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AERIAL HANDBOOK
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 with R.S. ROBERTS
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Second Edition **PUBLICATION DATE 26th JAN. 1968**
 REVISED AND ENLARGED

176 Pages Fine Art Paper. 144 illustrations (including 50 new to this Edition and 14 cartoons).

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The first edition of *Aerial Handbook* was published in October 1964 and the 5,000 copies were sold out in just over a year.

This second edition has been delayed until the plans for *Colour Television and Multiplex Stereo* have matured and could be dealt with from the angles of Transmission and Reception.

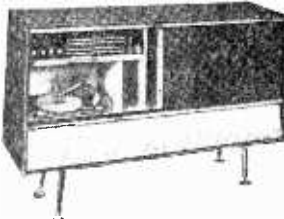
The activities of the BBC and ITA are well covered. Relay Systems, Eurovision, World Satellites and Colour Conversion, Post Office Tower etc. also receive attention in non-technical terms.

Chapter	Contents	No. of pages
1	General Principles	16
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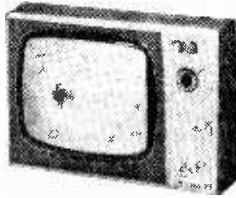
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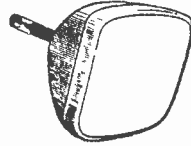
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DAP91	3/9	EL84	9/6	U26	10/9
DAP96	5/11	EM81	6/6	U26	10/9
DF33	7/6	EY31	6/9	U191	10/9
DF91	2/9	EY86	6/-	UAC80	6/-
DF96	5/11	EZ80	3/9	UA242	6/11
DK32	7/9	EZ81	4/6	UBC41	7/6
DK91	4/9	KT61	3/3	UBF89	6/6
DR56	6/9	N78	14/6	UCC84	7/9
DL33	6/6	PC97	5/6	UCC85	6/6
DL35	4/9	PC900	7/6	UCF80	9/6
DL82	4/3	PCC84	5/9	UCH42	6/6
DL84	5/8	PCC89	10/3	UCH81	6/6
DL96	5/11	PCC189	9/6	UCL82	7/3
DY86	5/6	PCC80	6/6	UCL83	8/9
DY87	5/6	PCF82	5/9	UF41	10/-
EABC90	8/3	PCF89	7/9	UF42	5/11
EB341	7/9	PCF805	8/9	UL41	8/6
EBF80	5/9	PCF82	8/9	UL84	6/6
EBF89	5/9	PCL83	8/9	UY41	8/6
ECC81	3/9	PCL84	7/3	UY85	5/6

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Practical Television

APRIL 1968

VOL. 18 No. 7

issue 211

Out of Context

IN a recent issue of *Which?*, the magazine issued by the Consumers' Association, a report was published on colour television. The C.A. is inclined to be rather stuffy—not to say discouraging—about quoting from their magazine, but the handouts accompanying issues sent to the press state that material may be quoted freely from these summaries. Let us, then, quote freely on the Colour TV summary:

Which? finds that colour television can be frustratingly unreliable but because it adds enormously to some programmes discusses whether to rent or to buy and how to choose your renter or seller.

That's it. The complete summary. And from this crumb of information certain newspapers magically conjured up a loaf of considerable size, doing the TV industry no good whatsoever.

Well, what is there in the report to produce such damning conclusions? The report covers five pages, nearly all of which deal with the problems of rent or buy, with typical scales of costs. The C.A. tells us that they dislike odd paragraphs taken out of context (with which we have no quarrel) but looking through the report this is all we could find of relevance to reliability, etc.

(1) "A colour set has more to go wrong with it than a black-and-white set, and, when it does break down, is more difficult to put right. Knowledgeable servicemen are in very short supply. In time, sets should get more reliable, and servicemen more used to them."

(2) "We have been plagued by breakdowns, and by slow repairs." (Nothing else of relevance in paragraph.)

(3) Under "Conclusions": "At least for the present, colour TV is extremely expensive and can sometimes be frustratingly unreliable—if our own experience is anything to go by." (Nothing follows of relevance.)

On this, *Which?* rests its case! There are no supporting data, no facts or figures, despite the slogan of "—the facts about the things you buy". Since the test reports to be published later were still under way when the report was published, such sweeping and unqualified statements seem to be extremely irresponsible and out of context. The industry, having poured vast sums of money into getting colour off the ground (and on the evidence of our eyes have produced some excellent products) receive another sideswipe with the clincher of "So for the rational consumer, it is too early to think of getting a colour set".

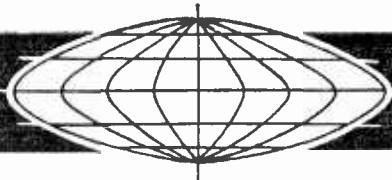
If these pseudo-ombudsmen can explain how the prices of sets (which they say are high) can be reduced if nobody buys any we would be pleased to hear from them.

W. N. STEVENS—*Editor*

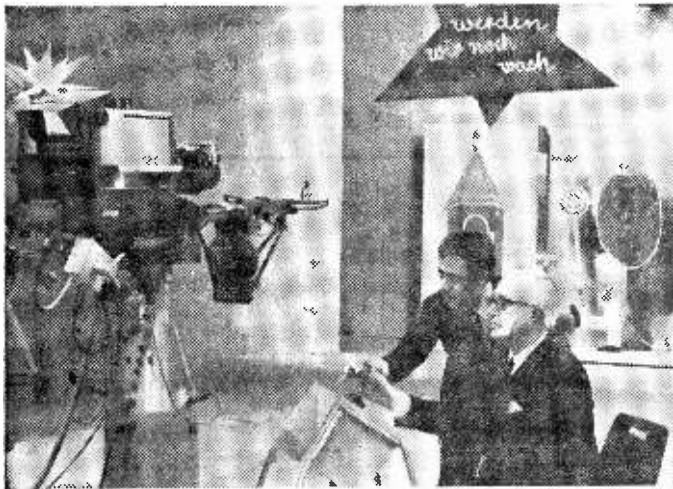
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THE NEXT ISSUE DATED MAY WILL BE
PUBLISHED ON APRIL 19



Der Goldene Schuss 'mit colour'!



LIKE its English counterpart, the television programme "Der Goldene Schuss" (The Golden Shot) produced on the West German 2nd Programme, has an estimated audience of millions. A couple of months ago by leave of a British Marconi Mark VII colour camera, this massive German audience saw the first full colour transmission of the show.

All previous attempts to produce "Der Goldene Schuss" completely in colour had failed because no colour camera had been found that could operate on top of the crossbow without losing colour registration when the weapon recoiled. The stability of the Mark VII colour picture during the transmission was apparently so high that observers at the picture monitors were unable to detect any recoil shocks on the screens.

The photograph shows part of the "Der Goldene Schuss" set, with Vitoria De Sica, television actor and film director, at the joystick control of the Mark VII.

Steady increase in TV licence sales

RECENT figures released of television licence sales for the last four months of 1967 show a continued increase.

Sales of combined radio and television licences increased by some 56,000 per month over the whole country. This is well over the normal rate of increase and continues the steady rate of growth apparent throughout 1967.

Television licence sales began to rise sharply in 1967 when the new Wireless Telegraphy Bill, which became an Act of Parliament in July, was introduced. This increased the maximum penalties to which evaders are liable on conviction from £10 to £50 for a first offence and from £50 to £100 for a subsequent offence. It also made provision for the involvement of television dealers in the GPO's licensing system.

At the beginning of this year, it was estimated that there were two million defaulters, which means a loss in revenue of £10m. per year. Three million pounds of this loss has been made good. There are reckoned to be about 1.4 million defaulters now.

Television dealers now have to notify the Post Office of all television sales and rentals to enable the Post Office to maintain its records of households with television sets. Evaders will, therefore, be at greater risk of detection. More than thirty thousand people were prosecuted for this offence last year.

TV 'hook-up' for Victoria Line

LONDON Transport recently announced details of a closed-circuit television network which will be installed at stations on the new Victoria Line. Closed-circuit TV will help to maintain a smooth flow of passengers to and from the trains. A contract worth approximately £50,000 has been let to Peto Scott Ltd. of Weybridge, for the supply of 74 cameras, 42 monitor sets and distribution equipment. This will cover the 10½-mile, 12-station section of the line between Victoria and Walthamstow, which will be opened to the public in stages between this autumn and the spring of 1969.

At most stations on the new line an operations room, generally at ticket hall level, will be equipped with two 11-inch monitor screens on which the supervisor in charge will be able to select pictures from any of the cameras at his disposal—varying from four at Highbury to eight at Oxford Circus and ten at Euston. A microphone connected to loudspeakers on the platforms will enable him to make announcements to passengers as necessary.

Television will also give a visual link with all Victoria Line stations to the line controller. At the control centre at Cobourg Street, Euston, he will have two 19-inch monitors on which to pick up pictures from cameras on the station platforms—so that in the event of a delay to the service he will be able to see the effect of the trouble at a glance. A two-way sound system, linked to the TV set-up, will enable him to hear as well as see what is going on within the range of each camera and to speak through the platform public address system if required.

For the train operators, who will sit in the front cab on the automatically-driven Victoria Line trains, monitor screens will be sited on each platform opposite the point where the front of the train stops. These will show the picture transmitted by the camera mounted at the opposite end of the same platform so that the operator can see what is happening at the rear half of the platform in crowded conditions.

EBU colour television symposium

FROM the BBC: "On the initiative of the BBC, the EBU held a symposium on Preparations for Colour Television in London, from 5th to 8th February. Attendance was limited to representatives of EBU members and the telecommunication administrations in their countries.

The BBC and the ITA/ITCA acted as hosts and the symposium was opened by Sir Francis McLean, director of engineering, BBC, and closed by Mr. Howard Steele, chief engineer, ITA.

The object of the symposium was to enable the European broadcasting organisations that have already started colour television to give the benefit of their experience to others that expect to start within the next few years. The experience already gained in the UK, France, Germany and the Netherlands has enabled colour television to get off to a good start in those countries and many lessons have been learned by experience from which other European countries could profit. The OIRT (the union of Broadcasting Organisations in Eastern Europe) were invited to send observers to the symposium.

The symposium included talks by experts, followed by discussion, on the planning of a colour service, the equipment and operation of studios and outside broadcasts, the televising of colour films and tape recordings, the training of operational staff, and liaison with the radio industry and the trade. Mr. Ed. Saxe, vice-president in charge of operations, CBS, gave a talk on the ways in which the approach to colour television in the USA differs from that in Europe. Although the symposium was mainly concerned with engineering problems, there was a session presided over by Mr. David Attenborough, Controller BBC-2, on programme production. Demonstrations were given by the BBC and by Independent Television.

On Friday, 9th February, a number of delegates went to Grenoble at the invitation of ORTF to see the arrangements for televising the Winter Olympics in colour."

OXFORD BBC-2 SERVICE

THE BBC-2 service from Oxford started on 17th February with transmissions on Channel 63, horizontally polarized.

The majority of BBC-2 programmes and trade test transmissions are now in colour and Oxford has transmitted the colour from the start of its test transmissions.

The aerial for good reception of the u.h.f. transmissions must have horizontal rods, and must be suitable for the BBC-2 Channel 63, as well as for the other three channels, 53, 57 and 60, which have been assigned to be used later for the duplication on u.h.f., 625 lines, of the existing BBC-1 and ITV services. The same aerial, in conjunction with a colour receiver, will be suitable for receiving colour transmissions.

Betws-y-Coed relay station

THE BBC has placed an order with Mr. H. S. Roberts, of Pandy Tudur, near Abergele, for the erection of the building for the new relay station which is to be built at Garth-y-Pigau, 2½ miles north-east of Betws-y-Coed, Caernarvonshire.

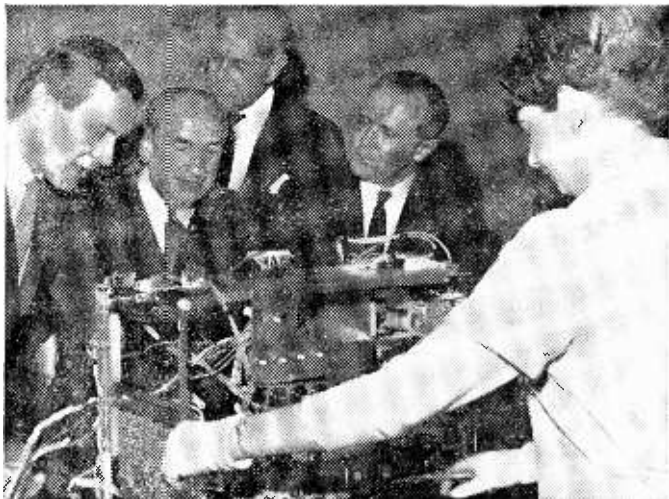
The Betws-y-Coed station will transmit BBC-Wales television on Channel 4, horizontally polarized, and v.h.f. radio services on Radio 2 (Light Programme) 88.2Mc/s, Radio 3 (Third Network) 90.4 Mc/s, Radio 4 (Welsh Home) 92.6Mc/s.

International Broadcasting Convention 1968

THE International Broadcasting Convention is next to be held in London from 9th to 13th September 1968, at the Grosvenor House Hotel, Park Lane, and will be sponsored jointly by the Electronic Engineering Association, the Institution of Electrical Engineers, the Institute of Electrical and Electronics Engineers (UK and Republic of Ireland Section), the Institution of Electronic and Radio Engineers, the Royal Television Society and the Society of Motion Picture and Television Engineers.

The Television Conference already announced by the learned societies for 1968 is incorporated within this convention at which a wide cross-section of the latest broadcasting equipment will also be shown.

Minister sees colour TV production



THE Minister of Technology, Mr. Anthony Wedgwood Benn recently watched production of Ferguson Colour TV receivers at the Enfield plant of British Radio Corporation.

He was accompanied by Sir Jules Thorn, chairman and Managing director of Thorn Electrical Industries of which BRC forms part.

Picture shows the Minister watching final assembly of a colour TV receiver. With him are Sir Jules Thorn, Mr. J. G. Stevenson, works manager, and Mr. D. A. Neill, Thorn director and BRC managing director.

fault finding

THE sync separator stage is one of the most interesting in the modern television receiver, and a good knowledge of how it operates is essential when investigating instances of impaired timebase locking. In addition since the introduction of dual-standard models handling both negatively- and positively-modulated carriers and the much wider use of flywheel line sync many questions are likely to arise concerning the mode of operation on both systems.

The sync system can truly be said to begin not at the grid of the sync separator valve itself but at the input to the video output stage, since many defects in this section of the receiver can attenuate or mis-shape the sync pulses. On both v.h.f. and u.h.f., and with either transistors or valves, the

BY S. GEORGE

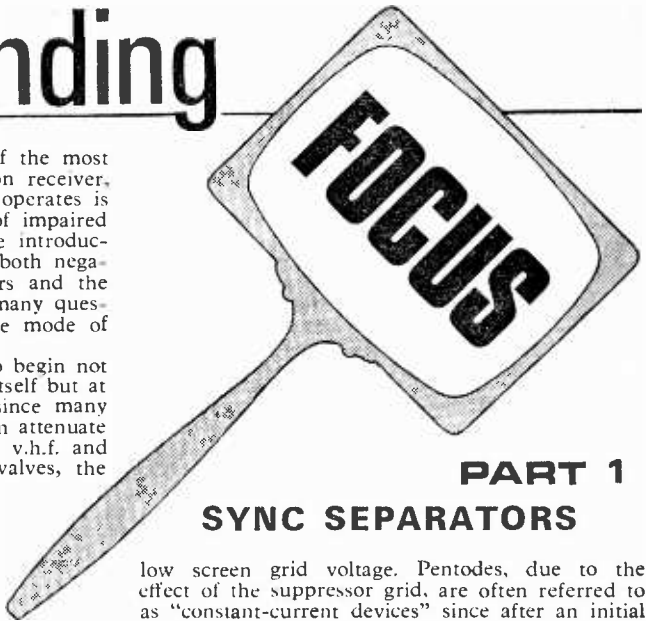
sync separator operates by being cut-off during and by the video picture content, conducting only during the sync periods. Now as the sync pulses on v.h.f. occupy the *lowest* amplitude section of the video waveform, but on u.h.f. occupy the *peak* amplitude of the waveform, it might be difficult at first to see just how the sync separator functions the same to both inputs. The answer lies in the fact that the video output stage produces the same anode voltage variations from both inputs so that the sync separator feed also remains the same.

For instance, on v.h.f. we have a positive-going output from the detector which is at a minimum on the sync pulses (0-30% of peak carrier amplitude), rising to a maximum value at peak white. In short, we have positive modulation. On application of this signal to the video output valve the anode current will be at minimum during the sync pulses and at maximum during peak-white picture content. Then by virtue of the $I_a R_L$ voltage drop across the video anode load resistor video anode voltage will be highest when the sync pulses occur and minimum on peak white.

On the u.h.f. system we obtain a negative-going output from the vision detector, by reversing diode polarity, in which the output falls from a minimum at peak white picture values to a maximum negative value on sync pulses, i.e. the opposite in polarity and amplitude to the v.h.f. signal. With the sync pulses representing the maximum negative detector output, however, the video anode current will still be minimum at such times so that, as before, video anode voltage is at maximum during the sync pulses.

The video output sense is thus the same on both systems, and so therefore is the sync separator input. And with the c.r.t. cathode driven from the video valve anode the peak voltages of the latter, i.e. the sync pulses, drive the c.r.t. beam to cut-off.

While triode sync separators are used in many Pye/Ekco group models, the most widely used sync separator in valved receivers is an r.f. pentode with



PART 1 SYNC SEPARATORS

low screen grid voltage. Pentodes, due to the effect of the suppressor grid, are often referred to as "constant-current devices" since after an initial rise to about 100V further increases in anode voltage produce only very marginal increases in anode current. It is the screen grid voltage of a pentode that mainly dictates pentode anode current, a fact that becomes very obvious in line output valves should the carbon feed resistor to the screen reduce in value and place excessive voltage on the electrode, for the valve then runs over-hot, reducing its output and shortening its life. By reducing screen potential to a very low figure, say 30-50V, the pentode is given what is known as a "short grid base" (see Fig. 1) so that only a small negative grid potential is required to drive the valve to cut-off.

Now without applied bias (i.e. with no cathode resistor) application of an a.c. signal to the grid will produce a negative voltage depending on the amplitude of the signal. With the sync separator, the a.c. input is the video feed from the video output stage via a small capacitor; and the bias thus produced, varying with the mean level of the signal, constitutes the source of a.g.c. voltage in most models.

On both systems the sync pulses represent a drop in the negative input, i.e. a positive-going pulse, which permits the grid capacitor to discharge, lowering the instantaneous grid potential and permitting valve conduction. During cut-off the valve anode voltage would nearly equal the supply voltage, but on conduction would reduce by $I_a R_L$ where R_L is the value of the load resistor.

Within limits, therefore, the larger the value of the load resistor and the current pulse, the greater the sync pulse output amplitude. Too great a value of load resistor, however, could distort the leading edge of the sync pulse, giving it a rounded edge, due to the stray capacitance being unable to quickly accept a rapid voltage change. The anode potential and therefore the pulse shape would in these circumstances change in a manner similar to that shown in graphs depicting the rise of voltage across a capacitor in an RC series charging combination. As it is the potential of the pulse leading

edge that triggers the timebases, such curvature must be avoided.

However, there is usually no need for very high amplification of the input sync pulse by the sync separator as its amplitude is already at a high level. Assuming, for instance, a picture voltage change of 50V at the video anode from black to peak white, the sync pulse voltage change would be about 20V on v.h.f., and rather less on u.h.f. due to the reduced sync amplitude. This would be attenuated by the usual series resistor and capacitor feed to the sync separator grid, but would still be a high figure.

The resistor usually employed in series with the feed capacitor is mainly to hold off the input capacitance of the sync separator from the video anode circuit and to keep the stray capacitive loading of the latter as small as possible.

In most but not all dual-standard designs it is customary to d.c. couple the vision detector output to the video valve on v.h.f. but to use a.c. coupling on u.h.f. As the video bias on v.h.f. must therefore be in excess of the midway Class A bias point to prevent peak values causing grid current flow, any further increase in bias can result in the valve being operated on its base curvature to the sync pulses, resulting in sync pulse clipping. Similarly on u.h.f., where a midway Class A bias point will be used, signal overloads can drive the valve off the straight part of its characteristic and clip the sync pulses.

The requirements of a pentode sync separator stage are that the screen grid potential must be kept low to ensure that the input amplitude can produce sufficient self-bias to drive the valve to

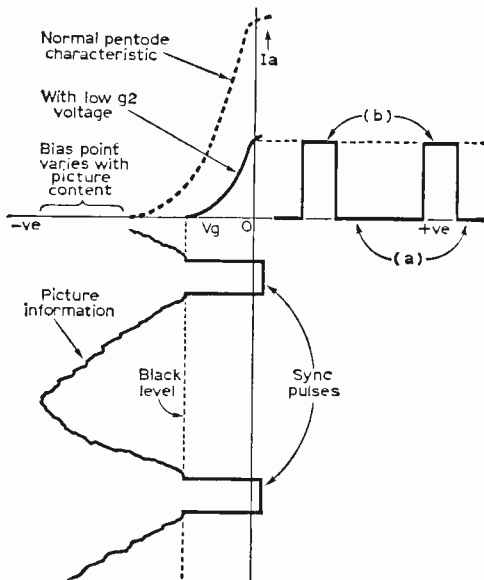


Fig. 1: Sync separator action. Due to the low screen grid voltage the negative bias developed by grid capacitor/grid leak resistor action cuts off anode current except when sync pulses arrive. Anode voltage when picture information is present therefore equals the supply voltage, reducing to $V_s - I_a R_L$ when sync pulses are present.

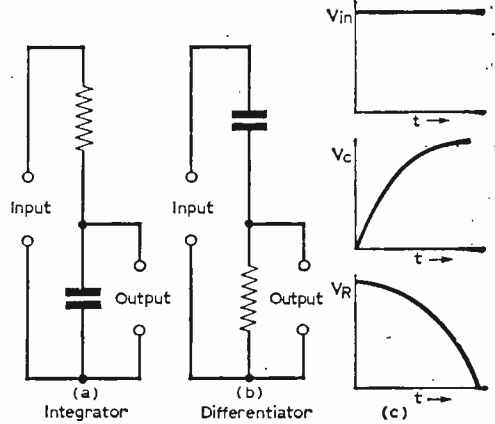


Fig. 2: Integrators and differentiators are both series RC circuits, the difference being that the output is taken from across the capacitor in the case of the integrator and from across the resistor in the case of the differentiator.

cut-off during picture content, while the time constant of the input CR combination, usually about 100mS, must permit a rapid return to conduction during sync pulse periods. Obviously if either the input or output circuits of the sync separator have excessive stray capacitance it will not be able to immediately respond to the sync pulse waveforms and either "cogging" or impaired sync locking will result

Some years ago c.r.t.s commonly developed heater/cathode leakage and apart from the resulting impairment of picture resolution these slight leaks were usually first evident by "cogging" on the Test Card circle due to this extra capacitive loading imposed on the sync separator, which of course is fed from the c.r.t. cathode. It is an interesting experiment to connect a small picofarad capacitor across the grid or anode load resistors of the sync separator and to note the effect of this on timebase locking.

Before leaving the subject of the sync separator, two points must be made. First, even with a perfectly operating stage unless the overall vision response curve of the receiver exceeds 2Mc/s weak sync lock will result due to mis-shaping of the pulse. Secondly, it is not unknown for defective i.f. valves to cause impaired sync on u.h.f. in dual-standard models by clipping the peak value sync pulses. Although such instances are by no means common, it should always be borne in mind where the fault only exists on the one system.

The output from the sync separator in valved receivers is always capacitively fed to the line and field sawtooth oscillators, but in transistorised models pulse injection is most likely to be via a winding on a blocking-oscillator transformer.

Of course the line and field sync pulses will be separated by the usual integrator and differentiator circuits, but as these two RC combinations (see Fig. 2) are now so well known there is no need to restate their action although it must be emphasised that they are both virtually the same circuit. Their difference lies purely in their use. The input is applied to the two components in series; if output

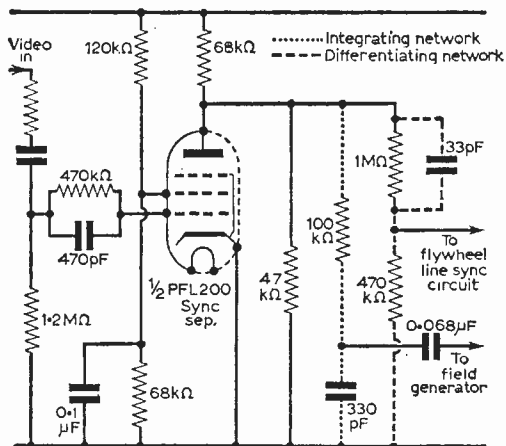


Fig. 3: Typical pentode sync separator stage.

is taken from across the resistor the circuit is a differentiator, if from across the capacitor the combination is an integrator. With a series RC combination on application of a d.c. potential or pulse the full potential will instantaneously be developed across the resistor to exponentially reduce as the voltage across the capacitor exponentially builds up. At all times the sum of the voltages across the resistor and capacitor equal the applied voltage. Figure 3 shows the complete sync separator stage, with line and field sync separation networks, used on recent Pye/Ekco models.

The time constant of these circuits will vary with their use, that for a line circuit differentiator averaging about $1\mu\text{s}$ on 405 and $0.5\mu\text{s}$ on 625, while a field circuit integrator will be about $40\mu\text{s}$ on 405 and $30\mu\text{s}$ on 625. These however are only average values and in practice can vary widely. Furthermore, as differentiators produce an almost vertical leading edge to the pulse developed across the resistor a partial differentiator may be incorporated into the field sync pulse shaping circuit to sharpen the characteristic jagged edge of the field pulse rising waveform. Thus the sync feed circuit to the field timebase may well be far more involved than simple theory would suggest, and unless the relevant service manual is to hand it is usually difficult to determine just what is the precise function of each component.

After eliminating valves it usually pays to change all suspect components when investigating cases of weak or intermittent sync.

In simple line generators the sync pulses directly trigger the sawtooth oscillator, but in a.f.c. or flywheel sync circuits these pulses, together with sample pulses derived from the line output stage, are applied to a discriminator circuit which then produces a d.c. output whose polarity and amplitude is then used to control the line oscillator by varying its bias. In many models a stage of d.c. amplification is used to amplify this d.c. control voltage to improve oscillator frequency stability.

As well as the usual integrator plus possible partial differentiator in the field sync feed system many models also incorporate a biased diode

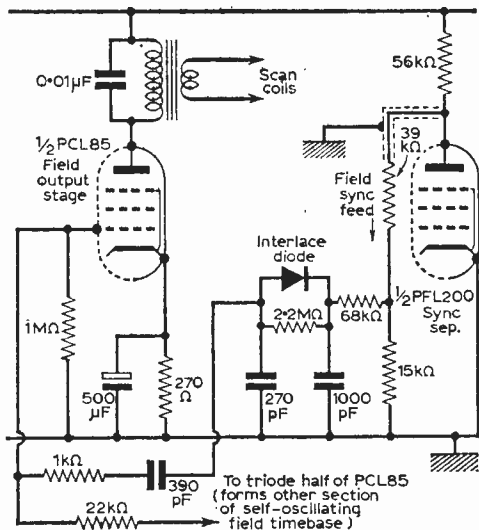


Fig. 4: Field sync circuit incorporating an interlace diode. The diode only conducts and passes the field sync pulse to the PCL85 when the rising integrated waveform reaches a certain amplitude thus filtering out line and noise pulses to ensure accurate triggering with optimum interlace.

which prevents random noise from triggering the timebase by "holding off" any pulse till it assumes a predetermined value. This circuitry also assists in achieving good interlace by isolating the field circuit from the line pulses which fail to reach this level, for only the field sync pulses have sufficient duration with a relatively shorter interval between them to permit the voltage build-up across the integrating capacitor. A typical modern field sync feed circuit is shown in Fig. 4. This is employed in the latest range of Bush/Murphy receivers. The self-oscillating PCL85 triode-pentode generator and output stage has the sync feed applied to the grid of the pentode section.

SERVICING

As with all faults, receivers with impaired sync should first be examined for evidence of other coincident faults. These could be: inadequate h.f. video resolution, high hum level, inability to control contrast normally, bad picture tonal grading, and sound-on-vision or vision-on-sound.

Inability to control contrast normally would strongly suggest that there was a major reduction in the negative voltage being developed by the sync separator grid for a.g.c., so that attention should be directed to the video amplifier and the feed to the grid of the sync separator. If bad picture tone was also present—soot and whitewash—this would confirm a video stage fault, most likely excessive bias.

Sound-on-vision or vision-on-sound with no other alignment defect would infer cross modulation in the tuner, again almost certainly due to lack of a.g.c. control stemming from the reduced sync separator grid voltage.

TO BE CONTINUED

INSIDE TV TODAY

PART 7 M. D. BENEDICT

THE GEMINI SYSTEM

Of the two methods of recording a complete television programme, film and video tape, film has many advantages. It can be shown on any line standard in use in any part of the world without expensive and complex standards converters; film machines, called telecines, are found in every television station, even the smallest, all over the world. Video tape machines are comparatively rare with only the larger studio centres able to afford such facilities. Film is far easier to handle, it is simple to edit, and filming in colour merely involves using colour film stock in place of black-and-white stock.

Filming is often a long and tedious job as each sequence, with its dialogue, is taken one shot at a time with the camera being moved, the lights reset, microphone booms repositioned and artists repeating their performance for a different camera angle. If the slightest flaw can be seen on a take of a shot it will be repeated and repeated until perfect—over fifty takes of one shot have been known. These techniques produce accurate and very polished results in the hands of an expert director but it takes time and costs a lot of money. On an average day only two minutes of the complete film may be shot.

Television Studio Output

In contrast to this a television studio can produce fifteen to thirty minutes of programme each day without much difficulty. In television three to six cameras may be used gathered around the set on which the action is taking place or about to take place. Each camera selects a different camera angle and position to give the shots which the director requires and the vision mixer selects the required camera. Mixes and wipes can be electronically generated to combine or change shots to produce the similar effects as with film. Before the action changes to another set the cameras not taking shots on the first set move round to the next set, and as the cameras on the first set complete their shots they move round to the next set. Hence the recording of a programme may be completed without stopping at all.

Most television programmes are recorded on video tape, a technique which has the advantages of cheaper cost, better quality and instantaneous replay, allowing an immediate check on recording quality. Recording on film can be done by pointing a film camera at a high quality monitor. Electronic control of the film camera's motors maintains an exact synchronism between the incoming television pictures and the film. Results obtained by this system are not very satisfactory, largely due to the limited definition of the television system, as well as several other defects. Colour telerecording is not, as yet, practical, although Technicolour have perfected a system in which each of the primary images, red, green and blue, are separately recorded and later combined.

Combined Film and Television

Several other approaches to the problem of combining film and television techniques have been adopted by equipment manufacturers. Most of these systems combine a television camera and a cine camera, so that the same scene is viewed by both. This involves, in most cases, using the same lens so that beam splitting arrangements must be made. In most cases a standard professional cine camera with all its complexities is used with a simple closed-circuit television camera. A more complex set-up would use several such cameras and a control unit to run each of the cameras at the required point as well as switching between the video outputs, some times recorded on video tape. Mitchell cameras are to be found in most film studios and Mitchell's have adapted one of their standard cameras by adding a simple plumbicon television camera and arranging for quick starts to be effected from a control unit. Helical-scan video tape recorders record the complete sequence, allowing production personnel, such as the director, the producer and designer, an exact view of the take which can then be replayed at will.

Electronicam is a similar technique with Arriflex cameras and a vidicon television camera viewing the viewfinder. Normally, a television control room, with a vision mixer, selects the output of each camera and codes the sound-track recorder in a manner which allows a film editor to cut the story in the same way as the vision mixer cuts the original sequence. Both these systems use 35mm. film.

Two versions of this technique were produced by Livingston Laboratories, both using Mitchell cameras. Add-a-Vision consists of a Mitchell BNC camera with a Philips plumbicon camera. The light for the television camera is derived from a beam splitter on the zoom lens fitted. A helical-scan video tape recorder may also be used and several monitors feed the camera output to guide the director, performers and technical staff. For multicamera techniques a more elaborate arrangement known as Electronic Filming System—e.f.s.—is available.

This is based on another type of Mitchell camera and uses a power-operated zoom lens of the type used in many television studios. Marker lights on each camera and coded tones on the sound track indicate which camera is on the air, this being effected from a normal control room. In this control room a vision operator controls the cameras' exposure in the manner of a television vision control operator. He also starts each camera. About 10 frames (0.5 sec.) are taken before the speed is steady.

In France, Thomson-Houston Company manufacture a special 16mm. camera designed for the job,



Left: The Gemini system—Marconi Mk. IV television camera with Auricon cine camera. The light passes through the zoom lens and is divided between the cameras by the beam splitter at the base of the lens. Note the 1200 ft. film magazine. In use a sound-proofing jacket covers the cine camera to reduce pick-up of noise from the cameras by the studio microphones.

with an instantaneous start facility. This allows the cameras to start their film as the vision operator depresses the cut button or starts to fade or wipe, thus saving a considerable amount of film stock.

Certainly the simplest technique, however, is the Gemini system which has been installed by an independent television studio, Granville Studios, in Fulham. Granville Studios are one of several television studios providing facilities for anyone requiring television work. Like the others, Granville are not part of the Independent Television programme contractors, although they, or the BBC, may hire the studio if facilities of their own are lacking. Such companies provide expert and efficient television services for anyone who requires a television programme. Customers include advertising agencies, television set manufacturers, foreign broadcasting authorities and the Conservative central office, who entrust party political broadcasts to an independent studio. Granville specialise in work for the Central Office of Information, who produce films about Britain for showing abroad. Originally these were telerecorded, but now the Gemini system has proved invaluable as it allows high-quality colour films to be speedily made at a low cost.

In the Gemini system a Super Auricon 16mm. camera is attached to a standard broadcast-quality television camera, in the case of the Granville a studio Marconi Mk. IV image-orthicon camera channel. A special lens system splits the light from the scene between the television camera and the film camera and consists of a 10 : 1 zoom lens fitted with a beam splitter. This diverts a proportion of the light to the film camera, the exact proportion depending on the film speed and being varied to give the correct exposure for both film and television cameras. After splitting, the light fed to the camera forms an image on the camera tube in the normal manner. Light reaches the film via a lens system allowing adjustment of image size relative to the television camera image size.

The film camera is mounted upside down beside the television camera on a firm base on to which the television camera is also bolted. After mechanical

alignment of all the components and the usual electronic line-up for the television camera, the optical adjustments are made to give an exactly similar view in the television and film camera viewfinders. Separate focusing adjustments are made to both film and television cameras; the alignment is then complete unless the major components are altered.

Recording and Editing

Each film camera carries a 1,200 ft. film magazine, giving a filming time of 33 minutes. Great reliability has been achieved with the Auricon cameras and they are very simple to operate in comparison with some types of film cameras. Hence little attention need be given to the cameras beyond loading and occasional cleaning. At the start of a programme each camera and the sound recorder is switched on; the cameras view a clapperboard, which is operated to mark all the films and sound with a reference point. All cameras remain in sync with the sound recorder and continue running whilst the cameras disperse to their starting points for the programme proper. Each cameraman holds his shot for as long as possible during the recording of the programme, whether or not his camera is on the air. Only whilst moving from position to position would the cameraman lose his shot. Cutting points as selected by the vision mixer are indicated on each reel of film in each camera by coupling a small bulb by the film gate of each film camera to the tally light circuit. Tally lights are the red lights on the top and the front of the television cameras, operated from the vision mixer, indicating to the artists, cameraman, sound crew and all on the floor which camera is on the air. When on the air the light exposes part of the film by the sprocket holes so that on the processed print there appears a thin white line between the sprocket holes, indicating the camera that was on the air at that particular point.

After processing, a film editor can run the film through and see instantly where the film should be cut. If desired, he can vary his cutting point from that indicated, and add shots from cameras off the air at that point in the recording. This is the reason for the cameramen holding their shots for as long as possible. In fact, on one occasion, the output of one camera was ruined by scratched film yet by editing it was possible to save the complete sequence by replacing each ruined shot by a shot from a camera not on the air at that point in the original take.

Three techniques are available to the editor assembling the three films from each camera into a complete sequence. With the simplest system, each required shot is assembled on to alternate reels of film, the unwanted part of each film being replaced by black film. On printing together the completed sequence is achieved. Sound is transferred from magnetic film to an optical track on the final print.

For complicated sequences, a positive print of each camera's film is made and is then cut together into a single reel, complete except for mixes and wipes. When a mix is required it is marked by a crayon and the sound track and assembled print is taken to the laboratories where it is used as a guide for the technician who edits the original negative film from each camera, using the cut print as a guide. Mixes are performed in the laboratory with a special technique.

Printing

Using a special printer with a variable iris, it is possible to speed up the process considerably. Such printers are used for "grading" films for television and the cinema by varying the exposure of each shot at the start of that shot in order to correct for errors in exposing the camera in the original scene. In use with the Gemini system it is programmed by the film editor to expose all of the required shots on one reel. This is done by running the film through the printer then recording the start and end of each required shot. Each camera film is then re-run through the printer and printed on to the final print. Unwanted portions are not printed by closing the shutter, which is controlled by the start and those points recorded earlier. Similarly the reel from the second camera is run through, the required shot being selected and the shutter programmed to open and close at the required points.

Printing then proceeds as before and the gaps in the film are filled up as each consecutive reel is printed. Mixes and fades are arranged by a slow opening and closing of the shutter, mixes by overlapping, fading up and fading down from different reels. Sound is added by transferring from magnetic track to the usual film optical track either recorded directly when running through the printer or by printing from a negative optical sound track. Such a technique allows a film to be prepared in less time, in fact within one working day.

Uses and Advantages

In many items it is advantageous to be able to use a shot of a person as they react to a question or a statement made by another person. Reaction shots, as these are called, can be very effective when used properly but it is very difficult to judge whether a reaction shot will fit before the reaction is seen. With Gemini the reaction on one camera can be seen at leisure and the editor can simply edit it in if the shot fits the rest of the sequence.

Interviews often become difficult to cover as it is not always easy to find the correct person who is speaking, especially if the speaker interrupts or replies very quickly. Each camera equipped with Gemini allows a director to select a shot for each speaker and if the cut to a new speaker is too late the editor very simply cuts the film slightly before the marked cutting point, where, in fact, the speaker starts his speech.

Should there be any requirement for quick transmission of the material, or even a live programme as well as the recording, it is perfectly simple to send the output of the vision mixer, which is perfectly standard, to a video tape recorder, or even to send it straight to the transmitter. This is possible because

the operation of the television cameras and video equipment is perfectly normal and fully up to broadcast standards, unlike the output from other systems' simple television cameras. Checking and review of the material can be made instantly by using any type of video tape recorder, even the simplest helical scan machines which are not suitable for broadcast use.

All Gemini's rival systems suffer from a considerable handicap. By agreement with the trades unions involved with television and film it is considered that each film-camera based system must carry the full complement of operators normally used with film, including sound crew. This may involve six or more operators. However the Gemini system is regarded as a television-camera based system and requires only one extra member of the crew who loads each camera with film, checks the mechanism, records film footages and operates the clapperboard at the start of each sequence. Naturally a considerable economy can be made with a smaller crew doing the same job.

Conversion for colour television is very simple, consisting only of loading the film cameras with colour film stock. Compared with electronic colour television, Gemini is much cheaper and easier to handle, but it cannot, of course, handle live colour broadcasts. Electronic colour television is considerably slower and more complex than monochrome television, mainly due to the complicated line-up and balancing of the three-colour-tube cameras. No extra line-up is required for Gemini in colour and, except for the artistic and lighting considerations of colour work, the Gemini system simplifies colour television working almost to black-and-white television working.

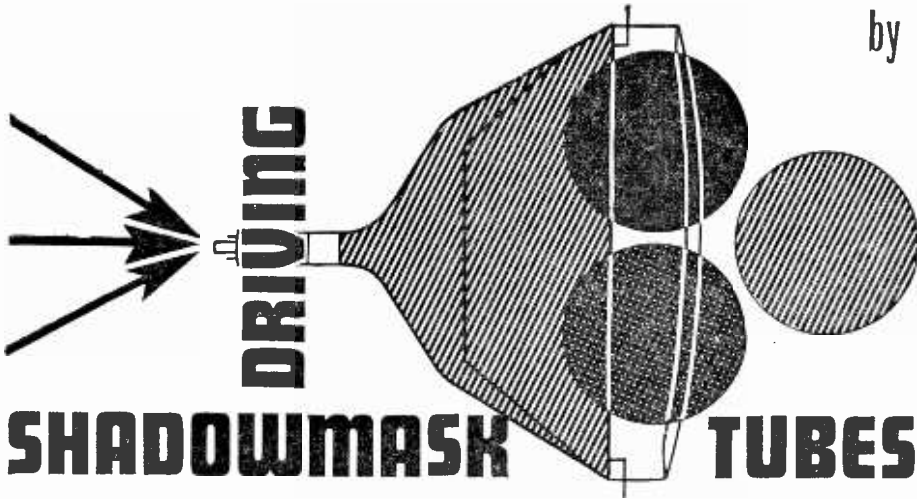
Other advantages of Gemini are, the simplicity of distributing programmes when completed. No complex links are required between various studio centres; instead the complete film can be sent by ordinary mail services and screened by local studios. Any number of copies can be quickly made without loss of quality, allowing the programme to be distributed all over the world, differing line standards being of no importance when film is used.

Mexico has a considerable geographical problem when distributing its programmes owing to the mountainous nature of the country. Instead, a black-and-white Gemini system is used, and the programmes distributed on film to different parts of the country.

Granville Studios leave the Gemini assembly fixed to the television camera at all times, even though they are not in use at the time, but it is quite simple to remove the equipment and mount it with different equipment. Hence it can be used for outside broadcasts; the Richmond Jazz Festival has been covered in this way.

Amalgamating television and film techniques speeds up film making and offers improved accuracy for television techniques. The lack of polish and precision which is so obvious with much of television when compared with the cinema can now, perhaps, be overcome, thus improving critical viewers' enjoyment. All direct-filming systems offer no loss of quality inherent in telerecording and the Gemini system offers both flexibility and simplicity. This is well demonstrated by Granville Studios and the author wishes to thank all of Granville's staff, in particular the chief engineer, for their assistance.

TO BE CONTINUED



THE single electron beam of a monochrome picture tube is modulated with picture signal in the manner shown in Fig. 1. Here the video output valve is biased to suit the positive (405-line system) or negative (625-line system) composite video signal fed to its control grid. With either polarity picture signal the anode current increases in sympathy with increases in picture white level. This means that relative to black the voltage at the anode of the valve falls as the picture white increases. For high definition 625-line pictures, this video voltage must change at a maximum rate corresponding to about 5Mc/s.

A voltage fall applied to the picture tube cathode from the video amplifier valve anode is tantamount to a rise in voltage at the picture tube grid with respect to the cathode. In other words the standing bias on the picture tube, as set by the brightness control, is reduced by an amount depending on how much white is contained in each "picture element" scanned.

Theoretically the television camera receives no light input from totally black elements, so that if the set's brightness control is adjusted until the illumination on the screen is just extinguished when the transmission is at black level the range of "whites" on ordinary transmissions will provide the correct range of picture contrast. We know in practice that there are one or two factors that detract from this ideal state of affairs, such as partial d.c. coupling in the video circuits and to the tube cathode, mean-level vision a.g.c. and less than 100 per cent regulation in the e.h.t. circuits. These generally make it necessary to adopt a compromise setting for the brightness control, and also detract to some extent from the black-level performance of the receiver so that a really dark scene may appear somewhat lightened.

To proceed to the shadowmask colour display tube we can compare the basic monochrome set-up depicted in Fig. 1 with the basic colour set-up shown in Fig. 2. In the colour set-up shown the tube itself acts as the final matrix in which the true primary-colour signals are derived during beam modulation from the transmitted colour-difference signals.

It is easier to consider this circuit first in the light of an ordinary monochrome transmission, in which case the luminance output valve acts in almost exactly the same way as the video output valve in Fig. 1. In this type of circuit it is not practicable to connect the

brightness control to the circuit of the control grids as was done in Fig. 1, for various reasons which will become obvious as we progress. Nevertheless, it is essential for the three grids to be biased by a potential corresponding to the signal black level, and this is achieved in Fig. 2 by virtue of the action of R1 and the triode clamp valve. It is most important to appreciate at this stage that each of the three shadowmask tube grids in the type of circuit shown has such a resistor and clamp triode; and, of course, its own colour-difference output valve, which will be dealt with later.

BLACK LEVEL CLAMPING

Now, the black level must be "monitored" by the receiver at some part of the video signal waveform which is also at black level, and this is where the positive-going line pulses at the triode grid come in. These effectively "switch on" the clamp valve at the black level parts of the video waveform and thus ensure that the colour tube grid potential is directly geared to the signal black level. The actual value of the voltage applied to the grid at these black level instants is a function of the circuit parameters, and is a design aspect which need not bother us unduly here. Suffice it to say that at luminance signal black level the potential reflected from the anode of the luminance output valve to the picture tube cathodes is related to the "clamping potential" at the grids of the tube in terms of the correct biasing; that is, the biasing required just to cut off beam current.

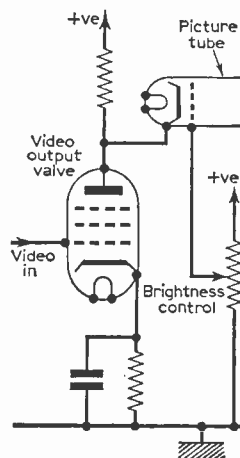


Fig. 1: Basic monochrome video circuit.

Now let us return to the main story and assume that the colour set is responding to a monochrome transmission. Because there is no colour in the signal, there are no colour-difference signals generated in the receiver. Indeed, the colour section is (or should be) muted by the colour-killer stage in the decoder. The red colour-difference stage shown in Fig. 2 is thus inoperative at this time, but the tube grids are still being clamped in the manner already explained.

GREY-SCALE TRACKING

The ordinary monochrome signal arrives at the grid of the luminance output valve and is applied to the three cathodes of the colour tube together, via the preset controls shown in Fig. 2 (note that these are shown in a much simplified manner in this circuit). The three electron beams are thus modulated with the monochrome signal and they create red, green and blue lights (dots) on the screen in a manner that shades of grey between peak white and black appear on the screen (if the proportions of red, green and blue light are correct).

To produce colourless (monochrome) light the intensities of the three colours must be almost equal (i.e., equal energy white light), and since the phosphor materials (red, green and blue) have different light-emitting properties—the red being a little “less sensitive” than the green, for instance—corresponding dissimilarities in beam currents are required to secure a correct, colourless monochrome display.

This is where the cathode feed presets come in, for these can be adjusted on a white signal until the beam currents are correctly proportioned to yield a white display from this signal without any colouring. It will be appreciated that these presets effectively serve to adjust the beams in terms of how much current they are carrying on white picture signal.

LOW-LEVEL ADJUSTMENT

Now let us suppose that the white in the picture signal reduces. What happens to the beam currents and do the proportions of current established by the cathode presets at high-level white hold at low-level white? The answer to this is that the proportions hold over the entire brightness range only when the characteristics of the three guns match each other fairly closely. Colour tubes, of course, are designed so that their guns have high matching tolerance, but absolutely perfect matching is impracticable.

Happily, however, low-level white matching is possible simply by adjusting the potentials applied to the first anodes of the three guns, and for this purpose all colour sets have preset adjustments on this electrode of each gun assembly.

BRIGHTNESS CONTROL

So far, then, we have seen how the video end of a colour set corresponds almost identically to that of a monochrome set, with certain added complications; but what about manual brightness control? The three grids are clamped, it is true, but so far no mention has been made about how the brightness of the picture can be adjusted to suit the ambient room lighting.

The commonly used scheme is shown in Fig. 2 and consists simply of a bias potentiometer in the control

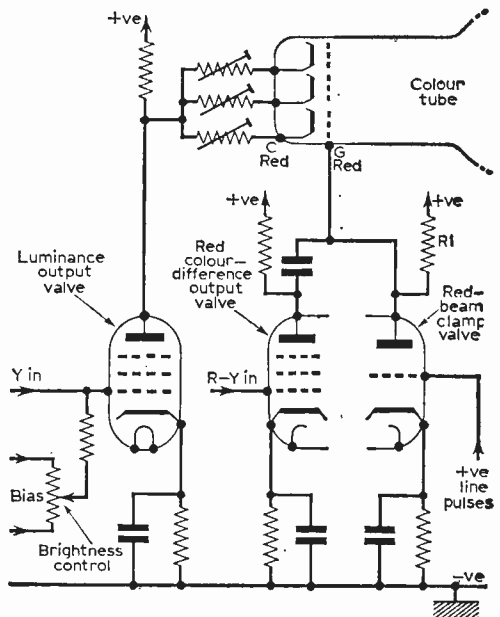


Fig. 2: Basic colour video circuit showing the luminance output valve and one colour-difference output stage with its associated clamp triode.

grid circuit of the luminance output valve. As the bias on this valve is adjusted, so the voltage at the anode—and hence at the cathodes of the colour tube—is changed; an effect, of course, which changes the tube biasing (of the three guns together) and consequently the overall brightness of the picture—whether monochrome or colour.

The same idea could be used in ordinary monochrome sets, but here it is that much easier to employ the grid-connected brightness control as shown in Fig. 1. It is essential with colour that the three beams are under identical brightness control to maintain the correct tracking of white, as already explained.

Y SIGNAL

The signal in the video stage of a monochrome set is called the “video signal”. The same signal in colour sets is called the “Y signal”. It is exactly the same as the video signal, as we have seen, and its make-up is truly panchromatic so that the monochrome representation of a colour scene coincides with the “brightness levels” of the various colours of which it is composed. This is the same as a panchromatic black-and-white camera film, which is sensitised so that colours, as seen by the camera, are produced in nicely proportioned increments of greys (black through white) with no black or white end of the scale compression.

White light, of course, contains all the colours in nature, and in a black-and-white video signal the three primary colours are in the proportions red 30%, green 59% and blue 11%. It follows from this that the red, green and blue signals derived from separate filtered tubes in the colour television camera are integrated exactly in these proportions to produce the

Y signal; and this, indeed, is the video (monochrome) signal.

So far, then, we have compared the action of the luminance stage of Fig. 2 with that of the video stage in Fig. 1. We must now consider the colour aspect of Fig. 2, which is really no more difficult to understand than monochrome.

COLOUR-DIFFERENCE SIGNALS

When colour is present in the transmission the colour killer stage switches off and colour-difference signals from the decoder are conveyed to the three grids of the colour tube. Figure 2 shows just one colour-difference channel (the red one): there is one just like this for the green grid and the blue grid. The colour-difference signals represent in each case the primary-colour signal (red, green or blue) with the Y signal subtracted, giving $R-Y$, $G-Y$ and $B-Y$ respectively, and the problem is to ensure that each beam is modulated so as to give the correct primary-colour signal. Thus the beam from the red gun needs to "see" the R signal only (not $R-Y$), that from the green gun the G signal only and that from the blue gun the B signal only.

This is easy to accomplish. The Y signal already contains 30%R (assuming that there is red in the picture element being scanned). Thus the colour-difference $R-Y$, or 70%R, must be added to obtain the red primary-colour signal, and with Y at the cathode (actually $-Y$, which is equivalent to $+Y$ at the grid) and $R-Y$ at the grid the voltages add together to give the required primary-colour signal to modulate the red beam. Exactly the same action occurs relative to the green and blue beams.

The net result is that while the *detail* of the picture is provided by the Y signal, the *colour information*, at a definition not exceeding 1Mc/s, is provided by the colour-difference signals in such a manner that each beam "sees" only its primary-colour signal as a modulating potential. Colour occurs on the screen because the colour signals alter the balance of the beam currents that would be required solely for a monochrome display. On a predominantly blue picture element, for instance, the blue beam contributes most to the display. Mixtures of colours in various proportions give the wide range of hues possible from a modern colour set.

DRIVE VOLTAGES REQUIRED

It is important next to get some idea of the signal swings necessary on the tube cathodes and grids for a fully-contrasted colour picture. For maximum contrast a swing of about 100 volts between black level and peak white is necessary at the cathodes, but the colour-difference amplifiers have to provide somewhat higher signal swings than this partly to cater for the reduced "sensitivity" of grid drive compared with cathode drive.

FULL TRANSISTORISATION

While swings of such magnitudes are readily obtainable from conventional video output valves, ordinary transistors with just tens of volts on their collectors obviously could not provide them. However, special high-voltage video transistors have been developed which work from 200 volts or so on their collectors and have collector dissipation ratings of

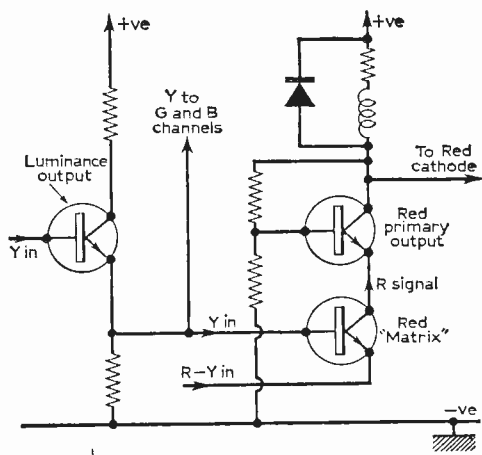


Fig. 3: Fully transistorised output stage used in the Thorn-B.R.C. chassis, in which the tube is fed with primary-colour signals at each cathode.

several watts. For use with these, luminance and colour-difference circuits of the type shown in Fig. 2 have been developed, but so far not many sets have adopted the idea. Most sets use the hybrid principle (a mixture of valves and transistors) with transistors operating in the low-power sections and valves in the high-power sections, including the timebases and video stages.

Nevertheless, the trend is towards complete transistorisation and one such set currently available (the Thorn-B.R.C. 2000 series) employs a unique video channel set-up in which the colour tube is fed at its cathodes with pure primary-colour signals.

THORN-B.R.C. CIRCUIT

The basic circuit of the video section is shown in Fig. 3, from which it will be seen that the luminance signal is delivered from the emitter of the luminance output transistor (connected in the emitter-follower mode) and fed to the base of the "matrix" transistor. To the emitter of this same transistor is fed the colour-difference signal ($R-Y$ in Fig. 3), the action of which is to add to the Y signal the colour-difference information so as to leave in the collector circuit the pure primary-colour signal (R in the circuit). This signal is then directly-coupled to the emitter of the primary-colour output transistor, from whence it is fed from the collector to the appropriate colour cathode of the shadowmask tube.

The great advantage of this scheme is that the high-power luminance amplifier is dispensed with, for the luminance output transistor in Fig. 3 need only be a relatively low-power one. Of course a primary output transistor is required for each colour (one each for red, green and blue), but since cathode drive is employed the signal amplitude from each primary-colour output transistor need not be quite as great as that required for grid drive. Moreover the three tube grids are left free for blanking and biasing purposes only. A brightness stabilisation circuit in this chassis is, in fact, incorporated in the grid circuits along with the blanking circuits. But that is another story!

Servicing TELEVISION Receivers

No. 144 - EKCO T368, T371 SERIES

by L. Lawry-Johns

THESE and associated models can be looked upon as being early versions of the T381-TC383 series which was the subject of a servicing article in the June-July 1965 issues. However at the request of readers having the early models with wired sound and vision strip we present this article which covers the following models: Ekco T368, T371, T368F and T371F. Ferranti models fitted with the same chassis are the T1046, T1049, T1046F and T1049F. Models suffixed F have a modified line timebase with flywheel sync. Other versions suffixed P are fitted with printed sound and vision panels. 17in. models use a CME1705 c.r.t. whilst the 21in. versions use a CME2101 tube.

Mechanical notes

The viewing window may be removed for cleaning although this is not often necessary. To remove the window, invert the set on a soft surface. The plastic extrusions at each side of the window are secured by woodscrews and spring clips through the cabinet base. Remove the screws and then withdraw the clips together with the p.v.c. strips. This reveals the four screws retaining both window clamps and on removal of one clamp the curved glass can be withdrawn. In some cases the other clamp may have to be slackened to release the window.

It is more likely that the cabinet will have to be removed in order to service the chassis rather than the window be removed for cleaning. To remove the cabinet, first remove the bottom and rear covers. These are retained by two polythene lugs each. Give a quarter-turn on each lug and lever the back cover out of the top and bottom channels. The channel selector knob is secured by a grub screw exposed when the fine tuner knob is rotated. Remove both. The escutcheon is held in position by a phosphor-bronze spring or clip which is pulled out from below. Slacken the two side wing-nuts which secure the cabinet to the chassis and move the top centre locking lever to the right. Push the cabinet forward and lift squarely up off the chassis. When the cabinet is put back on, ensure that the locking lever clicks into place as it is moved to the rear to engage the side brackets.

With the cabinet off, the tube tends to

hinder access to a large number of components. The tube can be moved forward if necessary by loosening the three hexagon-headed bolts at the top of the chassis, one on the loudspeaker support and the other two on the slotted members, then inverting and removing the two bolts holding the "ears" of the tube mounting. These are underneath the main chassis member and access to them is through the two holes in the member. Slacken the deflection-coils clamp locking screw and the tube can then be drawn forward to the extent of the ears. Replace the two screws and tighten up the hexagon bolts on top of the chassis.

Some common faults

Across the PY32 valve base is a 22Ω wire-wound resistor. This often becomes open circuit causing complete loss of vision and sound, leaving the set dead except for the heater circuit—all heaters remain glowing except the U26. The resistor can be checked

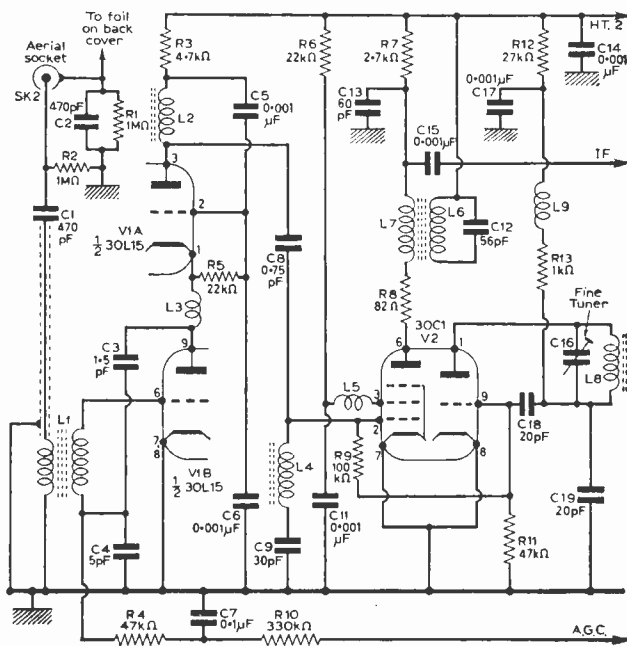


Fig. 1: Circuit diagram of the tuner unit.

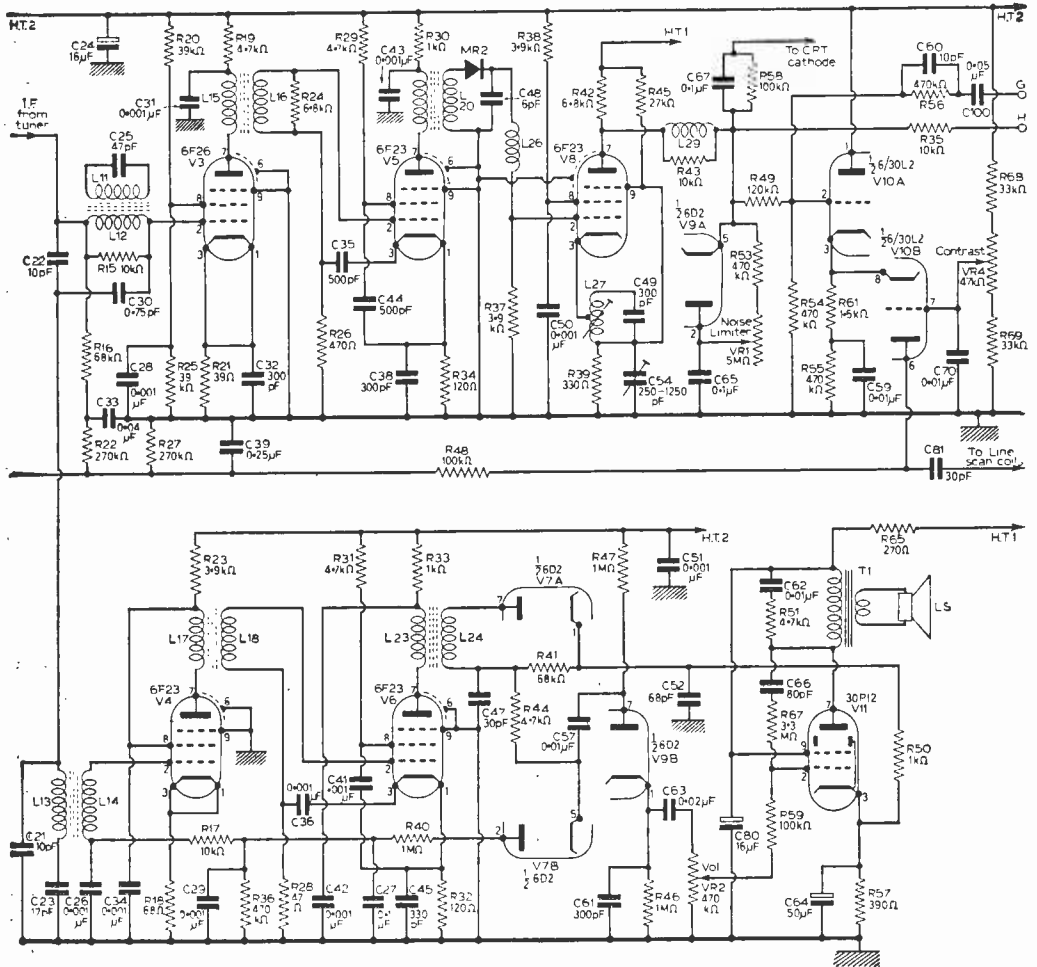


Fig. 2: Circuit diagram of the i.f. and timebase sections

and replaced once the bottom cover is removed.

At this stage in the receiver's life it is common to find that the main electrolytic capacitors require replacing. Normally the symptoms are a distinct hum on the sound and a very distorted picture, heavily shaded and curved. Replacement doesn't present much of a problem as the 100 + 200µF can is mounted on the side of the chassis in front of the e.h.t. section.

Video fault

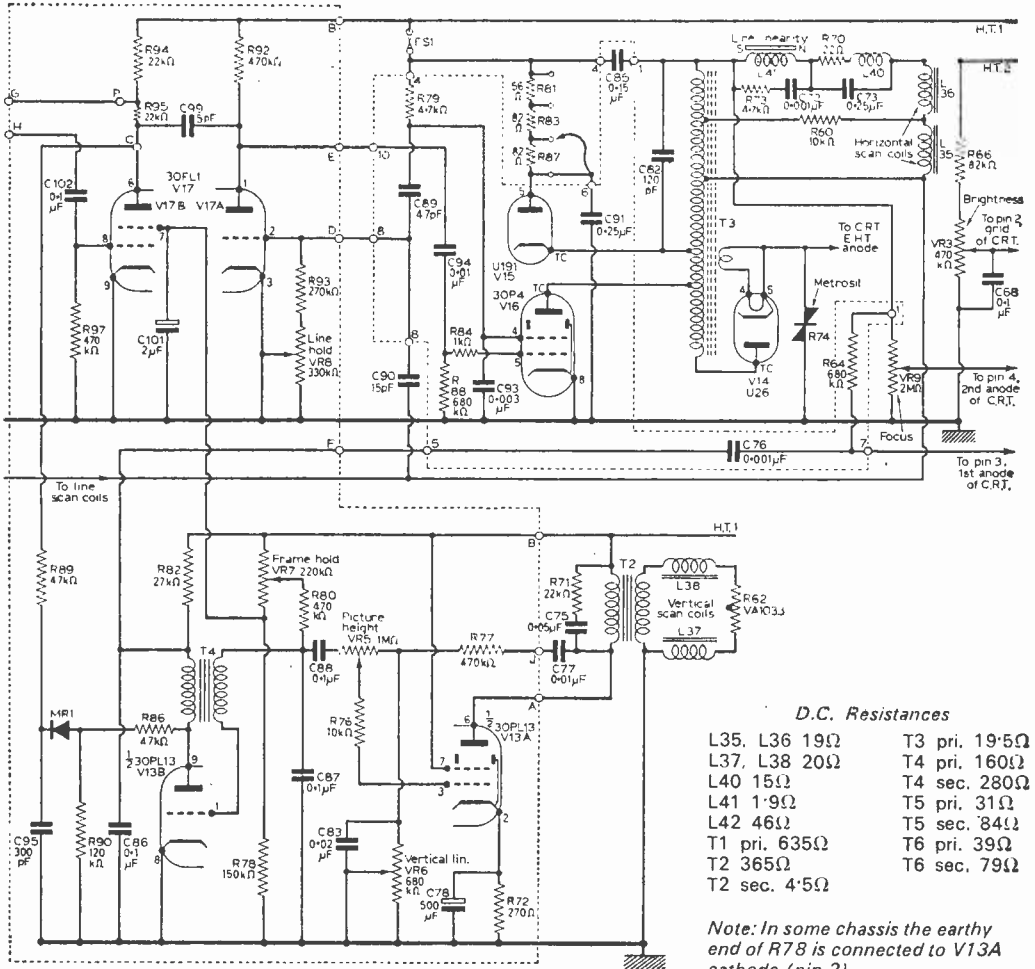
A very common fault, in these and many similar receivers, presents itself in varying degrees as the fault worsens. In the first place the line and field lock becomes more critical and the picture loses contrast. This is due to R45 (27kΩ) changing value. At this stage it presents a somewhat discoloured appearance and of course runs hot. This stage rapidly develops as the excess heat causes the value to fall further resulting in still more current flow and, of course, still more heat. R39 is the cathode resistor of the video

amplifier and this is also called upon to pass this same heavy current. It is quite likely that R39 will also change value or burn out altogether thus preventing a h.t. short or further trouble, but both R39 and R45 can become virtually short-circuited resulting in an almost dead short across the h.t. line, overheating V18, R96 and R98 and causing the main fuse FS2 to fail (if it is properly rated at 1.5A). Of course the situation should never get this far. The sync and contrast will be affected early in the cycle of events and thus call attention to what is happening.

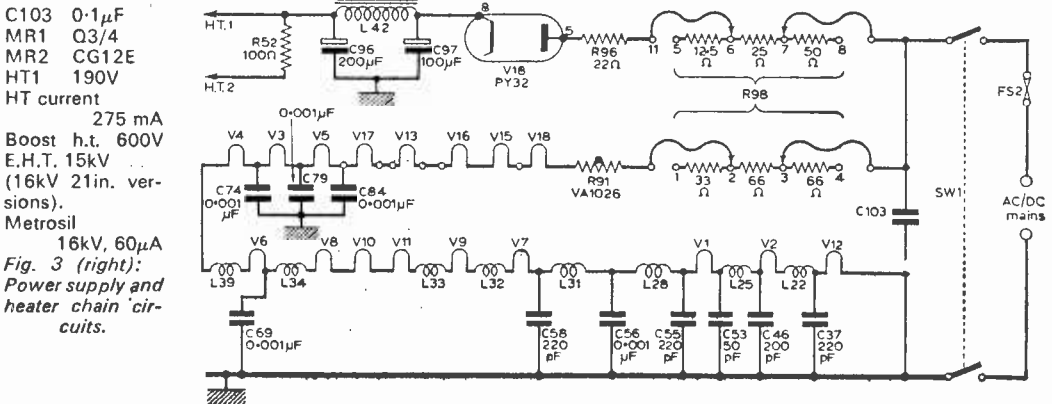
Another cause of weak sync

If the sync is weak, particularly on the field (frame) side, and difficulty is experienced in holding the picture for any length of time, but at the same time the contrast remains good, it is recommended that a test 2µF 350V capacitor be connected from pin 7 of the

—continued on page 307



of the receiver, Ekco T368/T371 and Ferranti T1046/T1049 series.



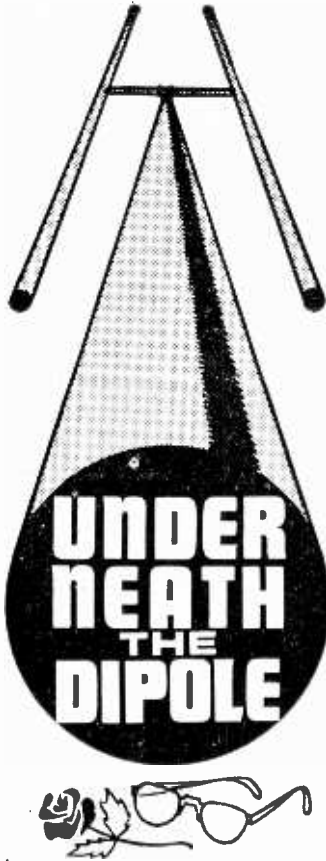
THE first three months of the year are regarded by many television producers and technicians as a time for mental and physical recuperation after their frantic panics in "big production" during the Christmas and New Year period. Now comes the second three months with three competing television channels, BBC-1, BBC-2 and ITV settling down for the "second round". BBC-1 having gained a little ground according to the TAM ratings.

General post on ITV

Executives and staffs at ABC TV, Redifusion and TWW are uneasy about the coming changes in their "front office" bosses, about their personal futures and even about the whereabouts of their places of work. TWW with its complicated mixture of Welsh-language programmes intermingled with the English language on a growing number of transmitters is faced with the takeover by Harlech-Television any day now. ABC and Redifusion's future has been complicated by the taking over of the American Warner Brothers' holding in the Associated British Picture Corporation, which is the parent company of the ABC TV. Everybody is still saying "Who's the boss?"

Shadows of Pilkington

There are likely to be further changes in the coverage of ITV companies when they turn over to ITA transmitters on u.h.f. for colour, an operation which will be parallel with the same programme in black-and-white, on Band III, 405 lines. Though the brilliant engineers of ITA have endeavoured to cover the same geographical areas with u.h.f. transmitters, the location of these has been dictated in many cases by the joint usage of the essential high masts by both BBC and ITA. Viewers have to take their chance with higher and higher aerials, too. This applies particularly to the sixty or seventy high-power transmitters necessary for u.h.f. plus about 260 medium-power transmitters and possibly hundreds of minitransmitters in the inevitable black spots of u.h.f. transmission. The Pilkington Committee can take part of the responsibility for this operation,



expensive even in prosperous times and ten times as difficult in this squeeze time. Every British government commits enormous follies, due mainly to bad selection of "experts" for the White Paper committees.

National film School

More recently, the Lloyd Committee has been dealing with a training scheme and a National Film School without having a single technician on the committee. In this technological age the Lloyd Committee should have included 25% of technicians and engineers. It is, however, unlikely that this scheme will materialise, because there already exists a number of very good film and television schools in various parts of the country. It would seem wrong to scrap these and replace them with one single National Film School institution turning out robots from the same mould and "brain washing" them.

The idea of a National Film School for the U.K. was put forward by the British Film Institute as a kind of comprehensive amalgamation of art and science. During the three years of deliberating on such an institution, the Arts Council has stepped in on the act. Technical progress has advanced at an amazing pace during this time, but the Lloyd Committee seems to be ignoring technological progress and the men who know its future possibilities as well as its present advanced state.

Colour's Technical Problems

In the last three years electronics have penetrated to the very heart of film making for cinemas and for television. But technical progress and its potentials have been largely ignored, leaving the universities in a chaotic mess and pouring about a quarter of a million pounds down the drain by buying incompatible television, video-tape and film equipment. When will those in authority learn to bring engineers and technicians into the act at the right time?

Progress in colour is followed by progress in ideas and a number of White Paper committees dealing with films and television have overlooked the fantastic changes that have taken place during the last year or so. The main changes during last year in the television industry, including BBC and ITV studios, transmitters, transmission frequencies, colour and black-and-white receivers have been of a basic and policy character. The BBC long proposed to adopt the NTSC (referred to as Never Twice the Same Colour) colour system standard but, in spite of the Postmaster-General's award of colour television to BBC only, the efforts of engineers from ABC Television and Rank-Bush-Murphy in collaboration with the Independent Television Association secured a delay so that the German PAL (Pale And Lurid or Peace At Last, depending on your point of view) and the French SECAM (Something Essentially Contrary to the American Method) could be considered in a practical manner. The ITA approach was on 75% technical grounds, not based on the vested interests of politicians, manufacturers, businessmen and

the stock exchange. It was a most unusual operation, a victory for technicians who were also great showmen in their own right. The final decision was in favour of PAL, of which there were three versions, the second of which was adopted.

Unfortunately frequency allocation for the PAL colour system in the U.K. is now all on u.h.f. frequencies, which restricts range and calls for enormous numbers of transmitters of high, medium and low power. This is partly a legacy of the Government's Pilkington Committee, in which engineers had only a minor role.

Colour telecine in the U.K. has advanced but is still inclined to be variable due to the additional contrast factors introduced in film printing and processing as compared with multiple-tube image-orthicon and Plumbicon cameras. This will no doubt be improved when film studios and laboratories have a telecine play-off on hand. The most popular colour-telecine film play-off is the 16mm. and 35mm. flying-spot, twin-lens (Cintel) and multicamera projection type, using three or four vidicon or Plumbicon tubes (Marconi).

Pinewood Studios is the first feature film studio to include in its facilities a colour telecine, of the type described above.

What's in a name ?

"Play of the Month" is a good title for an important television event, almost as good as "Armchair Theatre". In each case the

play is the thing, as Shakespeare said, without the advantage of the familiar characters who appear in the weekly serials or series, such as *Dr. Finlay's Casebook* or *Coronation Street*. With individual plays, you don't quite know what to expect unless you have read the details in the programme magazines. *The Parachute*, for instance, indicated an exciting war story of aerial conflicts; instead, it turned out to be a family saga of the German aristocracy with some good acting by John Osborne (who didn't write the play) and nothing much else—an epic best forgotten as quickly as possible.

However, *The Parachute* wasn't to be forgotten, because a week later the author and producer came under the spotlight in "Talkback", the weekly survey programme of viewers' criticisms with inquisitions on authors and other victims. It must have been a grim experience for the author, David Mercer, and the producer, Tony Garnett, whose presentation of themselves and their ideas could not have encouraged viewers to venture their viewing time on more plays from the same stable. Modern *avant-garde* plays are chancy entertainments, but known classics are a different category.

Take *Cyrano de Bergerac* for instance, the French play by Edmund Rostand, made famous in England by the famous airman/actor Robert Loraine who produced it at the Garrick Theatre in London, in 1919. A real tear jerker this was, according to my parents who saw it and duly wept several times,

responding to the magnificent and colourful performance by Robert Loraine. This was indeed a part for a real actor who could declaim the fine dialogue with the appropriate gestures of a swashbuckling musketeer. I saw this piece, too, as a small boy, astonished by the display of handkerchiefs used by the audience in the stalls from my vantage point in the front of the circle—all of them enjoying a good cry.

Eric Porter faced the challenge of the part gallantly on television, with a voice control which must have matched Loraine's on both delicate love scenes and in the heat of battle. *Cyrano de Bergerac's* nose has long been a monument in the theatre, a make-up man's dream as well as an actor's hope. On television this classic was worth watching, though the opening scenes and the very end sequences were somewhat prolonged. However, the strong story line and flashing swords of *Cyrano de Bergerac* cut to shreds *The Parachute*, thanks to the cast and James MacTaggart, the producer.

When you consider this play you realise that it was virtually a one-man production, a portrait of a flamboyant character embellished with many small parts, plenty of swordmanship and lots of colour. And, on television, fifteen minutes too long. Still, this was worth twenty anaemic modern plays!

Icons

SERVICING TV RECEIVERS

—continued from page 305

sync separator to chassis. In standard models the sync separator is the tetrode section of a 30FL1 (V17) but in fringe versions with flywheel sync it is a 6F23 (V19); in the latter case the relevant pin is pin 8.

This 2 μ F capacitor is part of a double can with C78 but there is no reason why a separate capacitor should not be fitted. We specified 2 μ F 350V as the rating for the capacitor as these are most generally available but in fact the voltage rating can be reduced to 200V without risk, as the screen of the sync separator is held at a much lower voltage by VR7 and R78 (standard chassis) forming a potentiometer across the h.t. line so that the voltage at the capacitor doesn't rise very high at all.

Striations

These are vertical rulings down the left-hand side, fading in intensity toward the centre. Check

R73 4-7k Ω (rises in value due to heat).

Instability and sound-on-vision

Generally this does not result from misalignment and cannot be cleared by adjustment of the sound rejector. The usual cause is an open circuit C24 16 μ F electrolytic which is part of a double can with C80 on the left side as viewed from the rear. The effect of C80 being open circuit is a drop in sound volume with, sometimes, a degree of vision buzz.

Tuner unit

The most common faults here are the usual improper contact between the studs of the coil biscuits and the contact springs. Normally it is only necessary to clean the biscuit studs. A low-emission 30L15 will produce a grainy picture, worsening to no picture at all as the emission falls to nil. The 30C1 is often responsible for a no picture condition but on occasions may be responsible for severe loss of gain.

To be continued

THE TELEAMP

J. B. WILLMOTT

LIKE many constructors, the author had acquired a number of discarded TV chassis over the years, either from friends or relatives, or second-hand junk shops when one is tempted into purchasing them for the sake of components which are sure to come in useful! After stripping off the more obviously useful components, the remains are apt to be consigned to an odd corner, and those "odd" valves added to the junk box. A means of utilising some of these less obvious valves and components recently occurred to the author, and thus "The Teleamp" was conceived.

It would, of course, have been a simple matter to build an audio amplifier using virtually the original audio circuitry and components of the TV receiver, but the author required an amplifier capable of a larger output than that normally provided by the sound channel of domestic TV, and it was therefore decided to use the line output valve as an audio output valve. The characteristics of a line output valve are those of a high slope pentode with a power rating greatly in excess of the average type of audio output valve, most line output valves would in fact be capable of handling a continuous output of 7 watts or more, at a distortion level of 10% so that at a normal listening level of say 2 watts (perhaps 4 watts on peak musical passages) the ample margin of

power-handling capacity could ensure a low level of distortion. The valve type PL81 enjoyed an extended period of popularity among TV receiver manufacturers, as a line output valve, and many constructors will no doubt have one or more such valves in their spares box; the obvious choice for the preceding a.f. stage is a valve of the EF80 type as these are quite common in discarded TV chassis.

Television receivers normally employ a.c./d.c. circuitry with half-wave rectification, quite often by a PY82 or its equivalent, and in fact, one of these is used in the design under discussion. It is essential that all valves be of the same heater current rating, 0.3A in the case of the types mentioned. The final choice of valve line up for the "Teleamp" thus becomes EF80 (triode connected as 1st a.f. stage), PL81 audio output, PY82 half-wave power supply rectifier.

One of the disadvantages normally associated with a.c./d.c. circuitry is that of the "live" chassis, which presents a shock hazard to anyone handling any metal parts when the apparatus is connected to the mains supply. However, it is possible to obviate this, and if the wiring instructions given later are adhered to, this amplifier is just as safe to handle as any other mains operated device; a "floating earth line" isolated from the metal chassis is featured, and all earth returns which would normally be connected to the chassis are connected to this earth line instead. The gramophone pickup leads are isolated (by capacitors) from the "live" amplifier circuitry, and thus there is no chance of shock when handling the pickup or its screened lead.

A further problem often encountered in audio amplifiers using half-wave rectification is the incidence of an unacceptably high hum level, but the prototype was found remarkably free from this defect; the high value of reservoir and smoothing capacitors (those removed from TV receivers usually being nominally in the range of "64 plus 250 μ F") and the use of an efficient choke working well below its accustomed current rating, are doubtless of considerable aid in this respect. A skirted valveholder with screening can should be used in the V1 position.

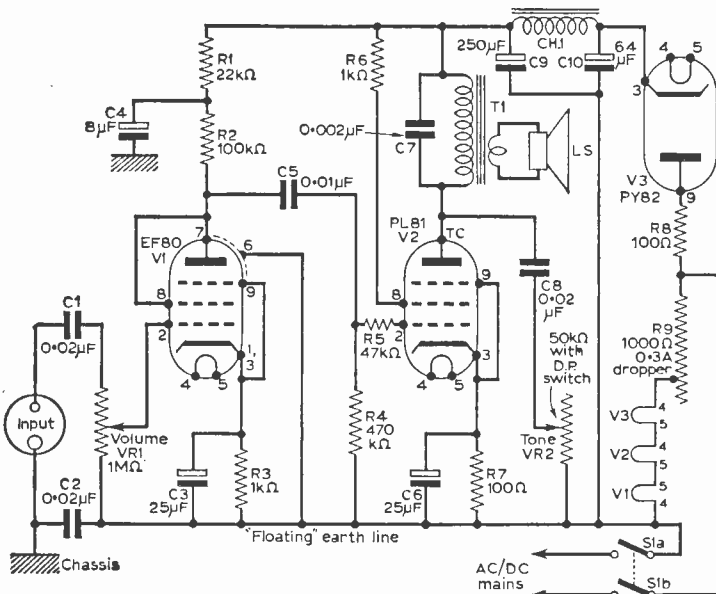
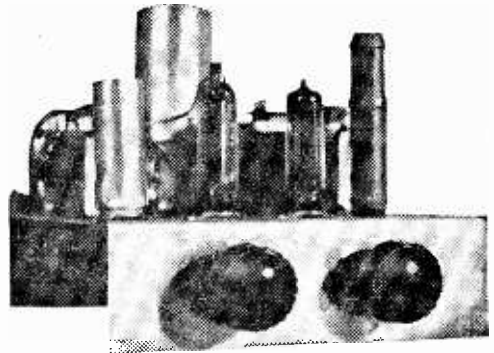


Fig. 1: Theoretical circuit of the complete amplifier.

The other unusual feature of the design is the type of output transformer used; at first sight the obvious choice would be the output transformer from the original TV chassis, but these components are small in size and incapable of handling a primary current in excess of 40mA, or a total power output of more than 2 to 3 watts. With a PL81 valve in the V2 position, primary current will be in the region of 70 to 80mA, and power output possibly in the region of 7 watts on peak passages. Naturally an ideal choice would be a heavy duty output transformer, of the multi-ratio type, capable of handling these power requirements, but such components are apt to be rather expensive. An acceptable substitute was found in the shape of one of the "low capacity" c.r. tube heater isolating transformers, which have been added to many early TV receivers in an effort to boost an ageing tube or to give a further period of use to a tube developing the symptom of heater/cathode leakage. Nominally, these transformers comprise a primary winding rated to carry the mains supply voltage (often with tapings to suit various supply voltages), and a secondary winding rated at 6.3V 0.3A, with additional tapings to boost the heater voltage by 10% and 20%. The basic turns ratio of primary to secondary is thus in the region of 40:1, and this was found to provide a reasonable match between the PL81 and 3Ω loudspeaker. Furthermore, the primary winding is quite capable of carrying the anode current of the PL81. Whilst audio "purists" might argue that a heater transformer is scarcely designed with high-fi audio performance in mind, in actual practice the author found that two examples of heater isolating transformer tried out in this novel use performed very satisfactorily.

The result of the foregoing investigations and experiments was that the complete "Tele-amp" was built almost entirely from components stripped from a TV chassis, the only major exceptions being the adjustable heater "dropper" (that existing in the TV chassis being unsuitable, as a much larger voltage requires to be "dropped"), and the potentiometer with switch, used as a tone control and on/off.

It is of course essential that all components are in good order: obviously a discarded TV chassis which has spent months (or possibly years) in an attic or shed is a doubtful source of components; particular attention should be paid to the main dual section electrolytic capacitor (C9/C10 in Fig. 1). A capacitor whose rubber bung shows signs of bulging, or traces of electrolyte leakage in the form of a white deposit where bung and can meet, should not be used, as such a component will almost



View of complete amplifier.

certainly be either partially dried up (resulting in low capacity) or "leaky".

BASIC CIRCUIT DESCRIPTION

Referring to Fig. 1, the incoming audio signal is applied to the control grid of V1 via the isolating capacitors C1 and C2 and the volume control VR1. The valve V1 is utilised as a triode, and hence has the screen grid connected to the anode, and the suppressor grid connected to the cathode. Note that pin

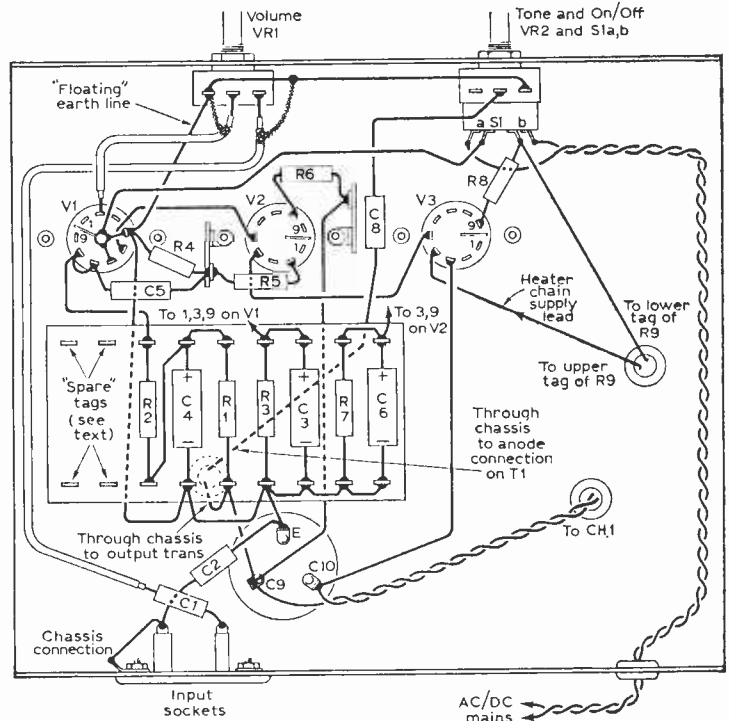


Fig. 2: Wiring and layout of the amplifier underside.

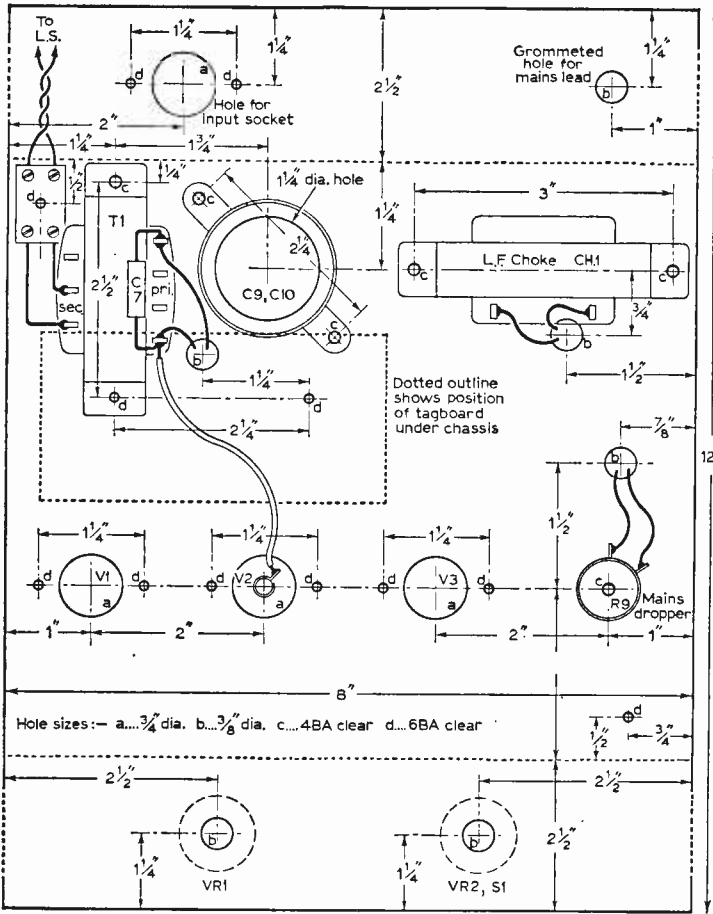


Fig. 3: Above chassis layout, drilling and chassis dimensions.

6, which forms the connection to the valve's inner screening, is connected directly to the earth line. Bias voltage is provided by R3 (with its attendant bypass capacitor C3) in the cathode circuit. The amplified audio signal is developed across the anode load resistor R2 and h.t. line decoupling by R1 and C4. The signal now passes via the coupling capacitor C5 to the control grid of V2. As this latter valve has a very high slope ("gain") the inclusion of a grid stopper resistor, R5, is essential. This resistor must be wired as closely as possible to pin 2 of the PL81 valve. Resistor R4 forms the customary grid leak for V2. Bias is provided by R7, with capacitor C6 in parallel. The screen grid of V2 is fed via the voltage dropping resistor R6, this is to ensure that the screen grid operates at a slightly lower voltage than the anode of the valve, otherwise the screen grid would tend to be overrun, resulting in distortion and damage to the valve. The output from the anode of V2 (which is the top cap of a PL81 valve) is taken to the primary of T1. A fixed tone correction capacitor C7 is wired permanently across the primary winding. A simple but effective variable tone control of the "top cut" variety is provided by C8 and VR2. This latter

control has the double pole on/off switch S1a/b ganged to it. It is important never to operate the amplifier without the loud-speaker connected, or damage to both output transformer and V2 will almost certainly result, due to flash-over or arcing.

Turning now to the power supply arrangements, it will be seen that one side of the mains is connected (via S1a) to the "floating" earth line previously mentioned, and the other mains lead (via S1b) is connected to the "top" of the adjustable mains dropper as shown in Fig. 1 (actually to the bottom tag of the component when mounted on the chassis). The slider of R9, set at the appropriate point of adjustment as described later, provides the take-off point for the supply to the valve heaters, which are wired in a series chain in the order shown. It is essential that V1 is included at the low potential end, i.e., nearest to the earth line, otherwise serious trouble will be experienced with an unduly high level of 50c/s mains hum in the amplifier output.

Returning to S1b, it will be seen that this side of the mains supply is also connected, via R8, to the anode of the rectifier valve V3. The object of R8 is to act as a limiting resistor, and on no account should this component be omitted, the reason being that the reservoir capacitor C10 and smoothing capacitor C9 present almost a short-circuit to the h.t. current

when these capacitors are charging up during the moments immediately after switching on, and the heavy current which would tend to flow through the valve V3 as soon as the latter "warmed up" could cause damage to its cathode. Insertion of R8 limits the initial charging current to a safe value, yet does not cause any serious voltage drop in the h.t. line once the amplifier is operating.

The pulsating d.c. current taken from the cathode of V3 is then smoothed in the usual manner by C10, C9 and the choke CH1. As the type of choke used in TV receivers is usually of low resistance, and limited inductance, smoothing is made good by the use of larger values of reservoir and smoothing capacitors than is normal practice in radio receivers or audio amplifiers.

CONSTRUCTION

The amplifier can be constructed on a U-shaped chassis measuring 8 x 7in., with 2 1/2in. deep runner front and rear, which means in effect that a sheet of 16s.w.g. aluminium 12 x 8in. is required, this is a standard size obtainable from several advertisers in

this magazine. It is best to drill all holes whilst the sheet is flat, before turning down the side runners. The exact position of mounting holes for the smoothing choke, output transformer, and C9/C10 will depend upon the physical size of these components, the actual dimensions used in the prototype by the author are however given in Fig. 3. Whilst minor modifications should have little effect in a design of this nature, it is recommended that a layout basically similar should be adhered to. Once the valvholder cutouts have been made (preferably with a $\frac{3}{4}$ in. diam. chassis cutter), the actual valvholders should be used as templates to mark the position of their fixing holes. Size 6 BA bolts and nuts should be used to fasten the valvholders, and the input socket on rear chassis runner; elsewhere 4 BA bolts will be found most suitable, the sizes of the respective drilling holes are clearly indicated on Fig. 3. The holes through which wiring is required to pass should be $\frac{3}{16}$ in. diameter and should be fitted with rubber insulating grommets. The majority of the resistors and capacitors are mounted on a paxolin tagboard, a nine-way board is specified although only seven sets of tags are actually used in the basic circuit, the use to which the two "spare" tags may be put is described under the suggested experimental modifications, which some constructors may wish to try out, at the end of this article. The tagboard should be supported clear of the chassis surface by placing 4 BA nuts between the paxolin and under-chassis surface, as spacers. One very important feature is that the can of the electrolytic capacitor C9/C10 *must* be insulated from the chassis, failure to observe this precaution would invalidate the "floating" earth line to which all earth returns are made. The capacitor should therefore have a layer of Sellotape, or stout brown paper tape, placed around it before the fixing clip is placed in position. The fixing clip should, when bolting to the chassis, be stood off therefrom by the use of spacing washers, or additional nuts, so that there is no danger of any part of the electrolytic capacitor's can coming into contact with the chassis. Components may be mounted in any order, using Figs. 2 and 3 as a guide. Note especially the correct orientation of the valvholders, and do not forget to use a holder with screening "skirt" in the V1 position.

WIRING NOTES

The series heater chain may be conveniently tested and adjusted as follows. If a multimeter is available, set to read ohms, and connect between end of mains supply flex. Insert all three valves, and turn the on/off switch to the "on" position and a reading of several hundred ohms should result. It is now necessary to adjust the setting of the slider on R9 to provide the correct voltage drop when amplifier is connected to the mains. The heater current required for correct operation of the specified valves is 0.3A, and their working voltages are:

PY82	19.0V
PL81	21.5V
EF80	6.3V

Total	46.8V
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Deduct the total heater voltage from that of the local mains supply, e.g., 240V less 46.8V = 193.2V.

Using Ohms law, the required resistance to drop

COMPONENTS LIST

Resistors:

R1	22k Ω	R6	1k Ω 1W
R2	100k Ω	R7	100 Ω
R3	1k Ω	R8	100 Ω 5W
R4	470k Ω	R9	1000 Ω 0.3A mains dropper with slider
R5	47k Ω		

(All 10% $\frac{1}{2}$ W unless otherwise stated).

Potentiometers:

VR1	500k Ω or 1M Ω
VR2	50k Ω with d.p. switch

Capacitors:

C1	0.02 μ F 750V paper
C2	0.02 μ F 750V paper
C3	25 μ F 25V electrolytic
C4	8 μ F 350V electrolytic
C5	0.01 μ F 350V paper
C6	25 μ F 25V electrolytic
C7	0.002 μ F 350V paper
C8	0.02 μ F 350V paper
C9/C10	64+250 μ F 275V electrolytic (dual section)

Valves:

V1	EF80	V2	PL81
V3	PY82		

Miscellaneous:

Heater isolation transformer T1 (240-6.3V or similar); smoothing choke CH1; B9A valvholders; B9A screening can; sheet aluminium 12 x 8 in.; 9-way tagboard; control knobs; 2-way tag strips; screened wire; wiring wire; nuts, bolts, etc.

the unwanted 193.2V is 193.2 divided by 0.3 = 644 Ω .

Connect the multimeter between the lower and slider contacts of R9, loosen the slider securing screw, and adjust the position of the slider until a reading as near 644 Ω as possible is obtained. If no multimeter is available, a reasonably accurate setting can be made by setting the slider of R9 so that about two-thirds of the length of resistance winding is in circuit.

Referring to Fig. 2, mount the specified components on the tagboard, and make the various interconnections on the tagboard itself and between the tagboard and various valve pins, and to C9, as clearly shown. The tagboard is fastened to the chassis by 6 BA long bolts, using a 4 BA nut as spacer to ensure that underside of tagboard is stood off clear of the chassis surface. It is recommended that the "floating earth line", should be of fairly stout gauge, not less than 18s.w.g.

TESTING

If a multimeter is to hand, a check should be made with meter set to ohms range, to ensure that there are no short-circuits or low resistance path between C10 (h.t. positive) and the floating earth line. If all is well,

—continued on page 324

the

IONOSPHERE

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TV

AT intervals, television reception is made difficult by interference from foreign transmissions, ghost signals and severe fading. This is usually attributed to "weather conditions", but the "weather" referred to is not that of our immediate atmosphere, but that of the atmosphere many miles above the earth, the region known as the Ionosphere. The story of its discovery and its effects is a particularly fascinating one, as it runs very closely parallel to the story of the progress of radio and radar.

FIRST TRANSMISSIONS

When the basic facts of radio transmission and reception were discovered by Heinrich Hertz in the 1880s, his equipment consisted of a spark-gap transmitter with a tinfoil plate attached to each side of the sparking electrodes. We would now recognise this as a dipole connected direct to the tank circuit of an oscillator. His receiver consisted of a loop of wire ending in another much smaller spark gap. When the transmitter was working, sparks could be seen in the spark-gap of the receiver. Several copies of Hertz's apparatus have been constructed, and it seems fairly certain that the predominant frequencies (for the bandwidth was very large) were in the microwave region, and not the low frequencies later used for broadcasting. Using this apparatus, Hertz demonstrated convincingly that the type of radiation he had discovered (later named Hertzian waves) obeyed the same rules as did light; it travelled in straight lines, was reflected, refracted and could be "absorbed" by a suitable receiver. Hertz found that excellent reflectors of Hertzian waves were sheets of any conducting material, and he used sheets of copper to prove that the beam was reflected, and that the angle of incidence was equal to the angle of the reflection as in optics. Figure 1 should clarify this rule of reflection. The waves which Hertz discovered fulfilled in every way the

theoretical analysis made by Clark Maxwell and were therefore classed as electromagnetic radiation along with light. Hertz died at the age of 36; the history of radio might well have been very different had he lived longer.

A large number of people were fascinated by Hertz's work; Marconi in Italy, Popov in Russia, Fleming in Britain and experiments in radio transmission began in several parts of the world. The discovery that higher and longer aerials could lead to reception over a greater distance seems to have been made by Marconi and Popov almost simultaneously, but it is doubtful if they realised that they were, in this way, using much longer wavelengths than had been used by Hertz.

Although by 1910 Marconi had succeeded in transmitting from the Isle of Wight to Poldhu (Cornwall) Hertz's discovery that the waves travelled in straight lines was still unchallenged and when Marconi announced that he was attempting transatlantic communication the impossibility of this step was pointed out. Such is the curvature of the earth that an impossibly high pair of aerials would be needed for straight-line communication across the Atlantic. Logically, the signals would disappear into outer space and be lost. As far as it went, this logic was correct; in fact, had Hertz attempted this experiment with his apparatus he would have found this to be so. Marconi, however, working purely on a hunch decided to try it out.

The results are well known. Communication was found to be possible though no one could say why with any degree of certainty. Various theories were put forward; a popular one being that the longer waves did not travel in straight lines. As a result, the longer wavelengths were reserved for Government and commercial use and the short waves tossed, like a scrap of meat to a dog, to the amateurs who were now becoming a formidable force in radio. The results of that decision are now

equally well known; the amateur operators, undeterred by theories, opened up one short wave band after another, and have been entitled to the use of certain bands ever since. That is another story, however, and the results of all the practical work done at that time served only to confirm that the radio waves travelled in straight lines.

MR. H. AND MR. K.

Curiously enough, a theory capable of explaining long distance radio communication had been in existence since the early days of the century. The British mathematician Heaviside had collaborated with his American opposite number Kennelly to publish a *Treatise on Electromagnetic Theory*. This put forward the idea that there existed in the upper atmosphere a conducting layer whose effect on radio waves must be similar to that of the copper sheet which Hertz used in his experiments.

Briefly, the theory submitted that any atom of a gas (or any other material) is electrically neutral because the atom consists of a central nucleus, which has a positive charge, surrounded by several electrons each having a negative charge. The number of electrons is always sufficient to balance out the charge on the nucleus so that the atom as a whole is neutral. Nitrogen for example, has seven electrons circulating round a nucleus which has a positive charge of seven units. It is the charge on the nucleus which decides what chemical properties an atom has; the "seven-charge" is Nitrogen, the "eight-charge" is Oxygen, the "six-charge" is Carbon and so on. It was known early on that one or more of these electrons could be removed by adding energy to the atom. Such energy might be electrical, as in a gas-discharge tube; thermal, as when a substance is heated, or radiated in the form of

where the ultra-violet light from the sun was most intense, and where the atmosphere was at a sufficiently low pressure to permit electrons to travel some distance. The result of the process described in the Heaviside-Kennelly theory is that in the upper atmosphere there must be a conducting layer of electrically charged particles; electrons, and portions of atoms whose electrons have been removed. These portions of atoms are known as ions (meaning "wanderers"), and they were already a familiar idea in the field of chemistry.

ENTER APPLETON

Although the Heaviside-Kennelly theory fitted the observed facts perfectly, and predicted that long-distance radio reception should be possible by reflection from this conducting layer, there was no direct proof that this reflection was taking place until the Appleton experiment in 1924. Appleton

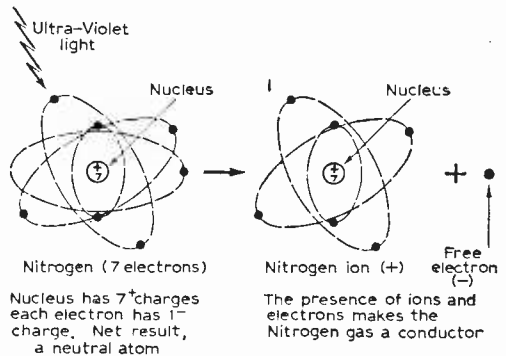


Fig. 2: Conversion of an atom to an ion.

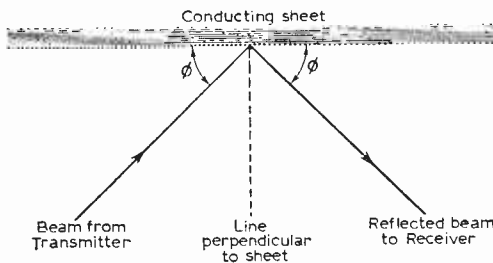


Fig. 1: Reflection of waves by a conducting sheet.

light. Heaviside and Kennelly found that the ultra-violet light radiated from the sun would supply enough energy to an electron for it to leave the nitrogen atom leaving the atom with a positive charge and a wandering electron which would behave as a negative unit of charge (Fig. 2). This process could occur only in the upper atmosphere

set out to prove that reflection was taking place and to measure the distance of the reflecting layer above the earth; the method he used is of some importance if we are to understand the effects of interference on TV signals. For his experiment Appleton used the BBC transmitter at Bourne-mouth and the receiving station at Oxford. Assuming that reflection was taking place above the earth, there should be two signals reaching the receiver, one coming directly in a straight line from the transmitter and the other reflected in two straight lines (Fig. 3).

Since the reflected wave had to travel a greater distance, and it was well established that all radiation travelled at the same speed of 186,000 miles per second the reflected wave would arrive at the receiver slightly later than the direct wave. If the reflected wave and the direct wave arrived *in phase* (Fig. 4) they would reinforce each other to give a strong signal at the receiver. If they arrived *out of*

phase they would cancel each other to give a weak signal at the receiver. There was no way of telling whether the time delay of the reflected signal would cause reinforcement or cancellation, but Appleton had an ingenious method of getting round this. He arranged for the transmitter to be changed slowly in frequency during the experiment. Since the time delay was constant, this meant that different numbers of wavelengths were involved and therefore the phase changed (Fig. 5). If Appleton's ideas were correct, the signal strength indicator should rise and fall continuously as the frequency was varied; this proved to be correct, and the existence of the Heaviside Layer was proved.

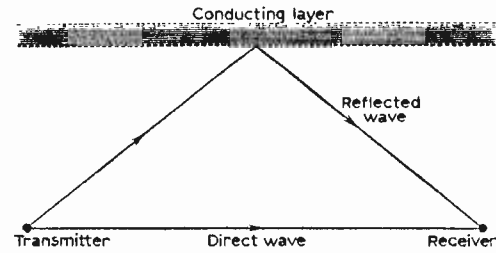


Fig. 3: Radio frequency waves reflected by a conducting layer.

It was found later that the Heaviside Layer acted as a reflector only of the lower frequencies (longer wavelengths), just as a chicken-wire fence can reflect a football but allows a golf-ball to pass. Appleton later used short pulses of waves to time the reflection of a vertical beam from the Heaviside Layer and thus determine its height (80 miles) accurately. During the course of these experiments, he discovered a second layer at a height of about 150 miles; this was later called the Appleton Layer in his honour.

VARIABILITY

The reflecting powers of the Heaviside and Appleton layers are very variable, and dozens of radio stations all over the world do nothing else but chart the amount of reflection from those layers. This knowledge is essential if long-distance radio communication is to be carried out, since frequencies can then be changed to give the most favourable conditions. Predictions of conditions of the layers (the ionosphere) can be made in the same way (but with more accuracy!) as predictions of weather in the lower atmosphere. Ionospheric weather reports can be made up from long-distance radio reception reports, from pulse measurements using radar and from rocket soundings.

SUN SPOTS

What causes changes in the "ionospheric weather"? Since the source of the ionosphere is ultra-violet radiation from the sun, it is reasonable to suppose that variations in the sun cause variations in the conditions of the ionosphere, and this turns out to be so. The amount of ultra-violet radiation from the sun fluctuates considerably, and this fluctuation is later detectable as changes in the ionosphere. Because of the distance between the earth and the sun (about 92 million miles) the radia-

tion takes about $8\frac{1}{2}$ minutes to reach the ionosphere.

Every so often conditions of complete radio blackout on many frequencies occur. These conditions come shortly after the eruption of a sunspot, and are caused by the sun emitting an unusual intensity of radiation accompanied by a stream of electrons and ions which, travelling more slowly than the radiation, arrive a few hours later. The effect of such an occurrence is to greatly intensify the effects of the Appleton and Heaviside layers. At first, the effect is noted as intermittent fading of long-distance stations accompanied by interference between stations. Long-distance reception becomes possible at shorter wavelengths than is normal, and eventually reception is severely disturbed by echo effects, and interference from distant stations.

Under normal conditions, the wavelengths used in television transmission are much too short to be reflected by either of the layers of the ionosphere. Television normally depends on the use of the direct or ground wave, travelling from transmitter to receiver in an approximately straight line, though it can "bend" slightly (a process known as diffraction) round obstacles and be reflected from objects on earth to cover a wider range than purely straight line conditions would indicate. The shorter the wavelength, the more closely the behaviour of a wave approximates to straight-line conditions, which explains the large difference in reception areas of ITV and BBC-2.

Because of this "straight-line" reception at the high frequencies used for television, a large number of transmitters are needed, each serving an area whose size depends on the height and location of the transmitting aerial and the undulations of the ground. Under normal conditions transmitters do not interfere with each other because adjacent transmitters work at different frequencies. Some frequency sharing is inevitable because of the limited number of frequencies available in Bands I and III, but any two transmitters working on the same frequency are widely spaced apart and, as a further safeguard, work with opposite polarisations, one vertical and the other horizontal.

INTERFERENCE

Ionospheric conditions usually make a certain amount of long-distance reception possible; however we seldom experience much interference due to distant transmitters. Seldom, that is, unless a particularly large sunspot erupts. Then the increased reflection from the ionosphere can cause the effects which drive normally placid viewers to telephone the BBC and ITV. Interference effects are very noticeable on television because of the effect of small phase shifts; a phase shift of $1\mu\text{S}$ causes a picture shift of nearly two inches on a 21-in. receiver. When large amounts of reflection are taking place several effects can be seen:

1. *Interference from other transmitters.* This may cause breakthrough in sound, in vision or both. In a mild form it may do little more than cause a herringbone pattern to appear on the screen, caused by the beating together of the two r.f. signals. Similarly a whistle may be heard on sound due to the interfering signal beating with the sound carrier of the local station. In more severe cases, the beat pattern in the video stages may cause synchronisation to be upset, causing slipping and

tearing of the picture. The interfering signal may even be strong enough to produce a picture which slips in and out of lock. In such cases it is often possible to obtain a better picture from a more distant transmitter. For example, during a recent sunspot cycle, Southern (Channel 11) was much less liable to interference than Croydon (Channel 9) in Essex, normally a Channel 9 region. The Channel 11 Anglia transmissions were little affected, being horizontally polarised.

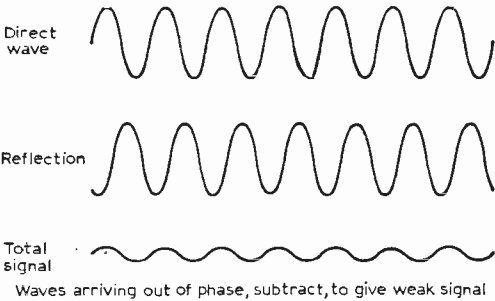
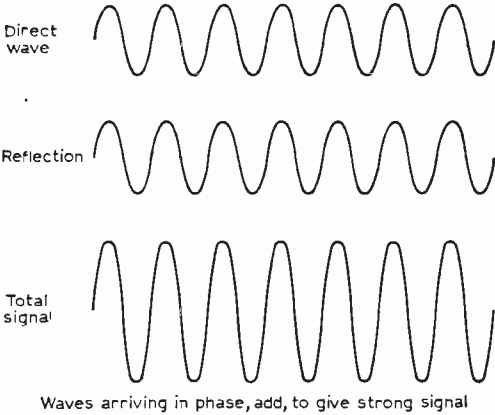
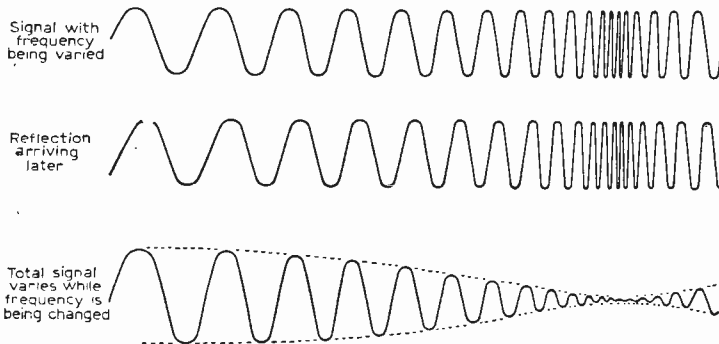


Fig. 4 (above): Phase difference of waves arriving at the aerial. The reflected waves shown equal in strength for clarity. Normally they would be weaker.

Fig. 5 (below): Changing the frequency of the transmitter —Appleton's solution to the problem of phase.



2 *Echo effects.* Even when there is no interference from other transmitters, reception can be effected by ghosting. Both direct wave and reflected wave reach the receiver, and they will not necessarily be in step. In television, as has been pointed out, a small phase shift can have a considerable effect. A picture is therefore obtained from each signal, the direct signal giving a locked normal picture, and the delayed signal a second picture (ghost) shifted along from the normal picture. Very often, both signals vary in intensity, and this can have the annoying affect of causing the set to lock on to whichever signal is stronger, so that the picture appears to shift to and fro across the screen. This is particularly so if flywheel sync is not in use.

As well as being shifted, the second signal may be inverted, causing a negative ghost, and there may be multiple reflections from different ionospheric layers and from paths involving ground reflections as well.

3. *Fading.* The strength of the reflected signal varies considerably from one minute to another, and, when the reflection is out of phase with the direct signal, this causes variable degrees of fading.

REMEDY

One obvious remedy for "sunspot blues" is to watch BBC-2. The other, as outlined earlier, is to use stations other than the nearest one so that no ground wave is present; this assumes that the variations of signal strength of the reflected wave can be dealt with by the a.g.c. system. A viewable picture can often be obtained in this way. If an aerial system of opposite polarisation is available, this may be used sometimes with advantage to pick up an adjacent station whose polarisation has been changed by reflection (as sometimes happens). Given a reasonably modern set and the inclination to fiddle with the fine tuner, a locked picture can often be obtained.

CONCLUSION

There is no complete cure to the effects of sunspots on television reception at Band I and III frequencies. Band IV is, however, little affected, due to the wide range of frequencies available, and the short wavelength which suffers very little reflection in the Ionosphere. It is worth noting that foreign stations on Bands IV and V can be obtained during a sunspot cycle, and their pictures locked, though sound is seldom obtainable due to the use of different standards.

We have come a long way since Appleton's confirmation of the Heaviside Layer in 1924. Practically every household now can see the effects of the reflection which Appleton was trying so hard to prove with simple equipment. It is, nevertheless, very humbling to think that the existence of the problem was worked out so completely by mathematicians at a time when radio and television were little more than a dream.

VIDEO TAPE RECORDING

PART 7

H.W.HELLYER

THE synchronising systems of normal television receivers are comparatively straightforward. A pulse triggers an oscillator at the appropriate line or field frequency to lock the speed of the deflection of the electron beam which traces the picture on the receiver's tube to the transmitted signal which is timed by the scanning beam of the camera. Design problems centre around preserving constant oscillator frequency, keeping the lock-in range of the oscillator within bounds, shaping and selecting the pulses to avoid random triggering, and other familiar problems.

When we consider the added problems of synchronising that video tape recording raises, however, it is small wonder that the sync and servo circuits are among the most critical and elaborate in the whole equipment. A television signal being recorded will carry its own train of pulses, but these cannot be impressed as a varying magnetism on the tape to act as a trigger for oscillator circuits during replay without a number of safeguards—without, in fact, a number of drastic changes to make the transition from the electrical to the magnetic mode possible.

Then the mechanical system which transports the tape must be given suitable information to enable it to replay at exactly the same speed as it recorded. So the incoming pulses will have to be used as electronic triggers for a reference-pulse system that can be sensed by the mechanical system. More complications! But we have not finished yet. When using the camera instead of the television receiver as our source of pictures we must produce our own sync pulses and servo reference pulses both to trigger the timebases of the screen we intend to use as a monitor while recording and also to control the equipment on replay. An advantage of the system employed by Sony is that it is largely independent of variations of both the sync pulses of the television signals and of supply frequency.

We have already discussed the general principle

of servo systems, and can now afford to look a little more closely at this particular method. In Part 4 of this series in the January 1968 issue of PRACTICAL TELEVISION a brief account of the head and servo assembly and its operation was given. To recap briefly: three different sets of timing pulses at 25, 50 and 10,125 times per second are needed, the first to control a braking force which retards the common motor spindle and acts as a servo to maintain the correct speed by means of a simple sampling device, the 50c/s pulses to trigger the camera vertical oscillator and also to synchronise the monitor, and the 10,125c/s pulses fed to the camera to trigger the horizontal oscillator. Finally it must be remembered that the spindle with its drums, coils and pole pieces, and the heads mounted at the top, is revolving at 25c/s, upon which all the synchronising depends.

Figure 23 shows the system in more detail. Beginning at top left when recording off-air the incoming video signal is applied to a sync separator biased so that the sync signal drives it into conduction.

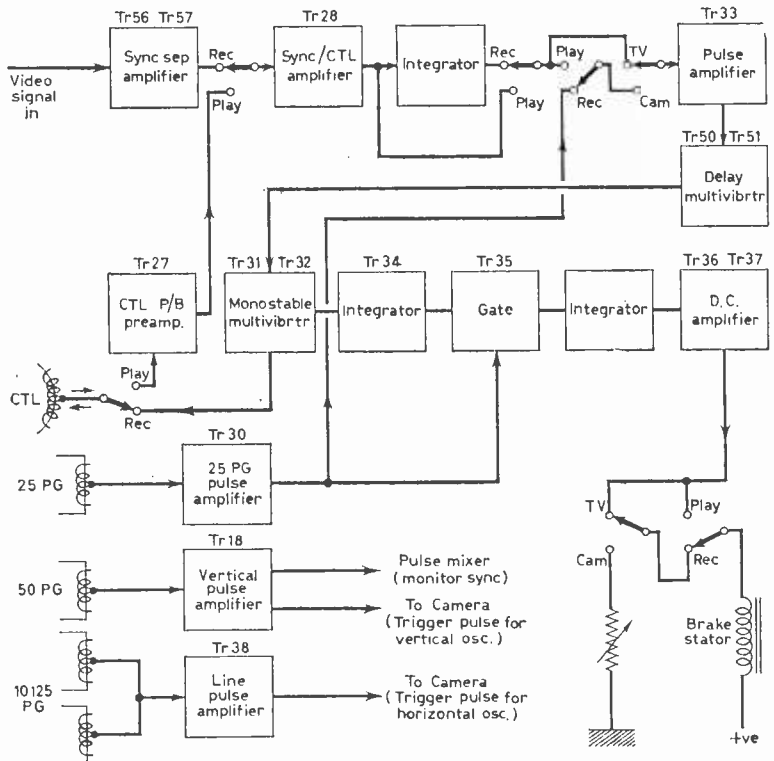


Fig. 23: Block diagram of the sync and servo control arrangements.

The sync pulse is thus both amplified and safely parted from the picture information portion of the signal. After further amplification by Tr57 it is shaped by Tr28 and applied to an integrator, which acts as a low-pass filter, leaving only the 50c/s sync pulse as shown in Fig. 24b. These pulses trigger the delay multivibrator, the output of which is a train of pulses of the same mark-space ratio but delayed as shown in Fig. 24c. The trailing edge of these pulses is used to trigger the monostable multivibrator, from which two outputs are taken, a 50c/s square wave output of the type shown in Fig. 24h, of mark-space ratio determined by the delay time of this circuit, which is taken from Tr31 and fed to the control track head and recorded on the tape as a control pulse, and an output of the form shown in Fig. 24d which is taken from Tr32 (Fig. 25 shows the circuits in greater detail and we shall return to them shortly), integrated by Tr34 and the output (Fig. 24e) applied to the gate along with a signal from the 25c/s pulse generator. This consists of a pole piece on the drum on which a coil is wound: the voltage in the coil is changed in time with the 25 per second revolution rate. The coil has d.c. flowing through it and the passing of the magnet varies the flux. The 25c/s pulses, shown in Fig. 24f, open the gate for a period determined by the timing of the pulses. The output from the gate is integrated (Fig. 24g) and applied to the d.c. amplifier which provides a control current which is fed to the brake stator.

On playback the pulse output from the control head (Fig. 24i) is used to trigger the multivibrators via Tr27, Tr28 and Tr33, the output from Tr34 again being gated by 25c/s reference pulses and the output used to control the braking action.

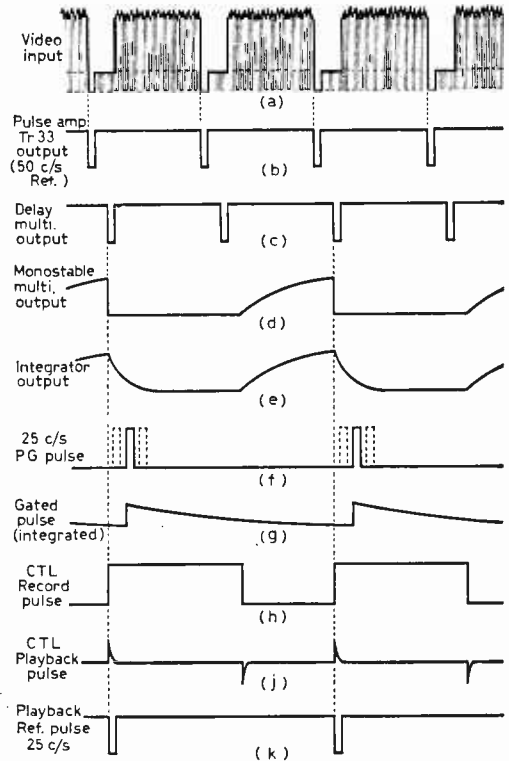


Fig. 24: Waveforms associated with the control circuits.

Brake and pulse generators

The electromagnetic brake is something like a conventional squirrel-cage induction motor in principle. Interaction of stator field and the induced field in the rotor causes a braking effect proportional to the current causing the stator flux.

Also when recording off-air the pulses from the 50c/s pulse generator coil are fed to the mixer stage in the video amplifier section to synchronise the monitor field timebase, the output from the 10,125c/s pulse generator being applied to the monitor via the video amplifier with the composite waveform.

When recording from the camera there are of course no 50c/s sync pulses as provided by the monitor when recording off-air. Instead the reference pulse recorded by the control track head is derived from the 25c/s pulse generator and fed to the head via the pulse amplifier Tr33, the delay multivibrator and monostable multivibrator. In this mode the brake coil is energised via the preset shown, the setting of which is determined during an off-air signal to maintain constant speed. The 50c/s and 10,125c/s pulses are again applied to the camera to trigger its field and line scanning, and both are mechanically locked to the 25c/s pulses.

During playback, the pulse which was recorded on the tape is switched to the sync amplifier Tr27, taking the place of the video sync pulse, and this subsequently becomes the comparison pulse for the braking action as we have seen.

The purely electronic sync pulses must be provided exactly in step with the running of the mechanism,

not taken off electronically from the signal. If we were to attempt the easy way out, i.e. direct sync pulse filtering and application, there would be a tendency for hunting and moiré patterns on the replayed picture. So we take off a 50c/s pulse from a coil past which two pole pieces, 180 degrees apart, are moving as the drum rotates. The pulse is amplified by Tr18 and applied to the camera as a trigger pulse for its vertical oscillator; and also to the mixer stage in the video amplifier chain for triggering the monitor. This 9V peak-to-peak signal at 50c/s is in fact a good deal more stable than the average sync pulse from a TV timebase and provides a solid field lock.

The 10,125 signal for line timebase locking—remembering that we are still with the 405-line system—is also derived from the drum action. Two coils, 180 degrees out-of-phase, are sited at the periphery of a drum with 405 grooves which rotates, of course, at the basic rate of 25 times per second. Thus $405 \times 25 = 10,125$ and this number of pulses is induced in the coils and fed to a balancing circuit with an adjusting potentiometer. From here the pulse is amplified by Tr38, coupled through a variable-tuned circuit and fed to the camera as trigger pulse for the horizontal oscillator.

Multivibrator circuits

Both multivibrators in the double multivibrator arrangement shown in Fig. 25 are of the monostable variety. In the case of the delay multivibrator Tr50

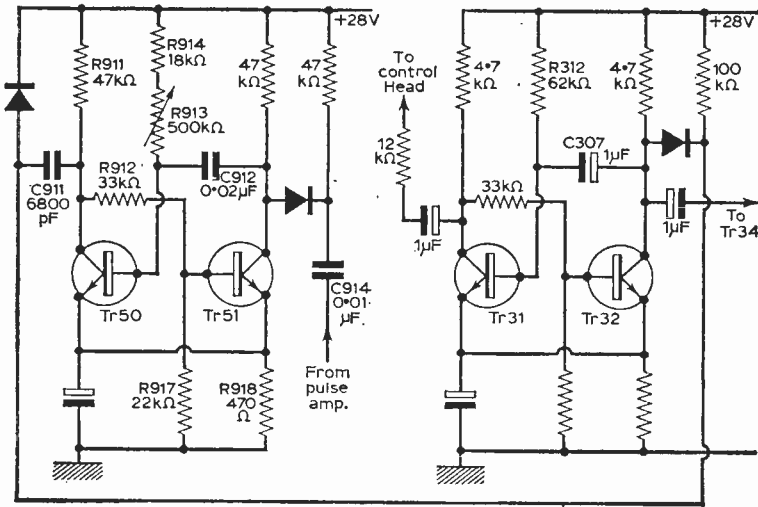


Fig. 25: Delay and monostable multivibrator circuits.

Tr51 the bias on Tr50 is arranged so that it is normally conducting. A negative pulse applied to its base via C912 cuts Tr50 off and the rising collector voltage is then coupled via R912 to the base of Tr51, which conducts. The collector voltage of Tr51 then falls and C912 begins to discharge through R914 and R913. Tr50 remains cut-off until this discharge is complete, when it resumes conduction and causes Tr51 to cut off. This state of affairs is maintained until the next pulse arrives. The discharge rate of C912 is the important factor and this is varied by making R913 a preset resistor. Fig. 24 shows the relative position of pulses in and out of this circuit obtained by this triggering action. In practice, the output pulse from Tr50 as shown is not used, but rather the trailing edge of the positive pulse at its collector is employed, differentiated by C911 and becoming a negative spike. It is this spike that acts as the trigger for the next multivibrator pair.

In setting up an oscilloscope is connected (vertical plates) to the video output test point and synchronised by the separated 50c/s sync pulse from an off-air signal at the output of the sync separator circuit, after the low-pass filter. The 50c/s pulses from both the video signal and the 50c/s pulse generator coil will overlap on the screen of the 'scope, and adjustment of R913 should allow a theoretical coincidence of the pulses. Theory is all very fine, but we all know that practice is very different and if we can reduce the overlap to within 1/25th of the pulse interval we are doing well and the circuit will pull into step. Obviously a good scope is needed, as

coincidence of this fineness can be little more than the thickness of a trace. The pole pieces can be adjusted to minimise displacement of the pulses, and this combination of adjustments should always make it possible to keep the error to within 4μS which is 1/25th of the pulse interval as viewed.

When the signal is coming from the camera, a further multivibrator pair is connected in the input of the pulse mixer and a preset resistor in the collector of the left-hand element allows adjustment for exact timing. In all cases it is necessary to set up the circuits first with an off-air signal to get the sync right, then switch to camera and bring the auxiliary circuit into step.

To do things the other way round leads to some curious results if the original timing is a little way out of step.

The second section of the multivibrator pair shown in Fig. 25, consisting of Tr31 and Tr32, is a similar monostable circuit, that is, it has one stable and one unstable state: the vertical sync pulse triggers the circuit into its unstable state, and it stays in this state for a period of time determined by C307 and R312, giving an output for 40mS approximately.

Consider the circuit when first switched on, with Tr32 cut off and Tr31 conducting. A large negative pulse is applied to the collector of Tr32 through the diode, causing the collector voltage to drop, which cuts off Tr31 and, raising the base voltage of Tr32, allows it to conduct. As long as C307 remains charged, Tr32 continues to conduct. When C307 discharges Tr31 base voltage rises so that it conducts, again cutting Tr32 off. The output from Tr31 is taken off as a pulse and recorded on the tape via the control track head. When switched to camera, the

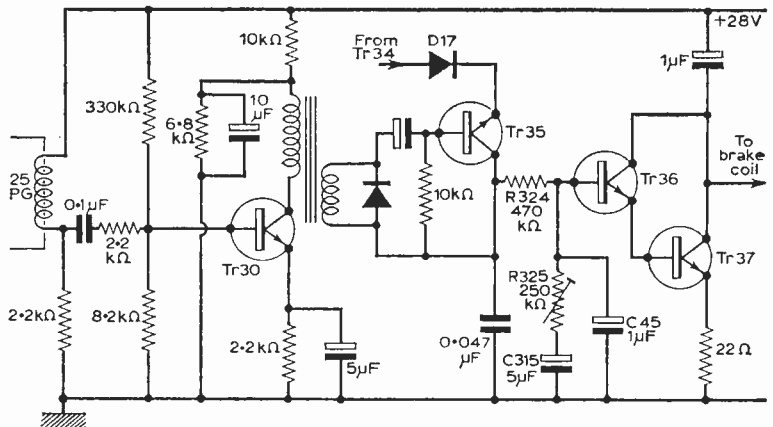


Fig. 26: 25c/s pulse amplifier, gate and d.c. amplifier circuits.



The motor drives the head assembly via a crossed belt.

pulse from the 25c/s pulse generator acts as the trigger instead and the same process takes place.

Braking control

The 25c/s pulse derived from the 25c/s pulse generator coil is amplified by Tr30, as shown in Fig. 26, and used to perform the triggering function as mentioned above. It also acts as a reference by being fed to the gate, Tr35, to which a pulse from the monostable multivibrator is also applied, following pulse amplification and integration by Tr34. Tr34 also acts as a form of impedance match to provide the high impedance that is needed for integration. The integrated output of the multivibrator is fed via D17 to the Tr35 gate, while the output from Tr30 is transformer coupled to the base-emitter junction of the gate. The reason for this method of coupling is to allow the emitter and base to float above ground, relative to both a.c. and d.c. When the base is made positive with respect to the emitter by an incoming suitably polarised pulse, the gate opens as Tr35 conducts. In effect, the gate is opened by the leading edge of the pulse and a portion of the envelope of the integrator output (see Fig. 24) is passed. According to the relative position on the time scale of the pulses from the multivibrator and the pulses from the 25c/s pulse generator pickup coil, so a greater or lesser portion of the envelope is allowed to pass, as the dotted pulses shown in the waveform diagram indicate. Too high a speed results in the earlier arrival of the pulse so that a larger portion of the envelope is passed. This is amplified by the d.c. amplifier (Fig. 23) and causes a stronger braking force, pulling the drum back to its regular speed.

The output from the gate is passed via the integrating network C315, R324, C45, R325, with the variable resistor R325 acting as a preset to determine the time constant. The signal now goes to Tr36 and Tr37, the d.c. amplifier, which consists of a Darling-ton pair with paralleled collectors. The output from this goes to the stator coil to provide the braking current.

Of the other parts of the circuit not described so far we need say very little. The audio section of the Sony CV2000B is a conventional four-transistor record/playback circuit, with a push-pull (two-transistor) oscillator, while the power supply uses three transistors in a fairly straightforward regulator circuit, giving the 28V line for the whole machine.

TO BE CONTINUED

NEXT MONTH IN Practical TELEVISION

X-RAY RADIATION METER

Because of the high e.h.t. necessary with shadow-mask tubes very large X-ray dose rates are produced by shunt-stabiliser triodes used in the e.h.t. section of hybrid receivers, so that a significant radiation hazard exists if a colour receiver is operated with the protective shielding removed from the e.h.t. section. In monochrome receivers shorts in the c.r.t. anode circuit also produce X-rays from the e.h.t. rectifier. Hence the importance of being able to detect X-ray radiation in experimental work. The meter described in this article has been designed to fulfill this requirement.

TELEVISION RECEIVER TESTING

The first part of a new series on television testing techniques, concentrating on the test procedures adopted by the professional service technician. Field methods using the minimum of equipment will also be highlighted, the emphasis throughout being on speedy fault diagnosis. Part 1 deals with testing for aerial signals.

IMAGE INTENSIFIERS AND CONVERTERS

An interesting group of devices ensures that today no scene is "untelevisable". Image converters sensitive to infra-red and ultra-violet radiation produce corresponding visible light images so that, for example, hot bearings in machinery or intruders lit by heat energy in darkness can be seen. A variation, the shutter tube, makes picture exposure at speeds up to a few nanoseconds possible. The image intensifier produces brilliant images by light amplification so that we can see in the dark.

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LETTERS TO THE EDITOR

DID BRITAIN INVENT TELEVISION?

SIR.—May I correct a few errors regarding early discoveries and inventions, which Mr. V. Yome includes in his extracts from two encyclopaedias.

The most authoritative account of Nipkow's pioneer work is in Rhein's *Wonder of the Waves* (Scientific Book Club, 1940). Paul Nipkow was a 23-year-old Polish student of "natural science" living in Berlin when, on Christmas Day, 1883, he conceived the scanning disc idea. He sketched his proposed TV system, applied for a patent a few days later, and was granted his well-known German patent in 1884. His family was living in Lauenburg in Pomerania. He later became a railway engineer in Germany, with several valuable patents in that sphere. He did no practical work on his disc, as he admitted when watching a demonstration in Berlin of Baird's system.

The only first-hand authority on Baird's pioneer work is *Television today and tomorrow* by Moseley and Barton-Chapple (Pitman, 1931), with foreword by the inventor. Following considerable earlier experiment Baird transmitted "simple objects" publicly (at Selfridge's) in April, 1925, and demonstrated "real images" including "living faces" to prominent scientists in his Soho workshop in January 1926. *Radio News* of USA, after investigating Baird's claim, confirmed that he was demonstrating the first real television in history. In March, 1927, *New York Times* supported this with a full-page description.

If I may also add a comment on "Frame Wobble", may I express agreement with Mr. C. Wehner in condemning the short persistence phosphors of our c.r.t. screens.

On page 353 of PRACTICAL TELEVISION, May 1967, I explain how, by copying film projection practice, flicker is generated by the scanning. He will agree, I know, that the phosphor response should last nearly as long as the persistence of vision, (see Fig. 2). With suitable phosphors our television could be flickerless, and this would allow more lines in fewer pictures, making better use of our v.h.f. stations, and saving valuable transmission space.—A. O. HOPKINS (Worthing, Sussex).

* * *

SIR.—According to your article on the invention of television, page 4 October PRACTICAL TELEVISION, I have it on record that a German scientist named Ruhmer in the early 1920's by means of a telegraph apparatus transmitted pictures over a distance.

When Ruhmer died he was making an instrument by which he hoped people would be able to see each other over the telegraph line while talking.—D. COURTNEY (Didcot, Berkshire).

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.

WHO WANTS?

SIR,—I have in my possession five different makes of TV sets, for which I have no further use.

I was wondering therefore if any PRACTICAL TELEVISION readers would like any parts of them. They would be most welcome to have any they should wish. I would indeed be most grateful though, if they were to help me in return, by sending something just to cover the cost of return postage.

Three following sets are dismantled: GEC BT6641; Ferguson 203T; Ferranti 17T4.

Two following sets are complete: Ferguson 113T; Ultra V427.—C. WRIGHT (84 Catisfield Rd., Fareham, Hampshire).

COLOUR CONVERTER

SIR,—With reference to Mr. R. I. Blaney's (Billericay, Essex) letter to the Editor (PRACTICAL TELEVISION, June 1965) regarding A Colour Converter, I would be grateful if any readers could lead me to any additional information on this or advise me where I may obtain the plans.—ERIC ARMSTRONG (102 Mountcollyer St., Belfast BT15 3EF, N. Ireland).

SOBELL 1000 DST INFO

SIR,—For some considerable time I have been trying to obtain, through adverts in your columns and other sources, a service sheet for a television receiver Sobell 1000 DST.

Up to the moment my endeavours have been costly and fruitless, and I would be grateful if any other readers could help me.—J. SARTORIUS (35 Lingham Lane, Moreton, Wirral, Cheshire).

ISSUES WANTED

SIR,—Since August 1966 I have taken a great interest in television and have all issues of PRACTICAL TELEVISION since then.

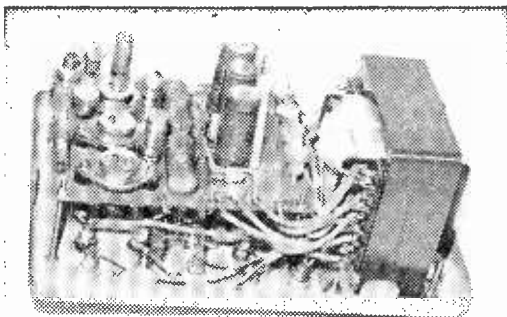
After haunting local second-hand bookshops I have only been able to buy odd previous issues though I should like to obtain all issues back to approximately 1960.

I would much appreciate it if you could ask in "Letters to the Editor", for anyone who could sell me a complete set of copies from 1960 to August 1966 approximately.

Thank you for a very interesting and instructive magazine.—R. DOWDING (14 Stanborough Road, Plymstock, Plymouth, Devon).

* * *

SIR,—Could any reader please sell or loan me the following issues of PRACTICAL TELEVISION: October 1963; January, February, May, June 1964; July, August, November, December 1966; July 1967.—D. ELLIS JONES (67 Pennant, Llangefni, Anglesey).



any positive or negative h.t. output circuit is short-circuited, but it remains intact on switching surges when connecting external circuits with large input electrolytics. The mains primary fuse blows on l.t. short-circuits only if these appear across the full 12V a.c. or 18V d.c. outputs. Short-circuits across other a.c. or d.c. l.t. outputs do not blow the fuse and would lead to rapid destruction of diodes, transistors and mains transformer. Brief short-circuits or partial shorts (2 or 3 seconds maximum duration) do not lead to damage; thus if one can be sure of noticing them when they appear, it suffices to switch off the mains switch S1 *at once* and then clear the fault on the experimental circuit. In all cases of doubt, or if experimental circuits are left running unattended, the output lead from the power unit to the experimental

bench POWER UNIT

PART 2

MARTIN L. MICHAELIS, M.A.

CAREFUL thought is necessary for the front panel layout of a multi-output power unit. Three requirements must be met: human safety, clarity, and minimum danger of making inadvertent connections. Human safety is here ensured by using substantially insulated coloured wanderplug sockets as output terminals, and an earthed metal cabinet. A three-pin mains connection *with earth lead* is essential. Clarity is established by means of colour-coding of the output terminals, which are on a white card background carrying the voltage markings, current ratings and lines to show internal interlinkages. White is used for the respective common terminals, one pair each for the h.t. complex and for the l.t. complex. These complexes are not interconnected internally, which fact is expressed on the front panel layout by placing the three green earth terminals, the bias control potentiometer and the mains primary fuse in a row between them. It is thus most unlikely that connections would be made in error to a h.t. output when a l.t. output is desired, or vice versa.

All a.c. outputs in either complex are blue, whilst all positive d.c. outputs are red and negative d.c. outputs black. Black is on the left, red on the right. Larger negative outputs are further left, larger positive outputs further to the right. Polarities and voltage markings are with respect to the white common terminals. Higher voltages are higher up on the panel, lower ones lower down. In this sense, a.c. ranks higher than d.c. This arrangement is clear, pleasant in appearance and leads to absolute minimum danger of unintended connections. The wanderplug sockets must be insulated for 1kV d.c./700V r.m.s. a.c. working, with the contact sleeve adequately recessed in the coloured plastic sleeve to prevent accidental contact with the fingers. For making connections, use wanderplugs or banana plugs with properly insulated plastic sleeves containing no metallic collars or grubscrews which can touch the fingers.

FUSE PROTECTION

Only a medium-delay 0.5A fuse has been specified for the mains primary circuit. This blows at once if

circuit should include a cable fuse or magnetic cut-out (see Fig. 7). Fit a fuse cartridge of suitable current rating, or set the magnetic cut-out to the appropriate trip current, for the particular circuit in question. Full fuse protection on the front panel would have led to complications in layout and synoptical appearance and thus would have invited mistakes in connecting up, or would have called for a larger cabinet making field use impossible.

CONSTRUCTIONAL DETAILS

Figures 4-6 give full constructional details, which are largely self-explanatory. It merely remains to emphasise some special points. The printed wiring on the circuit board is called upon to carry high currents, so that it must be coated *generously* with solder. Take great care to observe adequate spacing between adjacent conductors and to avoid projecting spikes of solder, since some conductors are carrying very high voltages. To prevent dust deposits leading to shorts bridging adjacent conductors, apply a generous coat of approved varnish for printed circuits, after completing component soldering and conductor-tinning. Use insulated wire with additional sleeving for the connections to the printed-circuit board.

The power transistors must be raised off the circuit board, using small plastic bushes of about 3 to 5mm. length. This is necessary to permit airflow under the transistors, which are vertical in the normal positioning of the completed unit. If the power transistors are clamped directly against the circuit board, cooling is inadequate. Additional fins are not required, however. Those diodes and electrolytics which are mounted standing on the board must be fitted so that the anode ("—") of the diodes or the positive lead of the electrolytics is closest to the circuit board, whilst the cathode ("+") of the diodes or the negative case of the electrolytics forms the other, bent-over wire connection. This avoids short-circuits across these components.

When selecting wanderplug sockets for the output terminals make sure to use a type whose plastic casing is not thermoplastic. Thermoplastic wander-

The heading photograph shows the printed panel and mains transformer mounted on the front panel, with the rear cover removed.

plug sockets are suitable only for screw connections, not for soldered connections. Screw-type sockets inevitably work loose and give rise to endless trouble in a power unit where connections are frequently plugged and unplugged for experiments. Thus soldering is essential. Also avoid screw-clamped soldering tags here; use sockets intended for direct soldering on to the metal sleeve cartridge at the rear (e.g. Hirschmann BIL20). After drilling the holes, take care to file them clean and flat and then screw-down each socket only moderately tightly. After making the soldered connections on the rear of the front panel, apply a dab of two-component adhesive (e.g. Araldite) to each socket, run over the sleeve thread, fixing nuts, plastic sleeve and on to the rear of the panel. Allow 48 hours for this adhesive to set. These measures will positively prevent short-circuits or faulty contracts due to sockets working loose and twisting.

This power unit develops little heat, since silicon

rectifiers have very low internal dissipation and high-current smoothing circuits are not included. Thus use a cabinet with only small shrouded ventilation slots at the rear, to minimise entry of dust, dirt and dampness on the shelf, in the toolbag or on field work.

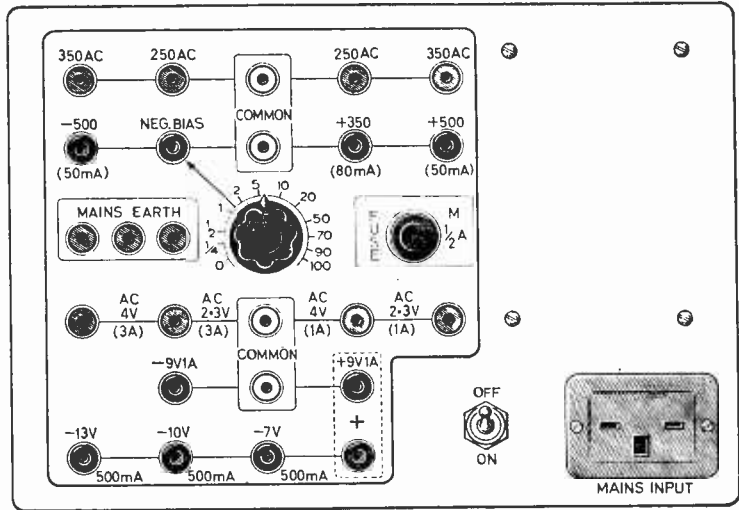


Fig. 4: Front panel layout. Actual size of panel is 7 1/8 in. x 5 3/8 in.

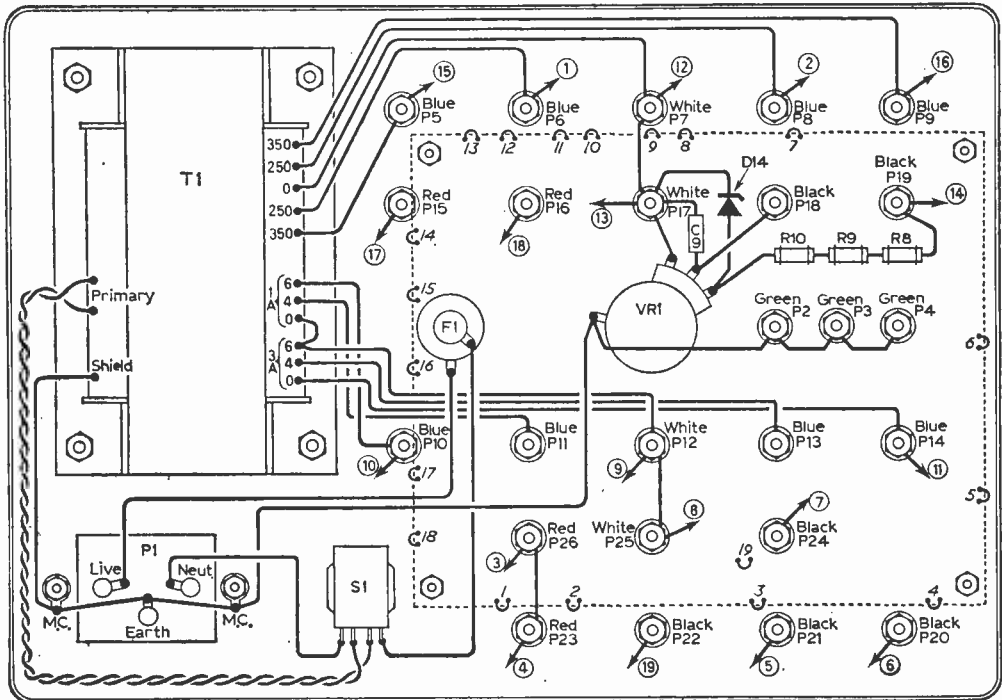


Fig. 5: Layout and wiring, rear of front panel. The printed panel, shown dotted, is mounted on the front panel on stand-off bolts, component side upwards. Encircled numbers at sockets show connections to numbered loops on printed panel. Panel forms a push-in unit for the otherwise empty cabinet.

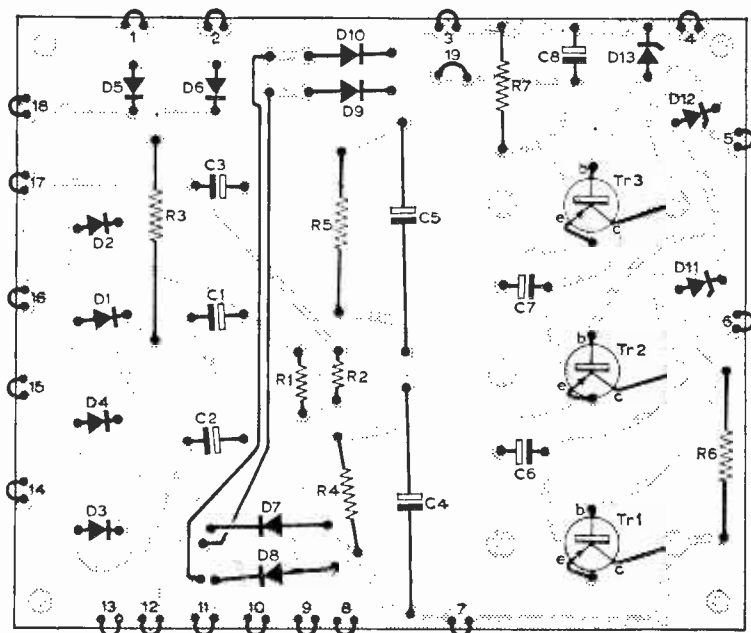


Fig. 6: Printed circuit board viewed from print side, i.e. components mounted on other side. Actual size is 4 1/4 x 4 in.

The mains transformer should possess an electrostatic shield between the primary and secondary to avoid modulation hum, i.e. to prevent mains-borne r.f. signals reaching the rectifiers and there being modulated with the 50c/s supply frequency followed by re-radiation. The electrostatic shield is connected to the mains earth.

It is neither necessary nor advisable to provide additional switching for the individual output circuits. The common mains primary switch suffices, but it must be a double-pole switch. There are no components subject to restricted service life in this unit, with the possible exception of the electrolytics. Thus there is no economical objection to having all outputs present whenever the unit is switched on, even if only some or just one is required. The life of electrolytics is indeed improved if voltage is frequently applied to them, so that there is a distinct advantage in allowing all circuits to operate whenever the unit is switched on.

SMOOTHING AND RIPPLE RATINGS

None of the h.t. or l.t. d.c. outputs, with the exception of the 7V d.c. stabilised output, is fully smoothed, since only reservoir capacitors are used. Smoothing resistors or chokes and smoothing capacitors must be interposed externally, i.e. they must be provided as part of the respective experimental circuits. The d.c. outputs as they stand thus carry considerable ripple components. For numerous experiments these are tolerable.

Any conventional smoothing circuit increases the internal impedance of a power supply and thus impairs its voltage regulation. A practical smoothing circuit must thus be matched to the intended current drain, so that it is impossible to incorporate a satisfactory universal smoothing circuit for each d.c. output. This is the reason for using only reservoir capa-

citators in this power unit. There is a gradual transition, not a clear distinction, between the functions of smoothing circuits and interstage decoupling circuits. The decoupling networks must be placed in the individual stages of a given circuit anyway, so that it is reasonable practice to include the smoothing components for experimental circuits also in these circuits, not in the power unit.

Universal smoothing can be achieved only with the help of a proper electronic stabiliser circuit. Fig. 8 shows examples for such stabilisers which may be made up as separate units interposed between the power unit and the experimental circuit when required. Voltage calibration can be made against the respective potentiometers VR2 and VR3. Layout is not critical for either circuit, so that any convenient arrangement may be used. The grid stopper resistors R13 and R14 must be very close to the respective grid pins to avoid parasitic instability. The heaters of V2 and V3 are at a high positive voltage to chassis (h.t. common) to distribute the voltage stress with respect to the cathodes. Thus the heater supply is drawn via a small separate transformer, to keep the l.t./a.c. outputs free for external use. T2 may be connected directly to the mains, but the indicated connection to the 250V a.c. output is recommended to bring the stabiliser under the control of the mains switch S1.

STABILISER PRINCIPLES

V2 compares the voltage at the slider of VR2 against the arc voltage of V1 and amplifies any difference as an error signal. The amplified error signal is applied to the grid of V3, correcting the impedance of V3 so as to restore the correct output voltage at its cathode. C10 gives powerful negative feedback for ripple. D15

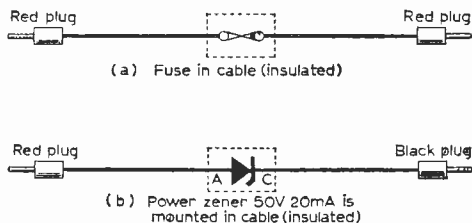


Fig. 7: Cable accessories (see text). (a) Fused cable. (b) Zener cable for modifying voltage output.

DX

A MONTHLY FEATURE
FOR DX ENTHUSIASTS

by Charles Rafarel

AFTER the rather encouraging improvement last time, we seem to have slipped to an all-time low level, and I would rate the recent period as by far the worst for DX reception that I have experienced in the past eight years.

There were only five days during the period 22/1/68 to 17/2/68 on which I could note any Sp.E. activity at all. On the 22nd and 29th January, the 13th and 16th February Czechoslovakia R1 Ostrava was seen on test card, and on 17th February there was an unidentified programme, probably USSR, on R1.

The Czech. signals were bursts of very short duration and might well have been meteor shower reflections and not Sp.E. at all. The possible Russian was of longer duration and of Sp.E. origin.

The less said about the Tropics, the better; they too have never been worse. I have had to fight every day to raise my French "local" F2 Caen so things are really bad.

NEWS AND REPORTS

(1) The mystery of the East German u.h.f. on Ch.34/35, reported by several readers, has now been cleared up by Ian Beckett of Buckingham. He saw this one complete with name and channel caption, and it is Rostock Ch.34, DDR 2nd chain, one of the nearer East German stations on the Baltic almost due south of Copenhagen.

(2) Still on the East German 2nd chain, new stations in the latest lists include Berlin Ch.27, Dequede, Blessberg, and Inselberg all apparently on Ch.31, and of course Rostock Ch.34.

(3) West Germany. The new ones include Krehberg/Odensee Ch.33(DBP 2c), 100kW hor., and Hof/Gr. Waldstein Ch.57(DBP 3c) 500kW hor. (The "c" refers to colour transmission.)

Lists now show some of the West German Band III stations as using colour as well, and it seems likely that it will apply to Band I also.

(4) Austria is now starting a 2nd chain on u.h.f., and we have details of Shoekel ORF-2 Ch.23, power now 800kW hor.

(5) Norway has a new station at Varanger on E2, power 30kW hor., and the power of Hadsel E4 is now up to 30kW.

(We are indebted to R. Bunney for the above.) I feel that there must be more East German 2nd chain stations than those mentioned above, and any information would be gratefully received, as it is a little difficult to acquire from DDR, and it certainly looks as if reception is a distinct possibility under favourable conditions.

The most interesting news this month is in respect of F2 propagation. No transatlantic pictures

as yet, but at least a great leap forward in this direction, and all credit and congratulations to an old DXer friend of ours who achieved it.

There was a phenomenal increase in the sunspot count at the end of January 1968, and a figure of 205 was reached. The "red letter" day for Frank Smales of Pontefract was 18th January, the channel was A2 USA, and the time was 15.30 GMT when he heard American sound with a brief station announcement of WLWD/WMT/TV (Dayton, Ohio). After a burst of signal it "went off in a distorted sort of way", but there was some further unidentified USA speech activity at 18.09 GMT on the same day.

After the recent "dull" period this is a welcome ray of sunshine, and we now eagerly await the first report of transatlantic picture reception! I regret to say that in spite of concentrated attempts I myself have seen or heard nothing as yet that could be identified as F2 signals.

A. Papaeftychiou of Cyprus reports F2 activity on 30/1/68, and 2/2/68 on Ch.E4 from Nigeria, and again on 7/2/68 on Ch.E3 and E4 apparently African TV stations again.

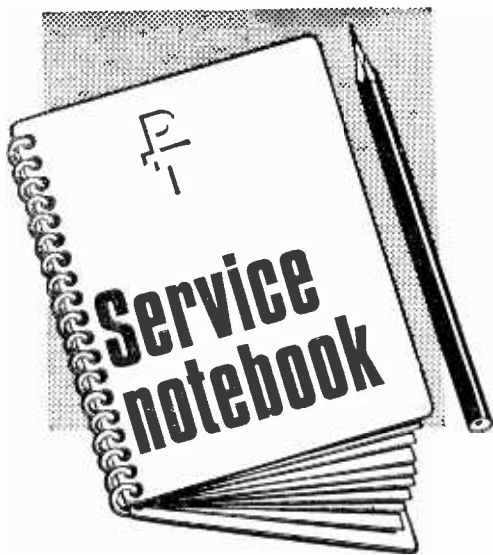
There is another "mystery" signal about on E2 according to R. Bunney, who reports reception on 10/2/68 of a test card rather similar to the "old" E. German card of the E3/E4 channels with apparently three vertical columns in the centre circle, and rather reminiscent of one I had on R1 last year. Has anyone seen this one?

Reports still continue to arrive for the wonderful Trop. period of November last. R. Alexander of Winchester reports: France F2 Caen, F8a Lille, Belgium E8 Wavre, E10 Wavre, Holland E7 Markelo, in Bands I/III, and on u.h.f. Holland Ch.27 Lopik, Ch.29 Goes I, Ch.31 Roermond, Ch.32 Goes 2, Ch.40 Wieringermeer, W. Germany Ch.21, 32 and 45 Munster (1, 2 and 3 chain) and Ch.40 Bielefeld, and France on channels 21, 22, 23, 25, 27, 29 and 33.

During an unspecified period one of our Dutch readers G. f. van de Wijngaart of Mierlo logged Yugoslavia E3 Kapaonik, E4 Labistica, W. Germany E2 Grünten, E4 Flensburg (NDR on card), and a rare one for most of us E2 Göttelborner Höhe Saarland (his test card photo of this was published last month). It would appear that this one and Flensburg were most likely to have been Tropics.

He also had a weird test pattern of vertical black-and-white bars with black-and-white horizontal rectangles of various lengths, and this is yet another "mystery" one to us.

D. Bowers of Saltash says that he feels that he has not done too badly this winter in spite of conditions. He has received Norway, Sweden, E. and W. Germany, Austria and Italy, and he has had a new type of caption, in the form of a card with shaded corners with a diamond pattern in the centre with illegible writing in it. He has seen this on a number of afternoons as a "smeared" image, and that makes one think again of F2!



by G. R. WILDING

PROBABLY one of the most surprising aspects of the retail side of TV is the fact that probably at least 50% of valves asked for by name by laymen—certainly not PTV readers—are completely unassociated with the receiver's fault condition. If asked what leads them to believe that the valve is faulty they may reply that it "doesn't seem to warm up", "gets too hot", "runs too cold" or "looks black inside". They usually seem very surprised when told that some valves normally run very hot while others normally run cool, and that the black deposit inside the glass envelope is present in new valves.

Thus we get asked for PCL84s when Band III reception is grainy, and tuner valves when raster size is insufficient. Unhappily in spite of our assurance that the valve has no bearing on the fault symptom they often still require the valve, "just to try". Of course if we test the valve in a valve-tester and it indicates appreciably less than 100% they are still further convinced that replacement of this particular valve will cure the defect.

Then we get customers who remove all the valves from the set, or rather all that they can see, for they usually fail to bring in those in the e.h.t. can, but blithely forget to mark where each valve is fitted.

However, the point to be emphasised with valve tests is that most valves in most sets after a period of service will not be 100% compared to new ones, and that receiver circuits are designed to accommodate natural deterioration within limits. Of course these limits vary widely with valve type and usage. Line output pentodes especially need to be in good heart since any loss in output affects width, e.h.t. and general brilliance. On the other hand valves in the sound circuit, so long as they don't introduce distortion, can be of comparatively low emission without causing concern since there is usually more than ample volume available.

There are very many valves in use today in

television receivers but there are just a few—once termed the "top ten" by one or two manufacturers—that most frequently change in service due to their extremely arduous working conditions. Type numbers vary from make to make, but in general they include the line output pentodes already mentioned, boost rectifiers, e.h.t. rectifiers, double-triode line and field timebase generators, all types of triode-pentode used in field and sound output stages, video amplifiers, tuner r.f. amplifiers and mixers. If you want to do any service work, these are the hard core of valves required.

Armed with such valves, various fuses, a selection of wire-wound, high wattage resistors to replace o/c surge limiters and sections of mains-dropper resistors, a meter, soldering iron and hand tools, you can clear up the great majority of instances of complete failure to work, sound but no picture, insufficient width, blooming raster, insufficient height, poor vertical linearity, distorted sound and grainy Band III reception.

Transistor bottoming

With the increasing use of transistors in TV, manufacturers' service manuals and technical literature make frequent use of the term "bottomed" when outlining circuit operations; in such phrases for instance as "Tr2 is normally held fully bottomed". Now while bottoming in a transistor is closely analogous to saturation point in a valve, there are subtle but important differences between them.

With a valve, saturation point is reached when all emitted electrons are collected by the anode (including screens in multi-electrode types) and when anode current cannot be further increased by increasing anode voltage or the potential of other electrodes including the control grid.

However, the bottoming point in a transistor depends on the value of collector load and the supply voltage. To illustrate—if a transistor is fed via a 20k Ω collector load resistor from a 10V supply, collector current cannot exceed $V/R = 10/20,000 = 0.5\text{mA}$. Therefore once base forward bias produces such a collector current the transistor becomes bottomed, for collector current cannot be increased. However, with a 500 Ω collector load, collector current could rise to a maximum of $10/500 = 20\text{mA}$. The transistor therefore now requires a forward bias sufficiently high to produce this collector current before bottoming occurs.

A further major difference between valve saturation point and transistor bottoming is that with the former the cathode/anode current path or d.c. impedance still represents many thousands of ohms, but when a transistor bottoms its emitter/collector current path has a resistance of only a few ohms. Transistors are therefore better suited to switching actions than valves.

Transistors are normally used at or near the bottomed state as a.g.c. amplifiers in TV receivers when they may be used as virtually a variable series resistor to control the supply potential applied to the r.f. and i.f. transistors. In such cases it is easier to follow their action by viewing them as variable resistors rather than as amplifiers. At cut-off a transistor represents a high resistance between emitter and collector. This reduces to a very low figure as forward base bias is increased, and, con-

sidered in this way, their utilisation in new applications becomes easier to grasp.

Towards the automatic

In the recent articles under the above title we outlined those circuits which automatically maintained height, width, brilliance and contrast level once set by the viewer. Philips in their colour receiver now claim to use more automatic circuitry than any other manufacturer and list them as follows: (1) Automatic tuning and system switching by tuner push-button; (2) Automatic control of horizontal hold which also takes care of transmitter variations; (3) Automatic stabilisation of power supplies to maintain height and width constant; (4) Automatic degaussing of the c.r.t. each time the set is switched on; (5) Automatic white switching. This compensates for the difference in colour reception white and the white reproduced in monochrome.

Probably the most surprising feature is the absence of the line hold control, for at the back of the receiver there are only two presets, one for vertical hold and the other to make slight tint variations in colour. A further feature is the incorporation of a tuning meter to indicate the optimum tuning point on colour.

Tailpiece

Servicing a 405-only 23in. Decca receiver recently which the owner said had suddenly gone "off", we found the merest suggestion of sound on both Bands I and III, but only when the fine tuner was carefully set at optimum; while the brilliant raster was completely devoid of any noise or even car interference spots. There was no hiss from the speaker. Of the three valves common to both sound and vision, the PCC189 r.f. amplifier, PCF86 frequency changer and EF183 common sound and vision i.f. amplifier, which one *must* be tried first in these circumstances, and which in fact restored the set to life?

Absence of screen noise and sound hiss pretty well rules out the r.f. amplifier, while if the frequency changer was failing to oscillate car ignition interference could still get through as it covers such an extremely wide frequency band. The common i.f. valve was at fault, probably because of an internal disconnection, the faint sound signal getting across the stage via stray circuit capacitance. A degree of vision signal would similarly get across the stage but would not reach the tube with sufficient amplitude to produce any identifiable modulation.

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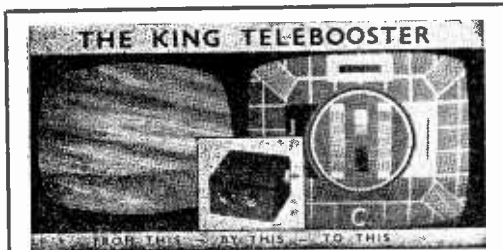
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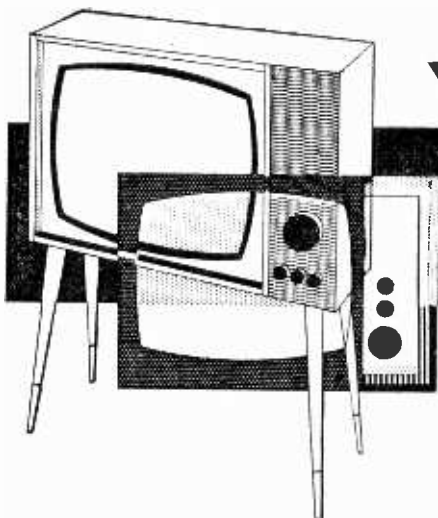
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184	4/9	12A77	3/9	DC990	8/6	EC499	3/9	PC982	6/-	147	13/6
185	3/9	12A16	4/9	DF93	7/3	EC44	9/6	PC986	9/9	149	13/6
174	2/9	12A17	4/9	DF91	2/9	EC90	4/9	PC980	11/3	152	4/6
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6BE6	4/3	30PL14	12/6	EAB080	6/6	EM34	13/9	PL81	7/3	1C99	8/3
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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 page 332 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

BUSH T57

This set is giving quite good sound and picture. The only fault is that there are two broken lines at the top of the screen.—A. Cook (Bridgend, Glamorgan).

Pin 3 of the PCL83 field oscillator/output valve is returned to chassis via a $1.5k\Omega$ resistor. Wire a $2.2k\Omega$ resistor across this and note the difference.

Reduce the value of the $47k\Omega$ resistor to pin 6 of the ECC83 if necessary to $33k\Omega$. We presume that these lines only appear on BBC transmissions.

PETO-SCOTT 1964

On switching on, the picture is very dark then it increases in brightness for about half an hour or so which necessitates constant adjustment of the brightness control. This fault only applies to BBC-2.

Could you also let me know which valves are at fault if the picture collapses and leaves only a thin horizontal line in the centre of the screen.—H. Watkins (Birmingham, 14).

If the fade-on effect occurs only on BBC-2 and not on the v.h.f. channels, it could be caused by (a) drift in the u.h.f. tuner, (b) drift in the alignment of the 625 standard i.f. channel, (c) fault in the video amplifier valve (which shows up when switched to the 625 standard). There are other possibilities, but those given above should first be investigated.

A fault causing field collapse need not lie in a valve. Indeed, a breakdown almost anywhere in the field (vertical) timebase circuit would result in the symptom.

MURPHY V240A

The picture and sound are excellent when the set is working but at intervals of about three minutes, the horizontal hold control has to be reset because the picture suddenly pulls to the left of the screen and disappears into a mass of lines.

On other occasions, the picture suddenly disappears and only the shadows of the figures on the screen can be discerned. In both of these

cases, just a touch on the horizontal hold control restores the picture.—J. Humber (Pembroke Dock).

You appear to have a faulty line oscillator or discriminator valve. These are the 20L1 and 20D2 just between the line output "cage" and the mains resistor. Check these valves by substitution, and if no improvement results, a systematic check of their associated components is indicated.

PYE SP17

There is no raster but the sound is O.K. I have changed the EY86, PY81 and PL81 valves. The PL81 anode glows red hot and the line whistle is present.

An interesting feature of this fault is that when the line frequency is increased by operating the hold control, the red glow disappears from the PL81 and the heater of the EY86 glows, which did not occur before.—W. Surgeon (Windsor, Berkshire).

Your trouble is possibly a fault within the deflector coils. If you disconnect the line scan feed wires from them and the e.h.t. improves, this would substantiate this opinion. Alternatively suspect a faulty screen grid feed resistor on the PL81 or a faulty line output transformer.

ULTRA V1782

Could you say how I can boost the tube employed in this receiver (it is a CME1705). If a transformer is fitted, could you say whether the heater wires have to be joined together.—C. Matthews (Bradford, Yorkshire).

The tube heater is in the overall heater chain. Thus, by removing this heater the chain goes open-circuit. This can be compensated by connecting a 20Ω , 5W resistor in place of the tube heater. The tube heater may then be energised from the secondary of a booster transformer whose primary matches the local mains supply voltage. The primary, in fact, can be connected across the set side of the on/off switch, so that the tube heater is switched at the same time as the set.

REGENTONE 194

This receiver has developed the following fault: firstly, a section of the dropper resistor broke down and I replaced it by a 20Ω resistor, but the set now gives a slightly negative picture covered with white dots. Also, after about a minute, the sound goes off and stays off.—J. Lee (Hull).

It is possible—if the set was normal prior to the resistor replacement—that too much or too little heater current is being applied to the valves. Check the voltage across the tube and valve heaters to determine this. Too low voltage means insufficient heater chain current and would cause a negative picture. This would indicate the wrong value dropper resistor.

PHILIPS 1768U

On switching on and during the warm-up period there is "motor-boating" from the speaker. This continues until the line oscillator starts and then stops.

When the e.h.t. comes up, it can be seen all around the e.h.t. valve insulator casing. This then dies down after a period of about 10 minutes but seems to be constantly "hissing".—C. Clements (Gillingham, Kent).

The sound instability could be caused by (a) worn or otherwise faulty sound i.f. or (more likely) audio valve, (b) poor h.t. filtering (check electrolytics) and (c) misalignment of the sound i.f. channel.

The symptom may appear only before the line generator takes over, since at that period the h.t. line voltage is higher than when the line timebase is operational, and any tendency for sound channel instability would be aggravated by the higher voltage.

The e.h.t. (corona) effect may indicate dampness in the set. It seems as though this dries out after a while.

HMV 1890

The picture is all right but there is a violent hum on the sound. I have tried three new PCL82 valves and some resistors and capacitors. Having an old PCL82 valve with pins 6 and 7 shorted, I put this in to see if any improvement would be made. It made the sound normal but with some distortion. Could the cause of the trouble be the $400+100+16\mu\text{F}$ electrolytic smoothing capacitor, and if so, state from where I may obtain a replacement?—J. Brettle (Cradley Heath, Staffordshire).

It seems unlikely that the electrolytic capacitor is the cause of your trouble.

By inserting a valve with pins 6 and 7 shorted, you cut out the screen feed, effectively converting the stage to triode operation, and if this temporarily regained the sound we would rather think that the 1 megohm feedback resistor from the pentode anode of the PCL82 to the triode anode has open-circuited.

You will find difficulty in obtaining the specific electrolytic for this out-of-date model and would perhaps be better advised, if you must change it, to fit a standard $400+100\mu\text{F}$, 350V Wkg., as available from several sources, and add a separate $16\mu\text{F}$ tubular electrolytic.

DECCA DM4

I would like to know if it is possible for the two rectifier valves, type PY82 to be replaced by a silicon rectifier.—D. Greig (London, N.8).

It is a good idea to replace the paired rectifiers of the Decca DM4 with a silicon diode, as poor h.t. was one of the faults which caused many of the problems with this receiver.

You should use a BY100 with a series 25Ω 5W resistor, connecting one end of the resistor to the anode of the BY100, the other end of the resistor to the linked anodes of the PY82 valves. Then disconnect the lead from the reservoir capacitor to the PY82 cathodes, take it to the cathode of the BY100 (cathode is the lead that joins to the outer casing). Leave the valve heaters in circuit to maintain correct heater drop, but do not connect across the h.t. line, as the usual fault with these valves, horizontally mounted, was flashover.

BUSH TV66

This receiver has gradually developed a series of intensity-distorted lines across the screen. These usually consist of two brighter-than-normal lines followed by three darker-than-normal lines, although the intensity of the distortion is not always constant, nor is their position on the screen.

Valve voltage checks indicate normal operation and the field output valve is only a few months old. I suspect smoothing trouble but have no way of checking this.—A. Fitz (London, S.E.26).

The trouble is in the PCL83 circuit. Re-check the valve if operation of the height and form controls does not indicate the fault to be in these.

Then check the PCL83 base contacts etc. and interchange the sound PCL83 for a quick test.

REGENTONE 10-4

When first switched on, there is a space at the bottom of the picture. Otherwise the picture quality is good.

Also, there is a perfect picture on BBC-1 but on ITV the picture is very faint and sometimes wavy lines appear across the screen.—J. Barn (Fife, Scotland).

You report two separate faults: the shrinking of the bottom of the picture is generally caused by the ageing of the PCL82 field output valve, situated to the front of the receiver, behind the line output transformer (viewed from behind). Alternatively, the $100\mu\text{F}$ cathode bypass capacitor could be faulty—this is a common cause of shrinking.

The poor ITV picture is probably caused by a weakening PCC84, r.f. valve, the rearmost of the two tuner unit valves. You may get slightly better results if you replace this one with a 30L15, but will probably have to retune the r.f. coil slightly. This is accessible to a plastic trimming tool via a hole in the rear of the tuner.

Remember that both these faults may have a common origin, i.e., low h.t. Change the PY32—fit a PY33, and note the overall improvement.

SOBELL ST287DS

Straight after switching on this receiver, the picture is quite normal. This continues for about two or three minutes, when the picture folds to roughly half-frame with the vertical hold scrambled.

If the vertical hold is adjusted and the set left for a further two to three minutes, the picture returns to the normal size once more with the vertical hold scrambled. After further adjustment of this control, the set remains normal for the remainder of the viewing period.

I have replaced the PCL85 but this has had no effect on the fault.—L. Wilson (Nottingham).

It is possible that there is an intermittent connection in the field timebase printed circuit panel. Try applying pressure to the panel when the set is working. If this brings on or clears the symptom, check around for badly soldered connections. These can alter as the temperature of the set varies.

EKCO T345

For about a week this receiver worked perfectly with a normal picture but after about 5 minutes the screen would go extremely dark. At this time, the raster lines would still be faintly visible, and the sound would not be affected.

If the set was switched off for about 5 minutes, then switched on again, the picture would be perfect for the remainder of the evening.

Now, the set will not come on normally at all—the picture remains very dark but the sound is still perfect.

I have changed the 30PL13 and had the 30FL1, 6F19, U26, U191 and 30P12 tested and all found O.K.—W. Gould (London, S.W.11).

Your symptoms suggest a faulty cathode ray tube, possibly with an open-circuit cathode. A method of checking this is to tap the tube neck gently whilst the set is running and observe if bright flashes are produced, but alternatively the video and brightness circuits could be eliminated by shorting the grid and cathode of the tube together momentarily with a short length of wire, which action in a good tube will produce a white screen.

MARCONIPHONE VT153

On first switching on, the picture is very weak but well defined and locked with plenty of movement on both field and line hold controls. However, after a few minutes, lock on both field and line cannot be obtained and no sync pulses appear to be present.

Towards the time of the break-up of the picture, the picture goes negative when contrast is increased, though illumination does not increase.—H. Wilson (Birmingham, 22A).

It seems as though the vision channel overloads, causing the negative picture and lack of locks. This could be caused by a heater/cathode short in one of the controlled (a.g.c.) valves or trouble in the vision a.g.c. and/or contrast control circuit. You should test along these lines. A valve is likely since the trouble occurs after the set is hot. Also check that all valves are properly seated in their holders.

MASTERADIO TJ7T

On switching on, I get only the sound and on switching off, no spot persists on the screen. I have replaced R19 about which I have my doubts, although I get an excellent spark from the top caps of R19, PY83 and 50CD6G. The spark at the final anode is possibly $\frac{1}{2}$ in. long.

On endeavouring to increase the brightness, the picture appears, enlarges and disappears.—G. Lane (Co. Durham).

First, check the first anode voltage of the c.r.t. You should get about half as much again as the h.t. at this point, using a meter of sensitivity of $20,000 \Omega/V$ or better, such as the AVO 8. If this voltage is low, check the $2M\Omega$ resistor feeding this electrode from the boost line. Often, as a tube ages, it is necessary to shunt this resistor with about $1M\Omega$. Don't overlook the $0.25\mu F$ paper capacitor decoupling this circuit—temporarily open circuit to test. But if replacement of the resistor cures, put the capacitor back, as resolution is improved thereby.

In emergency, the Brimar CM17PM, LM or SM type tubes can be tried as triodes, omitting the first anode tetrode connection. But resolution is seriously impaired, and replacement is ultimately the best solution.

SOBELL T24

First of all this set was very erratic. The horizontal and vertical holds needed constant resetting, improving as the set warmed up. The picture was very good in between the slipping bouts, but would sometimes turn very bright and, without adjustment, return to normal.

It was at this time that the other fault developed. A black line across the centre of the screen with a narrow double vision top and bottom. No adjustment at all would cure this condition.

After changing PL81 and PY81, the picture returned to normal but the slipping still persisted. After about two days, the narrow double vision fault occurred once more.—J. Cook (Co. Durham).

The narrow double picture divided by a horizontal black band is false field lock. On the Sobell T24 this is most likely to be caused by poor h.t. smoothing. It is also possible that the h.t. is low.

Alternative versions of the receiver used PY80 and PY82 valves or a metal rectifier. The latter is very prone to ageing, and should be replaced by a BY100 half-wave rectifier, with a series 25 ohm 5 watt limiting resistance. You can check the smoothing capacitors by bridging, but on a set of this age it is advisable to change them completely, even if the bridging appears to cure the symptoms.

FERRANTI T1023

The picture is poor but the main fault is horizontal lines which appear on the screen.—H. Haffern (Belfast, 15, N.I.).

The horizontal lines, if dark, could well be caused by co-channel interference due to your aerial picking up not only the wanted station but also the signals from a distant station sharing the same channel number. If this is the cause, you should concentrate on improving your aerial system, arranging for greater discrimination between the wanted and interfering signals.

BUSH TV24C

On switching on, the picture is perfect, but after approximately 20 minutes, "snow" begins to appear and gradually worsens until on dark scenes, no detail can be seen at all.—P. Holmes (Uppingham, Rutland).

The effect can be caused by a faulty h.t. feed resistor to one of the EF80 valve bases.

If the effect is worse on ITV, check the PCC84 valve on the tuner unit. It may be necessary to check the e.h.t. connection and lead from the EY51 to the side (or top) of the tube.

BUSH TV95

The trouble is lack of width. The width control is set at maximum setting but the picture remains about lin. short of the mask on either side. The height remains normal.

I have changed the ECC82 and PL81 valves without success.

Also, from time to time, the line whistle becomes harsh and much louder than usual.—R. Butler (Belper, Derbyshire).

The h.t. is probably low. If this is so, change the metal rectifier or bridge a silicon diode across the existing one.

The harsh line whistle may be due to loose laminations on the line output transformer or a noisy PL81.

PHILIPS 19TG120

The sound is very poor and there is no sign of any e.h.t.—A. Thomas (Bristol, 4).

Lack of e.h.t. voltage could be caused by trouble almost anywhere in the line timebase or in the e.h.t. circuits. Shorting turns in the line output transformer is a possibility. Low sound could mean a weak aerial signal, malalignment of the sound channel, low h.t. voltage, faulty sound valve—almost anything in the sound channel! We really need to know more about the faults before we can give a more material analysis.

BUSH TV62

The sound is all right but I cannot get the EY86 to light up and there is no picture.—T. Brimelow (St. Helens, Lancashire).

Check the line drive to the PL81 control grid (pin 2). If absent, the PL81 will overheat, in which case, check the ECC82. If the ECC82 is working, check the 0.1 μ F boost line capacitor (junction of the 100k Ω etc.) and the line deflection coil connections.

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PRACTICAL TELEVISION, APRIL 1968

TEST CASE -65

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

A receiver with a multichannel (switched) tuner, as distinct from a turret tuner, suffered from bad breakthrough on sound of the local m.w. radio station. The vision was also very slightly affected, the symptom here being akin to mild sound-on-vision interference. The tuner was considered to be responsible for these troubles, but normal testing of the active circuits failed to reveal any fault. The valves were checked, since it was thought that, perhaps, the first valve was low emission and overloading on the powerful m.w. signals. All appeared to be in order.

Attention was then directed to the aerial, and tests on this proved that the TV signal had a strength of about 300 μ V vision and 200mV sound, which was perfectly reasonable for this type of set. The symptom was almost certainly caused by the spurious m.w. signals beating with the v.h.f. local oscillator, giving rise to spurious signals within the sound and vision i.f. passbands.

What was the most likely cause of this trouble? See next month's PRACTICAL TELEVISION for the solution to this problem and for a further item in the Test Case series.

SOLUTION TO TEST CASE 64
Page 284 (last month)

Some sort of beat effect was obviously responsible for the weaving verticals of Test Case 64, and as realignment failed to reveal the cause, it was concluded that the trouble must lie somewhere in the video amplifier stage. The reduced definition gave a clue, and special checks were made of the frequency compensating components in the anode and grid circuits, also the cathode decoupling and anode compensating capacitors.

The anode circuit components were normal, as also were the capacitors just mentioned. However, when tests were made round the control grid circuit with the set receiving a picture, it was noticed that the effect could be cleared by applying pressure to the i.f. filter choke in the vision detector circuit.

A detailed check of this part showed that it consisted of a 1M Ω resistor upon which was wound about 50 turns of insulated wire. Eventually a poor soldered connection at the lead-out wire termination of the winding was discovered. Re-soldering cleared the trouble completely and restored normal definition.

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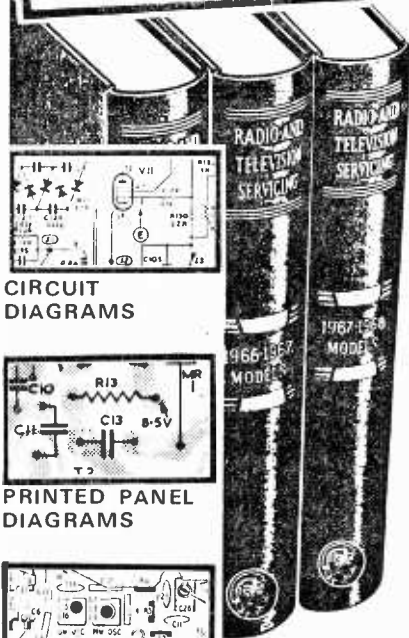
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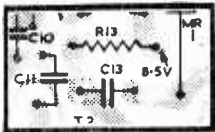
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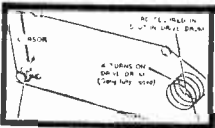
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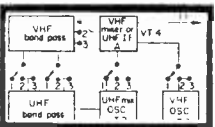
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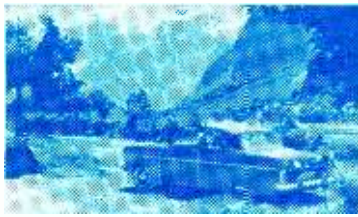
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