, a.c.c. and reference oscillator sections of a colour receiver decoder.

wise unbiased burst gate/amplifier stage Tr5, momentarily turning it on during the brief burst signal periods. In this way the required gating action is achieved. With Tr3 conducting again following the cessation of the negative pulse at its base the oscillatory circuit L4, C12 is heavily damped.

Burst Amplifier/Gate

A chroma plus d.c. supply is taken from the collector of the second chroma amplifier Tr2 and applied to the base of the burst amplifier driver stage Tr4 (the d.c. potential providing the forward bias required). This stage is connected as an emitter-follower with the output developed across the emitter resistor R18. This is fed via C15 to the base of the burst amplifier and as this stage is only switched on by the overswing pulses from L5 only pure amplified burst signals appear in its collector circuit. These are applied to the automatic phase control discriminator circuit. This is also fed with a sample feed from the reference oscillator and develops a correcting potential if the phase of the oscillator drifts away from that of the burst signal.

Automatic Chrominance Control

As the burst signal developed at Tr5 collector is not modulated it provides a useful reference indicating received signal strength. It is therefore used as the a.c.c. source. For this purpose the burst signal is coupled by C18 to the a.c.c. shunt rectifier D4. The output is smoothed by the a.c.c. filter R22, C20, C21, R23 and used to vary the forward bias applied to the controlled chroma stage Tr1. The a.c.c. potential is negative-going with increase in signal strength since D4 shorts the positive half-cycles of the burst signal appearing at the junction C18, R22 to chassis. Rising signal strength therefore biases Tr1 back to reduce its gain.

Oscillograms

The five oscillograms at the base of the Technichart show the waveforms in the burst channel. The first (a) shows the amplitude and duration of the oscillatory pulse and overswing produced by the ringing circuit L4, C12 when a negative-going line sync pulse suddenly cuts Tr3 off. The signal shown at (b) is the chroma signal that would appear at the emitter of Tr4 during reception of a colour-bar test pattern. The signal at Tr5 base is shown at (c) and consists of the colour-bar chroma signal fed via C15 and the negative-going pulse plus positive-going overswing induced in L5 and attenuated by R17. Tr5 being an npn transistor without fixed bias conducts only when the positive-going overswing appears at its base. As a result only pure amplified burst signals as shown at (d) appear at Tr5 collector. Feedback in Tr5 emitter circuit is used to prevent its gain when switched on being dependent on the amplitude of the switch-on signal, and a series tuned circuit tuned to the subcarrier frequency of 4·43MHz decouples this so far as the burst signal is concerned. The signal at the junction of D3 and R21 is shown at (e). When Tr5 is switched on by the positive-going overswing at its base its emitter current rises as shown. The effect of this on the collector waveform can be seen in (d) where the positive-going half of the signal reaches 10V peak while the negative-going half of the signal reaches 14V peak.

Chroma Amplifier

The chroma amplifier stages are quite straightforward. The first, Tr1, is a.c.c. controlled. The input is a composite video signal (luminance plus chroma) from the distribution amplifier, a stage which immediately follows the vision detector diode. The term distribution amplifier is used because in addition to providing the feed for the chroma amplifier it also provides luminance drive to the luminance channel and the 6MHz intercarrier signal for the sound i.f. strip. The values of C1 and R1 in the input circuit of the first chroma stage are chosen so that the two components act as a high-pass filter. The chroma signal centred at 4·43MHz is developed across R1 and applied to Tr1 base while the lower frequency luminance component is largely dropped across the series element of the filter, the capacitor C1.

The bias for the a.c.c. controlled first chroma stage is set by the a.c.c. preset R2. This is adjusted so that the amplitude of the burst signal at Tr4 emitter is 800mV (see waveform (b) in the Technichart). Normal reverse a.g.c. is adequate for a.c.c. purposes. Thus the a.c.c rectifier circuit provides a negative-going potential which counters the forward bias applied to Tr1 base via R2, R3 and R4.

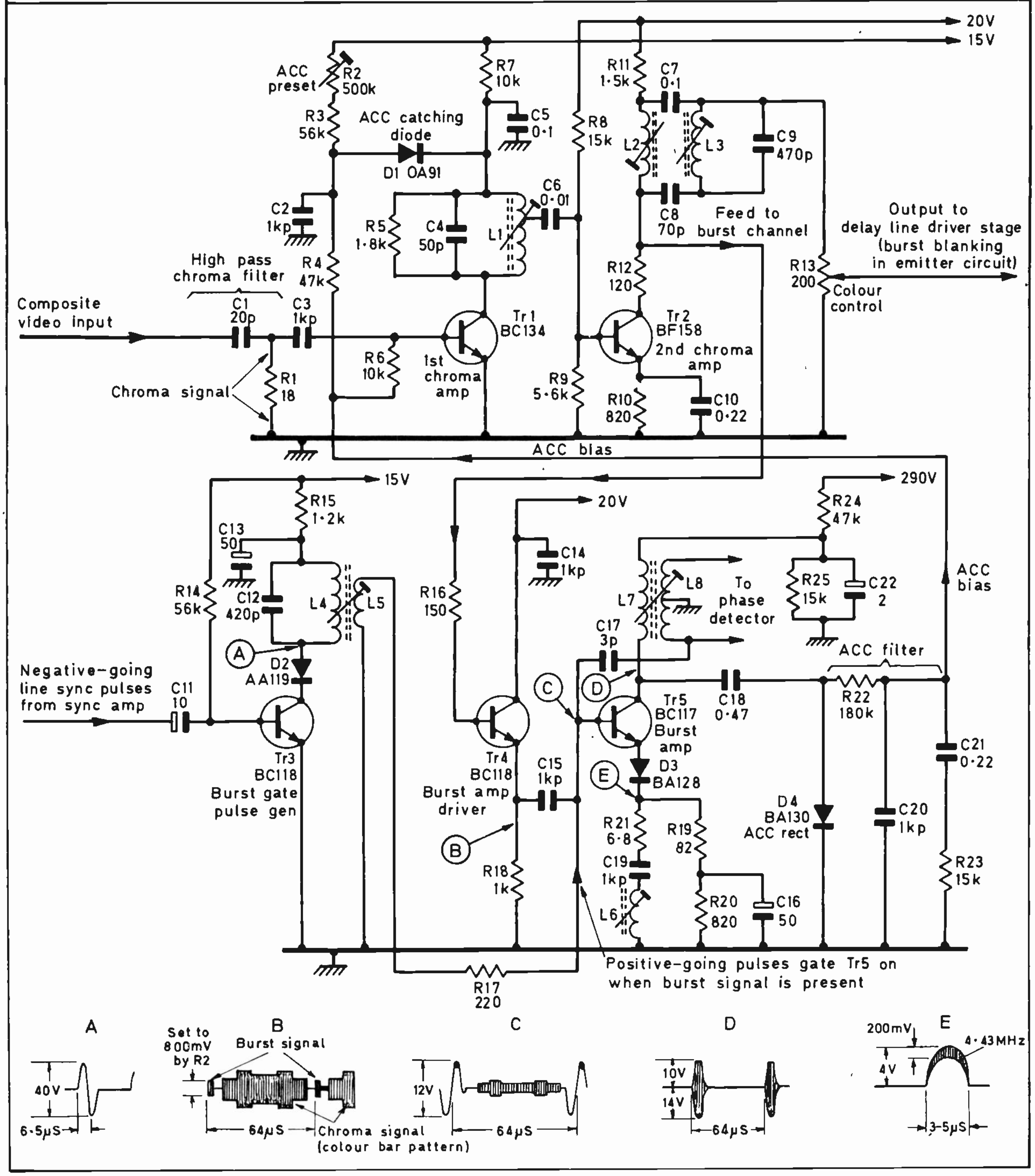
Catching Diode

An interesting feature of the circuit is the a.c.c. catching diode connected from the junction of R5, R7 in Tr1 collector circuit to the junction of R3 and R4 in its base circuit. This is normally reverse biased since the voltage of Tr1 collector will under normal conditions be higher than the voltage in its base circuit at the junction of R3 and R4. Under these conditions D1 has no effect on the circuit. Consider what would happen however if it was not present and a fault condition, excessive input signal or misadjusted a.c.c. preset resulted in Tr1 being driven hard on. If it was driven into saturation there would be no signal developed at its collector and in consequence no signal would appear at the a.c.c. rectifier and there would be no a.c.c. potential to restore normal operating conditions. D1 is included to prevent this situation arising. If Tr1 is driven sufficiently hard on for its collector voltage to fall below the voltage at the junction of R3 and R4 D1 will be forward biased and will conduct. As a result there will be an increased current flow through R2 and R3 and the increased voltage developed across these resistors, appearing as a negative-going change of voltage at Tr1 base, will bias Tr1 back again to its normal working point.

Miscellaneous Details

User colour control is provided by R13 which sets the amount of chroma signal tapped off and fed to the following delay line driver stage.

The chroma stages are conventional except for two features. First, fixed forward bias is applied to the second chroma amplifier Tr2 whereas it is more common to undertake the colour-killer action in this stage by providing a turn-on bias which only appears during reception of a colour signal so that the chroma channel is switched off during black-and-white reception. Colour killing, necessary to avoid spurious colour patterning on black-and-white, TECHNICHART No. 2 BURST GATING AND ACC by G. R. Wilding



is in these models undertaken in the colour-difference preamplifier stages. Secondly instead of burst blanking—removing the burst signal from the chroma signal—being undertaken in the chroma circuits it is undertaken in the following delay line driver stage—by feeding positive-going pulses to its emitter so that it is switched off during the burst signal period (the delay line driver, being an npn transistor, will be cut off by the application of a positive bias of sufficient amplitude at its emitter).

Two protective diodes are incorporated in the burst circuitry. D2 in Tr3 collector circuit is biased off during the negative-going overswing produced by L4, C12, thus protecting Tr3 when this overswing occurs at its collector. Likewise D3 protects the base-emitter junction of Tr5. ■

UNDERNEATH THE DIPOLE

It used to be said that theatrical melodrama didn't really start until the plot thickened! Ever since Sophocles wrote blood-thirsty plays for the Greek theatre, the popular basic story lines of drama and comedy have been three-sided "affairs"—the eternal triangle. It is said that there are five main basic plots, but each has thousands of possible variations. And even the millions of story lines now seem to be insufficient for plot-hungry television, cinema, theatre, radio and books.

IMP FILMS

This script shortage situation is no new problem. Indeed it afflicted the production of silent films for the cinema sixty years ago when Los Angeles was becoming the film centre of the world. One man who had an answer was Carl Laemmle.

Long before the advent of talkies Carl Laemmle fought and beat the monopoly hold of the Edison Patent Trust. He gathered together about fourteen motion-picture film producers who were outside the Trust (and refused to join it) headed by his own IMP film company, a name derived from the initials of the Independent Motion Picture Corporation. Each of the fourteen companies had to make a one reel silent picture a week, each reel comprising 1,000 feet of 35mm. film which ran for about 17 minutes on the handle-turned projectors of the time. All the films had to have plots and the shortage of scenarios, scripts and treatments was serious.

Mr. Laemmle determined to establish a film studio city a few miles out of town to accommodate all these independent film companies and he called this Universal City. Here he constructed a number of open-air stages (with overhead diffusers), one or two glasshouse studios, huge property rooms, workshops, laboratories, projection rooms and so on. Universal City even employed its own police force—including mounted police—to keep the peace in the hectic atmosphere generated when slapstick comedies were often shot back-to-back with religious dramas, military skirmishes or westerns.

AUTOMATED PLOT PRODUCTION!

The shortage of story-line plots eventually became acute. Always ready to meet a challenge, "Uncle Carl" Laemmle set up in a row multiple tombola hand-turned machines from each of which could be picked out cards. These indicated the characters and situations which could be built up into a story-line—rather along the lines of consequences, a game which Uncle Carl had once played. These plot cards were then set out on a long table and might, for example, reveal:

(a) *The hero:* District Attorney of Mid-West Town.
(b) *Possesses:* A swell automobile with headlamps or a bad tempered dog.
(c) *The heroine:* A smart and pretty stenographer.
(d) *Hero and heroine meet:* At the corner drug-store when buying ice cream sodas.
(e) *Action:* Dog begs heroine for food.

And so on!

Dozens of cards were set out in this way. The tombola containers were loaded with cards appropriate for comedies (slapstick; situations; chases; burlesques); dramas (lurid melodramas; military; family; westerns; religious); historic (US Civil War; Ruritanian; romance), etc. The whole idea was an early form of story-line computer, a dramatic kind of fruit machine which was highly successful in evolving plots for the weekly comedies, cops and robbers, cowboy dramas portrayed by the Universal studios' stock company of actors. Universal City's weekly output was prodigious and professional.

THE STUDIOS TODAY

Today the same studios, modernised and up to date, are occupied by several companies carrying on in the traditional way but with films for cinema and television, videotape, sound recording for stereo discs or commercial radio and even for cassette-loaded play-offs for connecting up with home TV sets. The plots are often along the same traditional story lines, but varied by today's changed tastes. In spite of the slump in American studio production, this particular studio is a bang up-to-date studio complex which is active while most other Californian studios are partly deserted or turned over for their real estate value. One major studio has even become a cemetery!

CASSETTES

A recent count by the Engineering Steering Committee of the B.K.S.T.S. revealed that there are now no less than fifty-three different types of cassette-loading play-off machines for providing entertainment (or instruction) via a separate input to existing home colour television receivers to which (in America anyway) may be added another input for PAY-TV. The play-off cassettes vary in type from half-inch width videotape to EVR (photographic plus chrominance coding signal), the RCA hologram tape (vinyl, scanned with a laser beam), 8mm. and Super-8 photographic film etc. To these must be added the complexities of different speeds of travel, differences in the relative positions of sound and picture, the input acceptance parameters of the home colour TV set, and so on. Will the public accept the additional costs of acquiring a gadget for providing yet another source of entertainment (and instruction)? This particular market is in my opinion already reaching saturation point, with the enjoyable (but time-consuming) activity of listening to hi-fi stereo from disc, tape or radio, local radio, pay-TV etc. Yet it wasn't all that long ago that we were satisfied with a crystal set and a pair of headphones!

SMPTE POLL

The interests of members of the Society of Motion Picture Engineers of America cover roughly the same technical grounds as the British Kinematograph Sound and Television Society in this country. It recently initiated a comprehensive survey of its membership's major and professional interests by means of a questionnaire sent to each of its 6,500 members. A computer was preprogrammed and the returns transferred to punch cards for electronic data processing.

The questionnaire was divided into two parts. The first was *major interest* and members were instructed to check *only one* of the disciplines which most closely paralleled their primary technical interest. These primary interests were: motion pictures; television; education; photo-science; instrumentation and high-speed photography. The second part covered nineteen other categories and members were asked to check off as many as possible that were closely allied to their professional or technical speciality.

About 5,000 questionnaires were filled up and returned, and 4,300 members adhered to the survey instructions. The part 1 results were motion pictures 2,211; television 1,204; education 315; photo-science 311; instrumentation and high-speed photography 90.

Detailed analysis of all the other categories and their subdivisions (e.g. television research and development; television production; television equipment; television engineering; television maintenance, etc.) provided a remarkable assessment of great importance to the planners of the highly important S.M.P.T.E. conventions held in New York, Los Angeles, Chicago and sometimes elsewhere. In England, the B.K.S.T.S. membership amounts to approximately 1,700. Many members also belong to the Royal Television Society. The Conference Room at the Independent Television Authority's premises in Brompton Road is frequently used by both societies, but not at the same time! Their interests are to some extent different, particularly in respect of TV transmitter problems, videotape, colour TV receivers and so on. But there must be some meetings and demonstrations in which there could be joint arrangements. There might even be lecture meetings which would interest the Royal Photographic Society, which was established about a hundred years ago at Croydon, long before it became "Royal".

Iconos

IMPROVING OLD LOUD-SPEAKER UNITS

M. A. Harris, B.Sc.

THE writer had acquired over a period of time a number of loudspeaker units—from old TV sets, radios and so on—that were of varying shapes and sizes and just gathering dust. Not only that—they were taking up valuable workshop space. Something had to be done. It was decided to make small extension speakers, even a column or two, and unload them on to friends and associates. The speakers were absolutely standard and thought was given to ways of improving them. The results eventually obtained showed this to be well worthwhile.

The aims were first to stiffen the cones and secondly to soften the cone supports. If the cone is not sufficiently stiff transients will tend to travel up the cone from the centre to the outside instead of making the whole cone move. On the other hand the corrugations around the cone which attach it to the frame should be soft enough to allow the cone to move freely in and out without any restriction. Fig. 1 illustrates these points.

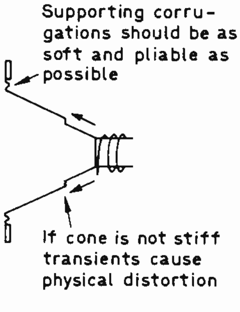


Fig. 1.

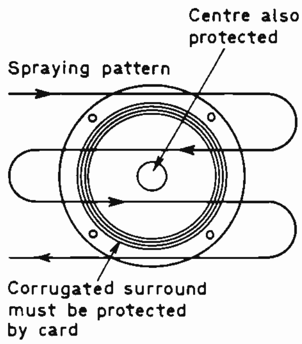


Fig. 2.

Cone Stiffening

Stiffening the cone is a very easy procedure. First of all two pieces of card are cut, one in the form of an annulus to fit over the corrugated surround to the cone and the other a circular disc to cover the centre hole. The speaker is then laid horizontally face upwards on a sheet of newspaper and the two pieces of card laid in place. Next paint from an aerosol can of cellulose paint (the sort sold for touching-up cars) is sprayed *lightly* on to the loudspeaker cone as shown in Fig. 2. The spray *must* be light otherwise the cone will become wet all over and consequently distort off-centre. Five or six light coats should be sufficient. The colour of the spray is of course immaterial (the writer has however found one or two cut-price motor accessory firms selling black slightly cheaper than colours).

Support Softening

When the paint is completely dry—allow about 10 minutes between coats—the card masks can be discarded (unless more than one speaker is being treated) and attention turned to making the cone support more pliable. Some ordinary rubber solution is obtained and mixed 50-50 with petrol. A small paintbrush is then used to paint the surround with this mixture—again two or three *light* coats are recommended—and the speaker allowed to dry out. It is best next to leave the treated speaker(s) overnight to dry thoroughly—they can easily be damaged if used whilst they are still wet.

The results obtained show that the speakers sound crisper and slightly smoother so that the treatment is well worth doing. The writer has treated all his spare speakers in this way—and the aerosol and rubber solution tins are not yet empty! ■

SERVICING television receivers

L. LAWRY-JOHNS

ITT-STC VC 51 CHASSIS—*cont.*

Field Hold

If the hold control is at the end of its travel and the valves are in order check the value of R88 (390kΩ). If this is in order check C78 (0·01μF). If the fault is more one of weak or absent sync, i.e. the picture rolls up or down but the locking point is restricted or not obtained at all, check the voltages at V8A (pentode) and V7B (triode sync pulse amplifier). R63 is likely to be high but check also R66 and R72. If the effect is experienced on 405 only, check C66 in the video cathode circuit.

Line Oscillator

Returning to the subject of h.t. shorts it is as well to remember that the windings of L63, L64 can work their way down the former until the bottom fixing screws stop them. As the windings are at h.t. potential this can result in R128 burning out. The writer has not encountered this as yet on these receivers but met the condition several times in the similar Featherlite models. Warning that the windings are on the move is given by the necessity to screw down the coil core in order to lock the picture. Obviously windings moving down the former have the same effect as the core being unscrewed.

Of the several faults which occur in the oscillator stage perhaps the most common is due to the PCF802 valve. Usually this takes the form of the apparent loss of line sync, the hold control having no effect at all. If a PCF802 is not at hand, fit a PCF80 and adjust C113 for a locked picture on 405 only. This is only to prove the point and the correct valve should be fitted in order to obtain the correct 405-625 locking range. Other than the valve, loss of line sync should direct attention to the OA81 diodes and the resistors R127 and R130.

The other habit of the PCF802 is to stop oscillating altogether. This causes the PL36 to overheat and the PY801 to show signs of distress. The absence of a negative line drive at the PL36 control grid confirms this diagnosis. Replacement of the valve should restore normal conditions.

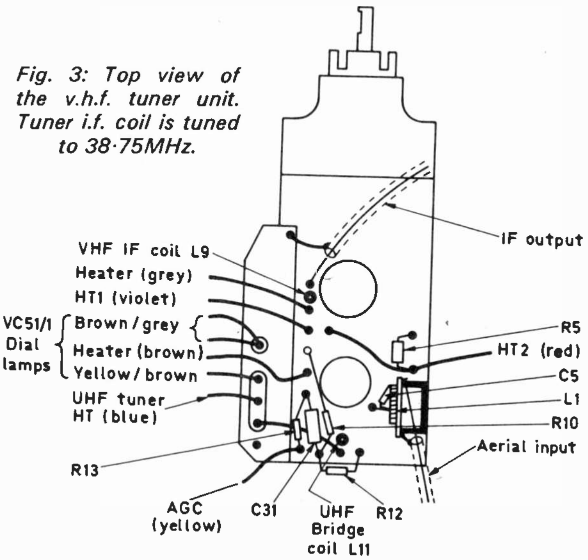


Fig. 3: Top view of the v.h.f. tuner unit. Tuner i.f. coil is tuned to 38·75MHz.

Line Output Stage & CRT

Quite often however there is line drive to the control grid and the PCF802 is not at fault. This is where several items have to be checked. First remove the top cap of the PY801 and try again. If the timebase now comes to life the boost line capacitor has shorted. This is C134 0·1μF and rated at 750V. The writer fits a 1kV capacitor in this position for lasting reliability.

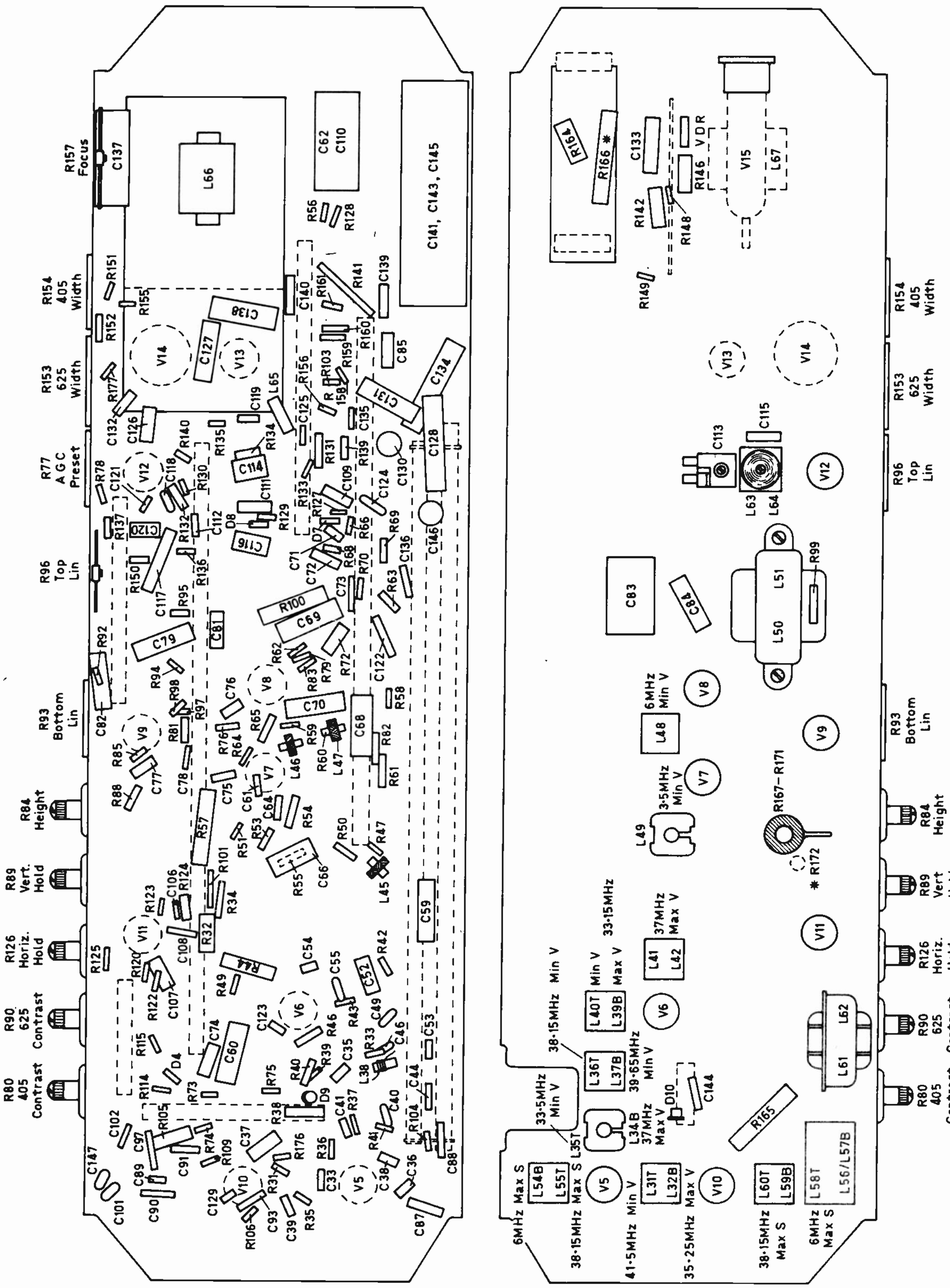
Assuming however that there is no response when the top cap is removed try removing the top cap of the DY86. If the timebase comes to life the valve is internally shorted and must be replaced.

If again there is no difference it is reasonable to fit replacements first in the PL36 position and then in the PY801. Normally one of these or both will be found at fault. If there is obviously very little current being drawn by the timebase check R141 (2·2kΩ) the screen feed resistor of the PL36 which may well be open-circuit.

If the valves and components check out and overheating is still taking place the cause could well be due to shorted turns in the line output transformer.

Insufficient width is normally caused by a low-emission PL36 (check PY801 also) but often the valves are not at fault. In this case the width control circuit must be checked to ensure that the resistors, including the preset controls, are of the correct value. A dud spot on one of the controls can give rise to lack of width on that system, i.e. the 405 preset R154 or 625 preset R153.

If the picture size varies considerably as the brightness of the picture alters the natural conclusion is that the DY86 valve is unable to cope with the varying tube beam current. This is quite correct but the valve itself may not be at fault. A replacement may improve the condition but then show the symptoms



Note: * R166 replaced by R166a on VC51/1
* R172 occurs on VC51/1

Fig. 4: Top and bottom chassis layouts.

of the true cause of the trouble which may then show as lack of width due to a low-emission PL36 or under driving of this valve. Again, a new valve may make no difference at all. The presence of a 2·5Ω resistor in series with the DY86 heater should be appreciated: this resistor can decompose leading to severe under running of the valve.

The condition of no picture or a very dark one should direct attention to the tube base voltages. These are indicated on the circuit diagram. If the

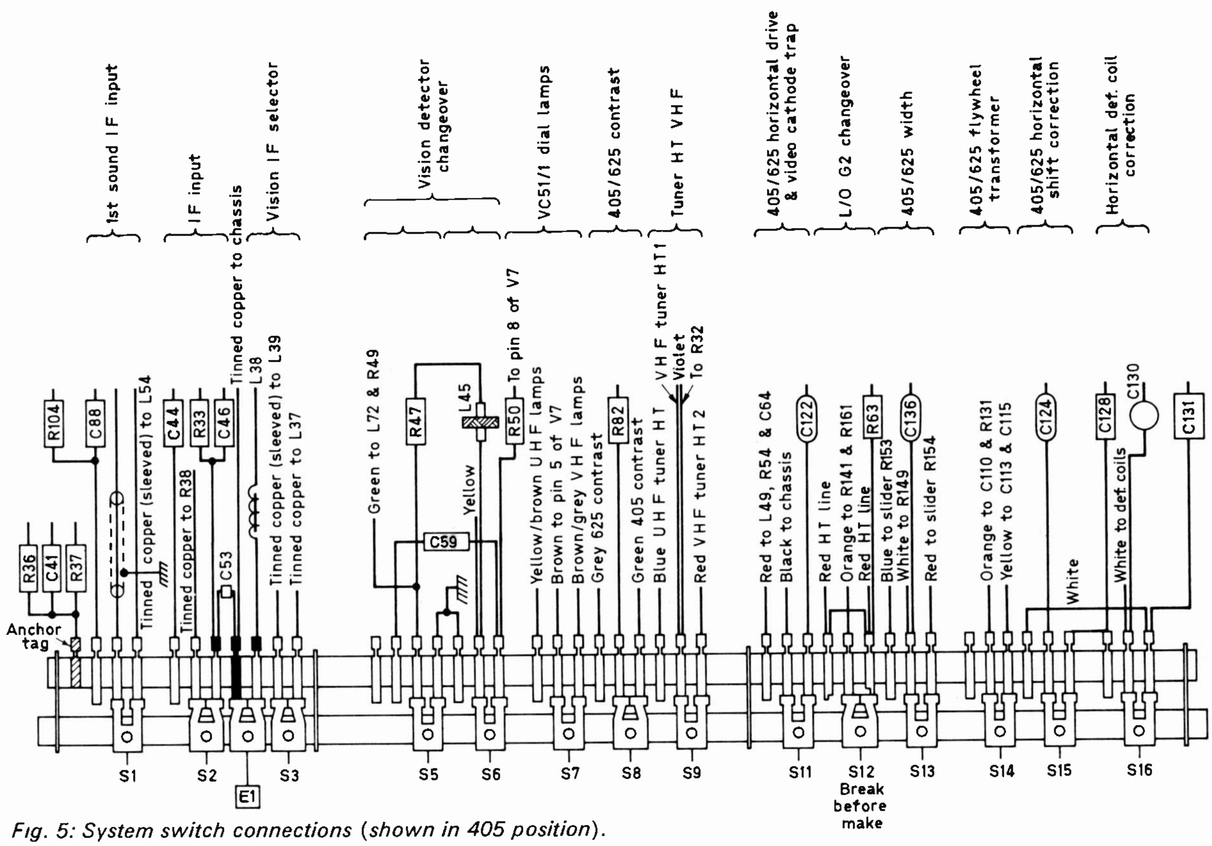


Fig. 5: System switch connections (shown in 405 position).

500V or so voltage reading at pin 3 cannot be obtained check C137. If the voltage is low check the value of the focus control which can change value and if necessary disconnect the lead from pin 3 as there may be internal leakage in the tube. If there is internal leakage it can often be blown clear by the application of a very high pulse voltage (properly applied with the tube base socket removed). This process of blowing leaks clear can also do wonders for the emission of an ageing tube (or shouldn't I have said that?). Also check the pin 2 (or 6) voltage. If very low or absent check C85, C139 and C140.

If the voltage at pin 7 is high (nearer 200V than 100V) check the value of R61 (390kΩ). This sometimes goes high, progressively pushing the voltage up to that of the h.t. line as it rises in value.

Distorted Sound

The complaint of sound distortion is one which will be met quite regularly. The first step is to localise it if possible. In most cases for example the distortion will be confined to 405 (BBC-1 and ITV on v.h.f.). This should immediately direct attention to the noise limiter stage where R115 (10MΩ) will most often be found at fault (gone high). Shunting it with a resistor of near value will normally restore good quality sound with no further ado.

If the distortion is common to u.h.f. and v.h.f. attention should be directed to the PCL86 output stage. It is rarely sufficient to replace the valve. The bias resistor R123 (120Ω) should be checked for appearance (it may be charred) and correct value. It can be damaged by a faulty valve and sometimes by excessive current caused by leakage through C108 (0·01μF).

Less frequent causes of distortion are the loudspeaker itself where the speech coil may be rubbing against the magnet, R122 (220kΩ) going high (low as well as distorted sound here) and leakage through C107 (0·047μF). Distortion on u.h.f. only is most often caused by misalignment of L56-L58 coil cores. Check the OA79 (or AA119) diodes and the setting of R111 if a buzz is constantly heard in the background.

Vision Stages

An overall loss of contrast will normally direct attention to the video stage where the PCL84 may be losing emission. Check the valve and associated resistors as previously outlined, not forgetting the detector diode D6.

If the loss of contrast is accompanied by picture noise (grainy background) check the i.f. stages as well as the tuner valves. The EF183 and EF184 are just as likely to be "down" as the tuner unit (v.h.f.) valves. Once again, check both standards. If u.h.f. is equally or more affected the fault is unlikely to be in the v.h.f. tuner. It could be in the mixer stage but nine times out of ten the i.f. stages will be found at fault with a low EF183 or EF184. Do not omit to check the screen feed resistor R34 (33kΩ) of the EF183 as it can change value or be damaged by the valve or C36. Check the action of the system switch and clean the contacts. Check the v.h.f. tuner, clean contacts and check the value of R11 (18kΩ).

Valves Not Heating

Every once in a while one encounters the fault of some valves heating excessively while others are quite cold. This is most often due to a heater-cathode short in a valve. The thing to do is to note which are heating and work along the circuit diagram heater chain until one comes to the first unheated valve. This could be at fault, as could the preceding valve which is lit up. If for example V8 is heated but the PC97 in the tuner isn't the fault could be in the PCF80, the PC97 or the brown heater lead which may be shorted before it gets to the tuner (or inside).

If the faulty valve has a cathode bias resistor the symptoms may be different. The resistor may be damaged or stand the current and show hum symptoms either on the picture or sound (at the same time shunting the heater current away from the remaining valves in the chain—including the tube). It depends. . . .

Later Chassis & Model Numbers

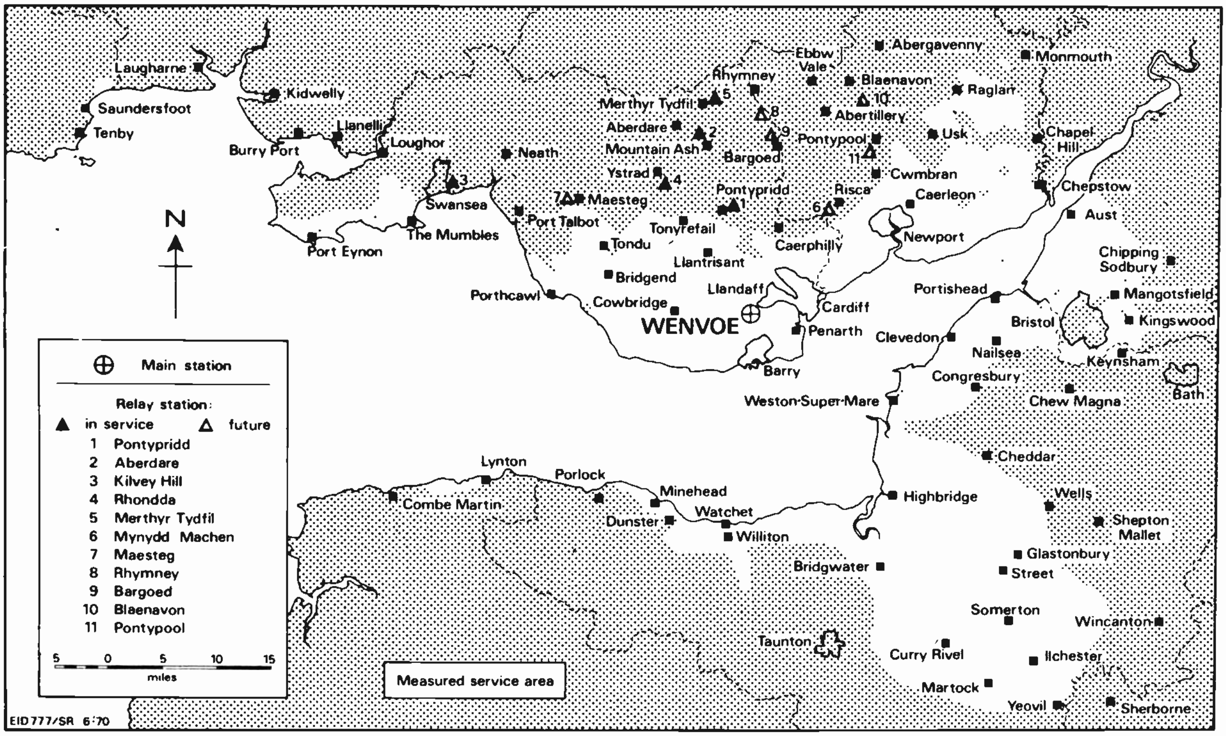
Chassis VC52 and VC53 are basically the same as the VC51 with the following modifications.

Chassis VC52: The following diode types are used: D1 and D2 AA119, D3 SFD108, D4 OA91, D6 OA90, D7 and D8 OA91. V10 is changed to an EF80 with R105 3·9kΩ and R106 150Ω. Voltages are: screen and anode 170-210V, cathode 0·4-2·3V. C148 22pF is added from the junction R108/R109/R110 to chassis. Some models fitted with this chassis have a 20in. (type A51-10W) tube and with this C146 is omitted. The 19in. tube fitted is type A47-26W/R and the 23in. tube type A59-23W/R. The h.t. voltage is 225V.

Chassis VC53: In addition to the above modifications V11P anode and screen are fed via a 100Ω resistor R179, R178 (2·2MΩ) is added in the feed to the c.r.t. first anode (pin 3), the position of R169 is moved to between the junction R168/C145 and D10/C144 and the brightness control circuit is modified with R163 deleted and instead a v.d.r. type E299DD/P336 connected from the earthy end of R162 to chassis. C45 is 19pF, the c.r.t. cathode bias resistors R58 and R61 are 330kΩ and 560kΩ respectively, in the sync separator circuit C71 is 40pF, R68 and R69 100kΩ and R72 1MΩ, with R68 connected to the junction of R69/R70 instead of the junction C71/R69. V8 pentode voltages are given as 75V anode and 26V screen grid. Some models are fitted with a 20in. tube type A50-120W/R and some with a 24-in. tube type A61-120W/R; C146 is omitted with these tubes.

The following KB (first letter of model number K) and RGD (first letter of model number R) models are fitted with these chassis: KV024, KV025, KV026, KV027, KV034, KV065, KV107, KV115, KV119, KV124, KV125, KV126, KV128, KV134, KV165, RV224, RV225, RV227, RV235, RV309, RV317, RV328, RV335. Some models bear suffixes /1. In addition later versions of the following models were fitted with the VC51 chassis: KV013, KV015, KV017, KV117, RV213, RV215, RV217, RV315, RV318.

NEXT MONTH: PYE 40F



The above BBC map shows the approximate service area of the **Wenvoe** *u.h.f. transmitter (maximum vision e.r.p. 500kW) Small pockets of poor reception too small to be shown in this map may be experienced. Channels: ITA 41; BBC Wales 44 BBC-2 51. Polarisation horizontal, receiving aerial group B.*

DX-TV

CHARLES RAFAREL

THE June 1970 SpE conditions continue to be really sporadic to say the least. After the long-awaited openings of May we seemed all set for a belated but even better start to the SpE season in June. The early part of the month was disappointing however. There was some SpE about each day but not so very much and what there was seemed to be back in the short-duration class that we all experienced earlier this year. In fact the first week of June was so poor that I started asking myself if the 1970 season had come and gone again! There was an improvement however as the month progressed, and from the 9th to 25th conditions were quite good though with some poor days. From the 26th to the end of the month there was very little.

On balance May-June 1970 has been well below standard. There may be a reason for this and R. Bunney suggests it is because of the abnormally high sun-spot activity for this period. The count on many days has been in excess of 100 which is good for F2 but not for SpE. So when things quieten down we should get better DX. There were however some very good SpE days when excellent results from rare stations were obtained.

The Trops were not as good as last month but there were reasonable openings on the 3rd, 4th, 13th and 21st, and F2 was about again on the 6th and 9th, with the USSR forward-scatter network coming in, but as noted above we could do without F2 at this time.

For the SpE log this time I am going to pick out the exceptional days, while noting that there was something in the way of the usual stations each day. The following is the "pick of the month".

13/6/70 USSR R1, Czechoslovakia R1, Italy IA and IB, Spain E3 and E4, Yugoslavia E3 and E4, Norway E2 and Iceland E4.

16/6/70 USSR R1, Czechoslovakia R1, Poland R1, Switzerland E2, Italy IA and IB, Spain E2, E3 and E4.

20/6/70 USSR R1 and R2, Czechoslovakia R1, Hungary R1, Rumania R2 and R3 (very good R2).

22/6/70 USSR R1 and R2, Spain E2, E3 and E4 and Portugal E2.

23/6/70 USSR R1 and R2, Czechoslovakia R1 (two stations), Sweden E2, E3 and E4, Norway E2, E3 and E4, Hungary R1, East Germany E3 and E4, Iceland E4, Italy IA and IB, Switzerland E2 and E3, Austria E2a, Spain E3 and E4, West Germany E2. These plus trops from France and Belgium make 15 countries.

24/6/70 USSR R1, Czechoslovakia R1, Austria E2a, Switzerland E2, Sweden E2, Norway E2, Poland R1 and R2, Portugal E2 and E3, West Germany E2 and E3, Italy IA, Spain E2 and Yugoslavia E4. These plus trops from France and Belgium make 14 countries.

These were the days for really long-duration strong signals. It is worth noting Rumania R3 (Band II) on the 20th: M. Opie also had this on 17th but I missed this as I was at work. Iceland too was most acceptable as was East Germany—curiously it is the first time I have been able to identify it this year. A SpE and Trop check here shows that 1970 has after all produced all the possible SpE countries except Denmark. It is about however according to readers' reports. There have also been no signs of Luxembourg as a Trop.

Now to the "new" electronic test card on R1/E2a as shown last month. As we suggested this is Austria all right. R. Bunney confirms it from subsequent transmissions and Seppo. J. Pirhonen of Finland tells us that he has checked the sound channel with Austria Broadcast Radio and they tally, i.e. they relay the local radio during the test card transmission like France.

Next to Spain. At last we have had a sight of the new test card here. The first information we had was a good sketch from Keith Hamer of Derby, and since then I have had some good views of it myself. A photo is on the way and we hope to publish it soon. For the moment I must describe it as follows: (1) Four corner circles with hatched squares mounted diagonally in them. (2) Top black bar with narrow vertical white band. (3) Bottom white bar with narrow vertical black band. (4) Centre circle with horizontal contrast wedge at top and small inner hatched circle. (5) Left-hand inside main circle, fan of narrow black lines; right-hand side, similar fan of wider black lines (this is a very notable feature of this card). (6) The letters TVE in a circle at the bottom.

France, strange happenings here. On 16/6/70 at 09.50 to 10.00 I saw Caen F2, Lille F8a and Brest F8 all radiating on 625 lines positive image with the ORTF2 second-chain picture of the girl with the big hat. I have not subsequently seen any further v.h.f. 625-line transmissions, but this reopens the question as to whether the ORTF first chain is going to change from 819 lines to 625.

Poland/Hungary. Since we have now identified the new electronic test card as E2a Austria we are still left with the old and vexed problem of Poland and Hungary using the same type of card. We can only rely on subsequent captions for positive identification as I have had to do.

R. Roper has done it again with Canary Is E3. This was very rare even last year. Garry Smith of Derby has turned in a good log which includes Norway, Sweden, Czechoslovakia, Hungary, Spain, Italy, USSR, West Germany and France. We wish him continued DX successes. H. G. Adams of Birmingham has the justified complaint of poor conditions but this did not prevent him from logging France, Spain, USSR, Czechoslovakia, Norway, Sweden and Italy. He also sends a sketch of a test card he received on E3. It looks very much to us like Iceland. If so it would be the first E3 report of its reception.

NEW ITV ENGINEERING TRAINING COURSES

A COMPLETELY new series of courses for the engineering staff of Independent Television commences this September. The courses are for both Independent Television Authority and programme company staffs and are at two levels, a Studio Engineering Certificate Course and an Advanced Television Engineering Diploma Course.

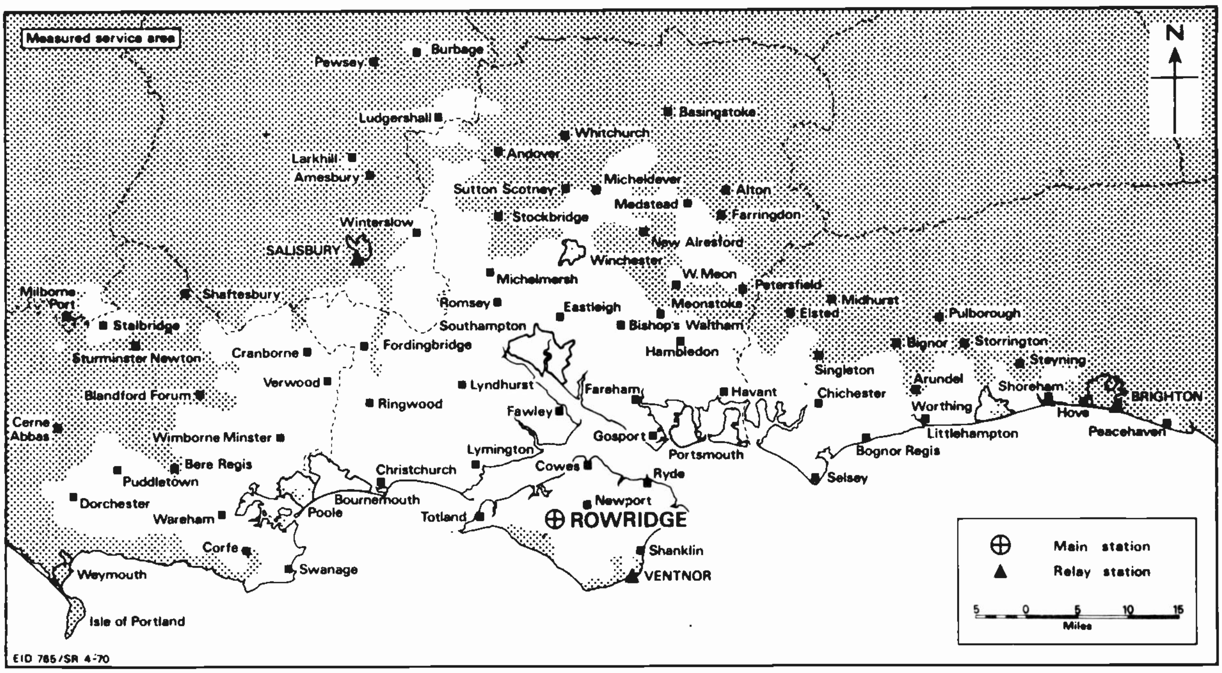
The ITA and the Independent Television Companies Association (ITCA) have chosen Plymouth Polytechnic to organise and operate these courses. The Polytechnic has already established itself in the field of Television Engineering and has been conducting colour television courses for the programme companies for some time. These courses give engineers already experienced in monochrome television the opportunity to learn the basics of colour, both theory and equipment operation, and have undoubtedly helped to provide the engineering experience necessary for the successful introduction of colour in Independent Television.

The lower level Certificate course will be held in two five week parts. It covers television fundamentals and operations and will be open to newly or recently appointed engineering staff. The expected entry level is at ONC or equivalent. The aim at this level is towards non-mathematical treatment but the scope is wide and the large amount of practical work undertaken should give the student a sound television engineering background before returning to his station.

The engineering level Diploma course is expected to attract HNC level entrants and the three sections of the course—Pulse Circuit Techniques, Television Engineering and Television Transmission—have been approved as HNC Endorsement subjects. Each section is of 11/12 weeks duration and the depth of treatment is intense. Pulse Circuits is concerned with electronic devices and system fundamentals, Television Engineering with all aspects of television at the studio centre, and Television Transmission with the theory and practice of television signal propagation. The first two are designed for students from the ITCA and the third for students from the ITA. All courses however are open to suitably qualified students from the UK or overseas and the Polytechnic has already received a number of such enquiries.

The demands upon the Polytechnic to successfully maintain courses of this nature are exacting in terms of both staff and equipment. The staff consists of a full-time lecturing/engineering complement of seven. Each has a broadcast television background and also a specialisation ranging from the physics of colour and electronic devices to high-power u.h.f. transmission. Equipment for broadcast television is expensive but Plymouth Polytechnic has managed to build up a complete broadcast studio and its ancillaries fully equipped for colour. That the system evolved is operational is ensured by the requirements of Plymouth Educational Television—producing programmes for distribution to the primary and secondary schools of the city. Studio facilities alone however are not sufficient for courses of this type and the full laboratory facilities of a modern Polytechnic are also available.

The establishment of these courses is a significant step in ITV engineering education and their assignment to Plymouth Polytechnic shows considerable faith in its facilities and staff. ■



The above BBC map shows the approximate service area of the **Rowridge** *u.h.f. transmitter (maximum vision e.r.p. 500kW, directional aerial). Small pockets of poor reception too small to be shown in this map may be experienced. Channels: BBC-2 24; ITA 27; BBC-1 31. Horizontal polarisation, receiving aerial group A.*

SERVICE NOTEBOOK

G. R. WILDING

Field Fault

THERE was a very unusual picture on a Bush model TV115L. The raster only covered about the centre 8in. of the screen and there seemed to be a complete double or treble foldover from top to bottom. We could not imagine valve failure causing this effect but before getting too involved we replaced the ECC82 field oscillator and PL84 output pentode just in case. There was no improvement.

The bizarre appearance of the picture suggested generator stage trouble rather than an output stage defect so we commenced voltage checking on the former. The anode of the ECC82 (a) section is fed (see Fig. 1) from the h.t. rail via a 100kΩ resistor and was slightly below the scheduled voltage. Section (b), which is fed from the boost rail via the height control and two limiting resistors, was about normal.

The cathode voltages on both sections, however, were zero instead of 3V. In this model the triode cathodes are connected together and returned to chassis via a 2·2kΩ resistor shunted by an 0·05μF decoupler. As expected this capacitor had a complete short-circuit and on replacement a normal picture was obtained. The anode voltage of the ECC82 (a) section also returned to normal since its grid is returned to chassis via a 10kΩ resistor and it is thus biased by the 3V developed across the common cathode resistor. The grid of the (b) triode section on the other hand is returned to its cathode and so was not affected or biased by the cathode voltage. It is in fact self-biased by grid capacitor, grid leak action on the sawtooth oscillations.

As is so often the case what at first appeared to be a difficult case involving considerable testing and component replacement turned out to be quite a simple one.

Varying Height

THE complaint on an elderly Invicta 21in. model was simply "poor picture shape". Inspection showed that the vertical linearity was bad while the tube was well past its prime, but after replacing the PCL82 field timebase valve and readjusting the presets and picture centring magnets we eventually obtained a good Test Card.

After leaving the set on test for a short while, however, we noticed that the top of the picture was shrinking and eventually left a gap of almost 1in. above the raster. When vertical shrinking occurs it is usually at the bottom of the picture, due to a slightly soft field output pentode or a reduced value cathode resistor causing it to be over-run.

We next noticed that on varying both brightness and contrast controls the gap could be varied, and it became obvious that the tube was leaky and getting worse as its temperature increased. This leak was imposing an additional current demand on the boost rail and when the e.h.t. current was increased—by advancing the brilliance or contrast controls—the boost rail potential could not be maintained so that the voltage to the anode of the field generator was reduced.

In such cases little can be done to remedy the situation, but as the set was good in other respects—tuner, line output transformer, mains dropper resistor etc.—we considered it worthwhile recom-

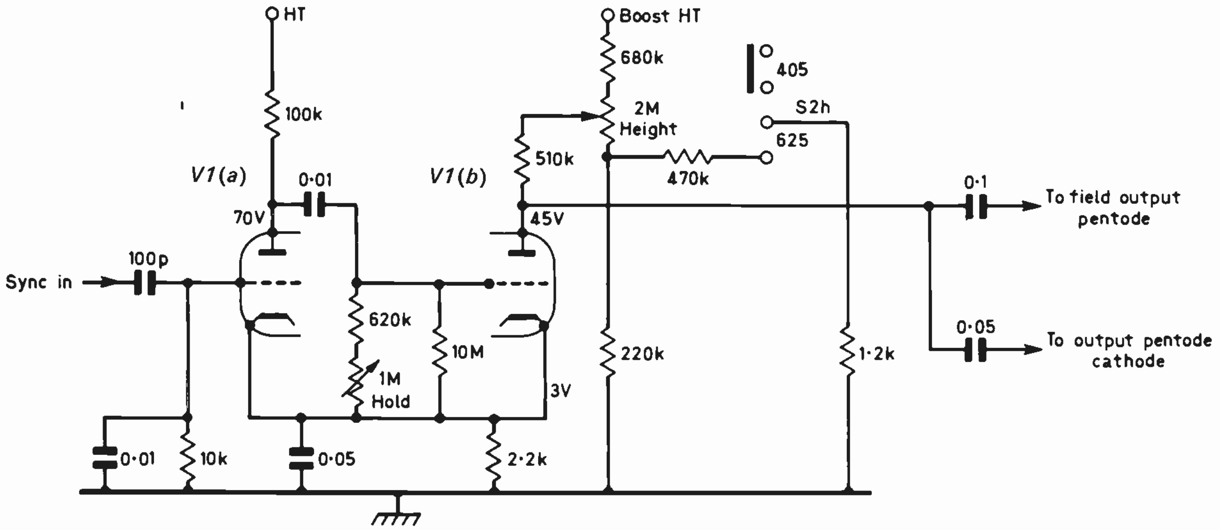


Fig. 1: Field generator circuit of the Bush Model TV115L. System switch S2h slightly reduces the right-hand triode anode voltage on 625 lines to equalise height. Fault symptoms were greatly reduced height and completely folded-over picture.

mending a reconditioned tube. We mention the dropper resistor because the condition of this vital component—flaking covering, discolouration and shunted open-circuit sections—usually gives a good indication of a set's previous use.

No EHT

No picture on a Pilot 19in. model was we found due to no e.h.t. There was no audible line whistle and only a minute spark could be drawn from the anode of the PL36 which was running excessively hot though not glowing. There was therefore either greatly reduced grid drive from the line generator or heavy loading on the line output transformer. Grid drive tends to be either about normal or completely absent so we concentrated on the latter possibility.

In this model as in many others the e.h.t. rectifier is mounted upside down in an insulating container, with the valveholder plugged on to the valve base rather than the other way round. We therefore first removed this valveholder in case there was an internal short-circuit in the rectifier overloading the transformer. There was no improvement in spark size at the PL36 anode.

There was no point in checking the arc size at the cap to the e.h.t. rectifier anode and as it would mean taking the valve out we followed the golden rule of not removing anything unless essential. This was an old model and if the anode cap had become tight on the rectifier—as they often do—it would have been easy to break it from the transformer lead-out wire and cause a lot of unnecessary work.

We next removed the top cap of the boost rectifier since this will result in greatly increased output if the boost reservoir capacitor is shorted. Again there was no improvement. We then noticed a tubular type of high working voltage capacitor connected across two tags on the line transformer assembly. On measuring across it we found a negligible resistance reading and, even more conclusive, there was a distinct swelling of the central section. This capacitor was shunted across a transformer section for third harmonic tuning so there would normally be a low resistance reading across it. On snipping it out we found it was virtually short-circuit.

On retesting the set we obtained a brilliant raster but only half normal width and height. Replacing the capacitor subsequently restored full raster size. When tracing lack of e.h.t. therefore check all such capacitors whether they show signs of breakdown or not, for when shorted they can produce the same sort of symptom as shorting turns in the transformer. Many line output transformers must have been considered finished when only a shunting capacitor was at fault. Similarly many puzzling instances of inadequate width are due to value loss or to a replacement capacitor not being of exactly the original value.

Insufficient Height

THE raster on an RGD Model 628 had suddenly reduced to about half normal size though with good linearity. Replacing both field timebase valves had negligible effect but on checking voltages we found there was only about 35V at the PCL85 triode anode instead of the minimum 74V expected.

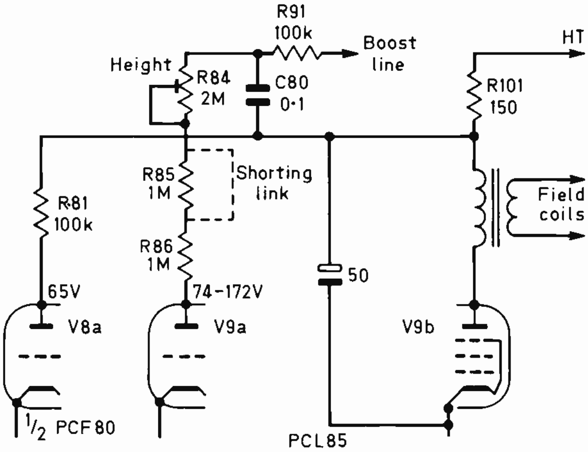


Fig. 2: Anode h.t. supplies in the RGD Model 628 field circuit. Height on this receiver had suddenly reduced to about half due to severe reduction of V9a anode voltage.

We immediately assumed that as often happens one of the high-value anode feed resistors had increased in value, although such increases are usually gradual and not a sudden deterioration. When we suspect that a high-value feed resistor has increased still further in value we generally shunt our meter on its 1,000V range—equivalent to 1MΩ—across the resistor and note the effect.

R85 in the circuit (Fig. 2) was already shorted out and the height control was at maximum (minimum resistance) setting, but stabbing the meter across R91 (100kΩ) and R86 (1MΩ) produced negligible effect. Normally if either of these resistors had been high-resistance there would have been a pronounced height increase.

We then found that linking the boost rail to the valve anode with the meter resulted in the Test Card circle almost filling the screen. There was no leak from triode anode to chassis and a resistance check showed that both R91 and R86 were close to normal. We then noticed that R91 was beginning to run hot, due we found to a short-circuit in C80 connected from the junction of this resistor and the height control to the h.t. rail. Disconnecting this capacitor produced normal height.

It was then apparent that this shorting capacitor had placed R91 across the boost and h.t. rails so that the triode was fed from the latter point, resulting in the low anode voltage. As R91 had been overrun for some time we replaced this as well as the decoupler C80.

LEEDS UNIVERSITY'S TV CENTRE

The new £500,000 TV Centre at Leeds University was opened on June 24th and incorporates a £100,000 installation of EMI TV equipment. This TV Centre is the largest and most comprehensive production service of any University in the Commonwealth, comprising two large studios (1,700 and 1,100 sq. ft.), each with a production control room, and a central operations and technical facility, all located in a purpose-designed underground complex. Up to eight programmes can be transmitted simultaneously to a total of 120 lecture theatres and laboratories.

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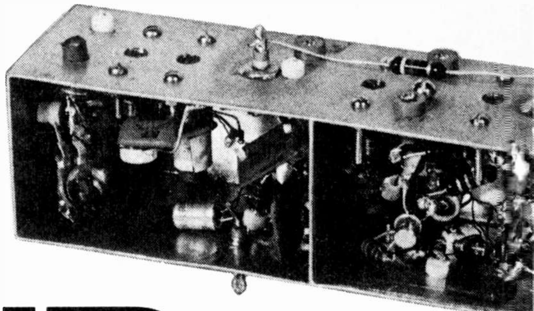
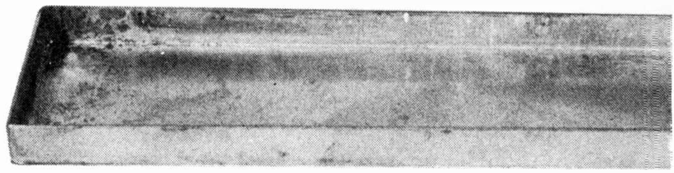




When the 625-line Constructor's Receiver (March-July) was originally being developed it was decided to use a manufacturer's surplus i.f. strip and tuner. The reason for this was simple: i.f. strips and tuners are generally difficult to construct and also there is the problem of alignment.

As many readers will be aware, the response of constructors to the new receiver was so great that supplies of the surplus i.f. strip ran very short. There was a period of concern both to constructors and the staff of Practical Television. A solution to the problem for present and future constructors had to be found. The use of other surplus i.f. strips would entail modifications to the receiver and possibly supplies would run out again.

The obvious solution appeared to be the production of a constructor's i.f. strip which could be built from standard components. It would have to be transistorised and compatible with the existing receiver design so that it could be substituted for the original i.f. strip. Naturally the production of such a unit takes time, but nevertheless we have endeavoured to keep the delay to a minimum so that constructors would not have to wait too long. The constructor's i.f. strip has now been built and tested, and the results show that a good performance can be obtained without recourse to involved alignment techniques.

Basic Requirements

To start with we shall consider the requirements and problems associated with i.f. strip design. It is necessary to define the characteristics of the i.f. strip first. The input should accept the output of any normal u.h.f. tuner of the two-transistor type now in general use. This output is lower than that presented by the original tuner unit used, so the i.f. strip needs more gain. This gain should however be variable so that tuners of the original type may be connected without any risk of overloading. (Readers will remember that the tuner originally used contained a stage of i.f. amplification.)

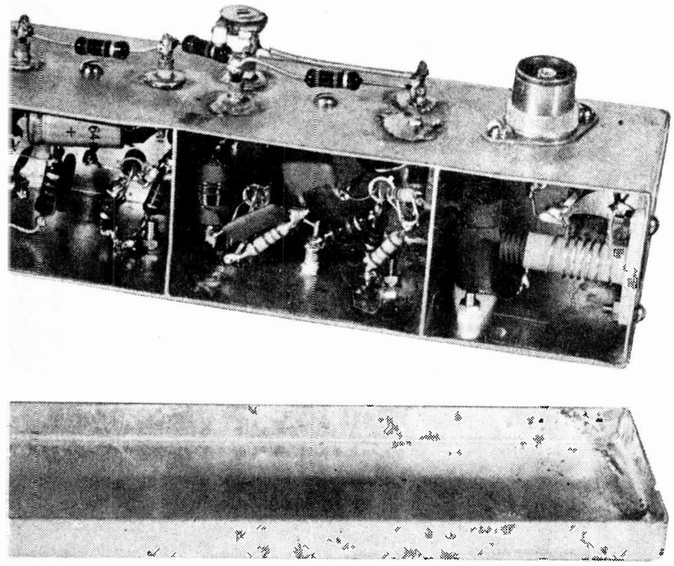
The i.f. strip should therefore have a maximum gain of around 40dB from the input to the video output. Besides the video output, intercarrier sound amplification and demodulation are needed, with an output to feed the audio section of the main receiver chassis.

It is well known that high frequency circuits employing transistors are more difficult to design than their valve counterparts. This applies particularly to i.f. strips where the overall response shape needs to be rigidly specified. The standard frequencies used for television i.f. working on the 625-line system are 33MHz for sound and 39MHz for vision. Vestigial sideband working is employed and attenuation of the sound signal is also necessary.

Conventional IF Strip

The conventional approach to the design is generally to use double-tuned circuits between stages. The tuned circuits are over-coupled to provide adequate bandwidth. In order to prevent regeneration, neutralising is often necessary, particularly with earlier types of transistor. Traps are used to finally shape the response. An i.f. strip of this type usually employs three transistor amplifier stages. The setting up is complicated owing to the interaction between the coupled tuned circuits and the

PART 1



ructor

KEITH
CUMMINS

variations in neutralisation. Furthermore the spreads in transistor parameters can make the optimisation of a design very difficult. In order to set up such an i.f. strip a signal generator, sweep generator and oscilloscope are strictly required.

Alternative Approach

It is obvious that if at all possible an alternative approach to the design should be adopted. If an i.f. strip could be designed which had a minimum number of tuned circuits in need of adjustment this would be a great help to the constructor faced with the problem of lining it up. The solution to our problem lies in the words "in need of adjustment": it is possible to employ wideband tuned circuits which are heavily damped and need no tuning adjustment. Variations in individual coils can be swamped by low-value damping resistors, and the tuning capacitors can be close-tolerance mica types. Some adjustments are still obviously necessary, but the design to be described has kept these to a minimum and in fact alignment is possible using a transmitted test card only.

One of the implications of using heavily damped tuned circuits is that the stage gain will be below the theoretical maximum. However, since our i.f. strip is transistorised it is a simple matter to increase the number of stages from three to four in order to compensate for the loss of gain. Furthermore, no neutralisation is necessary and the damping also effectively swamps individual variations in transistor parameters. The prototype i.f. strip had sufficient gain when initially switched on to enable a picture of sorts to be received immediately. The advantage of using non-critical tuned circuits is obvious!

Sound Circuits

Readers of the previous series of articles will remember that the intercarrier sound i.f. frequency is a constant 6MHz, which from the constructor's point of view is as good as having a crystal-controlled signal generator for the purpose of sound circuit alignment. Therefore if our vision i.f. arrangement enables the sound and vision signals to be passed through at an adequate level from the start, the alignment of the sound circuits should present little problem. Such has in fact been the case. The sound circuits need to be carefully aligned, as will be described later, to avoid distortion and intercarrier buzz, but the procedure is straightforward and should not present difficulty.

Construction

The i.f. strip is constructed in a metal box the dimensions and other details of which will be given next month. As with the main chassis, the box, which is made of brass, was constructed by: C. G. James Electronics, Boyers Yard, St. Albans Farm, Staines Road, Feltham, Middx.

It will be seen from the photographs that screening sections are included in the box, and the whole unit is enclosed by a tightly fitting lid. The box is divided into four sections. The first contains the "input-selective" circuits which will be described in detail later. The second section houses the first two i.f. amplifiers which are controlled by the a.g.c. circuit. In the third part are the last pair of i.f. amplifiers, the detector and a.g.c. diodes and the video preamplifier. The last compartment contains the sound section and the a.g.c. amplifier.

The separation of the different sections of the i.f. strip is essential in order to avoid instability and harmonic feedback. The supply rail is introduced into each section via feedthrough capacitors, which

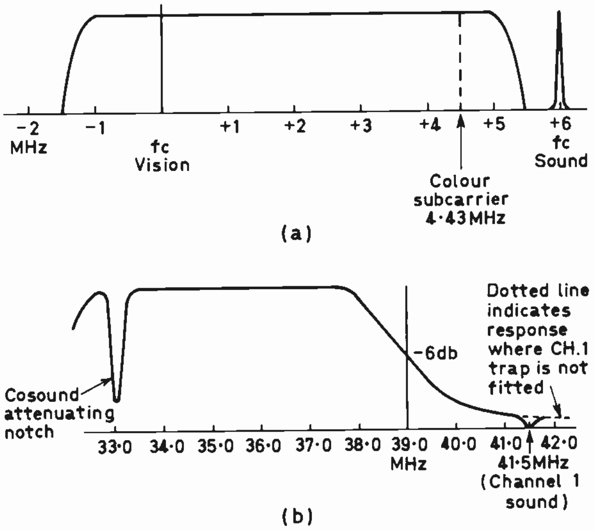


Fig. 1: (a) Transmission spectrum of a 625-line transmitter. (b) Response curve of an i.f. strip, using intercarrier sound, to handle the above transmitter spectrum. Note that the sense of the vision and sound signal is reversed at i.f. as the tuner's local oscillator operates above the channel frequency.

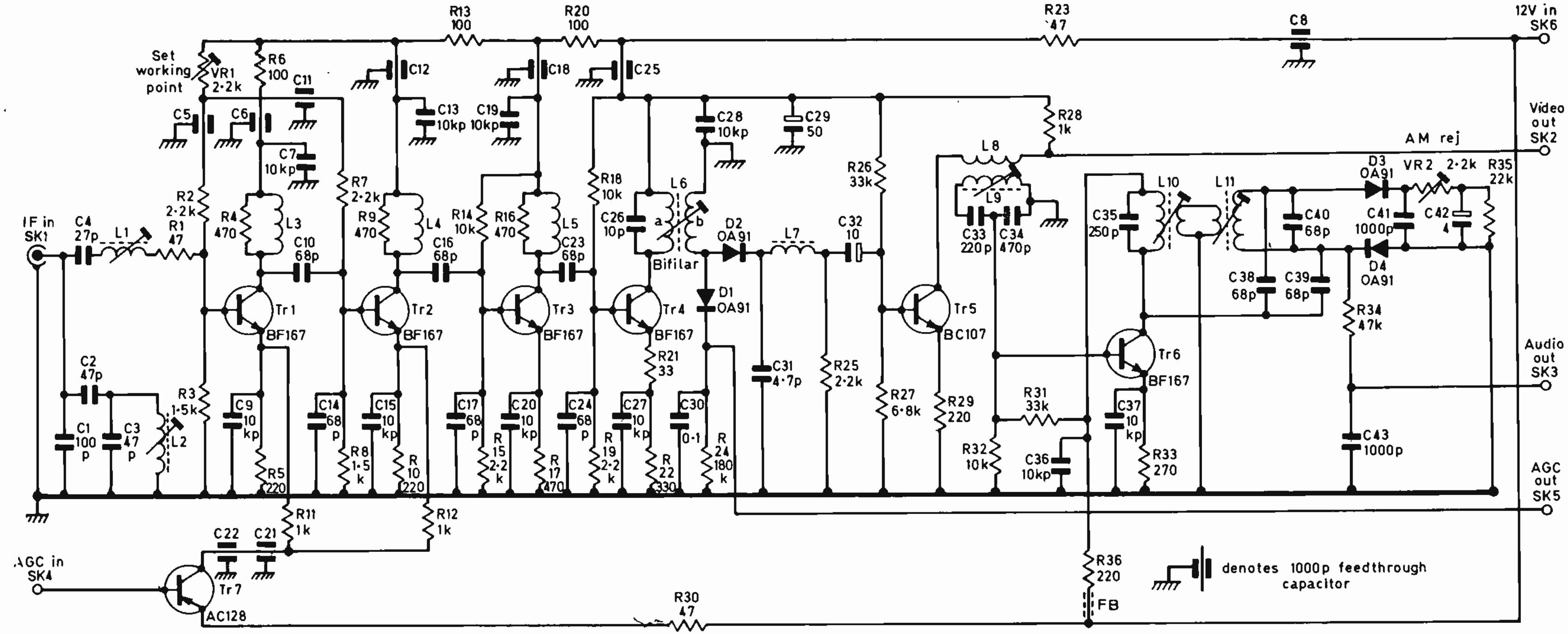


Fig. 2: Circuit diagram of the constructors' single-standard i.f. strip.

Resistors:

R1	47 Ω	R19	2·2k Ω
R2	2·2k Ω	R20	100 Ω
R3	1·5k Ω	R21	33 Ω
R4	470 Ω	R22	330 Ω
R5	220 Ω	R23	47 Ω
R6	100 Ω	R24	180k Ω
R7	2·2k Ω	R25	2·2k Ω
R8	1·5k Ω	R26	33k Ω
R9	470 Ω	R27	6·8k Ω
R10	220 Ω	R28	1k Ω
R11	1k Ω	R29	220 Ω
R12	1k Ω	R30	47 Ω
R13	100 Ω	R31	33k Ω
R14	10k Ω	R32	10k Ω
R15	2·2k Ω	R33	270 Ω
R16	470 Ω	R34	47k Ω
R17	470 Ω	R35	22k Ω
R18	10k Ω	R36	220 Ω
		All ¼W	

VR1	2·2k Ω
VR2	2·2k Ω

Miniature presets

Semiconductors:

Tr1	BF167
Tr2	BF167
Tr3	BF167
Tr4	BF167
Tr5	BC107
Tr6	BF167
Tr7	AC128
D1	OA91
D2	OA91
D3	OA91
D4	OA91

Capacitors:

C1	100pF Mica
C2	47pF Mica
C3	47pF Mica
C4	27pF Mica
C5	1,000pF Feedthrough
C6	1,000pF Feedthrough
C7	10,000pF Wee C
C8	1,000pF Feedthrough
C9	10,000pF Wee C
C10	68pF Mica
C11	1,000pF Feedthrough
C12	1,000pF Feedthrough
C13	10,000pF Wee C
C14	68pF Mica
C15	10,000pF Wee C
C16	68pF Mica
C17	68pF Mica
C18	1,000pF Feedthrough
C19	10,000pF Wee C
C20	10,000pF Wee C
C21	1,000pF Feedthrough
C22	1,000pF Feedthrough
C23	68pF Mica
C24	68pF Mica
C25	1,000pF Feedthrough
C26	10pF Mica
C27	10,000pF Wee C
C28	10,000pF Wee C
C29	50μF 15V El.
C30	0·1μF 30V Ceramic
C31	4·7pF Mica
C32	10μF 15V El.
C33	220pF Mica
C34	470pF Mica
C35	250pF Mica
C36	10,000pF Wee C
C37	10,000pF Wee C
C38	68pF Mica
C39	68pF Mica
C40	68pF N750K
C41	1,000pF Ceramic
C42	4μF 15V El.
C43	1,000pF Ceramic

Miscellaneous:

7 ¼in. coil formers and cores
4 stand-off insulators
2 ferrite beads
1 coaxial socket
6 miniature single-pin plugs and sockets (Radiospares)
6BA and 8BA nuts, bolts, washers and solder tags, 28s.w.g. enamelled copper wire, ½in. wide p.v.c. tape, connecting-up wire.
Coaxial input lead with coaxial plug to suit tuner unit used.

take care of harmonic feedback. Larger decoupling capacitors on the inside of the box provide a low-impedance path to earth at i.f.

Harmonics and Feedback

One essential point in the construction of an i.f. strip lies in "containing" the different sections at the frequencies involved. In particular, detector and discriminator circuits can generate harmonics which beat with the local oscillator and each other to produce spurious patterns. Feedback at i.f. can completely distort the required response curve so that it becomes impossible to set up the equipment correctly. It will now be clear why so much care has been taken with screening and the isolation of the different sections.

Circuit

This month we shall deal with the main i.f. strip circuit and its design, to be followed up by the constructional details and alignment information.

The complete circuit diagram is shown in Fig. 2. It is essential that the unit should accept any tuner output. To this end the series input matching circuit C4, L1, R1, with bottom-end matching capacitor C1, is employed. The circuit is adjusted by L1 which tilts the response away from the vision carrier frequency in order to provide the vestigial-sideband response necessary.

Vestigial-sideband Transmission

The principle of vestigial-sideband transmission is shown in Fig. 1. It is not necessary to transmit two sets of sidebands belonging to the main carrier: one will suffice, and the suppression of its mirror image enables the overall channel bandwidth to be reduced. It is, however, impossible to completely remove one set of sidebands, since severe transmitter design problems arise the closer the sideband filter approaches the main carrier frequency.

As a result a compromise solution is adopted with double-sideband transmission up to about 1.25MHz bandwidth on the 625-line system and with rapid attenuation of one sideband above this frequency. So it will be seen that double the energy exists in the transmission up to 1.25MHz, and it is necessary therefore to shape the receiver's response as shown in Fig. 1(b). This response shape introduces 6dB of attenuation at the centre carrier frequency relative to the response level of the unsuppressed sidebands above 1.25MHz, and the video content is thereby equalised over the video bandwidth used. Because of the vestige of one sideband which remains, this type of transmission is referred to as "vestigial-sideband transmission."

Input-selective circuit

In order that the sound carrier shall not interfere with the vision signal an absorption trap consisting of C2, C3 and L2 is fitted. This circuit is a low impedance at the sound carrier frequency and consequently attenuates the level of the sound carrier passed to the i.f. strip. The low-level sound signal is thus carried through the whole of the vision i.f. amplifier chain but causes no noticeable disturbance to the vision signal.

The whole group of components just described constitutes the "input-selective" circuit which is important since the overall response shape depends upon its adjustment. Those readers living in the London area served by Crystal Palace channel 1 may experience sound breakthrough on 41.5MHz. This can be prevented by an addition to the input-selective circuit consisting of another group of components similar to C2, C3 and L2 and tuned to 41.5MHz. Details of this will be published next month.

Controlled Stages

Having passed through the input-selective network the i.f. signal is presented to the base of Tr1, the first of two similar stages which are subject to a.g.c. No a.g.c. is applied to the tuner so two i.f. stages are controlled in order that sufficient range of control can be provided. Forward control is used, and under maximum gain conditions the a.g.c. amplifier Tr7 is turned on fully. +12V is thus applied via R11 and R12 to the emitters of Tr1 and Tr2, holding them at approximately +2V. The forward bias is then adjusted by VR1 for the maximum gain condition. When a.g.c. action occurs Tr7 is turned off progressively and the emitters of Tr1 and Tr2 are no longer held at +2V. Because the base bias network tends to hold the base potential constant, an increase of current occurs in Tr1 and Tr2 which reduces the overall gain. Using the a.g.c. circuit to be described later, over 30dB of control is easily available.

The collectors of Tr1 and Tr2 are connected to interstage tuned circuits. The tuned circuit for Tr1 consists of L3, C10 and C14. The two capacitors are effectively connected in series so that the capacitance in circuit approximates 34pF plus strays. The series connection of the capacitors provides a capacitive tap which feeds the base of the following stage. Resistors R7 and R8 form the base biasing network for Tr2. L3 is a coil without adjustment and is heavily damped by R4. The tuned circuit is arranged so that L3 is wound on R4. The constraints inherent in the method of construction of the i.f. strip ensure that accurate repeatability of the design is possible. L3, L4 and L5 are in fact identical to each other, being wound on R4, R9 and R16 respectively.

Third and Fourth Stages

The third i.f. amplifier Tr3 is completely straightforward and is not gain controlled. The signal level being handled at this point is low so that no special precautions need be taken in the design which follows normal practice.

The fourth and final i.f. amplifier feeds a bifilar-wound i.f. transformer, L6A and B, tuned by C26. Tr4 operates under higher current conditions than Tr3, since the stage has to drive the detector diodes. To improve the linearity of operation under large-signal conditions, the emitter resistor consists of two parts R21 and R22 of which only R22 is bypassed, by C27. The unbypassed resistor R21 introduces negative feedback which improves linearity.

Detectors

The secondary winding L6B feeds two diodes D1 and D2. D1 is connected to R24 and C30 in parallel. The time-constant of these components is large by comparison with the line scanning rate, so a voltage is developed across them proportional to the sync-tip amplitude, which is constant for all conditions of video signal. This signal reference level is employed for a.g.c. purposes, the information being passed out of the i.f. strip to the a.g.c. circuit via SK5.

Diode D2 is the video detector diode. The output after filtering by C31 and L7 terminates d.c.-wise in R25. The video signal, which includes the intercarrier sound, is a.c. coupled to the video preamplifier Tr5. A.C. coupling is in order here since we are providing d.c. restoration later in the circuit of the main video amplifier. Tr5 inverts the phase of the video signal to bring it into the right sense to drive the main video amplifier.

Video Preamplifier Gain

The gain of Tr5 is determined to a first order approximation by the ratio of its collector load R28 to the unbypassed emitter resistor R29, so a gain of 4.5 is obtained. Thus to apply a 2.5V peak-to-peak signal to the final video stage an output of just over 0.5V from the video detector is required. By the use of Tr5 therefore the output requirement from the video detector is substantially reduced. With this reduced output there is less harmonic radiation and linearity distortion and the last i.f. stage and video detector become less critical. Tr5 itself is of course operating under highly linear conditions since substantial feedback is applied as a result of leaving the emitter resistor R29 unbypassed.

Intercarrier Amplifier

The collector circuit of Tr5 consists of L8 and R28 in series. The video output is taken from the junction of these two components while L8 couples the intercarrier sound signal into the 6MHz tuned circuit comprising L9, C33 and C34. C33 and C34 form a capacitive tap to which the base of Tr6 the 6MHz amplifier is connected. This transistor is operated under maximum gain conditions. In its collector circuit is placed the tuned circuit L10, C35 which is tuned to 6MHz. L10, C35 are coupled by a loop to the secondary tuned circuit consisting of L11, C38, C39 and C40.

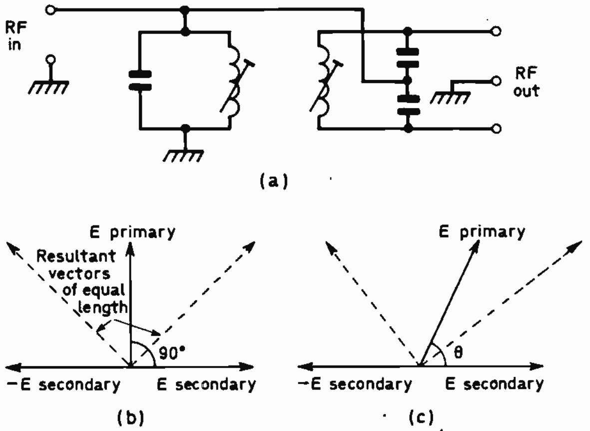


Fig. 3: (a) R.F. equivalent circuit of the ratio detector tuned circuits. (b) Relationship of voltages at resonance. (c) When the sound carrier frequency deviates the 90° phase relationship of (b) no longer applies and the resultant vectors are of unequal length: one detector diode therefore conducts more heavily than the other.

Ratio Detector Circuit

C38 and C39 form a capacitive tapping across the secondary tuned circuit, the final capacitance necessary for tuning being made up by C40. A sample of the signal present in the primary of the discriminator transformer made up of L10 and L11 is introduced at the secondary's capacitive centre tap, i.e. the junction of C38 and C39. When the two coupled tuned circuits are resonant at 6MHz a phase difference of 90° exists between the voltages in the primary and secondary windings. The secondary feeds two diodes D3 and D4 which connect to the stabilising circuit consisting of C41 (an r.f. bypass), VR2 (which adjusts the a.c. to d.c. load ratio) and the parallel network C42, R35 which has a long time-constant compared with the lowest audio frequency to be handled.

When the 6MHz sound carrier is unmodulated the 90° phase relationship described above applies and the diodes D3 and D4 conduct equally, since the 90° signal is equally ahead of and behind the voltages available at the ends of L11. Depending upon the signal strength, the capacitor C42 charges to a level slightly below the peak voltage appearing across L11.

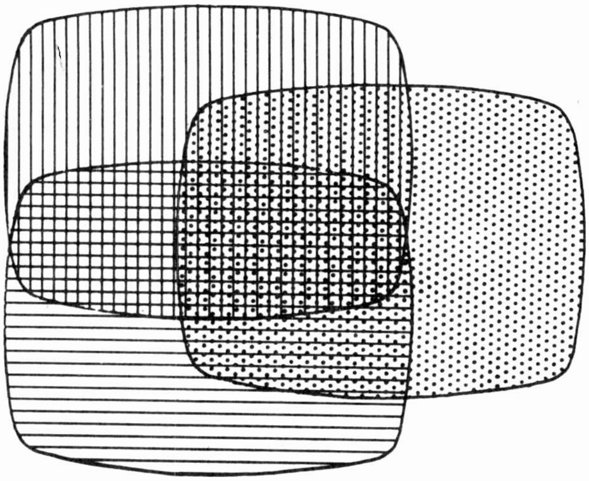
When the 6MHz carrier frequency is modulated by an audio signal, the 90° phase relationship between the voltages in L10 and L11 no longer applies. The greater the deviation of the carrier, the greater the change in phase angle becomes. As a result one diode conducts more heavily than the other and the circuit is no longer balanced. The degree of unbalance is proportional to the signal deviation which in turn is a function of the original modulation. The audio signal is taken from the discriminator circuit via R34, which serves as both r.f. stopper and de-emphasis resistor in conjunction with C43. The action of the discriminator is illustrated vectorially in Fig. 3. Readers will recognise the circuit as a type of ratio detector.

A ratio detector provides optimum rejection of amplitude-modulated signals when its d.c. to a.c. load ratio is adjusted to around 0.95. VR2 provides an adjustment which is set up operationally to the point giving minimum video buzz on sound.

A list of components for the i.f. strip is provided this month. Next month we shall go on to the constructional details and the setting up procedure, and also the modified a.g.c. arrangement. Recommendations will also be given on the use of the original type of tuner unit used in the 625-line receiver with this i.f. strip.

TO BE CONTINUED

625-Line Receiver: We have learnt that some of the line output transformers supplied have the connections to tag 3 and the tag beneath it marked "unused" in Fig. 4 (pages 302-3 April issue) reversed. If with such a transformer the coils are connected to tag 3 there will be reduced scan amplitude and foldover at the left. To cure this, drop the coil connection to the tag below tag 3.



TUBES FOR COLOUR TV

I. R. SINCLAIR

SINCE all-electronic, as distinct from mechanical, television systems for colour TV became a reality, the type of picture display tube used has determined the price and circuit complexity of the receiver. The purpose of a colour tube, just to remind ourselves, is to present at any point on the tube face a colour determined by the glow of three different colour phosphors (one for each primary colour), the intensity and the hue being set by the signals applied to the tube. So far the shadowmask tube, developed with astonishing speed by RCA and submitted as part of the complete NTSC system to the American Federal Communications Commission in 1952, has dominated colour TV. The reasons are not hard to find. The shadowmask tube was in commercial service before other types of colour tubes were even at the stage of laboratory demonstration. Though other possible tubes have been greatly developed and improved since then, so also has the shadowmask tube, and the vast expenditure on tools and jigs for manufacturing shadowmask tubes is paying off in keeping the price of the tube less than could be easily achieved by a competitor using similar receiver design. Some other tube types might be easier to manufacture, but require novel receiver circuits: no one however is going to make tubes without being sure that there will be sets to fit them. So breakthroughs are not going to come from small firms but from those giants which make both tubes and receivers.

The dominance of the shadowmask tube might not last however. We have after all seen a similar situation in car design, where the cheapness of conventional rear-wheel drive prevented the commercial success of front-wheel drive until the Mini made the breakthrough, and we have now reached the stage where very few cars of under 1·5 litres capacity have conventional front engine and rear drive except, oddly enough, here in Britain where the real breakthrough started. Perhaps there is a warning here.

TYPES OF COLOUR TUBE

Many colour tube ideas have actually emerged as hardware, but all can be grouped in three main categories. We can classify these as the *beam masking*, the *beam indexing* and the *beam deflection* types according to the way in which the electron beam(s) are forced to strike phosphor of the correct colour. Beam masking tubes—such as the shadowmask tube—are generally three gun tubes while the other types are single gun tubes. Other approaches, such as the beam energy tube in which a phosphor is used whose colour depends on the energy of the beam striking it, seem to have died due to insurmountable difficulties with materials. Recently however projection systems using laser light sources have been built and operated but seem a long way from being turned into consumer goods.

Before we survey recent developments in colour tubes it would be as well to review the best known principle, that of beam masking. The beam masking type of tube, of which the shadowmask tube is the first and best known example, uses three electron beams each of which is permitted to land only on phosphor dots of the correct colour. This selection process is carried out by a perforated metal shield in the shadowmask tube, this shield or shadowmask being placed close to the screen (Fig. 1). The manufacturing difficulties of the shadowmask tube are enormous, requiring extremely tight tolerances both in metal work and worse still in glass. They have however been overcome, which indicates that manufacturing difficulty is no real barrier to any type of colour tube proposed in the future provided the rewards are worthwhile.

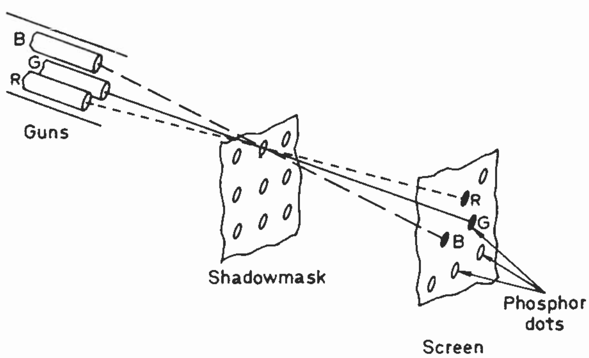


Fig. 1: Schematic of the shadowmask tube. The spacings have been distorted for clarity. In reality the guns are some 10-12in. from the screen, the shadowmask is about ½ in. from the screen, and the electron beams cover about three holesin the mask.

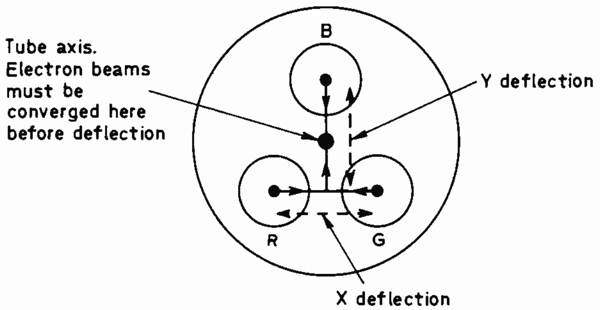


Fig. 2: Triangular arrangement of the three guns in the shadowmask tube, showing how X and Y deflections (convergence) have to be made to position the beams correctly on the axis of the tube before scanning.

There are nevertheless other problems which cannot be so readily overcome by mechanical ingenuity and money with the shadowmask tube. One is that because of the shadowmask only a very small proportion of the electrons leaving the gun cathodes reaches the phosphor dots (about 15% is quoted). This makes the display much less bright than that of the monochrome tubes to which we are accustomed despite the raising of the e.h.t. on the final anode to about 25 kV (much above this, X-ray radiation, which increases with the square of the voltage, becomes a problem). The lack of brightness is made worse by the relative inefficiency of the colour phosphors, particularly the red one. Despite considerable improvement in this respect due to the use of exotic new materials, brightness is still low and the elaborate process needed to deposit the pattern of phosphor dots itself helps to de-activate the phosphor.

The guns of the shadowmask tube are arranged in a triangular formation, Fig. 2, which means that *before* scan deflection the beams must be deflected in two planes X and Y in order to place each gun's beam on the axis of the tube This process is called *static convergence.* This situation then has to be maintained during scanning, and the geometry of the tube is such that varying deflection waveforms have to be fed to the convergence coils to maintain correct convergence during scanning. This is known as *dynamic convergence.* The arrangement of coils around the neck of the tube and the associated controls needed make for a costly and complicated yoke while the procedures for setting up the tube are long and involved.

BEAM DEFLECTION TUBES

The beam deflecting type of tube, the principle of which is shown in Fig. 3, has made occasional appearances in the last ten years but is still a bundle of problems. One form of this tube uses the phosphors laid in the form of horizontal stripes with a grid of horizontal wires held, in the same way as a shadowmask, just behind, i.e. on the gun side of the stripes. A single electron gun is used and the beam is directed to the correct stripe by applying deflection voltages to the wires.

This sounds a very simple arrangement, and would have the advantage of high brightness since the phosphors are continous stripes and the masking is very small. As is usual with simple ideas however,

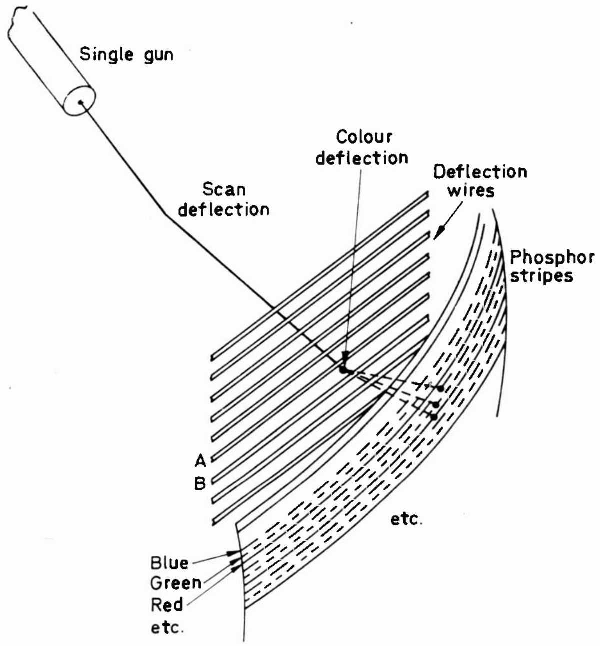


Fig. 3: Principle of the beam deflection type of tube. The chromatron is an example of this type of tube. The electron beam from a single gun lands on a green stripe if undeflected; if wire A is positive and wire B negative it lands on a blue stripe; if wire A is negative and B positive it lands on a red stripe.

there are fearsome difficulties. The main one is to ensure that the line scan is always moving exactly between two wires on each line and at every part of each line. This entails some crafty static and dynamic "convergence" techniques, and there is always rather a compromise between correct colour rendering at the middle and at the edges of the picture. In addition to this the voltages needed for deflection are large, several kV, and a large amount of power is needed to switch the wires to such voltages at such speeds (if we have 300-line resolution horizontally the beam would be switched three times at each picture element for a white display, i.e. the switching rate is $3 \times 300 \times$ line frequency). For these reasons although a great deal of work has been done on this type of tube it seems rather unlikely to challenge the shadowmask tube in the foreseeable future.

BEAM INDEXING TUBES

This type of tube (Fig. 4) represents a development of the thought behind the beam deflection tube. In this type of tube the beam is deflected over a set of vertical phosphor stripes and a detector system is used to feed back information on the position of the beam. If we know exactly where the beam is at any moment we can switch the cathode to the colour signal appropriate to the colour of the phophor the beam is striking.

In this form of tube the phosphors are arranged in vertical stripes in sequence. At the start of each sequence an index stripe of some sort is arranged so as to provide a signal when the beam strikes it.

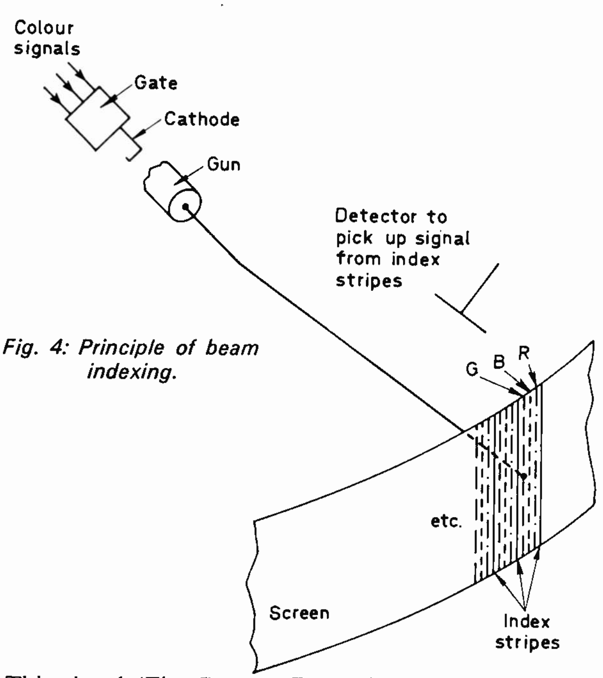
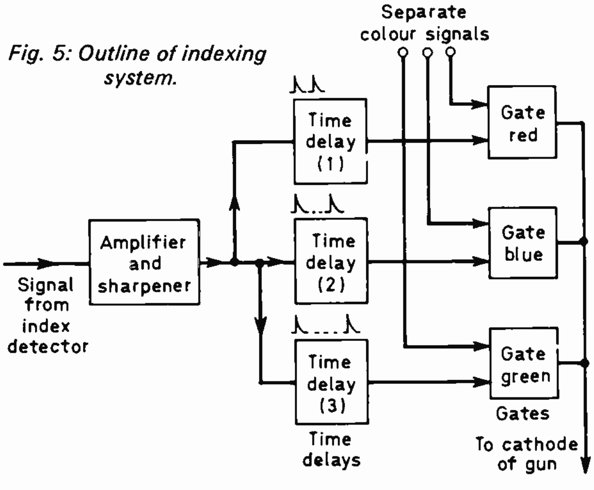


Fig. 4: Principle of beam indexing.

This signal (Fig. 5) sets off a series of pulse generators, one firing a short time after receiving the signal and generating a pulse which coincides in time with the time when the beam is scanning the first colour stripe, the red one say. The second pulse is generated a little later, when the beam has reached the next colour stripe, blue perhaps, while the third pulse coincides with the scanning of the third (green) colour stripe. These pulses can be shaped so that their durations accurately correspond to the times taken to scan the colour stripes and can be used as shown to switch the three separate colour signals in sequence to the single cathode of the tube.

In principle this tube should be and is cheap to make and requires little in the form of elaborate jigs save for the depositing of the phosphor, now a fairly well established procedure. In practice the difficulties have been with the indexing system and with the receiver circuitry, the circuit complications more than compensating for the simplicity of the tube both as regards cost and setting up difficulties. This is a situation which could change with the advent of suitable cheap integrated circuits. The costing of this type of receiver was originally done at a time when printed circuits were the up and coming thing and the possibility of making very complex circuits in i.c. form was not feasible. Much development work on beam indexing tubes has been carried out by the Philips organisation and although little has been heard recently of progress no one can afford to ignore any project which Philips think worth pursuing.

Fig. 5: Outline of indexing system.



RECENT DEVELOPMENTS

Two recent colour tube contenders in the race for stakes worth several million pounds are the Trinitron, a beam masking tube developed by the Japanese Sony organisation and already in production, and more remote a beam indexing tube as yet un-named which has been under development at Essex University but about which few details have been released since the first announcement.

BEAM INDEXING TECHNIQUES

We have seen already that the beam indexing tube has much to offer in simplicity of manufacture and of yoke construction combined with very high brightness since there is no masking of the beam. To offset this we have the problem of providing and processing the index signal, of which the first is probably now the more serious difficulty. To appreciate developments in indexing it is useful to look at the methods which have been tried.

The first method tried for indexing was laying a stripe of a material (magnesium oxide) with a high secondary emission ratio (Fig. 6). When electrons strike any substance their energy causes other electrons, which move more slowly, to be given off. The number of these secondary electrons, as they are called, can be considerably greater than the number first striking. This depends on the material and the voltages used. The idea of this indexing system was to collect the secondary electrons on an anode so that a signal was obtained whenever the beam passed over the stripe. Unfortunately however the phosphor gives off secondaries too, though not in such numbers, and some rather careful discrimination of signal strength had to be carried out by the amplifier connected to the detecting anode.

Also, since the secondary electrons travel rather

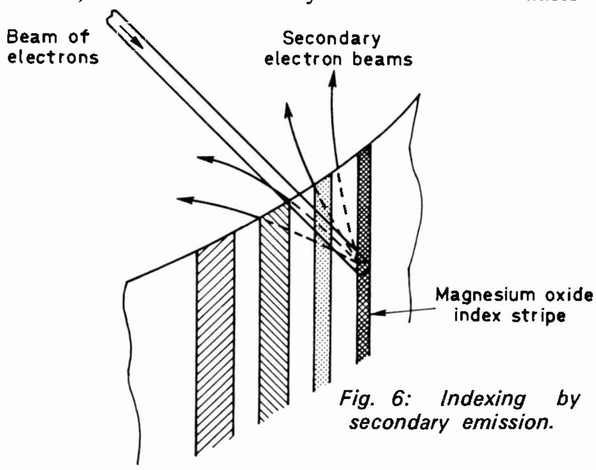


Fig. 6: Indexing by secondary emission.

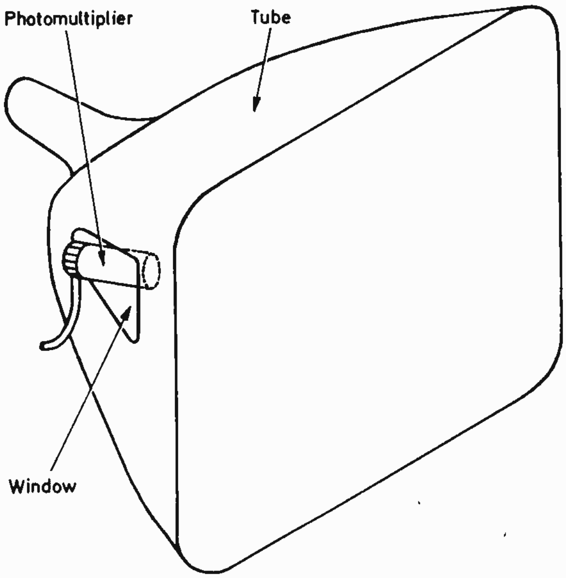


Fig. 7: Principle of ultra-violet indexing.

slowly (compared to the beam, that is—we are talking of speeds of several hundred miles per *second*) they take appreciably different times to reach the signal anode from different parts of the screen, so that the timing of the switching pulses used to gate the input signal is upset by a regular amount as the beam is deflected. This can be overcome to some extent by making the signal anode larger so that the stream of secondary electrons can reach it from any part of the screen without travelling too far, but this solution brings its own difficulties in the form of stray signal pickup by the large signal anode.

Another scheme, proposed and considerably developed by Philips, used a stripe which emitted ultra-violet (invisible) light when struck by the beam. Since light travels at several thousand miles per second (186,000 miles per second in free space) this solved the time delay problems. The ultra-violet light from the stripes was detected by a photomultiplier placed at a window let into the side of the tube (Fig. 7) facing the phosphor, and a filter was used to prevent stray visible light or the light from the colour stripes affecting the photo-multiplier. This scheme worked, though the circuit complications were vast and the photomultiplier and its associated amplifier and power supply made the cost high. There is a possibility that simpler solid-state detectors could now be used in an updated version of this system.

THE "ESSEX" TUBE

The "Essex" tube seems to have taken beam indexing to its logical conclusion. The face of the tube is covered with a grid of fine wires (there is a possibility that transparent conductive coatings could be used) set into the glass but exposed to the beam. This adds some manufacturing complication but simplifies indexing since a signal will appear at the wire grid each time the beam strikes a wire. The phosphor stripes then have to be laid to correspond to the wires, but this does not seem to be an insuperable difficulty. The signal at the wires needs only amplification, and not very much, to be usable in the associated switching system.

In principle this tube could cost little more to manufacture than the simpler types of beam indexing tube while the circuitry could also be economic given the use of i.c.s which would have to be developed for the job. Stray pickup by the wire grid might be a problem, but this could be screened out by making the front face of the tube conductive and earthing it (though this would increase the grid stray capacitance).

There is no indication at the moment as to how far these problems have been tackled. It is hard to be optimistic about the future of beam indexing tubes, or indeed any other tubes using a switched single gun. In a PAL receiver the signals are being switched at line frequency already and another set of switching pulses could raise problems of interaction. Patterning in fact seems to be a problem with every non-shadowmask type of tube which has ever been demonstrated. Perhaps the beam index tube might fare better with an NTSC receiver, yet it is just those countries using the NTSC system which have invested most in shadowmask tube production—as we have also. A dark horse remains in the form of the SECAM block, consisting of France and the Soviet Union. The French firm C.S.F. is reported to be still proceeding with a single gun tube for a SECAM receiver, but this too has not been seen for some time.

THE SONY TRINITRON

The Sony Trinitron tube starts with several advantages. First it is not a complete departure from shadowmask techniques but a modification of them. Secondly it uses phosphor stripes rather than dots, simplifying the application of the phosphor and giving a greater active area of phosphor and hence more brightness. Thirdly it uses a shadowing grill

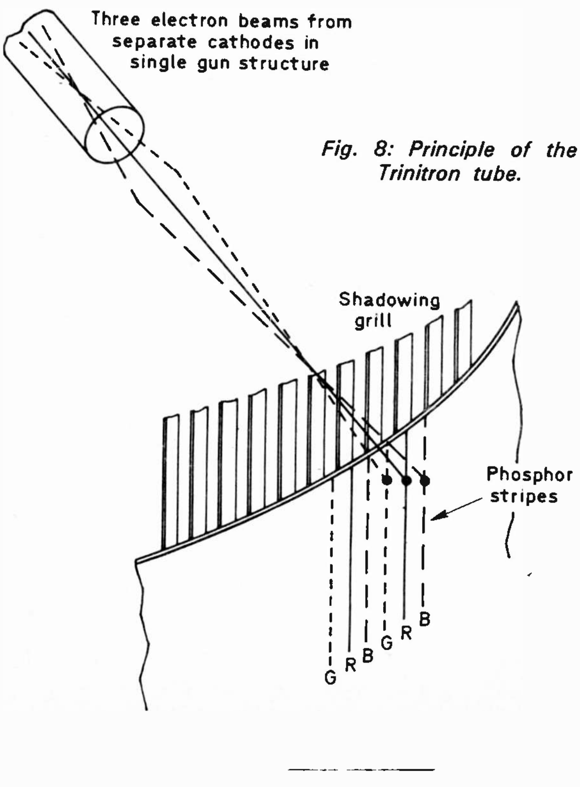


Fig. 8: Principle of the Trinitron tube.

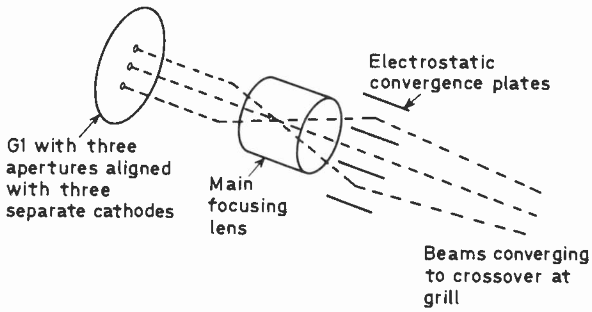


Fig. 9: Schematic of the Trinitron gun structure. The electron beams are converged within the tube with one very wide-aperture lens.

of wires with a greater open area than a shadow-mask, again giving more brightness. Lastly, and most important of all, it is in production and being used in receivers though these are at the moment in the portable 7 and 13in. class. The last point is significant. It may prove to be very difficult to make this type of tube in the larger sizes because of the problem of obtaining a rigid shadowing structure with wires and we may therefore find this tube available in the smaller sizes only for some time.

Figure 8 shows an outline of the Trinitron construction. It is basically a three-gun tube but the guns are arranged in-line abreast instead of in the triangular arrangement used in shadowmask tubes. In fact a single gun structure with separate cathodes and common focusing cylinders can be used. The beams are all very close to the axis of the tube and the convergence lens, which may be electrostatic, crosses them over within the gun. Since the beams are already in line convergence in only one direction is needed (Fig. 9). Though close tolerances in gun manufacture are necessary the setting up of the tube is very much simplified since the number of coils on the deflecting yoke is greatly reduced. A Trinitron tube could in fact be easily mistaken for a monochrome tube at a quick glance; no one could say that of a shadowmask tube!

At the screen end the phosphor is laid in vertical stripes with the shadowing grill on the gun side. The grill is a metal plate with vertical strips cut so as to allow each beam from the gun to reach only its corresponding phosphor stripe. The principle is very similar to that of a shadowmask but the amount of open space in the mask is increased so that greater brilliance at lower final e.h.t.s—an important factor in a portable receiver—can be achieved.

How well does it work? The tubes are being produced at a rate of around 50,000 a month but so far only portable sets working on NTSC standards have been seen and it is difficult to compare these with PAL receivers using shadowmask tubes. There is little doubt that the major manufacturers in this country and in the USA will be taking a very close look at the Trinitron and there is little doubt that we would be seeing much more of them if the Japanese were licensed to use the PAL system. Certainly the huge Sony corporation is not likely to let this development remain only on their home market, large though that is, and will do its best to push exports. In this there is some hope of cheaper colour TV and that in itself is welcome since present prices could hold colour back for a long time to come. ■

Workshop HINTS

by VIVIAN CAPEL

THE main concern of the service engineer is the correct diagnosis of the fault followed by the repair including replacement of faulty components. Once completed the object is to clear the job from the bench as quickly as possible to make way for the next one. In professional workshops time is money and with rising costs time wastage is something to be carefully avoided.

The result is often that although a first-class repair has been done the general condition and appearance of the receiver seems to belie the expert attention it has received. Especially if the repair has been an expensive one, the psychological effect on the customer who is presented with a large bill and is then confronted with a tired looking set that has seen better days is not very favourable. On the other hand a set that has been spruced up externally always gives the impression that a good job has been done.

Some time spent in finishing off is a good investment in the field of good customer satisfaction, and of course such time is chargeable. None the less it is necessary to accomplish as much as possible in the minimum time. If an apprentice or junior is available then he is the best one to carry out the work after the engineer has completed the repair since the wage cost will obviously be much less.

Setting up the Picture

The first item is really part of the service itself and most engineers do it automatically. This is setting up the picture on the screen. Height, width and linearity controls must be adjusted in conjunction with the picture-centring devices to give a linear, well-positioned picture. It may be that perfect linearity cannot be obtained due to a below-standard field output valve, trace of hum or some other reason. If the poor linearity is not too serious and the owner has not complained about it then it is best to get the picture as linear as possible with the presets and leave it at that. Serious non-linearity will have to be treated as a fault and dealt with accordingly.

Setting up is best done with the transmitter test card but it is often not on when required. With some practice quite good results can be obtained with a moving picture. First of all the height and width are reduced so that the edges of the picture are visible. Field linearity can be adjusted by comparing the line spacing at top, bottom and middle of the picture, remembering that most sets now have two linearity controls, one affecting the top of the picture and the other the overall linearity. These are often mounted on a printed panel. Line linearity is not so easy to adjust on a picture but this adjustment is not so often necessary. Once the linearity is set the picture can be centred by watching the edges and then filled out. Overscan of both line and field is desirable but the field especially needs to be overscanned to compensate for the shrinkage which occurs on the majority of sets.

Focus and definition can then be attended to. If the latter is poor, adjustment of the sound rejector may prove rewarding. This circuit is often quite critical and if a little off can impair definition before sound-on-vision occurs. It should only be adjusted when a strong sound signal is being transmitted—preferably the fixed note—so that any sound-on-vision will not pass unnoticed.

Exterior of the Set

After the setting up comes attention to the receiver's exterior. One of the first things to notice is the state of the screen. A dirty screen is a very poor recommendation for the service job. Discretion will however have to be exercised as to the extent of cleaning undertaken. In some models screen cleaning entails a lot of work including dismantling the tube and its mounting. Because of the extra labour costs therefore this should not be undertaken without the owner's authority unless the original repair involved much the same dismantling.

Where the front glass comes away by the removal of a few screws then the screen should be cleaned if this is needed. Often much of the dirt is on the outside, consisting of greasy finger marks and the like which the owner could have easily removed himself. Here a clean off involves little extra work but makes a world of difference to the set's appearance.

Control knobs usually collect dirt in their milled edges and if the control is light-coloured this looks very conspicuous. Cleaning individual grooves is an almost impossibly long task. The quick way of doing it is by means of a nail brush with a little soap and water. Brushing along the grooves will remove the dirt in a few seconds and adds tremendously to the rejuvenated appearance of the set. Spirit cleaners should be avoided if there is any lettering on the knob as very likely it will disappear along with the dirt!

Now comes the cabinet, the condition of which can vary considerably. Some are in such a poor condition that refurbishing would constitute a major operation. Others need only a few minutes spent on them to bring them up to a reasonable standard. Obviously major cabinet restoration is out of the range of a normal workshop repair.

The main cabinet renovation will consist of dealing with the numerous small surface scratches that accumulate over a period of time. Cabinet restoring kits containing stains of various hues and polishes to cover up such scratches have long been available. The most effective way of dealing with them however is also the easiest. Simply rub a thin oil such as Three-in-One into the scratch. On the majority of cabinets the scratches disappear like magic. The precise action is not too clear but the scratched exposed wood takes on the colour and appearance

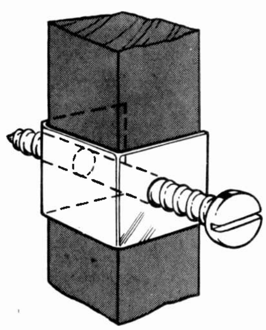


Fig. 1 (left): Back screw with cabinet clip, as described in the text.

Fig. 2 (right): How to make a neat bunch of the mains lead. See text for description of the steps involved.

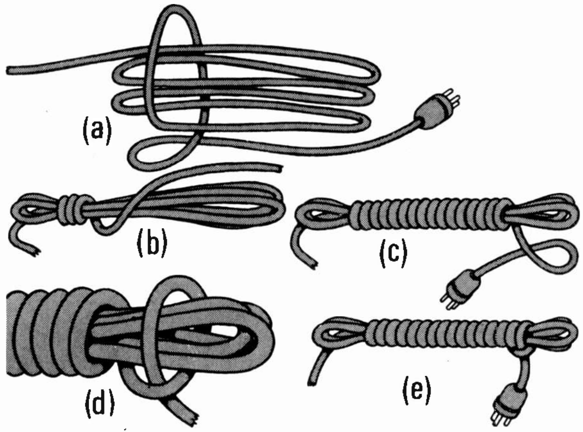
of the surrounding finish. Thus there is no problem of matching stains. Old scratches that have been polished over may need "cleaning" by running a pin point along to get down to the fresh wood

It is not necessary to treat each scratch individually. Some cabinet tops for example are a mass of scratches and individual attention would take far too long. All that is needed is to rub a small pool of oil well in, all over the surface, and then to rub off the excess. If on the first application there seems to be little effect, let the oil remain for several hours before rubbing dry. Some surprising results have been obtained on cabinets in this way but not all will respond. It depends on the type of finish. Unlike the results obtained by dabbling with stains and varnishes however if the scratches persist at least this treatment will not make matters worse as it is quite safe on all finishes. Generally even if the scratches remain they will be darkened and so rendered less conspicuous.

It seems that after some years' life during which the TV receiver will have made a number of visits to repair workshops (not yours of course) the back screws diminish in number until often the back is held on by a solitary screw. This presents a most untidy appearance as most backs seem to take a delight in gaping away from the cabinet unless firmly fixed by the required number of screws. Hunting for the odd screw or two through the junk box takes time and usually results in an ill-matched assortment. It is good practice to keep a supply of back screws always available. Only three or four different types are needed. First a short wood-screw for backs with retaining screws that screw directly into the woodwork. These should be black japanned dome-headed screws about No. 6 size and half-inch long. Some back screws are smaller than this which is why the holes become enlarged after several removals and refittings so that eventually the screws get lost. Using larger screws in these holes will avoid the need for drilling and fitting in another position.

The other type of back screw is the long self-tapping variety that is used in conjunction with sprung-steel clips. These clips fit over the wooden flange running around the inside of the cabinet. The screw passes through the front of the clip and a large diameter hole in the wood and engages with the far side of the clip (see Fig. 1). Provided they are long enough to reach that part of the clip the length is not critical as the screws pass out through the clip at the other end. A single length which can be fairly long—say 2in.—will serve most cases. Clips differ in the diameter of screw they will accept but generally two sizes will be sufficient to fit most.

A kit of back screws need therefore consist of only



three different types and sizes, though it may be considered desirable to include some special ones such as the Philips combined screw/washer if a number of these sets are handled regularly. A supply of fibre washers should also be included and these too can be reduced to three basic sizes for use with the appropriate diameter screw. A good quantity of screws should be kept in the kit as a single set can take a half-dozen or more at a time. The supply should be replenished as soon as the number of any type drops below a certain level which can be determined by the average weekly use.

Bunching the Mains Lead

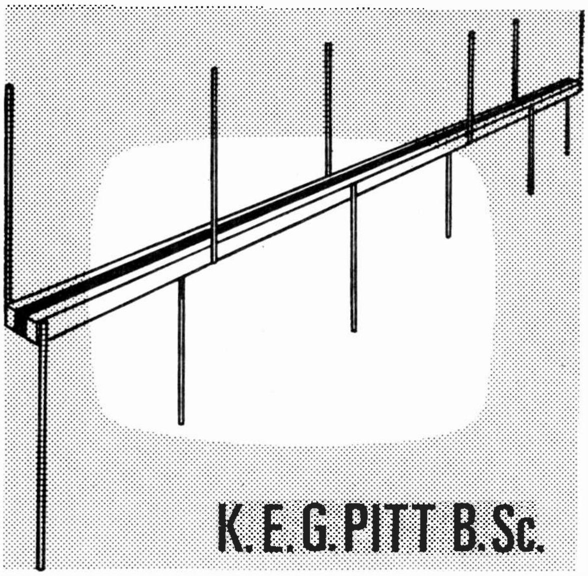
Finally a small point—but one that can often create an impression of a neat workmanlike job or the opposite—is the way in which the mains lead is coiled up. Often it is loosely coiled, wound around the cabinet or pushed through the slots in the back. This not only looks untidy but is a hazard to anyone carrying the set as the lead can easily fall to the ground and trip them—to say nothing of damaging the mains plug.

The neatest and most professional looking way of dealing with the mains lead is to tie it in a bunch in the same way that the leads of new equipment are often supplied. There is a knack to making a neat bunch which can be acquired with a little practice. Once mastered it is as quick if not quicker than other methods and certainly the appearance is more presentable.

First the lead is folded backward and forward across the palm of the left hand to form a number of loops. The number and length will vary according to the total length of the mains lead. For the average length two or three loops of about 6-9in. should suffice. Leave about a foot to 18in. over for winding. On the last loop bring the lead from the free end to the set end (Fig. 2 (a)) and start winding over and under, leaving an inch or two of loop exposed towards the set end (Fig. 2 (b)). Continue winding until about 4in. of lead is left. If you have judged the lengths nicely this should bring you to within an inch or two of the end of the bundle. Now form a loop so that the wire with the plug passes under that coming from the winding (Fig. 2 (c)). If it is formed the other way the whole thing will unwind. Next slip the loop over the bunch (Fig. 2 (d)) and pull tight (Fig. 2 (e)). It may sound complicated but it is a lot easier than it sounds.

FEATURE TO BE CONTINUED

LOG-PERIODIC SET-TOP AERIAL



IN APPEARANCE a log-periodic aerial looks very similar to a Yagi. In practice however it is considerably more complex. Each of the elements, except the rear one which acts as a reflector, is "active", i.e. it can act as a dipole for any signal close to its resonant frequency. As a result at any given frequency all the elements close to resonance combine to give an output from the aerial. This output is increased by contributions from the elements which are too short and thus act as directors. Similarly those that are too long act as reflectors. A detailed description of the theory of log-periodic aerials is given in reference 1.

Characteristics

The method of operation results in the unique property—which first brought the aerial into use—of very broad bandwidth. If sufficient elements are present a significant number will be operational at any frequency throughout the band for which the aerial is designed. For example a twenty-element version designed to cover the u.h.f. channels 21-68 would have an almost flat response over the whole of this range and provide an output roughly equivaent to an 8-9 element Yagi. From this it can be seen that the broad bandwidth brings with it the penalty of low gain relative to a Yagi of similar size. Also the construction is considerably more complex and therefore expensive. It would however be of value in areas where programmes are receivable from a number of different transmitters operating in different channel groups. (It is also very useful for DX enthusiasts.) It would also be useful for a number of transmitters which will eventually use non-standard channel groups requiring a much greater bandwidth than the normal 88 MHz.

An entirely different property however was found which gives it a great advantage over more conventional aerial systems: the polar diagram is remarkably free from side lobes and shows an exceedingly good front-to-back ratio. (The effects are marginally better with horizontal rather than vertical polarisation.) Details are given in reference 2. In plain language the log-periodic aerial has remarkable ability to remove ghosts. A commercial version by Antiference is marketed under the very apt name *Troubleshooters.* In many locations ghosts cause considerable difficulty so that even with high signal strength it is necessary to use multi-element aerials in order to obtain a viewable picture. In cases where gain is not the prime consideration but elimination of reflections is important the use of a log-periodic receiving aerial can often give the best results.

Room aerials are often inefficient because of ghosting and are also usually of low gain. The use of a log-periodic room aerial has been found by the author to give extremely effective results, even on colour. The set is situated on the far side of the house from the transmitter in an area of high signal strength. All other types of set-top aerial proved unsatisfactory in this room but the aerial described in this article gave viewable results which were not upset by movements of people near the set. A direct comparison with the double-square aerial described in a previous article showed a visible increase in gain as indicated by a decrease in snow on a distant transmission.

This article gives details of a seven-element log-periodic aerial designed to cover channels 21-68. Details are also given however for calculating dimensions for both larger numbers of elements and also for narrower bandwidths. The principle may be extended from set-top to loft aerials and if the right materials are used to an outside model. In the present version seven elements were used to minimise the size. There is no reason why larger numbers of elements should not be used if the space is available. From the results found in the u.h.f. band it appears obvious that the same principle could be used at v.h.f. giving a broadband aerial capable of even response over all channels in Band III.

Basic Design

There are a number of important differences from a Yagi in the construction of a log-periodic aerial. The name arises from the fact that each element has a constant mathematical relationship in its length and positioning with its predecessor in the series. Since all the elements except the longest—which is merely a reflector—are active, dipole insulation is needed in each case.

The aerial consists basically of two booms short-circuited together at one end by the reflector. The dipole halves are mounted on alternate booms. The spacing and lengths both reduce progressively by a factor *n*. The coaxial cable is connected at the *front* and brought back along the outside of one of the booms and then taken away at the back. This method of cable attachment gives the best matching and has minimum effect on the polar diagram. It is very important however to support the aerial at the *back* (see photo) and not to insert any support near the dipoles. The booms in this model are spaced $\frac{5}{16}$ in. apart and separated by insulators at intervals along the length. The principle is shown in Fig. 1.

For the set-top aerial the ratio *n* between elements was taken as 0.875. The spacings are in the same ratio. The first spacing is taken as $\frac{1}{3}$ the length of the first dipole (this is an approximation which works well in practice). Table 1 gives details.

This set of dimensions was chosen to cover the whole of the u.h.f. band. The results are similar to those obtained from a three-five element Yagi cut to the correct lengths for any given channel.

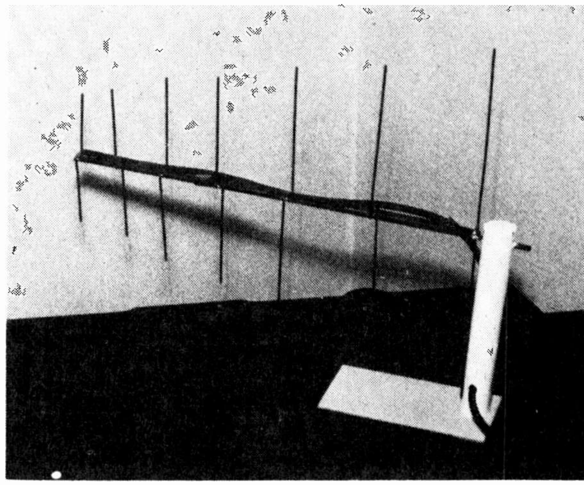
Construction

Square brass bar was used throughout for the construction of the set-top log-periodic aerial. The photograph shows the completed protoype. For clarity it is shown in use for vertical polarisation but may be used for either plane as required. The mounting stand consists of a wood or chip board base with a vertical wooden rod screwed to one end —a section of broom handle was used for this purpose. This rod is 7-8 inches long and supports the aerial cross-booms. The base of the prototype was $6 \times 3 \times \frac{3}{4}$ in. Larger pieces may be used for greater stability, especially if more than seven elements are used.

All wooden surfaces may be covered in Fablon or some similar vinyl adhesive sheet to give a neat finish. The isolating capacitors necessary for safety may be inserted in either the rod or the base and the cable must be cut to accommodate them. Alternatively it may be possible to mount the capacitors directly to the end of the cable where it is soldered to the cross-booms. If this is done a plastic insulating

Table 1: Element details for a set-top log-periodic u.h.f. aerial

Element	*Length (in.)*	*Spacing (in.)*
Reflector	12	
		3·5
Dipole 1	10·5	
		3·1
Dipole 2	9·2	
		2·7
Dipole 3	8·0	
		2·3
Dipole 4	7·0	
		2·0
Dipole 5	6·1	
		1·8
Dipole 6	5·4	



The author's prototype log-periodic aerial.

sleeve must be put over the joints in such a way that the capacitors cannot be exposed. This was not done on the prototype and it is not known whether their presence will upset the properties of the aerial. Capacitors are not needed if the aerial is to be loft mounted.

Figure 1 shows the constructional details. The two booms are $\frac{1}{8}$ in. square brass and all the elements are $\frac{1}{16}$ in. metal. Assembly of the rods on to the two booms is done separately. The reflector is not fitted at this stage. The upper boom is 2 in. longer than its companion. This enables it to be pushed through a hole in the wooden rod supporting the aerial. The hole should be made as close a fit as possible to the rod and should have a slight slope to compensate for any sagging in the structure in order to keep the cross-bar horizontal. Vertical or horizontal polarisation is obtained merely by twisting the boom in its hole and can be a viewer adjustment if desired.

The rods are soft or hard soldered to the booms. A gas stove is a convenient source of heat, although a large iron may be used with a little patience. When the two boom assemblies are complete, i.e. all the dipole halves have been assembed on to the $\frac{1}{8}$ in. cross-bars, the two booms are brought together

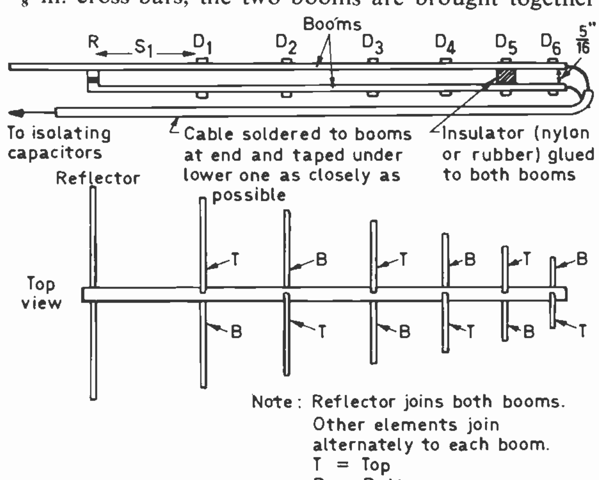


Fig. 1: Aerial construction.

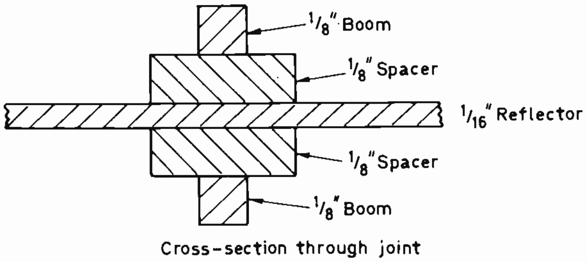


Fig. 2: Reflector assembly.

with the reflector and spacers physically terminating the line as shown in Fig. 2. This joint is also solderable with an iron or gas stove. The spacing between the booms does not appear critical and although $\frac{5}{16}$ in. is used here $\frac{1}{8}$ in. appeared to be equally suitable in use in an earlier model. This earlier model used $\frac{1}{8}$ in. rod for the reflector, spacers not being used. No difference was found in electrical performance. The change was made because $\frac{1}{8}$ in. rod is often supplied in 3 ft. lengths. This is sufficient only for the two cross-bars and spacers for a seven-element all-channel aerial.

The cable is soldered to the front of each boom. The inner goes to the top (assuming horizontal polarisation) and the outer to the lower boom. The cable is then taped to the underside of the lower boom and brought down to the base alongside or through the vertical wooden support. Boom separation is maintained by using a small piece or pieces of insulator such as polythene or nylon block, glued between the brass rods. In the author's model a section of india rubber was used.

Aerial Calculations

The length of a half-wave dipole for any frequency may be calculated from the following formula:

$$\frac{\lambda(\text{in.})}{2}=\frac{1{\cdot}12\times10^4}{f}$$

where f is in MHz.

At any given frequency a reflector is approximately 5% longer than its associated dipole. Similarly the first director is 5% shorter than the dipole. These approximations enable us to work out the range of element lengths needed for any given frequency group. We may in addition assume that the shortest director may be up to 15-20% shorter than the dipole.

In the model described above the elements ranged from 12 in. (reflector on channel 21) to 5.4 in. (director on channel 68). About four elements are near resonance on any given frequency. If n is the reduction factor between elements, N the number of elements needed, Lr the length of the reflector at the lowest frequency and Ld the length of the shortest director at the highest frequency, the general formula below may be used to calculate the number of elements needed:

$$N=1+\frac{\log (Ld/Lr)}{\log n}$$

Using this we can work out the aerial sizes for a number of different applications. We may, for example, need high gain and good directional properties in an area where ghosts are troublesome but where bandwidth is not a problem. If we take this hypothetical case as for group B, channels 39-51, then using n 0.95, Lr 9.5 in. and Ld 6.5 in. we find that N is 8.5, i.e. to cover this range we need nine elements. If higher gain were needed we could make n 0.975 giving a new value for N of sixteen. Another example of where a log-periodic aerial might be used with advantage is for channel group E, 39-68. Here its broad bandwidth makes it suitable.

Table 2 shows approximate rod lengths for the various channel groups. The first spacing is one third the length of the first dipole.

Table 2: Element lengths for u.h.f. log-periodic aerials

Group	*Reflector (in.)*	*Last Director (in.)*
A	12	8
B	9·5	6·5
C	8·0	5·5
D	8·5	5·5
E	9·5	5·5

Band III Log-periodic

A log-periodic aerial may also be used in Band III. Here the rod lengths range from 33 in. to 25 in. An eleven-element aerial is obtained if a value for n of 0.975 is used On any channel in the band about six elements are close to resonance. This would give results similar to a single-channel six-element Yagi. This type of aerial would be of considerable value in the conditions described in a recent article by the author (PRACTICAL TELEVISION, April 1970) where a number of Band III transmissions on different channels could be received at one site. Mounted on a rotating pole with facilities to change the plane of polarisation if necessary, a Band III log-periodic aerial is worth investigating if one is attempting to provide alternative and additional programmes.

Safety Note

Isolating capacitors must be used to avoid any risk of the aerial becoming live due to the failure of insulation in the aerial connections of the set. They must have a working voltage of at least 250V, preferably higher.

Commercial Log-periodic Aerials

A number of commercial log-periodic aerials is now available. In addition to the Antiference Troubleshooter range, there is the J-Beam Logbeam while the Troubleshooter range has been extended with models covering either the whole or part of the u.h.f. bands and also versions incorporating a built-in amplifier. For outside use one of the commercial versions would be of great value in difficult areas. A set-top version from a third manufacturer is also now available.

References

1. M. F. Radford, *Wireless World*, September and October 1964.
2. BBC Research Department Report 1969/70.

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43 ,,	4·7K	560K
47 ,,	5·6K	680K
56 ,,	6·8K	820K
68 ,,	8·2K	1M
82 ,,	10K	1·2M
100 ,,	12K	1·5M
120 ,,	15K	1·8M
150 ,,	18K	2·2M
180 ,,	22K	2·7M
220 ,,	27K	3·3M
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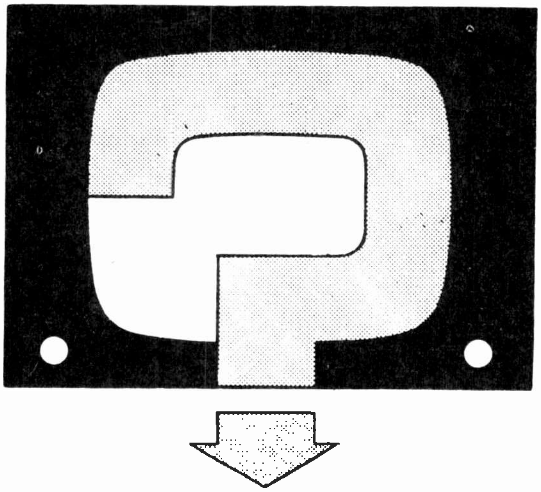

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FERRANTI T1055F

When first switched on the picture rolls then shrinks to a 4in. strip which opens out after a while. The lines are lively and flicker most of the time. V10, V17, V13, V11, V14, V16 and V15 have been replaced. The sync pulse lines are continuously visible.—K. Mason (Cheltenham).

The 27kΩ resistor in the video amplifier circuit (from h.t. to pin 9) and the 330Ω cathode bias resistor should always be checked in these models. Then check the 30PL13 circuit thoroughly, including the 270Ω bias resistor and its 500μF decoupling electrolytic. Fit a separate 2μF capacitor to decouple pin 7 of the sync separator (V17 30FL1).

GEC BT2155

There is a gap of 2in. at the top of the picture and 1in. either side, while the two bottom corners are cut off. Sound and picture quality are otherwise good.—E. Akland (Crawley).

Recentre the picture by means of the shift control on the neck of the tube. This should move the picture up and remove the bottom corner shadowing. For lack of width check the metal h.t. rectifier and line output valve.

ULTRA 6632

There is sometimes loud hum. When this develops there is a slight wave or ripple on the picture and both line hold controls are apt to need resetting.—E. Cruse (London, SE4).

The trouble is due to a defect in the smoothing block on the right side of the chassis. This large can of electrolytic capacitors will have to be replaced.

STELLA ST2717U/06

The sound is OK but there is no raster. All valves light up except the EY51. The ECL80, PL81, PY81, PY32 and EY51 (still does not light up) have all been replaced. There is medium strength line whistle which changes with hold control adjustment, medium spark at the EY51 anode and tube e.h.t. connector. —A. Nicholson (Newcastle).

Check the h.t. voltage. The reservoir capacitor may have deteriorated over a period with consequent drop of h.t. If the h.t. is in order note if the line whistle increases when the PY81 boost diode top cap is removed. If it does, replace the boost reservoir capacitor.

BUSH TV141

The picture has shrunk in both width and height. It can be restored by increasing the brilliance or contrast settings but the picture quality is then poor. Increasing the brilliance makes the picture expand and fade. The 625 raster is also affected. The DY87 e.h.t. rectifier has been replaced without improvement.—B. Morley (Shrewsbury).

The PL36 line output valve is almost certainly at fault. If replacing this does not cure the trouble check the PY800 boost diode.

EKCO T344

There is sound-on-vision on channel 1 sufficiently severe to occasionally break up the picture. It cannot be tuned out with the fine tuner. Channel 9 can be tuned in perfectly. A secondary fault is that the picture is elongated vertically for the first ten minutes after switching on. The height then becomes correct.—F. O. Bullimore (Morden, Surrey).

To cure the sound-on-vision adjust the local oscillator tuning in the tuner via the left-hand hole of the row of four holes exposed beneath the tuner when the back cover is removed. Suspect a faulty PL36 line output valve for the height trouble.

FERRANTI 21K6

The screen is white with no image. New valves have been fitted in the vision side of the set and a good aerial is in use. The fault appeared without any gradual deterioration.—J. Hunt (Bolton).

The fault appears to be caused by oscillation in the vision i.f. stages. Try decoupling pin 8 of each EF80 to chassis with a test 0·002μF capacitor.

SOBELL T24

The sound is OK but on switching on the e.h.t. comes up with the line whistle and after a short while the whistle fades and the e.h.t. drops. I have changed the PY81, PL81 and EY51 with no results. The EY51 does not light up.—R. Richmond (Leeds, Yorkshire).

It is not uncommon for the whistle to reduce in intensity and the e.h.t. voltage to stabilise after the set has warmed up properly. This would not necessarily indicate a fault. However, if the e.h.t. collapses completely then the line output transformer or booster reservoir capacitor could be in trouble, assuming that all the associated valves are definitely in good order.

AERIALS

Is it possible to combine BBC-2, BBC-1 and ITV aerials at the mast to one downlead then divide it at the receiver by a diplexer or signal input equaliser to the 625 and 405 sockets?—G. Wilson (Berkshire).

It is possible to combine u.h.f. with v.h.f. into a common feeder but this is highly undesirable owing to combining losses and the greater u.h.f. losses in the v.h.f. downlead. It is best to run separate downleads, very low loss for u.h.f. for the best signal/noise performance. If you must combine and divide you will have to employ a special u.h.f. diplexer, available from some dealers.

BUSH TV56

This receiver suffers from sound-on-vision which is more pronounced on ITV than on BBC.—G. Osley (Hereford).

There can be two causes of sound-on-vision. One is that the signal input is too strong; set left-side plugs to "local". The second cause is misalignment of the sound rejectors. These are contained in the two cans in the centre of the left-side chassis behind the tuner unit.

PHILIPS 1768U

Upon switching on I get a normal picture for about half-a-minute. It then breaks into a series of white lines about ¾in. apart. These roll up or down or sometimes just shimmer. If I switch off and on again the whole performance repeats itself. When the picture is normal the boost h.t. is correct—perhaps a trifle high—but when the picture breaks as described the boost volts drop to 350V, a loss of 180V.—G. Crossman (Hampshire).

The fault you describe is very suggestive of boost capacitor breakdown. This is C57, 39kpF. If this fails to cure the fault check the line output valve, the e.h.t. rectifier and the screen volts on the line output valve. Also check the anode feed resistors to the field oscillator valves and the electrolytic capacitor in the cathode of the field output stage.

REGENTONE 176T

The picture suddenly begins to jump and then to roll rapidly—usually from top to bottom of the screen. The field hold control has little or no effect. The fault is intermittent, sometimes clearing itself during the course of the evening, and the picture may remain steady for a week or more. The PCL83 field oscillator and output valve has been changed but with no improvement. The line hold is normal so I assume the fault lies in the field oscillator circuitry.—K. Smith (Somerset).

An often forgotten stage in the Regentone 176T is the field pulse shaper V5B. It is often responsible for poor field hold and should be the first valve suspected (V5 EB81). If the fault remains check C31 0·01μF from the cathode (pin 1) of V5B to earth and the bypass resistor R42 180kΩ and R43 100kΩ to the anode (pin 1) of V8. If the fault still remains after these checks look for a burnt component or poor connection.

GEC BT450DS

When a bright stationary picture appears on the screen a loud hum comes up on sound. I notice it particularly when a white table of football results is shown on a black background.—C. Mangold (Hampshire).

The hum you describe on your television receiver is that of the vision signal breaking through on to the sound channel. It is most noticeable with peak vision modulation, as you have observed, such as the peak white that is transmitted on caption material.

The vision i.f. should be tuned out at the input to the sound i.f. strip and it is coil T3 which will require adjustment on your receiver. It should be adjusted for maximum sound output—with the tuner adjusted at its normal position for the signal. It is preferable to do this adjustment with a signal generator but in any case do not move the core in the transformer more than two turns.

MURPHY V410C

There is a loud droning on the sound. I have tried to tune it out but there does not appear to be any fine tuner adjustment on this receiver. There are two coils in the tuner unit: the droning still appears with neither in circuit.—J. Pulham (Yorkshire).

The adjustment for the fine tuner is on the underside of each channel coil accessible from a hole in the cabinet bottom. You should check your smoothing by bridging a good electrolytic across each section and also suspect sound i.f. instability due to defective 0·001μF decouplers on the 30F5 sound i.f. valve.

PYE V830D

I would like this set to receive BBC-2 but I cannot get the proper Pye u.h.f. tuner. I have a Philips tuner which is supposed to be an equivalent and a Cyldon u.h.f. tuner—would either of these tuners suit? If so, with the exception of wiring in the tuner valve heaters, the h.t. and i.f. input, are there any other modifications which have to be done to the set? The Philips tuner has the number A3 285 12 marked on the side—M. Osbourne (Liverpool).

All that is required for either tuner is the heater supply, h.t. from the proper switched point and the i.f. output taken to the main chassis. No other alterations are required.

GEC BT455

About 10 to 15 minutes after switching on the picture brilliance fluctuates and is finally lost. Viewing is possible by turning the brilliance and contrast controls to maximum, but the resulting picture it too contrasty. Shorting the brightness control has no effect. Occasionally the brightness will temporarily recover.—W. Davies (Solihull).

We suspect that the first anode voltage to pin 3 of the c.r.t. is low. Trace the pin 3 lead back to the panel—at PC29. Check the 820kΩ feed resistor and the possibility of leakage to chassis. Another possibility is that the pin 2/6 voltage is low due to a leaky capacitor in the grid circuit.

BUSH TV161U

There is intermittent picture tearing on all three stations, otherwise performance is perfect. The valves have been renewed or tested and the channel switching cleaned and checked. The fault sometimes clears up for an hour or two and is quite inconsistent.—A. Green (Chelmsford).

Check the picture for signs of ghosting (secondary images to the right) which if the aerial is insufficiently selective will result in picture tearing on some scenes. If you are satisfied this is not happening replace the line sync discriminator diodes as these may be out of balance.

HMV 2637

About two to three minutes after switching on the 625 line width creeps in about 1in. on either side while the 405 width remains unaltered, the common width control being set at maximum. The h.t. voltage is normal and the boost diode, line oscillator and line output valves and h.t. rectifier have been renewed.—S. R. Morton (Edinburgh).

The usual cause of lack of width in this chassis (Thorn 950 Mk. 2) is a failing line output valve but the resistors in the width control circuit tend to change value and should be checked. Also check the 100pF feedback capacitor (C106) from the line output side of the circuit to the stabiliser v.d.r.: if this capacitor is leaky it must be replaced. Also check the v.d.r. Because of the difference in width on the two systems it is possible that the 0·1μF S-correction capacitor (C98) on 625 may be faulty.

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PRACTICAL TELEVISION, SEPTEMBER, 1970

94

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 colour receiver was brought in with the curious complaint of the colour disappearing completely on some transmissions, leaving a perfect monochrome picture, and reappearing for no apparent reason on other transmissions.

Tests using the workshop aerial system which delivers a signal of about 5mV showed this to be the case. After a protracted test period it was noticed that the colour information would often disappear on a camera change and reappear on the next camera or scene change. This was observed for a day or two and the trouble then corrected in a few minutes without having to make any component changes.

What was the adjustment required to restore correct colour working? See next month's PRACTICAL TELEVISION *for the answer to this question and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 93

Tests proved that the bistable circuit was switching somewhat at random, being triggered on to the incorrect V detector phase by camera changes and impulsive interference. An oscilloscope is almost a necessity for tracing this sort of trouble in colour sets. Using such an instrument the ident signal path was examined from the phase detector to the bistable ident pulse input. The pulses were present and their shape was correct but the amplitude was significantly below that detailed in the service manual.

The ident signal is derived from the swinging bursts so the next move was to check the burst signal amplitude at the burst amplifier output (only one burst amplifier stage is used in this model). Again it was low but not low enough to impair the subcarrier phasing. The amplifier is fed with composite chroma signals including the bursts from a burst tuned circuit, adjustment of which normally affects the burst amplitude considerably. In this case however there was no variation in burst signal amplitude as the tuning was adjusted.

Subsequent examination revealed a poor soldered connection on the burst tuning coil. Resoldering this increased the burst signal amplitude and the full amplitude was then restored by retrimming the coil according to the service data.

The colour killer " turn on " bias for the controlled stage in the chroma channel is obtained by rectifying the ident signal. As the bias under the fault condition was inadequate to put the controlled chroma stage into full conduction random changes in saturation were observed in addition to the hue changes due to the irregular switching of the bistable circuit.

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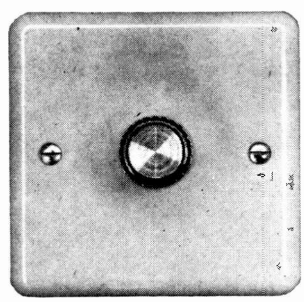

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