Practical TELEVISION

JANUARY 1969 2/6

INSTRUMENT C.R.T.s

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7R7	12/-	30PL13	15/-	EAF42	8/3
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EB41	4/6	EF39	5/-	EY84	7/6
EB91	2/3	EF40	8/9	EY86	6/-
EBC41	8/6	EF41	9/-	EY87	6/-
EBC81	5/9	EF42	3/6	EY88	7/6
EBF80	5/9	EF50	2/6	EY91	3/-
EBF83	8/-	EF73	6/6	EZ40	7/3
EBF89	6/3	EF80	4/6	EZ41	7/3
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EC53	12/6	EF85	5/3	EZ81	4/6
EC70	4/9	EF86	6/-	GZ33	12/6
EC86	10/3	EF89	4/9	GZ34	10/-
EC88	10/3	EF91	3/3	GZ37	14/6
EC92	6/6	EF92	2/6	HABC80	8/-
ECC31	15/6	EF95	4/6	HN309	27/4
ECC40	9/6	EF97	10/-	HVR2	8/9
ECC81	3/9	EF98	10/6	HVR2A	8/9
ECC82	4/6	EF183	5/9	KT41	19/6
ECC83	4/6	EF184	5/9	KT44	20/-
ECC84	5/6	EF804	20/5	KT61	12/-
ECC85	5/-	EH90	6/6	KT63	4/-
ECC88	7/-	EL32	3/6	KT66	17/3
ECC91	3/-	EL33	12/-	KT88	29/-
ECC189	9/6	EL34	9/6	KTW61	8/6
ECF80	6/6	EL36	8/6	KTW62	10/-
ECF82	6/6	EL41	9/3	KTW63	5/9
ECF86	9/-	EL42	9/9	MHD4	8/3
ECF804	42/-	EL81	8/-	MHLD6	7/6
ECF805	12/6	EL83	6/9	MU12/14	4/-
ECH21	12/6	EL84	4/6	N78	38/4
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ECLL800		EY81	7/-	PCC89	9/6
	30/-	EY83	8/3	PCC189	9/6
EF22	12/6				
EF36	3/6				
EF37A	7/-				

PCF80	6/6	R18	9/6	UF42	9/-
PCF82	6/-	R19	6/6	UF80	6/9
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PCF86	8/6	U10	9/-	UF86	9/-
PCF801	7/-	U12/14	7/6	UF89	6/3
PCF802	9/-	U16	15/-	UL41	9/6
PCF805	8/9	U18/20	10/-	UL84	6/6
PCF806	11/6	U19	34/6	UM80	5/-
PCL81	9/-	U22	7/9	UR1C	10/6
PCL82	7/-	U25	13/-	UU8	14/-
PCL83	8/9	U26	11/9	UY1N	9/-
PCL84	7/6	U31	6/-	UY21	9/6
PCL85	8/3	U33	29/6	UY41	6/9
PCL86	8/3	U35	16/6	UY85	5/6
PEN45	7/-	U37	34/11	VP4B	10/6
PEN46	4/-	U45	15/6	VR105	5/-
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PL36	9/6	U251	16/-	W107	7/-
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PL84	6/3	UABC80	5/9	*and diodes*	
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PL509	28/9	UBC41	7/6	2N2369A	4/3
PM84	7/9	UBC81	7/-	2N3866	20/-
PY31	6/6	UBF80	5/9	2N3121	50/-
PY32	9/6	UBF89	6/9	AA120	3/-
PY33	9/6	UBL21	9/-	AC107	3/-
PY80	5/3	UC92	5/6	AC113	5/-
PY81	5/3	UCC84	8/-	AC126	2/-
PY82	5/-	UCC85	6/6	AC127	2/-
PY83	5/6	UCF80	8/3	AC128	2/-
PY88	6/3	UCH21	9/-	AC154	5/-
PY800	6/6	UCH42	9/3	AC156	4/-
PY801	6/6	UCH81	6/6	AC157	5/-
PZ30	9/6	UCL82	7/-		
R10	15/-	UCL83	9/3		
R17	17/6	UF41	9/6		

AC165	5/-	BCY39	4/6	OC26	5/-
AC166	5/-	BD119	9/-	OC28	5/-
AC168	7/6	BF154	5/-	OC30	5/-
AC177	5/6	BF159	5/-	OC35	5/-
ACY17	3/-	BF163	4/-	OC36	7/6
ACY18	3/8	BF167	2/6	OC38	11/6
ACY19	3/9	BF173	2/6	OC41	10/-
ACY20	3/6	BFY50	4/-	OC44	2/-
ACY21	3/9	BFY51	4/-	OC45	1/9
ACY22	3/6	BFY52	4/6	OC46	3/-
ACY28	4/-	BY100	3/6	OC70	2/3
AD140	8/-	BY234	4/-	OC71	2/-
AD149	8/-	BY236	4/-	OC72	2/-
AF114	4/-	BY238	4/-	OC74	2/6
AF115	3/-	BYZ12	5/-	OC75	2/-
AF116	3/-	BYZ13	5/-	OC76	2/6
AF117	2/9	GET103	4/-	OC77	2/6
AF119	3/-	GET113	4/-	OC78	3/-
AF125	3/6	GET116	6/6	OC78D	3/-
AF127	3/6	GET118	4/-	OC81	2/-
AF178	10/-	GET119	4/-	OC81D	2/-
AF180	9/6	GET573	7/6	OC82	2/3
AFZ12	5/-	GET587	8/6	OC82D	2/3
ASY28	6/6	GET873	3/-	OC83	2/-
BA115	2/8	GET887	4/6	OC84	3/-
BA129	2/6	GET889	4/6	OC123	4/6
BA130	2/-	GET890	4/6	OC169	3/6
BC107	4/-	OA70	3/-	OC170	2/6
BC108	3/6	OA79	1/9	OC171	3/4
BC109	4/3	OA81	1/9	OC172	4/-
BC113	5/-	OA90	2/6	OC200	4/4
BC115	3/-	OA91	1/9	OC202	4/6
BC116	5/-	OA95	1/9	OC203	4/6
BC118	4/6	OA182	2/-	OCP71	27/6
BCY10	5/-	OA200	1/-	ORP12	15/-
BCY12	5/-	OA202	2/-	MAT100	7/9
BCY33	5/-	OC22	5/-	MAT101	8/6
BCY34	4/6	OC23	5/-	MAT120	7/9
BCY38	5/-	OC25	5/-	MAT121	8/6

We require for prompt cash settlement all types of above goods, loose or boxed, but MUST be new. Offers made by return.

Terms of business:—Cash with order only. No C.O.D. Postage/Packing 6d. per item. Orders over £5 post free. Any parcel insured against damage in transit for only 6d. extra. Business hours: Mon.—Fri. 9 a.m.—5.30 p.m. Sats 9 a.m.—1 p.m. No enquiries answered unless S.A.E. is enclosed for reply.

All goods are new first quality manufacture only and subject to makers' full guarantee. We do not handle manufacturers' seconds or rejects which are often described as "new and tested" but which have a limited and unreliable life. Complete catalogue of over 1,000 valves actually in stock with resistors, condensers, transformers, microphones, speakers, metal rectifiers with terms of business. 10d., post free.

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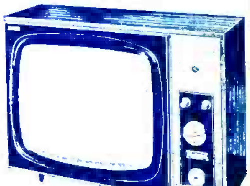
WIDE RANGE OF MODELS SIZES AND PRICES
DEMONSTRATIONS DAILY



TWO-YEAR GUARANTEED REGUNNED TUBES
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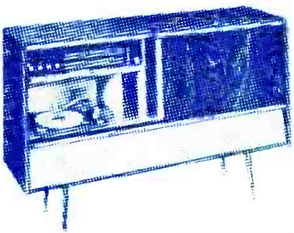
COCKTAIL/STEREOGRAM CABINET £25



Polished walnut veneer with elegant glass fronted cocktail compartment, padded position for two 10in. elliptical speakers. Record storage space. Height $35\frac{1}{4}$in., Width $52\frac{3}{4}$in., Depth $14\frac{1}{2}$in. Legs 1 gn. extra. **Other models. Send for free list.**

TRANSISTOR CHASSIS D.I 49/6
6 Transistors, LW/MW, Brand New. Famous British Manufacturer (LESS SPEAKERS). P. & P. 4/6.

TRANSISTOR CASES 19/6. Cloth covered, many colours. Size $9\frac{1}{2}" \times 6\frac{1}{2}" \times 3\frac{1}{2}"$. P.&P. 4/6. Similar cases in plastic 7/6.

TRANSISTOR RECORD PLAYER CABINETS 19/6. $11" \times 14\frac{1}{4}" \times 5\frac{1}{4}"$ and $14" \times 15" \times 5\frac{1}{2}"$ P. & P. 5/6.

AUTO-CHANGERS £8.19.6 Garrard 3000

DUKE & CO. (LONDON) LTD.
621/3 ROMFORD ROAD, E.12 01-478 6001-2-3

Practical Television

JANUARY 1969
VOL. 19 No. 4
issue 220

THE LAST COIN

IT seems at the time of going to press that the last coin has been dropped into the Pay-TV slot. Following its failure in America, the system has floundered in this country too. When the experiment was first proposed we asked one pertinent question and suggested one major requirement. The question was—do we really *need* Pay-TV. The requirement was that programmes should be sufficiently different from existing TV fare. (July, 1964 issue, page 435.) On both counts, the system appears to have failed.

Although the time limit imposed to evaluate the system has not yet expired, Pay-TV Ltd. have decided to close down. This was precipitated by the Postmaster-General when he recently ruled that the upper limit of subscribers would be 150,000. Lord Brabourne, chairman of Pay-TV Ltd., claimed that an upper limit of 250 000 was needed if the company was not to add a further £3M to the £1M already invested. With the upper limit imposed, it was said that the company could break even but could not recover their initial investment. Hence the closure. On the other hand, it should be recognised that the system was not exactly setting the Thames on fire with its 10,000 subscribers in London and Sheffield.

But what of programmes available? The purpose of the system was to provide entertainment not available on other TV channels, yet many of the programmes available were run-of-the-mill films, filmed wrestling, occasional sports features (largely racing). In our view, the offerings of Pay-TV have not lived up to the promise. Furthermore, it has always been a nagging thought that should a pay TV system succeed in obtaining rights to major national sporting events, the majority of viewers (who now get fair coverage on BBC or ITV) would be locked out. Surely this could not be a desirable situation.

So, we cannot claim to be too sorry that the experiment is to discontinue. There may, possibly, be a place for Pay-TV in our entertainments field, but if so a drastic re-think would be needed not only to provide an improved prospect for subscribers but to safeguard other viewers.

W. N. STEVENS—*Editor*

A Happy Christmas and a Successful New Year

from the Editor and Staff of
Practical Television

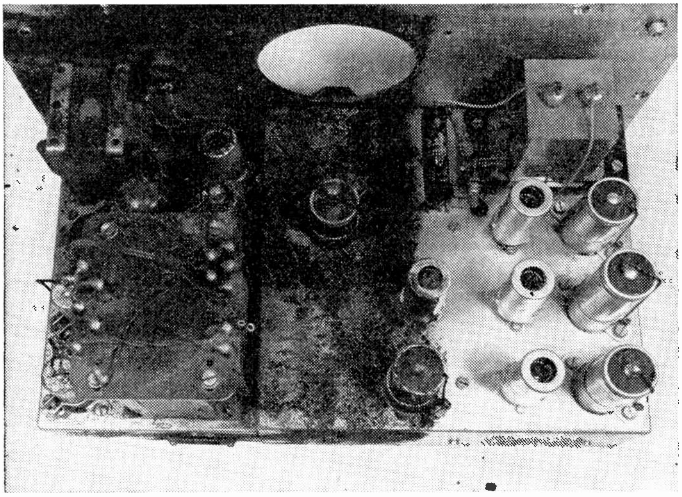
W. N STEVENS
L. E. Howes, G3AYA — J. A. Reddihough
H. W. Moorshead — T. R. Preece, G3TRP
C. R. Riches

THIS MONTH

THE NEXT ISSUE DATED FEBRUARY WILL BE PUBLISHED ON JANUARY 24

TELETOPICS

CLEANING BY ULTRASONICS



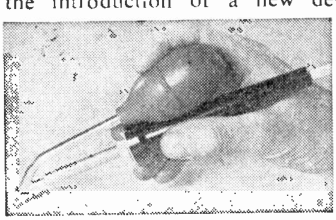
THE above photograph, sent to us by Dawe Instruments Ltd., shows how a chassis has been cleaned by one of their ultrasonic cleaning machines.

A tank of cleaning fluid is prepared and transducers are attached to, or immersed in, the tank of cleaning fluid. Electrical energy is converted into ultrasonic or vibratory energy. This produces high-intensity sound waves in the liquid and gives rise to the phenomenon of cavitation. Vast numbers of cavities filled with gas or vapour are formed continuously during the low-pressure half cycle of the sound wave and collapse violently as the pressure increases on the following half cycle. Shock waves then radiate in all directions at the instant of collapse. The energy released from a single cavitation bubble will be extremely small, but many millions of bubbles collapse every second. Cumulatively, the effect is appreciable and produces on the surface of the workpiece that intense scrubbing action which is characteristic of all ultrasonic cleaning. Cavitation occurs throughout the liquid if the energy intensity is sufficient and it is for this reason that ultrasonics can effectively clean inside blind holes and small crevices.

For further details of ultrasonic cleaning, contact Dawe Instruments Ltd., Concord Road, Western Avenue, London, W.3.

NOW A DESOLDERING TOOL

THE versatility of the Weller temperature control soldering pencils has been extended with the introduction of a new desoldering accessory.



This soldering aid can be operated by one hand, has an integral temperature control sensor, needs no air line or pump and fits existing pencils without modification.

From Weller Electric Ltd., the de-soldering accessory costs only £3 5s., and should be ordered as follows: DS-TCP for the low voltage temperature controlled soldering pencil and DS-W6OD for the mains voltage temperature controlled soldering pencil.

INCREASES IN TV LICENCES

BROADCAST receiving licence figures for the quarter ending in September show a further increase of nearly 90,000 in the total number of television licences over the total at the end of June.

However, the figures for September show a drop of 14,000 in the number of monochrome TV licences compared with the August total. Over a quarter of a million people took out new licences in the same quarter last year.

The number of colour television licences continued to increase at a steady 5,000 a month.

BBC-1 FROM HUNGERFORD

THE BBC-1 television service from the Hungerford, Berks, relay station started on 11 November, on channel 4, with horizontal polarization. For good reception of the BBC-1 service from this new relay station, it is important to use horizontal aerials designed for channel 4.

COLOUR CONVERSION FOR TYNE TEES

TYNE TEES Television, the Independent Television contractor for North East England, will, early next year, have their existing black and white Marconi outside broadcast vehicle converted to full colour operation.

The four existing Marconi Mark V black and white cameras will be replaced by a similar number of colour camera channels each comprising a Mark VII camera, a camera control unit and an operational control panel. Other modifications to the van include the introduction of colour balance controls and vertical aperture correctors, a dual synchronising generator, genlock and colour lock units, and colour synchronising equipment. The existing vision mixing equipment will be modified to enable the switching and fading of colour signals with separate preview facilities, and will include an output processing amplifier and a PAL colour caption module.

NEW IRONS

LIGHT SOLDERING DEVELOPMENTS LTD., 27 Sydenham Road, Croydon CR9 2LL, introduce two new thermostatically controlled soldering irons. Known as the Litestat 50 (£4 16s.) and Litestat 70 (£5) they are of 50 and 70 watts loading respectively, and are available for all voltages.

Temperature control (within plus or minus 2½ deg. C during idling) is achieved by a simple and robust mechanical system in which a micro-switch mounted inside the handle is operated, through an adjustable lever, by a pull-rod, in response to thermal expansion of the copper element core unit. Since this core unit is closely coupled thermally both to the bit and the element winding, rapid response without temperature overshoot is obtained. The ample thermal capacity of the system reduces initial bit temperature drop and contributes to good thermal stability.

The screw-on copper bits are available in four sizes for each model, and their life is considerably longer than is the case with uncontrolled tools. Philips iron-coated bits are also available, giving a life of at least 10 to 20 times that of copper bits.

BBC-1 FROM MARLBOROUGH

THE BBC's new relay station to serve Marlborough, Wilts, started transmissions of BBC-1 television on 11 November, on channel 7, with horizontal polarization.

For good reception of the service from the new relay station, it is important to use the correct type of aerial. Existing BBC-1 aerials will not be suitable. Satisfactory reception may be possible in many locations with aerials in use for receiving the ITA service from Membury on channel 12. However, for most viewers in the area served by the BBC relay station, one of the special wide-band aerials which work on channel 7 and channel 12, will be the best. A separate channel-7 aerial will be necessary at some locations from which the directions of the two transmitting stations are markedly different.

NINE MINUTES OF MULLARD!

A NEW 16-mm. colour film announced by Mullard Ltd. and entitled "Mullardability," presents, in the space of nine minutes, a dramatic and exciting look at the U.K.'s largest manufacturer of electronic components.

The film begins with illustrations of Mullard's *capability* to mass-produce—with its extensive plant and machinery and more than 15,000 employees—vast ranges and whole families of electronic components, from TV picture tubes to the tiniest electronic circuits.

Sequences filmed in the factories describe some of the complexities of manufacture. Many processes involve fantastic extremes of tolerance and measurement.

Copies are obtainable on free loan from: Mullard Film Library, Kingston Road, Merton Park, London, S.W.19.

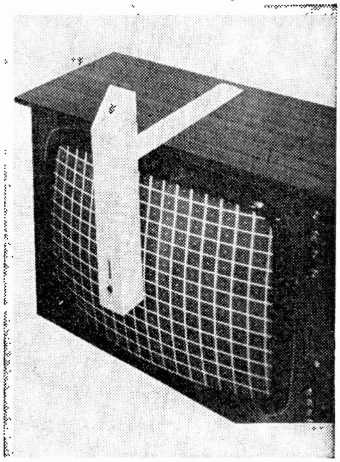
SAFER CROSSINGS FOR ITALY

VIDICONS made by English Electric Valve Co. Ltd. at Chelmsford will soon be watching level crossings on the State Railways all over Italy. An order for 175 tubes type P862 has been received from the Italian firm Magneti Marelli, who will fit them in their TV cameras.

This surveillance system will provide an extra safety margin against the possibility of accidents at unmanned automatic railway level crossings. Each camera, mounted in a position which will permit an unobstructed view of the whole of the crossing area, will feed a picture into a monitor in the signal box.

The picture displayed on the monitor will provide the signalman with a continuous view of the crossing and in the event of the track being obstructed when the barriers are lowered against road traffic, allow him time to warn approaching trains.

WHAT IS IT? It's the Static Convergence Periscope



BELIEVED to be the only one of its kind on the market, Philips new Static Convergence Periscope has been introduced to assist technicians when making adjustments at the rear of colour television receivers.

CCTV GOES TO THE DOGS

LONDON'S Clapton Stadium now uses CCTV for its greyhound racing enthusiasts. The camera used is a weather-proofed Philips with zoom lens and optical window on a 10ft. pole in the centre of the oval track. Panning is allowable up to four revolutions before reset to cover the maximum racing distance of 934 yards on a 360-yard long track. The camera is operated from a control room via a desk-top remote control unit which has a joystick-type control for tilt and pan, as well as an automatic pan facility with manual speed variation allowing for the speed of the dogs. Normally the first three or four dogs are kept on the screen and where the leading dog is several lengths ahead, attention may be fixed on the fight for second and third places. The race is shown on monitors in the stadium's restaurants, bars, judge's box, boardroom, control room and other vantage spots. Between races, the camera is trained on the totalisator for win, place and forecast of the next two races.

Also installed at the stadium is a Philips video tape recorder. Shortly after each race, the recording is played back with a sound commentary not previously broadcast. This gives any punter in doubt the opportunity to see the race again from a different viewpoint.

INSTRUMENT C.R.T.s

BY I. R. SINCLAIR

READERS of this journal should be thoroughly familiar with the type of c.r.t. used in television; in the USA it is termed a "kinescope" but there seems to be no corresponding name in this country to distinguish this type of large screen, magnetically deflected tube from the small electrostatically deflected tubes used for oscilloscopes, which are sometimes called instrument tubes.

Before we examine instrument tubes in detail let us consider for a moment the reasons for the difference between instrument and television c.r.t.s. For television purposes the picture must be large and bright, requiring a high accelerating voltage. The scanning speeds are fixed (apart from the 405/625 changeover); accuracy and linearity of scan are not greatly important and can be sacrificed (and have been) to small overall length. The resolution, that is the closest spacing of bars which can be seen, is not of vital importance since the line standard of the transmission and the video bandwidth restrict resolution anyway.

By contrast the instrument tube, though it should also give a bright trace, must not use too high an accelerating voltage if the deflection sensitivity is not to suffer. It should be possible to use scan rates varying from one scan in 10 seconds or so to rates of one scan per microsecond or shorter times and the scans should be as linear as possible so that 20V (say) applied to the deflector plates for any spot position should shift the spot by the same distance on the screen. The faceplate glass should be flat, preferably to optical standards so that the trace is not being viewed through a distorting glass. The resolution should be as high as possible so that high frequency waveforms can be viewed; this means that the size of the beam spot should be as small as possible.

The method of deflection is one of the most important differences between TV and instrument tubes. The magnetic deflection used in TV tubes depends on the fact that an electron beam is deflected by a magnet; the deflector may thus be an electromagnet with a.c. flowing through it to make the beam deflect to and fro. The sensitivity of this type of deflection is measured as the number of turns of coil × number of amperes flowing for a deflection of one inch or one centimetre (2·54cm. = 1 in.). This sensitivity becomes *less* when the accelerating voltage of the tube is *raised*, but the sensitivity is only *halved* when four times the accelerating voltage is applied.

Electrostatic Deflection

Electrostatic deflection depends on the fact that electrons are attracted to a positive voltage and repelled by a negative voltage. If an electron beam (Fig. 1) is forced to travel between two plates its direction can be controlled by voltages applied to the plates. If one plate is positive and the other negative the beam is deflected towards the positive plate. The sensitivity of this type of deflection can be measured by the number of volts applied to each plate for one centimetre deflection. When the accelerating voltage is raised the sensitivity is lowered *in direct ratio*; so an increase in the accelerating voltage of four times means a quarter of the previous sensitivity. For this reason electrostatic deflection is not favoured for c.r.t.s working at high acceleration voltages.

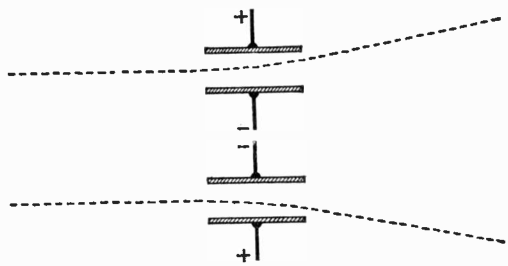


Fig. 1: The principle of electrostatic deflection. A beam of electrons is attracted by a positive potential and repelled by a negative one.

The two plates of a deflecting system have capacitance between them and to earth and a current must pass when the voltage between the plates changes. This charging current equals capacitance × change of volts/time and must be supplied by the amplifiers which feed the deflection plates. The capacitance between the plates is very small even when the plates are close together so that sensitivity is high.

When magnetic deflection is used either a very high current must be used or a large number of turns on the deflector coil for a smaller coil. It is difficult to generate high current scans, and when a high inductance coil (large number of turns) is used a very high voltage is required to make the current through the coil change rapidly. This voltage is equal to inductance × change of current/time and is familiar as the voltage peak across deflector coils during flyback. If a variable timebase is to be used with magnetic deflection the voltage supply must be able to provide the extra voltage required when the frequency is increased. In addition to this the reverse voltage across the coils during flyback must be removed before scanning can start again.

The difficulty of magnetic deflection at high frequencies has resulted in virtually all oscilloscope tubes being made with electrostatic deflection with the exception of some experimental models of a few years back with *internal* scan coils of a few turns built on to the electron gun.

The Electron Gun

The electron gun of a typical instrument tube is shown diagrammatically in Fig. 2. The first anode is at a positive voltage to attract electrons from the cathode. The grid (g1) is at a negative voltage and fulfils two functions: it varies by restricting the number of electrons passing so that the beam current decreases as the grid is made more negative, and it forms a region in which the electron paths cross over. This crossover region is very small, and it is the image of this region which is seen as the spot on the tube face. The combination of two electrodes with one other between at a lower voltage acts upon electron beams in the same way as a glass lens acts upon light and is therefore called an electron-lens (there are other arrangements which also provide this action but this is the type most often found).

The cathode-grid-first anode group of electrodes control the electron beam and form the crossover; the beam then has to be focused on to the screen and deflected. Following the first anode a focusing electrode (at lower voltage) is placed followed by the second anode (A2) usually in two parts with the deflector plates between. The second anode may be connected to the carbon coating which extends up to the screen of the tube or this coating may be brought out to a separate terminal as a third anode (A3).

The deflection plates should be placed together as close as the diameter of the beam permits, and should be as long as possible so that sensitivity is high because of the electrons being affected by the voltage on the plates for a longer time. Generally the plates are not parallel to each other but taper so that they are farther apart at the end nearer the screen. This prevents the beam which is of course deflected at the start of the deflecting system touching the plates at the other end.

Most tubes are designed for symmetrical deflection; that is, for a rising timebase voltage on one plate along with a falling voltage on the other so that the *average* voltage between the plates does not change. Any change in this average voltage between the plates has a lens effect in one direction only and causes flattening of the spot. The more expensive oscilloscopes have a control which adjusts the average voltage between the plates to a value which gives the roundest possible spot. This control is labelled "astigmatism" after the eye defect which causes equal horizontal and vertical distances to appear unequal (caused by a distortion of the lens of the eye). A few tubes have plates specially designed to be used with timebase voltages applied to only one plate of each deflection pair.

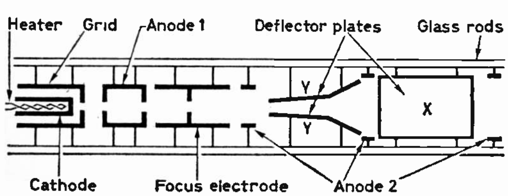


Fig. 2: Cross-section of the electron gun of a typical instrument c.r.t.

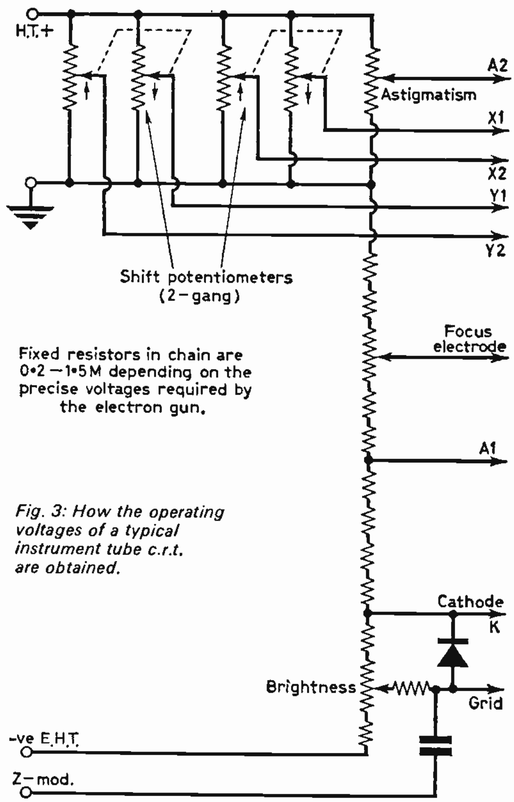


Fig. 3: How the operating voltages of a typical instrument tube c.r.t. are obtained.

Fig. 3 shows the circuitry needed to provide the correct voltages to a simple instrument c.r.t. of the type described. Notice that the voltage between grid and cathode is restricted to a minimum value of a few volts to avoid overrunning. Arrangements are made to pulse the grid on during the timebase sweep and the signal to the grid is d.c. restored. The deflector plates are connected for symmetrical operation as are the shift controls which consist of ganged pots. A simpler system uses a long-tailed pair to drive the plates directly and operates shifts by varying one grid voltage; astigmatism may be controlled by varying both grids. Notice the cathode of the tube is connected to negative e.h.t.: this is done to avoid having to couple the deflection amplifiers to plates at a high voltage which would be the case if positive e.h.t. were applied to the final anode. Since the potential between the plates (average) and second anode controls astigmatism it is usually simpler to vary the second anode voltage to provide an astigmatism control (with a small effect on brightness) than to attempt to vary the average plate voltage.

Spot Size, Brightness and Sensitivity

The simple form of c.r.t. suffers from some drawbacks which restrict its use to comparatively low frequencies. One drawback is that the size of the spot is fairly large so that a thick trace is drawn and fine detail of a waveform cannot be seen. The dramatic difference between a simple oscilloscope and a laboratory instrument is visible even when inspecting the mains voltage. The fine-trace tube shows transients and ripples in a waveform which simply cannot be seen in the simpler tube. In addition to this the brilliance of trace used in the laboratory oscilloscope tube is much higher at high trace speeds than that of the simple tube.

Both brilliance and spot size can be improved by one simple measure—increasing the e.h.t. A higher e.h.t. accelerates electrons faster and gives them less chance to scatter out of focus before reaching the screen, and means that more milliwatts are dissipated at the screen so that brilliance is higher. Unfortunately a higher e.h.t. also means that deflection sensitivity is *lower* and that amplifiers capable of a greater output to the deflector plates must be used.

Post Deflection Acceleration

There has been steady progress in tube design to avoid this problem. Mullard solved the problem very elegantly for the simpler type of tube by using a new method of laying a screen on to a transparent conducting coating on the faceplate glass. This screen gave much improved brilliance at low e.h.t. while improvements in gun design improved the spot size.

The more complex type of tube could use aluminising to push up the screen brilliance (uncoated screens have a shorter life at high e.h.t.) but the problem of deflection sensitivity remained. The first approach, some twenty years old now, was to separate the carbon coating A3 from the A2 electrode and to run A3 at a higher voltage. As far as deflection was concerned the sensitivity was unchanged because the voltage between cathode and A2 was unchanged, but the electron leaving the deflection region was accelerated by the extra A3 voltage so as to produce more dissipation and hence greater brilliance at the screen. This technique improves brilliance to some extent but the spot size is not reduced to the same extent and may even be worse. The reason for this is that the gap between A2 and A3 now acts as a lens which affects the focus of the spot.

The next stage in design (in the early 1950s) was to apply this extra voltage in steps by using several rings of carbon connected to voltages which were made progressively higher as the rings neared the screen. This was workable but clumsy and the next step was to make a coating of *high resistance*, one end of which was connected to A2 voltage and the other end connected to A3 voltage. The resistance has to be of about 5-50MΩ to avoid excessively high currents which would require elaborate power supplies. Such a resistance is extremely difficult to make in a reliable form and a better method proved to be *spiral p.d.a.* which is now a common feature of oscilloscope tubes. P.D.A. stands for *p*ost *d*eflection *a*cceleration, which is the process which we have been describing, and the spiral is the method of applying a coating of fairly low resistance so that the resistance between A2 and A3 is high. The coating is painted on in the form of a close spiral so that the total *length* of the coating is several yards; thus the resistance is high but the wound length of the coating is only a few inches. The technology of preparing the coating material, insulating between turns and from other coatings is not easy and spiral p.d.a. tubes were expensive for a considerable time.

Spiral p.d.a. tubes seemed to be the ultimate answer for maintaining deflection sensitivity while keeping e.h.t. high. A3 could be kept at about 5-7kV above A2 and though deflection sensitivity was affected to some extent the gain in spot size and brilliance was well worth while.

Electrostatic Screen

The use of transistors in oscilloscopes, however, brought a demand for very high deflection sensitivity to cope with the low voltage at which early transistors could run (especially high frequency types); but little relaxation of the standards of spot size and brilliance set by the p.d.a. tubes could be tolerated.

This time the tube designers used an entirely different approach (1959). Instead of introducing a gradual rise in voltage from A2 to A3, they stepped up the voltage very rapidly but placed an electrostatic screen between A2 and A3. An electrostatic screen such as a film of metal does not permit voltages on one side of it to interfere with voltages on the other side. In theory the acceleration voltage on one side could be as low as was required for deflection, a few volts if necessary, while the voltage on the other side could be as high as was needed for brilliance.

Although electrons can pass through metal films, particularly of the metals beryllium and aluminium, if they are very thin, a better approach seemed to be to use metal mesh which was being made in a very fine form (anything from 300 to 800 meshes per *inch*) for image orthicons and storage tubes.

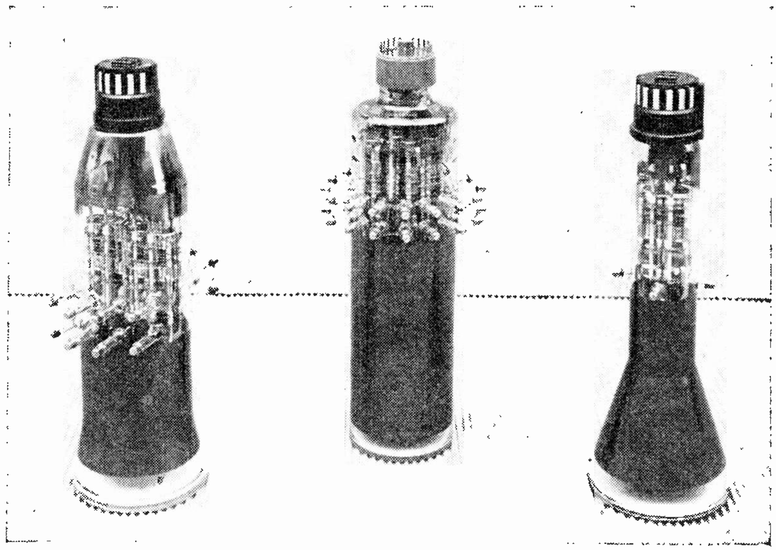
The process was not so easy as it seemed as the mesh had a bad effect on spot size, but tubes of incredibly high sensitivity could be made with a final acceleration voltage of 10 kV or more. As the lens effect of the mesh became better understood the spot size on later designs improved and transistorised oscilloscopes with bandwidths of d.c. to 800Mc/s can now be made using such tubes. In time there is a chance that reasonably priced specimens may appear on the amateur market.

Deflection Speeds and Bandwidth

At one time an oscilloscope which would cope with frequencies up to 5Mc/s was considered to be wideband. Pioneer oscilloscopes, notably the Solartron series introduced in the early 1950s, extended this bandwidth to 25Mc/s, and the introduction of the Tektronix 541 oscilloscope accustomed designers to think of wide bands in the region of 250Mc/s or more.

The maximum bandwidth of oscilloscopes has been increasing steadily ever since but this requires more than simply the design of better wideband amplifiers. The deflection plates of a c.r.t. have appreciable capacitance between them and in earlier tubes where all leads were taken to the base the long leads from the plates had considerable capacitance to other electrodes. At high deflection speeds the deflection amplifier must supply considerable currents to change the voltage on the deflector plates and if deflection speeds are to rise further the capacitance between plates must be reduced.

Accordingly the old design of gun with all the components mounted on a base was dropped and instead the deflector plates were mounted on pins or metal caps sealed into the neck of the c.r.t. and independent of the rest of the gun. The techniques of sealing in and lining up deflection plates were developed so rapidly that by the late 1950s 20th Century Electronics were showing an eight-gun tube with all its 32 deflector plates mounted in this way. This type of structure is essential now for any c.r.t. intended for instrument work.



Multiple-gun tubes by 20th Century Electronics Ltd.

At even higher frequencies, however, greater troubles arise. The electron, although it travels at speeds of several thousand m.p.h., takes appreciable time to travel from the start of a pair of deflector plates to the end. If the frequency applied to the plates is so high that the voltage on the plates has reversed before an electron has cleared the plates then the amount of deflection is negligible. As frequency is increased, the deflection sensitivity falls until somewhere over 500Mc/s it is insufficient to be usable.

Travelling Wave Deflection

The way round this is shown in Fig. 4. Several sets of very short deflector plates are used and the deflection voltages are applied through delay lines so that the deflection voltage reaches each set of plates *at the same time as the electron*. Using this technique, called travelling wave deflection, waveforms of 1500 Mc/s and over can be displayed provided suitable amplifiers (using the same principle) are used.

Multiple Traces

Another feature of the c.r.t.s used in modern instruments is the provision of multiple beams from separate guns. Early Cossor tubes used a splitting plate to form two beams from one at the Y plates so that a common timebase deflected both beams. The two beams were not entirely independent, however, and several firms started making c.r.t.s with independent guns which could be interconnected as desired. These tubes enable independent displays to be shown, usually with a common timebase, with very little interaction: up to eight guns have been mounted in one tube. 20th Century Electronics in particular have specialised in multiple-gun tubes of this type and the photograph above shows some of their large range.

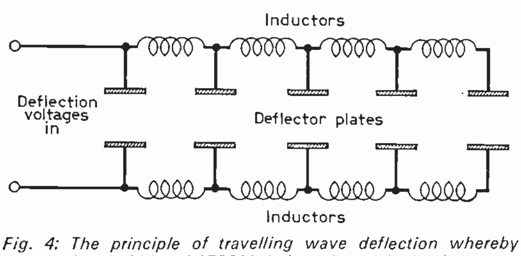


Fig. 4: The principle of travelling wave deflection whereby bandwidths of 1500Mc/s have been obtained.

Assorted Improvements

Because instrument c.r.t.s are used for measurements on waveforms it is important that the face of the tube should permit a measuring scale to be used; hence flat-faced tubes have been standard for such tubes for a considerable time. The end face of the tube is ground flat and polished to optical standards so that the minimum distortion to an image is caused.

Early cathode-ray tubes suffered from sparking between the electrodes, especially between carbon coatings when these had different voltages applied. This has now been overcome by applying insulating coatings of chrome oxide, a green powder, between the conducting layers.

The technique of gun construction has also improved. Early guns used ceramic rod formers with the gun electrodes attached by nickel clips. The modern method is to weld small studs on to each electrode, position all the gun electrodes in a jig, then force the studs into a molten glass rod which is then allowed to solidify. Two rods are applied at a time (four to a gun) and the resulting structure is very rigid.

BBC's SOUND-IN-VISION DISTRIBUTION SYSTEM

T. JOHN REPORTS

RECENTLY we attended an impressive demonstration of the BBC's new sound-in-vision signal distribution system. Up till now the separate sound and vision signals have been sent from the studios to the transmitters and other points in the BBC's network via separate circuits—mainly lines rented from the GPO. The new system, which has now emerged from its development stage and is being introduced into the BBC's distribution network, enables the sound signal to be incorporated within the vision signal bandwidth so that only a single channel is required for signal distribution purposes. In addition to the saving in line rental that this gives there is an appreciable improvement in the quality of the sound signal in the network, the sound bandwidth being increased from about 10kc/s to approximately 14kc/s. This we were able to check at the demonstration when a tape signal was first played to us direct and then via a network from Broadcasting House, London, to Kirk o'Shotts in Scotland and back using both the present two-channel system and the new technique for comparison.

For the present the system is restricted to network distribution: it could only be transmitted if additional circuitry was built into each receiver to enable it to decode the composite sound-in-vision signal. The extra circuitry required would be quite complex and such a step is not envisaged at present. It could, however, be a future development, possibly when the increased use of i.c.s will enable the necessary extra circuitry to be incorporated at not too great cost.

SOUND-ON-SYNC

The first question, of course, is where in the video signal waveform is there space to include the sound signal? The system uses the line sync pulse period for this purpose. For sync purposes the only important feature of the sync pulse is its sharp leading edge. The rest of the pulse period, $4{\cdot}7\mu S$ on the 625-line system, carries no modulation. So if the sound signal can be compressed and inserted into this space we can carry our sound signal within the vision channel. The new system makes use of $3{\cdot}8\mu S$ of the sync pulse period for the sound signal.

SIGNAL SAMPLING

The next question is how this can be achieved. And here we come to the real ingenuity of the system, the use of pulse code modulation to convey the sound information. The first step here is to use a signal sampling technique to measure the sound signal at regular intervals. Figure 1 shows how if the original sound waveform—which is termed an "analogue" waveform—is regularly sampled, at times T1, T2, T3, etc., we can get an accurate impression of the sound signal without the need for the sound signal to be continuously present. The point here is that the sampling rate must be higher than the rate at which the analogue waveform is changing: provided this is so no information of significance in the analogue waveform is lost. In the BBC system the sound signal is sampled at twice the line frequency, and this gives a sound signal bandwidth of 14kc/s.

Now we have two samples of sound signal per line but only one period per line in which these samples can be included. So the samples have to be delayed and compressed in time before they can be inserted into the next following sync pulse of the vision waveform. Thus what happens in effect is that instead of continuous sound a large number of short samples are used to provide a version of the sound signal that can be compressed in time so that it is of sufficiently short duration to be inserted in the sync pulse period.

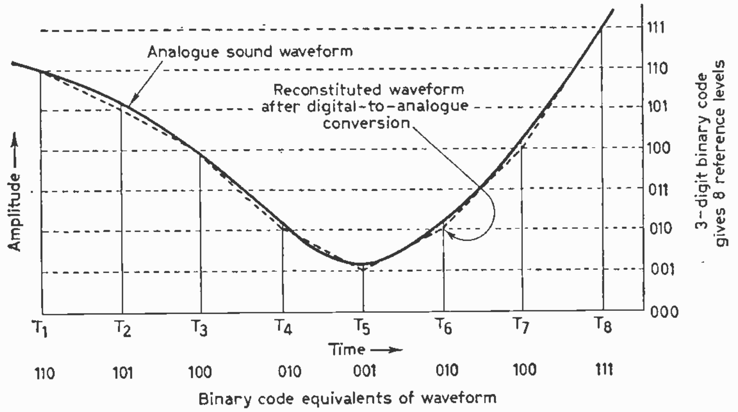


Fig. 1: Basic principle of sampling a sound waveform and converting the samples into binary form.

PULSE CODE MODULATION

The system as described so far is based on the amplitude of the sample pulses. The BBC system, however, uses the more sophisticated pulse code modulation (p.c.m. for short) technique. This combines low susceptibility to noise, interference and signal deformation in transmission with ease of signal regeneration at the receiving end. It is being increasingly used in telephone links.

In p.c.m. information on the amplitude of the sample pulses of sound is transmitted in code form—in practice by converting the signal into a binary digital code equivalent. A simple example of how this works is shown in Fig. 1. On the right is shown a three-digit—000, 001, 010, etc.—binary system. This has eight possible combinations of digits—0s and 1s—as can be seen, and each of these combinations is used to represent a different signal level. Now if each of our samples of signal, at times T1, T2, T3, etc., is converted into this form—the binary equivalents being indicated at the bottom of the diagram—we get a series of three-digit binary signals that give us a fairly accurate description of the original analogue waveform. This series of binary code signals consists of groups of pulses to denote 1s and 0s, and can be subsequently converted back into an analogue waveform by reversing the original analogue-to-digital conversion. Provided we have a binary digital system that gives us sufficient signal levels we should, in the same way that we lose no signal in the time-sampling process, not lose any information of importance. The reconstituted waveform shown in Fig. 1 indicates this. Clearly, however, a three-digit system giving only eight levels is inadequate for the accurate description of an analogue sound waveform such as we have in practice. Instead the BBC uses a ten-digit binary system which gives over 1,000 levels.

As there are two ten-digit samples per line, 20 digits (pulses) must be incorporated in each sync pulse period. An additional pulse is incorporated as a "marker" to indicate to the decoding circuits in the receiving equipment that the coded sound signal is about to arrive. This means 21 digits in the sync pulse period, and since only 3·8μS of this is used for the purpose the spacing between the 21 pulses works out at 173nS. An example is shown in Fig. 2. The pulses here read, as indicated, 101100101101010011010.

It will be seen that the pulses are not of the squared form we generally think of but instead consist of a series of high-amplitude spikes. These are officially described as "of the 2T form. that is, a raised cosine having a half-amplitude duration of 182nS." It will also be noticed that when two of the same digits follow one another, i.e., two 0s or two 1s, the resulting pulses tend to be of higher amplitude. These points do not give rise to practical difficulties.

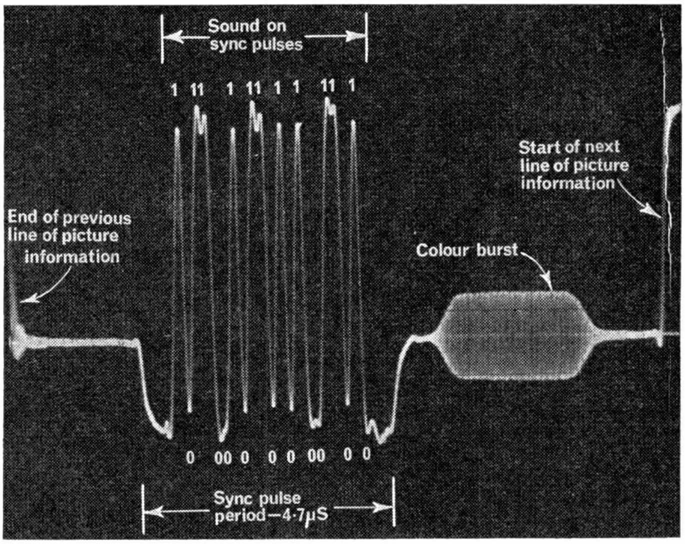


Fig. 2: BBC sound-in-vision signal. Two ten-digit binary signals are inserted in each sync pulse period. The pulses here read 101100101101010011010.

PRACTICAL PULSE TRAIN

A practical difficulty, however, is that under certain circumstances the presence of the sound pulses could disturb the post sync pulse blanking level, and a number of techniques are employed to overcome this possibility. First one of the two groups of ten pulses is complemented, that is the 1s changed for 0s and vice versa. Secondly, the two groups of ten pulses are interleaved so that the second pulse (the first is the marker) belongs to the first group, the third to the second group, and so on. And, lastly, the digits are arranged in the reverse of the normal order, the least significant instead of the most significant digits coming first. Thus the pulse train shown in Fig. 2 comprises the following: marker pulse, the two least significant pulses from each group of ten, one of which is complemented, and so on.

—*continued on page 165*

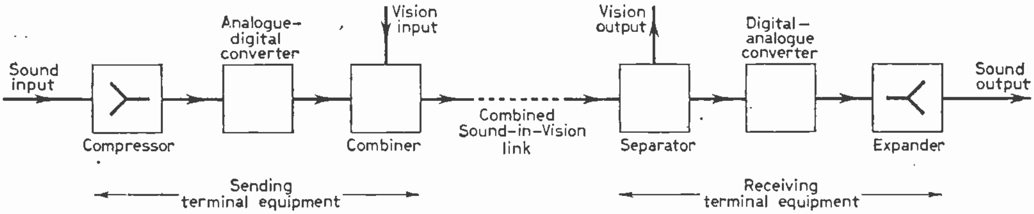


Fig. 3: Block diagram of the BBC sound-in-vision distribution system.

Servicing TELEVISION Receivers

No. 153 PHILIPS 19TG164A Series
—continued

by L. Lawry-Johns

No Picture

No e.h.t. Line whistle on 405 nice and clear, check DY87. Line whistle subdued, check PL36, PY800, R458 2.2kΩ and the capacitors C415 and C416. No line whistle, PY800 probably overheated; check ECC82 (V404) and associated components. Line timebase comes to life when PY800 top cap is removed; replace whichever one of C415 or C416 is shorted.

No Height

A total collapse of field scan resulting in a single white line across the screen—not reduced height or field amplitude. Check connections to the field coils and the continuity of the coils (disconnecting earthy end). Check whether R436 and R437 are still fitted (have not dropped off). Check PCL85 and if necessary V401 ECL80 (half of the field oscillator).

Reduced Height

If the loss of height is even top and bottom check R438 1.2MΩ and if accompanied by loss of brilliance check C417 and R424.

If the loss is far more severe at the bottom check C428 (100μF PCL85 cathode electrolytic), the PCL85 and C422 and C426 if the bottom is folded up. Also ensure that both R436 and R437 are in position.

No Sound

This is normally due to a faulty V203 PCL83 which may or may not have caused R223 to have dropped off its tags.

Distorted Sound

Normally due to the PCL83, with perhaps C228 being leaky or R257 (2.7MΩ) going high.

Feedback Howl

Oscillation depending upon the position of the volume control, check C227 100μF.

Vision Faults

A very frequent fault is caused when the PL83 video amplifier starts to draw grid current. If the set is used on 625 this will be noticed long

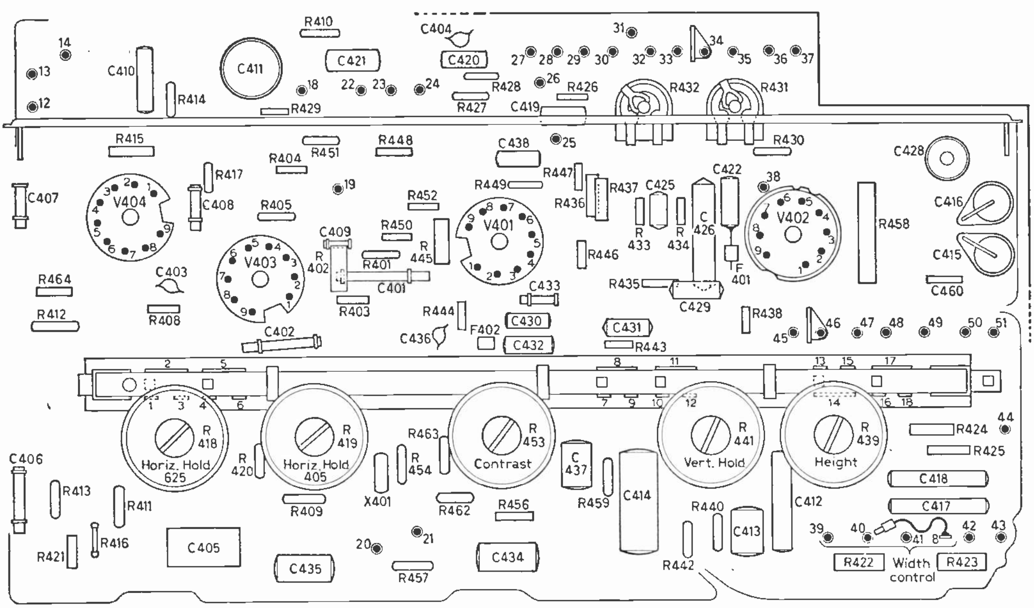


Fig. 4: Layout of the timebase printed board, viewed from the component side.

VOLTAGE DATA

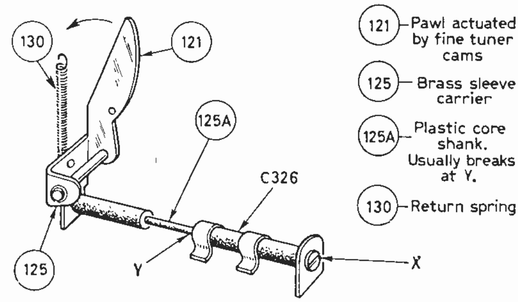
Valve		Anode volts 405	Anode volts 625	Screen volts 405	Screen volts 625	Cathode volts 405	Cathode volts 625
V201	EF85	170	170	60	60	1·1	1·1
V202	EF80	150	160	165	165	2·35	2·35
V203T	PCL83	36	36	—	—	2·35	2·25
V203P	PCL83	200	195	210	202	13	12·5
V204	EF183	175	175	70	56	0·2	0·3
V205	EF85	165	165	86	78	1	1·25
V206	EF184	165	165	165	165	1·65	1·65
V207	PL83	115	115	150	150	3·6	3·6
V301	PC900	120	0	—	—	—	—
V302A	PCF801	135	0	85	0	—	—
V302B	PCF801	30	0	—	—	—	—
V401A	ECL80	85	84	—	—	—	—
V401B	ECL80	82	70	16·5	15·5	—	—
V402A	PCL85	62	68	—	—	—	—
V402B	PCL85	165	165	175	175	15·5	15·5
V403A	ECC82	58	56	—	—	—	—
V403B	ECC82	48	38	—	—	—	—
V404A	ECC82	170	150	—	—	—	—
V404B	ECC82	40	48	—	—	—	—
V500	PL36	—	—	115	145	—	—

Voltages measured with no signal and 240V a.c. mains input, using a 100kΩ/volt meter. H.T. at X100 cathode 260V. H.T.1 210V 170mA on 405, 202V 190mA on 625. H.T.2 and H.T.3 176V 145mA on 405, 174V 140mA on 625. C.R.T. cathode 105-175V (pin 7), first anode 580V on 405, 600V on 625 (pin 3).

before the 405 standard is affected, due to the different operating conditions. The effect on 625 is for the picture to become lighter. This stage is quickly followed by weak sync where it is difficult if not impossible to lock the picture. Although a new PL83 will immediately restore good contrast and sync, a reduction in the value of R248 (1MΩ), say by wiring a 470kΩ resistor across it, will delay the fault recurring. The PL83 can also develop heater-cathode leakage, again upsetting the sync and producing horizontal shading (hum bars).

Loss of Contrast

Whilst this may affect all channels, the effect is more noticeable on 625. The PL83 may be at



C326 is the stationary member in which the core moves. Adjust and unscrew at X.

Fig. 5: Detail of the fine tuner mechanism.

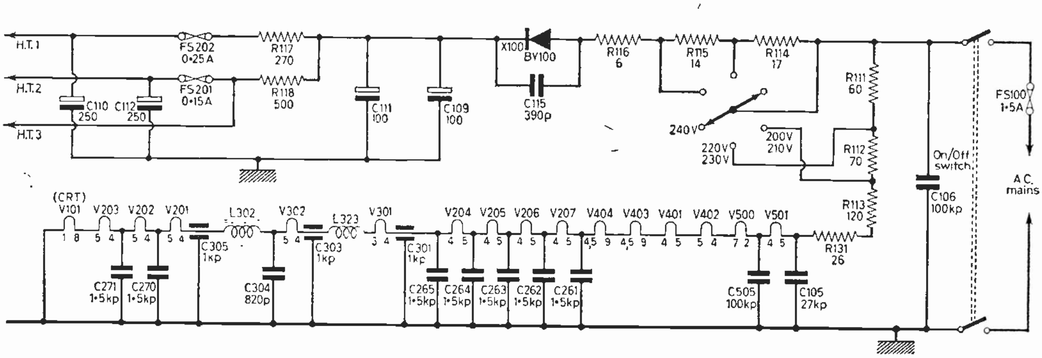


Fig. 6: Circuit of the h.t. supplies and heater chain.

D.C. Resistances:	*L101 3·5Ω*	*L105 18Ω*	*L107 9·5Ω*	*L233 9Ω*	*L237 9Ω*	*L501 2·7Ω*	*L507 6·3Ω*
L100 3·5Ω	*L104 18Ω*	*L106 280Ω*	*L108 320Ω*	*L235 7Ω*	*L238 12Ω*	*L502 25Ω*	*L512 100Ω*

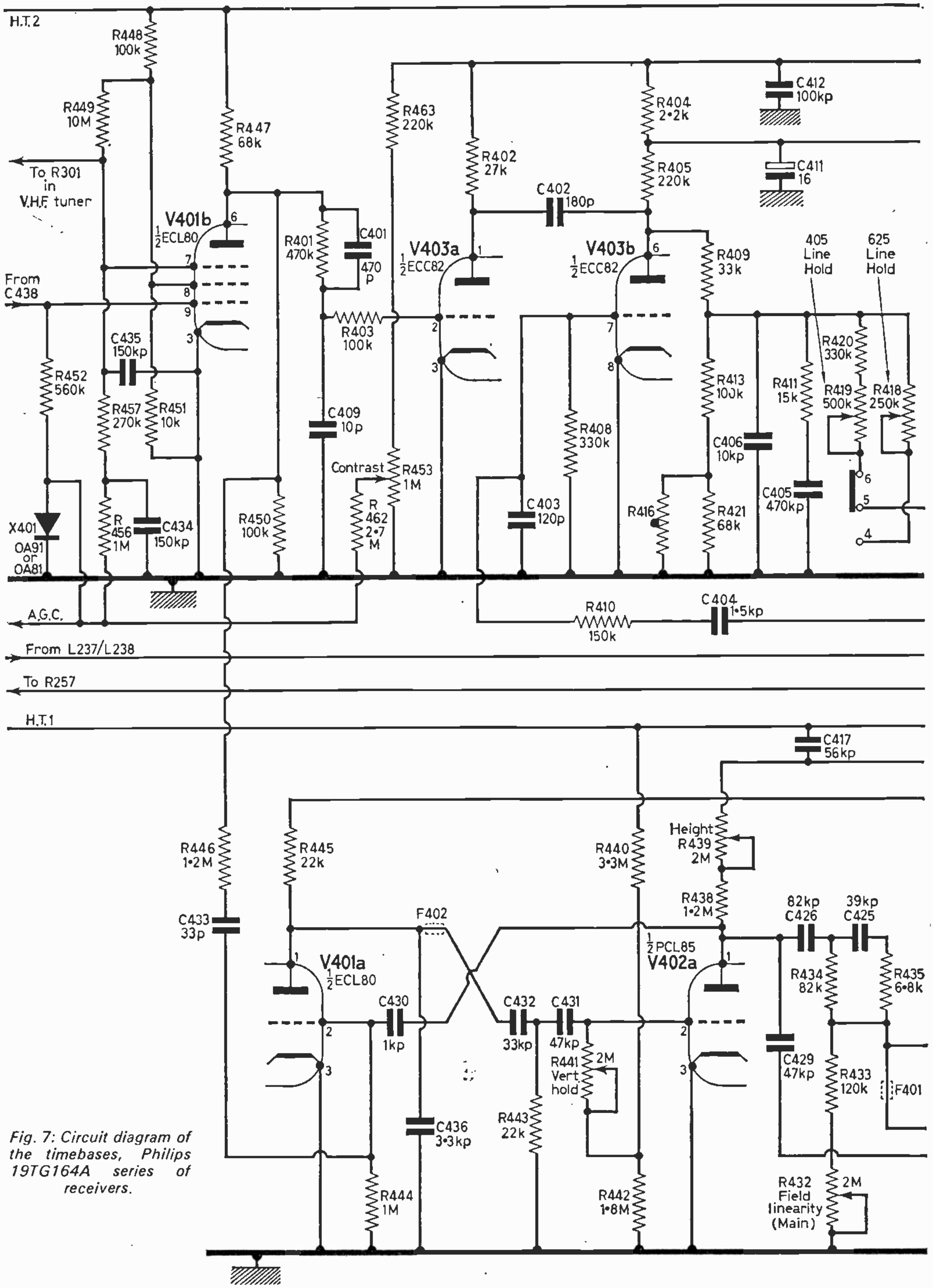
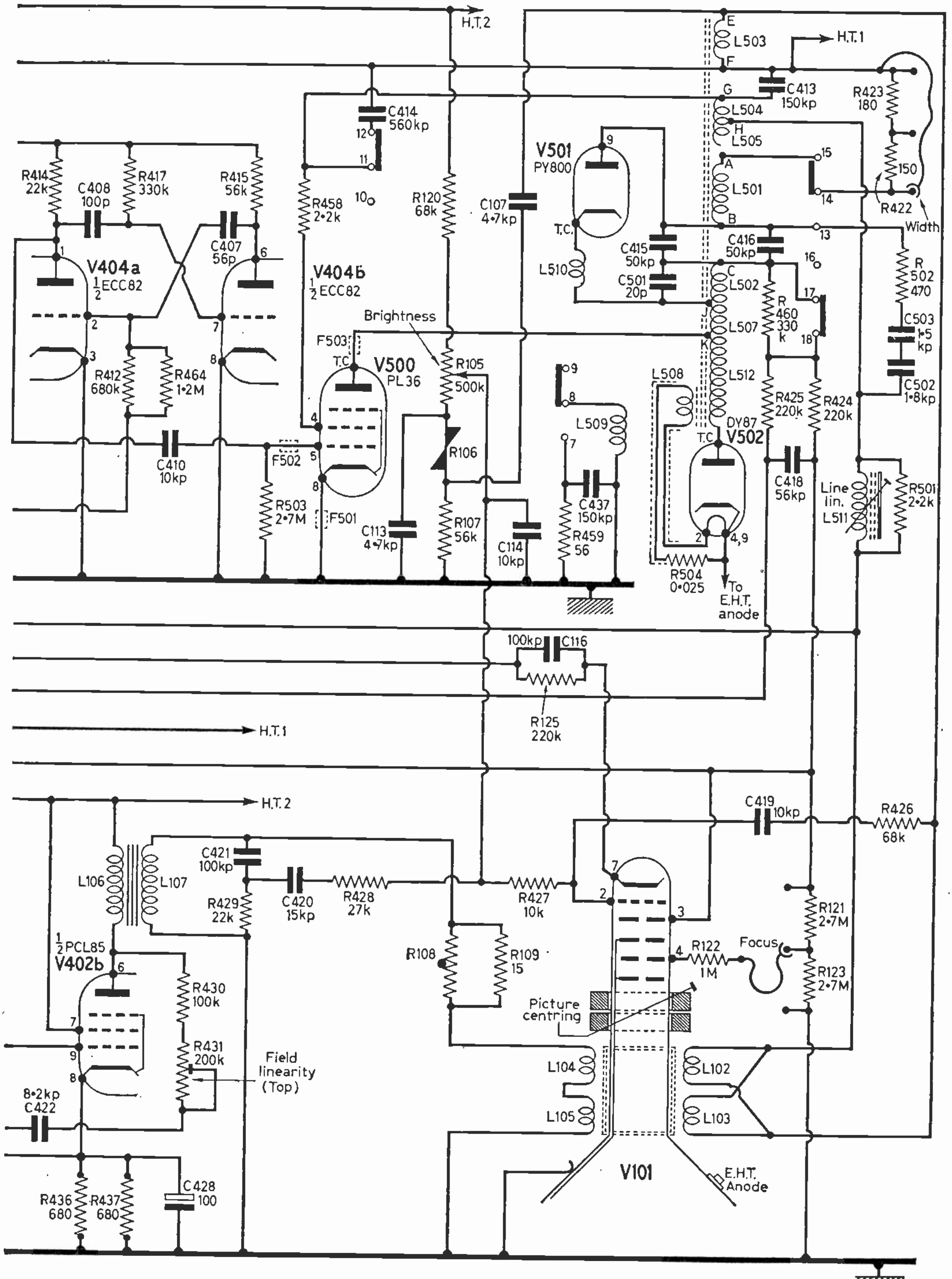


Fig. 7: Circuit diagram of the timebases, Philips 19TG164A series of receivers.

fault but quite often a replacement EF184 (V206) will produce surprising results. Also check the EF183 (V204) and EF85 (V205) in that order. If the loss of gain is only noticeable on 405, check the v.h.f. tuner valves PC900 and (if necessary) PCF801.



The u.h.f. tuner gives little trouble. On one occasion however a faulty AF186 (mixer-oscillator) had to be replaced and on another a dry joint at the junction of two resistors produced a " no signals on BBC-2 " condition.

continued on page 182

YORKSHIRE TELEVISION

B. HONRI REPORTS

COMMUNICATIONS between Lancashire and Yorkshire were poor for hundreds of years, the moorland heights of the Pennine Range getting in the way of the smoke signals of the 15th century. The Wars of the Roses were terminated not by the Battle of Bosworth Field but by the marriage of Lancastrian King Henry VII and Princess Elizabeth of York, with their respective red and white roses mingled in their wedding bouquets. Nevertheless communication improvements had to wait for the industrial revolution, with canals and railways bringing the two counties closer together. The Lancashire and Yorkshire Railway enabled Yorkshiremen to sample Morecambe shrimps while Lancastrians breathed deeply Scarborough's bracing air.

FORTY YEARS (OR SO) ON!

The other man's point of view began to be properly understood more easily in 1922 with the arrival of "Wireless." The BBC opened their Manchester broadcasting studio for serving both Lancashire and Yorkshire with one 1½kW transmitter 2ZY at the Metrovick works, Old Trafford. It was not until July 1924 that Yorkshire had its first studios, which were small 200-watt relay stations in Sheffield, Leeds, Bradford and Hull. The Leeds Studio in Basinghall Street fed transmitters in Leeds and Bradford and relayed programmes by line from 2LO, London. I remember these events very well, because I was the youthful assistant to the late Capt. A. G. D. West who, under the BBC Chief Engineer Capt. P. P. Eckersley, was in charge of an astonishingly rapid expansion of low-power provincial transmitting sources—one per month.

Naturally revisiting Leeds after all these years had a nostalgic flavour. The BBC's original makeshift studios were in Basinghall Street and the transmitting aerial was suspended from a factory chimney in Claypit Lane. These had naturally disappeared. Instead I beheld a magnificent steel-framed, brick-clad structure on Kirkstall Road, Leeds—not yet completed but with four television stages:

Studios 1 and 1A, Announcers' suite and continuity presentation, 240 sq. ft. each.

Studio 2, News and Features, 1,300 sq. ft.

Studio 3, Normal TV programme production facilities, 4,500 sq. ft.

All these studios are operational for 625-line transmissions and for later conversion to colour. In addition construction was proceeding with Studio 4, 7,700 sq. ft. together with additional dressing rooms, wardrobe, make-up, and other ancillary premises. Office premises, workshops, o.b. truck garages and scene docks are all being expanded. In the meantime the administrative offices of Yorkshire Television are operating from a former clothing factory next to the studios.

The design, construction and equipping of a television station is always a race against time. It was not easy in the early days of ITV, when it was an accepted and desirable expedient to convert a theatre, warehouse or chapel into a studio fully equipped and ready to go on the air on the appointed day. It is far more difficult to achieve such a complicated operation with brand-new, purpose-built premises and installing all the new colour and 625-line apparatus. Uncomfortable though the operation was, with delays in delivery of some of the equipment and the inevitable temporary improvisation which ensued, Yorkshire Television was "on air" on 29th July, 1968, thirteen months from the date the company was awarded the contract. The company is planning to become fully operational in colour, using the PAL colour system, by November 1969.

EARLY ITV LOSSES

When commercial television first started thousands, even millions of pounds were being lost and the ITA had difficulty in finding syndicates willing to take the risk in some of the regions. From the start of ITA it was felt by many people that the Lancashire and Yorkshire regions should have separate contracts; but the Granada Network was the only potential customer for the combined Northern England area. Following the precedent set by the BBC at the very beginning of sound radio and of television, ITA invited Granada to provide simultaneous weekday transmissions for both Lancashire and Yorkshire, with studios in Manchester. Sidney Bernstein, Granada's dynamic Chairman, actually located the site himself and was responsible for the first modern purpose-built TV studio to be built by an ITV company in Britain. Now it has been enlarged and has skyscraper buildings within a stone's throw of Deansgate, the shopping and theatrical precinct of Manchester. It has comprehensive and excellent facilities for a seven-day operation in Lancashire in place of the former five-day stint.

THE YORKSHIRE FRANCHISE

Times have changed. There was no absence of would-be syndicates when ITA invited applications for the Yorkshire franchise last year. Many consortia were set up, all with elaborate plans and promises; creative programme ideas and logical technical intentions. In the face of this intense competition the Yorkshire franchise was granted to the Telefusion Consortium.

The entrance to the Yorkshire Television Centre is a foyer which is modern in concept yet retains the clean lines of the brick-built

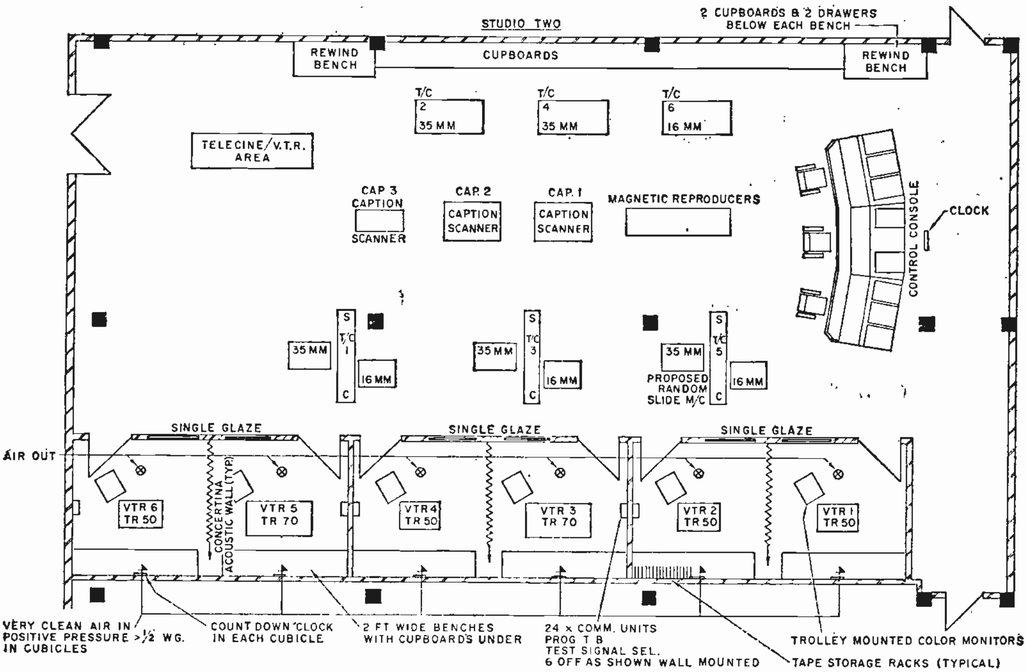


Fig. 1: Yorkshire Television's central apparatus room, showing the layout of the telecine/videotape area. At the top, three flying-spot telecine units, at the bottom of the main room three lead-oxide film chains, and between the caption scanners and tape reproducers. The videotape machines are arranged in pairs in the three booths: with the concertina doors open the pairs can be used for electronic editing.

exterior. Very plain but very pleasing, the stylish shape and sound of the Yorkshire Television reception entrance augurs well for the decor and acoustics of the rest of the buildings. The charming welcome by the receptionist, telephones, intercom bleeps and radio link, have the desired effect for the commencement of the "grand tour" of the shiny new premises.

BACKROOM AND FRONT OFFICE TEAM

The encouraging decorative and acoustic premonitions which impressed at the entrance foyer proved to be true in the corridors, offices, preview theatres, control rooms and studios as Simon Kershaw, a Yorkshire Television executive, conducted me around. Soon I was surrounded by a wealth of electronic knowhow as Phil Parker (Chief Engineer), Capt. Geoffrey Whittaker and Tom Marshall dealt with various new and exciting technical developments in this bang up-to-date plant. All these top engineers, together with Dave Whittle, technical consultant, had obviously carried out a magnificent operation under great strain, particularly since some sub-contractors had not delivered goods or services on time. The contribution of the architects George/Trew/Dunn was enormous, making logical use of the seven-acre site. But it was also obvious that they had the complete backing of their front office. This is not surprising when the board includes Sir Richard Graham of Telefusion Ltd., Sir Geoffrey Cox, late editor of Independent Television News and Mr. G. E. Ward Thomas, formerly Managing Director of Grampian Television and a director of the up-and-coming Prowest Electronics Ltd.

Studio 3 was the first stage to be seen, dimensions 75ft.×60ft. with a lighting grid 31ft. above the dead-level lino-covered television floor. The grid has Mole Richardson slots through which are supported the inverted monopole luminaire suspensions which enable lamps to be drawn right up to the grid instead of dangling a few feet below it. Plenum ventilation, with cooled and cleaned air, is brought in silently and pressurized downwards instead of through inlets on the side walls (which might be impeded by scenic backings). Compressed air, water and gas services are available for all kinds of purposes, including the dusting of electronic equipment. Fire precautions are provided with smoke and heat detectors plus water sprinklers, insisted upon in Leeds by the authorities. This was illogical: everyone knows how lethal and unnecessary water sprinklers are in premises equipped with electronic equipment. Smoke detectors will automatically summon the fire brigade fifteen minutes before a raging fire is likely to fuse the water sprinklers in a stage nearly fifty feet to the roof.

SOUND INSULATION

Each of the Yorkshire Television studio stages, foundations, frame and superstructure is isolated from the rest and from adjacent buildings, thus reducing structure-born noise. Reverberation of each stage is reduced to the minimum, mainly by fixing 7½in. deep plywood boxes with a number of different absorbing materials. These boxes can be changed in position to obtain best results. Perforated hardboard or metal facings give a clean appearance and are used in control rooms and viewing theatres. The large soundproof scenery doors, 14ft. square, are electrically operated on the lift-and-slide principle. By this means the 6-ton self-weight of the door is used to seal the opening for a designed insulation value of 50dBA reduction. The double sound-lock entrance doors and the sound insulating thick double-glass windows seemed to me to be as good or even better than those designed by the BBC. They are certainly better than the sound insulation doors and windows at most other TV and film studios.

LIGHTING

In Studio 3 there are 170 5kW and five 10kW lamps remotely controlled by a Strand Electric s.c.r. type dimmer console with multiple memories. The electrical supply for the whole plant is capable of loading up to 3,000kVA with three 1,000kVA transformers taking an input at 11,000V from the mains supply. Studio 4 will have no less than 220 5kW and 10 10kW lamps. All lamps will be supported by Mole Richardson monopoles and controlled from Studio 4's own large lighting console. Mechanical adjustments, focus, pan and tilt can be by pole operation from the floor.

ELECTRONICS

Electronic equipment includes 16 Marconi Mark VII colour cameras for studio and/or o.b. use, mounted on Vinten pedestals or cranes, three Marconi Plumbicon and three C.F.T.H. flying-spot colour telecine machines, two RCA TR70 and five TR50 videotape recorders, elaborate 16-channel sound recorders and outside broadcast trucks with microwave link apparatus. It's all there and operating well. Sophisticated electronic editing is readily available for the videotape equipment, which includes one mobile RCA TR70 machine. There are two line-standards converters from 625 to 405 lines, necessary because all Yorkshire TV's equipment starts on 625 lines for u.h.f. transmitters and is also simultaneously transmitted on the old and original 405-line transmitters. There is an extra converter—a special one for dealing with incoming signals on 405 lines, converting the picture to 625 lines, for cutting-in outside or "foreign" 405-line material.

Apart from contributing original ideas in design and layout the engineers and architects have clearly looked around at other television and film studios for the latest ideas and trends. Even some of Pinewood's dual-purpose stage ideas have been incorporated. They all did their jobs properly at the Yorkshire Television Centre in building one of the finest TV complexes in Europe. If their programmes are as good as their premises, equipment and facilities, they'll be all reet! My first glimpse of Yorkshire TV's programmes networked in the London region was *Tom Gratton's War*, an exciting and well-made adventure series, local in colour but national, even international in appeal.

INSTALLING and SERVICING COLOUR RECEIVERS

PART 4

P. G. ALFRED

THE complete service engineer has to be master of many skills and although the advent of colour TV has not changed his job in any fundamental sort of way it has certainly introduced a number of new circuit and setting-up techniques. In earlier articles we have discussed the problems of checking, adjusting and installing colour receivers in order to get the best possible picture and a long period of reliable service. It is now time to consider the special requirements relating to workshop organisation and equipment, and the problems involved with fault-finding in and repairing colour receivers.

The process of repairing a faulty colour receiver is not really very different from repairing a monochrome one. All the old basic skills can be used and what it really boils down to is that the receiver is more complicated and contains some new circuit techniques. It is basically a monochrome receiver on to which have been grafted a convergence network, a decoder and grey-scale tracking controls. There are also some extra requirements in the line and field timebases and a few other odds and ends. Although there is quite a lot to learn it is well within the capabilities of an engineer who is competent at servicing monochrome receivers.

Workshop Organisation

The starting point for all servicing operations of this kind is a well organised workshop. It is not a matter of providing lavish test equipment but rather of establishing a workshop environment and psychological climate that enables each engineer to realise his full potentialities and to work contentedly and efficiently as part of a team.

Good test equipment will gather dust on the shelf unless the engineers are encouraged and helped to learn how to use it to the best advantage. Scratched cabinets will pass unnoticed in a gloomy, unkept workshop, and picture adjustments will be done casually if no one seems to care about it. A gloomy picture, perhaps, but illustrative of the importance of good workshop management and the part it can play in achieving and maintaining high standards of efficiency.

Equipment for Colour Servicing

The following is a list of equipment that is necessary for servicing colour receivers (it is assumed that the workshop is already adequately equipped for monochrome working): degaussing coil; crosshatch generator (405- and 625-line operation); oscilloscope; high-resistance multi-range meter; signal generators covering 3-6Mc/s and 30-40Mc/s; and large mirrors — at least 15×12in. of clear glass. It is also highly desirable to have a proper colour-bar generator (not a rainbow generator although even this is very useful) and a standard source of illuminant C.

The degaussing coil is easily made from 800 turns of 25 s.w.g. enamelled copper wire wound on a bobbin of 8in. diameter. It will overheat if it is left switched on for long periods and so it is best fitted with a spring-loaded push switch mounted on the bobbin. The mains lead should be of generous length and adaptor plugs will be needed if the coil is likely to be used in customers homes or indeed anywhere outside the workshop. The coil should be used as a matter of routine every time a receiver is installed in a new location.

Crosshatch generators can be bought for under £100 and are indispensible. It simply is not practicable to converge a receiver properly on ordinary pictures or test patterns and in any case it can be done much more quickly and easily on a crosshatch pattern. Some generators have an alternative switch position which gives a blank raster and this is very useful for carrying out purity and grey-scale adjustments.

Many workshops find that they can manage without a proper oscilloscope for monochrome servicing, although it is undoubtedly very useful. For colour servicing a scope is an essential piece of equipment if some of the more obscure faults are to be diagnosed quickly and efficiently. This is particularly true when fault-finding in a decoder, and we shall be enlarging on this point when outlining logical systems of fault-tracing in a later part.

When choosing a scope for colour work there is no need to invest in a very heavy double-beam affair with a delaying timebase and an aircraft cockpit full of controls going cheap at £700 (trolley extra!). What you need is a readily portable piece of equipment with a single beam, a large bright display, a wide bandwidth (up to 5Mc/s or so), a good internal and external trigger, good sensitivity, calibrated voltage ranges, and the kind of design and construction that makes it easy to service yourself. This class of scope need not be unduly expensive as such things go but it pays to take your time over choosing the right one to suit your own particular needs. Remember that you will be using it for a very wide range of applications from 100mV of burst or colour subcarrier at 4·43Mc/s to several hundred volts peak-to-peak field, line, or video waveforms.

Multirange meters are too well known to need much comment. If you buy a cheap one you will always regret it afterwards so get one with a 20,000Ω/volt movement and a 50μA current range. Look after it carefully and it will last you for 10 years.

Signal generators are a standard item in any properly equipped workshop but bear in mind that the chrominance amplifiers have an overall bandwidth from about 3-6Mc/s so check to see if your generator covers this range.

Mirrors are a fairly mundane item but make sure that they are large enough and that the glass is completely clear. Tinted glass will distort the colour picture and also the grey-scale highlights, so explain the problem to your glazier and make sure he does his best for you.

We listed a colour-bar generator and a source of illuminant C as optional extras. This was out of deference to the depth of your pocket but really and truly they are so useful and time-saving that they should be standard equipment in every workshop. A source of proper colour bars makes you independent of off-air test transmissions and enables all sorts of adjustments and fault-finding checks to be carried out regardless of time or place.

A source of illuminant C can be made up quite cheaply from a 9W colour-matching fluorescent tube to BS1853 mounted in a garage-type unbreakable inspection lamp holder. The cost is only about £3 and it is money well spent. Alternatively a ready-made instrument can be bought for about £5.

Ingenious readers can doubtless add all sorts of extra items to this list which would gladden the heart of a wary service engineer, but it should be adequate for all normal purposes.

Need for Space

Good test equipment is a very great help in television fault-finding but it is impossible to get a smooth flow of work through the workshop unless the rest of the facilities match up to the same standard. Space is nearly always severely limited and this makes it even more important to make the best possible use of the space you have got. It is a good plan to gaze at your workshop from time to time with a critical eye, abandoning all preconceived ideas, refusing to be intimidated by that cupboard which has stood in the corner for 20 years and cannot possibly be moved, and to ask yourself how it *ought* to be laid out. Is there as much clear floor space as possible and are all spare gear and all receivers that are not being worked on today put away in racks or organised storage spaces? Are there separate receiving and despatch holding areas? The general principle must be to obtain the smoothest possible flow of work into the workshop and out again without causing any clutter in the process. Each engineer must have a generous amount of floor space and a bench of adequate size so that he is never hindered in his work. Every time he has to shuffle things around he is wasting time, breaking his concentration, distracting somebody else, and causing a general loss of efficiency.

Self-discipline plays an important part in using space to good advantage. If test gear is left lying about on a bench part of that bench is completely out of action and the working area becomes cramped. The same argument applies to all the other loose gear that inevitably tends to collect all over the place. A tidy workshop is nearly always efficient and a major effort is needed all the time to keep things under control. It pays handsome dividends, even if it strains your self-imposed discipline to the utmost!

Colour Servicing Requirements

An important facility for colour TV servicing is a dark area for carrying out colour adjustments. This area must be really dark and can usually be made quite easily with black curtains or studding and hardboard. For reasons of safety it must be inside the main workshop so that if anything happens it will not pass unnoticed and help is available immediately. On a hot day the half kilowatt of a colour receiver is unwelcome in a confined space and an extractor fan may be more of a necessity than a luxury.

Lighting needs special attention when long periods are spent delving about inside the rather large cabinet of a typical colour receiver. The ideal is a bench or wall-mounted lamp on a folding counter-balanced arm about four feet long. If the lamp swivels on the end of the arm light can be beamed in all directions and this is often a great help, particularly when working on printed boards where a high level of illumination is essential.

Good off-air signals are even more important for colour than for monochrome working. It pays to take a lot of trouble to have a good signal available for each bench, but this is not always too easy to achieve at u.h.f. Since u.h.f. distribution amplifiers are readily available it may be tempting to plan a sophisticated cable network all round the workshop. Sometimes this works surprisingly well, but it is rather easy to introduce too many ill-matched socket outlets and to finish up with a messy signal spoilt by reflections. It is better to plan the shortest possible run of cable; to use high-quality, low-loss coaxial cable, avoiding all sharp bends, and to have only one or two outlets on each spur.

If the incoming signal is poor install the best aerial that money can buy and test exhaustively all possible combinations of height, angle, and lateral position. Note that moving an aerial a foot or two laterally is often more effective than raising it another ten feet on the chimney stack. If the signal is weak an amplifier will be needed to boost it to a level adequate for distribution. If the amplifier is in the workshop at the end of a hundred feet of cable the signal will be attenuated by at least 6dB. Furthermore any stray signal picked up on the outer of the coaxial down-feed will be amplified as much as the wanted signal. Consequently the signal-to-noise ratio may be poor and ghosts are also likely to be present. The resulting signal may be at quite a high level but thoroughly messy. It is often better to install a simple masthead amplifier of quite low gain and then to reinforce this in the workshop if necessary.

Colour receivers are heavy and bulky objects to move about. It takes two men to do it and causes considerable disruption to workshop activities. Why not put all colour receivers on small trolleys that even a child can push along? It is surprising how much time and effort this saves.

Safety

The safety of a service engineer lies largely in the safekeeping of his own working technique, but there are a few points that must be taken care of in the workshop also. If the floor is of concrete or similiar material or is ever damp the working area around each bench should be covered by a rubber mat.

Bench mains supplies should be isolated, and should be tested and inspected at regular intervals, together with all mains-operated equipment. Faults are fairly uncommon but when they do occur they are completely unexpected and correspondingly more dangerous. They are made worse by the presence of any earthed metalwork, and this should be covered up wherever possible to reduce the chances of a full-blooded mains-to-earth shock.

A final point concerns the telephone. No service engineer working on colour receivers should be allowed to answer routine phone calls. It should always be done by somebody else. An engineer can so easily leave a receiver switched on—perhaps with the heaters out of action—and when he comes back he forgets that the receiver is live and takes hold of the mains dropper to change it. Enough said.

We have discussed safety problems in some detail because with sensible precautions the near-certainty of a nasty accident occurring sooner or later can be made the near-certainty that accidents of this kind will be avoided. Worthwhile—isn't it?

Collating Information

Record cards form the case history of each colour receiver. More than this, they provide a wealth of accumulated experience which is of great value for fault-finding purposes and also for deciding spares stocking policy. Information is of little use unless it is easy to extract when wanted, so the cards must be carefully filed and all faults must be clearly listed under the headings of effect, cause and replacements. It is then a simple matter to establish which items should be stocked as spares, and those which can be ignored because they seldom give any trouble. This takes the guesswork out of a problem that can often result in a large amount of capital being tied up in useless stock.

When the service organisation consists of a number of branches the information from all the record cards can be usefully collated at the head office. The combined information, carefully screened and condensed, can then either be disseminated to all branches or else can form a central pool of knowledge upon which all engineers can draw when they come across a tricky fault. Instead of spending hours struggling with the problem they can pick up the phone with the reasonable expectation that the answer is at the other end. This is just one example of the sort of teamwork that can do so much to improve the efficiency of a service organisation.

Training

Many readers of PRACTICAL TELEVISION would be surprised if they knew just how much effort the best TV rental companies spend upon training. Many of them employ full-time staff organising training programmes for their engineers and drawing up information manuals and instructions to send out to the branches. Engineers are sent on courses at Polytechnics and Evening Classes and are encouraged to attend colour TV Symposia and set manufacturer's training schools. The result is that a high standard of knowledge and efficiency gradually spreads throughout the organisation and the customer reaps the benefit.

It is to be hoped that the management of every service workshop will see the advantages to be gained from a sensible programme of training and encouragement of its staff and will follow the excellent example set by the leaders in the field.

TO BE CONTINUED

SOUND-IN-VISION

—continued from page 155

ending with the two most significant digits. By using these techniques a signal is obtained that causes as little interference as possible to the following part of the waveform.

EQUIPMENT

Figure 3 shows the equipment in simplified block schematic form. A compressor-expander system is used to ensure that the mean signal level applied to the analogue-to-digital converter is as high as possible. The compressor is actuated by the high-frequency components of the signal which have been boosted in a pre-emphasis circuit. This technique improves the signal-to-noise ratio of the p.c.m. system by 13dB and makes the 10-digit system better in this respect than a 12-digit one without a compressor-expander system.

Our earlier account may have suggested that the signal sampling and analogue-to-digital conversion processes are carried out separately. However, the analogue-to-digital converter samples the audio signal fed to it at twice line frequency and delivers an output in p.c.m. form to the combiner unit. This unit combines the vision signal and the sound pulse signal which is then fed into the sound-in-vision link. At the receiving end the processes are reversed.

Since many picture monitors will not lock when a sound-in-vision signal is present a simple p.c.m. remover unit has been developed to enable such monitoring equipment to continue in use.

The developments described give excellent results, as we were able to hear, and form a major advance in TV engineering. We congratulate the BBC Engineering Research Department on its achievement.

R.F. AMPLIFIERS

M. G. HULL

IN nearly all current TV models utilising valved v.h.f. tuners the r.f. amplifier is a triode of the PC97 or PC900 type which have now almost completely superseded the once universal dual-triode cascode. Why this transition to a single triode? The answer is intimately bound up with valve design and receiver requirements.

In the first post-war receivers pentodes were universally used as r.f. amplifiers because of their high stage gain, but the later commencement of Band III transmissions made it advisable to change to a type that introduced less valve noise. All multielectrode valves produce more noise than triodes owing to partition effect, that is the random but slight variation of cathode emission into separate anode and screen currents which becomes increasingly pronounced at higher frequencies. Triodes were preferable on this ground but apart from their lower gain compared to pentodes the interelectrode capacitances of the types then available made their use impracticable. It is interesting to look into the exact reasons for this.

The main triode capacitance is that existing between the grid and anode C_{ga} and the grid and cathode C_{gk}. An average value for the former is about 1·5pF and for the latter 5pF. Due to Miller effect however C_{ga} in effect increases according to the stage gain of the valve. This can best be appreciated by remembering that when an input signal is driving the grid negative an amplified version of the signal is driving the anode potential more positive. Thus when a negative-going signal is charging the grid-anode capacitance the amplified signal at the anode is charging this capacitance in the opposite direction. Thus as valve action reverses phase the net charging current equals that taken by a capacitor of value C_{ga} plus C_{ga} × stage gain, or more concisely $C=C_{ga}(A+1)$, where A is the stage gain. The total effective input capacitance then equals this value plus that of the grid-cathode capacitance, or $C_t=C_{gk}+C_{ga}(A+1)$.

As an example let us apply the typical figures previously quoted to find the apparent capacitive value for a stage gain of 10. $C_{ga}=1.5$pF, $C_{gk}=5$pF, $C_t=5+1.5(10+1)\text{pF}=5+(1.5\times 11)\text{pF}=5+16.5=21.5$pF.

What are the effects of this very considerable rise in effective valve capacitance? First and foremost amplified signals developed in the anode circuit can filter back through the anode-grid capacitance to cause self oscillation. The only way to offset this possibility is by neutralisation, that is by feeding back an opposite-phase but equal-amplitude signal to that filtered through the valve so that the two "feeds" cancel out. This is particularly difficult in a v.h.f. tuner which must cover 41-68Mc/s on Band I and 174-216Mc/s on Band III so that neutralisation will not be at the optimum over the entire frequency range.

A further snag is that the comparatively large valve input capacitance is effectively shunted across the grid tuned circuit. As there will be considerable stray capacitance already existing in the incidental wiring, and as the frequencies covered are so high, the small inductance required to tune to the various channels will produce a small LC ratio resulting in small tuned circuit amplification.

Finally as the effective input capacitance is dependent on stage gain variation of a.g.c. will produce attendant variations in this capacitance which can result in mistuning and change in the degree of neutralisation.

The first consideration is the most important however, and to offset this factor the cascode double-triode circuit was introduced and remained in universal use for many years till the advent of the beam triode types PC97 and PC900.

The cascode amplifier consists of two series-connected triodes, i.e. the anode of the first is connected to the cathode of the second across the h.t. supply so that the available voltage is shared between them. The first valve working into the low effective load presented by the second valve gives only unity stage gain but serves to couple the signal to the second valve which operates as a grounded-grid stage. A.g.c. bias is applied to the first triode and the coil linking the two valves is designed to resonate at about 225Mc/s with the stray circuit capacitances to maintain gain at the higher Band III channels. Overall, the cascode gives a level of amplification comparable to that of a pentode at v.h.f. but with the noise factor of a triode.

Originally valves of the PCC84/30L1 type were used but mainly to improve gain on Band III the frame-grid PCC89 was later introduced. This in conjunction with a PCF86 frame-grid mixer provides total voltage gains 12dB better than those

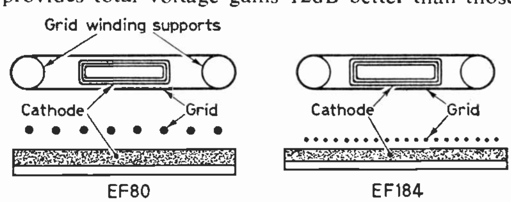


Fig. 1: How frame-grid construction (EF184) reduces grid-cathode spacing.

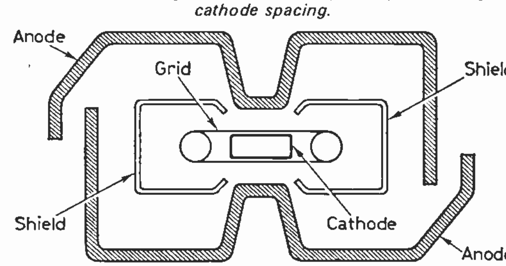


Fig. 2: Construction of a beam triode using shaped anodes and earthed shields to reduce anode-grid capacitance to a minimum.

Fig. 3: Typical beam-triode v.h.f. r.f. amplifier stage, showing simplified circuitry compared to cascode stage.

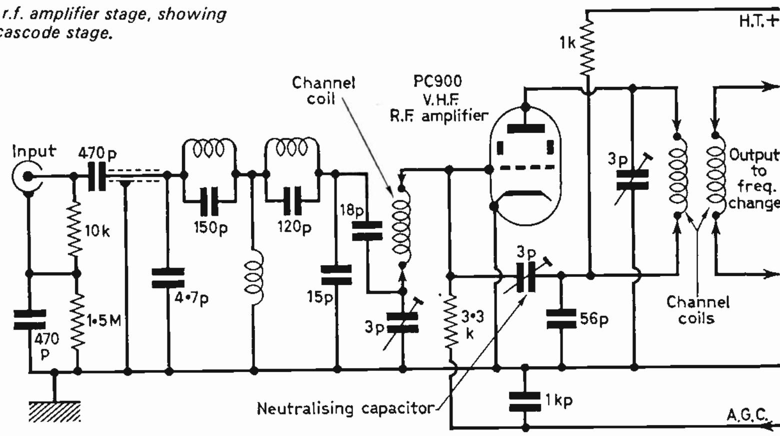
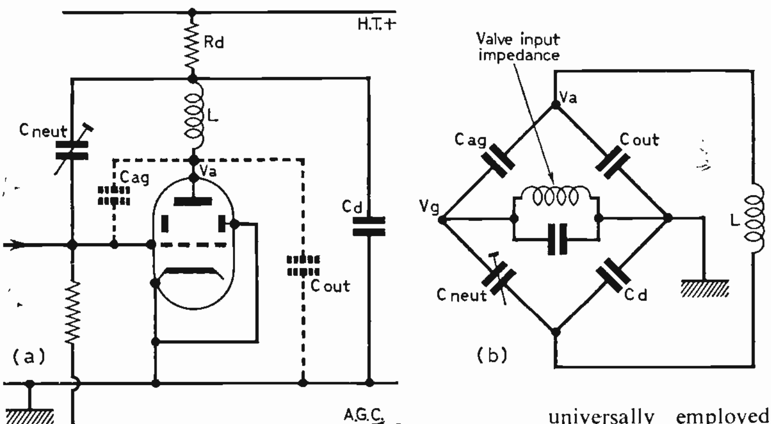


Fig. 4 (below): Basic beam-triode circuit (a) with equivalent neutralising bridge arrangement shown at (b). Optimum stability is obtained when the bridge is balanced: This is achieved by adjusting the neutralising capacitor, resembling adjustment to the null point in a Wheatstone bridge.



obtained from the PCC84-PCF80 combination. A v.h.f. tuner employing these frame-grid types has a gain of about 60dB on all channels. This gain is achieved because valve slope is dependent on electrode spacing, particularly grid-cathode spacing, and by employing the extremely rigid form of construction employed in frame grid design this spacing is greatly reduced. For example one of the earliest frame-grid valves was the EF184, a straight r.f. pentode which with a grid-cathode spacing of 50 microns had a slope of 15 mA/V compared to its conventional EF80 predecessor which had a grid-cathode spacing of 110 microns and a slope of 7·4mA/V (see Fig. 1).

Such very close grid-cathode spacing naturally requires a thinner grid winding, rigid electrode supports, an additional mica clamp, precision-size cathodes and extremely fine tolerances throughout manufacture. The grid wire of the EF184 has a diameter of only 10 microns, less than a seventh of the diameter of a human hair, and with a tolerance of ± 0·2 microns. The closeness of this tolerance becomes more evident when it is realised that the wavelength of sodium light is 0·5 microns. These and other frame-grid types—the PCC189, PCF806 and 30L17 etc.—were used in the now familiar cascode circuit for a number of years till the advent of the specially designed single triode.

As only one of the two valves in the cascode circuit provides any significant amplification, if a single triode could be utilised—mainly by reducing its internal capacitance—there would be a considerable economic and design advantage. The first frame-grid triode for use in UK television receivers was the PC97, developed by Mullard from the 6ER5 designed for the American market where the cascode system was not universally employed. Although its gain was slightly less than that of the cascoded PCC89 it had an equivalent noise factor with an anode-grid capacitance of only 0·5pF.

This was achieved by special internal construction (see Fig. 2) such that only the active section of the anode, that in line with the main electron stream, was brought close to the grid, while the capacitance between the grid support rods and the anode which accounted for the major proportion of the total C_{ga} was shielded by shaped plates brought out to a base pin for earthing.

The low anode-grid capacitance of this and other beam triodes made neutralising much easier. It can be achieved in two ways, but that employed in the example (Alba) shown in Fig. 3 is probably the most widely used. The equivalent capacitive bridge set-up is shown in Fig. 4.

While manufacturers' instructions on neutralising capacitor adjustment must always be followed the procedure for the Alba example shown makes a sound basis when data is not immediately available. (1) Apply −9V bias to the tuner a.g.c. rail to cut off triode anode current. (2) Switch to channel 12. (3) Connect a sweep generator centred on this channel (208Mc/s) to the v.h.f. aerial socket. (4) Adjust the neutralising capacitor for minimum response at the grid of the a.f. triode (ideally checked by a scope probe isolated by a series 100kΩ resistor). ■

CONVERTING 405 SE F

PART 1 BY K.C

THE current availability of u.h.f. tuners and i.f. panels for conversion of particular receivers to BBC-2 reception poses the question of whether other types of receiver, apart from those for which the components were originally designed, can be modified in this way. In the writer's experience remarkably good conversions of old sets are possible provided the task is tackled methodically and the problems fully appreciated from the start. It is the purpose of this article to lay down a procedure for conversion, but first of all the problems of such a job must be investigated.

In the first place one has to pick a suitable set. This presents a problem in itself for the line timebase has to be speeded up by a factor of 50%. If the timebase is incapable of operating satisfactorily under this condition there is little point in pursuing the matter further with the particular set. The main point here is that modifications to the line circuit can often render a doubtful proposition quite realistic, and we must establish how this decision is to be reached.

Speeding up the Line Timebase

The first step involves speeding up the timebase as far as possible, using the line hold control and observing the results. If the brightness increases or remains constant, hope exists. Even a slight diminution of brilliance need not cause too much concern. Usually the line hold control will not take the line speed up high enough on its own, and the next step is to find the line oscillator in order to modify it temporarily to obtain the frequency required. If the line oscillator takes the form of a multivibrator the timing capacitor associated with the line hold control circuit should be reduced in value. Usually the slider of the line hold control connects to a resistor which in turn is taken to a grid of the oscillator valve. To this same grid will be coupled the feedback capacitor which should be reduced in value. Values of 47-220pF are commonly found and a 50% reduction in value is usually correct.

It must be appreciated that extra power is required by the timebase when scanning at 15kc/s and part of the modification may involve the generation of this power. When the timebase is running at 15kc/s in some unfortunate cases there may be hardly any e.h.t. If this is the case it is best to abandon any further hopes of conversion since it is obvious that the line transformer and scan coils have far too high an inductance to allow sufficient energy to be absorbed in the shorter scan time available.

In most cases however the brightness will be adequate even if the scan amplitude is reduced and in some fortunate cases there may be no reduction of scan amplitude. Obviously the wider the scanning angle of the tube the more acute the conversion problem is likely to become if the set is not specifically designed for 625-line conversion. The older sets in question, which are not "slim" and thus have enough room inside the case to accommodate the extra u.h.f. components, are unlikely to have a scanning angle greater than 90° and will probably be 70° sets.

Line Output Stage Operation

Figure 1 shows a typical line timebase of the type to be found in the sets we are considering. There are quite a large number of variants of this basic circuit, but the differences do not alter the basic operation of the circuit. It is easier to start by considering the conditions existing when the scan has reached the right-hand side of the picture. At this time the current in the scan coils, which are predominantly inductive at line frequency, is at a maximum and has been increasing with time at a rate determined by the applied voltage and the total inductance in the

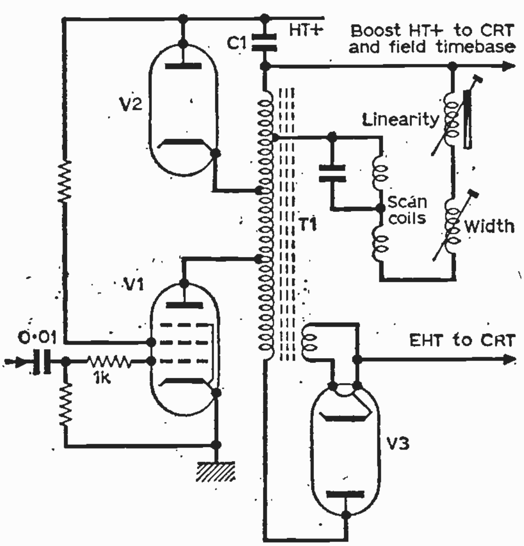


Fig. 1: Typical line output stage. V1 line output pentode, V2 efficiency or boost diode, V3 e.h.t. rectifier. T1 is the output transformer and C1 the boost reservoir capacitor.

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circuit. At the end of the scan V1 is switched off by the line oscillator output waveform and its anode current ceases. The current, prior to this point, has been flowing through V1, the line output transformer T1 and V2 and the impedance of the scanning coils has been reflected into the output stage by the line output transformer. When the current ceases energy is left in the magnetic field of the scanning coils. The cessation of current from the line output valve causes the field to collapse and as a result an oscillation commences at a frequency dependent upon the inductances and capacitances present in the circuit. As the collapse of the field is very rapid a large positive pulse appears at the anode of the line output valve and by the use of an overwind on the line output transformer this pulse is stepped up to around 14-16kV. The overwind voltage is applied to the anode of V3 the e.h.t. rectifier which provides the e.h.t. for the cathode-ray tube.

The positive pulse is followed by a negative swing, the next half-cycle of the oscillation referred to above. This drives the cathode of V2 negative with respect to its anode so that it conducts. The current from the scanning coils then passes through V2 and charges the boost reservoir capacitor C1 thus absorbing the remaining energy. The polarity of the charge is such that the total voltage applied to the line output valve anode is the h.t. supply plus the voltage appearing across C1. Thus the recovered energy is used to provide an increased average h.t. supply for the line output valve, so improving the efficiency of the stage. It will be seen that the overswing and damping action of the line timebase must occur during the line sync period. If the process takes too long it will not be complete before the commencement of the next line of video information. Visually the effect takes the form of the picture being folded over on to itself at the left-hand side of the screen. The scan velocity is much greater than normal during the overswing and if this effect is seen the video displayed during the overswing will be stretched out disproportionately.

Conversion Problems

The reader will now see the reason for giving this account of line timebase action. There is a chance that while the retrace action is satisfactory on 405 lines, for which the timebase will have originally been designed, it will be too long for 625-line operation. If this is so the effect described above will be seen. Unfortunately this is only likely to appear when a picture has been obtained, which implies that all the other hard work will have been done. We would then be left with an unacceptable picture at the very last stage of modification. It is not always possible to speed up the retrace but it is possible to apply a blanking pulse to the c.r.t. so that the video on retrace is not seen. If the c.r.t. is then slightly overscanned the loss of picture at the left-hand side will not be noticed at all. This blanking modification will be dealt with in part 2. If the effect occurs it generally involves a loss of line scan equivalent to the width of the castellations at the extreme left-hand side of the test card, which is negligible.

It may be found impossible to adjust the width control for adequate width on 625 lines. If the circuit is of the type shown in Fig. 1 simply shorting out the width control will probably provide an adequate scan, slightly larger than the tube face. This short-circuit is switched in during 625-line operation only.

Extra Power

An increase of h.t. is often useful in producing extra power on 625 lines. Since the inductance of the scanning components cannot be reduced the only way to obtain more power is by "pushing harder" from a higher h.t. rail. The reader will probably be aware that most older sets use a valve h.t. rectifier. Changing this to a silicon diode of the BY100 variety can produce another 20V of h.t. quite easily which is very useful in providing more line power. The heaters of the tuner and i.f. valves used on 625 may then be substituted for the rectifier heater and with due luck will probably add up to around the same voltage. The substitution should not occur at the same point in the heater chain however because of the heater-to-cathode voltages present. The rectifier heater feed should be shorted out and the chain opened further down in the i.f. stages to allow the u.h.f. section heaters to be coupled in here.

It has already been pointed out that the generation of a 625-line scan involves a 50% increase in power requirements. It is the general practice to use the boosted h.t. rail from the line timebase to feed both the c.r.t. first anode and the field scan charging circuit. If the power in the line circuits is increased an increase in the boosted h.t. voltage will occur. Thus on 625 lines

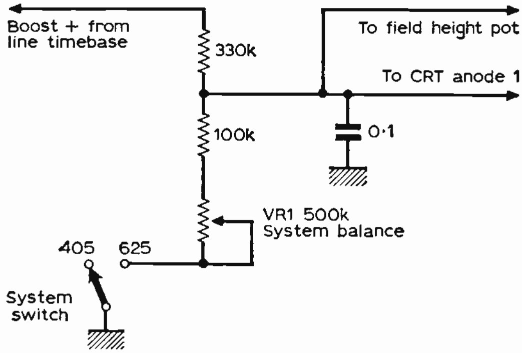


Fig. 2: Method of balancing the boost voltage on the two systems.

a 50% increase in boosted h.t. can be present. It is necessary to include a network to reduce this voltage to the same level as on 405-line operation otherwise the c.r.t. first anode voltage will increase and upset the focus and brilliance and the field will be badly overscanned. The circuit is shown in Fig. 2. The system balance potentiometer VR1 is adjusted to produce the same picture height on 625 as on 405. This automatically takes care of the c.r.t. voltage.

While this part of the circuit is being investigated it is advisable to check the voltage rating of the boost reservoir capacitor and replace it by a higher rated one if necessary.

Line Oscillator Speed Change

The line oscillator speed now has to be switched. One simple way of achieving this involves the use of two hold control potentiometers (see Fig. 4) connected in series across a supply of 100-125V. The sliders are selected by the system switch and connected to the grid resistor of the line oscillator. The timing capacitor is then selected so that the controls cover the ranges required. The potentiometer at the high voltage end of the chain is of course the 625-line hold.

Some early Philips and Stella receivers used an oscillator transformer connected between the screen and control grids of the line output valve, a PL81. The line hold control took the form of a variable inductance connected across a control winding on the transformer. The variable inductance consisted of two series wave wound coils with an adjustable core. The circuit will oscillate at 15kc/s if one of the coils is switched out. By connecting a small auxiliary coil in series with the remaining coil on 405 lines a single setting of the control can be found which is compatible with both systems.

Synchronisation

Ideally because of the effect of noise peaks on the sync pulses of the negatively modulated video signal used on 625-line transmission a flywheel line timebase should be used. Fortunately since in the UK negatively modulated transmissions are confined to u.h.f. this noise problem is unlikely to cause trouble except at the limits of the service area or in particularly bad reception areas. In most cases direct synchronisation of the line oscillator will produce adequate results.

If modifications are carried out to a set employing a flywheel timebase a tendency may be found for the timebase to "hunt" on 625-line operation. This condition is characterised by an oscillation, usually of the top part of the picture, about its correct position. If this occurs, locate the a.f.c. line from the line discriminator to the oscillator. Generally this has two capacitors and a resistor connected between the line and chassis as shown in Fig. 3. Adjustment of the value of R1 will usually clear the condition without adversely affecting the operation on 405 lines.

Line Output Stage Modifications

In some cases it may be found that when running on 625 lines the e.h.t. rectifier heater is overrun. This can easily be observed if the heater brightens considerably when the 625-line speed is used. The simplest way out of this problem involves fitting a series heater resistor so that the rectifier is slightly underrun on 405 and slightly overrun on 625. Because of the e.h.t. voltage on the heater circuit it is not practical to attempt to switch the resistor. A value of 22Ω is usually satisfactory.

As a means of controlling scan power between systems it may be useful in some cases to switch the screen resistor of the line output valve. If the output valve shows signs of suffering during 625-line operation, for example an overheated anode, it may be advantageous to change the valve to a larger type. For example a PL81 can be replaced by a PL36. This latter valve is octal based however and can be difficult to fit in some chassis. In the majority of instances this rather drastic action will not be required.

The e.h.t. voltage may vary between systems but the writer has not found this to be very troublesome. A severe change in voltage can upset the focus and ion trap adjustments. A solution can be found for difficult cases by fitting a voltage-dependent resistor across the e.h.t. line to stabilise it. Some early Ekco receivers

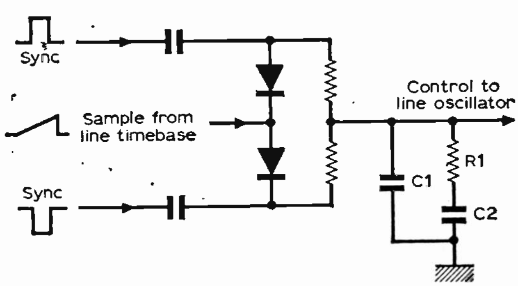


Fig. 3: A simple type of flywheel line sync discriminator; C1, R1, C2 are the flywheel components.

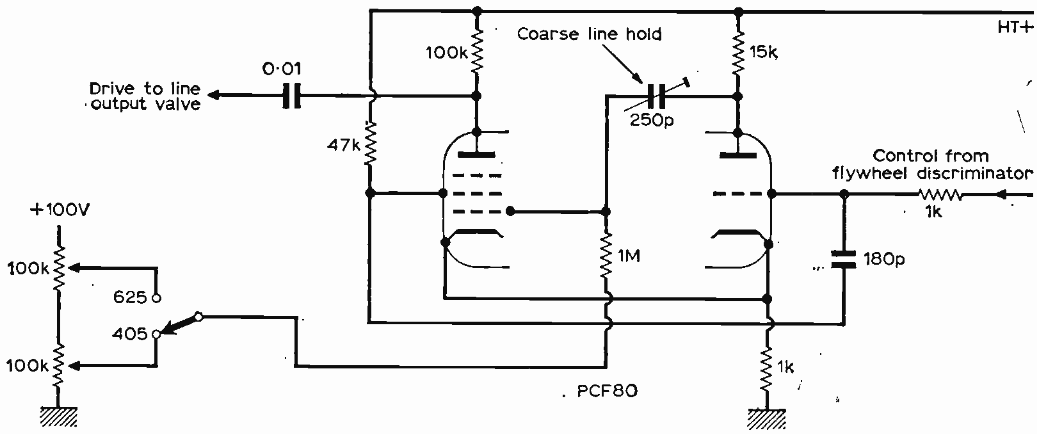


Fig. 4: Representative line generator circuit. This multivibrator employs both cathode and anode-to-grid cross-coupling. To reduce the load on the oscillator, feedback to the triode is from the screen grid instead of the anode of the pentode section of the valve.

used this system of e.h.t. stabilisation and probably the simplest way of obtaining a suitable v.d.r. is to track down such a receiver. In most cases however the only effect observable from a change in e.h.t. will be a slight difference in the required setting of the brilliance control. This effect can be eliminated by a technique to be described later.

Greater consistency between the results obtained on the two standards can sometimes be achieved if necessary by paying attention to the scan correction capacitor (if fitted) and the third-harmonic tuning of the line transformer.

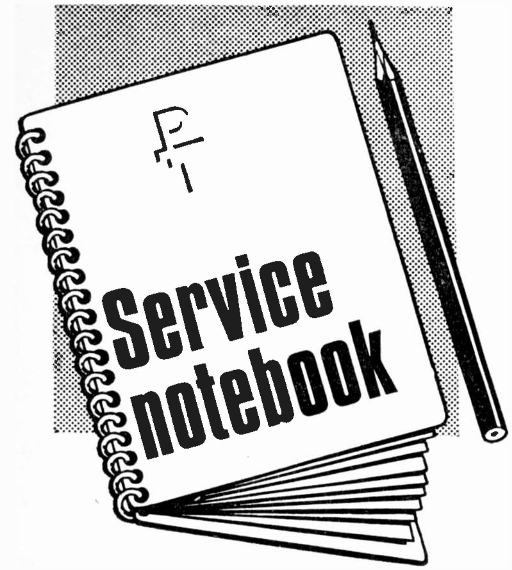
It will sometimes be found that a capacitor is connected in series with the scan coils, more particularly with wider-angle tubes. This is the so-called S-correction capacitor which has the effect of slowing down the rate of scan at the sides of the picture and speeding it up at the centre where the effective "beam leverage" is less owing to the reduced distance between the gun and screen of the tube. In the absence of such correction the picture can appear cramped near the centre. Even if no correction is used on 405 switching in a capacitor during 625-line operation can sometimes improve the scanning ability of the timebase. Where an S-correction capacitor is already fitted a good experimental choice for the 625-line component is about half the value used on 405. If no capacitor is found one of between 0·047 and 0·1μF can be tried in series with the scan coils on 625. This technique often works well where cramping is in evidence. Some experimenting is inevitably needed if this approach is used.

Third-harmonic tuning of the line transformer involves varying the coupling between the main windings and e.h.t. overwind, so affecting the leakage inductance and overall resonance of the transformer. If the coupling between the windings is very tight, for example if the e.h.t. winding is wound directly on top of the main winding, it is extremely difficult to adjust the coupling. However generally speaking such transformers seem to be the most successful in conversions and need little attention. Often if the e.h.t. overwind is mounted on a different limb of the transformer the leakage inductance may cause a problem on 625 by introducing striations at the left-hand side of the picture. One way of tightening up the coupling involves two additional windings on the transformer. One is wound adjacent to the main winding and the other close to the overwind. The coupling can then be adjusted by linking the two windings together in phase opposition. Fine control of the coupling can be achieved by placing a selected value capacitor in series with the two windings. The coupling can be open-circuited if necessary during 405-line operation. The writer has found that coupling coils of about 40 turns each seem to be adequate. Great care should be taken to avoid arcing between the additional coils and the original transformer windings, particularly the e.h.t. section. 30 s.w.g. wire is suitable and is not too tedious to wind on, although patience is still needed! The winding should not be closer than $\frac{1}{8}$ in. to the overwind and should be wrapped over with p.v.c. tape.

A further point worth noting is whether the line output transformer has any capacitors connected across its sections. These are likely to be third harmonic tuning capacitors. It may be useful to experiment with the value of such capacitors which may need optimising between standards.

This first part has attempted to note all the likely factors and difficulties concerned with speeding up line timebases. There may be others not included but the writer feels confident that when approached along the lines indicated the problems will be solved in the most logical and straightforward manner. Part 2 will deal with the addition of u.h.f. facilities to the modified receiver.

TO BE CONTINUED



by G. R. WILDING

U.H.F. Sound Faults

U.H.F. sound faults can broadly be divided into three categories, (1) vision-on-sound (vision buzz), (2) distortion and (3) inability to peak maximum volume with optimum picture quality. Quite often the latter two faults are both present.

Vision-on-sound often develops due to the intercarrier sound system in which the vision i.f. acts as a local oscillator with the f.m. sound carrier to produce a 6Mc/s beat signal. To prevent a.m. variations of the vision signal being impressed on the f.m. sound the amplitude of the latter must not rise above the minimum value of the former, which on 625 lines is between 18-20% of peak value and corresponds to peak white. To this end the receiver i.f. circuitry includes a cosound i.f. rejector at 33.5Mc/s to attenuate the sound signal to the required level. Whereas other wave-traps or rejectors are usually designed for maximum efficiency, the cosound rejector on u.h.f. must be regarded as an attenuator rather than a stopper.

To accommodate the ±50kc/s deviations of the f.m. carrier, overall receiver response must include a distinct flat step or ledge so that the sound cannot be amplitude modulated by sweeping up and down the upper frequency response sloping flank.

While slight misalignment could be the cause of vision buzz, in practice this is quite rare and the first thing to check is that any u.h.f. preset sensitivity control is not over-advanced and thereby reducing the vital vision-sound signal strength ratio. Secondly a slight readjustment of the a.m. ratio detector balance control might be needed.

Most sets have some arrangement whereby any slight a.m. modulation of the sound signal and/or impulse interference is skimmed off in the sound i.f. stages. This is usually accomplished by operating a sound i.f. pentode with reduced screen grid voltage to provide limiting action similar to that employed in valve sync separators, but many models in the Pye-Ekco and Philips ranges employ a shunting diode across an i.f. transformer as a variable impedance load. It could therefore pay to replace the valve in the former instance and check the diode in the latter.

Especially in fringe or near-fringe areas, a good roof aerial is essential, for though set-top aerials may often give viewable results they could over favour the sound channel and thereby upset the receiver's vision-sound response and introduce slight vision buzz.

Sound distortion when v.h.f. sound is normal, especially with inability to simultaneously peak volume with optimum picture resolution, is often due to slight misalignment of a 6Mc/s tuned circuit or i.f. transformer. However before attempting to check that this is so obtain the service manual or a service sheet and positively identify which are the 6Mc/s tuned circuits. Note any slug adjustment made so that if unsuccessful it can be returned to the original setting.

Distortion with correct sound-vision peaking can be due to a faulty diode or diodes in the detector stage and these can conveniently be checked by comparing their relative forward and reverse resistance readings. Any real disparity is best cured by replacing both diodes.

Thermistor Usage

How easy it is to make incorrect assumptions with changing circuit trends was vividly brought home to us the other day. We had been called to see a dual-standard 23in. GEC Model 2006 with the complaint of simply no results. Inspection showed all valve heaters to be glowing, but there was zero h.t. tested from a conveniently placed. chassis-mounted smoothing choke directly fed from the BY100 h.t. rectifier. There is no separate h.t. fuse in this model so it appeared to be a simple case of an open-circuit surge limiter.

Now as most readers are aware it is general design practice to wind both the heater-chain dropper resistor and the surge limiter on the one porcelain former. The mains supply usually enters at a mid-point on the former from the on/off switch so that one end of the dual resistance winding will feed the top of the heater chain via a thermistor while the other end will feed the anode of the rectifier either directly or via an additional small value surge limiter. The latter is generally incorporated in the design to ensure that even when the h.t. voltage tapping is adjusted to the minimum value or if the main surge limiter is shorted out there will still be sufficient resistance in circuit to protect the rectifier.

In this particular model this dual-purpose resistor is mounted across the chassis and at the far end we could see a thermistor mounted and connected to the end tag. As the valves were glowing, we therefore ignored those tappings from the component centre leading to the thermistor and checked those leading to the near end. There was high a.c. voltage on all tags so as there was zero d.c. at the BY100 rectifier cathode we assumed that there was an additional surge limiter which was open-circuit or that, improbable but possible, the BY100 was open-circuit.

Either possibility meant withdrawing the chassis, but after doing so we found to our surprise that the tags we had been testing were the *heater* circuit tappings which directly fed the first valve in the chain, the PY800 boost rectifier, via an 85Ω resistor but without the thermistor. The thermistor was included in the a.c. supply to the BY100 anode, so in this model, and others in the series, there is a complete reversal of established practice. The circuit is shown in Fig. 1. Tests then showed that a section of

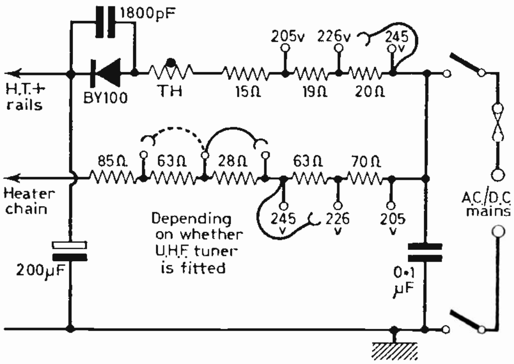


Fig. 1: Unconventional connection of the thermistor in the h.t rectifier surge limiter circuit instead of in the heater chain in the GEC 2000DS series.

the surge limiter on the former leading to the thermistor was open-circuit and when shunted with a wire-wound resistor of equal value normal operation was restored.

Thermistors have been eliminated from other makers' models but this was the first instance we had come across where it was transferred to the rectifier a.c. supply. Incidentally, in other GEC Sobell/McMichael/Masteradio receivers of very similar appearance to the one we were servicing the conventional method is adhered to.

However, there is one indication which always shows up which end of the dual resistor feeds the appropriate circuits in a working receiver. Do you know what it is? The voltage drop across the surge limiter will be very much less than the voltage drop across the dropper resistor which must absorb the difference between the total valve and c.r.t. heater voltages and the mains supply voltage. Even in circuits employing a BY100 to reduce current consumption and heat dissipation the voltage across the heater dropper resistor will be in excess of the surge limiter voltage drop.

Transformer Arcing

We came across a very old Ekco 17in. receiver the other day still giving yeoman service although on the 230V tapping. However as the owner explained the picture wavered and streaked, especially when the brightness level was increased. This unusual effect is generally due to a defective U25 but on removing the cabinet back we found that the thin lead from the e.h.t. overwind on the line transformer was broken, or rather had been burned away for a full quarter of an inch from the anode soldering point of the U25. Thus there was no direct electrical connection to the e.h.t. rectifier anode, continuity being maintained by a constant arc.

With great difficulty, for this wire is extremely fine and removing the outer insulation often breaks the wire, we eventually succeeded in soldering the short lead to a piece of 5A fuse wire, slipped some systoflex over the join and then soldered the fuse wire end to the U25 anode connection. Results were then quite good, and after changing the 20P4 line output pentode and PCC84 r.f. amplifier we were even able to restore the mains tapping to the correct voltage.

The surprising thing to us was the viewable picture with only a permanent arc maintaining a.c. supply to the U25 anode.

Fusible Resistors

Many receivers now use fusible resistors in series with the main or subsidiary h.t. rail to protect the rectifier and other components should a partial or full short-circuit develop. Such fuses are basically a wire-wound high-wattage resistor with a spring clip switch mounted over and kept closed with a light spot of solder. Should excessive current pass through the fusible resistor the resulting high temperature melts the solder so that the spring clip flies open and breaks the circuit.

If you find one of these components open the cause of the excessive current responsible must be located and cured before resoldering the clip.

Often this is quite a simple matter, a badly discoloured resistor indicating where the fault lies, but sometimes it is not so easy. We had two quite separate instances recently.

The first was in a current BRC 16 in. portable model which had sound but no picture. The cause of the latter was no e.h.t. or indeed line circuit voltages anywhere due to the opening of a subsidiary fusible resistor. Ohmmeter tests showed that there was neither an h.t. short-circuit nor even a heavy leak present, so in the circumstances all we could do was to lightly resolder the clip and switch on.

As the valves commenced to warm up it soon became apparent that the resistor was passing excessive current with the absence of line whistle indicating that the probable cause was lack of drive to the PL500 line output pentode. We changed both valves in the line generator circuit and also the PL500 without restoring line whistle. Our first voltage check was to the grid of the line output valve and we found a strong negative voltage which varied as the line hold control was operated. This suggested that the PL500 was receiving at least a fair measure of grid drive although it was impossible to draw off the slightest spark from the anode connector.

We then removed the top cap (cathode) connector of the U193 boost rectifier to see if this restored line whistle. A complete short-circuit in a boost reservoir capacitor can often completely prevent line output stage operation, and if on removing the efficiency diode cap h.t. still remains on the anode of the line output valve it can be taken as practically certain that this capacitor has broken down. On this occasion removing the U193 top cap also removed h.t. from the PL500 anode so that despite the negative poten-

—*continued on page 185*

INSIDE tv TODAY

PART 15 M. D. BENEDICT

THE BROADCASTERS—1

WHILE ENGINEERING provides the highly complex mechanism that enables a production to take place and its subsequent transmission, without the many aspects of *production* there would be no programme. And although each programme is the work of a producer and his production team, these teams exist within the basic form of the broadcasting organisations. In this country there are at present 15 broadcasting organisations ranging from the BBC employing about 13,000 people in television to Channel Television with a staff of 66 people.

The BBC is "a Body Corporate set up by Royal Charter and operating under a licence from the Postmaster General. Its object is to provide a public service of broadcasting for general reception at home and overseas." The Body Corporate is administered at the highest level by the Board of Governors. Under the Board and responsible to it is the Director-General, who from April 1st will be Charles Curran. As Chief Executive he will be head of the permanent staff of the Corporation.

BBC's Beginnings

As in many things the BBC practice stems from sound radio roots. In 1922 the British Broadcasting Company was formed by the major wireless set manufacturers at the instigation of the Postmaster-General, who licensed the Company to provide a broadcasting service. J. C. W. Reith, who later became Lord Reith, was appointed General Manager and his exceptionally high standards established the Company's policy of impartiality. As a result the Government decided that the Company and its policy should be continued and set up a public Corporation which took over the responsibilities of the Company. So on January 1st, 1927 the British Broadcasting Corporation was formed to continue the Broadcasting service of the company, but with fewer restrictions than previously. In fact, this was basically a name change as all existing staff were retained. A charter was laid down and was renewed every ten years, or with slight alterations to cover developments.

Television experiments using early Baird systems were conducted in 1932, although still pictures had been transmitted in 1928. Finally in 1936 the BBC was authorised to test the Baird mechanical system against the newer all electronic Marconi/EMI system. Alexandra Palace was selected as the site and on November 2nd, 1936 the first high-definition television service in the world was launched using the Marconi/EMI system. Today the BBC Television Service broadcasts about 4,000 hours per year on BBC-1 and 2,000 hours on BBC-2, most of the latter in colour.

Commencement of the ITA

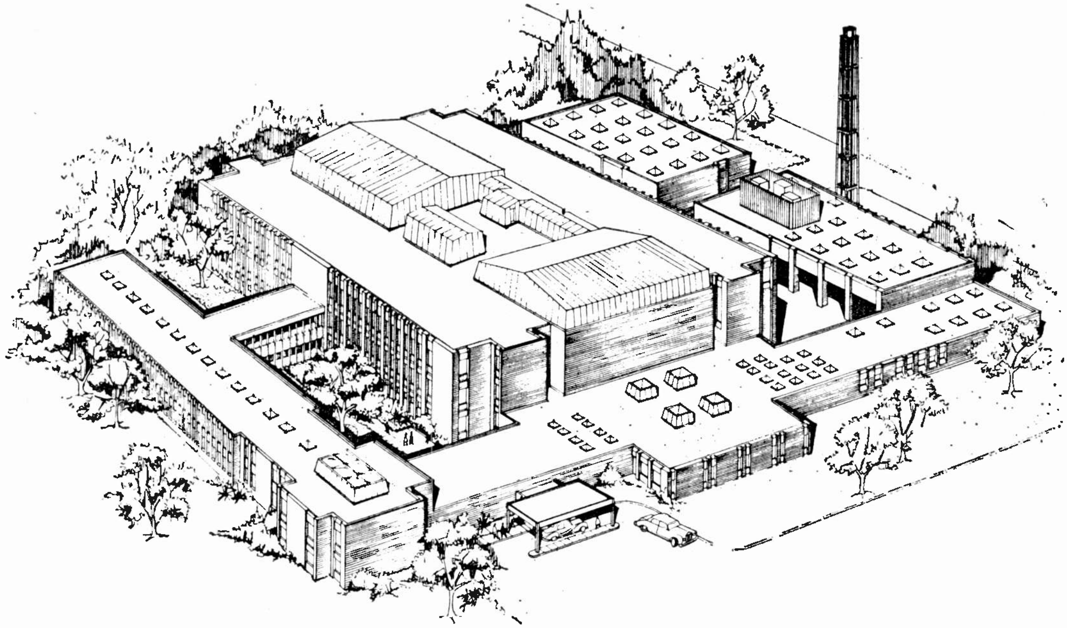
In 1952 pressure coming from a very small number of conservative M.P.s resulted in a White Paper suggesting that provision should be made to permit some element of competition in television. No mention was made of who should organise it or allowing advertisements to be transmitted. Opponents of the idea rallied under the banner of the National Television Council with the Popular Television Association representing the opposite point of view backed by many parts of industry and almost all the public relations and advertising agencies who realised the opportunities offered if advertisements were allowed.

Clever organisation by the Popular Television Association forstalled many criticisms of commercial television by promising that adverts should never be part of the programmes as in American television. US TV was, at that time, of very poor standard and opponents of commercial television held it up as an example of the disadvantages of commercial television. By conceding this point the Popular Television Association was able to dodge all criticism of this sort and turned to attack the dull and often pretentious programmes broadcast by "Auntie" BBC at the time. Finally Independent Television was set up in July 1954 with the establishment of the Independent Television Authority.

Programme Contractors

Under the Television Act the Authority provides the transmitters, selects the programme contractors and controls the programmes and advertisements, ensuring that they conform to standards of good taste and are within the Television Act. In each area the ITA appoints a programme contractor who supplies the programmes for the ITA's transmitters. Contractors appointed initially were Associated Rediffusion, London area weekdays; ATV Network, London area weekends and Midlands weekdays; ABC Television, Midlands and the North weekends; and Granada, Midlands and the North weekdays. These form the big-four and in addition there were Southern ITV, South Coast; Westward Television, South-West England; Channel Television, Channel Islands; TWW for South Wales and the West of England; Tyne Tees Television for the North-East; Border Television; Scottish Television for Central Scotland; Grampian Television for North-East Scotland and Ulster Television for Northern Ireland. All these smaller companies had seven-day contracts.

Under the chairmanship of Lord Hill, then Lord Aylestone's predecessor, the ITA invited new tenders for the contracts in large areas. Naturally each established programme contractor applied



Yorkshire Television's studio complex at Leeds.

for his own area, as did many other potential contractors. In order to compensate for the considerable difference in revenue between the five-day week and the two-day weekend which applied in the London area, the changeover was to be made at 7.00p.m. on Friday night so that in effect the week is now divided into four days and three days. London weekdays were offered to a combined ABC TV and Rediffusion company: now called Thames Television Ltd., the combined company was based in favour of ABC TV control. Weekends were won by a new company, then called London Television Consortium and now London Weekend Television Ltd., which offered the ITA a very strong line-up of creative talent by using several of the BBC's more successful programme executives under the chairmanship of Aiden Crawley who set up the Independent Television News organisation. In addition to this, however, the ITA insisted on allowing newspaper interests to form another consortium to take part in the company.

When, however, the ITA considered Scottish Television they took the view that the 55% of Scottish Television owned by Thomson Newspapers was too high and as a condition of renewal of Scottish Television's contract required the sale of over half of this, preferably to Scottish interests to increase local representation.

The North region was roughly divided into Lancashire and Yorkshire. Granada lost half their area but gained a seven-day contract: more local representation was required at the boardroom level. Contracts for Yorkshire were sought and contested by ten applicants of whom Telefusion Yorkshire, based on the television rental firm, and Yorkshire ITV were the most promising. Finally Telefusion Yorkshire gained the contract but with the participation of several of the Yorkshire ITV's backers, particularly those with local roots. Telefusion Yorkshire is now called Yorkshire Television Ltd.

In the Midlands ATV who lost London weekends gained a seven-day contract in the area but the ITA required more locally originated programmes despite their four-studio complex at Elstree in North London.

TWW lost its contract completely and this went to Lord Harlech's Consortium with its strong Welsh backing. They took over TWW's studios and facilities and TWW withdrew from commercial television.

Other studios changing hands were the Rediffusion Wembley studios which were taken over by London Weekend, Thames Television preferring the more modern and better equipped Teddington Studios of ABC TV. Yorkshire TV built a completely new studio centre in Leeds, equipping it entirely with colour equipment.

ITA Control

In each area the ITA maintains offices to check on the advertising of their local programme contractors, both in the programme content and the adverts being shown. In London the headquarters of the ITA co-ordinates the activities of these offices and works with specialist committees to lay down policy. In fact very little direct action is taken as all the companies realise their responsibilities. The new arrangements emphasise the vulnerability of the present companies. Within each company a

Managing Director or a Controller of Programmes decides what programmes will be broadcast. He is responsible to his Board of Directors for the day-to-day running of the company so that it conforms with the requirements of the ITA and produces the required commercial return for the shareholders.

ITA & BBC Organisation

The ITA itself is controlled by a board of distinguished people from many walks of life, as with the BBC's Board of Governors. The Board, with its present Chairman Lord Aylestone and an executive staff under a Director General, Sir Robert Frazer, perform the functions of the ITA. This, then, is similar to BBC practice.

Both the ITA and the BBC's Board of Governors have a number of specialist and general committees to give a measure of informed public opinion about programmes and the running of the BBC and ITA. In the case of the BBC any policy change is effected directly to the programme department or group concerned. These are Presentation, Drama, Light Entertainment, Outside Broadcasts, Current Affairs, Music and Arts, Documentaries and Features, Family Programmes, Schools Broadcasting, Further Education and Religious Broadcasting. As all programmes except News come within these categories, policy and comments can be referred direct to the production team concerned.

In the case of the ITA a very complex set of rules and regulations are drawn up. Basically these set out standards and restrictions to be observed by all producers within all programme companies. Similarly a set of even more stringent regulations apply to adverts.

An organisation called the Independent Television Companies Association represents the programme companies, and along with several committees and some informal contacts provides channels of communication between the ITA and the producers and the programme companies.

Control of Adverts

Advertising control is effected by codes designed to protect the public. No subliminal advertising may be used (this is the technique of flashing a short duration slogan on the screen without the viewer being aware that it has been shown—a very powerful psychological technique not far removed from brainwashing). Nor must any advertisement appeal to fear. Special claims for products must be justifiable, and scientific terms and statistics must not be misrepresented or used to confuse. Adverts appealing to children are subject to even stricter restrictions, both in the message of the adverts and the actual scenes within the advert. Children must not be seen doing dangerous things, or acting carelessly on the road, nor must any medicines etc. be within reach. Fires must have a fire guard. Adverts for medical products also have strict requirements and many items, particularly those referring to serious and unpleasant complaints, are banned completely.

In order to check all these points the complete advert has to be approved by the ITA, but in order to avoid costly or difficult alterations in the final advert scripts are usually submitted before any shooting has even taken place. The necessary specialist committees are usually consulted over any specific point.

About 26,000 new adverts are shown each year, of which about 18,000 are captions with a five-second spoken message advertising local events and services. Of the 8,000 filmed adverts for branded goods about 10% need to be amended at the script stage, although many more get by with a change of word or phrase. Only 1% of the finished films needs alterations, usually of a minor nature.

Advert Time & Placing

Other restrictions on advertising imposed by the ITA are the amount of advertising and the placing of adverts. No adverts are allowed as part of a programme. Adverts may only be shown at specific points, called "natural breaks" in a programme, and at the beginning and the end. Adverts are usually separated from the programme by a caption giving the title of the programme and a starburst or wipe. All adverts must be clearly separated from the programme proper and must not seem part of that programme. This basic difference between ITV and commercial television of the American type was the result of the Popular Television Association's conceding this point to its opponents in 1953. In practice the ITA's techniques are now widely copied abroad as they undoubtedly improve the standard of commercial television.

From the start of ITV only six minutes of adverts have been allowed in each hour, averaged over a day, but up to seven minutes may be transmitted in any one hour. In practice this means that contractors try to cram more adverts into the high-priced 7.00-10.00p.m. period, easing off in the other periods to give an overall average of six minutes per hour. Surprisingly enough there is less advertising allowed on ITV than any foreign commercial broadcasting organisation.

TO BE CONTINUED

DX-TV

A MONTHLY FEATURE
FOR DX ENTHUSIASTS

by Charles Rafarel

AGAIN it is very much the mixture as before: conditions remain atrocious. The deterioration in SpE reception is of course normal for this time of the year but this time it is even more frustrating. November is once again with us and at the time of writing there has been no worthwhile Tropospheric opening to compensate for the poor SpE.

We had foggy conditions here on the 22nd and 23rd October, and sure enough the French Band III and u.h.f. signals began to build up, but before a good peak that would have enabled reception of W. Germany and Holland in the u.h.f. bands was reached, the winds rose, the rot set in again and we were back to the "abnormal" normal once more. All this is particularly annoying in my area. In about 12 months' time the l.f. end of the u.h.f. bands will be completely "clobbered" with the new BBC-1 and ITV transmitters going into service, and the most profitable sections of Band IV will no longer be available for Continental DX.

Because of this coming problem I wish together with other South Coast DXers to make a concerted attempt to significantly increase the Continental u.h.f./DX log, but so far the chances have been just nil. So when we do at last get another opening I recommend strong action by all of us before it is too late! We shall of course have "cleared" channels in Band V to try our luck on, but propagation is even more difficult as the frequencies increase so do not let any chance pass in the near future. Good luck to you all!

SpE reception, period 18/10/68 to 11/11/68:

18/10/68 Czechoslovakia R1, Poland R1.

22/10/68 USSR R1.

30/10/68 Norway E2 and F3. Two good floating cards on E2 Melhus and ? Griepsted. This was the best long duration day 1½ hour opening, very good to both countries.

1/11/68 Czechoslovakia R1, USSR R1.

3/11/68 Poland R1.

5/11/68 Spain E3.

6/11/68 Poland R1.

In all a very grim list, but there was one brighter and more interesting spot however. I cannot really make up my mind if the reception was F2 or SpE, but from the distances involved I would favour the former as there was no SpE from E. Europe at the time, on the 25th-28th October inclusive. This was the period of the most recent Russian space shots and I am going to take some credit for predicting to various friends on the 25th that something was going to happen. The 35-41Mc/s band was full of Russian ground stations giving long lists of Russian numerals; I counted five stations in all. By the 26th the space flight was in progress and at least seven stations were heard, including two command signals (whistling notes) for the Soyuz 2 and 3 space craft. Even more interesting at times the voice of the astronaut himself could be heard. I checked the voice with a BBC recording and it tallied. This mass of signals continued throughout the 27th. and even after the landing on the 28th the ground stations continued for a while.

I would suggest that the ground stations were located at Baikanur Siberia, which is quite a distance in view of the strength of the signals received. This is of course not strictly DX/TV, but as possible F2 reception it does show that if the frequency ceiling rises a little above 40Mc/s we could get F2 DX/TV at the l.f. end of Band I. The receiver used was a converted Bush TV62 with the tuner coils modified by pressing the turns together to get down to 35Mc/s, making the vernier tune London B1 at the extreme anti-clockwise end.

We have the following list of USA paging stations which are additional to those already published:

35·58Mc/s	Jacksonville Fla.	KIC 518.
	Scranton N.J.	
	St. Petersburg	KIG 844.
	Oklahoma City	
	Atlanta Ga.	KIE 953.
	Boston Mass.	KGB 890.
	Miami Fla.	KIE 637.

I have seen a letter from F. Dombrowski, USA, whom I met here some years ago. His notes on recent DX in the states make one very envious indeed. SpE has been very active and there has even been extreme DX in Band III via Aurora reflection. In view of this one wonders if the possible relationship between sun-spot maximum and SpE minimum ought to be re-assessed? We shall probably have to wait another 11 years for the answer!

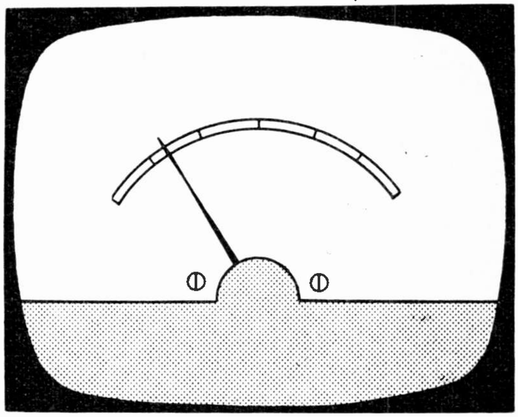
For extreme u.h.f./DX RAI Italy 2nd chain Ch.29 Portofino 1.000 kW horizontal has opened, coordinates 09E10—44N20. With its high power it could be a possible here.

Further to our comments on F2/DX and our old friend Frank Smales of Pontefract, the station that he says he received on 21/9/68 was WGR/TV Buffalo USA Ch.A2. He saw a news reader with WGR behind him at the top right-hand side of the screen. It was a 525-line 60c/s field image.

CDX (colour DX) is once again with us in a report from P. Beard of Folkestone of colour reception from Ch.34 ? Grosser Feldberg and Ch.32 ? Münster Bamberg. Also monochrome from Ch. 29 Osnabruck, Ch.30 Hamburg, Ch.35 Spessart plus Holland Chs.31 and 32, also France.

TELEVISION RECEIVER TESTING

Part 7 by Gordon J. King



TIMEBASE GENERATOR TESTS

As is implied by their name the timebase generators actually make signals. This simplifies testing, or at least the sorts of tests that tell whether or not signal is in fact being made. However, in addition to this basic "generating" function the timebase generators have to control the nominal frequency of the signals and embody preset adjustments to set the frequencies for faithful locking by the sync pulses. There are two generators, one for the line scan and the other for the field scan signals: the field scan frequency is 50c/s—the same as the mains supply frequency—while the line frequency depends on the picture standard, being 10,125c/s on the 405-line standard and 15,625c/s on the 625-line standard.

The generator signals control the line and field output stages so the shape of their output waveforms must be specially tailored to suit the nature of the output stages. Thus apart from the generators ceasing to produce signals trouble can arise due to (1) incorrect frequency and locking and (2) incorrect waveform. In addition to complete failure, these are the kind of things we have to test for.

Last month we explored line output stage testing; this month we shall examine testing techniques in both line and field generators *and* in the field output stage. Before getting involved in these things however it should be mentioned that some line output stages are "self-generating" or "self-oscillating", that is some sort of positive feedback exists between the output of the stage and its input. Thus the stage fulfils the two functions of generation and amplification. Feedback is often applied via a small capacitor connected from a tap on the line output transformer to a triode cross-coupled to the line output valve grid. Since however this arrangement is little used in dual-standard sets we shall not pursue it further for the present.

Line Generators

Many dual-standard line generators are based on the multivibrator circuit, an example of which is given in Fig. 1, this particular circuit being used in the Defiant 900 series sets. The two sections of the triode-pentode PCF80 valve are arranged so that the anode of the triode is capacitively-coupled to the control grid of the pentode, with overall feedback achieved by a common coupling between the two cathodes. This is called a cathode-coupled multivibrator for obvious reasons.

It will be seen that a common line hold control satisfies both line standards. With S1 open—in the 405-line position—the two padding resistors R3 and R4 at the top and bottom of the control ensure that the control can bring the oscillator frequency to 10,125c/s. On the 625-line standard with S1 closed a preset resistor is introduced in parallel with the top padding resistor the effect of which is to change the oscillator frequency to 15,625c/s. The idea is first to set the hold for the best 405-line lock and then to switch to a 625-line channel and adjust the preset without altering the main hold control. In this way the line lock remains correct when switching between the two standards, avoiding the need for line readjustment.

Indirect—or flywheel—line sync is used, as it is with most dual-standard sets (on 625-line operation at least). This is where the two M1S rectifiers come in (on the left of the circuit). These constitute a balanced discriminator (along with their associated components) which is arranged to receive sync pulses from the sync separator and line pulses from the line output transformer. The discriminator circuit compares these two sets of pulses and when they are out of phase—as would be the case with the generator unlocked—the rectifiers conduct unequally to produce a control potential at the junction of R1 and R2. This is filtered by the following resistors and capacitors and is used to change the frequency of the oscillator so that it is brought back in step—e.g. in sync—with the sync pulses. The line timebase then provides a correctly locked picture in the horizontal direction on the screen.

Oscillator Checks

A no-raster symptom accompanied with zero e.h.t. voltage could mean that the line generator has ceased to work. It could also mean other things as explained in Part 6. However, one major test is to find out whether or not the generator is working so that if it is we can go on to the line output stage and look for troubles

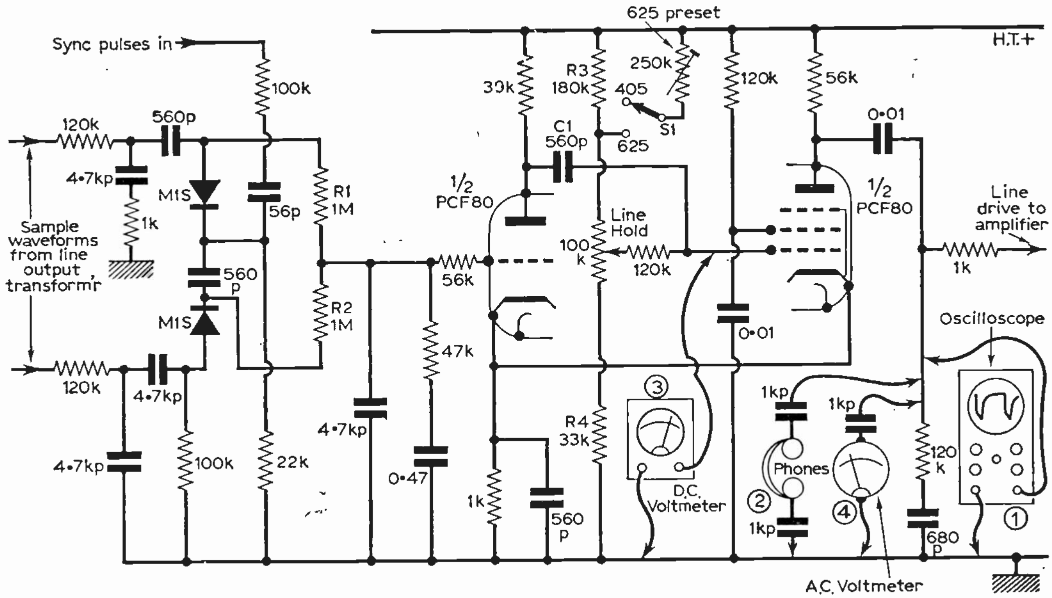


Fig. 1: Basic tests to make in the l ne oscillator stage. The stage shown uses a cathode-coupled multivibrator with flywheel line sync.

there. A simple test is to listen for the "line whistle": if this is present and varies in pitch on the 405-line standard as the line hold control is swung over its range with the aerial removed (to kill the line sync) this indicates definitely that the generator is working. Some sets have a very weak whistle, however, while not all of us (especially those of us in advance of 40 years of age) can hear up to 10kc/s anyway. Thus it is desirable to have some other method of testing for signal.

The best way is by "looking" at the signal on an oscilloscope as shown by Test 1. The scope should be adjusted to lock on a 10kc/s (or 15kc/s) signal and display one, two or more complete waves as shown in Fig. 2, Part 6. If our hearing is not too bad up to 10kc/s we can use an earpiece or pair of headphones (high-resistance ones, though) as shown by Test 2, but here it is *very important* to use series isolating capacitors—one in each lead as shown—for the sake of safety, bearing in mind that the chassis of contemporary sets is in direct connection with the mains supply. A value in excess of 1000pF (0·001μF) should be avoided for fear of passing too much mains current to the ears in the event of an electrical leak or short-circuit somewhere. Again, the aerial should be unplugged and the line hold control adjusted over its range. This will produce signals at about 8kc/s at one end of the range which should be heard by most of us.

Another idea is to check the d.c. voltage on the control grid of the second valve in the multivibrator circuit, for when the stage is oscillating this voltage will differ from its static value. It is essential to use a high-resistance meter (preferably a valve—or transistor—voltmeter) connected as for Test 3. If the stage is oscillating a substantial difference in reading will be indicated when the anode-to-grid coupling capacitor is disconnected on one side (that is C1, 560pF, in Fig. 1).

A fourth technique is shown by Test 4 where an a.c. voltmeter is connected between chassis and the multivibrator or oscillator output. To avoid the effect of d.c. here an isolating capacitor (about 0·001μF) should be connected in series with the "live" lead as shown. Provided the meter is sufficiently sensitive and of high impedance it will register on the low-voltage range when the circuit is generating. In Part 6 it was shown how a d.c. voltmeter can be connected to the control grid of the line output valve to check for line drive and hence for generator signal, so this is a test in addition to those illustrated in Fig. 1 this month.

Usually an active generator on 405 lines will remain active on 625 lines. This can easily be proved by Tests 1, 3 and 4 but rarely by Test 2 as 15kc/s is getting towards the auditory limit of even the youngest of us enthusiasts.

Frequency and Waveforms

It has been shown how a line generator can be tested for activity; but what of waveform and frequency? Waveform testing demands an oscilloscope and also sample oscillograms or drawings of what the wave should appear like at various points in the circuit. Many service manuals now provide this very useful information. The oscillograms so depicted also indicate signal amplitude, allowing us to tell whether the generator, although active, is producing signals of sufficient strength fully to drive the line output stage. Badly shaped signals can incite overheating of the line output transformer, precipitating its failure, produce line scan distortion and low and high scan amplitudes, put a bright, vertical line somewhere in the middle of the picture and severely affect the e.h.t. voltage, reducing or increasing its value and often giving rise to impaired e.h.t. regulation where the picture blows-up balloon-like as the picture contrast and/or brightness increases. There are other more subtle symptoms arising from waveshape trouble.

The accurate determination of signal frequency again demands the use of a horizontally calibrated scope; but if the generator is running it is not too difficult to discover from looking at the results on the screen whether the generator is running fast or slow. The correct frequency should occur with the line hold control reasonably near range-centre, but if the picture just tends to lock with the hold control hard on one of its end stops then something is amiss with the frequency-determining components, such as the line hold control itself, the top and bottom "padding" resistors (i.e., R3 and R4 in Fig. 1) or the coupling capacitor C1. All these items influence the generator running speed, so increase or decrease in value will dramatically put the generator out of range of line sync. The valves are also critical in this respect, changes in emission having similar results.

For correct synchronism the generator speed must be set a slight amount *below* the sync pulse repetition frequency, the pulses then triggering the generator before the same action is brought about by the build-up of voltages across the capacitors, i.e., the free-running state. The action with flywheel sync circuits is, however, a little different: here a bias voltage rather than direct sync pulses controls the generator speed, as we have seen. It is not proposed to dwell too much on the flywheel sync circuits as testing techniques in these are the subject of a later part in this series. Direct line and field sync testing was dealt with in Part 5.

FIELD TIMEBASE

So much for the line generator: now let us swing our attention to the field circuits and look at the field timebase as a whole. This is less complicated than the line timebase, which also produces the e.h.t. voltage.

Most dual-standard models use a multivibrator circuit, generally with the field amplifier acting in the dual capacity as one of the multivibrator valves. An example is shown in Fig. 2, which is from the Baird 620/640 series. A triode-pentode valve is a typical choice, of the PCL85 type for the field circuits, as in the circuit shown. Oscillation in this case is sustained not by partial coupling in the cathodes as in Fig. 1 but from the anode of the triode to the grid of the pentode through C1 (0·033μF) and from the anode of the pentode to the grid of the triode through C2 (0·01μF). Thus failure of either of these components would cause oscillation to cease, giving the well known symptom of a bright, horizontal line on the screen in place of the raster or picture.

Testing

As this symptom could also be caused by failure somewhere in the field scan coil feed circuit or in the coils themselves it is often as well to know at the outset whether or not the stage is oscillating. This is most scientifically performed with an oscilloscope, as in the line timebase circuits, and such an instrument is useful to tell whether the generator or amplifier is faulty in sets where the amplifier is not a part of the oscillating generator. Most earlier models feature either a multivibrator or blocking oscillator driving a pentode amplifier valve, so the horizontal line symptom could mean either that the generator has failed *or* that the generator is working but the amplifier has failed. By checking with a scope whose Y input is coupled to the generator output the stage at fault is conclusively pinpointed. The oscillogram in Fig. 3 is the kind of signal that drives the amplifier.

The same applies to the self-oscillating timebase, as in Fig. 2, but here if the coupling is defective on one stage there will be no drive signal even though the triode part of the circuit is without fault. Thus this kind of circuit must be checked as an integrated whole. We can however connect a scope as shown at Test 1 which at least will tell us whether the horizontal line symptom is caused by lack of oscillation or lack of signal current in the field scan coils. By moving the Y connection from A to B we can tell whether the field output transformer is working as it should, for signal at A and not at B could mean that the transformer has shorting turns, though it must be borne in mind that as the transformer has a step-down ratio the signal amplitude at A will be considerably above that at B.

It is assumed that the ordinary voltage tests on the valve electrodes etc. will have been made before getting too involved in dynamic testing. An open-circuit primary on the field output transformer for example will cut the oscillations in Fig. 2, while at the same time causing the screen-grid of the pentode section to glow red hot. This will be shown by lack of pentode anode volts on an ordinary voltmeter.

The field timebase runs at 50c/s and although this frequency is a bit low as a fundamental to incite much response in ordinary headphones or earpieces the nature of the wave results from the addition of many harmonic components so that although the fundamental 50c/s signal might not be heard the harmonic components certainly will—as a buzz. This means that we can easily check for oscillations with headphones or an earpiece as shown by Test 2. Again the importance of adequate isolation against the mains supply *must* be stressed. The 'phones test is also useful in those sets employing a generator which works independently of the output stage, for it enables us easily to tell whether the symptom is the result of a generator or amplifier failure.

Another interesting test in the field output stage consists of introducing a 50c/s mains signal to the control grid of the output pentode as shown by Test 3. If the horizontal line then opens into a rather distorted raster—or if there is a tendency for this to happen—we can be sure that the amplifier section of the circuit, including the d.c. supplies and field output transformer, is in order and that the trouble is due to lack of field drive. Only a low-amplitude mains signal

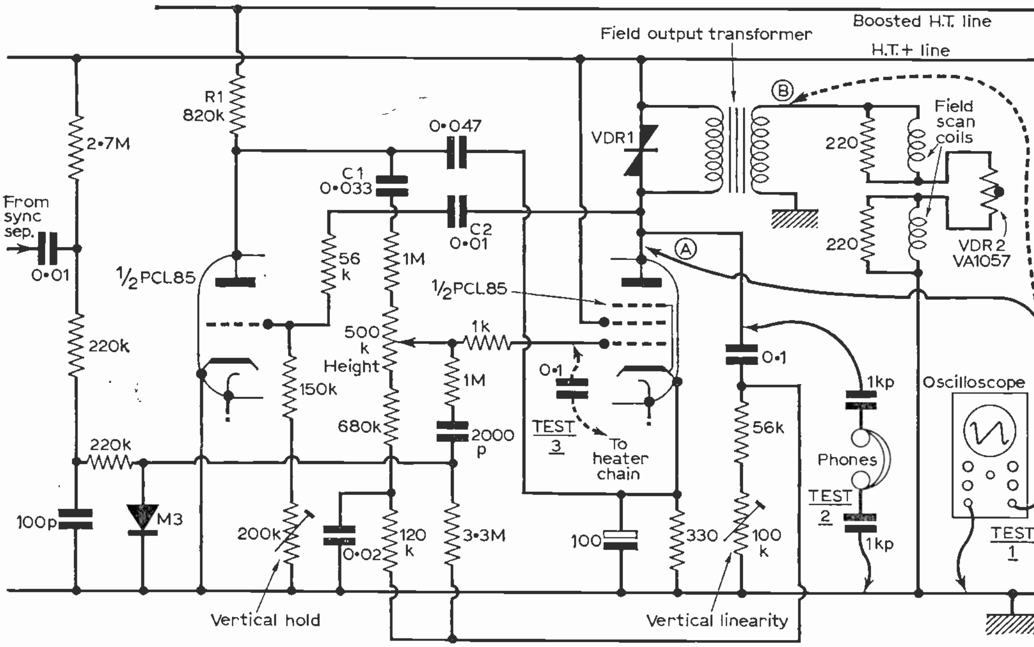


Fig. 2: The widely used PCL85 field generator/output circuit, showing basic tests.

must be applied (certainly not anywhere near the full mains potential) and injection must be through an 0·1μF isolating capacitor. A suitable voltage source exists on the heater chain, and a reasonably low-level signal is present on one pin of the picture tube heater—that which is not "earthed".

Modern circuits also feature a thermistor connected in series with the scan coils and arranged to sample their temperature, see v.d.r. 2 (type VA1057) in Fig. 2. This combats the positive temperature coefficient of the coils, which increase in resistance as they warm up, and without the thermistor, which falls in resistance with temperature rise, reduces the amplitude of the field scan. This is a vulnerable component since it tends to break or go open-circuit thereby cutting off the field scan current although the oscillator and output stage may be functioning normally.

Another important aspect of the field generator is the feed from the first valve's anode to the boosted h.t. line through a high-value resistor—R1

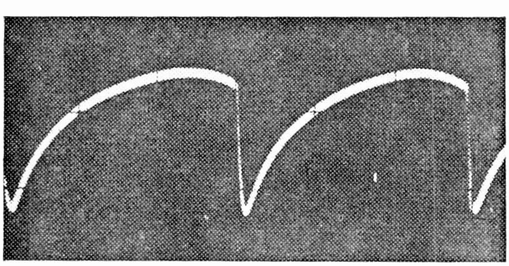


Fig. 3: the field drive waveform as it appears at the grid of the field output valve.

in Fig. 2. If this resistor goes high or something happens to the boosted h.t. rail then the scan either fails completely or its amplitude is reduced. Thus it is possible for failure of the line timebase also to cut off the operation of the field timebase by the lack of boosted h.t. voltage. The boost voltage is used by the field generator, incidentally, to achieve an improved waveform linearity and to some degree to assist with stabilisation, especially when the line output stage is stabilised with a v.d.r.

The v.d.r. across the primary of the field output transformer mutes the high-amplitude pulses generated during the field retrace. When the potential across the v.d.r. is high—as during these periods—its resistance drops and cuts the voltage, while during the scanning periods when the potential is relatively low the v.d.r. presents a high resistance in shunt with the primary and has no affect on the scanning operation.

Pulses are also taken from the field timebase and after shaping by resistors and capacitors applied to the grid of the picture tube. Since they are heavily negative-going they push the tube into beam current cut-off during the field retrace and thus black out the field flyback lines—giving flyback-line suppression. Sometimes similar suppression is applied during the line retrace, from negative-going pulses in the line timebase.

Of recent years the BBC in particular have radiated test pulses during the field intervals and in a correctly operating set these cannot be seen since they appear in the black between the fields. However, if the timebase develops a fault which slows down the retrace the pulses can show at the top of the picture or on a non-modulated raster, as depicted in Fig. 4(a). Their correct, between-fields position is shown in Fig. 4(b).

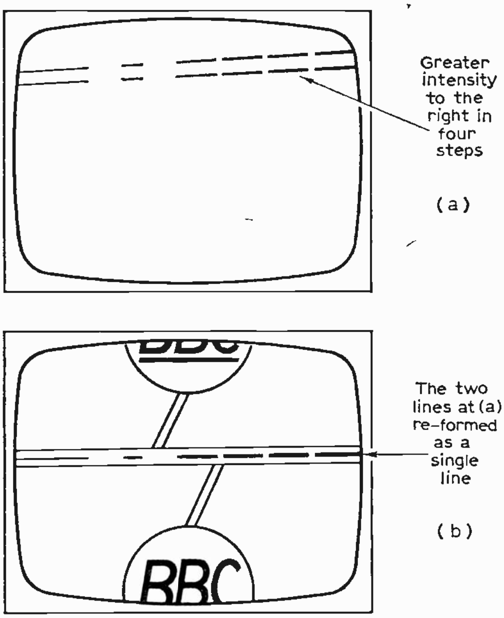


Fig. 4: Slow field retrace will show the BBC test pulses at the top of the picture as at (a). They are normally present between fields as at (b).

Slow field retrace can be aggravated by a low-emission valve in the generator circuit, by an increase in value of a resistor in the anode circuit, by incorrect vertical linearity adjustment or a change in component value here or by leakage in a transformer such as the field blocking oscillator transformer—in that type of circuit—or even in the field output transformer.

Still another field timebase symptom brought about by recent transmitting techniques takes the form of a very slow waving of the picture in the vertical direction when the picture is correctly locked on the screen. This results from the lack of synchronising between the field sync pulses radiated and the 50c/s mains frequency. At one time the pulses used to be locked to the mains; but this is no longer always the case and is virtually impossible with colour. When the pulses were so locked any residual picture or field time-base hum simply produced a very slight horizontal shading on the picture (a hum bar) which was indiscernible under normal conditions because it was locked on the screen. The current asynchronous working however causes this bar to drift slowly up or down the screen and as it does so the picture tends to wave depending on the magnitude of the residual hum.

The effect is less troublesome on recent sets owing to their improved h.t. smoothing; but old models can certainly get into trouble over it and the only real solution lies in improving the filtering and mains smoothing with an extra electrolytic and/or choke. Of course if there is a definite fault such as a low-value electrolytic or a heater-cathode leak in a field or vision valve then the symptom will appear even on more recent sets.

TO BE CONTINUED

SERVICING TV RECEIVERS

—continued from page 159

Partial or Complete Loss of Sound on 625

This is often caused by a faulty connection to one of the sound i.f. coils. Moving and resoldering the faulty tag or wire end will restore normal operation.

Adjustments

Field Linearity: Adjust presets with insulated screwdriver. Lower control corrects top of the picture, upper is the overall control.
Line Linearity: This is L511 in line output transformer assembly; slide centre core up and down when locknut is released.
Width: Three-position socket at bottom left-hand corner of timebase panel; adjust for small amount of overscan.
Picture Rotation and Centring: To rotate, slacken scan coil clamp screw and rotate assembly as required. Centre first on 405 by adjusting shuffle plates behind deflection coils, then centre on 625 using 625-line hold control.
Focus: Set for optimum focus at high and low brightness levels (three-position plug and socket on picture tube base connector).
U.H.F. Sensitivity: Adjust R128 for maximum gain on a very weak signal—correct setting should occur with slider turned almost fully clockwise (this control is factory preset).

Tuner Removal

Model 19TG158A: Pull off u.h.f. and v.h.f. tuner knobs, then remove bolt retaining the rear bracket of the v.h.f. tuner to the cabinet.
Model 23TG164A: Pull off v.h.f. tuner knobs, then remove the retaining bolt from the rear of the tuner; remove u.h.f. tuner in the same way.
Model 19TG164A: Pull off all the front control knobs, then remove the two nuts which retain the tuner mounting plate to the cabinet.

Main Chassis Removal, All Models

Remove tuner assemblies as above. Pull off volume and brilliance knobs and remove the three securing screws from the volume control mounting plate (Model 19TG158A only). Pull off the side control knobs and remove the two securing screws from the mounting plate (Model 23TG164A only). Unclip the loudspeaker leads. Separate the switch rod coupling plate from the main chassis by releasing the retaining spring. Remove the two main chassis bolts, then disconnect the c.r.t earthing lead (pin 13, timebase panel), c.r.t. base and e.h.t. connectors. Loosen the deflection coil clamp screws and remove the complete chassis assembly, at the same time sliding the deflection coils assembly from the neck of the c.r.t.

NEXT MONTH: DEFIANT 9A61U SERIES

UNDERNEATH the dipole

THE International Television Design Conference—Colour was yet another good BBC idea, organised by Richard Levin, Head of BBC's Television Design Group. It was attended by 150 delegates from 45 television companies and organisations from 20 countries all over the world. The 20 countries comprised all those already operating public colour television services plus those planning or equipping for colour in the near future.

Efficiently organised and carried out, the Conference smoothly integrated a ready exchange of ideas, brilliantly merging the technical aspects into artistic fulfilments. It did not take very long for everyone to realise that a historic event was taking place: a new concept that engineering logic can become an art form in itself, that designers, art directors, producers, directors, and even script-writers are willing to listen to engineers instead of demanding the impossible. For many, many years film production has suffered from script-writers who casually put down such specifications as "the ship sinks, taking with it 250 sailors", without knowing the slightest thing about travelling matte, back-projection, overlay, inlay, optical work and other trick devices. In this manner large amounts of money have been sunk without trace and without the specialised technical advice that might have avoided waste.

The BBC felt that the only way to raise the standards of colour television was to bring the world practitioners together and give them the opportunity of seeing and discussing each other's work. Thus, with the blessing of the Director General, Sir Hugh Greene, the show started and the whole event gave evidence of the enormous steps in colour television techniques that have taken place in the year, especially in Britain since the PAL system was adopted. It also demonstrated that the BBC can achieve colour TV production in the same *time* as monochrome.

Industrial competition

Brilliant though British progress has been the NTSC system would probably have been adopted three years ago had the PAL system not been strongly supported and demonstrated by engineers of one of the leading TV receiver manufacturers supported by the Independent Television Authority and BREMA! Competition between the two types of television originating organisations that exist in Britain (BBC and ITA) has given them an incentive to improve. Wars and industrial competition are the only factors which drive forward technical progress. It is the healthy competition between EMI, Marconi and Philips which has put them into the world lead in colour television cameras. On the other hand the American Ampex and the RCA companies' rivalry in videotape has undoubtedly led to a steady improvement in detailed design, refinements and end-product from both manufacturers.

Road shows

A few days after the BBC's highly successful convention the BKSTS and the Association of British Theatre Technicians together with the National Illumination Committee held an afternoon seminar on *Lighting and Design for Colour* followed by *A Year of Colour Television* in which BBC engineering executives took part. A good (but somewhat controversial) time was had by all—BBC, ITA, ITV, BREMA and a new but important set of initials, *FPA*, which stand for *The Film Production Association of Great Britain*, an organisation which covers technical as well as artistic points of view on big-scale film production for cinemas. This involves spectacular "road show" projects like *You Only Live Twice* and other James Bond million-pound productions, and *Half a Sixpence*, *Oliver*, and *Chitty Chitty Bang Bang*. These road-show films fill cinemas for weeks and sometimes for months, with bookable fauteuil seats in luxurious auditoria and amenities such as licensed restaurants, escalators, message services and—of course—perfect projection.

The BKSTS seminar turned out to be a joint affair with the Association of British Theatre Technicians and the National Illumination Committee and had a packed and intent audience. This was the first time that theatre technicians had made a progressive move for years, apart from attending the excellent lectures organised by Strand Electric Ltd. Naturally this mixture of lighting men for films and television (colour) and lighting men for the theatre (who forget portraiture and concentrate on scenery) revealed to me just how backward the live theatre is in this field. For some unknown reason they have abandoned "filler lights" by omitting the footlights! Naturally with no filler light but hard top front light women age and men look aged. With rings under the eyes, mouths as black as the dark hole of Calcutta, dirty necks and no colour separation from the scenery, how can a coloratura soprano look as good as she sounds. This is where theatre people can learn a few things from lighting directors of top-budget road-show films and, I'm glad to say, technical managers of television.

Many film producer members of the FPA also make films of a less ambitious type than the multi-million dollar spectacles. They even make glossy film series for television, sometimes in the hard way with single cameras repeating all the close-ups, two shots, long shots, track shots almost ad nauseam—but with a devotion to detail, portraiture and the dramatic art which does credit to their craft and their pockets.

The old monochrome picture *San Francisco* on BBC-1, with Clark Gable, Spencer Tracy and Jeanette Macdonald playing together in a 1906 period production made by MGM about thirty years ago, makes you think. The special effects in the earthquake scenes, the perfect photographic portraiture, the good diction and good recording all contributed to good entertainment which does not date. Sometimes when looking at a BBC-2

colour TV play with absolutely perfect technical trappings I fall asleep at the utter boredom of the story, presentation and subject matter, if it is not well produced. I keep awake, even through creative "clangers" (a BBC-2 speciality). There wasn't much chance of this when the BBC put on a deafeningly noisy pop show offering, which must have been put on as an example of how to drop clangers galore.

Initials

The Film Production Association (FPA) has taken under its wing the Federation of Specialised Film Associations (FSFA) which, in turn, represents the Association of Specialised Film Producers (ASFP), the Advertising Film Producers Association (AFPA) and the British Animation Group (BAG). These groups respectively cover documentary and educational films, advertising films and cartoon films. There are a total of 84 independent film-producing companies involved and almost every one has made some contribution to television programmes. Several individual producers have even ventured into the technically complicated field of videotape, monochrome or in colour. They all have differing points of view and their educational, artistic and technical backgrounds are not, thank goodness, from the same National Film School.

Videotape developments

The marvels we have seen on closed-circuit colour television monitors during the last few weeks from colour videotape have surpassed our most optimistic expectations. Second and even third generation transfers from the original tape have been seen which have had only minimal degradation. Nevertheless it is wise for the engineers to frown upon the use of such "dupes" with their inevitable loss of quality, however small. It has been said that the limit has now been reached in the amount of information that can be recorded on videotape. The stage when noise can interfere with a videotaped colour picture has arrived—but the search for even better magnetic materials and base is carrying on. Sooner or later it may be able to equal the quality of the correctly exposed photographic colour negative. This may take a long time to achieve—probably calling for 1,000 lines or more to give the resolution needed for large wide-screen reproduction in a cinema. The manufacturers of professional motion-picture cameras are already wondering whether videotape will put them out of business.

The latest film studios to be built all include accommodation, if not equipment, for such developments. Already electronic aids to motion-picture cameras are in use at ABC studios, Elstree; Intertel Studios, Wembley; and Pinewood Studios. The main present requirement is for a number of monitors on the production stages for director, camera operator, sound mixer, continuity girl and others, including an executive in a front office. To these facilities have been added videotape of helical-scan type one inch wide. The FPA (and all their associated organisations) are anxious to standardise on particular helical-scan machines to enable them to be played-off when required in one another's studios. The time for this standard to be adopted is *now*. Otherwise the film studios will be in the same pickle as the educationalists are, with different standards at different universities and with educational heads who don't know the difference between a videotape and a smoke signal. Let us hope that 1969 will be a vintage year, with technologists and electronic engineers given a hearing and voice in matters of policy.

Iconos

SERVICE NOTEBOOK

—continued from page 173

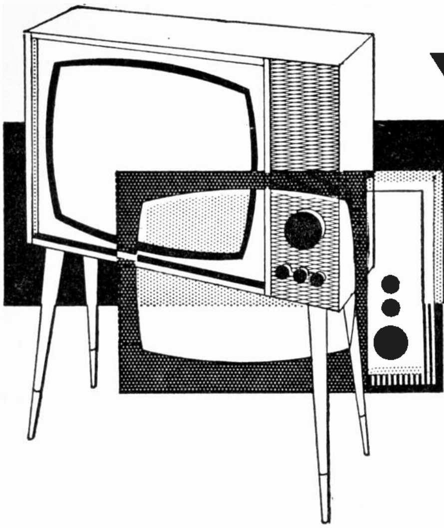
tial developed on the latter's grid we commenced voltage tests on the 30FL1 line generator valve.

We found only 25V on the triode anode instead of the normal 150V. The feed to this anode is via two series resistors and a winding on the line blocking oscillator transformer and further tests showed the resistors to be of correct value but a leak of about 3kΩ from anode to chassis. The only possible suspects were the 180pF capacitor connected from this point to chassis or the transformer winding. The d.c. resistance of this winding is only very low but by taking careful tests we found that the leak was slightly greater at the anode end so the probability was that the capacitor was faulty although we usually find that voltage-carrying capacitors go completely short-circuit rather than leaky. On unsoldering one end of this capacitor we found it to have a 3kΩ leak and on replacing it obtained normal line whistle, e.h.t. and a perfect picture. This shows that presence of negative voltage on a line output pentode grid even if it varies with the line hold control setting is not a sure sign of normal grid drive.

In the other instance we encountered the fusible resistor was in series with the main h.t. rail, but as before there was no detectable short-circuit or leak across h.t. and chassis. Again, the only possible first move was to resolder the clip and switch on. Minutes after the valves had warmed up it became apparent that the resistor was overheating and again as there was no line whistle it seemed that the excessive current must be taken by the line output pentode.

We changed the line generator without restoring results but on replacing the PL500 obtained normal vision. The fault with the original PL500 was a short-circuit between the screen and control grids thus placing h.t. directly on the latter. This inter-electrode short-circuit had not become apparent when testing for a short across the h.t. rail and chassis as the control grid was returned to chassis via a 2.2MΩ grid leak resistor.

TO BE CONTINUED



Your Problems Solved

Whilst we are always pleased to assist readers with their technica difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 188 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

GEC BT304

The fault on this receiver is "plastic", i.e. excessive white after black. This occurs on both channels but seems worse on BBC-1. The recommended adjustments of L17 and L9 have been tried but do not seem to make any difference. Also, substitution of V6 for one of the other valves of the same type on the i.f. panel has no noticeable effect.

From all other points of view, the performance of this set is satisfactory except for a lack of horizontal definition.—G. Williams (Birmingham).

The effect you have is overshoot. Plastic shows up as reduction in contrast ratios mainly. Since the symptom you describe is accompanied by lack of horizontal definition we feel that the vision i.f. channel is out of alignment.

Alignment should first be checked and if this appears normal attention should be directed to the video output stage—check cathode and anode components.

PYE 13

I have fitted a u.h.f. tuner using the appropriate kit. Although the performance on BBC-1 and ITV is very good, the performance on BBC-2 lacks "punch". There is a tendency to "hunting" all the time. The field scan is reduced in amplitude when switched to 625-lines and cramping to the right of the picture becomes marked. The picture is not grainy but lacks contrast and there is overshoot giving a blurred effect although the 4·5Mc/s bars can be resolved. I have a good outdoor aerial and feeder and this is a good reception area.

I cured a sound-on-vision fault by adjusting the slugs on the appropriate coil in the sound section and now the sound is excellent without any trace of buzz.—T. Priestley (Manchester, 9).

We advise you to check the valves in the u.h.f. tuner, particularly the PC88. Also try a slight adjustment of the i.f. transformer within the u.h.f. tuner. The location of this core varies with the tuner supplied, but it is the only iron dust core accessible through the side of the tuner.

PHILCO 1060

The trouble with this set is burnt out scan coils. New scan coils have been fitted; also L.O.P.T. rewind, together with new PL81, PY81, EY86, but no picture. There is good line whistle but the EY86 does not light up, and no e.h.t. but on removing the plug for the line scan coils from the L.O.P.T. the e.h.t. returns, the EY86 lights up and a narrow vertical line appears.—J. W. Finch (Lancashire).

The line scanning coils are certainly loading the line output stage abnormally. This could be caused by incorrect line generator frequency, incorrect scan coils for the L.O.P.T., or excessive loading applied to the line output stage due to a fault in the boost diode circuit, this being reduced by disconnecting the scan coils.

PYE CTM17S

This receiver is fitted with an MW43-80 tube which needs replacing. I have an MW43-69 tube and wonder if this may be used as a replacement.—J. Calloway (Somerset).

Your cathode-ray tube exchange would work if you could accommodate the MW43-69 which is physically larger. You may find that due to the difference in scanning angles the picture is extremely large and adjustments will have to be made to the height and width controls.

PHILIPS 17TG100U

I have lost both the picture and the raster. The sound is in order. I have changed the EY86, PL81 and PY81 valves but this has had no effect. A hissing noise could be heard coming from the line output transformer and a neon tester would light up if held about two inches away.—I. Gair (Northumberland).

Note whether the EY86 lights up. The fact that the neon lights suggests that the e.h.t. may in fact be in order. Check the tube base voltages particularly the grid voltage at pin 2 or 6 which should vary with the brilliance up to 100 to 150V.

GEC 318

The sound is normal but the picture does not appear for 10-15 minutes and sometimes goes again for a few minutes after having been on for about 5 minutes.

The picture loses and then regains height at top and bottom quite frequently. It also jumps rapidly or flickers at the bottom. Distortion (short legs, long heads) occurs and the vertical control is at the limit and very touchy so that the distortion is difficult to correct.

The e.h.t. rectifier (U49) and field output valve (PCL82) have been replaced without curing the faults.—R. B. Johnston (Newcastle-upon-Tyne).

It seems from your letter that the set is suffering from power starvation. Check the h.t. rectifier and make sure that the h.t. line voltage is well up to 200V. It is possible, too, that the line output valve and/or booster diode are low emission. Have these checked and replaced if below 70% sufficient.

PHILCO 1020

The sync has never been very good on this set. A few months ago the picture started to suffer from line tear which was worse on the weak ITV signal than the local BBC-1 signal. I connected C86 (1000pF) into the circuit and as this made only a little difference I replaced C71. This cured it completely but since then the line hold has gradually become more critical and has to be reset about 4 or 5 times during the first half hour of viewing, after which it does not drift. Although the field hold is not critical and locks perfectly well the interlace is not very good and tends to be better on some parts of the picture than others. The sync separator (V6 EF80) is new and all other valves are either new or satisfactory. I have servicing details and test meter. All voltages at the sync separator valve pins are normal. —B. Pollard (London).

We would advise you to check R21 and R23. If necessary examine the other components in the video and sync separator stages.

DECCA DM45

On first switching on the set operates perfectly; then after 15-20 minutes the sound begins to diminish and very soon drops to zero output. As the sound output drops the picture becomes slightly distorted. If I turn the channel change knob to the next adjacent channel and back again I get the sound and picture perfectly but for a few seconds only. I have checked this receiver with the aid of the service sheet and I have replaced the tuner and sound i.f. and sound output valves without any results.—A. Forster (Newcastle-on-Tyne).

It is possible that one of the valves in the vision i.f. channel under the control of the a.g.c. system develops slight grid current when hot. This reflects a slightly positive potential on to the a.g.c. line and can cause distortion of both sound and picture in the manner described. The best plan is to try interchanging the controlled valves with others of the same kind in the set.

PYE V700A

I have had this receiver repaired twice for the same fault which has occurred once again. The symptoms are that the screen is blacked out for approximately a third of the height from the bottom and there is a bright white line ½in. wide running across on top of the blackened out portion.—C. Harrington (Essex).

Your trouble could be almost anywhere in the field timebase, or alternatively due to a faulty cathode-ray tube with a first anode leakage. We could probably assist you further if you provide us with details of checks you have carried out.

BUSH TV21

The fault usually occurs after the set has been on for an hour or more. It starts as a thin white line at the bottom of the screen. This slowly rises leaving a black area below it which ultimately extends upwards to a height of up to 2 in. At the same time the white line itself widens and develops into a foldover varying in width on different occasions from ¾ in. to about 2½ in. The linearity also alters, the top of the picture becoming streched and the bottom cramped. The fault reaches a maximum in 5 to 7 minutes and then slowly reverses and has gone after a total of 10 to 15 minutes.

Some evenings the fault does not appear at all but on others it may occur two or three times at intervals of perhaps half an hour.

Replacement of the 100μF electrolytic capacitor which is connected between the cathode of V3b and chassis (C19 in the main deck circuit diagram as published by the makers) which I first suspected has made no difference. The puzzling thing is the way the fault corrects itself and the fact that its occurrence is not in any way predictable. Can you suggest which components I should now check and/or exchange?—G. B. Sockett (Staffordshire).

We would suggest you replace V3 PCL83 and then suspect R25, C17, C37, and C16.

STELLA ST2049A

This set gives perfect reception on both sound and vision when switched on to BBC-1 or ITV Channels and remains this way over long periods of time. On changing over to BBC-2 however the picture is good for a very short time. After about five minutes it gradually gets brighter and brighter until the screen is completely white. Adjusting the controls is effective when the picture first starts to go, but once the limit of the control is reached the picture is out of control altogether. The sound is not affected and appears to be good at all times.

On switching back to either BBC-1 or ITV a good picture is immediately available, but the fault condition returns as soon as the set is put back to BBC-2. The set is located in an area of good signal strength.—W. Dougall (Somerset).

You should replace the PFL200 video amplifier, and the resistor R258 (1MΩ) should be changed to 150kΩ. Also change C249 to 0·15μF—at present 0·022μF (22,000pF). These components are to the left of the PFL200.

ALBA T717

Could you tell me the value of the preset control for the field linearity? I have a service sheet which lists this as 27kΩ but the value marked on the one in the set is 47kΩ. Would this have a noticeable effect on top linearity?

Also may I replace the h.t. rectifier PY32 with a BY100 and if so will it require any modification to the existing circuit?—J. Hill (Staffordshire).

The linearity slider has a value of 47kΩ. Check the associated capacitors and in particular the 0·1μF capacitors. Check the ECL80 and cathode electrolytic if necessary.

Use a PY33 for rectifier replacements as the circuit may not be able to stand the 300V or more which would be applied instantaneously when the receiver is switched on if a BY100 is used.

BUSH TV53

After this set has been in operation for about 45 minutes, the picture shrinks to about postcard size. The shrinkage is gradual but speeds up at the end with darkening of the picture and loss of horizontal hold.—A. Campbell (Devon).

Check valves PL81 and ECC82 on the right side by substitution and if necessary check the boost line components.

QUERIES COUPON

This coupon is available until JANUARY 24, 1969, and must accompany all Queries sent in accordance with the notice on page 186.

PRACTICAL TELEVISION, JANUARY 1969

TEST CASE -74

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

? *The picture on a Ferguson Model 406 was perfect but the sound gradually became more and more distorted after several hours working until after about five hours the audio was severely clipped and unintelligible. The time could be dramatically shortened by impairing the ventilation by covering the set with a blanket, showing that the fault was temperature sensitive.*

The audio valve was tested by substitution, but the trouble remained. A not uncommon cause of this trouble is over-running the triode-pentode audio valve due to incorrect adjustment of the mains selector and although this was set a little low for the mains voltage in the set in question re-setting to a higher voltage offered no improvement or change in time period to the fault developing.

Attention was then directed to the audio coupling capacitor on the control grid of the sound output pentode; but there was no sign of electrical leakage in this neither when cold nor hot. The trouble, in fact, was still present in its original form after replacing the audio coupling capacitor, the audio valve and components associated with the audio stages.

What other component(s) can cause this sort of trouble? See next month's PRACTICAL TELEVISION *for the solution to this problem and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 73

Page 141 (last month)

The cyclic pulsating picture effect which was the subject of last month's Test Case stems essentially from the so-called asynchronous operation of the TV transmitters. In the past the field sync pulses were locked to the 50c/s mains supply frequency, but with the advent of 625-line working and colour transmissions this synchronous mode of operation gives rise to various technical complications and as a result the field pulse frequency tends to differ by a cycle or less from the mains frequency. This shows up on any set exhibiting even the slightest hum on the picture in the manner mentioned last month.

As the older type of set normally operated under synchronous mains conditions, slight picture hum was fixed in one position on the screen and was not easily discernible so that this type of set could get away with relatively poor mains smoothing. This shortcoming is however now showing up on asynchronous transmissions and the only solution to the problem lies in improving the 50c/s smoothing filters—either by fitting an additional stage of filtering (and extra 100μF electrolytic and smoothing choke) or by increasing the value of the existing smoothing electrolytics.

The effect is also aggravated by slight heater-cathode leakage in a field timebase valve or in the video amplifier valve which is why the experimenter in Test Case 73 found that valve replacement cleared the symptom—or reduced its effect—in one or two cases but not in all of them.

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