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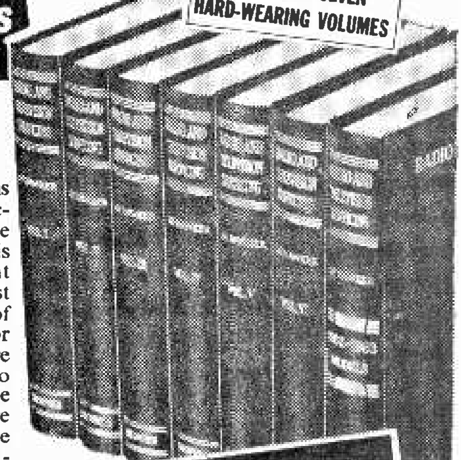

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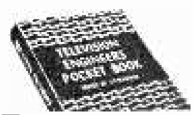

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Practical Television

AND TELEVISION TIMES

VOL. 14, No. 161, FEBRUARY, 1964

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Contents

Nation Shall Speak Peace Unto Nation

THE first London Festival of World Television, held recently, broke new ground. Apart from being the first television festival in which awards of merit were *not* made, it was the first in which completely comprehensive technical facilities were provided for displaying on closed circuit TV to the largely professional audience, television pictures in the same manner as seen on the monitors of the originating television station. Delegates from TV stations all over the world attended.

No item was excluded for reasons of technical convenience. The organisers decided from the start that programmes must be viewed on the electronic apparatus for which they were intended. This presented the Festival's Technical Committee with a large number of problems in providing equipment for handling different line standards of magnetic television tape, different gauges of film (directly photographed or telerecorded), different mains frequencies—and even different languages.

The result was a technical triumph, and great credit is due to the combined engineering talent of the BBC, ITA and various Independent Television companies, under the chairmanship of Mr. C. A. Marshall of the Television Society.

Many companies provided equipment and personnel for the operation, and the British Film Institute made available their splendid National Film Theatre on the South Bank of the Thames. This theatre is already equipped with apparatus for the projection of films of various gauges and types of sound track. It also possesses sound facilities for language translation, with headphone distribution in separate circuits to eight groups of seats, enabling (including the loudspeakers) nine languages to be distributed, if necessary. Two only were used on this occasion.

All of these facilities demonstrate the great possibilities of closed circuit television for international occasions, whether they be for summit conferences, Parliamentary debates, sporting events like the Olympic Games, or any major event of world interest.

The BBC's motto—"Nation Shall Speak Peace Unto Nation"—is coming to fruition, vision giving it the impact that sound alone lacked.

The experience gained at the first London Festival of World Television has given a pointer to the future, to the broader use of television technology in international relations. Usage as an industrial aid to productivity, in the sciences of ergonomics and cybernetics, data processing, and the like, is already well established. In its use as a cultural aid for the exchange of ideas, the Festival has broken new ground. Let us hope that the initiative and leadership exercised by the British Film Institute will be continued next year, and that the second London Festival of World Television will maintain the lead now established for this event.

Carry on, B.F.I. !

Our next issue dated March will be published on February 21st.

TELETOPICS

EDUCATIONAL PROGRAMMES FOR ADULTS

WITH the agreement of the Independent Television Authority, Southern Television is currently producing an experimental series of 12 Adult Educational programmes dealing with English Literature.

The object of the experiment is to assess the value of active rather than passive, use of educational television for adults by means of programmes designed to supplement and help the work of teachers at evening classes provided by the various educational bodies and authorities. It is for this reason that the early evening transmission time of 7 p.m. has been chosen. The programmes will, however, also aim to be attractive. and of value to viewers at home who wish either to follow the whole course independently or to view intermittently.

The Ministry of Education, at whose request the series is being undertaken, is to regard this as "a controlled experiment" in the use of television for adult education and has agreed to give financial assistance to education authorities for the provision of tutors. All such authorities within the Southern Television reception area have been asked by the Ministry to organise groups to study the subject as presented in the programmes.

The Extra-Mural Departments of Oxford and Southampton Universities are co-operating with the Education Authorities in arranging classes and providing extra tutors.

The series, entitled "The Full Man" has been devised by Professor David Daiches, Dean of the School of English and American Studies at the University of Sussex and is produced at the Southampton studios of Southern Television.

BBC-2 TEST TRANSMISSIONS

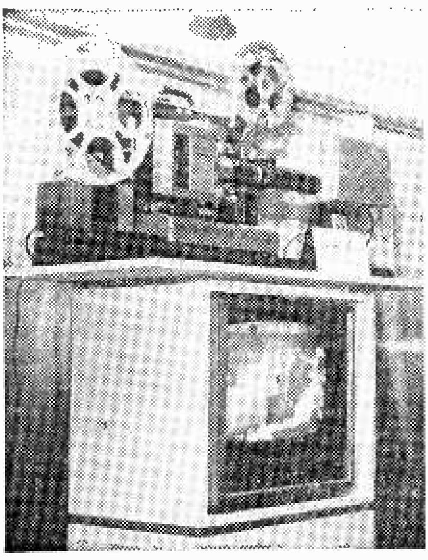
TRADE test transmissions on 625 lines u.h.f. from the BBC's London television station at Crystal Palace commenced on 4th January, 1964.

These transmissions are to assist the Radio Trade in the installation of receivers and aerials for reception of the second programme, BBC-2, which starts in London on 20th April, 1964, and are radiated on Channel 33 (vision 567·25Mc/s; sound 573·25Mc/s) with horizontal polarisation.

The times of transmission are: Mondays to Fridays 9 a.m. to 1 p.m., 2 p.m to 8 p.m. Saturdays 9 a.m. to 8 p.m.

The nominal effective radiated power will be 500kW when the installation of the new transmitting aerial is completed about the beginning of March. Until then the effective power is expected to be approximately half this figure. Every effort will be made to maintain continuity of transmission, but there may be interruptions and variations in power during the installation period.

The test transmissions will consist of periods of Test Card, with 400c/s tone or music, alternating with periods of film. These films have been carefully chosen for their high technical quality to ensure that the best possible pictures are transmitted during the test transmissions. Their showing has been scheduled so that they not only allow the television supplier to show his customers something more interesting than just the familiar test card but also to give some entertainment to viewers who have already equipped themselves to receive 625-line u.h.f.



625-Line Telecine System

THIS equipment recently demonstrated by the Audio Visual Division of the Rank Organisation enables a film to be received by closed circuit television receivers located in many different lecture halls or class rooms. A Bell and Howell 16mm projector is coupled to a Murphy TV camera and a 19in. monitor is provided for dispaying the vision output.

The illustration on the left shows the closed circuit telecine equipment for 625-line operation.

NEW WELSH SERVICE FROM WENVOE

A NEW high-power Band III transmitter at Wenvoe, to be used for the separation of the BBC television service to Wales from that to the English Regions, will be brought into service on February 8th.

This new BBC television service for Wales from Wenvoe will be on the present 405-line standard but the transmission will be in Band III on Channel 13 (vision 214·75Mc/s, sound 211·25Mc/s) with vertical polarisation. It will serve most of the South Wales area covered by the existing Band I transmitter at Wenvoe; the latter transmitter will continue to use Channel 5 and carry the network programme (BBC-1) and those items appropriate to the West of England.

To receive the new Service viewers in South Wales will need to have their receivers adjusted for reception on Channel 13. Sets designed for Band III reception will, in many cases, require only a simple tuning adjustment, but some will need additional tuning coils. Viewers living near to the Wenvoe transmitter may find that their existing Band III aerial for reception of the ITA transmissions on Channel 10 will be suitable for reception of the BBC transmissions on Channel 13. Further away and in less favourable locations a separate aerial (with vertical elements) for Channel 13, or one capable of receiving both Channels, will be needed.

Wenvoe is the first BBC television station to use a channel in Band III, a band hitherto used in the United Kingdom only by ITA.

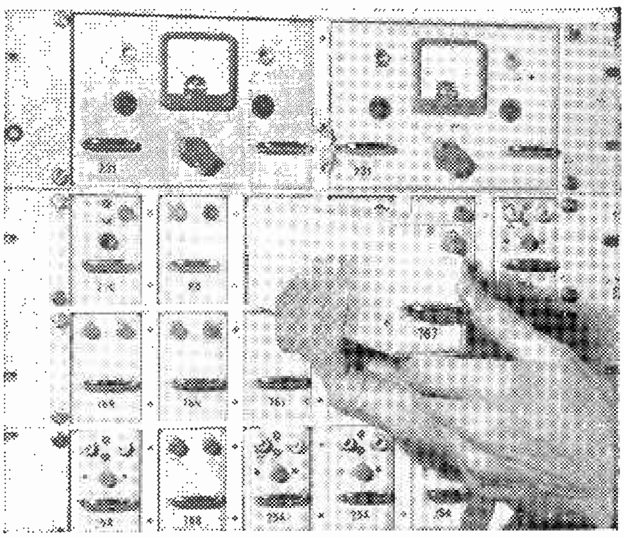
Semiconductor Video Switching System

COMPLETE flexibility of television studio system engineering is made possible by the new semiconductor video switching system announced by EMI Electronics Ltd.

This system offers considerable advantages over the relay and electro-mechanical switching equipment hitherto used in most TV studios.

Modular construction is employed so that facilities can be provided to meet individual requirements and further plug-in modules can be added as needs grow. New design techniques have greatly reduced the rack space requirement and improved the performance, and the system is suitable for use in all television system standards, for both monochrome and colour.

An important facility, when cutting from one shot to another is the ability to switch during the vertical blanking interval, without "flashing" or streaking across TV screens. Other advantages are a high degree of inter-channel cross-talk isolation and the increased reliability which results from the exclusive use of semi-conductors.



The flexibility afforded by the use of standard-sized modular units is shown in this illustration of the semiconductor video switching system.

MOBILE CONTROL ROOMS FOR BBC

THE BBC has already taken delivery of the first of a series of outside broadcast units capable of multi-standard working. From them it is possible to transmit pictures on 405, 525 or 625 lines and it takes about ten minutes to turn the equipment over from one line standard to another.

Each mobile control room is divided into three sections: an operational area; an area occupied by the engineering manager, the producer and his secretary; and a technical area. Four television cameras operate within the unit and, at a later date, a caption scanner will be added. It is quite easy for these four cameras to work in a de-rigged position.

Among the refinements found within the mobile control room are two 14in. preview monitors and a 17in. transmission monitor. Various production techniques such as cutting, mixing, wiping or inserting, can be carried out electronically at the press of a button.

All the outside broadcast units were built by Pye to BBC specifications, and the first has already been undergoing a series of trials.

NEW RELAY STATION AT EASTBOURNE

THE BBC's new television relay station at Butt's Brow, Eastbourne, was brought into service mid December last. It operates on Channel 5 (vision 66·75Mc/s, sound 63·25Mc/s) with vertical polarisation.

This station will provide improved reception for some 60,000 people in and around Eastbourne and reduce the effect of interference from continental stations. Local dealers and service men will be able to advise viewers with regard to new aerials and any receiver adjustments required.

CONVERTING THE CONVERTIBLES

BY T. S. SMITH

MANY of our readers, particularly those in the London area, are now beginning to consider the possibilities of converting or having converted their existing television receivers for dual standard operation. That is, having the sets arranged so that, in addition to the 405-line transmissions, they will receive the new BBC-2 programmes on the 625-line standard, which are due to start early in 1964 from the Crystal Palace transmitter in London.

Bands and Channels

It is now widely known that the 625-line programmes are to be transmitted in channels on the ultra-high frequency (u.h.f.) bands, called Bands IV and V. Band IV extends from 470Mc/s to 582Mc/s and Band V from 610Mc/s to 960Mc/s and in these bands can be accommodated 44 channels each with a bandwidth of 8Mc/s. Band IV comprises channels 21 to 34 and all this is available for television transmissions. The low part of Band V is not available but frequencies between 614Mc/s and 854Mc/s (comprising channels 39 to 68) are immediately available.

Channel 33 is that selected for the first BBC-2 transmissions from London. U.H.F. channels are referred to in terms of vision frequency only and on channel 33 this is 567·25Mc/s. The sound carrier is always 6Mc/s *above* the vision carrier on the u.h.f. channels. (It will be recalled that the sound carrier is 3·5Mc/s *below* the vision carrier on the v.h.f. channels—channels 1 to 13—of Bands I and III.)

Channel 33 has been accommodating Crystal Palace test signals for some time now, using a power of 160kW. Ultimately the power will go up to about 500kW (e.r.p.) when the actual programmes start, but this will increase the local signal field strength only by about 80% (5dB) relative to the signal field, due to the test transmission, which is less than some people suppose!

Each station area is allocated four u.h.f. channels—each channel 8Mc/s wide—with guard channel between. In many station areas the four channels will occupy a total spectrum of 88Mc/s. This, for example, applies to the London region, where channels 23, 26, 30 and 33 are allocated; also to Suffolk, where channels 41, 44, 47 and 51 are allocated.

Aerials

Unfortunately this basic pattern of 88Mc/s may have to be broken in other areas or regions. In North Kent, for instance, a spectrum of 200Mc/s has been allocated, catering for channels 40, 43, 46 and 65.

In regions where the spectrum is 88Mc/s wide over the four channels, like London and Suffolk, one single u.h.f. aerial will embrace all four channels, but where the channel jumps up to a high number, like North Kent, then two u.h.f. aerials will eventually be required.

However, that is some time in the future and for the present we need consider only 88Mc/s spectrums. Thus the first thing that we must look into is the u.h.f. aerial system. For viewers in the London region one aerial suitable for the four channels must be obtained, even though for the time being only BBC-2 on channel 33 is to be radiated. Later, of course, additional programmes—like ITV-2—will occupy one of the partnering channels, but this should not necessitate a replacement u.h.f. aerial or an extra one; and will not provided the correct aerial is fitted in the first place.

This article is concerned essentially with conversions but a future article is being prepared which will be concerned with aerial systems and associated problems.

We have already seen the problems involved in the conversion of a 625-line-only receiver to 625-line-only operation ("Towards 625", *Practical Television*, July, August, September and October, 1963).

Generally speaking, such a conversion can be considered solely as a rewarding experimental exercise.

Owing to the many parameters which have to be changed on switching from one standard to another it is not feasible, even experimentally, to convert a 405-line-only set to dual-standard operation, so permitting it to be switched over both standards, as with the new commercial "switchable" sets. This should be noted well!

Dual-standard Designs

Several years ago set makers examined the problems of making a receiver which would be suitable for both 405-line programmes on the v.h.f. channels and 625-line programmes on the u.h.f. channels. The problems were fully solved but at that time it was not known definitely whether 625 lines were to be used or even the parameters of the signal should it be decided to use that number of lines.

The poor set makers were thus put in a state of quandary. It was not until after the Pilkington Report that the situation was made clear. But for months prior to the report the public anticipated

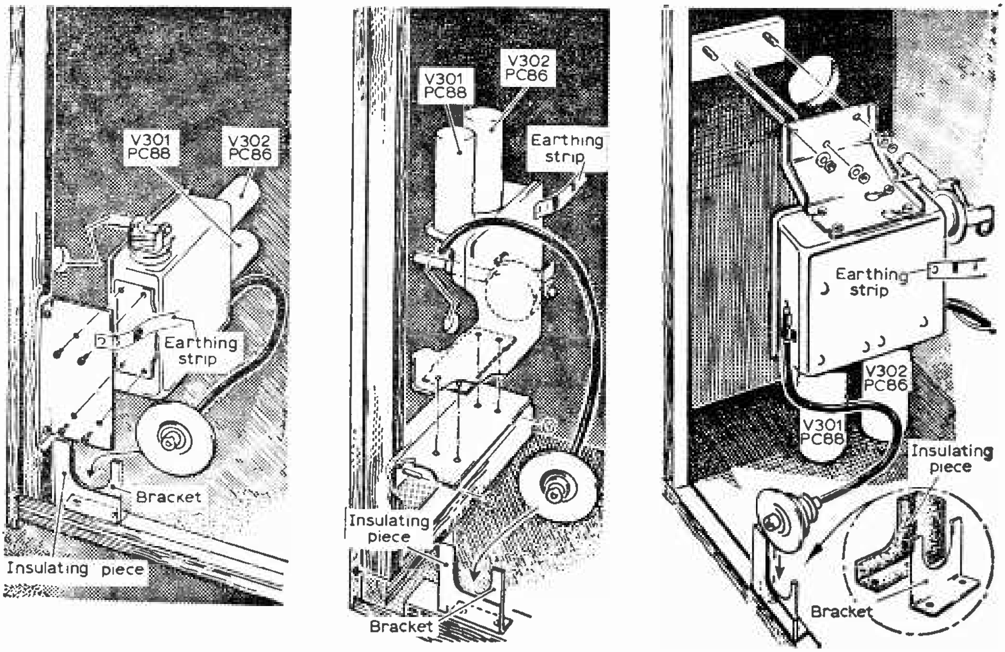


Fig. 1—These diagrams show three ways in which the u.h.f. tuner may be fitted into the current Ferguson receivers, depending upon the octual model.

a change from 405 to 625 lines and as a consequence ceased buying receivers. The Pilkington Report was delayed and the television industry suffered economic difficulties.

Set makers were not keen to make 405-line-only models any more and they were reluctant to make dual-standard models at that stage, since the parameters of the possible 625-line signal were not known. Many makers compromised and at that time made basic 405-line-only models featuring a switch labelled "405/625". This switch often did virtually nothing at all or very little (being either partially wired or unwired and/or locked or operating only in the line timebase circuit) but its presence at least gave the purchaser the satisfaction of knowing that the set was one step above the 405-line-only models and that at some date in the future it would be suitable for conversion to the new standard. We shall talk more about the conversion of that type of receiver later.

Other makers put more into their "convertibles" than a timebase switch. These receivers were designed all the way through for dual-standard operation but only the items necessary for 405-line working were fitted at the time of purchase, the philosophy being that it was bad economics to fit equipment that may not be required for years to come. This kind of set represents the true "convertible-to-switchable" model.

Once the Pilkington Report made known the future of television broadcasting the "timebase switched" type of receiver disappeared and, in addition to the true convertible to switchable model, the real dual-standard model appeared on the scene.

This type of set is in two versions, the type which needs the installation of a u.h.f. tuner and the type which is complete with u.h.f. tuner and is ready for action on both standards after connection to suitable aerials, of course.

U.H.F. Tuner Installation

There are thus three types of convertible receiver which we shall call (i) "the gimmick switch" type, (ii) the true "convertible-to-switchable" type and (iii) the "dual-standard" type which simply requires the addition of a u.h.f. tuner.

Type iii, of course, needs no further comment apart from saying that the installation of a u.h.f. tuner calls for no undue skill, since in many models the work simply resolves to a "bolt-on" and "plug-in" exercise. Extreme care must be taken, however, to ensure that the receiver is perfectly safe mains-wise after the tuner is fitted, bearing in mind that the metal chassis of the receiver (and the u.h.f. tuner) is connected direct to one side of the mains supply and if it is possible for a person to make contact with any metalwork a fatal shock could result if the metal chassis is connected to mains "live".

U.H.F. tuners are available for around seven to eight guineas and they take up to 20 minutes to fit. In some of the Ferguson models requiring just a tuner, for example, the cabinet is already drilled and it becomes just a matter of cutting a couple of links, plugging in the tuner connector to the i.f. assembly and securing the aerial bracket to the cabinet, as shown in Fig. 1.

This sort of operation is typical of many dual-standard models in which u.h.f. tuners need to be fitted just prior to the commencement of a local 625-line u.h.f. service. There is not a lot of point in fitting a u.h.f. tuner, which can deteriorate if not used, in a set which is to be used in an area which will not have a 625-line service for a year or so.

Pre-aligned Tuners

U.H.F. tuners leave the factory pre-aligned and it is recommended that no tuner adjustments be made. This is advice well worth observing, for a little while at least! As has already been intimated, a separate aerial with 75/80Ω coaxial cable is required for u.h.f. reception. The coaxial should be low-loss variety with an inner connector no less than 0·04in. diameter.

Conversion of the genuine convertible-to-switchable receiver, type (ii) above, differs somewhat between sets of different make and model. There are two distinct modes of type (ii) conversion. Mode (a) is effected by the installation of an *additional* 625-line strip and mode (b) is effected by the removal of the existing 405-line strip complete and its *replacement* with a dual-standard strip.

Mode (a) conversion applies mainly to some of the early convertible-to-switchable models, while mode (b) conversion is of recent design and, in fact, it endows a converted receiver with the chief characteristics of a receiver designed specifically for dual-standard operation. Very few dual-standard models as such employ two separate strips. The technique is to make use of a single strip which can be altered in characteristics to suit the two standards by switching sections of the circuit.

Mode (a) conversion, then, uses a 405-line i.f. strip complete with a v.h.f. tuner and a 625-line i.f. strip side by side with the 405-line strip complete with a u.h.f. tuner. Each strip has its own sound and vision detectors and video amplifiers, the dual standard switching being arranged in the vision channel to the picture tube cathode and sync separator stage and in the sound channel to the audio stages.

Some Philips Ideas

Some of the Philips receivers use mode (a) conversion. The unconverted set features hinged panels and plug-in components for facilitating both general servicing and the conversion.

The receivers have a grille on the left which partners one on the right and which is changed on conversion for a unit which carries a u.h.f. tuning dial on the front and a u.h.f. tuner, flywheel sync section and 405/625 switch assembly at the rear. Fitting is by means of two pegs at the front and a screw behind.

The additional 625-line strip is fitted by means of four screws and it is designed with contacts so that when it is in position and clamped down the contacts unite with similar contacts on the 405-line strip, thereby giving automatic circuit inter-connections.

Shorting clips are removed from the 405-line strip and six leads from the u.h.f. tuner/flywheel sync unit are connected in their place.

Independent tuner i.f. circuits are used right up to the video amplifier stage and the final coupling is through a cathode follower, which keeps the frequency losses very low.

The set employs flywheel sync only on 625 lines (direct sync on 405 lines) and the change-over from one standard to the other is accomplished essentially by the switching of the h.t. supply, a practice which avoids the problems associated with the switching of signal circuits.

Flywheel Sync

Note that flywheel sync is necessary on the negative vision modulation of the 625-line standard to avoid the vertical picture components from appearing with ragged edges. Noise and interference can affect negative modulation more than the positive vision modulation of the 405-line standard in terms of "ragged verticals" and the effect can be further aggravated by the higher line speed of the 625-line standard. Flywheel controlled line oscillators eliminate the effect and all dual-standard and the majority of convertible-to-switchable models (after conversion) contain such circuits of some kind or other either on both standards or just on 625 lines, as in the Philips set described.

Note that the basic idea given above is used also in Cossor, Stella and Peto Scott sets, since they are now in the same group as Philips.

A block diagram showing mode (a) conversion is given in Fig. 2.

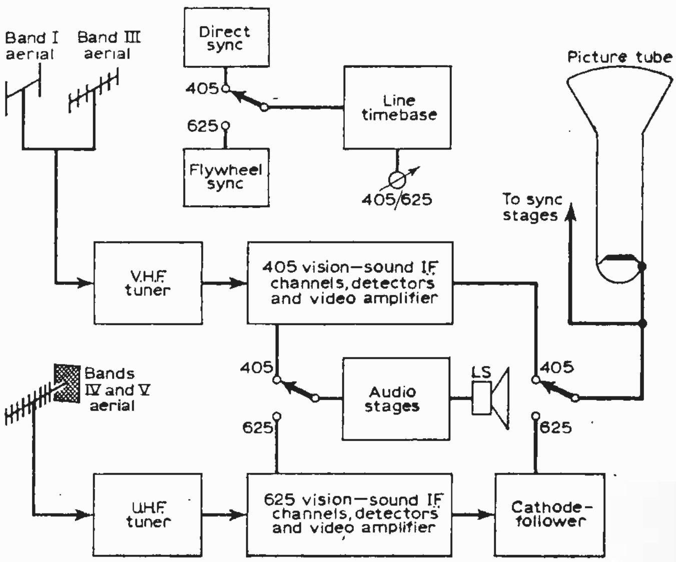


Fig. 2—Block diagram revealing the operation of a receiver which employs separate 405-and 625-line strips after conversion, as described in the text as "mode (a)" conversion.

Convertibles of the Murphy range also adopt mode (a) conversion. These sets, however, use a plinth-type unit which is screwed to the base of the parent receiver cabinet. The plinth unit carries the u.h.f. tuner, the i.f. strip, the detectors and the video amplifier.

The "405/625" change-over switch is accommodated on the main receiver, but after the plinth is installed it protrudes through an escutcheon on the plinth front panel. This also carries the u.h.f. tuning dial and two control knobs. Conversion is no more difficult than inserting a plug-terminated cable from the plinth unit into a matching socket on the receiver.

Other sets utilising mode (a) conversion include those of the Thorn Group (e.g. Ferguson, HMV, Marconiphone and Philco) and Ultra. Fig. 3 shows the Ultra Mermuda (Model 1984) with the plug-in conversion unit inside the cabinet.

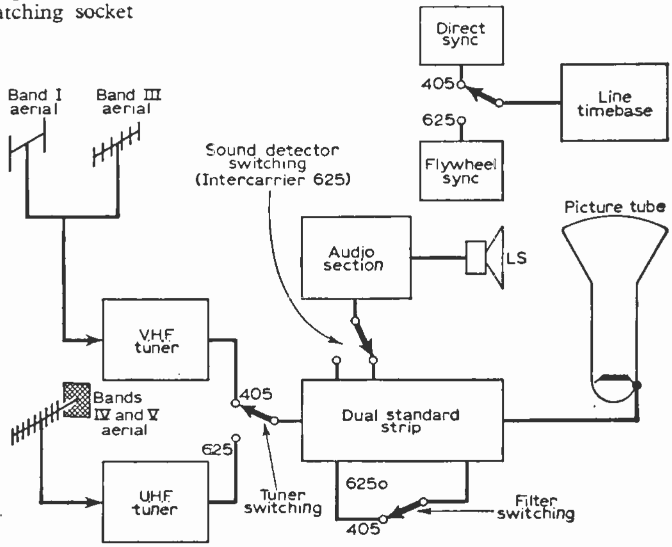


Fig. 4—Basic block diagram, after conversion, of a receiver which employs an integrated "dual standard" strip, as described in the text as "mode (b)" conversion. This technique is commonly employed in the genuine dual standard receivers.

Integrated Conversion Strips

Mode (b) conversion is used in some of the Bush models. Conversion requires the replacement of the old i.f. panel with one of the "switched bandwidth" variety—that is, the i.f. channel is designed for the 625-line bandwidth and on 405 lines filter circuits are switched in so as to restrict the response, making it the same as that of a 405-line channel.

This technique is adopted in all (or almost all) real dual-standard models. The arrangement is shown in basic block form in Fig. 4. GEC models also use mode (b) conversion. Conversion kits are provided with simplified step-by step instructions. The existing 405-line i.f. panel is removed and replaced with the new 625-line strip, which incorporates the f.m. detector circuits.

Valves are transferred from the old to the new panel, an operation which calls for two extra valves—an EF183 and an EH90—and which makes one EF80 redundant.

When conversions are being considered the term "i.f. panel" or "i.f. strip" crops up time and again. In the majority of cases the item, however it is termed, contains not only the i.f. stages, both sound and vision, but also the sound and vision detectors, the video amplifier and sometimes the flywheel sync unit and the audio stages as well! Thus, when the conversion calls for the replacement of the i.f. strip, quite a large portion of the set is being replaced, even though the valves may be transferred from the original 405-line-only strip.

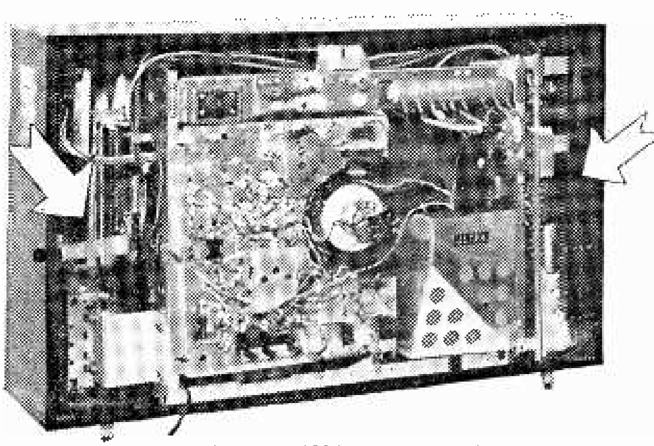


Fig. 3—Ultra Bermuda (Model 1984) showing the plug-in conversion unit in position inside the cabinet. The arrows point (left) to the 405/625 switch and (right) to the tuner and sub-chassis.

The conversion items come in complete kits and range from seven guineas for a u.h.f. tuner alone up to £20 or £25, depending upon the type of receiver and the design for conversion in the first place. Less labour!

Transistor Conversion Items

Some of the early ideas for conversion have since been modified. With certain Ekco models, for example, changes have been made in the procedure for con-

—continued on page 203

A Novel Method of Frequency Control for a Blocking Oscillator

BY G. K. FAIRFIELD

FREQUENCY control in a blocking oscillator of the type used in television scanning circuits is generally achieved by means of a variable resistance or potentiometer included in the circuit. This is a component which is subject to failure, generally by the resistance track becoming open-circuit, and so an alternative method which is described below has been developed to improve the reliability of the scanning circuit.

This method makes use of an unusual property—the magnetic control of emission of a thermionic valve. A familiar use of this property is in magnetron operation and those readers who have some knowledge of radar principles will, of course, recognise this in my description of the method.

Principle

If we take the typical blocking oscillator shown in Fig. 1 we see that the frequency may be controlled by the C/R time constant, the applied h.t. and the grid bias developed at the valve grid. This last parameter is dependent on the magnitude of the pulse of cathode current that occurs at the end of each sawtooth scan period. Normally this is fixed by the parameters given above and also by the mutual conductance of the valve. By subjecting the cathode-anode path of the valve to an axial magnetic field the magnitude of this peak cathode current is affected and with it the grid bias and frequency of the oscillator.

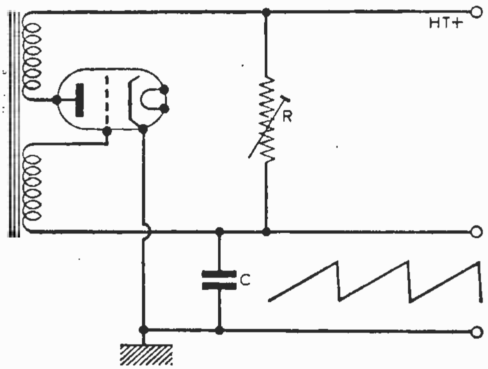


Fig. 1—A typical blocking oscillator circuit.

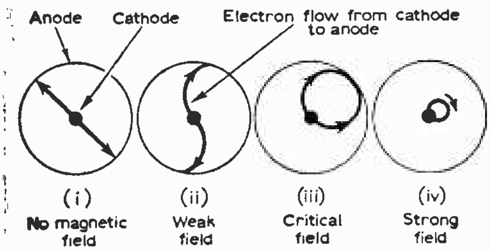
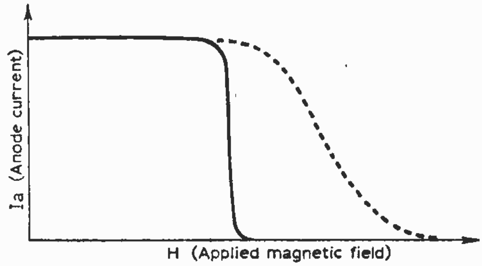


Fig. 2—The effect of a magnetic field on the flow of electrons from cathode to anode in a diode.



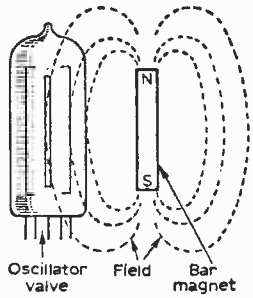


Fig. 3 (above)—The graph illustrates the change in anode current with the applied magnetic field. Fig. 4 (right)—The magnetic field in relation to the cathode.

Magnetic Field Effect

This will be made clear from the diagram given in Fig. 2. This is drawn for a diode only and shows how the presence of a magnetic field will affect the anode current for a given field strength. In a magnetron diode this change is very abrupt and the anode current alters rapidly from a steady maximum value to almost zero as shown by the full-line curve in Fig. 3. If a non-uniform magnetic field is applied along the length of the cathode, as shown by the magnetic field drawn in Fig. 4, then this change is more gradual and is indicated by the dotted line in Fig. 3. This is a much more suitable characteristic for frequency control.

A practical set of curves for a 6F12 pentode valve is given in Fig. 5, which illustrates how the grid bias necessary to define a particular anode

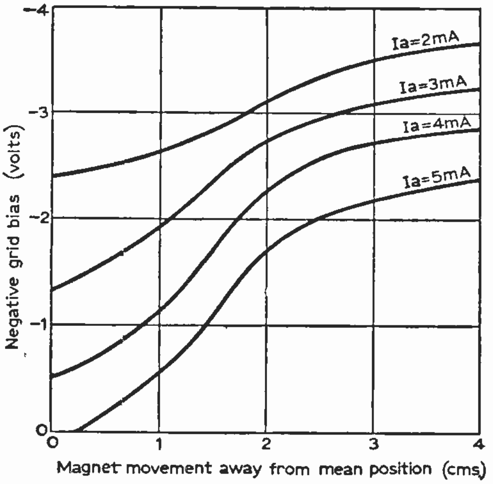


Fig. 5—A set of characteristic curves for the 6F12.

current will vary as a small magnet placed alongside the valve is moved up and down.

Practical Considerations

To achieve a suitable range of control only a small ticonal magnet will be necessary. This can be a Mullard type measuring 1¼in. x ¼in. x ¼in. and is the type sometimes used for the linearity control of line scanning circuits as described in my previous article, "Scanning and Synchronisation, No. 6", which appeared in the pages of PRACTICAL TELEVISION for February, 1958.

Two methods of mounting suggest themselves. A tube, acting as a magnet guide, can be affixed to the aluminium valve shielding can as shown in Fig. 6(a). A movement of the magnet up and down within the tube will control the frequency of operation. Alternatively a rotating movement of the magnet can be achieved by affixing this to a scrap potentiometer mounting close to the controlled valve as shown in Fig. 6(b). In this case conventional knob control can be used.

Finally it should be noted that this method of changing the mutual conductance of a valve by magnetic means can also be used in the control of multivibrator circuits used in timebase and pulse circuits. This may be of value in experimental work. ■

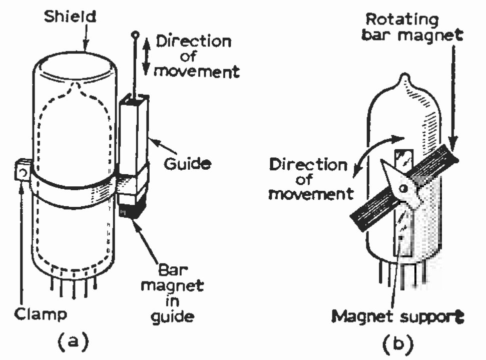


Fig. 6—Alternative methods of mounting the bar magnet.

Converting the Convertibles

—continued from page 201

verting by the recent addition of a transistorised 625-line-only strip. This incorporates the f.m. detector and is fitted alongside the existing i.f. panel.

It is said that this new arrangement involves less work in terms of fitting than the original valve idea.

Dynatron is another firm which has brought out a transistorised conversion kit. Cost is expected to be in the region of £20 to £25.

As some of the very early "gimmick switch", our type (i), receivers are now getting on for three years old it is debatable as to whether they represent an economic conversion proposition. Some makers are suggesting that such models are returned to them for conversion, but if £20 or £30 has to be paid to convert an early model, by far the better solution may well be to trade the set in for one of the very latest models.

However, we feel sure that many of our readers would prefer to keep this kind of set, even if only as a "second", and probably themselves "have a go" at converting it later. Now that there will shortly be three programmes available to London viewers an extra set would not be amiss and may indeed go a long way towards stabilising the domestic situation.

It seems as though there will eventually be many conversion kits on the market which could possibly be used to convert models for which they are not intended. But in the first instance there will be a big rush for the kits and those of our readers who will be needing one would be well advised to put in their orders without delay. ■

THE "PRACTICAL WIRELESS" FILM SHOW

The "Practical Wireless" Film Show which is held annually and to which readers of P.TV are invited, is to be held, as before, at Caxton Hall, Westminster. The date and time of the Show, which is arranged in collaboration with Mullard Limited, is the 31st January, 1964, at 7.30 p.m.

The programme will appeal to all readers of "Practical Television" and of special interest will be the illustrated talk on **colour, 625-line** *and* **u.h.f. television,** *which will form the first part of the programme. After a break for refreshments, the programme will continue with a film entitled "Ultrasonics".*

Tickets may be obtained free on request from these offices. A stamped addressed envelope must be enclosed with all applications for tickets.

ICONOS takes a look at the first

LONDON FESTIVAL OF WORLD TELEVISION

THE first London Festival of World Television was one of the most remarkable events in the history of television. Unlike the established TV festivals at Cannes, Montreux and Monte Carlo, it was non-competitive, and Oscars, Grand Prix, medals or diplomas were *not* awarded. It aimed to show examples of the best of world television, regardless of political or technical factors; quality and interest were the prime considerations—an entirely new and refreshing basis.

About the Festival

The British Film Institute's National Film Theatre on the South Bank of the Thames was converted into a viewing hall in which the selected programme could be seen as reproduced on the type of electronic apparatus for which it was intended.

The expedient of using the normal cinematograph projection apparatus of the Natonal Film Theatre was scrupulously avoided, and the programmes were seen closed-circuit-wise on eight 23in. monitors distributed around the auditorium, plus a large screen TV projector reproducing a picture about 9ft. wide.

The determination of the organisers to present such a variety of material on the original television medium used, be it video tape, 16 of 35 mm positive or negative film (with combined or separate sound tracks, magnetic or optical), different languages (with translations), led to permutations and combinations which must have made it the most comprehensive and versatile technical closed-circuit forum ever to be assembled.

Technical Facilities

The National Film Theatre is of modern design and appearance, with good acoustics, and equipped with facilities for the audience to hear—via headphones—translations of the dialogue of foreign films spoken in a small presentation studio overlooking the screen and the audience.

The permanent equipment includes 35 and 16mm projectors, which can be run interlocked for separate sound or for 3D. Little of this was used, however, in the Television Festival. With the cooperation of the BBC and ITA, an impressive set of television equipment was assembled, and installed in Mobex and other vehicles parked outside the Theatre.

There were two Ampex video tape recorders (one capable of playing off on 405, 625 and the other 525 lines), two Rank-Cintel telecines (one for 16 or 35mm film, one for 35mm only), a high quality off-air receiver, distribution amplifier banks feeding the monitors and large screen TV projector in the hall, a master control for switching to any of these originating sources, or to ATV's Foley Street TV Centre for any additional facilities (such as telecine with sound on separate film), and to the BBC's Lime Grove Studios for colour TV.

Well Deserved Credits

Technical planning was by Bernard Marsden, ATV's Technical Controller, and the installation and running of the whole complicated bag of tricks was carried out by Peter Fowler, one of ATV's Supervisory Engineers. Great Credit must be given for this technical triumph, carried out in record time, with essentially a temporary hook-up.

Credit, too, is due to Lew Grade and to Terence Macnamara, his Technical Counsellor, for making possible this whole technical operation, for which the BBC, ITA and all other companies loaned much equipment.

The Festival Programmes

I have enthused about the technical facilities. I wish I could enthuse completely about the programmes presented. Their selection must have been quite an endurance trial in itself. Five hundred programme-originating TV companies all over the world were invited to submit material, and upwards of two hundred hours of tape and film had to be viewed to choose the fifty hours of programmes for the festival.

The fact that it was a non-competitive festival, in which contributions from very small TV organisations would be represented alongside those of the big networks of Britain and the USA, must have made the final selection a difficult problem.

It was hoped that the interest of being able to see work from entirely new television originating areas would compensate for inadequacies of execution. This was a first-class idea—a new approach—which should not be abandoned, notwithstanding the dreariness of a few items amongst the brilliant ones.

There was drama from West Germany, cartoons and tricks from Hungary, the original TV "Marty" from the U.S.A., "Steptoe and Son" and "Gurney Slade" from England, "Tema Nova" from Finland, and travelogues and concoctions of documentary contributions from goodness knows where. The volume of television material must have overwhelmed the critical faculties of the audience even more than the selection committee. Thanks to the comfortable chairs, I had several cat-naps myself! Nevertheless, it was a highly successful nine days' wonder, with four 2½ hour sessions each day from 10 a.m. until 11 p.m.

Q & A Section

Question: Is it worth while holding a similar festival next year?

Answer: Certainly.

Question: Would it be improved by introducing a number of awards?

Answer: No. The method of selection and presentation was unique. It gave one a chance of seeing what is happening in TV all over the world. These medals and Oscars are becoming rather a bore.

Question: Some of the items were a bore too, didn't you say? If the London Festival wasn't 100% successful, what would you suggest?

Answer: Some of the individual items were far too long. It is difficult (and often impossible) to show only part of an item, but the right to cut should be a condition of submission.

Question: How could cuts be made, particularly in video tape? The owners of the tape wouldn't like the original masters being tampered with.

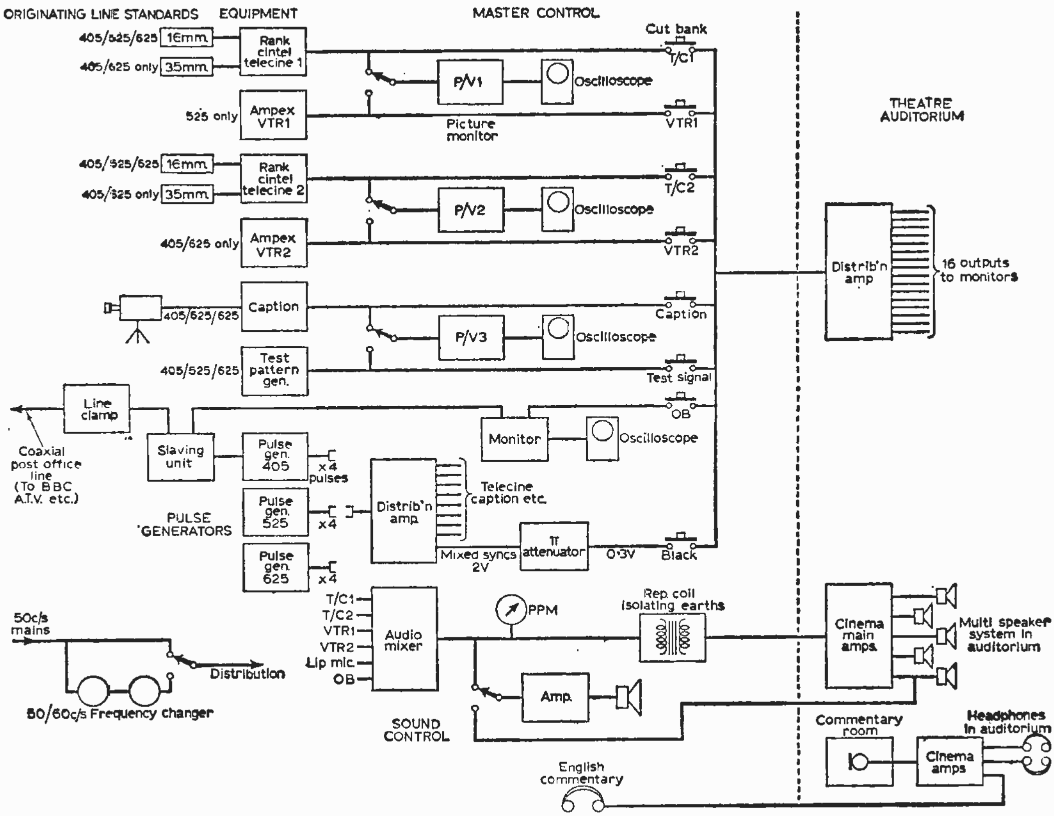
Answer: True. But this Festival has turned out to be a professional affair, attended largely by the people who are in television and in films, accustomed to evaluate by sampling, able to detect trends in production methods, qualified to judge and make allowances for a "rough cut".

Question: Do you think TV commercials should be included? The vast majority of world TV stations owe their existence to commercials.

Answer: The selection committee had a hard enough job without that. But there is a strong case for showing a number of outstanding commercials which could be selected from the International Advertising Film Festival prize winners. Or better still, an entirely separate sub-committee could select commercials under terms of reference similar to those which governed the choice of programme material—with no *prize winning qualifications. There's talent as well as gold in commercials.*

Question: Where did the gold come from to promote this Festival?

Answer: Running expenses were about £10,000, met largely by equal contributions from the BBC, the ITA and the Independent Television Companies Association. The organisation was carried out by the British Film Institute, whose director, James Quinn, his dedicated executives and committees, were responsible for the idea, its planning, development and execution. ■



Block diagram of the Technical Facilities.

INSTANT DIAGNOSIS

PROBABLY the most common instance of snap fault diagnosis is that afforded by the radio or television receiver which is obviously "live" from the aerial socket but produces no signal output except clicks from the speaker when the wavechange or channel selector knob is operated.

In such cases the fault is very often the failure of the triode oscillator section of the frequency changer valve. Similarly, of course, in TV receivers weak and grainy results, particularly on Band III, is due in 90% of instances to a low-emission duo-triode r.f. amplifier valve.

But how many other snap diagnoses can be made that invariably prove right?

Some notes on spot checks

by
G. R. WILDING

High Screen Grid Current

Take the case of "no sound" or "no frame" in a TV set incorporating a triode-pentode type of valve. If the pentode section appears to glow very bright, and on close inspection is found to be due to the second grid running hot, it can be assumed that the primary of the sound or frame transformer feeding the pentode anode is open-circuited, thus causing the g2 current to increase considerably.

Similarly if a line output pentode glows in such a manner it will indicate the absence of anode voltage. This is not usually due to a faulty line output transformer but to a reclaim diode with an internal cathode or anode disconnection.

If a line output valve passes little or no current yet has ample anode voltage and is itself all right, seeing that the cathode will be tied down to chassis, the most likely cause is that the screen feed resistor is of the wire-wound type and is completely open-circuited.

To double check it is not necessary to remove chassis or even an inspection panel but merely to ohms-test from any point on the smoothed h.t. rail to the g2 pin on the valveholder for a figure approximately 2kΩ.

Faulty Screen Feed Resistor

On the other hand, if a line output pentode gives a good output but runs even hotter than usual and tends to decrease its output after some minutes of running (again presuming that the valve is good) then in most cases the fault will be found to be that the screen feed resistor is of carbon type and has decreased in value. In older receivers and those makes known to use carbon types this fault is particularly common.

If, however, the line output valve passes an excessive current and fails to give any output the cause is almost certainly due to a lack of input from the line generator, which in turn is often due to a faulty triode oscillator.

Line pentodes derive their bias exclusively from the incoming sawtooth pulses and any failure of input is equivalent to running the valve with zero bias.

H.T. short-circuits are not very common in television receivers; theoretically they can occur in any part of the circuit but in many cases the cause will be an internal short between the anode or screen grid of a pentode valve and the control grid or cathode and is highly likely to be either the pentode section of a PCL83-type of valve or an EF80 when used as a video amplifier.

EF80s in this position tend to break down most readily because in this stage they handle the biggest voltage excursions. While replacement of the valve will immediately remove the short-circuit it is almost always necessary to replace grid and cathode resistors burnt up by the short-circuit.

Heater Chains

Open-circuit heater chains, when not due to faulty valves, are nearly always caused by the double pole mains switch, the breakdown resistor, the thermistor, a bad valveholder or, of course, the fuse and mains lead.

The procedure is to ohms-test each side of the twin mains lead to chassis and the high-voltage end of the breakdown resistor, which is almost always easy to get at. Continuity being proved on both sides of the mains lead we have eliminated both poles of the on/off switch, the fuse and lead itself without having to actually get at anything in the receiver.

Keeping one test-prod on the high-voltage end of the breakdown resistor, test each tag progressively along the component, then test the thermistor by keeping on prod on the breakdown resistor and the other on the heater of the first valve in the chain, usually the rectifier.

If it does appear that a valve may be the cause test the PY81, PY32 and similar high-voltage heater valves first, as of the very small number of valves that do develop open-circuit heaters only a very small minority are of the 6V "E" type.

Where the e.h.t. is present but the screen remains black and only lights up when grid and cathode of the tube are momentarily shorted together this is indicative of a faulty video amplifier or associated component.

Conversely, in instances where it is impossible fully to "kill" the brilliance so that picture brightness level is too high, although this can be due to video stage faults, it is often also due to inter-electrode leaks in the tube itself.

Low Emission Amplifier

In cases where the picture has very little contrast but is free of grain, and where increasing the gain seems merely to make the picture disappear into the raster, it is often found that a PCF80 is used as the video amplifier and that the pentode section of this valve has a very low emission. The incoming video signal to the pentode grid drives it to saturation point and the whole picture "whites out".

Sometimes receivers develop a vision-on-sound buzz without any of the trimming cores being dis-

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PART TWO

A Flying-Spot Transparency Scanner

BY J. G. RANSOME

FURTHER grid bias for the tube is obtained by applying a voltage to the cathode of the tube and is obtained from the slider of VR2. Since this potentiometer has a resistance of 100kΩ the voltage drop across its two fixed ends is 100V and the slider potential thus varies between +3 and +130V with reference to A depending on whether it is at the bottom or top of its run. This provides control of brilliance and satisfies the condition that the grid shall carry between −1 and −100V as specified by the tube manufacturers.

The focus control is VR1 and has a value of 500kΩ which, of course, means that the voltage drop across this control is 500V. Thus the bottom of the control is at +103V and the top is at +603V with respect to A. As can be seen from the tube specifications the focus anode requires between 260 and 470V and this condition is adequately catered for by this value for VR1. The resistance R7 completes the bleeder chain and is required to drop 2,000V, which means a resistance value of 2MΩ. (This could also be arrived at by our original calculation when it was stated that the chain should have a resistance of 2·65MΩ, and since we already have a little over 0·6MΩ in circuit this leaves 2MΩ to find.)

Unfortunately we cannot use a single resistor for this resistance as the maximum voltage which may be applied to a ½W resistor is 600V; so in order to withstand 2,000V we need to use a minimum of 4 x ½W resistors in series and so R7 is made up of 4 x 500kΩ ½W resistors.

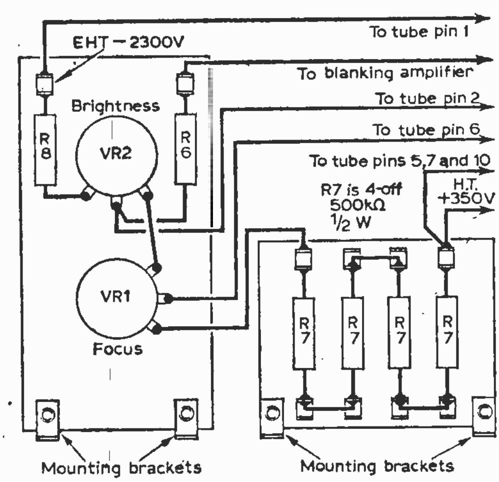


Fig. 8—Wiring diagram of the grid bias network.

The circuit having been designed we must now look at its construction. As has already been mentioned for the power supplies, all components must be kept well clear of earth points to prevent flash-over. The potentiometers VR1 and VR2 must be mounted on an insulated panel as they are some 2,000V negative with respect to earth. The control spindles must be well insulated from the control knobs for the same reason and it is suggested that the control spindles of the potentiometer used be extended with paxolin rods and the control knobs fixed to these extension pieces.

Other than these simple precautions there are no other constructional difficulties. A wiring diagram for the network is shown in Fig. 8.

Testing the Power Unit and Tube Unit

Having checked the wiring, the tube unit should be connected to the relevant parts of the power unit and the X and Y plates strapped together and taken to the h.t.+ line.

With the power supplies on, it should be possible to resolve a spot on the tube face and to focus it. Minimum brightness should be used throughout to prevent burning a hole in the fluorescent screen. It will be found that the focus and brightness controls are interdependent in that as the brightness is varied so the focus will have to be readjusted.

Having completed this test satisfactorily the connection to the X and Y plates should be removed and the next stage commenced.

THE TIMEBASE AMPLIFIERS

Two amplifiers are required, one each for the frame and line timebases, and in every respect the two amplifiers are identical. Fig. 9 shows the theoretical circuit. This is probably the simplest amplifier that can be designed and uses the minimum of components.

The signal from the timebase is taken to the grid of the first triode section of the amplifier V6 (V7), where it is amplified and appears at the anode 180 deg. out of phase with the input signal. However, an in-phase signal appears at the cathode of this triode which is coupled via R11 and R14 to the cathode of the second triode, which causes an amplified in-phase signal to appear at its anode.

We have the situation then that if we have a positive-going waveform at A we have a negative-going one at B, so that if A and B are connected to opposite plates A is "pulling" whilst B is "pushing" the beam towards the plate attached to A.

The potentiometer circuit comprising VR3 and R15 is connected to the grid of the second triode and has the effect of varying the h.t. voltage at B, which deflects the spot. This control is used for centring the trace. The capacitor C7 is used to by-pass any hum voltage that might be present to earth. The anode load resistors R10 and R13 are specified as 47kΩ, but it was found that any value between 22kΩ and 150kΩ was satisfactory.

Construction

The amplifiers should be placed as close as possible to the tube base and Fig. 10 shows the layout of the prototype.

The construction of the amplifier should follow that normally used for a high-gain a.f. amplifier in that precautions should be taken to prevent hum pick-up. The wiring diagram is shown in Fig. 11 and it should be noted that the leads carrying the output to the tube should be twisted together as a further precaution against hum.

Testing

The amplifiers are connected to the power supply and to the tube and their inputs temporarily connected to chassis, using 0·1μF capacitors. The shift controls should be adjusted to first find the spot and then to centre it. In this condition the voltages measured in the prototype with a 20,000Ω/V meter were:

H.T. line 350V.

Anode (pin 2) 200V Cathode (pin 3) 70V
Anode (pin 5) 200V* Cathode (pin 6) 70V*

* These values vary with the setting of the shift control.

It should still be possible to resolve a sharp spot in this condition. If this cannot be done the valves should be removed and if the trouble still persists it means that there is hum pick-up in the output leads and screened wire should be employed here for the output connections. If removing the valves does cause the spot to sharpen then the wiring must be examined and rearranged so that the heater wires and other sources of hum do not pass near the grid connections.

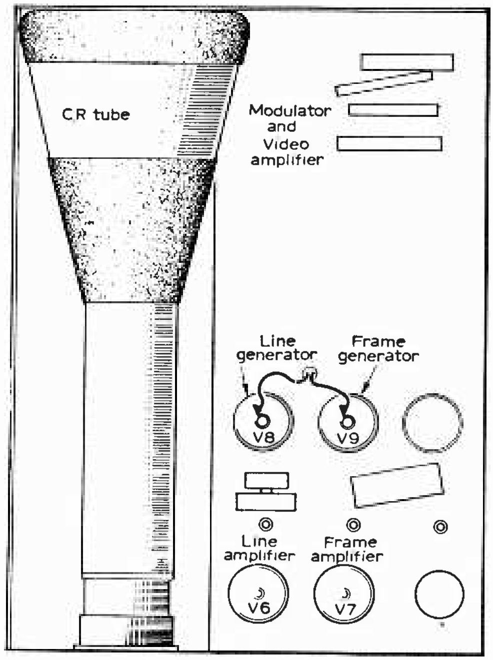


Fig. 10—Layout diagram showing the relative positions of the timebase generators and their associated amplifiers.

When these tests are satisfactory the temporary capacitors connected between the input and earth should be removed and reconnected between the input and pin 8 of their respective valveholders. In this condition it should be possible to draw out on the screen a diagonal line (the actual linearity and shape does not really matter at the moment) and this indicates that the amplifiers are functioning satisfactorily. The temporary capacitor should now be removed.

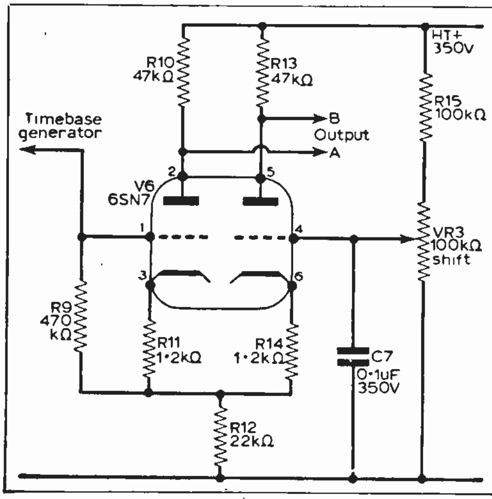


Fig. 9—Circuit of the identical timebase amplifier. Output from the frame amplifier goes to the Y plates; output from the line amplifier to the X plates.

COMPONENTS LIST
LINE TIMEBASE AMPLIFIER (Fig. 9)

Resistors:

R9	470kΩ	R13	47kΩ
R10	47kΩ	R14	1·2kΩ
R11	1·2kΩ	R15	100kΩ
R12	22kΩ		

VR3 100kΩ potentiometer

Capacitor:
C7 0·1μF paper 350V

Valve:
V6 6SN7

FRAME TIMEBASE AMPLIFIER (Fig. 9)

Duplicate of above. For identification purposes, the resistors and the capacitor have the same circuit references but with a suffix (a) in each case. The valve is designated V7.

THE LINE TIMEBASE

The line timebase is shown in Fig. 12 and is constructed around an SP61 (V8), using the familiar Miller integrator circuit which is extremely linear at these frequencies.

The functioning of the circuit is as follows: The anode of the valve is fed with h.t. via VR5 and this anode voltage charges up the capacitor C8, which discharges through R16 and VR4. This discharge, which causes a change in anode current and thus a change in the voltage across VR5, causes the spot to be deflected from the left-hand side of the screen to the right and draws out a line. The time taken for this line to be traced out is called the scan period.

While C8 is discharging, the anode current is increasing, causing the anode voltage to drop (this is section AB of Fig. 13). As the anode voltage drops the screen voltage also drops, since the grid voltage is increasing. However, there comes a time when a further increase in the grid voltage has no effect on the anode current (the valve saturates) and when this happens the screen grid takes a surge of current through R17, causing the screen voltage to drop very quickly.

The screen grid is connected to the suppressor grid via C9 and so this voltage pulse is transmitted to g3. Until this moment the voltage on g3 has been fairly constant and the pulse it receives causes a further current increase in the screen grid circuit. This causes the anode current to cut off.

As the valve cuts off (zero anode current) the voltage drop across VR5 is zero and thus the anode voltage rises to that of the h.t. line and C8 charges up again, commencing a new cycle. Also, as the valve cuts off and reverts to its original state the spot moves rapidly from the right to the left and this action is known as flyback and is the phase of the cycle shown as BC in Fig. 13.

(Referring to Fig. 13, the sharp negative pulses at the screen grid are used for synchronising pulses as explained when we come on to the sync section.)

The variations at the anode are transmitted through the slider of VR5, which acts as the amplitude or "width" control, and the capacitor C10 to the amplifier circuit. The low value of C10 is

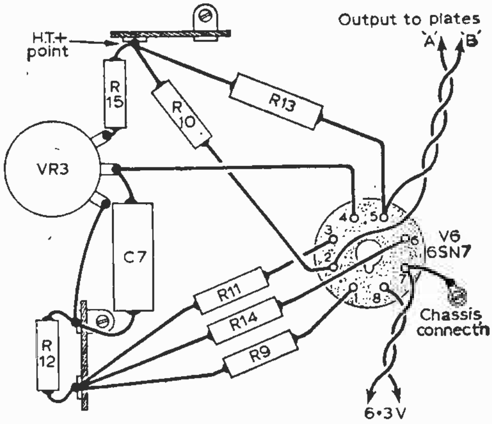


Fig. 11—Wiring diagram of the timebase amplifier.

useful in that it helps to block any mains hum voltages which might be found in the timebase circuit.

Now the speed of discharge of C8 is dependent upon the values of C8, VR4 and R16, the time taken being given by the simple formula:

$$\text{Time (secs)} = C \times R$$

where C is the value of C8 in Farads and R is the combined value of R16 and VR4 in ohms.

For example: If we assume that VR4 is set at 0·543MΩ so that the combined value of VR4 and R16 is 1MΩ and that C1 is 100pF or 1×10^{-10} Farads, the time constant of the circuit is $1 \times 10^{6} \times 1 \times 10^{-10} = 1 \times 10^{-4}$ sec. (0·0001 sec.) and this is the scan period.

This means that the oscillation frequency is

$$f = \frac{1}{0{\cdot}0001} \text{ or } 10{,}000 \text{ cycles per second.}$$

This value is not far away from the timebase frequency required which is the same as that used commercially, namely 10,125c/s, and the actual value can be obtained by varying VR4. This

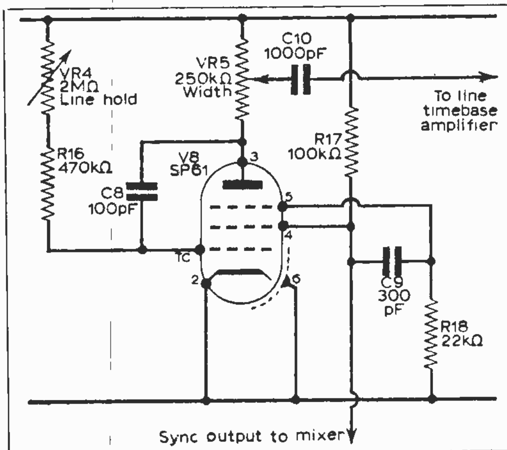


Fig. 12—Circuit diagram of the line generator. For the wiring diagram refer to Fig. 14.

COMPONENTS LIST
LINE GENERATOR (Fig. 12)

Resistors:

R16	470kΩ	R18	22kΩ
R17	100kΩ		
VR4	2MΩ	VR5	250kΩ

Capacitors:

C8 100pF, C9 300pF, C10 1,000pF — ceramic or silver mica

Valve:

V8 SP61

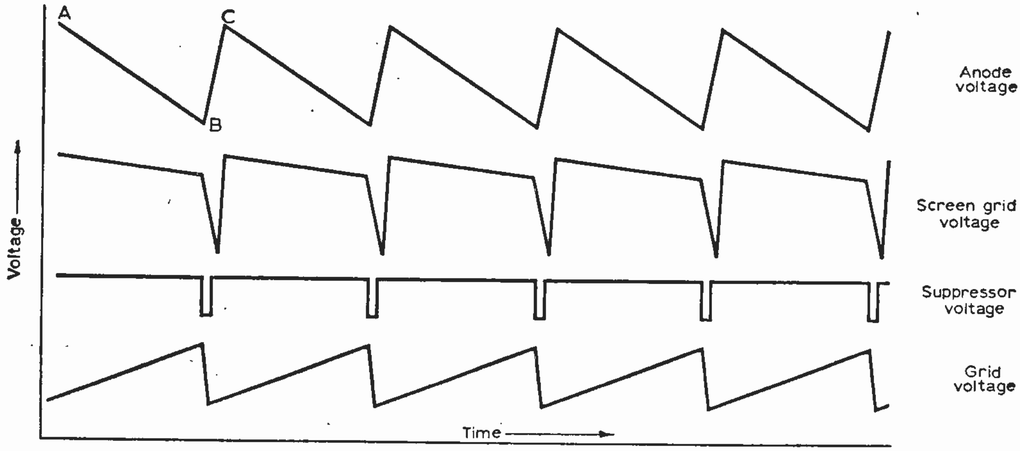


Fig. 13—Electrode potentials in the line timebase generator.

potentiometer is thus the frequency or "line hold" control.

Unfortunately the above expression does not give us the exact time for each line since we have to add on the flyback time, but since the flyback time is small compared to the scan time the above formula is a good approximation, any error being well catered for by the value of VR4, which is higher than calculation would suggest.

Construction

A wiring diagram of the timebase is shown as Fig. 14. The grid connection should be made off, using screened cable, and all connections to this part of the circuit should be as short as possible. The capacitors C8 and C9 must be of the highest possible quality and so, to a lesser extent, should C10. Other than these few considerations there is nothing special in the construction of the circuit.

Testing

The unit should be attached to its amplifier (that connected to the X plates) and taken to the relevant power supplies. When the valve has warmed up a line will be traced on the face of the tube and a high-pitched whistle will be heard from the valve (this is not such a reliable test as the visual one as the whistle may be outside the normal hearing range of some). It will be found that the length of the line can be varied by use of VR2 and a full screen width trace should be obtained.

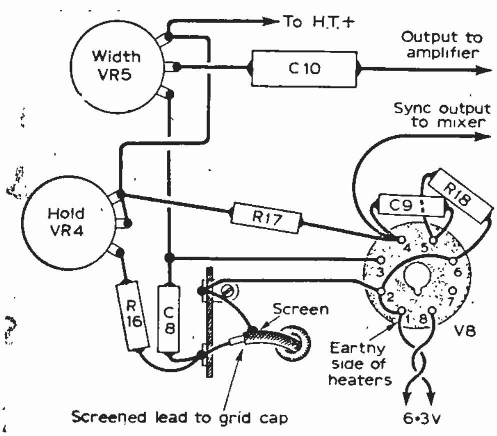


Fig. 14—Wiring diagram of the line timebase amplifier.

With a full screen trace the test voltages in the original were:

H.T. voltage 350V
Anode voltage 80V
Screen voltage 100V

measured with a 20,000Ω/V meter.

Should this not be so the circuit should be checked for correct wiring and especially for dry joints, which can play havoc in this type of circuit.

THE FRAME TIMEBASE

The frame timebase is shown in Fig. 15 and is identical, save for the component values and the resistor R22, to that of the line timebase.

At low frequencies the Miller circuit is not very linear, but in this type of circuit this is only of minor importance. The time constants of the frame generator are calculated for a repetition frequency of 50c/s—this means that the scan time for one cycle is 0·02 sec. Using the same formula as before we find that if we make C=0·01 then R must be 2MΩ. This means that since R19 is 470,000Ω the value of VR6 must be about 1·5MΩ and this is satisfied by the value assigned to this component.

The resistor R22 connected to the heater line allows a low voltage a.c. signal to reach the suppressor grid of the timebase generator, and when the oscillator is running at the correct speed the negative-going half of the a.c. voltage arrives at g3 at the same time as the pulse from g2 and locks the oscillator to the mains frequency. Not only does this mean that the frame timebase is frequency stable, but it ensures that any hum which

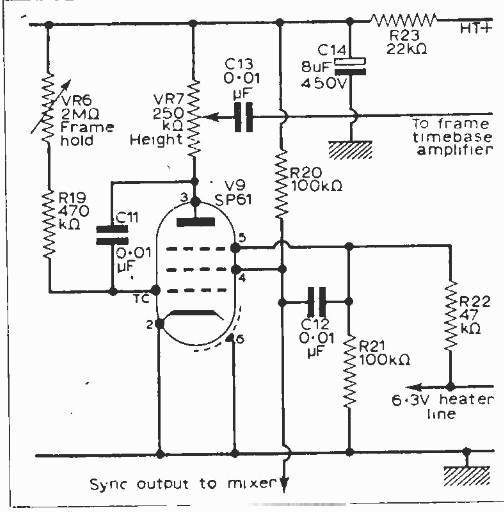


Fig. 15—Circuit diagram of the frame timebase generator. It is important to ensure that all capacitors are of the highest quality. An SP61 is specified in view of its cheapness, but equivalents may be used.

COMPONENTS LIST
FRAME GENERATOR (Fig. 15)

Resistors:

R19	470kΩ	R22	47kΩ
R20	100kΩ	R23	22kΩ
R21	100kΩ		
VR6	2MΩ	VR7	250kΩ

Capacitors:
C11 0·01μF paper
C12 0·01μF paper
C13 0·01μF paper
C14 8μF electrolytic 450V

Valve:
V9 SP61

might appear at the frame timebase anode is cancelled out, eliminating annoying hum bars which could mar the trace and give an "underwater" effect.

The combination R23 and C14 decouples the generator from the h.t. line and prevents interaction between the two timebases.

Construction

The construction follows exactly the same pattern as that for the line timebase with the exception that the extra resistor R22 is wired from pin 5 to pin 8. No separate wiring diagram is given, therefore, as Fig. 14 will serve this purpose.

Testing

With all the circuits connected up and running it should be possible to show a television-type raster on the screen the height of which can be varied by VR7 of the frame timebase circuit. The circuit should be adjusted for a full screen picture. Under such conditions these test voltages were measured in the prototype:

Voltage at C14	330V
Anode voltage	70V
Screen voltage	95V

these measurements being made with a 20,000Ω/V meter.

The complete scanning unit should now be adjusted for the brightest, finest focus trace; and this done the first phase has been satisfactorily completed.

Continued next month

INSTANT DIAGNOSIS

—continued from page 206

turbed, and in such cases one often finds a diode-pentode EBF80 in the sound strip, which when replaced completely cures the fault. It would appear that when ageing some of these valves develop grid current, which acts as a resistor paralleled across the sound tuning circuit and flattens its response to incorporate some of the vision signal.

If any of the valves controlled by the contrast potentiometer or the a.g.c. line develop appreciable grid current it will inhibit the range of the control and often cause it to give peak gain at a point well below the maximum setting.

Up to a point negative a.g.c. or control voltages swamp the positive grid current and still leave the control grid negative, but when reduced too far by advancing the gain the grid or grids run slightly positive and the gain falls off.

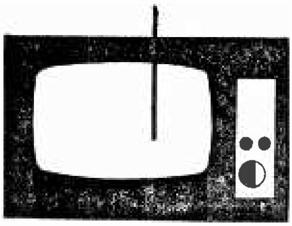
If the triode grid of a triode-pentode sound amplifier is directly coupled to the volume control, and due to age develops even a slight current, it will make the volume control seem particularly noisy.

Many television defects are immediately discernible on the screen, faults like lack of sync, poor definition, open-circuit scan coils and poor linearity, but it will be seen that there are many faults that can be pinpointed almost immediately with little or no meter tests and with only the broadest indication on the screen.

One final point. When confronted by a strange receiver in which there may be a number of ECL80s, PCF80s or PCL82s and it is necessary to find out the function of any one, instead of pulling out any one haphazardly and possibly causing a surge in the heater circuit, contact the control grid of each with a low-reading voltmeter or with an earthed small value capacitor and the effect will immediately be observed without putting any strain on the heater-cathode insulation of any valves in the chain. ■

A MONTHLY COMMENTARY

Underneath the Dipole



BY ICONOS

INTEREST in the live theatre has revived a little and new theatres are being planned and built in various parts of the country. These are mainly sponsored by local authorities, usually with additional grants from the Arts Council. and in some cases with financial aid from one or other of the ITV programme companies. Repertory theatres do not always provide actors with a lush standard of living, but experience gained in them is regarded as an essential post-graduation course, and a qualification for the bigger prizes of principal parts in theatrical, film or television productions. Achieving fame and fortune in these fields is not subject to the luck of the draw, which often comes the way of pop singers and guitar strummers. The young men and women with flame in their eyes, fire in their bellies, and vocational theatrical ambitions, have to work just as hard—or even harder—then their stage-struck grandparents—by training at such drama schools as the Royal Academy of Dramatic Art, the London Academy of Music and Dramatic Art, and the Central School of Speech Training. A close watch on all of these sources of potential talent is kept by scouts from the BBC and Independent Television companies, who sometimes aid the most promising young actors by facilitating the final stages of their training in the smaller repertory companies.

Bricks and Mortar

Television companies do more than provide financial aid to these repertory theatres and clubs, to keep them out of the "red" in their week-by-week or seasonal budgetting. They provide solid financial aid to many dramatic schools together with annual awards of various kinds. At the other end of the scale, they give considerable financial support to the very large sums of money now required to construct new theatres, to modernise old ones, and to provide the specialised equipment necessary for modern production.

The theatre of today is no longer the chancy stereotyped auditorium of sixty or so years ago, when local architects and builders would be called in to design and construct auditoria which were chiefly notable for their elaborate ornamental embellishments, their haphazard seating arrangements, with poor sight-lines in front of the curtain, and complete lack of comfort and reasonable accommodation behind.

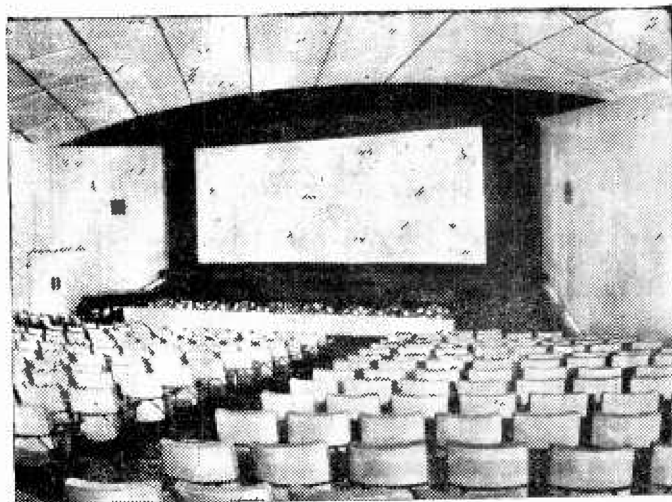
Acoustics

Of course from the acoustic point of view, the traditional grandiose internal decoration, plaster designs, pillars, alcoves and such-like, had their advantages. The complicated reflection surfaces broke-up and diverted the sound in a thousand different directions, which often resulted in enhanced musical timbre. and at the same time amplified the human voice. A few professional theatrical architects acquired a kind of instinct for achieving just the right kind of reverberation, the most notable one being Frank Matcham, designer of the London Hippodrome, Coliseum, Wood Green Empire and dozens of music halls—nearly all, alas, now demolished. But there were many theatres with poor acoustics, with dead spots, reflective domes, whispering galleries, riccochet echoes on the one hand and insufficient sound insulation against the noise of its own plumbing and outside traffic. The acoustic principles laid down by Sabine were then regarded mathematic hocus-pocus. Heating and ventilation problems were dealt with as troublesome afterthoughts.

Theatre Design Today

The theatre architect of today has a much more difficult job to do. Contemporary taste favours functional design, with plain, bare walls. Every seat in the house is expected to have a clear and comfortable view of the entire stage. The exits must be more than adequate and conveniently sited for statutory reasons. The ventilation must be continuous, noiseless, warm in winter, cool in summer—and the inlet air must be cleaned. The stage must be capable of dealing with a variety of presentations, particularly in provincial towns, where, to keep the theatre fully occupied all the year round, it should be capable of accommodating traditional theatrical presentations, theatre-in-the-round, variety, boxing and other sporting events, cinema seasons, and—of course—television.

Television's influence in this respect has made itself felt in many new theatres. At Plymouth, for instance, the new small Athenaeum Theatre was built at the same time as the neighbouring premises of Westward Television, and largely on this account, it was fitted with a stage revolve, first-class lighting, and an "orchestra lift" which could form a useful 8ft apron extending into the auditorium. Permanent ducts are provided from Westward to the Athenaeum stage, and also the projection box at the back of the stalls for camera, sound, communication and monitor cables. The example of the owners of the Athenaeum, the Plymouth Institution, in having the foresight to provide these facilities, is one which I hope will be copied in the many civic theatres now being constructed. The modern facilities of the fine multi-purpose theatrical buildings at Chichester, Nottingham, Derby, Coventry and Eastbourne, are the pride of these towns. I am not at all sure that many of them have made preparations for the accommodation of television or film cameras. One has heard of very important auditoria in London being built without a projection box for films or slides, and having to patch it on in a make-shift way afterwards. These are points which Denys Lasdun, the architect appointed to the proposed South Bank Theatre and Opera House, is likely to watch with care, integrating many of the facilities with those of the adjacent National Film Theatre. At least, that is what I hope for.



Interior of the National Film Theatre (venue of the Festival of World Television) as arranged for Cinemascope projection. See page 204.

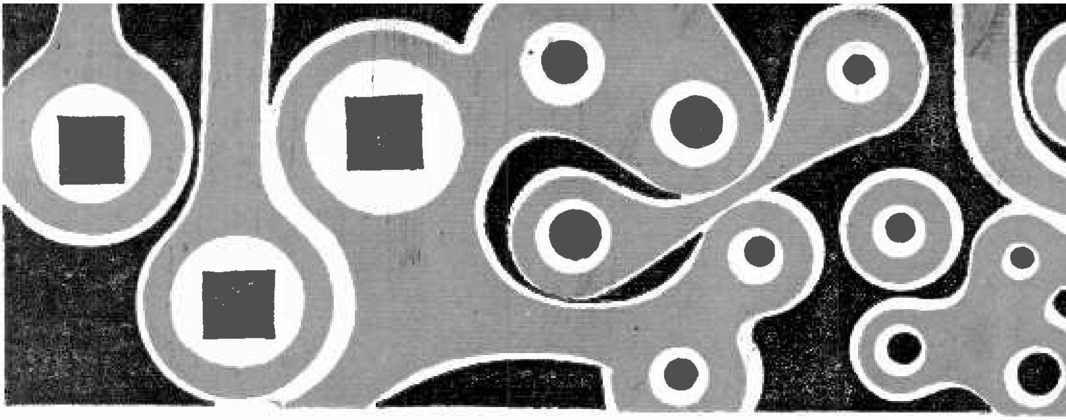
Sound on Commercials

Have you noticed the bite the recordists manage to inject into the sound of television commercials? It has, they say, clarity and volume which is far superior to the sound on live and taped television, or, for that matter, on cinema films. In this case, "they" are the advertising agencies and the makers of TV commercials who are speaking. Substitute the same actual advertising dialogue, but recorded with the frequency characteristics, compression and diction normally used in these other media, and you would probably agree. It sounds terrible. Sloppy diction, throwaway dialogue, and excessive reverberation applied to a TV commercial picture are just *not* acceptable, but are perfectly satisfactory for drama.

The sound balancers in TV drama take a very jaundiced view of the methods and the results achieved by their colleagues in the commercial field, an attitude which is reciprocated. Film recordists don't hold with the mehods of either, preferring to cut a large amount of bass and to apply a considerable amount of compression. This is in order to counteract the effect of excessive reverberation in cinemas, and the loss of quietly spoken words or whispers by the ambient noise of the cinema audience shuffling in and out during continuous performances, the munching of sweets, and the holding of conversations. Lose the audience's attention for a few minutes, you have a dozen conversations starting up in various parts of the house. Horses for courses! The go-ahead sound department of the Independent Television News prepared a special dummy commercial as an example of what could be done by the more moderate use of compression, lower modulation and less hysteria. I thought it was a good compromise when I saw it about a year ago. It is high time that this ingenious educational film clip was re-circulated to all persons involved in making TV commercials.

Jungle Noises

TW3 has finished, but its shrill jungle noises linger on. "It was as a pillar of the Establishment that I yielded to the Fascist hyenalike howls to take it off!" said Mr Hugh Carleton Greene, Director General of the BBC. He was joking, of course—or was he? Anyway, as a so-called Fascist hyena (which I am not) I strongly object to the braying young jackasses in this and other BBC programmes being given a free-hand to ventilate their destructive opinions. Power has been wielded without responsibility. It is high time that the BBC programme people put their part of the house in order. If they were only a quarter as good as the brilliant engineering side, the organisation might regain its lost prestige. After reading the complaints of Scottish civic dignitaries about alleged misrepresentation in "*Panorama*", I have been thinking that it is time for some of the programme people to be given their cards and coppers, or to be seconded to a jungle TV station amongst real hyenas and jackasses.



ONE of the biggest problems in the construction of small items of television equipment, particularly when very-high frequencies are involved as in pre-amplifiers, channel converters, and carrier generators to enable closed-circuit TV to be displayed on commercial sets, lies in keeping inductive and capacitive circuit strays to the very minimum.

Longer-than-necessary circuit connecting wires and flimsy chassis assemblies not only give the equipment the stamp of the non-professional but they also impair the performance to a greater or lesser degree. The commercial and professional solution to both of these problems is the printed circuit board. In addition, the original printed circuit drawing can serve as a "negative" for the subsequent reproduction of the item of equipment. This attribute is not very important so far as the experimenter is concerned, of course, since he is usually interested in just one (or sometimes two) reproduction.

Nevertheless, this should not deter the experimenter, for it can often prove less costly to make a single printed circuit board than the more conventional metal chassis assembly. Anyway, making a printed circuit board is far more exciting than using the old chassis technique; moreover, the finished item will often work better than a chassis-made partner and, at the very least, look much better!

Experimenters are often loth to try their hand at printed circuit board making, thinking that there is something weird and wonderful about it, and that it is well outside their sphere of activity. Generally speaking, there is less mechanical complexity in producing a printed wiring board than a fully-fledged chassis assembly. The biggest problem is in translating the theoretical circuit to the printed circuit "pattern"; but before we consider that side of the exercise let us look briefly at the way a board is produced.

Basic Construction

The foundation usually consists of a laminated thermo-setting plastic sheet with copper foil securely bonded to one or both sides. The simple board in which we are at this stage interested has the copper bonded only to one side of the plastic.

Upon the thoroughly cleaned copper surface is "drawn" the printed circuit pattern, in such a manner that each line or area drawn remains in copper on the finished board. The copper which is not required in the finished circuit is deleted by an etching process. The circuit must thus be drawn with an "ink" or other substance which has the power of resisting the etching solution, so that the copper upon which there is no "ink" or drawing is dissolved.

The "ink" which is used to make the drawing is, for obvious reasons, called the "resist", while the solution used to dissolve the copper is called the "etchant".

Home printed circuit makers simply "paint" the resist on to the copper in accordance with a preconceived pattern of the printed wiring, the resist being coloured dark to facilitate this process. A

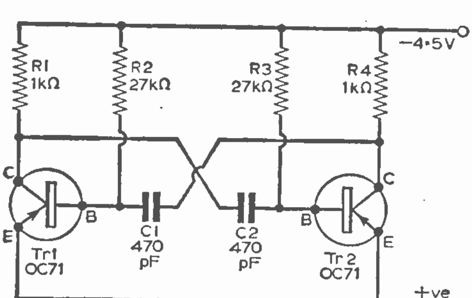


Fig. 1—Transistorised 5kc/s multivibrator circuit used as a basis for a printed circuit board design.

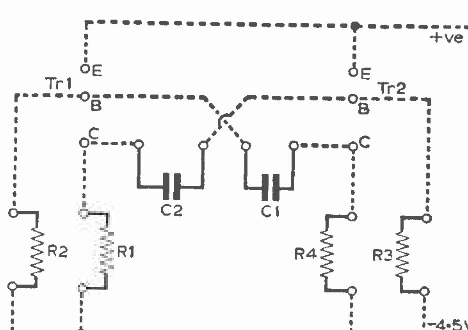
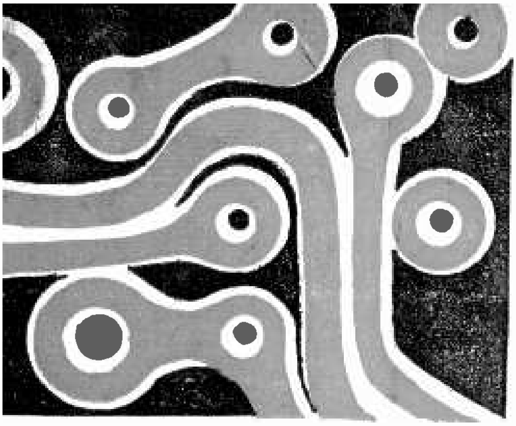


Fig. 2—First stage towards the production of a master circuit for printing.



MAKING PRINTED CIRCUIT BOARDS FOR TV EQUIPMENT

BY K. ROYAL

good home resist is either black cellulose paint or coloured shellac. Commercially, photography or other form of "pattern" printing, such as by silk screen, is employed, as here the emphasis is on reproduction in terms of exact replica of the original.

Complete Project

With these basic factors in mind, we are now ready for our first complete printed circuit board project. A television device which may well be developed in this way is shown in Fig. 1. This is the circuit of a multivibrator using a pair of transistors instead of valves, and could be used in a transistorised television receiver or closed-circuit camera. It could also be used as a signal generator,

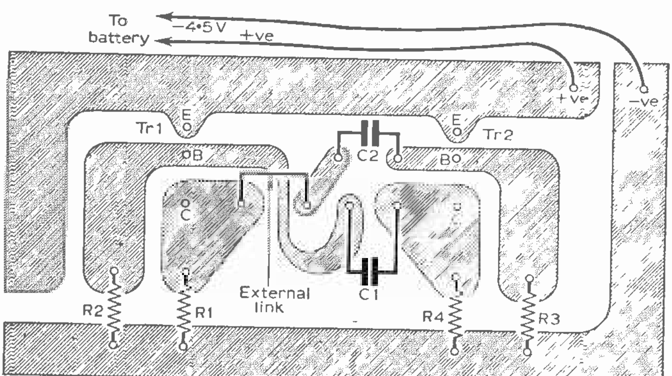


Fig. 3—The final printed circuit master pattern. Compare with Fig. 1 and Fig. 2.

as the output is fairly rich in harmonics, in conjunction with the "signal tracing" technique.

The component values selected will give a pulse repetition frequency in the order of 5kc/s, so apart from serving as a printed wiring board exercise, the finished item of equipment will also be useful to the experimenter. There is no need, of course, to employ this circuit for the exercise, for the following text will explain how any circuit can be translated to a printed circuit pattern.

From now on the exercise is one of logic, it being necessary to change the theoretical circuit to copper lines and areas on a plastic board, with holes drilled to accommodate the component connecting wires.

The aim should be to arrange the circuit for (a) the shortest possible connecting distance between components (all components) and (b) to avoid cross-over wiring as much as possible. A simple circuit as in Fig. 1 does not take very long to change into a printed wiring form, but more complicated circuits require much doodling and scrap paper before a satisfactory pattern is achieved. Large firms and manufacturers who deal extensively in printed circuits have their own drawing offices and art departments to take care of this translation business. Smaller firms (and even some experimenters) utilise the drawing and prototype facilities offered by firms specialising in the production of printed circuits.

After a reasonable amount of doodling on scrap paper has revealed the basic pattern, a first stage final pattern can be drawn on 0·1in. square paper, giving something like that shown in Fig. 2. This, at least, gives the layout of the components and shows that there is one crossover connection (C2 to base of TR2). It is not easily possible, of course (without using both sides of the plastic), to cross connections on printed circuits, which means that an external "jumper" link will have to be employed here.

From Fig. 2 an exact-size "master drawing" must be prepared, as shown in Fig. 3. Again this is best done on 0·1in. graph paper. The positions of the component fixing holes should be accurately marked by small circles, as shown on Figs. 2 and 3. Symmetricity should be the aim when marking the holes, for a finished job lacks glamour if the components are at various angles and out of line with each other.

From Fig. 3, it will be seen that the connections between the various "holes" are not necessarily straight thin lines. There is no point in dissolving unnecessary copper just for the fun of it, and the more area of copper retained the better the adhesion to the plastic. Where possible, it is also a good idea to retain a copper edge to the board, broken only where the circuit demands. These points are clearly revealed in Fig. 3.

continued overleaf

Transferring Drawing to Copper

The next step, after being absolutely happy with the finished master drawing, is to transfer the drawing on to the copper side of the laminate. But before this is attempted, the copper must be thoroughly cleaned as a pre-requisite to the etching process. It is essential that the etching solution makes intimate contact with the copper that it is required to dissolve, and that can happen only if the copper is very clean. Even grease from the fingers can cause the etching solution to form in small blobs on the copper and thus detract from the efficiency of the etching process.

One of the domestic cleaning powders can be used to clean the copper, and "Vim" has been successfully employed by the author. After the copper has been brought up really bright by hard rubbing, it should be thoroughly washed in running warm water and then allowed to dry.

There are two methods of transferring the drawing to the copper, one is by outlining the conductors via carbon paper on to the copper, and the other is by hand drawing a copy of the master on to the copper. The former method is not all that simple, especially if the printed board is on the small size. However, if it is adopted, the master drawing is best made of tracing paper. The direct drawing method is not as difficult as it may first seem, and could easily be used for the exercise in hand.

In any case, the master should be placed over the laminate board—which should now be cut to the correct size and the edges filed smooth—and the positions of the holes impressed upon the copper side with a scriber or similar pointed tool. Note that the holes are not actually drilled until after the etching, but indicating their positions at this stage facilitates the accurate transfer of the master drawing on to the copper, especially when the direct drawing method is adopted.

Applying the Resist

The outline of the conductors is transferred on to the copper and the area between is eventually filled in with the resist. The coloured resist should, in fact, cover the copper in exact accordance with the shaded parts of Fig. 3. A water-colour brush of good quality is best employed to paint on the resist solution, and this should be made reasonably thick to avoid runnng on to the parts of the copper which require etching.

If shellac is used, about $\frac{1}{2}$ oz. of the crystals should be dissolved in 3 to 4 oz. of methylated

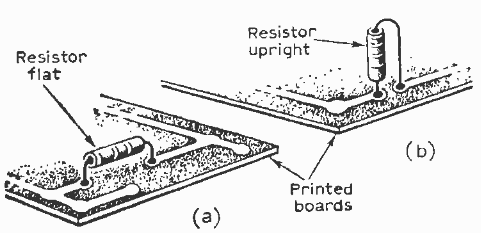


Fig. 4—Methods for mounting the components upon the printed board.

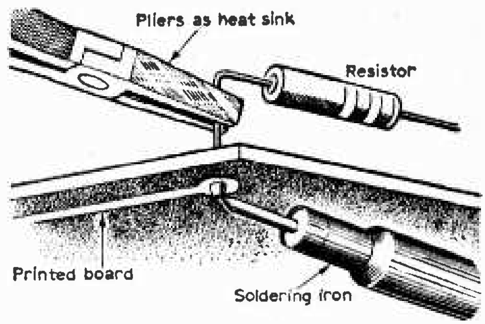


Fig. 5—Prolonged heat must not be applied to the component when soldering, and it is essential to use a pair of pliers or other suitable tool as a heat sink.

spirits overnight, and a little dark-coloured spirit dye can be added as required to make the solution more visible when applied.

Extreme care is needed to apply the resist and to ensure a good line definition on the finished board. Always remember that only the parts not covered are those which are to be dissolved (e.g. etched away). If a mistake is made it is best to reclean the copper and start all over again; some authorities recommend cleaning only the error from the copper with a resist solvent, but the author has always found that some resist remains and the etching process around the corrected area is considerably retarded or made impossible.

Home etchers should, where possible, give at least $\frac{1}{16}$in. clearance between conductors as a tolerance for "painting" errors. It should also be noted that $\frac{1}{32}$in. holes are necessary to carry one typical component wire, while $\frac{1}{16}$in. holes are required to anchor several wires at one point. The conductor at the point where the hole is later to be drilled should thus have adequate copper to cater for the hole and to give a reasonable area of copper around it.

The Etchant

The etching solution consists of 4oz. of ferric chloride dissolved in 6oz. of water with 1oz. of hydrochloric acid or commercial spirits of salts added. It must be noted that this etching solution is poisonous and, if splashed into the eyes, could impair the eye-sight. In this event, the eyes should be thoroughly washed with warm, clear water and a doctor or hospital consulted.

The solution, which is deep orange in colour is additionally highly corrosive and should be kept in a clearly marked bottle well away from children and food.

A suitable quantity of the solution should be poured into a shallow, plastic dish, of the kind used by photographers. and the "painted" laminated board immersed in it. To accelerate the etching process the solution should be agitated by gently rocking the dish or, alternatively, a suction cup

—continued on page 224

A CLOSED CIRCUIT TV *Camera*

By E. McLoughlin

PART FIVE: THE SCAN CIRCUITS

CONTINUED FROM PAGE 180 OF THE JANUARY ISSUE

THE frame timebase oscillator is in the form of a blocking oscillator. At the low frame frequency (50c/s) this form of oscillator is the simplest and most stable among the various types. At the much higher line frequency (approximately 15·6kc/s) a blocking oscillator would be less satisfactory as it does not then permit waveform shaping in the same reliable manner as possible with more suitable arrangements. Thus a pure sinewave oscillator, using a conventional resonant LC circuit, is used in a cathode coupled Hartley circuit as line timebase oscillator.

The frame oscillator drives the output stage directly, both triodes being contained together in a single envelope (V11, ECC82). For the line timebase two shaping stages are interposed between the line oscillator V10 and line output stage V9.

Magnetic Scan

When using magnetic deflection the *current* in the scan coils must rise linearly and fall back to the starting value during flyback, whereas the voltage waveform across the scan coils is of secondary importance.

The frame coils are wound with many turns of fine wire. The d.c. resistance is 168Ω and the inductance is 50mH, having an inductive impedance of only 180Ω at 50c/s. It is thus clear that the resistive portion is predominant and the required voltage waveform is very nearly a sawtooth.

The line coils have only 4Ω d.c. resistance, but 1mH inductance, having an inductive impedance of nearly 100Ω at the line frequency. This means that in this case the resistive component is small and the inductive component predominant; the required voltage waveform is very nearly a pulsed square wave.

An important feature of the voltage waveform across the line scan coils is the well-defined positive pulse during flyback, due to the predominance of the inductive square wave. This pulse is usable directly as video blanking pulse (black-level blanking) on the vidicon during line flyback.

In the already published camera head circuit we accordingly saw that this blanking pulse was coupled from the line scan coils to the cathode of the vidicon tube internally in the camera unit.

A similar arrangement internally within the camera is unfortunately not possible to achieve blanking during frame flyback because the frame scan voltage waveform possesses no well-defined flyback pulses. Frame flyback pulses must thus be obtained from a different point in the circuit, in fact from the frame oscillator, and suitably shaped. This is the function of V12, pins 6, 7, 8 (Fig. 17b), the amplified frame blanking pulse for the vidicon being fed out at coaxial socket P3, together with the variable d.c. grid bias voltage for beam current control corresponding to the brilliance control voltage on a receiver tube.

The Frame Timebase Oscillator

The right-hand half of V11 is a blocking oscillator designed to run at 50c/s and sychronised rigidly to the mains frequency by returning the cathode to the heater line instead of to chassis. The circuit may be considered as being an ordinary grid-tuned oscillator with reaction (T2), the tuned circuit being T2 and C26.

Frame Drive Ramp

The anode waveform of the frame timebase oscillator consists of virtually nothing but rough square pulses during flyback (brief half-cycle oscillation). An additional resistor is included in series with T2 as anode load (R26), the flyback pulse being developed across this resistor. However, the main function of R26 is in a different sense, it being the charging resistor through which C23 attempts to charge up to the positive voltage selected on VR3.

During each flyback, when the blocking oscillator is briefly conducting, the valve is heavily cut-on and virtually short circuits C23 (ignoring R25 for the moment), thereby removing any charge C23 may have. As soon as the blocking oscillator valve cuts off again, C23 starts to recharge through R26 on the time constant represented by the product of these two component values, i.e. one eighth of a second.

This is very much larger than the period of one frame, so that only the small linear initial portion of the charge exponential is completed before the blocking oscillator cuts on again and discharges C23. We thus have one of the simplest basic sawtooth timebase generators, employing a capacitor and resistor, with a class-C operated valve periodically discharging the capacitor. This arrangement is often referred to as a ramp-circuit, to emphasise the sloping "ramp" form of the sawtooth.

The actual waveform across C23 and R25 is a sawtooth ramp with superimposed anode pulses of the blocking oscillator. This ramp waveform is used to drive the left-hand portion of V11, the frame output stage. This is biased such that the flyback pulses cut it off, and the sawtooth component drives it linearly to maximum current.

Frame Output Stage

The frame output stage thus functions as linear Class B sawtooth amplifier, with an almost perfect sawtooth voltage output in the anode circuit. The use of negative feedback (R19, C24) and the linearising resistor R25 make this voltage sawtooth of the optimum form as required for linear sawtooth current in the frame scan coils. T3 merely serves as impedance matching transformer in the usual manner. C22 and R20 critically damp the inductances of the frame scan output circuit and so prevent "ringing".

Frame scan amplitude is varied by altering the amplitude of the frame drive ramp. This is achieved very simply by varying the aiming voltage of the charge process for C23, by means of VR3.

No changes at all are required for the frame oscillator and output stages if intending to build the equipment for 405-line operation.

The Sync and Blanking Mixer

V12 serves the function of establishing frame blanking pulses for the vidicon grid, which we saw could not be obtained from the frame scan coils, and tapped off from the anode circuit of the frame blanking amplifier and are also applied to the grid pin 7 via C30, R40 and the biased hold-off diode D2 preventing passage of line pulses to P3.

In the absence of line and frame pulses, V12 anode pin 1 is conducting heavily, as virtually all grid bias for the valve is absent. The anode current is limited to just over 5mA, by R1 on line Pink A in the h.t. supplies and by the characteristics of V12. This current is drawn through the common and very small cathode resistor of V12 pin 3 and of V6 pin 7 in the video amplifier (Fig. 16). Line and frame pulses cut V12 off at pin 2 for their duration, so that just over 5mA of current temporarily vanish in R80. This represents a low-impedance negative pulse of precisely 100mV amplitude injected into the video amplifier at V6 cathode pin 7.

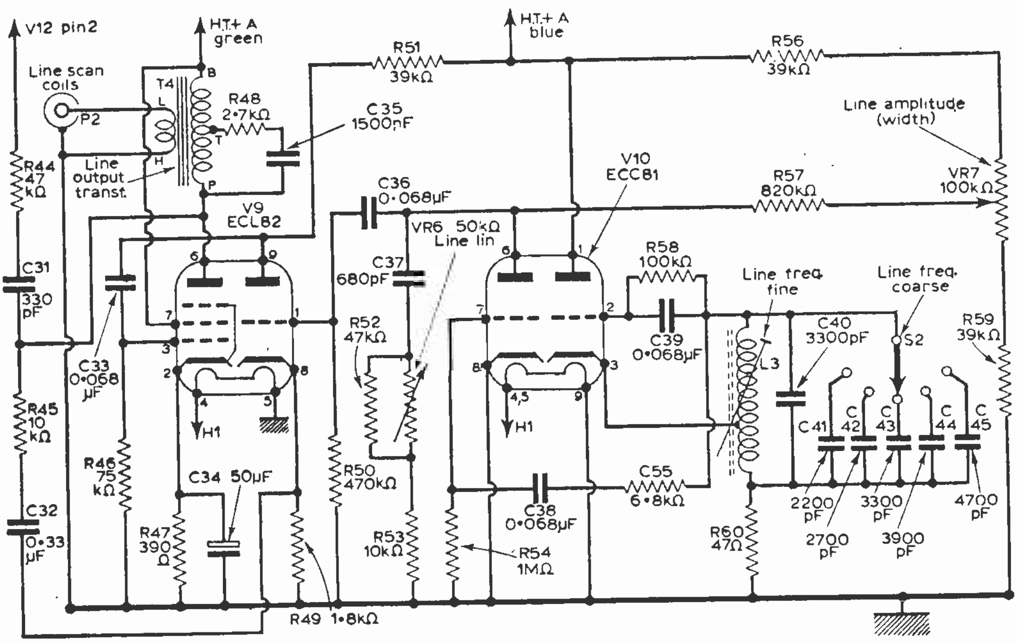


Fig. 17 (a): The line scan circuit.

it also combines line and frame pulses for simplified addition to the video waveform as sync pulses for receiver and monitor.

D1 is biased at the cathode such as just to remove the black band at the bottom of the frame, and the additional positive pulse from T2 coupled in to V12 pin 7 via C27 and associated resistors, giving an excellent frame blanking pulse in the anode pin 6 circuit of V12.

Sync Pulse Addition

The right-hand triode of V12 serves the function of sync pulse injector for the video amplifier. The arrangement is a zero-bias current-diversion cathode follower. Negative line flyback pulses are applied to the grid pin 2 via C31 and R44 from the line output transformer, and frame blanking pulses are

As a result, sync pulses of the same negative polarity and, at normal setting of VR8, 500mV amplitude, appear in the anode circuit at V6 pin 6, and are transformed to lower impedance by the cathode follower V6 pins 1, 8, 9 and passed to the video output socket P7 and the modulator V7.

Receiver Sync Separator Stability

The sync pulses should normally have some 30 to 45 per cent of the amplitude shown by maximum picture content. Otherwise the sync separators in the receivers are unable to function properly, giving either poor lock or "vision-on-sync" resulting in wavy verticals varying with picture content.

All traces of the latter fault are, of course, difficult to remove with the very simple waveform generator adopted in the present basic equipment, but very reasonable performance is achievable, once the factors involved are understood, and adjustments are made properly and carefully.

If a receiver is connected via the r.f. output from P8, the ultimate criterion during 625-line operation is chiefly that of obtaining correct modulation depth due to the sync pulses alone, regardless of the vision component. D6 in the tuner restores the composite waveform such that the sync pulses give maximum carrier amplitude. The black level should then give about 60 to 75 per cent of this carrier amplitude.

Since, with video input at P6 removed, the equipment will be running at black level for most of the total time, the best check is that the output at P8 should be (with P6 removed) about 60 to 75 per cent of the value obtained when R80 is temporarily shorted (r.f. valve-voltmeter, wave-meter, absorption wavemeter setting of grid-dip meter).

Note that such checks must be made *after* completion of tuner neutralisation procedure already discussed under the tuner heading.

In the case of 405-line operation, with modifications to tuner and video amplifier already described, a different method of checking for correct sync modulation depth is required. Assuming that neutralisation and adjustment described under the tuner heading for this case has been completed, approximately correct sync modulation depth is present if simultaneous shorting of R80 and decrease of 405-line value of R98 by 1kΩ causes no significant change in the reading of a wave-meter connected at P8, under conditions where P6 is disconnected from the camera.

If the modulation depth for the sync pulses is found to be incorrect, and a correct setting cannot be found within the range of adjustment of VR8, then the value of R80 must be adjusted until the test conditions are satisfied with VR8 at approximately mid-way setting.

Line Sync Stability

The three camera controls (Focus, Beam, Target) must be adjusted, apart from considerations of good contrast and brilliance, for establishment of minimum vision-on-sync on the receiver, i.e. for straightest verticals. Some receivers will be more critical than others in this respect, but the conditions for optimum image contrast and brilliance generally coincide with best sync stability too; no serious difficulties were experienced with the prototype except for the need to get accustomed to making exact adjustments to all controls and knowing the function of each.

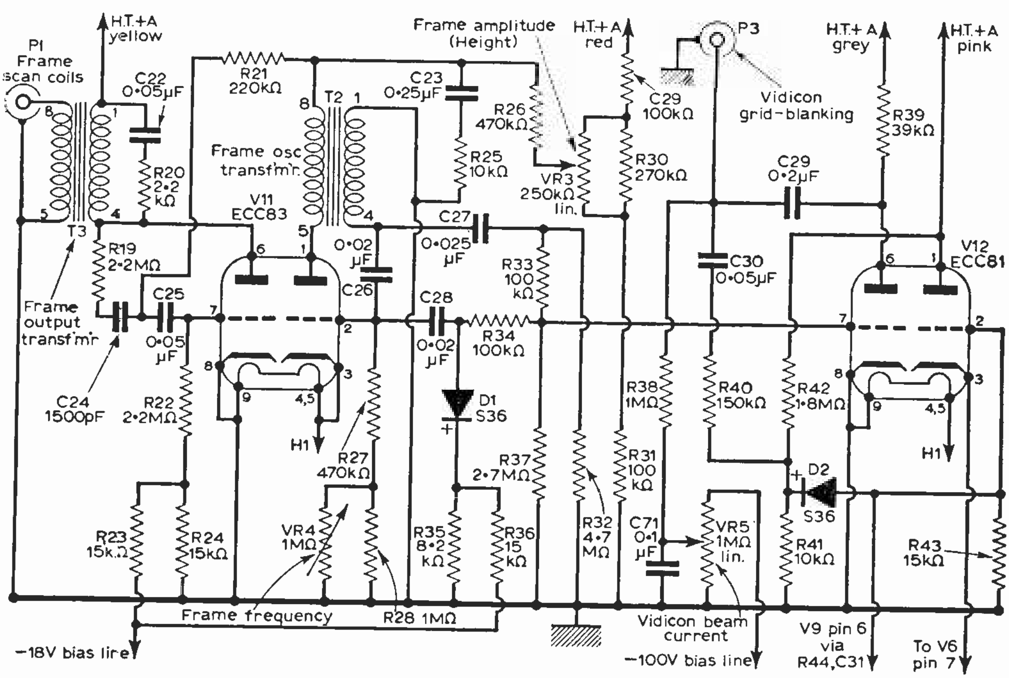


Fig. 17 (b): The frame scan circuit.

A monitor running off P7 and taking sync signals from P1 and P2 over a differentiating circuit is, of course, absolutely free of all vision-on-sync troubles.

In rare cases of severe difficulty, it can help to mask a small portion of the top of the scanned raster on the vidicon target mechanically, by means of attaching a narrow cardboard vane to the target-exterior glass surface on the face on the tube. This gives a narrow black band at the very top of the picture, and, apart from improving line sync throughout the frame, also assists earliest possible line sync recovery after the interruption during the simplified frame pulses. Such vanes at the left and right picture edges on the vidicon also afford a simple mechanical method of adding front and back porches to the line pulses, if necessary.

The Line Timebase Oscillator

The right-hand portion of V10 in Fig. 17(a) is a cathode-coupled Hartley sinewave oscillator, coarsely tuned by selecting various capacities on S2 and finely tuned by adjusting the core of L3.

The valve does not oscillate very strongly, and it was found that, using the specified EMI coil actually manufactured for 405-line operation with a different capacity, oscillation can cease at frequencies not very greatly above the 625-line frequency. However, performance seems to be very stable and satisfactory at 625 lines with the arrangement shown in Fig. 17(a).

Both the core of L3 and the switch S2 have been located for adjustment from the front panel without opening the instrument, yet neither control is fitted with a knob, to prevent unwanted accidental misadjustments.

Line Scan Drive-Waveform Shaping

The grid-cathode section of V10, pins 7 and 8, functions as negative d.c. restorer diode (leaky-grid detector action) for the 50V peak-to-peak sinewave fed in from L3.

For maintenance of the peak rectified voltage across R54, V10 grid pin 7 must draw grid current and consequently produce a heavy pulse of anode current at pin 6, for brief periods around the positive peak of each input sinewave cycle.

The brief pulses of anode current mean that V10 is shorting C37 for their duration, thereby discharging it. At all other times V10, pins 6, 7 and 8 is cut off, so that C37 can charge along the initial portion of an exponential, with R57 as charging resistor and aiming-voltage selected on VR7 and thus determining the amplitude.

The left-hand portion of V10, together with C37 R57, VR7 and the linearity control and resistors around it, are thus seen to constitute a drive ramp circuit in every way analogous to the frame drive ramp already discussed.

R55 is a component of vital importance in this circuitry. Its correct choice greatly influences line sync stability on the receiver, and must, in general, be trimmed to suit the particular receiver to be employed. The function of R55 is to determine the amplitude of the grid current flowing at V10, pin 7 on the sinewave positive peaks, and it thereby fixes the duration of the grid current pulses, which is the factor of ultimate importance. In other words, variation of R55 allows the duration of line flyback and line blanking and sync pulses to be varied, without altering the rest of the line waveform. The value of 6·8kΩ shown in Fig. 17 was found to be satisfactory for the author's receiver, giving a line pulse of about 12μsec width.

A value of 56kΩ for example, gives a line pulse about 20μsec wide, and if R55 is omitted altogether, the line pulse is narrowed down to about 4μsec. The use of this narrow line pulse width on the prototype equipment (temporarily) still gave reasonable receiver performance, but accentuated ringing effects in the line output transformer of the unit here being discussed.

Line Driver and Line Output Stages

V9 is essentially a two stage linear amplifier with linearising negative feedback over R45 and C32. The correct required voltage waveform for achieving linear sawtooth *current* in the line coil is, as discussed in the introduction, a combination of a squarewave and a sawtooth of appropriate and comparable amplitudes.

This waveform is already generated by the ramp in V10 pin 6 anode circuit, the voltage across C37 providing the sawtooth component and the voltage drop across R52, R53 and VR6 due to the constant charging current of C37 producing the squarewave component. In varying the ratio of the amplitudes of these two components, VR6 serves as line linearity control.

R48 and C35, tapped across part of the line output transformer primary, critically damp the effective inductances.

Damping on both line and frame scan output transformers may need slight adjustment when building to 405-line standard; such adjustments should now be clear, and are not included in the list of changes for 405-line operation given below.

Changes for 405-line Operation

On the line oscillator, make C40 and all capacitors on S2, 2·5 times as large, or dispense with S2 and associated capacitors, and increase C40 to 0·015μF. Increase C38 to 0·01μF; modify R55 according to above discussion, if found to be necessary.

In the ramp circuit, increase C37 to 1000pF. Increase C36 to 0·01μF. Increase C33 to 0·01μF also. Increase C32 in the negative feedback circuit to 0·5μF. In the line sync feed, replace C31 by a 500pF capacitor and change the value of R44 to 38kΩ.

In the portion of the scan circuits within the camera head (component numbers here refer to previously published camera circuit—Fig. 9), make the following changes. Increase C14 to 0·05μF. Increase C15 to 0·25μF, this latter change also being worth trying on 625-lines if linearity and suppression of last traces of ringing prove difficult. Other values for C15 can also be tried if necessary. Note that line ringing must be suppressed to a very high degree, since, if present, it leaks into the video amplifier and produces very annoying vertical bright and dark bars across the picture.

Waveform Check Method

A reasonably good oscilloscope is an essential requirement when building the CCTV equipment described in these articles.

Almost any type of home-built or commercial oscilloscope will be found satisfactory, provided it has a Y-amplifier bandwidth extending up to 2Mc/s and timebase speeds covering the range 2μsec/cm to 20μsec/cm on a c.r.t. screen diameter of at least 2·5in.

Coil Positions on Vidicon Tube

The line and frame scan coils and the focus coil are mounted concentrically around the vidicon tube, the line scan coil being innermost. See Fig. 4 (November issue).

The line coil is wound on a former of total length 5in., the back end of which (connection-tag end) was hard up against the vidicon-base clamp in the finally adjusted prototype. The rear side (connection side) of the vidicon base was flush with the rear face of the base clamp.

Under these conditions, the line scan coil was found to be at the correct location along the axis of the vidicon, the front end of the former thereby just not reaching the sealed glass nose on the tube near the target.

The frame scan coil fits securely over the line scan coil, and is on a former about one and a third inches shorter. The axial position found satisfactory in the prototype was with the front ends of both line and scan coil formers flush.

The best axial position of the focus coil found in the prototype was with the front end of the *windings* (not the very slightly longer former) dead level with the glass seal nose on the vidicon tube, near the target, bringing the rear end of the focus coil windings (where the flying connecting leads emerge) 2·5in from the vidicon-base clamp front surface.

connecting tags point at about half past ten o'clock, i.e. in a direction sloping upwards towards the tag-strip assembly above the camera unit chassis.

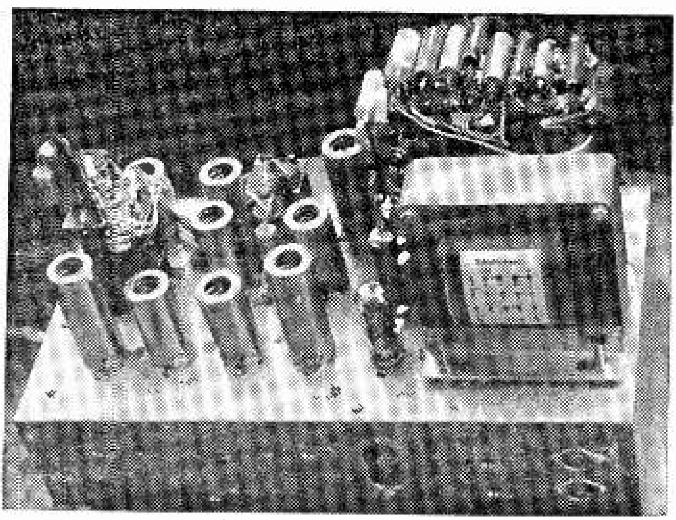
Under these conditions the lower connecting tag goes to chassis and the upper one to the frame scan input at P4 on the camera unit. The line joining the centres of the pair of pancake windings on the frame scan coil former is then approximately vertical.

Note that this is just 90 degrees different from the normal arrangement on receiver c.r.t.s, the orientation on the vidicon being as if the windings were electrostatic deflector plates (see below for explanation).

The line scan coil is rotated angularly such that the line joining the centres of the two pancake windings is approximately horizontal, again corresponding to electrostatic X-deflection plates. It does not matter which of the two orientations separated half a revolution and satisfying this requirement is adopted. The two connecting tags at the rear end of the former will lie on a diagonal line in either case. Whichever tag is uppermost should be connected to chassis, and the lower one goes to P3 via R15 (component numbers on camera unit circuit).

The vidicon tube itself can be rotated in relation to the coil assembly by slackening the pinch bolt of the rear clamp gripping the ceramic base.

The correct orientation is with the glass seal nose of the vidicon near the target pointing dead level horizontally in the direction of the two amplifier valves. This adjustment is to be maintained precisely under all circumstances; the other adjustments, both axially and angularly, should, if necessary, be trimmed *slightly* by trial and error, until the picture is quite erect and line and frame scans run truly perpendicular (televise a sheet of paper with ruled squares for all checks).



The completed control unit.

Angular Coil Positions

The focus coil was orientated angularly about the axial position just described such that the flying connecting leads emerge at the dead top (twelve o'clock).

Under these conditions, black goes to chassis and red to the positive focus supply at P2 of the camera head.

Reversal of the focus coil connections simply inverts the picture, without deterioration of focus (see below). Rotation of the focus coil should theoretically have no effect at all, but should be used judiciously in practice in the course of image alignment.

The frame scan coil was angularly rotated in the prototype such that, looking from the vidicon base end (connecting tag end), and the two closely spaced

Coil Adjustment Procedure

If an individual coil is to be shifted axially or angularly just move it in the desired manner in the case of the scan coils, since these are a secure but not locked fit inside the focus coil.

For moving the focus coil alone, slacken the pinch bolt on the front clamp, hold the scan coils fast with one hand and move the focus coil as desired with the other.

For moving the coil set bodily, either axially or angularly, just slacken the front clamp pinch bolt and move the focus coil without holding the scan coils fast.

When final optimum settings have been reached, secure the positions with two drops of Durofix, one at the point where the frame scan coil emerges from the focus coil and the other where the line scan coil emerges from the frame scan coil. Position these drops of glue such that they can subsequently be removed without damage at any time if future readjustments to the coils should prove to be necessary.

The reader is again reminded that the value of R14 is fairly critical; a value should be chosen such as to make the point of optimum electrical focus fall roughly in the middle of the track of VR2.

Cables Between Units

The coaxial cables should be of a good quality thin type for laboratory instruments and the two power cables three-core microphone or tape recorder cable with common screening.

The cable from tuner to receiver aerial terminal can have any desired length within reason, even some hundreds of yards, and should use normal TV aerial coaxial feeder. Twin feeder is not permissible as it has high losses when dirty and leads to undesirable amounts of radiation or interference pick-up.

If the receiver has aerial terminals for twin feeder the symmetrising unit must be close to the receiver(s).

Picture Alignment

It is not possible to make running adjustments on the open camera chassis—on the one hand because the lens is then not in position and excessive stray light enters, and on the other hand because excessive breakthrough of medium wave broadcast stations at the target and into the video amplifier obscures all picture observation on a receiver.

The correct procedure is to set up the camera accurately levelled on a good photographic tripod and set up an accurately aligned sheet of paper with ruled squares in a suitable holder. If the squares are then not aligned on the televised image on the receiver the paper should be rotated until the televised picture appears correct. The angle of rotation required can then be measured with a spirit level and protractor on the paper and ruled in. The camera is then switched off and disconnected and opened.

A small pencil mark should be made on the rear of the line scan coil former and the vidicon base clamp, marking the existing orientation. The required angle of rotation on the square-ruled paper is then transferred to the vidicon base clamp in the form of a second pencil mark on it at the appropriate position, and the scan coils can then be rotated to coincide accurately with the new mark. This procedure should normally correct a skew picture in one step.

In case of oblique distortion the procedure can be carried out for the scan coils individually, noting two angles on the paper from receiver observations and working with five pencil marks once the camera is opened. ■

MAKING PRINTED CIRCUIT BOARDS

—continued from page 218

could be pressed onto the plastic side of the board and the board moved backwards and forwards from time to time by holding the rubber "pip" of the cup. It is best to use rubber gloves!

The etching will take between about thirty and sixty minutes to complete, and it is essential that all of the unwanted copper is perfectly dissolved. Towards the end of the process small particles of copper will be seen between the "painted" conductors. This must be deleted. It will be understood, of course, that the board should not be put into the etchant until the resist is thoroughly dry, and it is best to leave a "painted" board overnight to ensure this condition.

When the etching is completed the board should be thoroughly washed under running warm water and dried with a soft cloth. The resist can be moved with a suitable solvent, such as methylated spirits, coupled with some domestic scouring powder (e.g. "Vim") and hard rubbing with a tough cloth! This will expose the non-etched copper conductors, and to ensure that there is adequate insulation between sections of the copper an ohmmeter should be employed.

Drilling

The holes should next be drilled, but this is not a difficult matter as the positions for them have already been impressed upon the copper side of the board. We thus end up with a perfectly satisfactory printed circuit, and all that remains to be done now is to mount the components, as shown in Fig. 3.

The usual mounting method is shown in Fig. 4(a), but an alternative arrangement is shown in Fig. 4(b). When soldering components to the circuit, especially transistors, a pair of pliers should be employed as a heat sink, as shown in Fig. 5. It is also important to use the iron only once for the connection, and this is facilitated by first tinning the copper close to the hole and also the component connecting lead (again using a heat sink to avoid damaging the component). ■

SERVICING TELEVISION RECEIVERS

No. 98: PHILIPS 17TG100U and 21TG100U

By L. Lawry-Johns

THESE receivers were the first of an extensive range by Philips and Stella and manv of the later models shared many features with the 100U and 200U which form the subject of this article. The 100U was a 17in. model, the 200U using an identical chassis but with a 21in. tube.

Accessibility

A noteworthy feature is the use of hinges which lower both sides of the chassis to allow easy access to valves and components. With the rear cover removed it is only necessary to remove the lower screen of the upper right side latch, lift the latch and raise the chassis off the bottom stud. The chassis is then swung open.

There is no need to remove the side control knobs as these are designed to swing in with the chassis.

This exposes all valves, but if it is desired to remove the chassis completely it is necessary to remove the e.h.t. cap, c.r.t. base connector, release the c.r.t. clamp and slide the scan coils off the c.r.t. neck. Then unclip the speaker leads and chassis earth wire, remove the lower chassis hinge fixin screw, raise the hinge and remove the chassis.

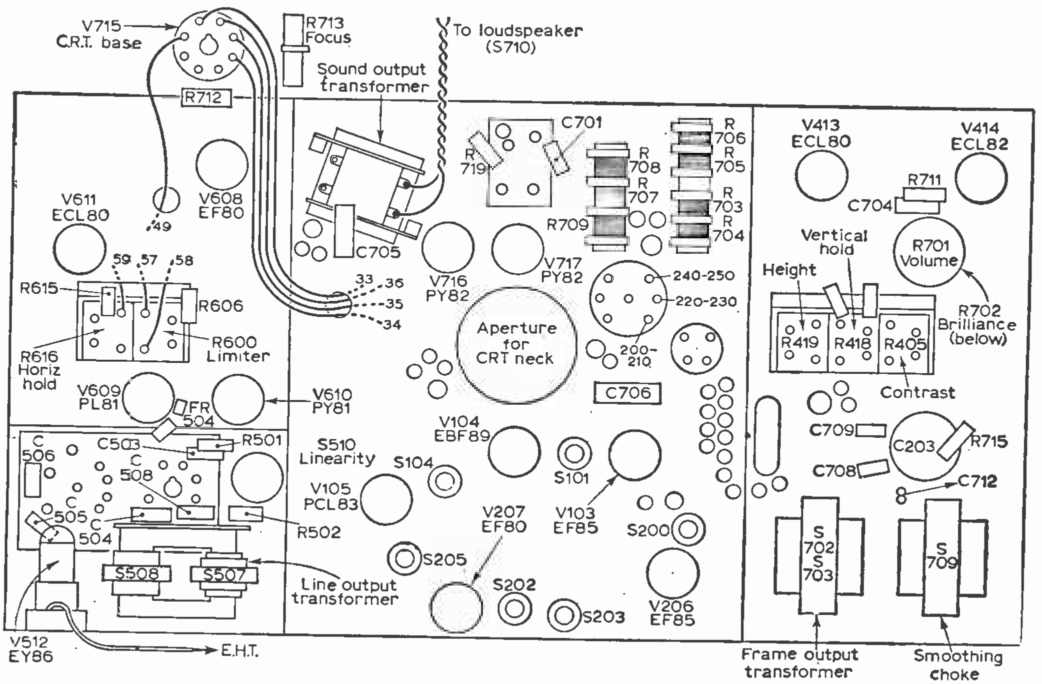


Fig. 1—Front view of chassis, as seen when swung open.

Common Faults

One quite common fault which can give rise to somewhat alarming symptoms occurs when the PCL83 sound output valve develops an internal short. This results in resistor R715 overheating and smoking, sometimes burning out completely. There is no point in replacing this 330Ω resistor or checking for shorts in the circuit, C703 etc; until the PCL83 (V105) has been checked as this will almost certainly be found at fault.

While on the subject of the sound stage it should be pointed out that there is no conventional noise limiter. Limiting is carried out by R113 and C114, and thus the value of these components is somewhat critical. Whilst C114 (560pF) is unlikely to change in value, R113 2·7MΩ) is, and this results in distortion particularly on strong signals. Thus in some areas the sound on BBC may be distorted whilst the ITV signal may be quite clear or vice-versa until R113 becomes too high when all signals become low and distorted. Note that this also happens when there is a fault in the line time base which results in a drop of boost line volts since the supply for pin 1 of the PCL83 (triode anode) is derived via R113 from the boost line rather than from the normal h.t. line. Hence there is no sound until the PY81 is operative.

Defective Focus Control

Still on the subject of the boost line and thus the supply to the audio stage and the supply to the height control and first anode of the tube, we would direct attention to the habit of this type of focus control changing value. The correct value is 2MΩ and the control is wired with one end to the 465V boost line and the other to chassis. Obviously then, a severe change in value of R713 (focus) will result in the voltage at the junction of R622 and R713 dropping as the value of R713 falls, since the above mentioned supplies are taken from this junction and the total value of R619 and R622 in series is 220kΩ.

For example, should the focus control element change value to about 220kΩ the boost line voltage would be halved, the brilliance would suffer and the height decrease as well as the expected drop in sound response and quality. Therefore it is always a good plan to disconnect the focus control if the e.h.t. and width seem normal but the above symptoms become manifest. If the control is at fault there will be an immediate increase of brilliance—height and sound, the focus being little affected.

Complete or Intermittent Loss of Sound

This is usually caused by a faulty PCL83 (V105) and where the sound is intermittent there may be sharp cracks as it comes and goes; note that R715 need not be affected at all. Check R111 (150Ω) which could be damaged.

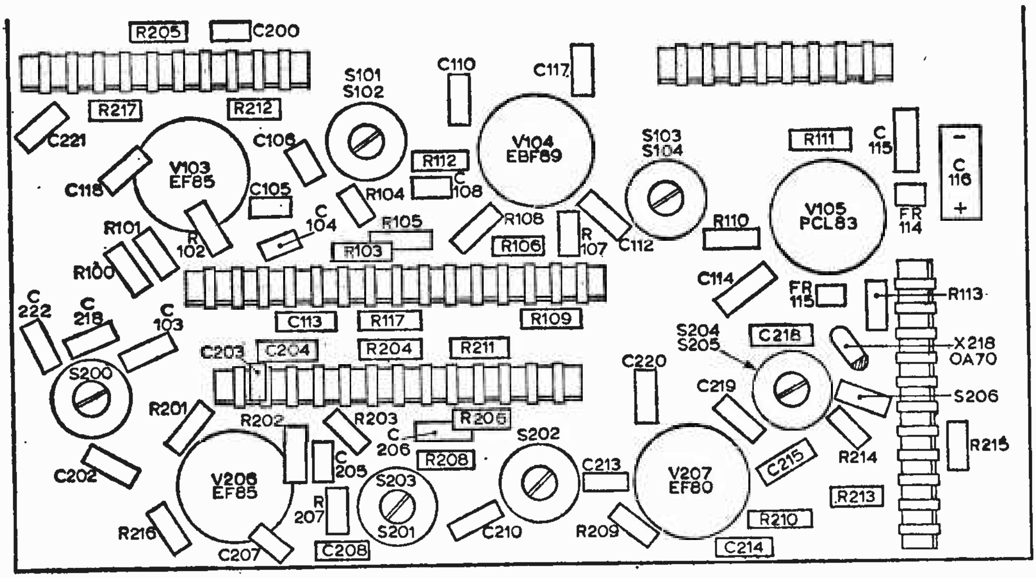


Fig. 2—View of lower rear centre of chassis.

No Picture, No Raster

Listen for the line timebase whistle. If absent check the PL81 (V609) and fuse Z722, which can fail due to an intermittent spark-over in the PL81 or PY81, or if excess current is being drawn, since the fuse is only rated at 250mA.

The line oscillator ECL80 (V611) does not often give drive trouble and if the PL81 is found to be red hot the ECL80 is not often responsible. Usually a replacement PL81 restores normal conditions. If the line whistle is present note whether the EY86 is lighting up. If it isn't, replace it. If it is, the e.h.t.

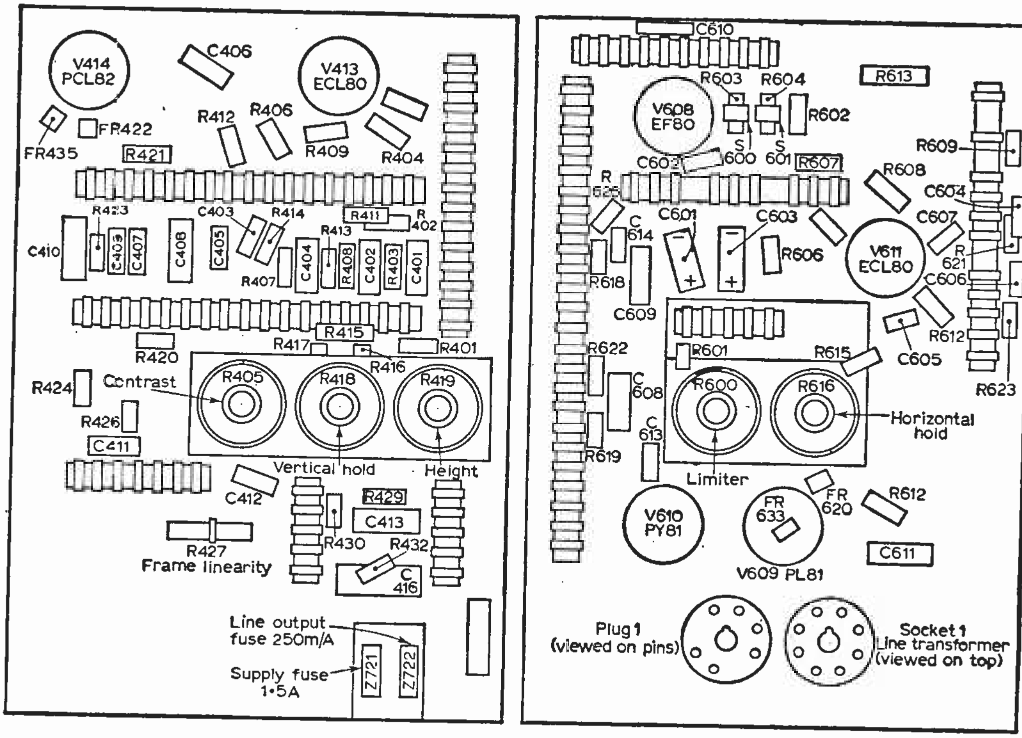


Fig. 3—Rear chassis views, left and right sections.

is likely to be in order and the boost line volts at the end of the focus control should be checked as previously mentioned.

Lack of Width

Check the PL81 and the PY81 and ensure that both PY82 rectifiers are operative. Both should light up (if one doesn't the vacuum could be impaired by a cracked base) and d.c. should be present at pin 9 of each.

The screen feed resistor of the PL81 does not often give trouble as it does in some receivers (R613).

Line Hold

If the control is at the end of its travel and a picture cannot be resolved, check V611 (ECL80), R615 (820kΩ) and note the effect of disconnecting the link between the hold control and the vision noise limiter (R600). This control has been known to change value and give rise to line hold trouble.

Bottom Compression

Check V414 (PCL82) first. If the trouble persists check R421, C408 and C411. These are the "usual" items which may be found at fault.

Lack of Height

Even top and bottom. Check R420 (820kΩ) in series from the height control to pin 9 of the PCL82. Also check the boost line voltage and focus control.

No Signals

If the raster is displayed when the brilliance is advanced and there is some background noise from the loudspeaker but there is no sound or vision signal, check the PCF80 (V302) on the tuner unit by substitution and if this does not restore normal conditions, try another PCC89 (V301). If neither is at fault check the voltages to the tuner unit valves and the condition of R323 and R312. At the same time check the turret pegs and contact springs to ensure that these are not damaged. These remarks of course, assume that the aerial is in order and that the coaxial plug is properly wired and plugged in.

TO BE CONTINUED

A MONTHLY FEATURE FOR DX ENTHUSIASTS

DX-TV

by Charles Rafarel

NOW that we have dealt with the basic principles of propagation and reception of DX signals, some tips on how to set about the indentification of signals is necessary.

First of all you will need an accurate list of all TV transmitters in Europe, and you cannot do better than use the official one—a copy of which may be obtained from:—The European Broadcasting Union, Technical Centre, 32 Avenue Albert Lancaster, Brussels 18, Belgium.

This will cost you 50 Belgian Francs (7/6d.) which can be paid by International Money Order obtainable from your local Post Office. The book will provide you with full station details printed in English and French. The main edition is issued in March each year and the 7/6 covers its cost and the six supplements per year which keep the details up to date until the new issue the following March.

This is certainly the "best buy" for DX work, although it does not provide photos or details of test cards because of frequent changes in test card design.

For the identification of signals we require test card information, but as there is no published list, we are on our own here. This is why we ask you to send in details of any "mystery" test cards that you receive so that we can identify them for you. Please give the date and time of reception, the channel, and (if possible) photographs or at least a reasonably accurate sketch.

Mr. C. Hamer of Eastleigh for example, has recently sent us a very good test card photograph, which we can positively identify as Javerling, Austria. This is a typical case which shows why we want full details, for the test card shown is identical to the West German one, except for one important detail—it does not carry any letters or words on it, whereas the West German ones have either the initials of the regional area, or the station name. The difference between these test cards is only slight, so if you have any photographs, a closer look may well reveal yet another country.

Other useful sources of information are (1) opening captions, (2) clocks and (3) the language. Most of us will probably be able to recognize Russian script for the USSR, but if you can give details of other opening words and designs we can help you in identification.

Clocks used as time checks nearly always have a "local" flavour in design, and the difference between our local time and that shown on the "mystery" clocks can indicate the region that the signal comes from.

The third method is to check the appropriate sound channel, but do not forget that some countries have a common language. German, for example, is spoken in Austria and parts of Switzerland as well as Germany.

A word of warning here, particularly in respect of East Europe and its Intervision Service (the Eastern equivalent of Eurovision): I have often been shown photos containing the word "Moskwa" and the owners claim reception of Moscow. The station name in Russian is "Mocba" and the "Moskwa" is only an indication that Moscow is being relayed by a Polish transmitter.

Regarding test card identification, let us consider the BBC test card. This carries no information regarding the station of origin so we are very much in the dark. This applies equally to many Continental cards. ITA is much better, but the criticism here, (as on the Continent) is that the lettering is too small to read on weak signals.

Some cards do have good lettering. Mr Le Couteur of Guernsey has sent in a good sketch of a test card carrying the letters NRK which we can identify as Norway. he states he has already identified Norway, but this was by means of another type of card. Norway is one of the "awkward" countries which uses three types of test card.

We are now in the winter period of poor DX but here is a technique to sustain our interest. Just set up your receiver on say Channel OIRTI, leave it running and just wait. As I write these words Ostrava is coming in, even if somewhat fitfully, via Sporadice. A rapid check would have revealed nothing, but leaving your receiver running will produce intermittent short bursts of reception. The frosty, foggy, winter evenings can produce good tropospheric Band III reception as well.

Now for the experienced DX viewers a few words again on u.h.f. reception. As you will have seen from Mr. Blaney's reception reports and my own and others, DX TV from the Continent is certainly possible and occurs during good tropospheric conditions. So if Band III conditions are good, try u.h.f. The signals can be excellent as shown by Mr. Blaney's photographs. It would seem that the BBC and the press may not be correct (happily for us DX viewers) when they say that BBC 2 will be free from Continental interference. It will be less prone to it but not free under certain atmospheric conditions, so why not get going on u.h.f. before the bands get cluttered up with "locals" in the next two years?

We still know relatively little about u.h.f. propagation, but it does appear that the ducting path can lie very near to ground level between 25ft and 50ft up, and experiments here show that at times a signal is better with the aerial at 30ft instead of 60ft, and this is worth further investigation.

PRINCIPLES AND PRACTICE OF COLOUR TELEVISION

PART 8

BY G. J. KING

CONTINUED FROM PAGE 166 OF THE JANUARY ISSUE

PAST articles have concentrated mainly on the American NTSC colour television system, how it works, how it is transmitted and how it is received. This month we shall be dealing with the French SECAM system while also looking in at the German PAL system.

Towards the middle and end of July, 1963, colour demonstrations organised by the BBC in co-operation with the Post Office, the ITA/ITCA and the radio industry were established to reveal the characteristics of the three major colour television systems.

It was shown how pictures transmitted on NTSC, SECAM and PAL systems compared in performance under various conditions of interference, mixing and fading, compatibility and user control.

Standard European System

The idea of the demonstrations was to form a basis of appraisal of the three systems to facilitate a final decision on a "standard" European system as soon as possible in 1964. It is the Government policy that Britain should adopt a colour TV system which is common to that employed by European countries for ease of programme interchange and the general development of colour television. If the final decision is made early in 1964, then there is the possibility that colour in Britain could be made available in 1965.

There are two sides to the debate at the time of writing. One is prudent in holding back on any decision of system until the European Broadcasting Union has arrived at a definite decision, even though this could delay the commencement of a European colour service, while the other is pushing for an immediate introduction of a colour service on the NTSC system, it being argued that the NTSC system has now been adequately proven by several years' operation in America and that there is little need of further extensive tests, since the differences in performance between the NTSC system and the other two are only marginal.

Fully Compatible

At the outset it must be made clear that the three systems are fully compatible, as explained in last month's article, and that they all give extremely good colour pictures. There are some differences in circuitry and the operation of the set between the three systems can differ slightly from the user's point of view. The display device, whether a tricolour tube or three tubes in a filtered optical system, is also common between the three systems.

Indeed the first stages of the SECAM system are substantially the same as those of the NTSC system. These stages still produce the Y′ luminance signal and the R′-Y′ and B′-Y′ colour difference or chroma signals (sometimes called the red and blue colour-difference signals or the I′ and Q′ signals, as we have seen from past articles). The chief difference is related to the manner in which these three signals are encoded for transmission and decoded at the set.

It will be recalled that on the NTSC system the Y′ and the two colour-difference signals (three signals in all) are transmitted simultaneously, as briefly described below.

NTSC System

Both chroma signals are modulated on to a sub-carrier by the process of quadrature modulation (see Part 6). After suppression of the sub-carrier the sidebands of the chroma signals are applied to the modulator of the transmitter along with the Y′ signal, and the two chroma and the mono signals are used to modulate the v.h.f. or u.h.f. carrier signal (see Fig. 23 in Part 6).

At the receiver the sub-carrier is replaced, which then allows the demodulation of the Quadraturely modulated chroma signals, and the colour-difference signals are then re-formed at the output of the detector.

Phase Sensitive

Quadrature modulation relies upon a 90 deg. phase displacement between the two effective sub-carriers at the transmitter (these are eventually combined to form just a single, complex sub-carrier), and if this phase displacement is not maintained within a few degrees over the entire system incorrect colour rendering will result. Normally this phasing is held accurately in rather the same way as the line and field frequencies are held accurately by the sync pulses.

If the line sync pulses become distorted for any reason the top of the picture is likely to bend or wobble or the picture is likely to tear or go out of line sync. Similarly the picture will roll if the field sync pulses are distorted.

From the colour aspect the colours will change if the phasing shifts outside tolerance. This can happen just like anything else due to a fault in the set or due to maladjustment. It can also happen to some extent due to distortion of the signal during its journey between the transmitter and receiver, just the same as the sync can be affected by propagation shortcomings and reflections and so on. This accurate phasing then may not be quite so important as one may first conclude.

It was necessary to investigate the phase aspect of the NTSC system again just prior to considering the SECAM system, for the latter is not phase sensitive as we shall see.

Sequential

In the SECAM system the chroma signals are transmitted *sequentially*, with alternate scanning lines carrying red and blue difference signals. The mono Y′ signal is carried on all lines the same as in a mono system. This, then, means that only two signals are ever being transmitted simultaneously — (i) the Y′ signal plus the *red* chroma signal and (ii) the Y′ signal plus the *blue* chroma signal.

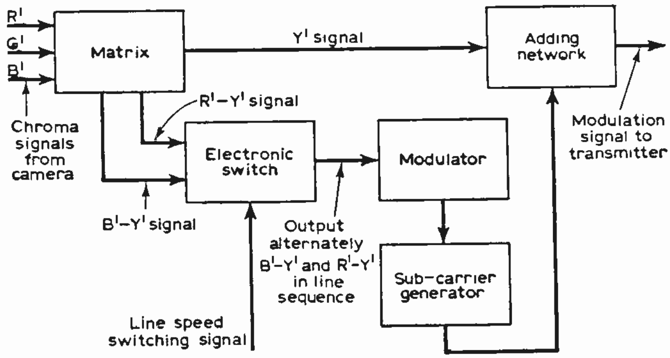


Fig. 31: A simplified block diagram of a SECAM sending end, showing the encoding arrangements

This technique avoids the use of phase sensitive quadrature modulation. The Chroma signals can be switched in terms of modulating a simple sub-carrier from red to blue and so on over alternate lines, meaning that only one chroma signal will modulate the sub-carrier at any instant.

Sub-carrier modulation on the NTSC system is amplitude and while this was used initially on the SECAM system it was found to give rise to various problems and frequency modulation is now used.

A block diagram of the sending end of the SECAM colour system is shown in Fig. 31. Here, like the NTSC system, we have the "matrix" which accepts red, green and blue gamma-corrected signals from the colour television camera and produces the Y′ mono signal and the R′-Y′ and the B′-Y′ chroma signals.

Electronic Switch

The two chroma signals are applied to the input of an electronic switch. At the output of the switch occurs alternate B′-Y′ and R′-Y′ signals in line sequence, and the signal at any instant is applied to the modulator which modulates that chroma signal upon the sub-carrier, as produced by the sub-carrier generator.

The modulated sub-carrier is then applied to the adding network along with the Y′ signal.

The electronic switch is actuated by signal pulses occurring at line frequency. Thus on one line the switch is positioned such that the R′-Y′ signal is allowed to pass through, while on the next line the switch changes over so that the B′-Y′ signal is allowed to pass. When the switch is in the "red" position the blue signal is cut off and when it is in the "blue" position the red signal is cut off. The switching signal is derived from the line scanning circuits at the transmitting end.

A block diagram of a SECAM receiver is shown in Fig. 32. The operation is not as complicated as it may seem from a quick glance at the diagram. It is as follows:

Appearing at the output of the vision detector are the Y′ luminance signal and the red and blue colour-difference signals. The colour or chroma signals are split into two channels after the chroma amplifier. One is the "direct channel" and the other the "delayed channel". The delay is introduced by a device called a "delay line" and the delay line is designed to give a delay equal to one line period (64μsec).

The input chroma signal is R′-Y′ and B′-Y′ on alternate lines. The signal in the direct channel is the same. However, due to the action of the delay line over a single line period the signal in the delayed channel is B′-Y′ and R′-Y′ (opposite to the direct channel signal at the same instant). At any instant, therefore, a R′-Y′ signal is in one channel while a B′-Y′ signal is in the other channel, and the signals are changed over at line speed by an electronic switch, as we shall see.

Colour Delay

The reason for introducing a one line delay is so that the colour information from each line can be used twice! The signal in the direct channel corresponds to the line which at that same instant is being scanned at the transmitter, while the signal in the delayed channel corresponds to the previous line.

This idea is based upon the fact that the colour information on successive lines is very similar, meaning that the colour on one line can be duplicated on the next line with very little colour impairment. Theoretically, of course, there would seem that some colour loss is inevitable, since only half the colour information is transmitted, but in practice this is shown to be very small and it has been suggested that perhaps the NTSC system transmits unnecessary colour information, thereby making the system more complicated than it need be!

This is one of the features of the case now being investigated by the EBU, leading to a final decision on colour system.

The diagram in Fig. 32 shows the direct and delayed channels connected to an electronic switch. This is shown as an ordinary two-pole two-way switch to make it easier to understand. The switch is changed over at line speed and is, in fact, actuated by pulses produced in the line timebase of the receiver.

In the switch position shown the R′-Y′ signal is directed through the switch and the corresponding channel and appears at "A" output. At the same time the previous line, which has been delayed, passes through the other section of the switch and appropriate channel in terms of B′-Y′ signal and appears at "C" output.

On the next line the switch changes over and passes the now B′-Y′ signal in the direct channel to "C" output and the now R′-Y′ signal in the delayed channel to "A" output.

the equivalent of the video amplifier in a black and white set) is fed to the tube cathodes. This arrangement is interesting, for it automatically cancels out the Y′ signal at the "A", "B" and "C" outputs, leaving only the red, green and blue signals, corresponding to those applied to the matrix at the transmitter (Fig. 31).

The PAL System

PAL is short for "phase alternation line" and this system is probably closer to that of NTSC than SECAM. A luminance and two chroma channels are used as in the NTSC system with suppressed sub-carrier transmission.

The two chroma signals are transmitted simultaneously, but while the phase of one is held constant the phase of the other is changed by 180 deg. between alternate lines.

At the receiver the two chroma signals are derived by adding or subtracting the sub-carrier signal, which is delayed during one line to or from the sub-carrier which is transmitted during the next line.

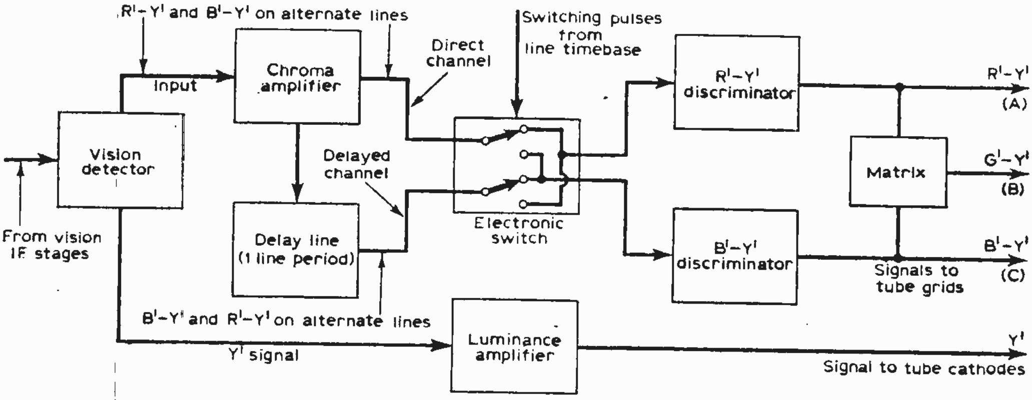


Fig. 32: A simplified block diagram of a SECAM receiver, showing the decoding arrangements. The receiver circuits are the same as NTSC circuits (and many mono sets) prior to the vision detector.

Colour Memory

It is easier to understand when it is remembered that the signal at any instant being scanned is in the direct channel, while the signal which was scanned a line previously is in the delayed channel. Thus on, say, line 2 of any field the R′-Y′ signal of that same line at the camera is being displayed at the set at the same time as the B′-Y′ signal of line 1. On line 3 the B′-Y′ signal of that same line at the camera is being displayed at the set at the same time as the R′-Y′ signal of line 2 and so on.

The SECAM system is thus line sequential and the delay which stores the colour information of one line is termed "memory", the system being known as "sequential and memory".

As in the NTSC system a "matrix" is used to derive the G′-Y′ signal (e.g. green colour-difference signal) and outputs "A", "B" and "C" are applied to the red, green and blue grids of the display device (e.g. tricolour picture tube).

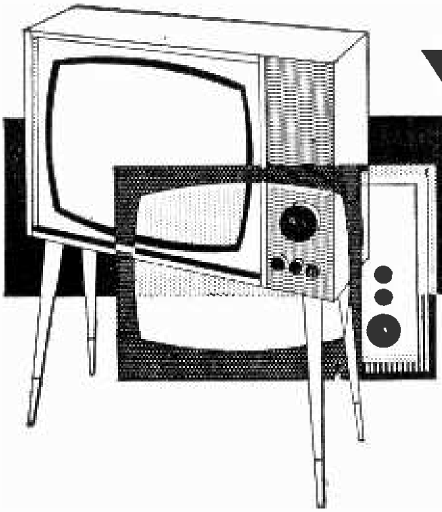
Y′ signal from the vision detector via the luminance amplifier (which, it will be recalled, is

The colour signals for applying to the tube or colour display device are obtained from envelope detectors after phase separation of the chroma signals. A change-over switch reverses the phase of one detector in synchronism with the transmitter switching on the line sync pulses.

The PAL system is the German Telefunken Co.'s scheme which is said to combine the advantages of the NTSC and SECAM systems. It is said that the phase alteration of the PAL arrangement makes this system considerably less sensitive to phase distortion than NTSC. The SECAM system overcomes the phase problems completely though has a theoretically reduced vertical colour definition and a somewhat expensive delay line or circuit for correct operation.

The proof of any colour television system is in the display and simple viewing under varying conditions is really the best way to decide which is the best system for Britain (or Europe?).

THE FINAL PART OF THIS SERIES APPEARS NEXT MONTH



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 236 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

PYE VT4

This set has low e.h.t. so that the tube just glows faintly with no picture or raster even with the brilliance control fully advanced.

I have checked the PY81 and PL81 by substitution. I have also checked the base voltages of these valves and have found them to be correct, however the top caps of both show only 400V. The EY51 is also in order.—F. Pearce (Dartford, Kent).

This trouble could easily be the line output transformer, but the scancoils can produce similar effects if faulty. To check this remove the pink and screened wires from the scancoil tagstrip, and if the e.h.t. is increased rather than decreased, the scancoils are faulty.

PHILIPS 1768U

I wish to clean the tube-face of this receiver and would therefore like to know the correct method for removing the chassis from the cabinet.—H. Jones (Birmingham).

First remove the rear cover. Turn both top retaining slips of the right side tuner control panel through 90 deg. Remove both plugs, lean the unit outward and lift free of the bottom grooves. Release rear flange screws and slide out the chassis.

HMV 1842

There is a good raster but when receiving either BBC or ITA transmissions there is a severe patterning on the screen. The line hold also becomes critical.

I have replaced the video amplifier, line oscillator and line output valves and the efficiency diode. I also replaced the PCF80 and PCC84 as adjusting the fine tuner alters the pattern.

The other fault on this set is that after being switched on for about an hour, the frame collapses leaving a horizontal line across the screen. The frame scan can be restored for an indefinite period by switching the set off for a few minutes, and then switching on once more.

I have replaced the frame output and frame oscillator valves without curing the fault.—J. R. Blackburn (Cardiff).

Ensure that the screening cover of the line output stage is in position and that the leads are properly dressed. Note whether the interference is still present when neighbouring receivers are not in use, as radiation from a nearby receiver can cause this trouble, particularly when the aerials are close.

The decoupling capacitors should be checked if the fault is definitely in the set itself.

The frame collapse is probably due to a faulty capacitor. Check the 2μF capacitor in the boost line feed to the frame oscillator and tube first anode (pin 10 lead). Also check the 0·1μF and 0·05μF capacitors associated with pin 1 of the PCL83.

KB QV301/1

When first switched on, the sound and vision appear as normal but these disappear after a few seconds. This leaves a bright raster on the screen, except for about 2in. top and bottom which remain dark.

This fault does not occur every time the set is used, but when it does present itself it may come and go several times in an evening.—A. Philpott (Alfriston, Polegate, Sussex).

Check the 6AL5 valve by replacement and then the decoupling capacitors of the V3 (9D7) stage (2,200pF) from pin 8 to chassis. You may also have to check the a.g.c. line capacitors by shunting each in turn with a component of like value.

One of the tuner unit valves could be at fault and these should also be checked by substitution.

FERGUSON 992T

A very poor quality and weak BBC picture is received on this set, although the ITA picture is perfect. A better aerial improves matters, but only slightly. Also if the contrast control is advanced

beyond a certain point in its travel there is a slight click and both picture and sound will disappear leaving a bright raster and a "herring bone effect" on the screen. This only occurs on BBC.

I have replaced V1 and V2 and also the 150pF capacitor between these two valves. I have also renewed the EY51, the PL81 and the PY81.—H. P. Colquitt (Widnes, Lancashire).

We usually find that the 1kΩ h.t. supply resistor to pin 8 of V1 is at fault, probably damaged by a faulty 0·002μF decoupling capacitor. Check this and the bias voltage of V1.

KB QV20/1

When switched to the ITA channel, good sound and vision cannot be secured at the same time; i.e., with the fine tuner adjusted to give good volume the picture becomes "watery"; when readjusted to give good vision the sound can only just be heard at full volume. This fault is not present on BBC.

Also there is present down the left-hand edge of the screen, a thin dark vertical band.—E. B. Alexander (Cheltenham, Gloucestershire).

The slight vertical band is evidence of the reception of ghosting or reflected signals which are of course unwanted and must be rejected by resisting or redirecting the aerial. The poor ITV reception could also be due to a weak aerial signal or perhaps a low emission PCC84 valve in the tuner unit.

PHILIPS 1446U

This receiver presents two pictures on the screen when the vertical hold control is set mid-way. Any adjustment to this control results in the picture rolling up or down.

I have changed the ECL80 frame oscillator and PL82 frame output valves without clearing the fault.—O. W. Jones (Burry Port, Carmarthenshire).

Check the resistors connected to the vertical hold control and replace any whose value has altered. If the trouble persists, suspect a fault in the frame blocking oscillator transformer.

STELLA ST 8917U

Operation of the frame hold control fails to prevent the picture from slipping, which it does occasionally, especially when changing channels. —D. Fox (London, S.E.18).

If the frame hold control needs to be towards one end of its range to hold the picture, the trouble is probably in one of the resistors actually connected to this control. Check them for value and replace if incorrect.

If the frame slips even though the correct locking point is well within the control's range, checks should be made on those components between the sync separator stage and the frame oscillator.

ULTRA V1780

Recently the picture on this set went negative, losing some of the details of the picture at the bottom and sides of the screen. The contrast control also seems to be inoperative.—T. Dabner (Dartford, Kent).

Check that the potential on the slider of the contrast control, relative to chassis, varies as the control is operated. If it does not, check the control and associated components. If it does, however, the trouble lies somewhere on the a.g.c. line or in the a.g.c. amplifier.

Check the associated 30FL1 (V6) and the valves to which the a.g.c. bias is applied; for example, the tuner valve and the EF183 (V3).

PHILIPS 19TG 108U

Occasionally the 250mA fuse which feeds the e.h.t. booster diode and line output valve, blows. I have replaced the efficiency diode and line output valve but the fault remains.—G. Down (Cowfold, Horsham, Sussex).

Surges in either of the valves mentioned could cause the trouble and no harm would be done by stepping up the fuse rating to 500mA—but no more! If the trouble then persists, suspect an intermittent short in the line output transformer.

FERRANTI T1057F

When first switched on the sound is present for about one minute and then fades away completely. After about five minutes silence, the sound returns accompanied by crackling and distortion. Eventually, however, the sound becomes normal and remains so.—B. Powell (Mosborough, Sheffield).

The suspect valves and components are on the i.f. panel (panel E). Check the top 30P12, 6D2, 6F23 valves on the left side and associated circuitry and components.

ULTRA WT9 17

When first switched on, the U25 e.h.t. rectifier does not light. The valve has been replaced without altering the results.

A weak, out-of-focus picture can be obtained by advancing the brightness control to a certain point. Beyond this point in its travel, however, the picture blows up leaving a blank screen.

If I leave the brightness control set for a weak picture, after an hour the U25 lights and a full strength picture appears.—G. Johnson (Bolton, Lancashire).

Check the 20P4 line output valve and the U329 efficiency diode. Also check the 4.7kΩ resistor to pin 4 of the 20P4 valve base and the 500pF e.h.t. smoothing capacitor if necessary.

EMERSON E708

The top and bottom of the picture are cramped and the centre stretched. No adjustment of linearity and height controls corrects the condition completely.

I have replaced the frame output valve, V7, and tested most components in the associated circuitry. The cramping and stretching is more pronounced when the set is first switched on.—R. F. Fraser (Wideopen, Newcastle upon Tyne).

You should check the PCL82 frame oscillator output valve and also C54, C56 and C57 (0.1μF, 0.001μF and 0.04μF respectively). One of these capacitors is likely to be defective.

SOBELL TS17

The picture on BBC is perfect. On ITA, however, the picture is dim and pulls to the right. This condition lasts for about 20 to 30 minutes after switching on, when it reverts to quite a good picture.—F. G. Forster (Northampton).

Check that the mains tapping is set to suit the mains voltage applied to the set.

It is possible that the trouble is caused or aggravated by a partly worn tuner valve. A possible trouble being that the emission of the valve rises to normal as its temperature increases over a longer than normal period of time.

EKCO TC 267/1

This set suddenly went dead and on examination I observed smoke coming from the tuner unit. On further examination of the tuner, I discovered that the 2.7kΩ resistor to L5 had burned out. The 56kΩ resistor from L5 to V2 was also charred, and so I replaced both these components with ones of similar value and $\frac{1}{2}$W ratings.

Since then, however, I have only been able to obtain a weak ITA picture with poor sound. Neither BBC nor v.h.f. radio can be received.

I have replaced the tuner unit valves without improving the situation.—E. Skilbeck (Loughor, Swansea, Glamorganshire).

The 56kΩ resistor which you have replaced between L5 and V2 should in fact be 56Ω. We feel sure that this is the cause of the low gain, but check also the coupling capacitor to the grid circuit of the i.f. stage.

H.M.V. 1824

I recently fitted a new tube to this receiver and now the picture is distorted, there appearing to be three or four ghost images of the picture across the screen.

I have changed V10, V11, V12, V13 and V14 without curing the fault.—H. Tillotson (Bradford, Yorkshire).

You should check the continuity of the 25kΩ horizontal hold control and the 330kΩ resistor in series from it to pin 2 of the V11 valve base.

TEST CASE -15

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

? *After several years of fault-free operation an experimenter's receiver suddenly developed the symptom of reduced picture width. Apart from this, the sound was normal as also was the picture in terms of definition and brightness.*

Thinking that the mains rectifier—which was a valve type using several anodes—was at fault, this was replaced but the symptom remained, and even by turning the width control to maximum it was not possible to obtain a full horizontal scan.

What other components should the experimenter have checked?

SOLUTION TO TEST CASE 14 (Page 188, last month)

The symptom given last month is nearly always caused by an intermittent, partial short-circuit in the heater of the picture tube. As most sets feature a series-connected heater circuit, a short-circuit in one of the heaters in the chain is absorbed by all the other heaters. If there is a partial short, then the resistance of the heater decreases though the current through it remains the same. This results in a fall of voltage across the section of the heater which is intact, thereby causing the heater to dim and reduce in temperature.

In the picture tube, of course, this trouble is bound to give all the symptoms of a low emission picture tube. It can be detected quite easily either by measuring the a.c. voltage across the tube heater when the fault occurs and comparing it with the voltage present without the fault, or simply by observing the brightness of the heater under the fault condition and comparing with the normal brightness.

Such trouble can often be brought on or temporarily corrected by tapping the neck of the tube with the handle of a screwdriver. On a.c. circuits, the tube heater can be removed from the series chain and energised from an independent heater transformer. In this way greater current can be pushed through the intact section of the heater, thereby causing the cathode temperature to rise for normal emission. Note, however, that if only a small section of the heater remains intact energising from a constant voltage source—such as a heater transformer—is likely to result in total failure.

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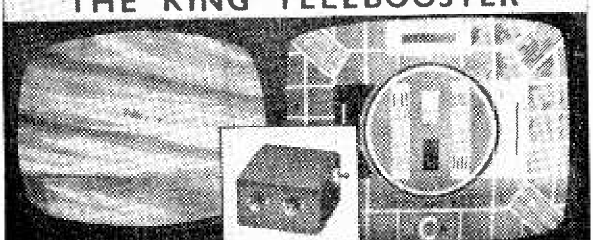

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