Practical TELEVISION

NOVEMBER 1964

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30C15	7/6	ECC83	4/6	EY86	6/-	PY32	8/-	UL41	4/-
30P4	7/6	ECC84	5/-	EZ40-41	5/6	PY33	10/-	UL84	6/-
30P12	5/6	ECC85	5/6	EZ80-81	5/6	PY80	3/6	UU8	9/6
30PL1	6/6	ECF80	5/-	GZ34	6/6	PY81	4/6	UY41	5/-
30PL13	7/6	ECF82	5/6			PY82	3/6	UY85	6/-
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Practical Television

AND TELEVISION TIMES

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Editorial and Advertisement Offices

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Contents

FORWARD LEAP

CRYSTAL-GAZING has always been a profitable occupation. Especially so when intelligent foresight allows us a vision of what the future should—logically, sensibly—be like.

But the March of Science has a clumsy habit of trampling on the seer. There have been quite a few radio prophets in the trade and technical press. In magazines with as free an editorial policy as *Practical Television*, many pointers to the future have appeared. It is no truism to say the amateur of today is the established scientist of tomorrow, but this has been true in the past and again, with experimental TV occupying more and more of our readers, may well be true in the future.

Yet who knows what is to come? Who, writing years ago about the scaling down of equipment size, could have possibly imagined the impact on design made by the transistor? Who, now, predicting the future of television, can foresee the particular lines of growth? Will there be revolutionary discoveries that should totally alter the logical procession of development?

These thoughts are sparked off by Mr. S. Z. de Ferranti's crystal-gazing in a recent issue of the I.E.E. Journal, *Electronics and Power.*

This knowledgeable gentleman sees the formation of an 'electronic grid', a parallel to the national electricity grid. Pulsed systems will be used, all systems, including TV, to be on a time-shared basis, and waveguide feeds and links within the cities. In the offices, paper work will be reduced to a virtual nil. (Pause for cynic's laughter.) Even letter-writing will be outmoded by the instant-transfer technique of permanent imprints on sensitised paper, a development of existing photographic and electronic techniques.

Waveguide links, Mr. de Ferranti predicts, will bring TV to the home much as water, gas and electricity are at present supplied. The same link will carry the 'message line'—telephones being supplanted by visiphone devices.

The poor old c.r.t. will at last have had its day as a display device. Electro-luminescent panels of any size, with inbuilt microcircuits, will be incorporated in the architecture. Our newspapers will come to us as the writing on the wall, and *Practical Television* will be a mere roll of microfilm at the central library, referred to by the code number on a dial.

Logical though this may be, we confess to a sentimental twinge of regret. No more thumbing through the dusty bound volumes in a search for that elusive article. No more browsing in a heap of tattered back numbers, on our knees among the memories.

Instead, a remorseless blank screen that refuses to decode our request: *'You know, that piece with the squiggly drawings and a photo of a magnified hair. By Whatsisname.'*

Things won't seem the same, somehow.

Our next issue dated December will be published on November 20th

TELETOPICS

British Television Amateurs' Convention

THE 1964 Convention of the British Amateur Television Club was held in the Conference Suite of the Independent Television Authority building in Brompton Road, London, S.W.3, on September 12th (See "Teletopics" September issue).

An informal gathering and demonstration of equipment took place during the morning. Equipment on show included transistor sync pulse generators by G3SYY/T and G3LEE/T.

G3LEE/T also displayed a flying spot slide scanner. A transmitter for 432Mc/s which is normally kept in use at G3NDT/T (Harrow) was shown, along with equipment supplied by G3MSN/T.

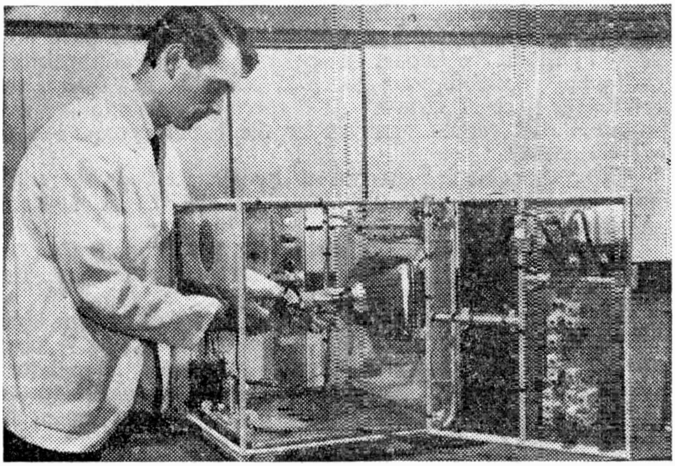
A 2C39A trebler (70cm—23cm) was shown by G3OPB/T, and also seen was a demonstration of C. Grant Dixon's transistorised slow-scan vidicon camera using a 7290 vidicon.

Transmissions were received in the Conference Suite from G3OUO/T at Wembley, although the pictures were at times marred by heavy interference, despite the use of an 8/8 slot antenna on the roof of the Convention hall.

During the afternoon various papers were read and a raffle was also held.

The Hon. Secretary of the BATC (4 Inwood Close, Shirley, Croydon, Surrey) will always be pleased to hear from amateur enthusiasts interested in joining.

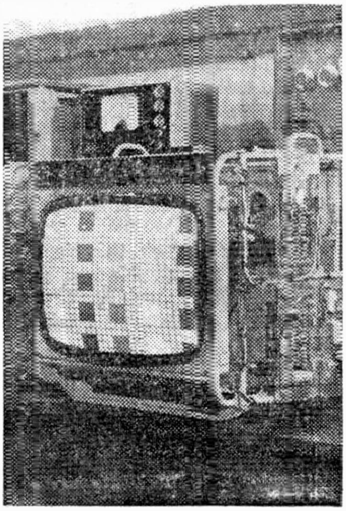
TRANSISTOR TAKE-OVER IN TELEVISION



TECHNICIANS at the Mullard applications laboratories spend much of their time developing new television receiver designs, and here as in most other fields of electronics, transistors are finding greater application.

In the photograph above a Mullard engineer fits the deflection coil assembly to the 90° picture tube of a test-rig receiver, which will be the prototype of an all-transistor design for a portable, dual-standard set.

The photograph on the right shows another Mullard television development during its alignment. In this receiver too, valves have given way to transistors, but not entirely. Although the u.h.f. and v.h.f. tuner, i.f. stages and audio circuits employ transistors, valves are retained for the video, synchronisation and deflection circuits.

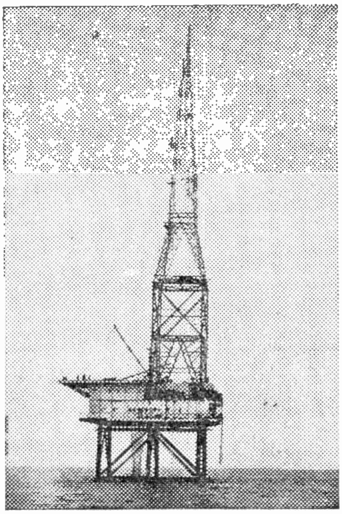


Television Society Meetings

THE Television Society regularly holds meetings in the Conference Suite of the ITA headquarters in Brompton Road, S.W.3 which non-members may attend by obtaining a signed ticket from any member or from the office of the Society at 166 Shaftesbury Avenue, London, W.C.2.

Forthcoming meetings, all of which begin at 7 p.m., include "Factors Affecting the Acceptability of Colour Reproduction" on Friday, November 6th, "A British Video Tape Recorder" on Thursday, November 19th and "Television University" on Friday, December 4th.

NOW IT'S TV PIRATES



THIS is a photograph of a pirate. A television and radio "pirate" which has been erected on an artificial island built in the North Sea.

First reports indicate that it is a Dutch undertaking and is known as REM Island. According to these reports regular television and radio programmes carrying advertisements are already being transmitted.

Further details have not yet become available, but future "Teletopics" will give any additional information as it appears.

ITA REPORT BLAMES INADEQUATE AERIALS FOR POOR RECEPTION

THE first of a new series of quarterly opinion reports conducted by Research Services Ltd. for the Independent Television Authority shows that 64% of the people interviewed thought that ITA sport programmes were good, 34% thought that it was true there was too much violence and 12% that it was true the programmes were rude to people interviewed.

Of more interest to the technician, perhaps, is the fact revealed in the report that of the small proportion (6%) who complained of poor ITV reception, two-thirds, it was found, had inadequate aerials. This month's *Practical Television* provides details of one solution to this problem—on page 72.

COLOUR TV USED IN SIMULATOR

COLOUR television equipment made by Marconi will be used in a flight simulator recently ordered by the Ministry of Aviation. The simulator is being designed for Britain's newest supersonic fighter, the TSR-2.

Pilots who will fly the TSR-2, will receive their initial training in this flight simulator (a full-scale model of the cockpit incorporating all the control facilities of the actual aircraft) where the view through the cockpit window will present the trainee with a full colour television picture of a model of the countryside surrounding a typical airfield.

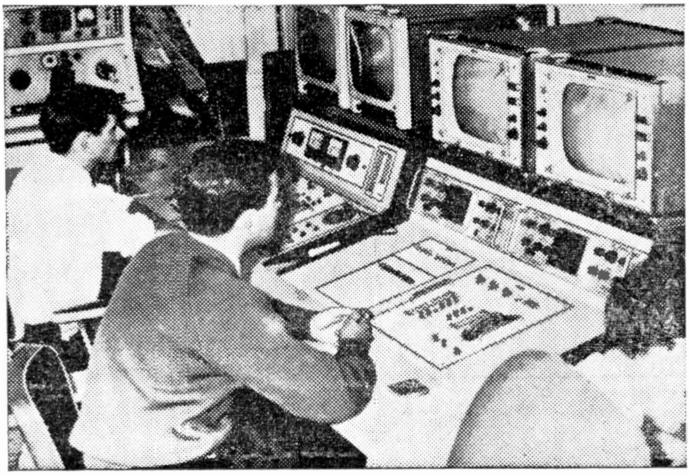
To provide this simulated panorama, the Marconi colour camera will be mounted above the model which is built on a continuous moving belt driven at a speed corresponding to that of the aircraft. At the same time the camera itself is linked to the simulator's controls and will adopt any "flying" attitude in relation to the ground model in accordance with the pilot's operation of these controls.

Aerial for Welsh ITV

THE Independent Television Authority recently placed two contracts with EMI Electronics Ltd. for new equipment at the ITA transmitting station at St. Hilary, near Cardiff. One was for the supply and erection of an additional aerial on the existing mast, and the other was for two new independent semi-flexible transmission lines from the transmitters to the existing aerial to replace the existing rigid feeders.

Vertically polarised, the new aerial will transmit the ITV Welsh programme on channel 7 over the populated areas of South Wales without causing interference in the West of England.

Television Equipment for New Zealand



THIS photograph shows presentation switching equipment made and supplied by EMI Electronics Ltd., in service at the Wellington studios of the New Zealand Broadcasting Corporation.

Another similar control suite has recently been ordered by the NZBC, to improve studio facilities at its Christchurch station. This is the third such order, the other being for an installation at Auckland.

At Wellington, the installation will provide a centralised control for the selection of the various sound and vision sources for transmissions, thus relieving the main studio control room of this task.

Other contracts placed recently with EMI Electronics Ltd. by the NZBC, were for studio vidicon camera channels and off-air receivers for r.f. monitoring of transmitted signals.

THE MINIMUM OF ADDITIONAL COMPONENTS AND MODIFICATIONS WILL TURN AN ORDINARY DOMESTIC RECEIVER INTO AN EFFICIENT

VIDEO MONITOR

BY B. W. SMITH, G3LGJ/T

A VIDEO monitor is the counterpart of the domestic television receiver. The television receiver is designed to receive and demodulate, radio frequency broadcasts modulated with a video waveform; while the video monitor is designed to work with the standard video waveform direct. This video waveform is fed via 75 ohm coaxial cable at 1 volt peak to peak, thus the vision monitor is always connected to the video source by coaxial cable.

Apart from electronic circuit refinements, the monitor has less basic electronics than the television receiver. The receiver has, in fact, practically the complete circuit of a monitor plus the r.f. sound and vision circuits. Because of this, a very good vision monitor can be made using a television receiver as the basis. Few amateur TV operators can afford the time or energy to construct a vision monitor completely from scratch.

The circuit to be described is very straightforward, and needs the minimum of additions to the receiver (see Fig. 1), in fact only one additional valve is used. The receiver after modification can be used as a vision monitor or r.f. receiver as desired, and the performance as a vision monitor will be limited by the receiver's own circuits, not the addition.

The receiver to be modified should be chosen with care, it is no good adapting any old receiver, otherwise mediocre pictures will result. The following points are desirable in the receiver to be adapted:—

(1) Choose a reasonable size TV receiver, a small 14in. table model is ideal. Large console sets should be avoided because they take up space and are not very portable.

(2) The receiver must have good e.h.t. regulation and the c.r.t. should be in its prime, with plenty of brilliance.

(3) If the monitor is to have a proper black level response, the receiver before modification must also have the necessary d.c. coupling of its video stage. This type of receiver is rarely made today; most modern sets have mean level a.g.c. circuits with a.c. video coupling.

(4) The line and frame timebase circuits should lock well and the frame scan should interlace perfectly. It is often very useful to be able to reduce the scans of the monitor to see all four corners of the raster.

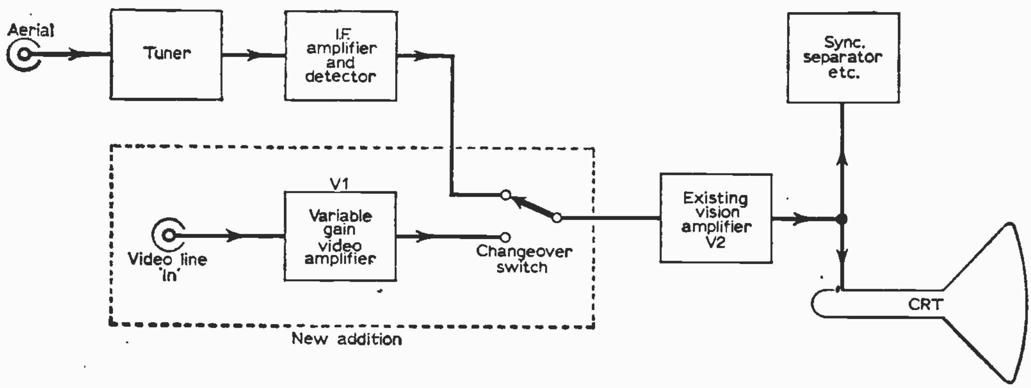


Fig. 1—A simplified block diagram of a television receiver, indicating the additional sections.

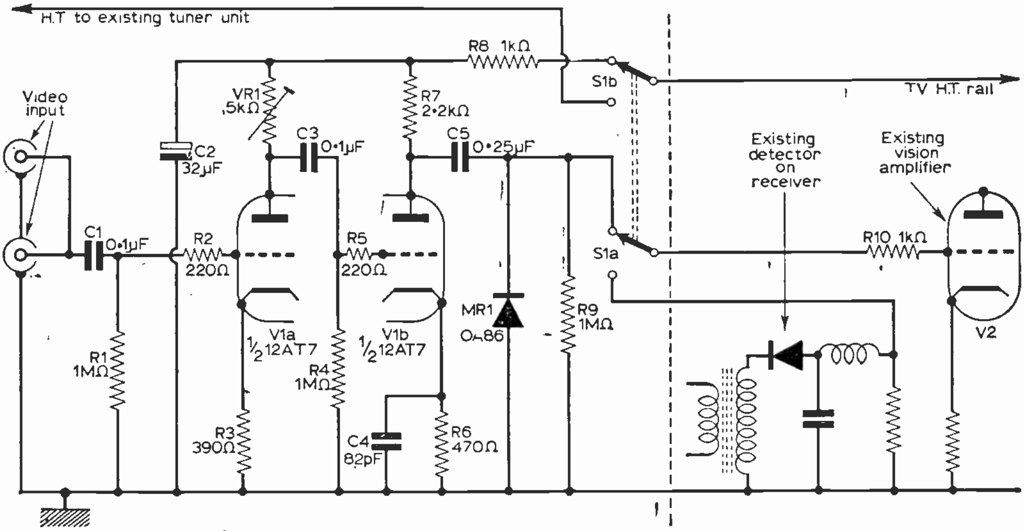


Fig. 2—The circuit modification. The circuitry to the right of the dotted line belongs to the existing receiver.

COMPONENTS LIST FOR FIG. 2

Resistors:

R1	1MΩ	R6	470Ω
R2	220Ω	R7	2·2kΩ ½W
R3	390Ω	R8	1kΩ ½W
R4	1MΩ	R9	1MΩ
R5	220Ω		

All ±10% ¼W carbon unless otherwise stated.

VR1 5kΩ carbon potentiometer

Capacitors:

C1	0·1μF paper 250V
C2	32μF electrolytic 350V
C3	0·1μF paper 250V
C4	82pF silver mica
C5	0·25μF paper 250V

Miscellaneous:

V1	12AT7
MR1	OA86 diode
S1	D.P.D.T. rotary switch

Circuit Description

The circuit modification is shown in Fig. 2, the part of the circuit enclosed by the dotted line is the existing television receiver circuit which will have variants from receiver to receiver. V2 which is the existing video output valve has its output coupled to the cathode of the c.r.t. The video required at the c.r.t. cathode varies but will be about 50V peak to peak for full contrast, with negative peak whites, and positive syncs. Thus the video required on the grid of V2 is positive going about 2V peak to peak. It is possible to couple a 1V video feed line direct to this grid, but there is no variable video gain and the gain is rather low anyway, which does necessitate a further stage. In order to keep the vision phase correct two stages of amplification however, are necessary, and are provided by the double triode V1.

The h.t. supply for V1 is obtained from the existing h.t. supply in the TV receiver. Extra decoupling is provided by R8 and C2. The heater supply required for V1 is 6.3V at 0.3A and if a receiver with a 0.3A heater chain has been chosen, the valve heater can be connected in series with the existing valves. If the receiver does not have a 0.3A chain a separate step down transformer is necessary.

V1a is a straightforward vision amplifier, except that the anode load VR1 is adjustable and provides variable gain or contrast. The output of V1a is coupled into V1b which has a low gain of about 4 times determined by the resistors R7 and R6. This stage is really only necessary to provide the second phase reversal required, but has its cathode resistor decoupled by C4 to provide boost at higher frequencies, off-setting the fall in h.f. video response of V2 (which usually has a high anode load).

The output of V1b is d.c. restored by C5 and MR1 establishing sync bottoms to chassis potential, this provides the black level stability if the receiver is d.c. coupled from V2 to the c.r.t. cathode.

S1 switches V2 grid from the existing detector circuit to the d.c. restored video from MR1, and also switches h.t. from the tuner to V1 amplifier stage.

The only other addition to the receiver, which must be used is an isolation transformer (see Fig. 3). TV receivers almost without exception have a chassis which is connected to the mains supply, and this is highly dangerous when using the TV set as a monitor, since the chassis is also used as the equipment earth. This situation can only be made safe by using a proper isolation transformer, and the circuit of the modification is shown in Fig. 3. The transformer output is connected to the mains input of the TV receiver and the receiver's chassis is connected to mains earth.

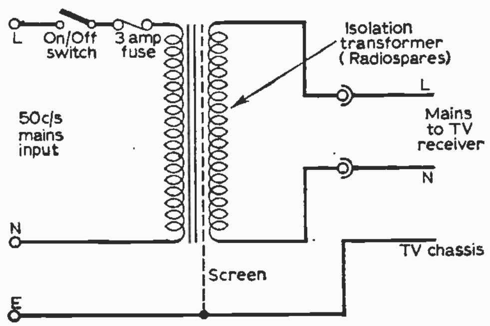


Fig. 3—Making the receiver safe for use as a monitor by the inclusion of an isolation transformer.

Construction

S1 should be mounted as near V2 as possible as long lead runs must be avoided. V1 should also be situated as near V2 as practical, and its gain control VR1 also positioned close to V1 using an extension or flexible coupling to the control knob. Many TV receivers have spare holes which can be utilised for the purpose, however if this is impossible, the whole of the stage, excluding C2 if necessary, should be mounted on a separate chassis or bracket, which can then be fixed to the main TV chassis. The construction will depend on the layout of the TV receiver under conversion so only pointers can be given, the main concern is to keep all the video amplifiers' stages near each other.

Two input sockets connected in parallel have been drawn on the circuit and their use will be discussed later. They can be mounted on a

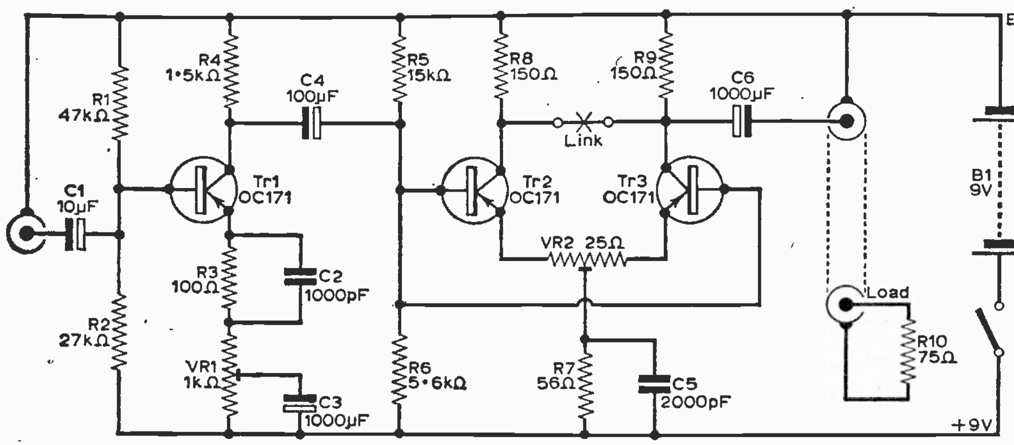


Fig. 4—The circuit of a vision distribution amplifier.

separate bracket and fitted anywhere accessible, using coax to connect earth and line to V1 stage.

V1 heater can be coupled in series with the receiver's valves if they are in a 0.3A heater chain. V1 heater should be near the chassis end of the line and can be connected between V2 heater and the other valves. If V1 heater cannot be supplied in this way a transformer, 240V a.c. to 6.3V at 0.3A will be needed.

R10 has been added in the grid lead of V2 and is a precautionary measure against parasitics which could be aggravated by the extra leads on V2 grid. S1 which switches V2 grid is also used to switch the h.t. supply between the v.h.f. tuner and the vision amplifier. It is not strictly necessary to switch off the tuner but by doing so, extra h.t. current will not be needed for the vision amplifier which will relieve the h.t. power supply of any extra load. Also vision break-through of either source on to the other cannot occur.

Testing

There are no setting up or critical adjustments so that if correctly wired the converted TV receiver should now work, either as a normal TV receiver

COMPONENTS LIST FOR FIG. 4

Resistors:

R1	47kΩ	R6	5·6kΩ
R2	27kΩ	R7	56Ω
R3	100Ω	R8	150Ω
R4	1·5kΩ	R9	150Ω
R5	15kΩ	R10	75Ω

All ±10% ¼W carbon unless otherwise stated

VR1 1kΩ preset carbon potentiometer
VR2 25Ω preset w.w. potentiometer

Capacitors:

C1 10μF electrolytic 15V
C2 1,000pF disc ceramic
C3 1,000μF electrolytic 6V
C4 100μF electrolytic 6V
C5 2,000pF disc ceramic
C6 1,000μF electrolytic 6V

Miscellaneous:

Tr1, 2, 3 OC171 transistors
B1 9V battery (PP7)

or, by operating S1, as a video monitor. Normal TV operation can easily be checked, but video operation will require a video feed source from a camera, etc. However, by temporarily connecting h.t. to the receiver tuner and switching S1 to video monitor operation, the video output from the receiver's own detector can be coupled to the video input sockets. A picture should be obtained and its contrast will be controlled by RV1.

When changing from video to r.f. and vice versa, the raster brilliance may need adjustment. Brightness will also vary when VR1 the contrast control is altered. Contrast can be reduced to nil when VR1 is turned fully one way, i.e. off, remember this point when checking video operation.

The transistorised TV camera described in the July, 1964 issue of PRACTICAL TELEVISION will provide a suitable video line feed for this monitor. The coaxial cable length used to connect between the two should not be in excess of about 20 feet, and must *not* be terminated at either end. More will be said about terminations and bridging later. The output amplifier used in the camera does not provide a 75Ω output and consequently only short lengths of cable can be used, otherwise video high frequency response will suffer due to cable attenuation and reflection.

Fig. 4 is the circuit of a vision distribution amplifier which will convert the camera output into a 1V peak to peak signal with a 75Ω source impedance. This amplifier can be used to drive into over 1,000 feet of terminated cable. The amplifier also provides aperture correction to the vision signal.

Circuit Description

The circuit basically is in two parts, Tr1 is a voltage amplifier which drives the output stage comprising Tr2 and Tr3. Working backwards, consider Tr2, Tr3 output stage. R10 is the amplifier load, and can be any length of terminated 75Ω cable. Its impedance can be considered equivalent to 752Ω resistor and is represented on the circuit by R10. R8 and R9 in parallel provide the input 75Ω termination impedance suitable for the cable. C6 only serves to block the d.c. and presents zero impedance to the vision signal. The total collector load impedance of the output stage at a.c. is 37.5Ω.

Tr2 and Tr3 are in parallel and provide a current feed for the load impedance. These two transistors are each biased to provide respectively about 10 mA d.c. current into R8 and R9, current balance and load distribution between Tr2 and Tr3, is adjusted by VR2. Two OC171's are used to overcome the limited power dissipation of the OC171. The OC171 was chosen because it has a high current gain and is very cheap, however a more expensive higher power transistor could do the work of Tr2 and Tr3.

Maximum signal output voltage that can be delivered to the load before overloading is approximately 2V peak to peak. The output stage however, although having a power gain, has a slight voltage loss, and Tr1 stage has to provide about 2V of video in order to deliver the required 1V output. Tr1 is operated under constant current conditions, gain is varied by VR1. The voltage gain of this stage depends on the setting of VR1 and is approximately the ratio of total load impedance to R3 plus the portion of VR1 which is not by-passed by C3. Maximum gain of this stage is about 9 times.

The necessary aperture correction required for the transistor camera is provided by the emitter h.f. compensation capacitors C2 and C5, and should give a 3Mc/s plus definition.

The performance of the amplifier can be summed up as follows:

Output: 1V vision across 75Ω output load (i.e. R10).

Input: 0·3V to 2V. Input impedance about 2kΩ to 10kΩ.

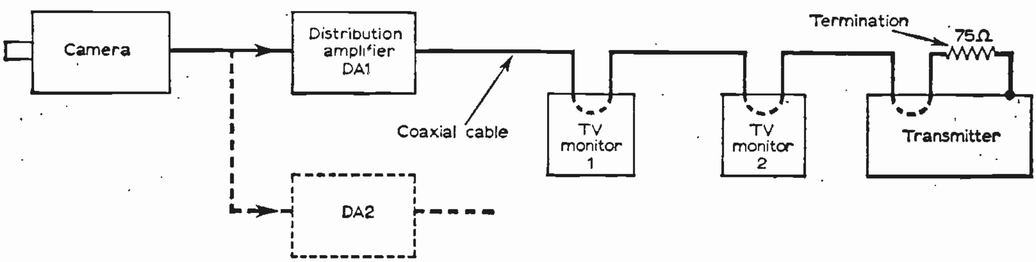


Fig. 5—An amateur television station set-up including a distribution amplifier (DA).

Construction and Testing

The amplifier is easily built on to a paxolin board about 3½in. x 2½in. using pins or lugs placed to take the components. All components should be fitted on one side of the board and the intercomponent wiring kept to the other side. Alternatively a hand drawn printed circuit board can be designed and made as already described in February, 1964 PRACTICAL TELEVISION. VR1 and VR2 are preset miniature variable potentiometers. The layout is not critical but all leads should be kept short and components layed in a similar order to the circuit drawing, input at one end and output at the other. A photograph shows both sides of a printed circuit arrangement of the amplifier.

The link which connects Tr2 collector to Tr3 collector (marked with a cross on the circuit diagram) is not connected initially. The amplifier plus battery is fitted into a standard 6in. x 3in. chassis, which also has an on/off switch and input and output coaxial connectors. The battery leads

—*continued on page 61*

A PRACTICAL TELEVISION REPORT

The New TV RECEIVERS

TV & RADIO SHOW EARLS COURT 24 AUG. — 5 SEPT.

TELEVISION trend-setters of the 1964 Radio and Television Show have been Tuners, Teak and the Tiny screen.

Despite the challenge of the "splinter shows", largely concentrated on radio and audio products—and such novelties as oil heaters, toasters and electronic pencil sharpeners!—despite the reduced size of the ground-floor-only exhibition at Earls Court, there was plenty of scope for the development-hunter around the gaily-decorated stands.

Attendances for the first four days were only 40 per cent of the 1962 figures. But the two trade-only preview days were reported to be a success, and order books rapidly filled. The Radio Show, it seems evident, is becoming much more of a trade exhibition, only attractive to the general public when they can see the pop-star idols in the flesh. This year's decision to have a stage show came too late and drew too little star-quality support.

Developments

Tuner-units, especially the transistorised u.h.f. types now fitted to Thorn group, some S.T.C. and Philips receivers, allow greater gain for less noise. The upshot has been to push the "fringe area" farther outwards, make possible the use of simpler aerials, and allow a wider range of receivers following a basic styling.

Example: Basic set 60 gns.; fringe model 62 gns.; with u.h.f. tuner 67 gns.; with u.h.f. tuner and fully fringe 69 gns. The "fringe" addition being a plug-in flywheel sync panel.

Some v.h.f. tuners have reduced in size still more, in particular a recent Philips transistorised design, and the u.h.f. tuner has undergone a radical aletration. The S.T.C. group quarter-wave design is hardly twice as big as a matchbox.

Some models have four-station push-button tuning while others, as used on G.E.C./McMichael receivers, employ a rotary tuning control. Fast/slow u.h.f. tuning is used on many models, including the latest Pye designs.

Transistor development has resulted not only in the neater tuner, but also in small, efficient pre-amplifiers, so that set-top and mast-head designs have tidied-up this field considerably. The hybrid receiver is already with us, if we consider a valved set with transistorised tuner in this category.

Evolution of the cool-running Thorn 900 chassis points a way to further transistorisation, and although designs are still in the development stage, engineers were able to see some of the auguries for the future within several dealer stands.

Mullard showed a hybrid dual-standard receiver, suitable for 19 or 23 inch styling, with transistors in the v.h.f., u.h.f., i.f. and audio circuits, but using valves in the video, synchronisation and deflation circuits. An all-transistor design, even for the line output and e.h.t. circuits, was demonstrated on an 11 inch prototype.

Compatibility Plus

The "standard" set with 625-line convertibility is no longer with us. Design is for 625 lines, with the 405-line standard compatibility accepted. Improved switching circuits have been developed to this end, and one-position 405/625 switching is possible on selector controls.

A novel device is marketed by Pye, who have separate picture controls for the two standards and a shutter which blanks off the inappropriate adjustments.

Front-facing loudspeakers are much more in evidence. The asymmetric look has taken over from the balanced centre-tube effect on most models. The use of implosion-free tubes, and other patent devices, such as dust-filters, panorama view tubes, etc., have made the push-through tube styling much more evident.

In the higher price ranges, teak has found favour, and some very attractive cabinets were to be seen in this material, in natural elm, and the more familiar mahogany Sapele veneers, as well as the traditional straight-grained walnut. In the Ferranti range receivers housed in teak are only fractionally more expensive than others in more "coventional" finishes.

Tendency, even with the more conservative designs, is to avoid fussiness with the carpentry, saving the frills for the knobs and trim, most of which are anodised aluminium, silver or spun gold.

Bedside Manners

There were three eye-catching "bedside" sets. The much publicised K-B *Featherlight* mains transportable, with its counterparts by other members of the STC group; the late entry Ferguson "baby", with Thorn 900 chassis and transistorised u.h.f. tuner, built around an 11 inch tube, and styled in teak, and the prototype 7 inch battery model made by Thorn for the Ever Ready Co. Ltd.

This last is the Mark 5 version, after attempts going back as far as 1958, and designs for Marks 6 and 7, dual-standard sets, are already in hand. The tube is a 7 inch, 42-degree deflection angle, electrostatic type, and the power consumption of the receiver, 3 watts. The TV1 battery is estimated to have a life of 40 hours at an average usage rate of 2 hours a day.

A notable omission at this year's show was colour television, which seems to have bored everybody

—continued on page 61

A summary of the new television models seen at the 1964 TV and Radio Show at Earls Court. The following tables show new models only, and do not represent the complete range of the manufacturers concerned.
For details of radio, audio and associated products released at Show time, see *Practical Wireless*, November 1964.

TELEVISION RECEIVERS

Model	*Tube size (in.)*	*Style**	*Price*	*Features*
ALBA T990	19	C	67 gns.	Sapele mahogany with polyester finish. Less u.h.f. tuner.
T995	19	C	74 gns.	With u.h.f. tuner. Packaged service system, both models.
BUSH TV123u	19	T	61½ gns. (u) 68½ gns.	Two-tone, moulded cab. Push-button selection, all models.
TV125	19	T(S)	69 gns. (u) 77 gns.	Optional stand 2½ gns. extra. Straight-grained African walnut veneer cab.
TV125cu	19	C	93 gns.	Sliding doors.
TV128	23	T	80 gns (u) 88 gns.	A.G.C., scan-stabilisation, flywheel sync, all models.
TV128cu	23	C	110 gns.	Sliding doors, front-facing speaker.
COSSOR CT2373	23	T	86 gns.	Natural Afromosia veneer with wax finish, blue surround. (CT2375, as above, with grey surround.)
CT2372	23	T	77 gns.	Side controls, blue surround. (CT2372/02, grey surround.)
CT1973A	19	T	71 gns.	Med./light sapele, charcoal grey leathercloth front.
CT1964A/77	19	T	72 gns.	Finish as above. A/78 without u.h.f. tuner, 66 gns.
CT1972A	19	T	67 gns.	Finish as above. A/90 without u.h.f. tuner, 61 gns. All models with optional extra, legs, stands, and magazine racks.
DECCA DR1	19	T	71 gns.	Basic table model. New P.B. system allows u.h.f. selection of four stations, retaining variable tuning over band, all models except DR1. Glide-away doors.
DR121	19	T	89 gns.	
DR122	23	T	99 gns.	Glide-away door.
DR123	23	C	115 gns.	Full-length fold-away doors.
DR888	23	C/RG	185 gns.	TV plus radiogram (transistorised stereogram), Prestomatic tuning as above. Front-facing 10 in. × 6 in. L/S.
DEFIANT (CWS) 9A61U	19	T	70 gns.	Sapele veneer, silver trim. Dual standard, all models.
9A62U	19	T(S)	72 gns.	Novel stand as optional extra.
3A60U	23	T(S)	83 gns.	Magazine rack. All models with u.h.f. tuner, P.B. system switch.
DYNATRON *Kensington* TV73FT	23	T	105 gns.	Satin walnut, fold-away doors, matching table, 7 gns.
Kingston TV76FT	23	C	118 gns.	Oiled teak, Scandinavian style, doors, P.B. station selection
Marlborough TV75	23	C	135 gns.	Queen Anne period cabinet with full-length doors, walnut.
Marlborough TV75CH				As above, in Chippendale styling, mahogany.
Knightsbridge TV70	19	T	85 gns.	Walnut veneer, with fold-away doors. Table extra 5½ gns.
Knightsbridge TV74			(F) 87 gns.	As above, oiled teak finish with bow-fronted table extra, prices, 74, 86 gns., 74F, 87½ gns.
Beaufort TV71	19	C	129 gns.	Queen Anne period cabinet with full-length doors and cabriole legs.
Regency TV77	23	CE	125 gns.	Regency styled, doors, antique handles, brass speaker grille, warm flared mahogany veneer.
EKCO T433	19	T	66 gns. (F) 68 gns.	Press-button tuning. Less u.h.f. tuner. Straight-grain French walnut veneer. Fringe models with plug-in flywheel sync.
T433/T	As above		(F) 75 gns. 73 gns.	Optional legs 27s. 6d. With u.h.f. tuner
T434	19	T	61 gns.	Sapele veneer—for rental schemes. (F) 63 gns. Rotary controls.
T434/T	As above, with u.h.f. tuner		68 gns.	(F) 70 gns.
TC435	23	CE	76 gns.	Straight-grain Australian walnut veneer. Fringe—78 gns. /T, u h.f. tuner 83 gns., (F) 85 gns.
T436	23	T	69 gns. (F) 71 gns.	Sapele veneer—suitable rental receiver.
T436/T	As above with u.h.f. tuner		76 gns. (F) 78 gns.	Legs, optional 27s. 6d. Click-control, rotary tuner.
TC437/T	23	C	102 gns.	Flush-fitting doors. Straight grained French walnut with polyurethene finish. Press-button tuning.
FERGUSON 3624	19	T	69 gns.	Sapele veneered cab. Toughened glass cover. Legs, 2 gns.
3626	19	T	74 gns.	Front-mounted controls and speaker. Stand 3 gns.
3625	19	T	72 gns.	With v.h.f. radio.
3623	23	T	76 gns.	All preceding models at 7 gns. less without u.h.f. tuner. Metal legs, 2 gns.
3627	23	T	85 gns.	Matching stand 3 gns., legs, 2 gns. Sapele veneer. All sets use Thorn 900 chassis.
3629	11	T	50 gns.	Mains-operated, transportable in teak cabinet. 21 × 11 × 9 in. Weight, 26 lb. With u.h.f. tuner, 57 gns.
FERRANTI TC1122	19	CE	78 gns. (F) 80 gns. Less tuner 71 gns. (F) 73 gns.	Teak veneer cab. Solid teak stands. Press-button tuning. Front controls and speaker.
TC1124	23	As above	88 gns. (F) 90 gns. Less tuner 81 gns. (F) 83 gns.	
TC1126	23	C	99 gns. (F) 101 gns.	Teak veneer cabinet with fold-back doors.

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TELEVISION RECEIVERS—*continued*

Model	*Tube size (in.)*	*Style**	*Price*	*Features*
T1121	19	T	74 gns. (F) 76 gns.	Sapele veneers; matching stand 3 gns., legs 2 gns. Without tuner, 7 gns. less.
T1123	19	T	68 gns. (F) 70 gns.	Stand 3 gns. Less tuner, 7 gns less. Turret tuning.
T1125	23	T	76 gns. (F) 78 gns.	
G.E.C. 2000 DS–T	19	T	Rental	Natural elm finish, with black and gold trim
2001 DS–T	19	T	72 gns.	Electra brand-name. Front grille and speaker.
2002 DS–T 23	23	T	79 gns.	With u.h.f. tuner (both models). Legs available, 2 gns.
GRUNDIG K230 Console	23	C	129 gns.	Teak or Canaletto (American walnut) cabinets with folding doors. Two 7 × 4 in speakers, P.B. u.h.f. tuner, ch. sel. v.h.f.
K450 Stereotheatre	23	C	365 gns.	Scandinavian light walnut or dark walnut gloss finish. Combined radiogram. TV, with space for tape recorder. Stereo decoder, optional extra. Speaker compartments each end: each 12 × 8 in. and 7 × 5 in. units Dual 1009 transcription gram unit. Sliding doors.
INVICTA 7021	19	T	73 gns.	Catylised semi-matt sapele. Press-button u.h.f tuning
7041	23	T	84 gns.	Available with stand £2 10s. extra. Fringe versions 2 gns. extra.
H.M.V. 2620	19	T	70 gns	New Thorn chassis.
2621	19	T	74 gns	Press-button tuning.
2623	23	T	76 gns.	
KOLSTER-BRANDES KV003	11	P	49½ gns.	"Featherlight" mains transportable, see text Silver stone grey cabinet. With u.h.f. tuner, 59 gns.
WV90	23	CE	97 gns.	French walnut and Afromosia veneer. Two 8 × 5 in. speakers. Tambour door. Push-button tuning.
WV80 and WV30 models, previously released, now incorporate transistorised u.h.f. tuner. Prices: 91½ and 81½ gns				
MARCONI 4611	19	T	69 gns.	Thorn 900 chassis. Sapele veneered, slim profile. Main controls front panel.
4612	23	T	76 gns.	Thorn 900 chassis. Sapele veneer. Legs extra, 2 gns., both models. Controls front panel.
MASTERADIO 4002	19	T	68 gns.	Paldao veneer. Dual standard.
4003	19	T	72 gns.	Dark wood cab. striped surround. Both models, u.h.f. tuner.
McMICHAEL 3001	19	T	70 gns.	Dark sapele veneer, gold-fronted panels, black screen surround.
3002	23	T	79 gns.	Both models. u h.f. tuner, instant single-move selection Front controls.
MURPHY V879	19	T	69 gns.	Sapele veneered. Metal legstand extra, 3 gns. Press-button tuner.
V873	23	T	80 gns	Both models tuner 8 gns. extra. Legstand 3½ gns.
V879C	19	C	85 gns.	Two-tone French Walnut. Tambour door. u.h.f. tuner model CU. 93 gns.
V873C	23	C	102 gns	As above. Forward-facing speaker.
PAM 5144/U	23	C	105 gns.	Alternative versions in teak and walnut. Fringe area chassis 2 gns. extra. Push-button controls. Gold trim, white Suwide screen surround. Front-facing speaker.
5141	23	T	68 gns.	Sapele veneer, satin-finish, gold trim. With u.h.f. tuner. 514/U 75 gns. Fringe model 2 gns. extra. Stand £2 10s.
PETO SCOTT TV961	19	T	—	—
TV350	23	T	—	—
PHILIPS 9164	19	T	—	High-gloss burnished polyester cab. Silver trim. Magazine rack stand. Tinted safety-guard c.r.t. Two-speed transistorised u.h.f tuner.
3164	23	T	—	Straight-grained walnut. Nove. rack stand. Two front-facing speakers. Preset 405 tuning. Transistorised u h.f. tuner.
9156	19	T	67 gns.	French walnut cab. Side-mounted 6 × 4 in. speaker. Designed for rental market
3156	23	T	74 gns.	Zebrano veneer cabinet, satin finish, light grey knobs, silver trim. Tinted safety guard screen. Stand 3 gns.
9154	19	T	71 gns	Panorama filter screen tube. French walnut cab., silver trim.
PYE 22U/F	19	CE	79 gns.	Swedish style Afromosia. Silvered contact tuner with fast/slow tuning. Independent u.h.f./v.h.f. picture controls.
23U/F	23	CE	85 gns.	Teak, with black satin aluminium control panel. Shutter control exposing correct standard picture adjustments.
24U/F	19	T	76 gns.	Teak, anodised black aluminium control panel and speaker grille. 4-gang, silver contact tuner. Matching stand £2 10s.
REGENTONE 401	19	T	63½ gns.	Sapele mahogany veneer. Slim lines. u.h.f. tuner,
501	23	T	71½ gns.	both models 7½ gns. extra. Tuner has rotary dial, continuously variable.
R.G.D. RV203	11	P	49½ gns.	Impact resistant polypropylene cabinet, mains-operated transportable, valved chassis, and transistorised u.h.f. tuner 59 gns. 5 × 3 in. speaker. 110° tube.
RV202	19	T	63½ gns.	Waxed teak, with Afromosia stands and magazine racks, both models. Hand-wired chassis. Push button
RV302	23	T	71½ gns.	selection, linear u.h.f. and u.h.f. tuner, 7½ gns. extra.

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TELEVISION RECEIVERS—*continued*

Model	Tube size (in.)	Style*	Price	Features
SOBELL 1002	23	T	76 gns.	Dark sapele cab. Silver screen surround, anodised aluminium control panel, silver controls. u.h.f. rotary tuner. Front speaker.
1000	19	T	Rental	Paldao cab., gold knobs and grille.
1005	19	T	70 gns.	Dark sapele veneer, pale bronze trimming. Legs extra all models.
STELLA ST2113A	23	T	—	Push-through tube. Side-mounted 6 × 4 in. speaker and controls.
ULTRA 6625	19	T	62 gns. (U) 7 gns.	Bermuda model, polyester surface, black control panel, gold-centred knobs. Legs.
6626	19	T	64 gns. (U) 7 gns.	Push-button model, sapele cab. Forward-facing speaker.
6627	19	T	76 gns.	Natural elm cab. With v.h.f. and u.h.f. tuner. Matching stand and magazine rack, 3 gns.
6628	23	T	69 gns. (U) 7 gns.	Dust-free contact lens tube sapele cabinet, grey leathercloth surround, black control panel.
6629	23	T	88 gns.	Natural elm, with v.h.f. radio and u.h.f. tuner, satin gold and black with spun gold knobs. Mag. rack 3 gns. extra.

* C—Console. T—Table. T(S)—Table with optional stand. C/RG—Console with radiogram. CE—Consolette.

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with its tantalising "round-the-corner" promise. This does not mean that development is not going on, and one item of news recently announced was that increased numbers of RCA 25 inch colour tubes are to be made available this year at a reduced price.

The other selling-point which has been played down by the Industry—some say, regrettably—is the growing demand for BBC2: Lord Hill's opening speech stressed the need for greater sales, underlining the trend toward the "second set", and there is some concern in the radio trade about the swelling stockpile of new models.

Price-wise, the Radio Show has done little to send customers rushing to the shops. With the increased accent on the 23 inch screen, models on display being divided roughly between 19 and 23 inch, and a levelling of add-on facilities, the price of a 23 inch set is only little more than that of a 19 inch model. Greater accent has been upon development, rather than price-cutting.

As a final example, Thorn/AEI are still juggling with circuits to improve interlace and prevent line pulse breakthrough, using now a diode in their experimental designs. And their 900 chassis, used on many different models, is quite obviously aimed at eventual transistorisation. ■

VIDEO MONITORS

—continued from page 57

should be kept as short as possible and the 9V supply should be connected to the board, negative as near R8, R9 as possible and positive as near R7 as possible. The battery used must always be in good condition because as soon as it begins to run down it will increase its internal resistance, and this internal resistance affects the performance of the amplifier.

If the wiring is correct the amplifier will only require the initial balancing of Tr2 and Tr3 drive currents. The amplifier output must not be terminated or the input connected to the camera when setting up VR2. Connect a low reading voltmeter between Tr2 and Tr3 collectors and adjust VR2 for zero or minimum volts. Tr2 and Tr3 collectors can then be joined with the links and VR2 will require no further adjustment. The amplifier is now ready for use.

VR1 on the distribution amplifier is used to set the output for a particular camera, and must be set, using an oscilloscope, to provide 1V composite video peak to peak across the 75Ω output load (R10). This output should not be set above 1V, otherwise sync crushing and peak white limiting may occur.

Fig. 5 shows a block layout of an amateur television station using the distribution amplifier (DA). DA1 takes a direct video feed from the camera at high impedance and converts to 75Ω. Video monitors 1 and 2 are unterminated and high impedance, and the coaxial feed bridges these

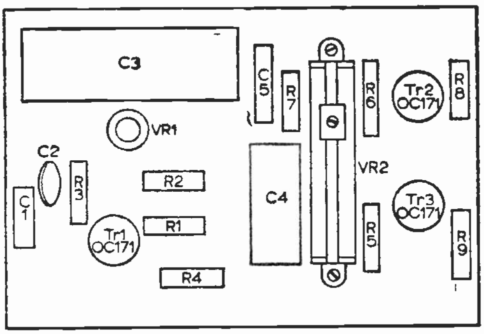

Fig. 6—A suggested layout for the distribution amplifier, for either printed circuit or conventional wiring.

monitors to the transmitter. Because the transmitter is at the end of a cable run, the cable must be terminated at the transmitter by 75Ω.

Other equipment items can be, if required, bridged into the circuit. This method of coupling equipment is extremely simple and for the amateur station has no serious limitations.

DA2, shown dotted, is an identical amplifier to DA1 and can, if required, provide a second completely isolated signal feed to that of DA1 output. The input of DA2 is in parallel to DA1. The advantages of using an isolated source output only becomes apparent in large equipment layouts, where many feeds of the same source are needed. ■

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

ONCE again as I write these words (mid-September) very long distance reception via Sporadic "E" propagation continues to be very poor. The July "lull" is unfortunately still continuing and the reception reports both from here and the Continent do not give us any great encouragement at the moment.

I am, however, always an optimist (essential for DX success!) and I feel that towards the end of September and the start of October we may well have a return to better conditions for this class of reception; this has happened before and can well happen again this year.

The Tropospheric front has been more rewarding. Conditions really have at last improved, the warm late August and early September days have been followed by the cooler evenings and nights. This, during periods of relatively low wind velocity, has produced the necessary conditions for temperature inversion and the production of layers of air of different densities and temperatures which are conductive to tropospheric refraction of signals, particularly in Band III.

We have had many interesting reports of reception in this band. **Charles Hopkinson,** of Malton, Yorks, has received Sydjaelland, Denmark, Channel E6, on September 5th, 1964. **Jim Snelling,** of Southampton, at about the same time had two good RTF catches—namely, Clermont-Ferrand on Channel F6v and Metz-Luttanges on F6h, and I myself have had Strasbourg F5h and Rheims-Haute Villiers F6v in addition to those above.

The technique used for the RTF stations was to note when reception of the more regular Band III stations appeared to be good, to accurately position the aerial array in the direction of the required station, then to sit back and wait with the set tuned to the required frequency. In due course our patience was rewarded.

During the coming weeks, when tropospheric conditions should show further improvement, it will pay to adopt a similar plan for your attack on certain "possible" stations you wish to log. Haphazard viewing will not very often produce the desired results.

Before long I expect that we will be getting those foggy evenings that we DX-ers long for, much to the chagrin of our motoring friends! Fog really does bring in those tropospheric signals, so get organised now, make sure that the receiver is capable of its maximum performance and that you know the calibration of the various channels accurately so that you can pretune the set with confidence that the frequency is correct.

Also, before the bad weather sets in, your aerial arrays should be overhauled with particular reference to the connections.

MYSTERY SIGNALS

Once again we have some of these to report. On about 50Mc/s. a new test card has been reported from various sources. This card is somewhat similar to the standard card of Czechoslovakia but with no lettering and with two shaded bands, one above and one below the circle running horizontally.

It is possible that this card originates from Finland since the Y.E.S. organisation there are, it is understood, opening new transmitters. There are two organisations in Finland—the Y.E.S. and the T.E.S. The test card of the latter (with the letters T.E.S.) has been frequently seen on Channel E2 and this new one could be from Y.E.S.

Reports from **C. Hopkinson,** of Malton, Yorks, tell us that he has seen the R.T.P. Portugal standard test card on Channel E2. At present the only Portuguese Band I station listed is, of course, Coimbre on E3, so this must be a new one. More details as soon as I have them. Has anyone any information to add to the above? If so I will be delighted to hear from them.

READERS' REPORTS

We have again had a number of interesting reception reports from our readers, for which many thanks. Here is a selection:

R. D. Watkins (Birmingham) followed our suggestion of possible reception of R.T.F. France via Sporadic E and he has logged Limoges-les-Cars on Ch. F2 in addition to his excellent log which included Spain, Italy, Switzerland, Russia and possibly Czechoslovakia.

J. Grant McLennan (Glasgow) has logged Grunten (West Germany) on Ch. E2, Bydgoszcz (Poland) on Ch. R1 and Budapest (Hungary) on R1.

G. A. Raby (Preston) has turned in an excellent log with T.V.E. Spain on E2, E3 and E4, Portugal on E4, France on F2 and F4, Italy on Ia and Ib, Switzerland on E3, West Germany on E2, Sweden E3 and E4, Norway E3 and E4, Russia on R1 and R2 and Jauerling (Austria) on E2a.

Desmond Kelly (Banbridge, N.I.) is another DX viewer who has received R.T.F. France via Sporadic E on Ch. F2.

Ian Uden (Strood, Kent) has had **Russia** on Ch. R1 (identified by a test card photograph that he sent to us). He has also had Roumania, Spain, Norway, Finland and Italy, and (in Band III)

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CHANGING CATHODE RAY TUBES

PART 8: PHILIPS GROUP —110° MODELS

By H. Peters

THIS is the last of the major groups to be covered by the present series. It comprises the brand names Philips, Stella, Cossor, and Peto Scott. The latter two joined the group in the period covered by this article, but in the case of the Cossor Brands, the last of the true Cossor chassis (type 950 etc.) is similar to model 948, replacement details for which were given in our first series (PRACTICAL TELEVISION, page 126, December, 1959).

The basic Philips chassis styling has been carried through the last five years and comprises a hinged framework with the valves usually facing inwards. The majority of components can be reached without any major dismantling and so the remarks about chassis removal need only concern readers who are replacing the tube, or in need of access to the tuner.

A novel feature of the printed panel chassis is the inclusion of "drop off" resistors which melt their solder and fall if overheated.

These, of course, have no bearing on the c.r. tube replacement except that they have a habit of falling off as the chassis is disturbed, especially if they have been overheating.

BASIC MODEL 17TG100U

Chassis Removal

Swing open the chassis by unscrewing r.h. hatch. Remove e.h.t. cap, c.r.t base connector, slacken and remove deflector coils from tube neck, unplug chassis, earth wire and speaker leads. Remove lower hinge fixing screw, raise the hinge and remove the chassis.

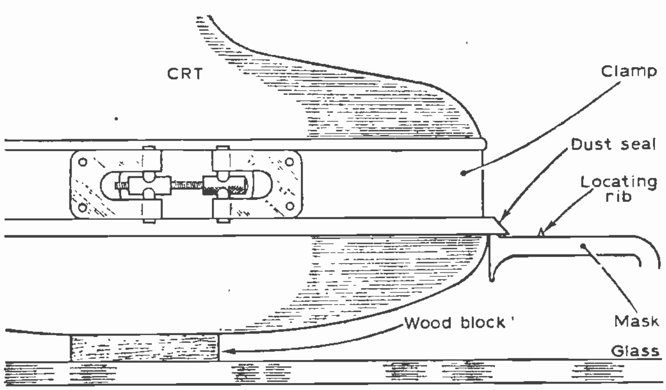


Fig. 1—Tube replacement diagram for the 17TG100U. The wood block fitted to ensure correct spacing between the c.r.t. and the glass should be 7mm thick.

C.R.T. Removal

Remove loudspeaker and escutcheon, also tuner escutcheon. Lay cabinet face down on a soft cloth. Remove screws and brackets in each corner and lift out tube and clamp. Clean all parts thoroughly.

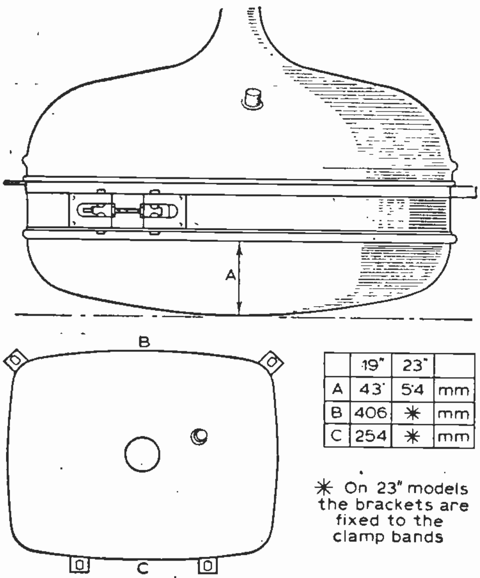
When refitting, lay a block of wood 3in. square and 7mm. thick on the safety glass and fit the new tube in the mask so that it rests squarely on the block. Fit the clamping band, pressing well down, and tighten up. Lift out the tube and clamping band, remove the wooden block and refit the tube. Refit the corner clips and tighten in turn until the tube is firmly and squarely mounted.

BASIC MODEL 19TG111A

Chassis Removal

Remove back, detach remote control and mains input brackets (2 screws each in slotted holes). Remove the three control knobs and detach the control panel inside the front moulding. Disconnect e.h.t. cap, c.r.t. base connector, and speaker plugs, Unsolder the c.r.t. chassis bonding link from the scancoils.

Remove the correction ring where fitted around



	19"	23"	
A	43	54	mm
B	406	✳	mm
C	254	✳	mm

✳ On 23" models the brackets are fixed to the clamp bands

Fig. 2—Critical measurements to be observed with the 19TG111A series.

the tube neck, slacken and remove scancoils. Unclip chassis retainers and light dependent resistor and lift chassis up off hinged plate.

C.R.T. Removal

Lay cabinet face down, detach the earthing lead assembly on 19in. sets. Remove four screws holding the tube clamp and remove tube and clamp.

On 23in. sets slacken the wingnuts, and slide back the wedges on the support rods and remove rods from clamp brackets. Four screws release the nylon adjusting blocks after which the tube and clamp may be lifted out.

Re-fitting

Check that the dimensions in Fig. 2 are observed when re-fitting the tube. Make sure all parts are clean before re-assembling.

BASIC MODEL 19TG121A

Chassis Removal

Remove the mains, control and aerial panels. Release the tuner (1 screw and a cleated cable). Pull off the three control knobs, and detach the control panel (two screws). Remove e.h.t. cap, base connector and chassis leads, unplug loudspeaker. Slacken scancoils and remove two chassis fixing screws from below the cabinet.

Pull the bottom of the chassis out until the top clears the retaining pegs. Ease out further—slowly

Peto-Scott	Cossor	Stella	Philips	Type	See Under	C.R. Tube
	CT1700U	ST1017U	17TG100U	17" Table	17TG100U	AW43/88
			17TG102U	”	”	”
			17TG106U	”	”	”
			17TG200U	17" Fringe	”	”
		ST3017U	17TG306U	17" with F.M.	”	”
		ST1029U	19TG108U	19" Table	”	AW47/90
TV944*	CT1901A	ST1039A	19TG111A	19" Table	19TG111A	AW47/90
TV943*			19TG112U	”	”	”
			19TG114U	”	”	”
	CT1922A		19TG121A	19" Table	19TG121A	AW47/91
TV945A		ST1049A	19TG122A	19" Table	19TG122A	”
			19TG123A	”	”	”
	CT1921A		19TG125A	”	19TG121A	”
			19TG133A	”	19TG122A	”
TV949A	CT1935A	ST1089A	19TG142A	”	”	”
TV959A	CT1938A	ST2019A	19TG148A	”	”	”
	CT2100U	ST1011U	21TG100U	21" Table	17TG100U	AW53/88
			21TG106U	”	”	”
			21TG109U	”	”	”
		ST1023U	23TG107U	23" Table	”	AW59/90
	CT2310A	ST1033A	23TG111A	”	19TG111A	”
			23TG113A	”	”	”
	CT2321A	ST1043A	23TG121A	”	19TG121A	AW59/91
TV239			23TG122A	”	19TG122A	”
			23TG131A	”	19TG121A	”
TV249			23TG132A	”	19TG122A	”
			23TG142A	”	”	”

*= Near equivalent.

Alternative Philips numbering

1914 = 19TG114U
9121 = 19TG121A
9122 = 19TG122A
9123 = 19TG123A
9125 = 19TG125A
9142 = 19TG142A
3121 = 23TG121A

—until chassis, scancoils and tuner (all attached) are free of the cabinet.

C.R.T. Removal

19in. models—Lay cabinet face down, remove chassis bonding link and four screws holding the c.r.t. clamp bracket. Remove tube and clamp and replace clamp parallel with face and spaced at 43mm.

23in. models—Lay cabinet face down. Remove chassis mounting brackets and detach the four nuts or bolts holding the tube and frame. Remove tube and cradle by a series of angular movements.

Slacken the clamp bolt on the tube clamping band, remove the four corner straps and hinge the wire band clear of the tube. Separate the tube from the safety glass and frame.

When reassembling prop each corner of the mounting frame about 3in. above the bench. Fit the safety glass to the frame and lower the c.r.t. into the rubber seal. Swing the wire band into place, attach the corner straps, replace all the tube packing and straps. Tighten the clamp bolt until adjacent coils of the tension spring are just touching. Re-fit the assembly to the case with the two hinge straps near the cabinet bottom, and e.h.t. connection furthest from the loudspeaker.

BASIC MODEL 19TG122A

Chassis Removal

Release mains and aerial panels. Remove the control knobs and the control mounting plate. Release the tuner unit, held by one screw. Detach the e.h.t. cap, c.r.t. base connector and bonding leads from the tube assembly and unplug the loudspeaker. Slacken the scancoils and remove the two chassis fixing screws beneath the cabinet.

Remove the chassis (bottom first) assisting the scancoils off the end of the tube neck until the chassis complete with tuner and scancoils attached is released from the tuner.

C.R.T. Removal

19TG122A
23TG122A } **See 19TG121A**

19TG123A—Lay cabinet face down, remove chassis bonding link, remove four corner fixing screws, and lift out the tube and cradle complete.

In place of the usual safety glass, the tube is protected by a Cornehl safety hood, which is in appearance similar to transparent sheeting. Release the hooks retaining the hood, and remove the clamping band. Separate the tube from the hood taking care not to scratch or finger it unduly.

Clean the inside using a soft brush. Thread a 5ft. length of tough waxed string through the eyelets as per Fig. 3. Warm the hood (do not use warm water) and place on a soft cloth. Whilst the hood is still warm, insert the tube, and pull string tight. Smooth out the hood from centre of tube face outwards, and tighten string tourniquet fashion as in Fig. 3. Refix clamp and brackets 43mm. from face whilst hood is still warm.

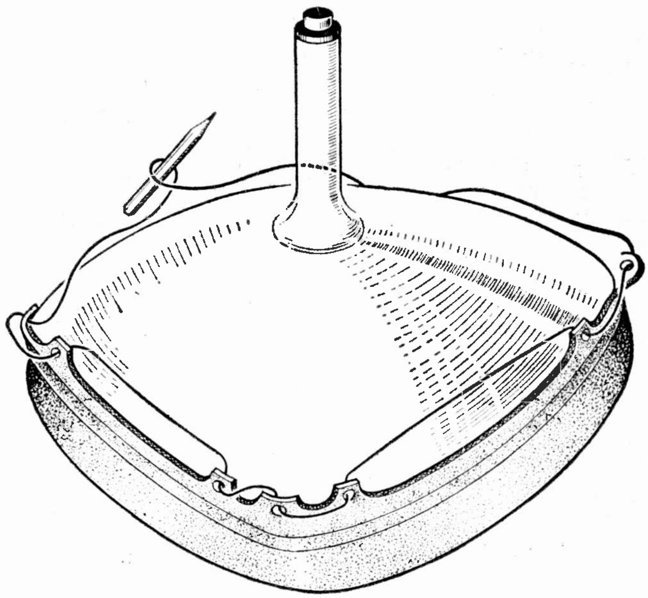


Fig. 3—Refitting the Cornehl safety hood to the latest type of tube.

When cool slacken the clamp, refit the ten hooks, and tighten up again. Refit tube cradle to cabinet. Check and adjust height of clamp brackets if necessary before finally tightening down.

A Last Word

The preceding article represents the conclusion of the series. In addition to the c.r.t. tube changing information, readers may feel that it has helped them to obtain equivalent circuits for their models by reference to similar chassis types marketed under other brand names.

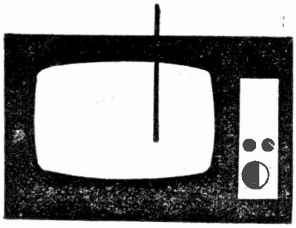
In the Philips article, details are given of the re-fitting of the new Cornehl implosion guard. This will also be found in some of the new receivers using the Thorn 900 "cool" chassis.

Another new development in c.r.t. tubes which will be encountered in next year's receivers are the *Panorama* and *Rimguard* implosion-proof tubes which need no protective screen, and have the cone covered by a glass fibre and polyester skin. The rim of the face plate is protected by a metal shell with fixing lugs.

Like their predecessors with bonded face-plates these tubes are rather expensive to replace. A typical example costs £19 5s. 0d., and this factor should be borne in mind when considering the economics of subsequent servicing at the time of purchase of a new receiver. ■

A MONTHLY COMMENTARY

Underneath the Dipole



BY ICONOS

IT seemed natural that the Ivor Novello play series on BBC-1 was followed up by a Noel Coward series on ITV. Both of these versatile playwrights were also musicians, composers, lyric writers, actors and producers, and both achieved many successes in the theatre twenty years or so ago, and in films, too. As I mentioned in this column previously, I thought that the BBC's Ivor Novello series presented a number of disappointingly faded extracts from Novello's colourful musical spectacles which were, however, supported by good interviews and reminiscences by the actors who originally played in them and by other friends. The scrap-book idea would have been much better if the musical sections had been produced on a more elaborate scale. Noel Coward plays, with the Master himself giving short introductory speeches, were more satisfying—but not quite good enough. *Present Laughter* and *Blithe Spirit*, for instance, were stage plays which had long and successful runs in London theatres, preceded and followed by provincial tours and revived from time to time by repertory companies. As directed for television by Joan Kemp-Welch, the pieces seemed rather stagy and restless, with actors constantly on the move from chair to chair, door to door and O.P. to promptsides of the not very convincing settings. One of the essentials of good acting on the theatrical stage is that such moves should appear effortless, natural and relaxed, and this applies also to TV production.

Movement: Too Much or Too Little?

Plays which are packed with the cut-and-thrust of smart dialogue and in one or two settings, need movement too, otherwise the actors become shop window dummies. The stage director often gives meticulous instructions to the players on the required movements, but it is the art of the actor that conceals by motivation the mechanical effect, and in this respect I thought that Griffith Jones, Helen Cherry and Hattie Jaques succeeded very well in *Blithe Spirit*. Hattie Jaques seemed to model the part of Madame Arcati, the clairvoyant, upon the familiar eccentricities of Margaret Rutherford, and a highly entertaining performance it was. The Coward series of plays obtained reasonably good TAM-ratings, which is more than can be said for most of the plays on TV which do not form part of a series. Viewers seem to like series plays, especially when they get to know the characters in the stories and the actors that play in them. It is not necessary to take up time in introducing them individually. The writer and director can, therefore, get down to the story line without delay, building up the complications, red herrings, drama and comedy without further ado. Also, if the viewer doesn't like the mixture as before, he can switch off equally quickly.

Caleb Cluff

Policemen, hospitals, detectives, doctors, police stations, casualty wards: there seems to be no end to the permutations and combinations of the plots which have to be contrived week by week with the same central characters. There are times when the story-lines of BBC's *Cluff* series are not too easy to follow, but the first sight we see of Sergeant Caleb Cluff, C.I.D. man at the Yorkshire town of Gunnershaw, who appears on the title background, sets our minds at rest. Here is a new type of detective who strides over the moorlands accompanied by his faithful dog, watchful for clues of an astonishing amount of criminal activities which seem to afflict the small town. The plots may have been highly improbable, but were elucidated by the excellent cast, headed by Leslie Sands as Cluff and Eric Barker as the bad tempered Inspector Mole, also ably supported at the Gunnershaw Police Station by John McKelvey and John Rolfe as constables, uniformed and plain-clothed respectively. The friction between Cluff and Inspector Mole provided comedy relief which did not seem at all out of place in some of the rather grim stories. There were occasions when continuity seemed lacking, however. In the middle of some situations there were unexpected cuts to entirely different scenes which gave viewers mental somersaults for a few seconds before they realised that a door had been opened in an entirely different room. This change used to be indicated by quick dissolves or wipes, a convention which provided a reasonable punctuation in the continuity of a story. However, *Cluff* was good entertainment, and I hope it will be continued by Gil North, who wrote it, and Terence Dudley, who directed. Technical qualities were first-class, especially the exterior scenes which were filmed and

gave a real open-air atmosphere which was refreshing.

Promotion for Jack Warner

The strong arm of the law strikes again!

It seems to have taken a good many years for Dixon of Dock Green to attain promotion. At last he has got his stripes as a Sergeant, which accounts for Jack Warner's friendly grin. The image of a reliable and likeable London policeman really commenced in films, when Jack Warner played a leading part in T. E. B. Clark's screen play *The Blue Lamp*, a film made partly at Ealing Studios (now operated by the BBC TV Film Division), and partly on exteriors in the Paddington area. It was a tremendously successful film, and the fact that P.C. Dixon was shot by a crook (played by Dirk Bogarde) outside the Coliseum Cinema, Harrow Road, half-way through the film, led to Jack Warner being asked to continue to play the part of a policeman on radio, films, the stage and on television for many years. This is his 11th TV series. Previously he had appeared as a railway engine driver (in *Train of Events*), also in every kind of uniform in the three services, and as a prisoner of war, apart from many parts in mufti, including the Huggett family series on films and radio.

What follows the kitchen sink?

Hard words have been spoken about live-theatre kitchen sink drama in the last few weeks. Some newspaper critics, satiated with a full diet of plays and musicals of all kinds, seem to have acquired a taste for productions which are as off-beat as well-hung grouse, game or matured cheese. Nevertheless, theatrical experiments in this field have attracted audiences to specialised theatres and cinemas of the arty-crafty-type. On television, appeal to the minority audiences which have acquired the taste for off-beat (and sometimes off-colour) TV plays seems to be falling off. Satire has been over-cooked and over-done. The puzzle for programme controllers is to find new forms of presentation, new themes and strong stories which hold, and which do not give the impression of being "dated" just because they have well-constructed plots with satisfactory beginnings and endings. Television is most effective as a close-up medium enabling characterisation to be effectively put over without resort to that robust form of acting known as "hamming". A good performance by an actor often has such a strong impact that it covers up shortcomings of the dialogue and plot of a TV play.

These shortcomings include bad construction in continuity of scripting; ends without an end—and, for that matter, "Act Two's" which lead nowhere, and kitchen sinks which have no plumbing. The puzzle is—now that the sordid gloom craze is on the wane—what is going to take its place? Let us hope that it will be bright, cheerful and humorous without being dirty. With this approach, I think, ITV will lead the way and ring the bell in the TAM-ratings.

Diary of a Young Man

BBC TV did evolve a new set of very original conventions for the *Diary of a Young Man*. The visual diary, in the form of an odd combination of live sequences, filmed scenes with commentaries, still photographs, sub-titles and voices-off, was quite a refreshing mixture of techniques wasted on the stale and sour subject. We have had so much down-beat material from the BBC about beatniks, layabouts and teenage delinquents, that it seems a pity to waste new ideas on themes which are merely variations of the worn-out kitchen sink. Kennedy Martin and John McGrath have evolved interesting techniques in this series, but new conventions in TV or film presentation are absorbed slowly by viewers, who become bored with quick cuts, quick changes of rhythm, and intentionally interrupted continuity. Some of the techniques were little more than professional jokes, highly appreciated by fellow producers and writers in television production—and also the TV critics of newspapers. Still, this *Diary of a Young Man* was a good attempt to break new ground. The same kind of biographical treatment would gain more viewers if the subject matter was more attractive.

Colour Compatibility

As time goes on, colour TV seems to be further away than ever in this country. Complications arise, of course, with the developments and improvements to each of the three main systems; N.T.S.C. (U.S.A.), S.E.C.A.M. (French), and P.A.L. (German), not to mention the individual modifications and improvements proposed by the BBC and ITV, whose contributions have mainly come from A.B.C.-TV. There is the question of compatibility of one or other systems when reproduced on black-and-white receiving sets. There are also the problems of transferring signals from 525 lines 60 cycles to 625 or 405 lines 50 cycles and vice versa, together with the possibility of using 629 lines as a kind of catalytic agent. It is easy to be wise after the event, but if the reintroduction of television in Britain had been delayed for an additional year or so there would have been more time to reconsider the line and other standards. The industry is wise in taking time in agreement on world standards, when some kind of interchange of material can be achieved.

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a series for the intending professional serviceman

The business of SERVICE

PART 3

by John D. Benson

CONTINUED FROM PAGE 23 OF THE OCTOBER ISSUE

REFERENCE has been made to receivers on rental. Businesses which specialise in the renting of receivers are generally large concerns, backed by a great deal of capital. Small firms have also got to offer the choice of renting, from a competitive point of view.

Rental conditions call for capital outlay with small returns during the early years of life. It is imperative then, that the maintenance of these receivers be kept at the lowest possible figure which in turn calls for systematic and speedy servicing.

CUSTOMER CALLS

As already mentioned, this is why obvious faults on rented receivers should be carried out on the customer's premises to obviate loss of time. In most cases, however, it is still the best policy to replace the faulty receiver and carry out repairs in workshop conditions.

Tact is one of the service engineer's major assets. It is obvious that if an engineer enters a customer's house and voices disparaging remarks about the type of receiver the customer owns, it is not going to lead to good customer-business relationships! Tactful approach can elicit a great deal of useful information regarding the performance of a receiver, which can be very helpful in quick diagnosing.

Television Aerial

The television aerial is always very much of an unknown quantity and should always be checked. A field strength meter is the ideal answer, but as these instruments are costly they may be outside the scope of the new business.

A very reliable check on the folded dipole type aerials can be made by using the ohmmeter section of a multi-range testmeter. A good aerial will show a dead short under all conditions, i.e. strong winds, etc. Loose joints will be indicated by flickering movements of the pointer.

For straight dipole aerials it is worth while instructing the erectors to fit a 1kΩ resistor between the elements of the aerial—the ohmmeter test can then be applied and the aerial checked for faulty connections. It is a procedure that has saved many hours of time in the past.

Where aerial faults are suspected, a friendly neighbour's aerial can always be used as a check, again saving valuable time. Having ascertained that the aerial installation is not at fault, don't forget to check co-axial plugs for dirty or dry joints. Now the receiver can be returned to the workshop for examination.

Planned Journeys

A number of collections will be made during one journey, and much time can be saved if the route is planned before starting, to obviate covering the same ground twice. The time fixed for calling at cusomers' homes should always be strictly adhered to. Punctuality is an admirable reputation builder.

WORKSHOP FAULT-FINDING

In the workshop, the faulty receiver should initially be placed on the bench and with the back removed, should be connected to aerial and mains supply, and switched on. This procedure is important; if the receiver is cleaned or disturbed in any way *before* a test is run, indications of the cause of the breakdown may be obliterated.

Intermittent faults especially, come under this rule—for example, a lead may have become displaced and the insulation punctured through contact with some component running at high temperature. Again a valve may have worked loose in its holder—if cleaning is carried out first, the action of cleaning may be accredited with the cause and so the original fault is lost.

Service Data

It should be the apprentice's job to see that the service data is provided for each repair brought into the workshop and left with the particular receiver so that the service engineer has all the necessary information to hand, and this can be studied whilst the receiver is warming up. It is this attention to detail in servicing which makes all the difference between profit and loss.

Cleaning the Receiver

After the initial inspection the receiver should be thoroughly vacuum cleaned; a brush made of hens' feathers is ideal for getting into corners without causing damage. This job can be carried out by the apprentice while the service engineer checks up on finished receivers which are on soak test on the test bench. With the receiver free from dust and soot, it is ready for the engineer to commence work on.

Data Sheets

A television receiver can only be serviced efficiently if its construction and the functions of the various sections of which it is composed are thoroughly understood (vision and sound units, timebases, c.r.t. with Scan assembly, power unit). If the receiver is thought of in this way instead of as a complicated mass of wires and components, then the fault can be quickly localised without waste of time.

One of the principal uses of data sheets is the exact location of components which, according to the manufacture may be disposed of in the most unlikely places. There are engineers who profess that they can work on any type of receiver *without* service data. That may be so, but at best it can only be inspired guesswork and is certainly not the most efficient way.

SYSTEMATIC FAULT-FINDING

Let us now imagine that a receiver has had its initial check without finding any obvious fault, and therefore proceeding step by step, a systematic method of locating faults will be described.

With mains supply connected, after checking that the *correct* tapping is being used—this is very important—and the aerial connected to the receiver, the set is switched on and allowed to warm up. If there are no signs of the valves heating, switch the receiver off and starting at the mains connector, check if the voltage is present there.

If correct, reconnect to receiver and switch on: test that the current is passing through the switch, and if satisfactory proceed to test that current is passed by the fuses. If this proves correct, we pass on to the mains dropper and thermistor, proving that the current is passed by these components.

If the test is now positive, we know that an open circuit has occurred in the heater chain. The c.r.t. is the first obvious check, having first switched the receiver off. If sound continues, by using the ohms section of the multi-meter, proceed systematically to check all the heaters of each valve until the offender is found and replaced.

This may be the answer to all the troubles, but for the sake of this exercise, we will imagine that this particular receiver is suspected of having faults in all sections and proceed accordingly.

With the faulty valve replaced, the receiver is switched on, and we watch the heaters come to life, giving a few minutes for the working temperature to develop, the h.t. is measured at the smoothing capacitor and checked against the maker's figures.

Whilst doing this, the smoothing and reservoir capacitors are examined for visible signs of leaking or unusual bulges, which are certain indications that replacements are necessary in spite of the fact that the receiver appears to be functioning correctly.

Failure to replace will only defer the inevitable breakdown which will probably occur before the three months guarantee has expired and so give rise to an awkward situation and a dissatisfied customer.

Having checked that h.t. is correct, the sound control can be turned up, having first ascertained that the fine tuner is correctly adjusted. Result—no sound. The first step is to check that the sound output stage is working, so with test meter adjusted to low volts, the cathode voltage is checked and found to be non-existent, which immediately indicates that the valve is drawing no current.

With the receiver switched off, the primary of the output transformer is checked and found to be open circuit. Had the cathode voltage proved normal, then the indication would be an open speech coil.

Having fitted a new transformer, the receiver is again warmed up and welcome sounds issue from the loudspeaker, but the volume is far below standard, with distortion present. Again measuring the cathode voltage of the output valve, it is found to be excessive. Systematically the engineer moves to the grid of the valve and finds a positive voltage present.

The coupling capacitor has developed a leak; the faulty component is replaced and although the volume is greatly improved, there is still harsh distortion present. The noise limiter immediately comes under suspicion and a component check shows that the bias feed from h.t. has gone excessively high, causing incorrect bias to be applied to the limiter. The offending resistor is replaced and the engineer's ears are gladdened with a now undistorted output, but still volume is not up to standard.

As there remains only the i.f. amplifier valve circuits to check, a quick test of the cathode, screen and anode voltages, proves that the valve is not delivering its correct output due to low emission, and requires replacement.

NEXT MONTH'S ARTICLE WILL CONTINUE WITH THE CHECKING ROUTINE AND DEAL WITH TRANSISTORISED EQUIPMENT

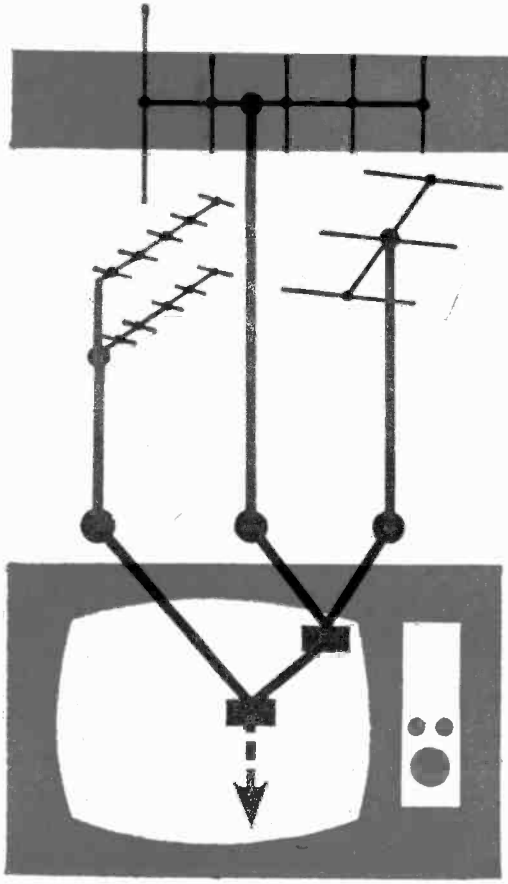
DX-TV

—continued from page 62

N.T.S. Markelo (Holland) on Ch. E7 with test pattern.

P. Wright (Andover, Hants) has had the "mystery" test card mentioned above as possibly Y.E.S. Finland in addition to reception from Spain, Czechoslovakia, Norway, Sweden and France. All on a combined Band I/III domestic aerial, so it can be done!

Just a final note that the hoped-for coming tropospheric period will equally apply to u.h.f. reception when it arrives as well as for Bands I and III. We hope you will be letting us have some u.h.f. reports before Bands IV and V get cluttered up with local transmitters!



MASTER TV/F

GORDON J. KING

NOW that u.h.f. television is getting underway, viewers are finding themselves with two sets, the old BBC1 and ITV model and the new dual-standard model. The reason for this is that the part exchange price offered for the old model is often so small that the viewer finds it advantageous to keep the set if only to delegate it to the kitchen, bathroom, bedroom or garage.

The two-set household now comes up against the problem of obtaining aerial feeds for both sets. A solution which may appear to be the most obvious is to erect or have erected a second set of aerials.

For viewers located near the transmitters, this is quite a feasible solution, for probably a very simple and inexpensive set-top, wall-mounted or attic aerial will supply the set with good-picture signals on all the local channels.

DUPLICATION UNNECESSARY

However, in areas where chimney-mounted aerials are needed, a duplication of these would be both expensive and unnecessary; that is, assuming sufficient extra chimney space could be found to cater for the second set of aerials.

Instead of a second set of aerials, the existing aerials could be turned into a "master aerial system". A master aerial system is one which is designed or arranged to feed the signal to more than one receiver.

Such an exercise must be handled with technical care if good sound and pictures are to be maintained on both receivers. The system must provide each connected receiver with a strong enough signal on each channel without upsetting the characteristic impedance of the cable.

Television sets are designed to work on the Band I and Band III v.h.f. channels (for BBC-1 and ITV) with an input signal of about 500μV and on the BBC-2 (u.h.f.) channels with an input signal of about 1,000μV. They will work with smaller signal levels, but then, depending upon the type and sensitivity of the receiver, the picture may be marred by snow or grain effects, which is an indication that the aerial signal is of inadequate strength to outweigh the noise signals generated in the tuner.

Moreover, British sets are designed to "see" an impedance of 70/80Ω across their aerial sockets. If this impedance is not maintained there may be troubles from "ghosting", due to the signal being reflected up and down the aerial cable, and there will almost certainly be trouble from poor definition and, in some cases, from instability.

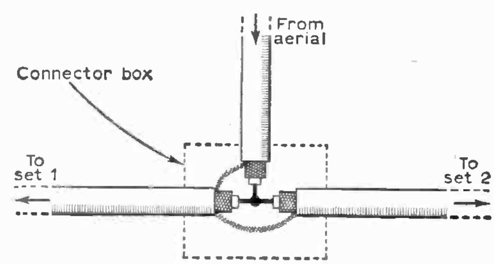


Fig. 1—Coaxial cables should never be connected in this way. This results in mismatch, standing waves and signal reflections.

SYSTEM REQUIREMENTS

Thus, the master aerial system must present an impedance of 70/80Ω at each outlet and it must also provide signal levels at each outlet of about 500μV on the v.h.f. channels and 1,000μV on the u.h.f. channels. In addition to these basic requirements, each outlet should be isolated from both the inner and outer conductors of the coaxial cable by

AERIAL SYSTEMS

capacitors not exceeding 0·005μF and possessing a 250V a.c. rating.

Isolation is needed to prevent damage should the isolating components in connected a.c./d.c. type receivers fail. It is also a good idea to bond to a good earth the output conductor of the coaxial cable network.

In an endeavour to work two or more sets from one set of aerials, it has been known for viewers simply to connect each outlet in parallel, as shown in Fig. 1. They have then been dissatisfied with the results and have written in to seek advice from our query service.

When coaxial cables are connected in parallel their terminal impedance is reduced and the loading to each circuit is also disturbed. Two 80Ω cables, for instance, would "look" like 40Ω when parallel-connected and like 160Ω when series-connected.

This "mismatch" would not only tend to give

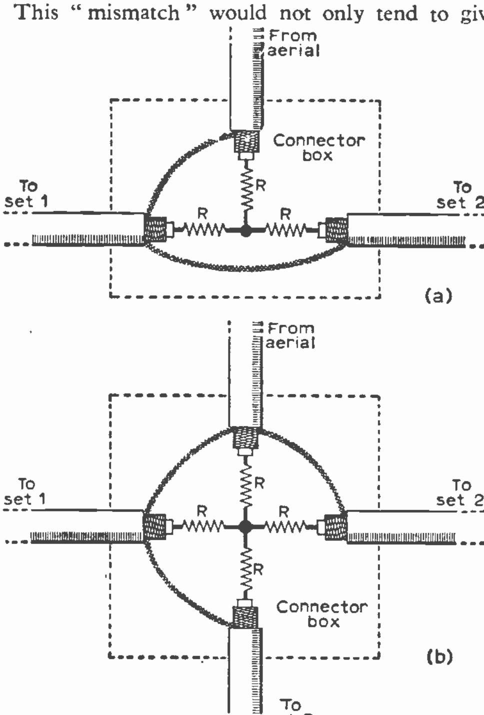


Fig. 2—Connections to more than one set from a common aerial system should always be made through resistors, as shown at (a) for two outlets and at (b) for three outlets. The value for R can be found by a simple calculation as detailed in the text.

the shortcomings mentioned above, but precious signal energy would also be lost. The system would tend to be unpredictable, in that the length of the cables would be critical and severe unbalance of sound and vision may result.

SPLITTERS

All these troubles can be overcome simply by the use of resistive "splitters" and matching devices. The least complex condition arises when it is required to feed just two sets from one aerial, and a suitable splitter for this requirement is shown in Fig. 2(a). A splitter for feeding three sets is shown in Fig. 2(b).

The common factor with all splitters of this kind is that in series with the inner conductor of each feed cable and the aerial cable is interposed a resistor. These resistors ensure that when each cable is terminated by a load (i.e., television receiver or the aerial itself), each signal outlet "looks" like the characteristic impedance of the cable.

This means, then, that should one set be unplugged from such an outlet a resistor equal to the characteristic impedance of the cable should be connected across the socket in place of the set. If this is not done, there will be a mismatch at the set (or sets) which remains connected.

Note, however, that a connected receiver does not need to be switched on to secure the correct "loding" effect.

The value of each resistor in the splitter is important, of course, and it depends upon the number of outlets required and the characteristic or loading impedance of each one and also of the aerial. However, since the characteristic impedance of the aerial and set-feed cables are equal, all the resistors will have like values, and R (Fig. 2) can be found from the simple expression:—

$$R = \frac{Zo(n-1)}{n+1}$$

where Zo is the characteristic impedance of the cables and n the number of outlets.

Thus, with a two-outlet splitter with an all-round impedance of 72Ω, R would be 24Ω, while for the three-outlet arrangement it would be 36Ω.

There is no limit to the number of matched outlets which can be obtained from this type of splitter—often called the "star splitter"—provided the insertion loss can be tolerated or countered, as we shall see. The resistors should be of the non-inductive carbon, insulated type of $\frac{1}{4}$- or $\frac{1}{2}$-W rating. The preferred value nearest the calculated value is suitable—giving 22Ω for two outlets and 33Ω for three outlets.

The splitter assembly is best made up in a small metal box, and to avoid the cable impedance being affected unduly, the resistor wire ends should be as short as possible. For u.h.f. work, the capacitances must also be kept very small indeed to prevent the signals from bypassing the resistors and travelling instead via the capacitance!

In this respect, shielding between the input and the outlet sections is desirable, provided this is arranged so that inductance is not added to the network.

The loss to the aerial signal offered by the splitter depends upon the number of outlets. With a two-outlet splitter, the aerial signal is divided by two, which means that each set receives only half the signal as picked up by the aerial. A three-outlet network divides the signal by three and a four-outlet network divides the signal by four, and so on.

INSERTION LOSS

Insertion loss is often given in decibels. 6dB loss, for instance, means that the signal voltage is divided by two. Thus, a two-outlet splitter has a 6dB insertion loss. A three-outlet version about 9dB loss, a four-outlet 12dB, a five-outlet 14dB, a six-outlet a little over 15dB, a seven-outlet 16dB, an eight-outlet 18dB, a nine-outlet 19dB and a ten-outlet 20dB.

The decibel values given are only approximate. They originate from a logarithmic law, whereby they are obtained by multiplying the common logarithm of the number of outlets by twenty.

This insertion loss is the price that has to be paid for maintaining a correct impedance match at each outlet, and there is no way of avoiding this loss, though it may be reduced a little by employing low-loss transformer-type splitters instead of plain resistive ones. But other problems can then arise.

Generally speaking, the loss introduced by a splitter, provided it is correctly designed, is equal (or nearly so) at all frequencies. This is not so with cable losses, however. Here the loss to signal increases with frequency. As a rough guide, the signal relative to Band I channels is weakened two times at Band III channels and about three times at Band IV channels.

This, though, may not bother us very much where we simply want to feed two sets from one aerial, but it must be taken into account on any system which uses abnormally long cables.

The simple two-outlet system, as shown in Fig. 3(a), will operate on both BBC-1 and ITV channels in all but fringe areas without any trouble or calculation. If the pictures are good and grain-free on one set, 6dB loss due to the addition of the two-outlet splitter will not alter the conditions significantly.

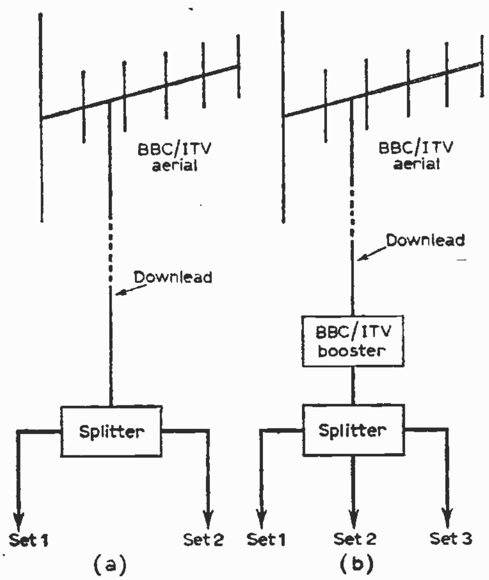


Fig. 3—Where the aerial signals are strong, the simple arrangement at (a) is suitable for two outlets, but where the signals are weak or if more than two outlets are required the boosted arrangement at (b) should be used.

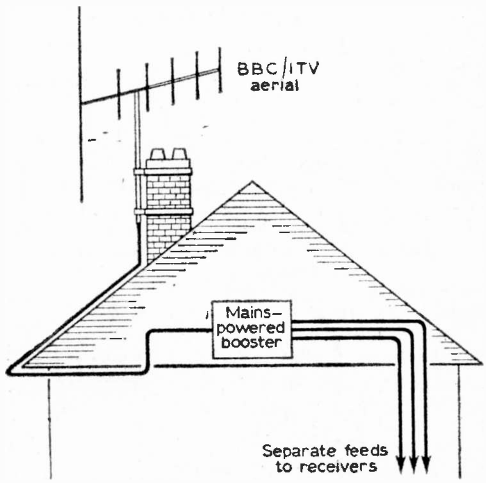


Fig. 4—The mains-powered signal booster can be housed in the roof space. Continuous powering is feasible, for the consumption is very small, amounting to a few pence of electricity per year.

BOOSTER REQUIRED

However, in fringe areas where the signals are not too strong to start with, and where there is a grain or " snow " tendency, a 6dB signal loss will certainly be noticed by an increase in grain and a deterioration in the quality of the pictures and probably a hiss on the sound as well. This effect could also occur even in a good signal area where more than two sets are operated from one aerial.

In these cases, as shown in Fig. 3(b), a signal amplifier or booster is needed to make good the signal loss. This can be located either at the top or bottom of the downlead. If it is mounted at the top of the downlead, by the aerial, some means will be required to power the unit from the set-end.

Mains or battery power units which feed power to the aerial located amplifier through the coaxial

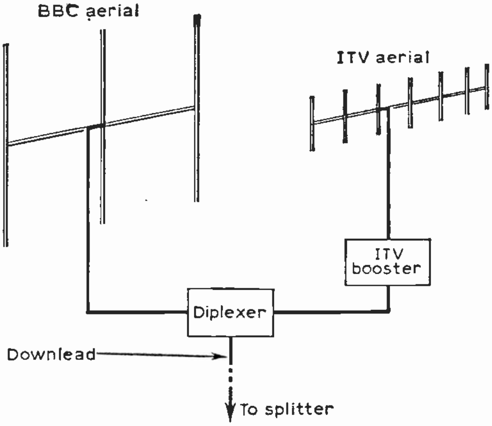


Fig. 5—If only one signal is weak, just one channel boost can be given, as this drawing shows.

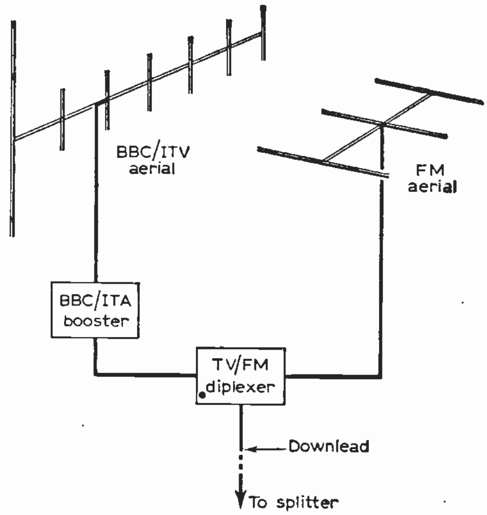


Fig. 6—Here is shown how f.m. is added to a master aerial system. If the f.m. signal is weak, a boost can be supplied with a separate f.m. booster.

cable are available for this purpose. But the booster, must, of course, be designed to accept signal from this route.

In the majority of cases, except, possibly, in very poor u.h.f. areas, the booster can be located at the set-end of the downlead, where powering is far less of a problem.

Battery-operated transistor dual-band boosters are available commercially for this application, and some such units feature a pair of outlets for feeding two sets, thereby eliminating the need for a separate splitter. Mains power units are also available for this type of unit to allow continuous operation. Many two-or-more set households have the mains-powered booster fixed in the attic, from whence the downleads originate (see Fig. 4).

The aerials are mounted outside (two in most cases) and the booster is permanently connected to the mains via a low-current fuse. Such transistor boosters take less from the mains than do electric bells and the electricity consumed is in terms of pence per year!

Where separate BBC and ITV aerials are used, the weak signal (usually the ITV) can be independently amplified and then combined to a common downlead along with the other signal, as shown in Fig. 5. An alternative arrangement is to amplify to the required levels the BBC and ITV signals independently in separate amplifiers and then combine them to a common downlead for application to a splitter. The combining process is performed by an ordinary diplexer (or triplexer).

To put f.m. signals on the same common cable, an arrangement as shown in Fig. 6 is needed. Here a TV/f.m. diplexer (or triplexer) is used. A triplexer would be employed, of course, on a system having separate BBC, ITV and f.m. aerials.

Any of the signals can be amplified as required

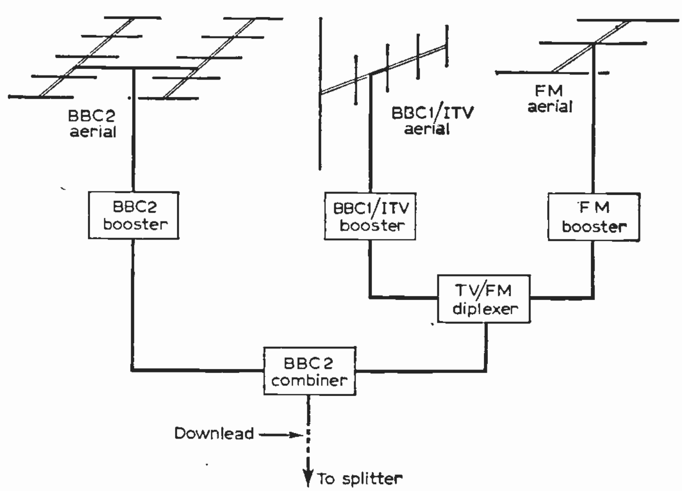


Fig. 7—BBC-2 signals nearly always require separate amplification before combining, as shown here.

before being fed to the combining unit (diplexer or triplexer), and the gains of the separate amplifiers can be adjusted for balanced signals at each outlet.

In Fig. 6 a combined BBC/ITV aerial is used for TV, so the best idea in this case would be to use a dual-band booster, as shown.

—continued on page 79

SERVICING TELEVISION RECEIVERS

No. 107: FERGUSON 546T, 506T and 508T, HMV 1890, MARCONI VT164

By L. Lawry-Johns

CONTINUED FROM PAGE 14 OF THE OCTOBER ISSUE

WHEN there is no picture but the sound is in order and the line whistle can be heard normally it is worth while checking the EY86 before taking any other action. If, however, its heater is visibly glowing this valve is not likely to be at fault. At all times treat this section of the receiver with respect.

When the circuit is functioning correctly a neon screwdriver will glow brightly when brought into the vicinity of the line output stage even though it is in no direct contact with any point. Do *not* touch the top caps of any line output valve (PY81, PL81 or EY86) with a neon as it is not only dangerous to do so but the neon is unlikely to survive to be of further use at normal mains voltages.

If the line whistle is not normal and boost voltage is low, check V9 and V8 and C64 (0·1μF). If the PL81 is red hot check V7 (ECC82). If the line output and e.h.t. is in order but the picture is dark, check pin 3 of the c.r.t. base (1st anode).

Remember that this point is supplied via a 1MΩ resistor and the quality of the meter will therefore

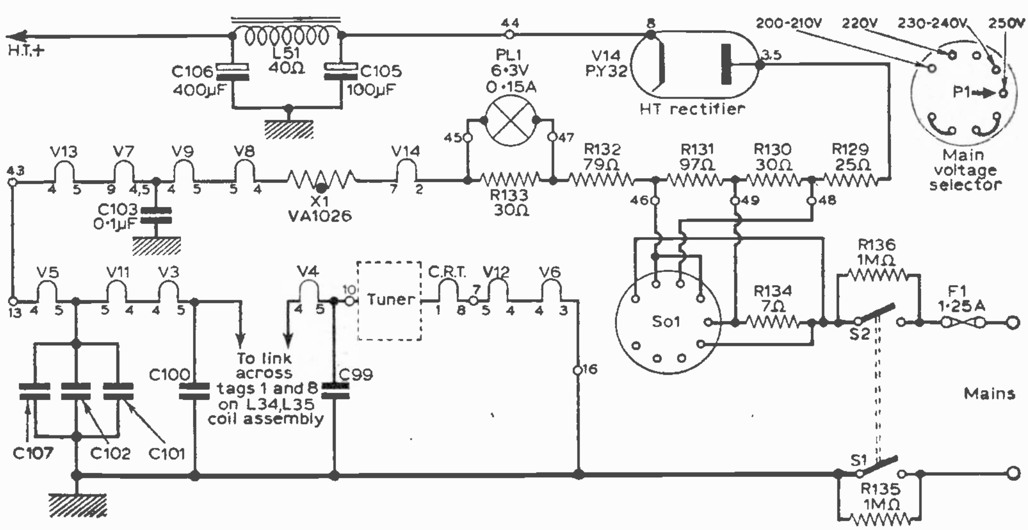


Fig. 4—The power supply and heater circuits.

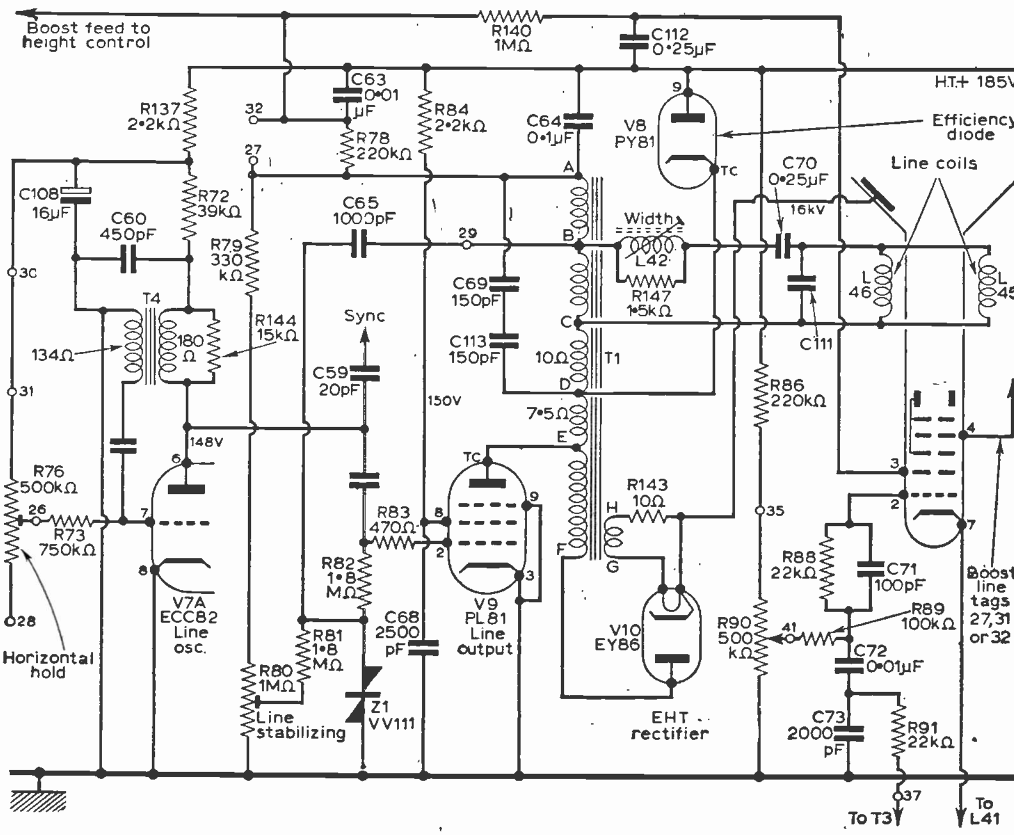


Fig. 5—The line timebase of the schedule C versions of the receivers.

affect the reading. If application of the meter reduces the brilliance further it can be assumed that this part of the circuit is not at fault.

The point is that a short or near short in the tube or in C112 (0·25μF) would result in a low voltage which would not be further affected by the comparatively high resistance of a meter.

If the voltage is low check C112 for leakage. A short would result in the voltage being held at 185V.

Field (or Frame) Timebase

Faults which affect this part of the circuit may range from total collapse showing as a single white line across the centre of the screen to lack of height, bottom compression or fold over, inability to lock the picture etc:

The first named symptom, that of total collapse resulting in a white line, could be due to a large number of causes almost all of which are revealed by voltage checks at the PCY82 valve base. Pin 9 should record about 170V.

No voltage should direct attention to the height control R120 (2MΩ). Low voltage should lead to further voltage checks at PCL82 base pins 3 (a positive voltage denoting leakage through C94 0·02μF) and 2 (cathode) which will be higher than the normal 15V.

If these pins read normal (no voltage at 3, 15V at 2) check pin 2 of ECC82, low end of C91 0·003μF. If the voltage here is positive, replace C91 which is often found to be shorted.

The writer has found that either C91 or C94 are the most frequent causes of little or no frame scan.

Another common cause or sometimes the result of a defective PCL82 or C94 is R124 330Ω, the PCL82 bias resistor which can go o/c altogether or change value, either effect causing the voltage at pin 2 to vary widely from the specified 15V.

As R124 changes value (rather than becoming o/c) the bottom of the picture is affected and the PCL82 may begin to draw grid current thus passing more current through the resistor which may then become very low in value, the bottom of the picture curling up to form a lighter band of reversed image.

The PCL82 and the resistor must be replaced and it is pointed out that both can be damaged by leakage through C94.

Where there is doubt and there is a positive voltage at pin 3 (R123) of the PCL82, short the h.t.

side (pin 9 of V13) of C94 to chassis. If the positive voltage remains C94 it is not likely to be a fault and the PCL82 and R124 should be checked.

When the height is reduced with severe bottom compression with voltages appearing normal check C96, 100μF across R124 which will almost certainly be found to be open circuited.

Smoothing Capacitors

It is not unusual for C106 (400μF) to dry up and this, of course, results in a heavy h.t. ripple, giving rise to hum on sound, a heavily shaded picture distorted with curved edges. These symptoms should immediately direct attention to the main smoothers above the PY32.

O/C Heater Chain

When one is confronted with a receiver which appears to be completely dead except perhaps for a faint tingling noise one can be 100% sure of a correct diagnosis by saying that the circuit is not complete!

The exact location of the break can almost always be found with nothing more elaborate than a simple neon screwdriver.

First ensure that mains is being applied to the input plug and that the neon does *not* glow when applied to the chassis. If it does, reverse the mains lead. The neon should glow at the fuse holder (both ends if the fuse is intact of course) and if it does proceed to check along the section of the mains dropper, failure in any section is indicated by a glow at one end of a section and no glow or very reduced glow at the other. In this event a replacement section is probably all that is required to restore normal working.

If all sections record a similar glow, turn the set up and check at pin 2 of the PY32 which is the "in" pin, the "out" being pin 7. Glow at 2 but not at 7 means a new PY32.

It is, however, quite likely that both pins will record a healthy glow or full mains potential if a meter is used and whilst the next heater is the PY81 (pins 4 and 5) the fact that a thermistor is between the two valves should not be overlooked as this (VA1026) may well be found to be cracked or open ended.

Normally if there is an open circuit in the heater chain it will be found between the dropper R131—R133 and the PY81. If these items all record mains potential proceed along the heater chain to pins 4 and 3 (in that order) of V6, EB91.

Short in Video Section

Indications of overheating in the vicinity of V5 (PCL84) should direct attention to R55 47kΩ. This sometimes changes value, passing heavy current through R53, R54 and R56, often damaging these components.

The original symptom is no picture but as the overheating becomes more severe the resistors either become virtually shorted resulting in excessive h.t. current through V14, R129 etc., or one resistor or more may disintegrate thus clearing the short but leaving the no picture condition.

When the resistors are replaced, R55 should be made a 1W to prevent the same condition arising again.

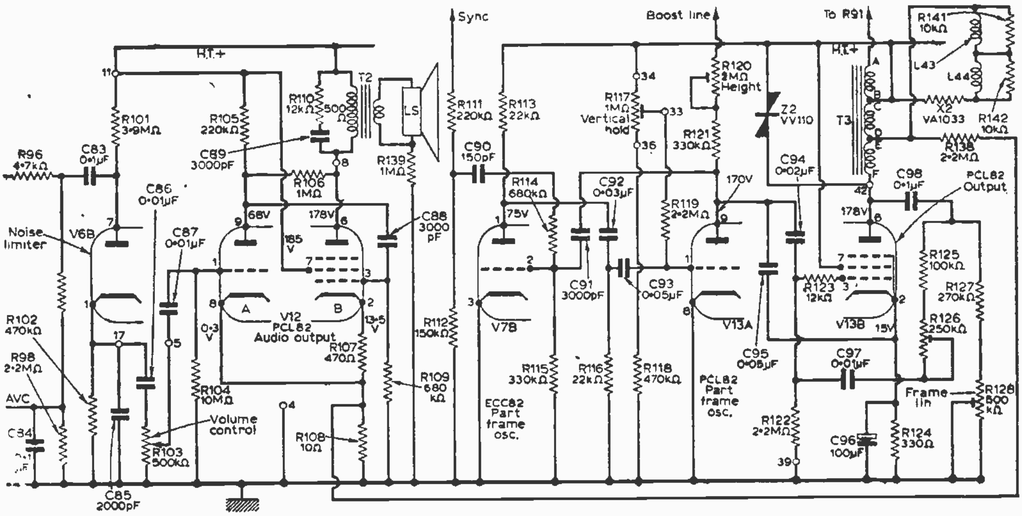


Fig. 6—The sound output and frame timebase stages of the circuit.

Distortion of Sound

If the distortion occurs more on a strong signal than a weak signal, check R101, which is a 3·9MΩ resistor to pin 7 of V6 (EB91) noise limited. If the distortion remains, however weak the signal, check V12 (PCL82), R107 (470Ω) and C88 0·003μF.

Apply the same remarks made on the frame output section regarding the valve, bias resistor and coupling capacitor.

Black and White Hum Bars

A no picture condition where a raster is showing bright white with broad black bands (roughly half and half) usually denotes that the grid of V5 PCL84 is "floating". This means that the circuit is not completed and L39 will normally be found to be open circuited.

Adjustments

Line Linearity. There is a closed loop on the neck of the tube which is magnetically coupled to the deflection coils. The sleeve has a moulded ring and locating lug to enable it to be properly positioned with respect to the coils. It is only intended to affect the line coils and thus it must not be rotated out of position. The sleeve should be fitted with the locating lug opposite the tube anode connector.

Optimum linearity is obtained when the locating lug is about half-way inserted into the deflector coils clamp. Inserting the sleeve further into the coils reduces width more on the left than the right and centre but it must not be pushed in too far and in fact should be withdrawn to the rear as far as possible consistent with good linearity.

Arcing can occur from the line coils to the sleeve giving rise to violent flashes across the screen and distinct irregular vertical bands of interference which may lead one to fruitless investigation of the line output transformer and e.h.t. sections. The sleeve can be withdrawn completely to prove the point.

Picture Shift

The large clamp immediately behind the deflection coils incorporates a round magnet which may be rotated to vary the intensity of its influence.

This produces picture shift in a direction depending upon the position of the clamp which itself is rotated to obtain the shift in the direction required. Some models use rotatable plates instead of the clamp magnet.

Frame Linearity

R126 and R128 presets adjust the relationship of he top, centre and bottom of the picture and usually have to be correctly set up when V13 is replaced or is ageing.

Local-Distant

R38 is provided to vary the a.g.c. voltage applied to the tuner for optimum reception in fringe or strong signal areas. Adjust for best signal-to-noise ratio consistent with freedom from vision-on-sound or other overloading effects.

MASTER AERIAL SYSTEMS

—continued from page 75

ADDING BBC-2

More and more viewers will want BBC-2 signals added to their master aerial systems, and to do that it will almost certainly be necessary to amplify the BBC-2 signals separately, for these are more readily weakened in the cables and, in any case, most dual-standard sets require about twice as much signal to give a BBC-2 picture comparable to those on BBC-1 and ITV channels.

A complete master aerial system giving BBC-1, BBC-2, ITV and f.m. on the one common downlead is shown in Fig. 7. Here, each channel or band is amplified separately, the TV and f.m. signals being first combined and then the BBC-2 signals being added with a special BBC-2 combine (now available commercially).

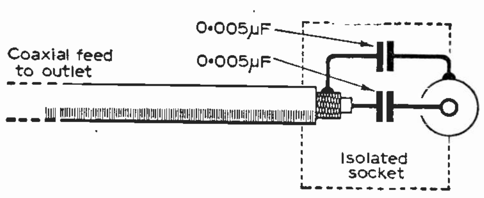


Fig. 8—It is desirable to isolate both the inner and outer conductors at each outlet, as this illustration shows.

Just how many outlets this system would feed would depend upon (a) the strength of the aerial signals and (b) the gain of the amplifiers. If the aerials give enough signal to give a reasonable, noise-free picture on one receiver, then the inclusion of boosters with about 14dB gain would allow five or six sets to be worked simultaneously, provided the cable lengths are not excessive (that is, not exceeding about 75ft. in length each).

Longer cable would mean that less outlets could be accommodated at full signal voltage. This could however, be overcome by the use of extra amplifiers when the signal becomes sufficiently weakened, but this brings us on to larger communal aerial systems which fall outside the scope of this article.

Remember, that each outlet should be isolated capacitively on both inner and outer conductors (see Fig. 8). Suitably isolated coaxial socket outlets can be obtained from Teleng, Belling and Lee and others, as also can ready made splitters of two or more outlets.

The big advantage of a master aerial system is that the aerials can be placed for the best possible signal pick-up, and that one set of aerials can feed multiple outlets in a block of flats or even adjacent neighbours all for the price of a few pence of electricity per year and without the unsightly multiplicity of roof or chimney mounted aerials.

Now that complex aerials will often be needed for the good reception of BBC-2 (and ITV-2 when it comes), master aerial systems will be very much in demand. They are already being viewed favourably by councils and estate controllers, and the simple ones described in this article are well within the installation capabilities of many readers of this magazine.

A Post Office licence is generally required for "relaying" television and/or radio signals, but where the system is small and of the nature of a master aerial, the licence aspect is not always fully enforced. We shall be glad to advise readers with regard to any specific master aerial system plan through the medium of our Query Service. ■

BY H. W. HELLYER

STOCK FAULTS

PREVALENT TROUBLES IN COMMERCIAL RECEIVERS

CONTINUED FROM PAGE 37 OF THE OCTOBER ISSUE

PART 7 THE FRAME CIRCUITS

LET me begin by forestalling the technically pure in heart. Yes, I know the correct term is "field". Yes, I am aware that "frame" is outdated, and yes, I *do* care. But the change to field has only reached the higher echelons of radio engineering as yet, and as long as manufacturers continue to refer to "frame" circuits in their spares list and service data sheets, it behoves me to curb my pioneering instincts and ask the technical purists to make the mental translation as they go along.

We have already considered the transmitted television waveform, and the timing and duration of synchronising pulses has been discussed. To recap, the eight frame pulses occur during the first four lines of each frame. They are 40 microseconds in duration. There are two complete "frames" per picture, the timing being such that the lines occur at exactly spaced intervals, the lines of the "even" frame sitting exactly between the lines of the "odd" frame. Each complete frame takes 1/50th of a second, so that there are 25 interlaced pictures per second forming the display.

The eight frame pulses are collected together, or integrated, to obtain the single pulse necessary to trigger the frame timebase 50 times a second. The timing of the start of the frame pulse is extremely important to maintain good interlace, and any cause of false tripping will give the effect of line pairing, jitter, or the excessive lininess that indicates complete loss of interlace.

Frame Pulse Integration

The process of integration is best illustrated by a diagram, such as Fig. 37. The basic integrator circuit is as Fig. 37(a). A square waveform applied to the input side of this circuit gives an output like that shown in (b), where the voltage rises initially at a rapid rate, from A to B, gradually levelling off until the incoming pulse (shown dotted) cuts off, when the charge that has built up in the capacitor C discharges toward the zero level D. The time constant, or product of resistor and capacitor values, determines the rate of charge and the position of the point B.

But, as we have seen, there are eight of these pulses arriving, each forty microseconds long and separated by a ten microsecond interval. So the train of pulses arriving at the integrator produces an output like (c), where the discharge from B of the first pulse does not have time to decay completely before the next pulse arrives, and the charge across C builds up with each successive pulse. As the charge voltage tends to oppose the input voltage, the effect is that this integrated curve tends to grow more horizontal: if the the train of pulses was continued, the output voltage would eventually equal the input voltage and remain substantially level.

As this frame pulse, integrated from the eight pulses, has a serrated leading edge, and the timebase is tripped when the voltage reaches a predetermined amount, usually at about the third pulse, the regularity of this integration is very important, not only for the frame timebase frequency, but also for the interlace. The frame timebase is normally triggered just prior to its "natural", free-running cycle. If the critical pulse voltage comes early, or if the voltage is too great, loss of interlace, or even of frame sync, can result. Many different circuits have been developed to overcome this erratic triggering, and space limitations prevent a complete discussion of frame circuitry, but the following faults and their illustrations have been chosen to show several differing systems, and to give a guide to similar faults in other, similar, circuits.

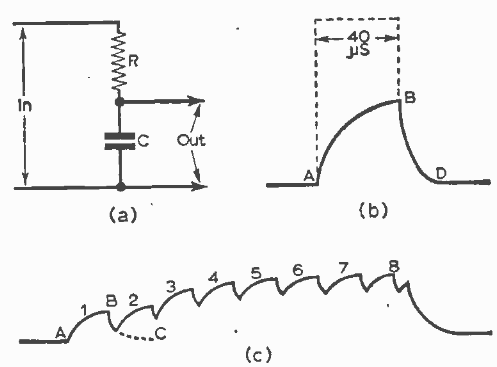


Fig. 37—Integration of the frame pulses: (a) basic integrator circuit, (b) output from an integrator when a square pulse is applied, (c) effective waveform produced from a chain of integrated pulses.

Applying Frame Sync

The general method of applying frame sync is via a differentiating network and a clipper, to get rid of the serrated edge shown in Fig. 37(c) and obtain a sharp leading edge to the frame pulse. Some quite complicated circuits have arisen. Their particular techniques induce quite characteristic faults. For example, where a differentiator and clipper circuit is employed, breakthrough of line pulses can cause interlace trouble. This does not happen so frequently with the "simple" circuit, as the line pulse does not reach sufficient proportions to trigger off the frame. Faulty decoupling can cause this kind of fault, and incorrect voltages in the clipper stage, as can unwanted coupling between line and frame pulses in the deflection coils. In some K-B receivers, a hum-bucking coil was fitted to overcome this defect, and other circuits have been developed to reduce the back-coupling.

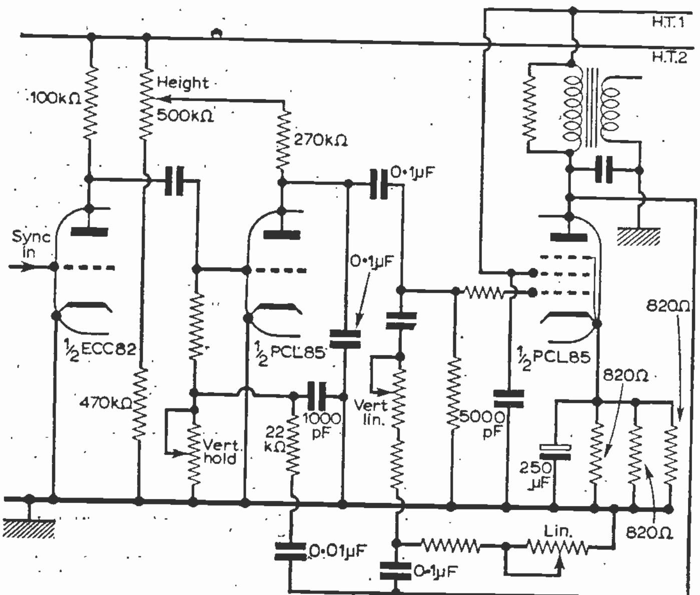


Fig. 38—Sobell T279 frame circuits: Sync pulse shaper, back-coupled triode oscillator and pentode output are typical of many circuits.

Complete absence of frame pulses results in a thin white line across the screen. The cause can be either in the output stage or in the oscillator, where the output stage depends on oscillator drive. To prove this, a touch on the output valve grid with the finger should produce a slight increase in the thickness of the line, due to the induction of hum. This gives a clue that the output stage is working, and attention can be turned to the oscillator. But note that the output stage grid is very often returned to chassis or to cathode via a small capacitor. A short-circuit at this point will also kill the scan.

Where a variation of the height control makes a small difference to the thickness of the compressed raster, this again indicates that the output stage is, at least, conducting. But variation of the position of the line, and to some degree its thickness, by adjustment of linearity or hold controls is not a very conclusive test, as these may simply vary h.t. to parts of the circuit still not operative for other reasons. An example of this misleading effect is the stock fault of 0·01μF coupler failure on the Sobell T279 and associated models.

The circuit, shown basically in Fig. 38, is interesting in that it uses a sync pulse shaper and a single valve oscillator and output valve, the triode-pentode PCL85. In addition to the usual waveform shaping linearity circuits giving two feedback paths from the output, there is a frequency-conscious feedback path from anode of the PCL85 to grid of the triode section, a 0·01μF in series with a 22kΩ resistor. A leak in this capacitor has the unexpected effect of producing a narrow band across the screen and rendering the height control ineffective. Reason is the imposition of a positive voltage of the triode grid, and a lack of drive to the output. If this fault has occurred, pay special attention to the height control, which may be damaged by an excess of current.

On another Sobell model, the T196, a cross-coupling capacitor of 0·005μF is used from anode of PCL85 pentode to grid of the triode. A leak in this component causes first a "bouncing" erratic frame, then intermittent collapse.

In many circuits, the height control varies h.t. to the oscillator. Carbon tracks of some of these controls tend to first develop a high resistance at the end rivet causing sparking, with attendant frame jumpiness, fluctuating height and intermittent collapse, then to burn out, with the result of no frame. Oscillator voltage is normally low, 50V or even less. Voltage readings can be misleading, as a non-operative stage will give incorrect readings, although the fault may be quite remote from the point at which measurement is taken.

An example is found in the circuit of Fig. 39, the Decca DM35 and 45, the Dynatron TV52, and other similar models. We shall be returning to this circuit later to illustrate other failure possibilities, which does not indicate it is a particularly bad one, but that it is a convenient style of circuitry to use as an example. In this case, starvation of the second half of the multivibrator, triode section of an ECL80 causes first erratic frame, then collapse. This occurs when C73, the 0·02μF capacitor develops a leak. In this circuit, the height control varies the drive to the output stage, and a partial raster may be obtained, variable by control setting. A further cause of loss of oscillation is a failure of C71, the 0·05μF timing capacitor.

Perhaps the most prevalent cause of failure is the reduction, again, of the h.t. to the oscillator anode by an increase in the anode load resistance. As can be seen from Fig. 39, the value is quite high, (R70, 4·7MΩ). The usual effect is first a gradual reduction in height, with loss of linearity that can be often compensated by control adjustment, and finally a loss of oscillation, drive and raster. (Collapse to a band about half an inch thick.) This fault is found on many similar circuits, including the Decca DM55, the Defiant 9A51, where the anode load is 330kΩ, and on several older Ultra Models. (An opposite effect is found on one Ultra model, the 6604, where the 22kΩ anode load goes *low* and although correct voltages may be obtained, the raster cramps at top and bottom.)

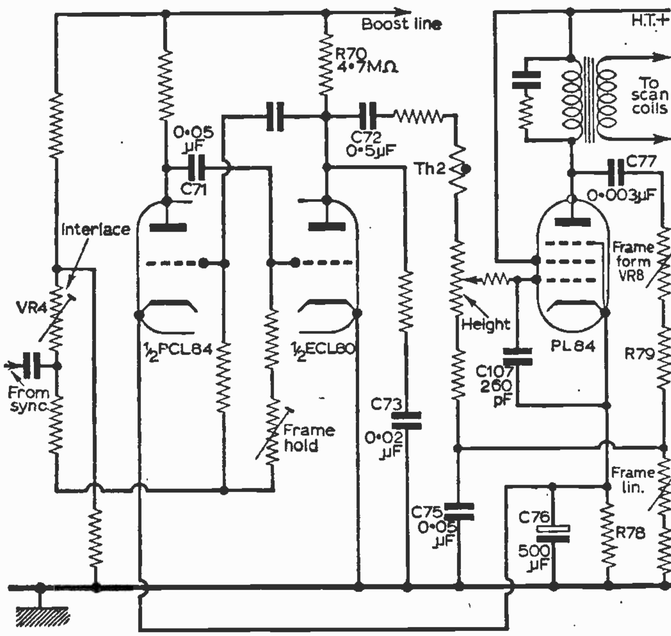


Fig. 39—Decca frame circuit. Note the interacting hold and interlace controls, the series feedback circuitry and the oscillator h.t. feed from the boost line.

Quite a different reason for reduction of the h.t. to the oscillator circuit can be noted with receivers using the higher, boost line, voltage for this part of the circuit. Typical of this method is Fig. 40 the Ferguson 506, and associated circuits. Here, although the output stage is fed, via the transformer, with regulating voltage dependent resistor across it, from the normal h.t. line, the oscillator is fed from the boost line via the height control. A favourite point to check here is the 0·01μF boost decoupler, which robs the oscillator of voltage when a leak develops. (In the Sobell T196, previously referred to, there is a VDR in the boost line feed, which should be checked if oscillator voltage is below par.)

In some Philips circuits, as the 1796, and associated Stella models, the focus control is fed from the boost line also, and a skeleton slider resistor, mounted across the c.r.t. base, begins to burn out, goes temporarily low, robs the boost line voltage and causes lack of height—disconcertingly, before any line symptoms crop up, where the signal is strong and well contrasted. This can be a real teaser, the first time one meets it.

On several models, a ruse to increase height where general deterioration caused a lack, was to reduce the value of the load resistor to the uncontrolled half of a multivibrator circuit. On the K-B OV30 range, this reduction from 1·8MΩ to 1·2, or even 1MΩ, is quite a legitimate modification. And on some, older, Masteradio receivers, it was the only way to get adequate height.

Distorted Raster

So far, we have considered a total lack of frame, or overall reduction in height. But, as any frustrated experimenter will know, the distorted raster or touchy frame hold can be a much more dodgy fault to trace and rectify. Taking the first group; by far the most common effect is cramping at the bottom of the screen. Although this can be caused

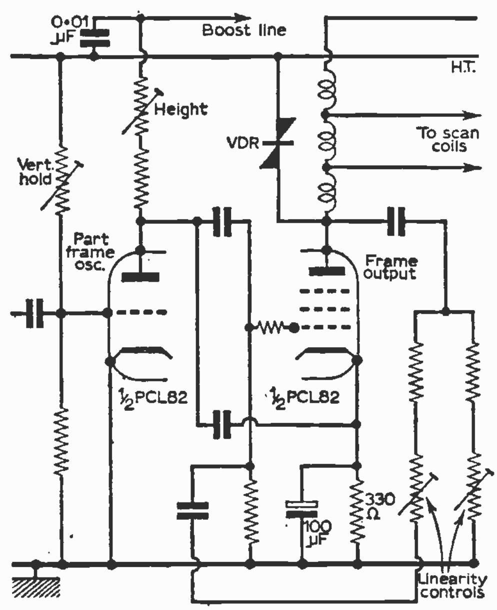


Fig. 40—Ferguson frame circuit. A typical feature is the provision of separate h.t. feeds and the VDR across the output transformer.

by loss of emission of an output valve, and may be temporarily cured by substitution, the cause is quite often a drying out of the cathode bypass electrolytic capacitor, as C76 of Fig. 39 and the 100μF component of Fig. 40. Note also, from Fig. 38, that the bias resistor may, in fact, be two or more components in parallel, to obtain the wattage that is needed and, equally important, to improve the heat dissipation.

Incidentally, it is not always advisable to alter the value of this bypass capacitor. As can be seen from the given circuits, the cathode circuit is often a return path for parts of the feedback loops, and an increase in the capacitor may simply cure the fault by causing non-linearity. Always check the value of the bias resistor, which can track and go low if over-run or with age. Look, too, for the combined electrolytic found in some older receivers, where faulty chassis returns, or inter-action between the sections, can cause not only frame faults, but perplexing video and sound faults due to break through of frame pulses. A mention of this kind of fault was made in Stock Faults 3, dealing with sound circuits, where mention was made of the HMV 1910 circuit. A 1MΩ resistor across the frame scan coils going open-circuit, produces poor smoothing and hum and poor sync results.

Faults in the negative feedback circuits can also cause this compression and, in extreme cases, fold-over. In the Decca circuit of Fig. 39, a prevalent cause, that can be very difficult to trace without the aid of an oscilloscope, is a leak in C71, the 0·05μF coupler. A somewhat similar fault is obtained when C72 goes leaky. In the Pye V310 range (also Pam 606), the fault mentioned previously, of a leaky boost decoupling capacitor, causes bottom foldover also. The Alba T655 has a 0·01μF across the primary of the frame output transformer, and if this little fellow leaks, the lack of h.t. resulting causes similar effects at first.

Compression and foldover at the top of the picture is almost inevitably due to a fault in the feedback circuits. The particular branch to check is that (directly or indirectly) between anode and grid of the output valve. In the Philips 1757, for example, a loop from a separate winding of the frame output transformer to the grid consists of three resistors with a 1,000pF capacitor across them. This capacitor goes short-circuit, causing top compression. In the Ultra circuit of Fig. 41, which is typical, a leak or short-circuit of C108, the 0·03μF capacitor in series with the 180kΩ grid resistor, and part of the feedback loop, effectively takes the 180kΩ to chassis and cancels the feedback. Incidentally, an improvement in this circuit can be effected if the 180kΩ is reduced to about 150kΩ and a 50pF capacitor added across the correction circuit as shown dotted.

An unusual cause of this kind of fault which is worth remembering as a possible test case, is the screen grid resistance of the output valve going low, a fault which occurs on the Pye CTM21. On the Decca circuit of Fig. 39 another cause may be noted: a leak in C77 causes both fold at the bottom and stretching at the top. A similar effect is noted on the Cossor 948, when the 0·25μF mounted just horizontally below the PCL82, goes open-circuit. On yet another model, the Pye V210B, the grid of the PCL82 pentode output section is decoupled with a 0·01μF capacitor for frequency correction, in conjunction with a very high grid load of two 10MΩ resistors in series. A leaky capacitor here causes the same, misleading, symptom.

An unusual fault, but common to the Cossor 950, is cramping in the middle of the picture. Again, this is a screen feed resistor fault. The correct value should be 1·8kΩ, and is quite critical. On the same set, another common fault symptom is a bright, wavy line across the top of the raster, as if the scan coils were faulty. In fact, it is caused by open-circuiting of a small thermistor, wired between the secondary of the frame output transformer and chassis, and situated above the heat-producing mains dropping resistors. Usually, the mounting wire goes brittle, and a temporary cure can be made by short-circuiting the tags.

In Figs. 39, 40 and 41, thermistors or voltage dependent resistors will be found. The action of these is well-known and needs no further discussion from me, but the effect of open circuiting of a VDR across the frame output transformer winding can be serious, due to the high flyback voltages not being supressed. Often, sparking between the anode pin of the output valve and the metal valve mounting or chassis develops. On

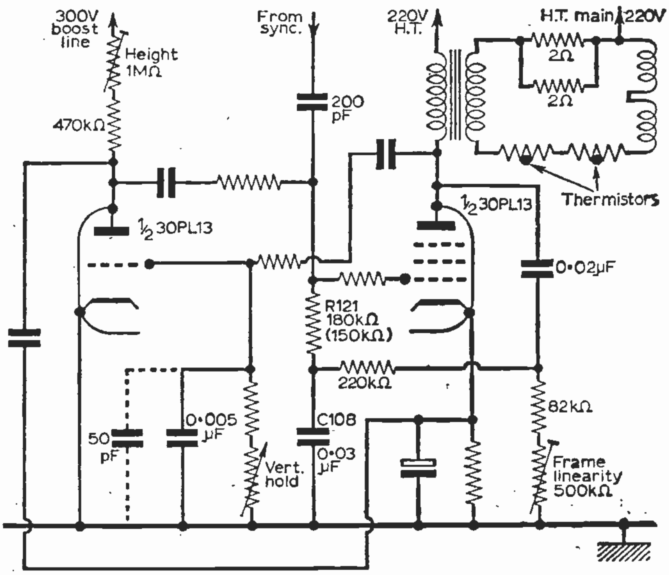


Fig. 41—Ultra frame circuit. A single linearity control is employed and thermistors are fitted in the output transformer secondary circuit to damp flyback pulses and compensate for changing characteristics with heat increase.

printed circuit panels, completely charred surrounds to the output valve base have been caused. Less obvious is the effect of lines at the top of the picture due to the slowing down of the frame flyback. This is very evident on sets of later construction, when receiving transmissions with the test pulses during the frame sync period, and can often be checked by causing the frame to slip down slightly, revealing the black pulse bar, on which the dash and dot pulse can be seen quite clearly.

Poor Frame Sync

This brings us to the further fault of poor frame sync. Not nearly so prevalent as on older sets, it can nevertheless be difficult to trace, sometimes being caused by faults as remote as faulty vision i.f. decoupling. If the line sync is unaffected, and only the frame sync weak, check whether the sections of the frame circuit have separate decoupling. Check, again, the anode feed resistor to the oscillator, and, equally important, the h.t. carrying resistors in the sync separator circuit. In the Decca DM4, for example, the anode feed is a 2·2kΩ and 100kΩ, with the frame sync taken from the junction. Improved frame locking can be obtained by modifying this network to 47kΩ and 68kΩ.

A jittering frame is another, somewhat similar fault, that can have a number of origins. On the Bush TV105, a leaky 0·02μF in the *Top Linearity* network causes this fault, and on the Pye CTM17T there is a 0·001μF across the frame output transformer primary, producing the same effect.

More usual is the symptom of poor interlace, which in its extreme condition produces this juddering effect. Often caused by valve trouble—and thus not worth our discussing here— it can sometimes be the result of faults in the special circuits developed to circumvent it. See Fig. 39 for an interlace circuit that is extremely critical in setting up, and disconcertingly touchy if wrongly set. To adjust, both interlace and frame hold controls should be turned anti-clockwise, then the frame locked by movement of the *interlace* control, with final adjustments of the frame hold for a solid lock when changing channels. Look for a tendency of bottom foldover as the frame approaches lock, indicating that the interlace control is wrongly set.

The Bush TV115 has a top linearity 220kΩ resistor which sometimes tends to arc when the full drive is applied—this can cause curious interlace and faulty sync symptoms. On the Peto Scott 1730, the video anode resistor, 15kΩ, tends to decrease if over-run, and causes similar trouble. On the Dynatron TV52, an intermittent 1MΩ height potentiometer can be the cause.

As a final note, frame flyback suppression should be mentioned. Its absence is obvious, with the flyback lines visible on the raster, and the circuitry is generally quite simple, consisting of a filtered feed from a suitable pulse point on the circuit to a modulation feed of the c.r.t. network. Fig. 42 shows the general arrangement, with a pulse from the frame output applied, via a 22kΩ resistor and 0·01μF capacitor, decoupled by a 0·002μF capacitor, to the grid of the tube. This circuit is given because a breakdown in the decoupling capacitor the 0·002μF gives peculiar hum symptoms of vertical bars on the picture. This is due to frame pulses being fed back to the h.t. line via the brilliance control, in effect, modulating the brightness at frame frequency. This circuit is very similar to the method used in Fig. 38.

This article began by offending the purists. Let us end by offending everyone with a reminder that

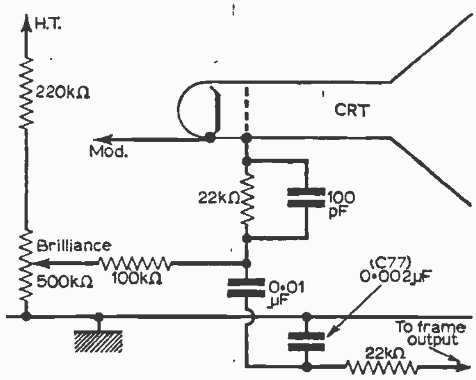


Fig. 42—Marconi method of frame flyback suppression. Open-circuiting of C77 induces vertical hum bars on the raster.

work around the frame timebase should be carried out with circumspection. Never run the set at full brightness when tracking down a frame fault—even a short duration bright line across the tube can cause irreparable damage.

PART 8 FOLLOWS NEXT MONTH

CONTINUED FROM PAGE 11 OF THE OCTOBER ISSUE

PUSH-PULL X AND Y-AMPLIFIERS FLYBACK BLANKING H.V. PROBE

The VIDEOSCOPE

TV OSCILLOSCOPE

BY MARTIN L. MICHAELIS

Excessive application of sync, greatly in excess of the amount at which rigid lock sets in, i.e. with VR2 turned up too high, generally leads to notches on sharp transients of the scoped waveform, which wander up and down these flanks in the direction of the arrows shown as the sync control VR2 is adjusted. If such injection-kinks do not vanish fully some considerable distance of travel of VR2 before lock is lost, then the screening at V6 grid is not properly adjusted. (Refer to Fig. 3 and especially to Fig. 6, wiring diagram.)

The thick line labelled "X" shown in Fig. 6 between V4 and V6 is an insulated "floating screen". This consists of a piece of thin brass foil cup somewhat larger than a postage stamp, with an insulated lead soldered to one edge. The whole is then wrapped in insulating tape, and the appearance is that of a small flat capacitor. The two leads are soldered to the chassis-solder tags shown. This insulated floating screen is then bent into the optimum position in the vicinity of V6 grid (R56, R57) until all sync-transient radiation from V4 is kept out of V6 for normal settings of the sync control and a safety margin beyond. Such an optimum adjustment is possible because of the relatively low impedence of V6 grid circuit in all timebase-operation positions, because R55 is then in circuit. In the position for "External X-deflection" applied to SK3 and controlled by VR4, the grid-impedance at V6 is much higher—but the sync amplifier is muted there because h.t. is switched-off for it and the whole timebase circuitry, at S1b, thus removing possibilities of sync-transient injection at V6 grid.

REFERRING to Fig. 2 on page 9 last month, V4 is a sync-amplifier with very high gain, so that a rigid lock of even small amplitude signals is possible. S1 enables internal sync action from either the positive or negative transitions of the Y-signal to be selected, or from the mains, or from an external sync signal fed in at SK2. In all cases VR2 controls the sync intensity. The setting of VR2 should be as low as possible, consistent with good lock, to prevent the generation of excessive transients at V4 anode which can radiate into the X-amplifier and cause peculiar kinks in the displayed waveform.

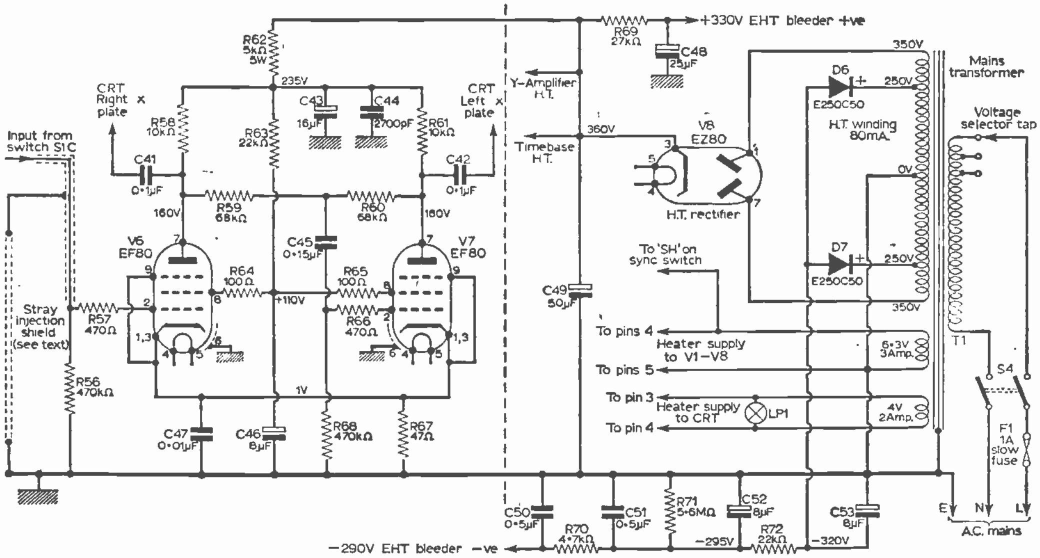


Fig. 4—X-amplifier and the power supplies. Conventional components are used in the power supply, and the X-amplifier can be used with an external signal or with the built-in timebase of Fig. 2 (last month). To avoid h.t. surges, V8 may not be replaced by a metal rectifier.

THE X-AMPLIFIER

R55 together with R53, forms a voltage divider for the timebase signal from V5, giving the X-amplifier (V6 and V7) the correct drive. This form of voltage division is preferable to a simple tapping of R47 near the h.t.-end for two reasons. Firstly, tapping R47 would certainly reduce the timebase voltage as desired, but would not give the slightest reduction of fluctuations on the h.t. line due to mains transients coming from outside or due to flickerings quite normal for all electrolytic capacitors and amounting to appreciable fractions of a volt. Such flickerings, which are random, receive 100-fold amplification in the X-amplifier, and would thus lead to continuous jitter of all displays by amounts up to 30% full deflection, which would be intolerable. The arrangement of R53 and R55, however, reduces signal and flickering by the same amount, so that the so-called "flicker-ratio" is not increased. This gives a more stable display, essential if waveforms are to be photographed off the screen. The second advantage of the arrangement used is that high voltages are

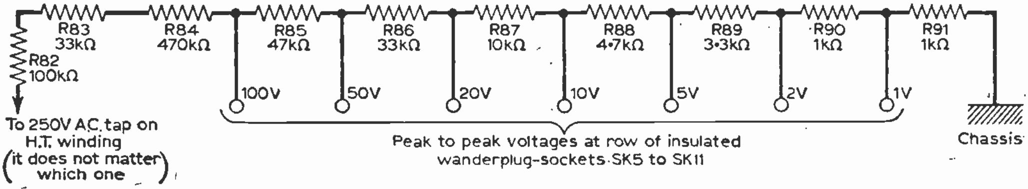


Fig. 5—Y-calibrator circuit. R82 may need reduction or omission, as one half-wave is flattened at the 250V transformer tap, on the conduction-half cycle of the main h.t. rectifier section on this side. This reduces the operative peak-to-peak voltage.

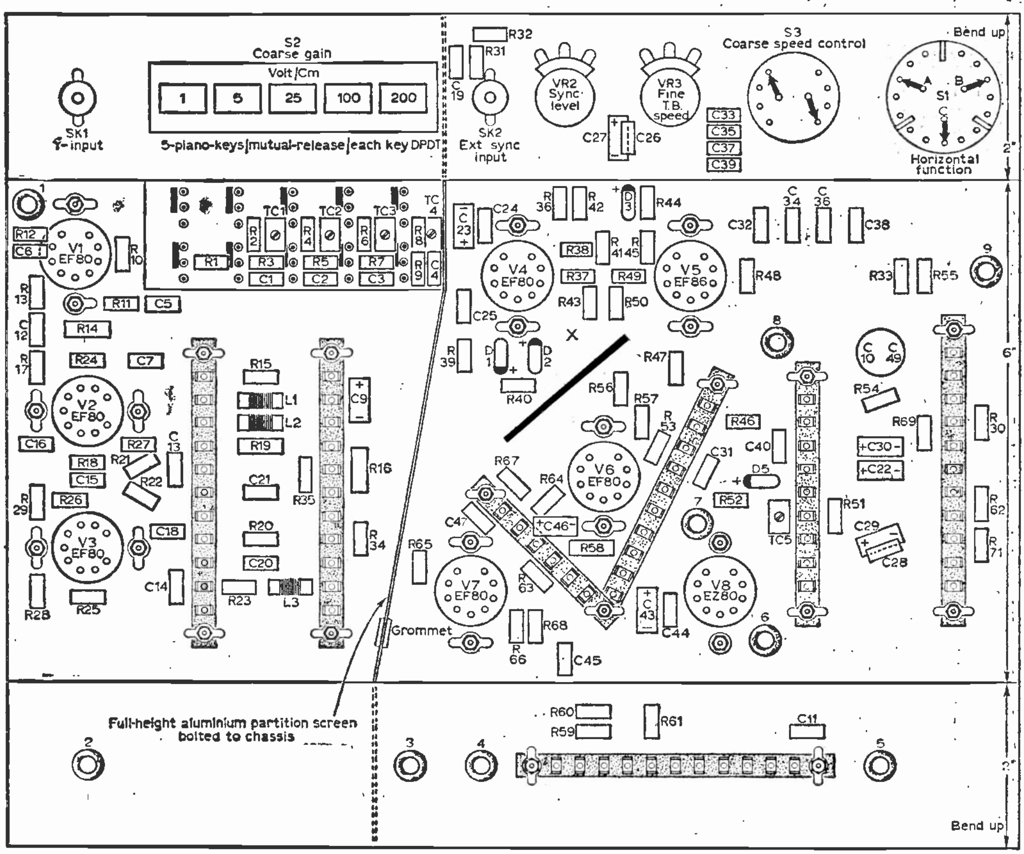


Fig. 6—Sub-chassis layout. The screen is essential to prevent blockage of the sensitive Y-amplifier by timebase transient injection.

kept off S1c and the impedance there is low, so that stray capacities do not impair the action at high speeds.

Some attention must be given to trimming-up for optimum linearity in the X-amplifier. The critical stage is V6, as this is supplying all the gain. V7 is self-linearising, being " slaved " at unity gain as phase-inverter. Similarly, the timebase valve itself is also self-linearising, by its very nature, so that when used direct in single-ended deflection, linearisation is automatic.

As V6 must operate linearly at an anode output signal of around 100 volts peak to peak, the adjustment of R67 is critical. A resistor of approximately the value specified should be selected and observation made on the CRT, at the same time feeding a sine wave signal of about 1kc/s into the Y-amplifier and locking this with the sync. Lack of X-linearity is evidenced by uneven spacing of the displayed cycles. If satisfactory linearisation is not possible without undue departures in the specified value of R67, then negative feedback must be introduced by inserting equal individual cathode resistors (unbypassed) between the top of R67 and the respective cathodes. Values between 10Ω and 27Ω can be tried, reducing R67 by *half* the value finally selected here. The drive applied to V6 may be adjusted if necessary by increasing the value of R53. Do *not* reduce the value of R55 for this purpose, because this can lead to different values of grade current bias for V6, V7, causing unequal anode currents. If the anode voltages of V6, V7 depart from values indicated in Fig. 4 or if more than 20 volts difference exists between the two anodes, adjustments should be made by suitable inequalities of the separate individual additional cathode-resistors already mentioned. R67 and any auxiliary cathode resistors must not be reduced below values giving 10mA standing anode current and 2·5mA standing screen current in each valve. Some patience is well-worth while to trim the X-amplifier to optimum linearity by applying these measures. The Y-amplifier output-stage, V2 and V3, can be treated analogously if required, though —because one generally uses less Y-deflection— matters are here much less critical.

Note that normally pins 7,11 of the c.r.t. are the Y-plates and 8,10 the X-plates; the functions have been changed over here and the c.r.t. turned through 90 degrees to compensate. This has two advantages for the present design. Firstly, it uses the plates nearer the final anode, and thus with higher deflection sensitivity, as X-plates, reducing the total deflection amplitude required from the critical X-amplifier. This measure was decisive in enabling success to be achieved without resort to a mains transformer with higher voltages than a " normal " h.t. winding of 350V. The second advantage is that it brings the clamping-plate of the standard mount and mumetal can unit, horizontal instead of vertical as in the original government apparatus. This allows a mounting-arrangement which is very simple to carry out and needs a minimum of tools and no unusual parts.

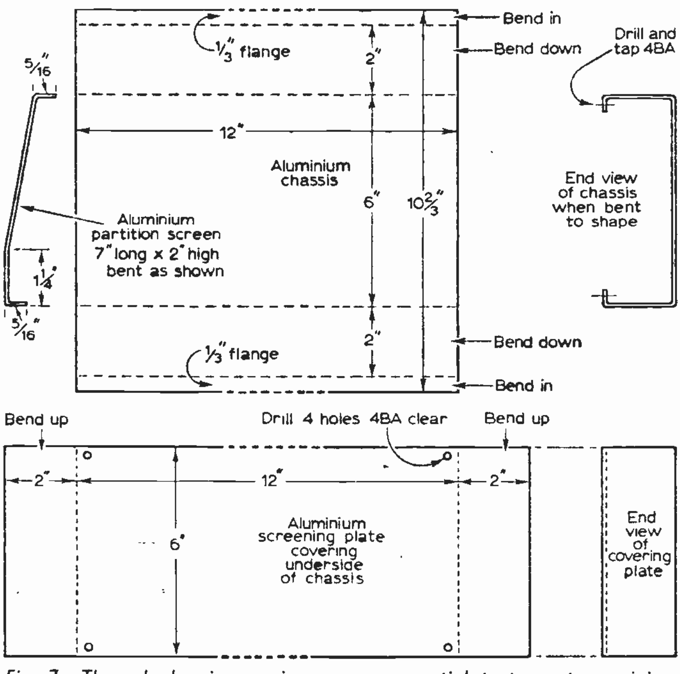


Fig. 7—The sub-chassis covering screens essential to prevent remaining timebase transients reaching the Y-amplifier and interference from direct pick-up of broadcast stations.

The X-amplifier can be fed from any desired external signal at SK3 with VR4 as gain-control. The final position of S1, "External-X", brings this function into operation and mutes the timebase. The X-amplifier then has an effective maximum sensitivity of about 250mV r.m.s. for full-screen deflection, and a level response over just the normal hi-fi *audio* range. The X-amplifier in this function is neither capacitively nor inductively compensated as for the Y-amplifier, and has just the simple volume control VR4 as signal-attenuator, which is *roughly* calibrated in volts per cm. This is satisfactory, because the expense of full duplication of the high-class video-amplifier (Y-amplifier) would be unwarranted for X-deflection, as such a refinement is seldom needed for normal TV experiments.

CONTINUED NEXT MONTH

SPECIAL NOTE: Will readers please note that we are unable to supply Service Sheets or Circuits of ex-Government apparatus, or of proprietary makes of commercial receivers. We regret that we are also unable to publish letters from readers seeking a source of supply of such apparatus.

The Editor does not necessarily agree with the opinions expressed by his correspondents.

ABOLITION OF THE MAINS DROPPER

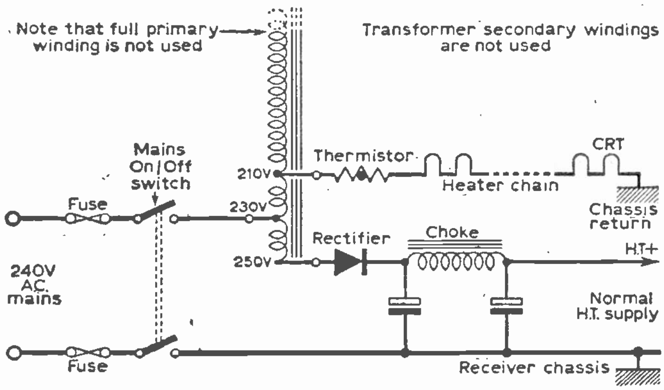
SIR,—I am a radio and television engineer and wondered if your readers would be interested in an experiment carried out in the workshop a few weeks ago. It applies to television receivers with series heater chains, usually of the 300mA type. The mains dropper section often open circuits and this usually means some difficulty in finding a similar wattage and value component.

As your readers will know, most of the heat in a television receiver is dissipated by the mains dropper, and I was thinking of an economical way to eliminate this waste heat and probably reduce many faults by making the receiver function cool.

I found that an old mains transformer could be fitted into the receiver using the method shown in the diagram on this page.

The transformer's inductive reactance is used to form the resistance required to drop approximately 110V according to the number of valves the receiver employs.

This method has been used in a Peto Scott receiver and it proved to work very satisfactorily. The transformer used was one of the c.r.t. isolating type, and after 8 hours running, the transformer was only just warm.—K. AMOR (Huyton, Nr. Liverpool, Lancashire).

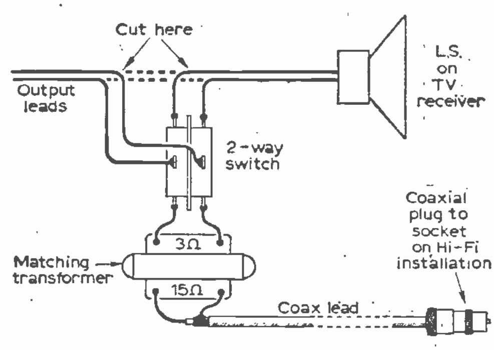


Above—The circuit arrangement evolved by Mr. Amor from his experiments to eliminate the mains dropper in television receivers. The modification makes use of part of an old mains transformer.

IMPROVING TV SOUND

SIR,—With reference to Mr Milton's letter on "Improving TV Sound" (PRACTICAL TELEVISION, September issue) I have done a very similar thing myself.

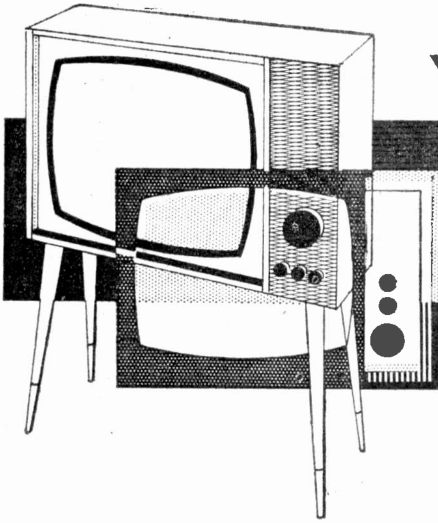
I have connected my stereo hi-fi installation to my television set via a d.p.d.t. toggle switch and an isolating and matching transformer. This enables me to use the speaker in the TV if that is all that is required, or alternatively to switch the internal TV speaker out completely, and the two hi-fi speakers in, whenever the programme warrants it.



Right—The simple switching arrangement used by reader Miss Jeyes of Birmingham to link the audio output of her TV receiver to twin hi-fi speakers in her stereo installation.

This method also gives a perfect balance for the BBC Saturday morning stereo broadcast, using one side for TV and the other v.h.f.

I might add that I am an elderly woman with practically no knowledge of electronics. — Miss L. M. JEYES (Quinton, Birmingham 32).



Your Problems Solved

Whilst we are always pleased to assist readers with their technical 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 p. 92 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

DEFIANT 4109

Please could you advise me which components in this receiver are likely to cause the line timebase to run at twice the correct speed.—J. F. Grindley (Oswestry, Shropshire).

We would advise you to check V7 (30FL1) and R78 (6·8kΩ). Check the associated components of the l.o.t. if necessary.

GEC BT312

When this set is switched on the sound comes on, but there is no vision or raster. As soon as the line timebase starts to operate, I can draw a vivid spark from the anode of the e.h.t. valve, but in about 2 seconds this disappears to practically nothing. E.H.T. valve, line output valve and efficiency diode are all brand new, and about a week before loss of vision, I fitted a new main reservoir capacitor.—A. Beckett (Swansea, S. Wales).

We would advise you to check the 0·1μF boost line capacitor C152 as we think this is the most probable cause of the trouble.

KB MV30

For some time now, this set has been critical on the line hold and now it seems the frame hold has gone, and I get a " Venetian blind " effect. Sometimes I manage to lock it, but with a horizontal band across the picture. I have changed the line valves and separator, but with no effect. —G Webb (London, S.E.25).

If the 12AX7 and 12AU7 valves are in order, it will be necessary to check smaller components. Do not overlook the 50μF 12V capacitor in the cathode circuit of the video amplifier. Check the resistors in series with the frame hold control and the electrolytic capacitors generally. All components associated with the 12AX7 should be checked unless voltage readings can direct attention to one particular point.

McMICHAEL M71T

There are vertical lines down the left hand side of the screen, and they are spaced about half an inch apart. There is also little or no contrast.—G Gilmore (Sale, Cheshire).

Vertical lines at the left of the screen usually signify trouble in the line output stage. A weak line output valve or booster diode could aggravate the trouble as also could low h.t. voltage due to a worn h.t. rectifier. In the latter case, the contrast may also suffer. We suggest, therefore, that you have the valves tested before delving too deeply into the circuit.

KB OV30

The picture becomes very distorted and there is a broad black band across the middle of the screen which gives a rippled effect at times. The picture also slips vertically and at times fails to hold, and I might add that the set takes a long time to " warm up ".—F. Riddell (North Kilbowie, Clydebank).

It seems as though the h.t. smoothing and possibly the rectifier is worn in this set. Firstly, check the rectifier. If hum on sound is bad, replace the electrolytic smoothing capacitors. Also have the timebase valves checked for emission and replace if they are below 70% efficient.

FERGUSON 206T

This set was working well on 200V, then it changed hands and was plugged into 240V without the voltage regulator plug being altered. It worked for three days then the picture failed, and no raster was present. There is perfect sound on

both BBC and ITA, and all the valves light up. There is no e.h.t. at the side of the tube.—A. Erwin (Lewisham, London, S.E.13).

The trouble lies somewhere in the line output stage. Check the line output valve and the booster diode. Also, if necessary, check the components related to these valves. Overloading could have damaged the line output transformer.

DEFIANT 4109

After being switched on for about 30 minutes or more, a howling and very bad distortion affects the sound. Upon altering the contrast control, this cuts out for a time, but then repeats itself until further adjustment is made to this control. There is also a slight picture tilt.—D. P. Riche (Gosport, Hampshire).

Microphony in the sound output valve is probably responsible for the howling symptom. Tap the sound valves when the trouble starts, and the valve which when tapped clears the trouble, should be replaced.

The picture can be straightened by rotating the scanning coils a slight amount in the appropriate direction on the tube neck.

ULTRA V17-71

Both blacks and whites have a "saw" or broken edged effect. There is also an overall appearance of a snow storm.—J. Storer (Watford, Hertfordshire).

These are symptoms of a weak aerial signal. We suggest that you try using a larger, higher outdoor aerial.

KB MV30

When this set is switched on there is no picture, only a thin white line right across the screen in the centre. The sound is perfect on both channels. After about 10 minutes, this white line opens out and the picture appears to normal size. When the picture has returned, there is a dark line down the right-hand side of the screen. I have tried altering the horizontal hold and the horizontal linearity controls, but these make no difference. — E. Murden (Widmerpool, Nottingham).

If the line is horizontal across the screen, the frame timebase is at fault. A most likely cause is a defective frame timebase valve. Check the 12AU7 and 6BW6 valves located directly beneath the neck of the tube.

HMV 1890

The top 1-1½in. of the picture is blank, the top half slightly egg-shaped, and the bottom cramped.

When the test card is viewed, the top outside edge of the card does not show in black and white, but in a very bright line varying in depth from ¼-½in. at different times. I have changed valves V7, V13 and V14.—R. Murphy (Southport, Lancashire).

If the PCL82 frame timebase valve is known definitely to be in order (the symptom you describe is often caused by low emission of this valve) check the 330kΩ resistor connected to the valve side of the height control, and the 1MΩ feed resistor (from the boosted h.t. line) to the other side of the height control. Increase in value of either could cause the symptom. If the trouble persists, check the smaller components in the frame circuit, paying particular attention to the 100μF electrolytic capacitor connected to the PCL82 cathode.

FERRANTI 21K6V

The frame hold has always been "touchy" but of late has become more critical. It can be locked but is triggered off easily by such a programme as "What the Papers Say". The black and white of the newspaper captions as they are screened, triggering off the hold continuously despite attempts to lock it.

I have tried substituting the PCL82, f.b. oscillator and f. output.—J. Mills (Gosport, Hampshire).

Try replacing the small metal rectifier in the frame interlace filter circuit. This is a type 39K2 connected to pin 9 of the PCL82 frame timebase valve via a 0·01μF capacitor and a 22kΩ resistor. Poor insulation in the frame blocking oscillator transformer is another cause of this symptom.

MURPHY V204

Can you please tell me what e.h.t. rectifier valve is used in this set; also the tube used, and which ITV converter to use.—W. Hall (Withernsea, East Yorkshire).

The e.h.t. rectifier used is a U25 and the c.r.t. is a CRM125. The i.f.s are 9·75Mc/s sound and 13·25Mc/s vision and suitable tuners are the Murphy C1 or Cyldon E101.

PYE CTM17F

The picture on this set takes at least 15 minutes to reach full quality. The only remedy I have tried was to replace the picture output valve, which made no difference.—J. Williams (Craven Arms, Salop).

The symptoms that you describe could suggest a slow heating cathode ray tube, and we suggest that you measure its heater volts.

If less than 6V, you could try fitting a boost transformer to raise it to between 7 and 8V.

PHILIPS 1446U

The above receiver has an intermittent frame roll. I have replaced the ECL80 frame oscillator valve, and the rate of frame roll has decreased so that the picture holds for perhaps 15 minutes and then slowly rolls again. I have also replaced the sync separator valve, but this seems to have no effect on the fault. Both the frame and line hold controls are very critical. — G. James (Swansea, Glamorgan).

We would advise you to replace the 180kΩ resistor connected to pin 6 of the sync separator.

DEFIANT 7A21

Even though the height control is turned to its maximum, there is a gap of about 2in. at the bottom of the picture and a somewhat smaller gap at the top. When this fault first occurred, it was apparent only when the set was first switched on and after 15 minutes or so, the picture gradually attained its normal height. Now however, there is no visible difference in the height of the raster

even after several hours of use.—G. Osborne (Wirral, Cheshire).

Check the frame timebase valve (30PL13), the 330Ω bias resistor from pin 2 and the 200μF bias electrolytic. Also check the 1·2MΩ resistor from the height control to the boost line.

COSSOR CT2310A

A white line appears on the screen and a buzzing sound comes from the line output section. All the valves were tested and found to be in working order.—F. Fillery (Luton, Bedfordshire).

The fault you describe could be due to a faulty main smoothing capacitor or to a fault in the deflector coils. Check especially the scancoil wiring.

G.E.C. BT/3252

The line hold on this set is very unstable, every few minutes the picture slips to one side, with a two inch band down the middle, although a slight turn either way on the knob restores the picture to normal for a minute or two. Is the control itself or its associated components at fault?—J. Elrick (Glasgow, S.W.3).

We would advise you to replace the 3·9pF (5 pF is a suitable value) capacitor between pin 7 of the sync separator and pin 8 of the line oscillator. Check the 100pF capacitor to chassis in case this is leaky.

SOBELL T.P.S.173

When this set has been switched on for about 15 minutes, the picture goes off completely, but there is a raster present when the brightness is increased and the line whistle is very noticeable.—J. Houlton (Weybridge, Surrey).

Tap the neck of the tube and if the picture returns, suspect a heater/cathode short in the gun assembly in the tube neck. If the tube appears all right, check the video amplifier valve and the feed from the vision detector to the video amplifier control grid.

TEST CASE -24

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.

? *On a recently installed dual-standard set, it was found that while good pictures could be obtained on the v.h.f. channels, when the set was switched to BBC-2 on channel 33, great difficulty was experienced in locking the picture vertically. After careful adjustment to the field hold control the picture could be locked for a while, but on some camera changes the picture would lock between frames, and then it would jump at random intervals from half-frame to normal lock and back again.*

Tests proved that the sync separator stage and the interlace filter were in correct working order, and that there appeared to be no significant variation between the frame sync performance between the two standards.

What was the most likely cause of this trouble and what steps should have been taken to prove the cause and correct the fault?

See next month's Practical Television for the solution to this Test Case and for another problem.

SOLUTION TO TEST CASE 23

(Page 44, last month)

The symptoms of last month's Test Case were those attributable to a set with a diminished d.c. component of the video waveform. To achieve the correct contrast relationship in a television picture it is necessary to hold the picture tube cathode voltage at a steady d.c. potential in terms of a voltage reference to establish the black level.

If this reference is deleted the picture black level varies depending upon the mean picture content. The picture is thus affected especially when the picture information has a low mean value—when the screen is mainly dark. Under this condition the black level is raised and the picture assumes a "sooty grey" appearance. Streaking can also appear on captions.

Unfortunately, the d.c. component of the picture signal is suppressed on many current receivers due to suppression coupling between the video valve anode and the picture tube cathode (to reduce aircraft flutter effects) and also as the result of a mean-level vision a.g.c. where the control potential is related to the mean picture signal as distinct from the true black level. Poor regulation of the e.h.t. supply can also aggravate the effects.

The symptoms featured in Test Case 23 could, therefore, well have been "normal" so far as the design of the set was concerned. It is worth noting that a recent circuit developed by a Mullard engineer could put an end to the shortcomings of d.c. suppression.

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Single Phase 230 V. 1400 r.p.m. ¼ h.p. motor with pulley, 26/-. Less pulley, 24/-. Fully guaranteed ex-washing machine. Carr. 8/6.

One Sixth H.P. Motor 15/-. Post 6/9.

New Indicator Unit. C.R.T.100. Complete with two tubes, type VCRX393 and VCRX298 plus 21 small values. Relays removed, 57/- or less valves 32/-. Carr. 10/-. Sorry no details on the unit.

New Boxed Test Set. 100 only. Type 350, complete with meter and case. No details. 37/6. Post 6/9.

New Condenser Parcel. Mixed. Send 6/-. Post paid.

New 12in. Speaker with built in tweeter. 15 or 3 ohms. 28/6. Post paid.

P.M. Speakers, all 3 ohm, ex-TV Sets. 6in. round, 6 x 4in. and 5in., 3/-. Post 2/-. 6 for 20/-. Post paid. 8in. round, 6/-. Post 2/-. 7 x 4in. 5/-. Post 2/-.

VALVE LIST
Ex equipment. 3 months' guarantee. All Post Paid.

EL91	1/6	20L1	5/-	PL38	8/-
ECL80	2/-	20P3	4/-	PY80	3/-
ECC82	3/-	20P4	8/6	PL82	3/-
EY51	2/6	20P1	4/-	PL83	3/-
EBF80	4/6	U801	8/6	PL33	3/-
EB91	9d.	U281	5/-	PY81	3/-
EL38	5/-	U232	5/-	PY82	3/-
EF91	9d.	U329	5/-	PCF80	4/-
6F1	1/-	KT36	5/-	PCC84	4/-
6F14	5/-	KT66	8/-	VR150/30	3/-
6F15	5/-	6V6GT	4/-	1T4	1/9
6LD20	5/-	6B8	1/6	12AT7	3/-
10C2	5/-	6K25	5/-	6CH6	1/6
10F1	1/-	6P25	3/6	6X4	3/-
10P13	5/-	6U4	5/-	R18	3/6
10P14	5/-	PY33	6/-	ARP12	1/6
20D1	2/-	PL81	4/-	807	5/-

EF50 1/-, doz. 6/-; 6K7 1/3, doz. 10/-; 6V6 1/9, doz. 18/-; 6K8 1/9, doz. 18/-.
Send S.A.E. for rare valve enquiry.

Breaking up Mark III Type 19 Sets. Meter, 500 micro-amp., 5/-. Post 1/9. Jack Socket 1/-. Post 6d. Doz. 10/-. Post paid. Jack 1/5. Post 6d. Toggle Switch Metal 6d. Post 6d. Doz. 10/-. Post paid. Relay Type 3000 1/9. Post 1/9. Doz. 20/-. Post paid. Any other spare send 2/- plus post to cover.

TV Sets. 13 channels. Untested but complete. 14in. 30/-. 17in. 50/-. Carr. 10/-. Well packed but sent at owner's risk.

Reclaimed Tubes. Six months' guarantee. 14in. Mullard and Mazda 17/-. Carr. 7/6. 17in. 30/-. Carr. 7/6.