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SEPTEMBER 1967

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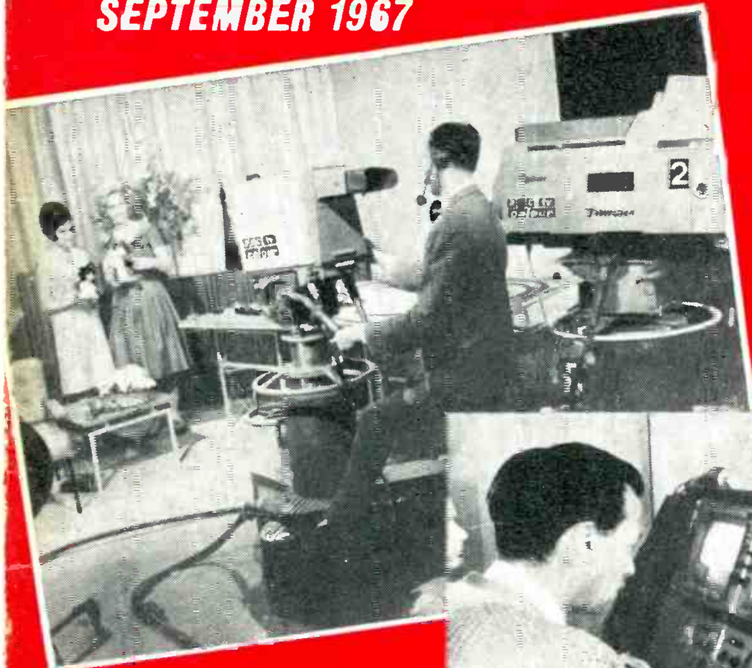

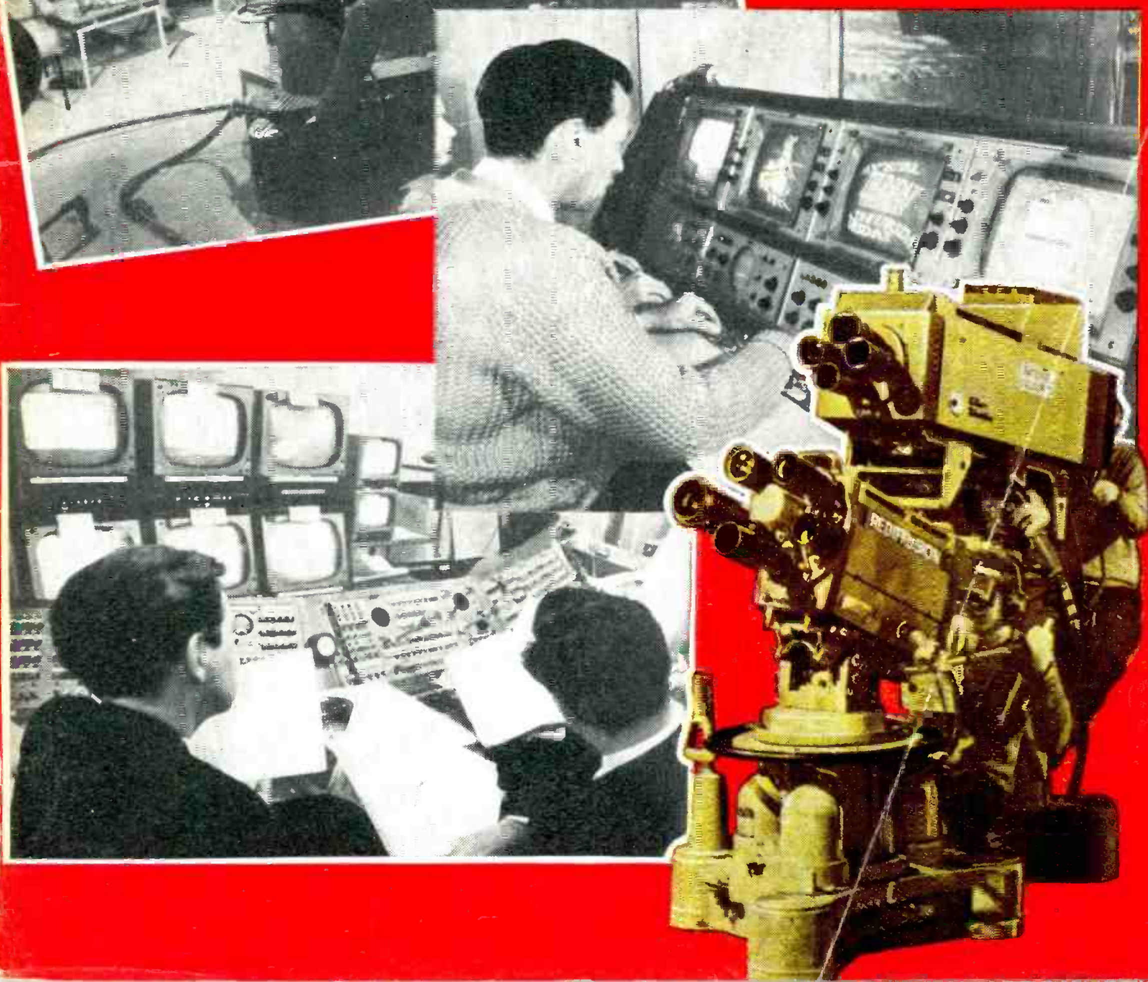

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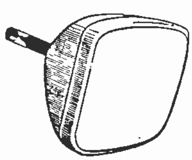

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Practical Television

WHERE ARE THE SETS?

JULY 1st 1967 should rank as an important date in the history of television, for it was on this day that the BBC launched the colour TV service on a run-in basis—five months ahead of the official opening on December 2nd.

There will, of course, be refutations of the BBC claim to be the first in Europe with colour, and we must admit that it is probably stretching it a little. However, let this not detract from the triumphal achievement of the BBC in not only being ready before the official opening of the service but in being willing and able to establish a launching period which started with about 30 hours of colour in the first week and at least five hours a week until the fanfares can be sounded officially.

The fact is that the BBC is radiating colour programmes on a fairly substantial basis. Their producers, cameramen, makeup and wardrobe departments, lighting engineers, and everyone else who works behind the scenes to provide the entertainment of millions are undergoing an invaluable baptism of working in colour which should enable the official service to get off with a bang.

It is a novel experience, too, that the BBC do not look like paying the penalty for pioneering that was exacted on us for being the first with public monochrome TV and on the USA for being the first with colour TV some years ago. Although we still have many reservations about the 625-line u.h.f. system we seem to be stuck with, the technical barometer seems set fair for British colour TV.

The BBC must be applauded for their energy in handsomely beating the deadline and in the technical quality of the end product. The set-makers, on the other hand, seem to have been caught off balance. The actual quality of the receivers (and we have seen all of the models demonstrated to date) is uniformly good and there is very little cause of complaint here. The prices are high, but this was inevitable and they will slowly come down as production allows. That is if production ever gets under way!

The situation has arisen whereby the BBC have done a magnificent job of window dressing—which amounted to a free publicity campaign for the benefit of all set-makers—only for the public to find that there is nothing in the shop window after all. The production of sets is at best a mere trickle. There are long waiting lists of prospective buyers or renters, despite the costs. But where are the sets?

W. N. STEVENS, Editor.

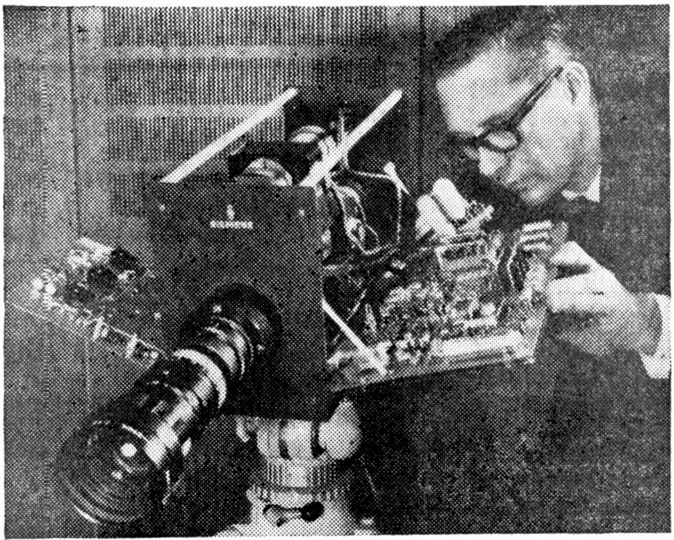
SEPTEMBER 1967
VOL. 17 No. 12
issue 204

THIS MONTH

OUR NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON SEPT. 22

TELETOPICS

SIEMENS AT THE HANOVER FAIR



ONE of the highlights of the 1967 Hanover Fair was a new Siemens wired colour television system, on the stand of Carl Zeiss of Oberkochen, Württemberg, in conjunction with a microscope. It consists essentially of a pulsing centre, colour monitor and a colour camera embodying vidicon camera tubes. Closed-circuit colour television systems such as this are suitable for hospitals, research, education and wherever colour pictures can provide more information than monochrome.

TV SET FUMES —A KILLER—

A CASE was reported recently when a 78-year-old woman was asphyxiated by carbon monoxide fumes when the line output transformer in her TV receiver failed. She was apparently viewing when the screen went blank, the sound continuing quite normally, and the set was left switched on. The line output transformer may have caught fire or "cooked", but it appears that it was this that gave off the fumes which killed the lady.

The Coroner suggested that it might be a good idea if manufacturers included a warning in their instructions telling people to switch off if there is a fault on the set, because one cannot tell what might ensue, including the risk of fire.

'POD' RELAY CABLES

BRITISH Insulated Callender's Cables Limited announce the introduction of new ranges of television relay cables, called "Pod" cables, which are the subject of a B.I.C.C. patent application. These cables are being used by the principal TV relay companies to distribute television programmes in the high frequency bands to subscribers on their networks.

"Pod" cables incorporate a basic unit which consists of a video pair of cores accurately laid up with a second smaller pair of cores laid in the interstices. The smaller pair of cores can be used for audio distribution purposes. This construction ensures minimum interference between the video pairs in the cable and results in a remarkably good cross-view performance.

INSTRUCTIONAL TV NETWORK FOR HANOVER SCHOOLS

BY joining forces, 29 schools from six different districts in the Hanover area will receive special video-taped instructional programming this autumn via their own 2-channel TV network.

Broadcasting will be in the 2,500-megacycle microwave frequency band.

Broadcasts will originate in the Hanover Borough School District's studios and be transmitted from a 250-foot tall tower atop a 1,220-foot elevation peak to blanket the area. Similar Micro-Link/Varian ITV systems serve school districts in Mifflin Co. and Altoona in central Pennsylvania, America.

GPO CONTRACT FOR EARTH STATION EQUIPMENT

THE Post Office have awarded a contract for the supply of equipment which will make possible the transmission and reception of multi-channel telephony and the interchange of colour television programmes between Britain and the American continent to G.E.C. (Electronics) Ltd. The contract, the value of which is in the region of £150,000, is to supply, install and test ancillary equipment for the Goonhilly Communications Satellite Earth Station, to be linked with the second aerial now in course of construction.

The equipment will enable Goonhilly to handle telephone traffic to and from a number of overseas earth stations simultaneously. Hitherto, Goonhilly has been able to work via "Early Bird" to only one destination at a time.

Ayr Relay Station

THE BBC's television relay station near Ayr was brought into service on July 3 It transmits BBC-1 television on Channel 2, horizontally polarised.

For good reception of the television service from Ayr, it is important that viewers use horizontal aerials designed for Channel 2.

The Ayr relay station serves some 60,000 people in Ayr, Prestwick and Alloway.

£3M ORDERS FOR COLOUR TV SETS

RANK BUSH MURPHY has received firm orders for £3m. worth of colour television receivers.

Announcing this recently, Mr J. P. Collis, managing director of the Bush Murphy Division of The Rank Organisation, said that production is geared to exceed 1,000 sets a week by the autumn.

"Receivers worth £2½m. will have been sold and delivered by the end of 1967," he added. "Key Bush and Murphy dealers, as well as rental companies, are already getting sets from us.

"Our production line at the Plymouth factory was in action in April this year, and this early start has enabled us not merely to talk about production but to lead in getting the sets into our customers' hands."

The sets now being delivered are 25in. console models. A 19in. table model and a 25in. table model will be in production by the end of the year.

"We are now getting the full benefit of the research and development programme into every aspect of colour television which the company has been carrying out for the past 12 years," said Mr Collis.

Europe's biggest ever CCTV hook-up

TELEVISION ADVISORS LTD., who handled all the Closed Circuit Television hook-ups throughout Britain for the Billy Graham Crusade of 1966, were again responsible for the overall planning and technical control of the TV relay for this year's Crusade. This was the biggest TV operation of its kind yet undertaken in Europe, in which 25 major cities from Aberdeen to London and Belfast were linked with Earls Court in London for two hours each night between June 23 and July 1 and which is estimated was seen by up to 100,000 people each night. Four cameras were used at Earls Court to televise the proceedings which were relayed by the GPO network to the various centres.

The largest CCTV network before this was for the Clay/Cooper fight on May 21, 1966 to 17 venues.

PARIS INTERNATIONAL COLLOQUIUM ON COLOUR TELEVISION

THIS conference will enable engineers to study technical considerations brought about by colour television and its exploitation. Particular attention will be given to the methods and equipment of measurement, both with regard to the picture itself as well as to the transmission circuits of the television signal.

The following suggest some of the problems which could merit attention: The colorimetry of analyser and receiver systems, the standardisation of the principal colorimetric parameters. Vision characteristics and photometric and colorimetric distortion tolerances. An objective and subjective evaluation of the quality of colour pictures. The colorimetry of colour motion picture film in relation to its utilisation in colour television and the equipment and methods of measurement in colorimetry.

Pye offers £3,000 awards

AT a reception in London recently to celebrate the first official BBC-2 colourvision transmission, from Wimbledon, Pye not only said they hoped their colour sets would grab "at least a 10 per cent slice of the market" in the first year, but announced also an annual £3,000 awards scheme to give a fillip to colour television in Britain.

All colour television shows, on both BBC and ITV, will be covered by the awards—total value £3,000—which will be presented annually to actors, actresses, producers, writers and directors of "the year's best", as chosen by a panel of experts. There will be special awards covering technical achievements in the colour field.

Full details of the scheme are now being worked out, and will be announced well before the regular BBC colour television service begins in December. On the day that ITV begins transmitting in colour, the commercial programmes will also become eligible for the awards.

ROYAL TELEVISION SOCIETY DONATES PLAQUE

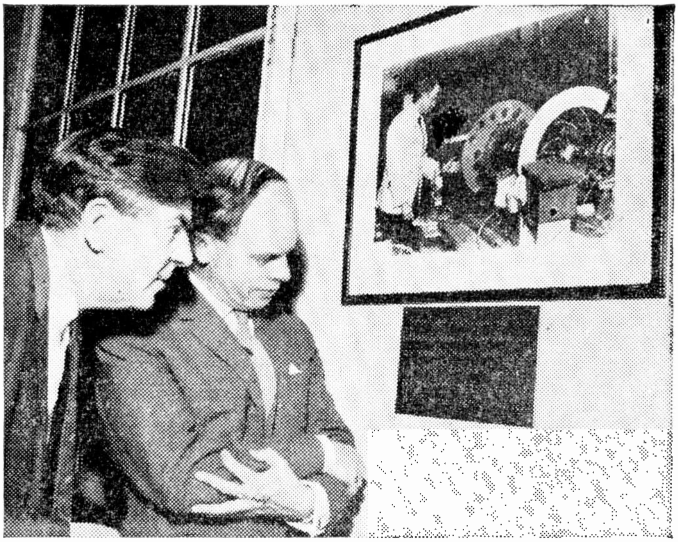


PHOTO shows John Ware (left) Chairman of The Royal Television Society and Charles Marshall, Hon. Secretary of the Society, seen during the donation of a plaque to Bianchi's Restaurant, Frith Street, Soho. The inscription reads "John Logie Baird gave the first demonstration of television before the Royal Institution in this house where the Television Society celebrated the 40th anniversary of that event on the 26th January 1966".

INSIDE tV TODAY

PART 1 **A.F. CAMERON**

IN this country, three television networks produce around 200 hours of programmes each week. Access to this form of entertainment costs each home with a television set a mere £5 0s. 0d. for a licence (more for colour) and about £8 0s. 0d. in advertising costs on goods bought. A total of 50 million people have television sets and audiences of over 20 million are not uncommon. A record of 400 million people from all over the world watched the World Cup Final.

With bald facts such as these it is too easy to forget the effort needed to get a straightforward thirty minute programme on the air. This series will attempt to describe the engineering and administration needed to broadcast programmes and to trace a programme from its inception as a rough idea until the last credit has faded from the viewer's screens.

Early Experiments

First, some history. All readers of PRACTICAL TELEVISION know of Baird and his experiments, but many very practical proposals for television systems had been proposed before Baird's system. For example, the German, Paul Nipkow, invented (in 1884) the scanning disc used by Baird. Boris Rosing, a Russian, used a cathode ray tube to display the received picture. Zworykin and Farnsworth, in the USA, developed electronic pick-up tubes.

Probably the most far sighted of these pioneers was a British scientist called Campbell Swinton who, in 1907, described with remarkable accuracy the modern closed circuit television system. However Baird was the first who actually achieved a working system. As his television system improved. the BBC, who had themselves tried some experiments, became interested until in August, 1932, they broadcast pictures from Broadcasting House using the Baird process.

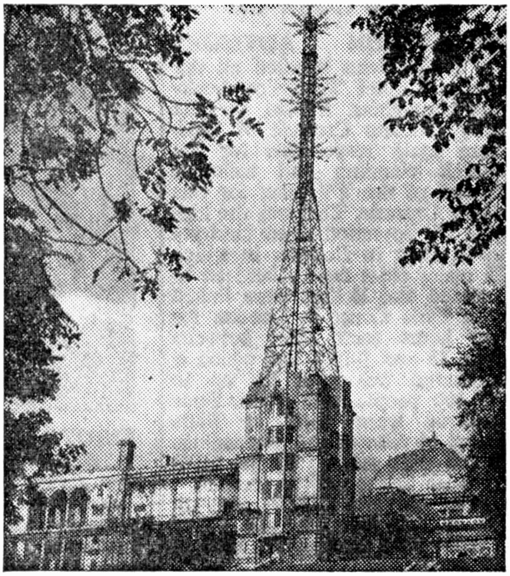
Soon, the mechanical Baird process was being rivalled by the combination of the Marconi and E.M.I. Companies who, under the guidance of Isaac Shoenburg, had developed an all electronic system which was far ahead of its time. Unfortunately, it did not show any great advantage over the Baird system, except that the potential was there for advancing techniques to utilise.

Thus the BBC selected the Marconi/E.M.I. system, and on November 2, 1936, the first high definition (405 lines as opposed to 30 or 120 lines systems) public television service was brought into action by the BBC, broadcasting from Alexandra Palace. This system was almost exactly the same as the 405 line standard system in use today.

Much work in the USA during the 1930s was continued all through the war. In 1941 the Federal Communication Commission authorised the NBC and CBC radio companies to go ahead with television from New York. Thus, after the war, the basis of the present television network in the USA was already in existence.

Interrupted completely by the war, the BBC TV service was re-started after the war, still on 405 lines, as at that time there were more 405 line receivers in this country than the total number of receivers operating on various standards all over the world. Hence 405 was the obvious line standard to use. The BBC expanded its facilities to the Gaumont British Film Studios at Lime Grove, and later the Shepherds Bush Empire and other London premises.

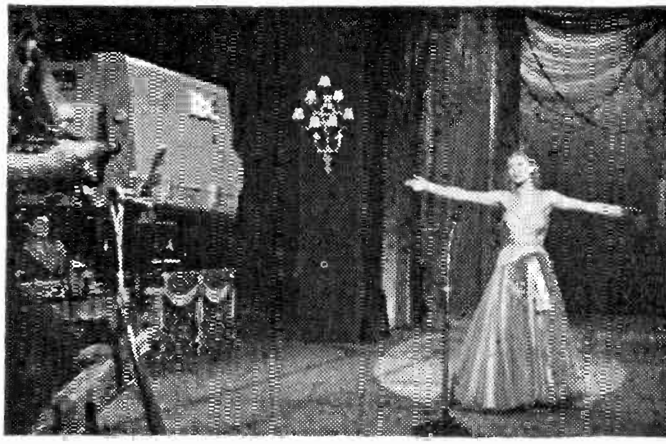
Coverage was being extended by building more transmitters: December 1949 saw Sutton Coldfield being brought into action to cover the Midlands; Holme Moss for the North in October 1951; and Kirk O'Shotts and Wenvoe in 1952. Programme techniques also improved with the first outside broadcast from the Continent in 1950, live pictures from an aircraft in flight in the same year and, in 1953, 21 cameras were used to cover the Coronation of Queen Elizabeth II, compared with three



Alexandra Palace, North London. *BBC photo* cameras for the coverage of King George VI's Coronation in 1937.

Regional studio premises, too, were being expanded until the BBC had large studios at Birmingham, Bristol, Cardiff, Manchester and Glasgow, with transmitters covering most of the country and 99% of the population. Along with the expansion, equipment and techniques were constantly improving, although the programme content was rather staid and presentation uninteresting.

Dissatisfaction at the general state of affairs and large commercial interests applied pressure to Parliament until in 1954 the Television Act was passed. This set up the Independent Television Authority (ITA) to actually transmit programmes. Programmes were to be provided by contractors and the first service started in the London area on September 22, 1955, with Associated Rediffusion (as it was then called) and Associated Television providing the programmes.



Lime Grove—studio scene with camera circa 1950. *BBC photo*

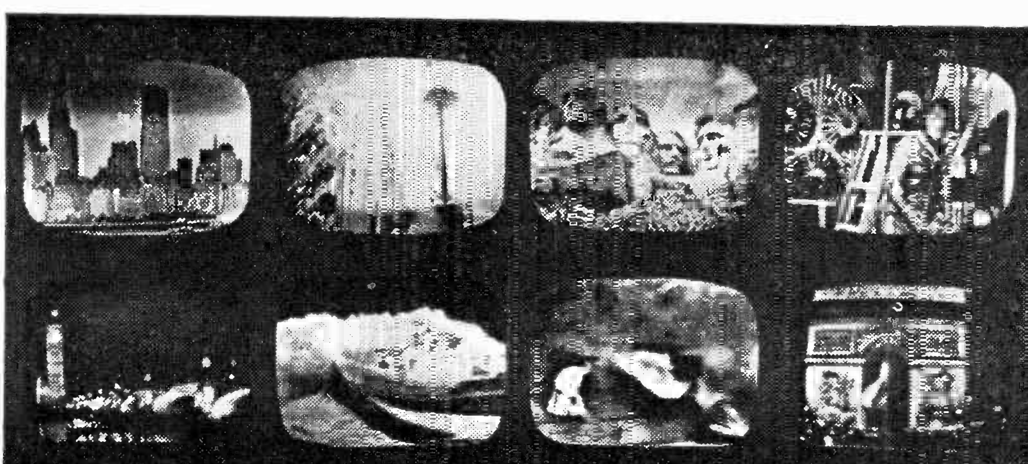
Midlands and the North were soon covered with ABC Television and Granada Television as contractors; to be followed by other contractors in other regions, until almost all of the country is now covered by the ITA transmitters and regional programme contractors.

625 Conversion

From such simple starts, the ITV companies have expanded their facilities to rival the BBC. Even so, "Auntie" has not stood still, and television engineering has expanded on all fronts. Many of the accepted facilities are BBC-developed and later taken up by industry. One man vision control was brought about by a BBC specification for cameras of suitable stability.

More recently, the BBC developed the line store type standards converter, allowing an all-electronic standards conversion from 405 to 625 to be achieved. These are now being produced commercially by Pye TVT Ltd. On the other hand, both Industry and the Independent companies have much to offer technically. ATV network and ABC TV were both in the forefront with transistorising distributor amplifiers. Industry has also played its part, as witnessed by the major advances in video tape recorders achieved by the leading manufacturers: Ampex and RCA.

Queen Elizabeth II's Coronation was fed to Europe as well as this country. Belgian, French, Dutch, Danish and German viewers were able to watch "live" pictures, the standards being converted to the various European requirements. This, and other international coverage, prompted the establishment of a clearing house for such programmes. The European Broadcasting Union was doing the same job for radio and undertook this job under the name of *Eurovision.*



Off the screen photographs from the Telstar programme. ***BBC photo***

Eurovision, with *Intervision*, its counterpart behind the Iron Curtain, now cover all Europe, with the exception of the Balkans and Greece, and reaches far into the USSR. Coverage of the death of the Indian Prime Minister, Mr. Shastri, was received from Tashkent far into the centre of Russia, a link of over 10,000 miles!

Telstar

In 1962, the Atlantic was spanned by *Telstar*. Pictures could now be fed up to the satellite positioned over the middle of the Atlantic and re-transmitted to the opposite side. *Telstar* however, was not high enough to remain in the same position so that it made a short pass through the required area and only in this short time could it be used. *Early Bird* was the first television satellite which remained in a stationary orbit 22,000 miles above the Atlantic. So pictures can now be received at any time from the United States.

After a short trial period, the costs of using the satellite were found to be too prohibitive and it was used only for the most newsworthy events. Now it is much cheaper so it is used for many News and Current Affairs programmes just as *Eurovision* links are used.

Nowadays there is little publicity for such links, but much news comes from the satellite: United Nations Debates covered during the Middle East War, Sir Francis Chichester as he rounded Cape Horn, are just two examples of satellite coverage. Much more common is material recorded from the News exchange with Europe.

Each day at 17.00 Central European Time, all services exchange News film of events around Europe. These are recorded on video tape and played back into the news bulletins. Hardly a day goes by without such a story being transmitted so that in this field at least, *Eurovision* has recorded an impressive success.

Competition between the BBC and ITA for audiences has, in many ways, improved the programmes but at the cost of eliminating much of the minority interest programmes. In order to provide for these programmes, there arose a demand for a third channel, to be broadcast in the u.h.f. region where sufficient bandwidths are available.

Photograph shows the International Control Room, Television Centre—taken during the inaugural Early Bird satellite transmissions. *BBC photo*

At the same time the BBC had developed a 405 line version of the American NTSC colour television system to an advanced stage, and manufacturers had conducted many successful tests on this standard.

The radio and television industry were divided as to whether to go for colour television, a rather large leap forward, or for 625 u.h.f. (a simpler step) with colour to follow. The Pye Group came out very strongly for 625 lines u.h.f. and much of the industry followed this positive lead. Engineering advice being conflicting, a political decision was needed so that the Pilkington Committee was set up in 1960, and in 1962 declared in favour of a 625 u.h.f. service, to be run by the BBC. BBC-2 started a day late, due to a spectacular fire at Battersea Power Station, in April 1964, and rapidly expanded to reach over half the population by the end of 1966. Colour Television, using the PAL version of the NTSC system, is just with us, and ITV will have colour on a u.h.f. channel within a year or two.

International Influence

On the international scale, the United States dominates the picture both in its influence over the organisation and in the programmes. American films from Hollywood are more prosperous than ever before, and now it concentrates on producing films for television. '*Bonanza*' is very popular in the Far East, Dick Van Dyke in South America, and most of the world Loves Lucy.

This domination of the film market is due to the fact that costs of production can only be absorbed by an audience as large as that found in the USA. After a showing in the USA, further showings abroad bring in the profit. Hence distributors can then sell such films at rock bottom prices, a fact which is welcomed by many organisations whose production facilities are very limited. Most countries start television broadcasting with little more than two or three telecine channels and a presentation/news studio.

American television is entirely commercial with each city having three to four stations. Several of these are controlled by a larger network such as NBC, CBS, ABC. Many television organisations of the smaller countries are carbon copies of a typical American studio, and American finance has helped many such organisations. Totalitarian states have appreciated the propaganda value of television so that many state controlled television organisations have made their appearances around the world.

To avoid the extremes of state control and tasteless commercialisation, many countries have adopted a similar system to the BBC, but of late, the financial advantages of the ITV system have attracted many governments who have set up such organisations in their own country.

Two of the most interesting areas are Europe and Japan. As one may guess from the advanced state of Japanese transistor radios and tape recorders available in this country, the Japanese have much to offer technically, as was demonstrated by the 1964 Olympic Games. Although started by the Americans, the Japanese have a national organisation, the NHK, equivalent in many respects to the BBC, four commercial channels and one very advanced educational channel complete the choice for the Japanese viewer. It must be remembered that the Japanese have introduced simple helical scan video tape recorders, ½in. vidicon broadcast cameras, hand-held lightweight miniature image orthicon cameras.

European television networks generally follow on from radio practice with state controlled organisations. The French TV service called ORTF, broadcasting on two channels is under very tight state control. In fact, between the years 1956 and 1959 not a single programme about the Algerian war was broadcast by the ORTF. Under De Gaulle ORTF was expanded and re-organised but criticisms of control are still levelled at the ORTF.

Norway, Sweden, Denmark and the Netherlands all have a similar form of state control, but Italy, Finland, Ireland, Austria and Switzerland incorporate advertising on a state run system. Germany has a different system, where a local organisation broadcasts to an area about the size of a large county. Commercials are broadcast, as well as having a licence fee, and the organisation is controlled by various local authorities through a board of administration. All the areas combine under the auspices of the ARD. There is a second channel on u.h.f., similar in organisation, called collectively ZDF.

Although European television is of a high standard, concentrating on television productions rather than films bought from the United States, it is generally conceded that British television is of a higher standard both technically and in the type of programme.

Let us now examine the complete broadcasting system, from the engineering aspects. As the basic requirements of the television system are the same, the difference between the BBC and Independent Television Companies are few. With the Independent companies, the equipment usually remains operational for longer and more often the equipment is bought from outside manufacturers, as the extra costs of running research and development departments would mean loss of profit. Other than this, the main differences are in the operational techniques, principally the networking of programmes.

All programmes can come from two basic sources: a television camera, or a film camera. Production from the television camera with the action in a studio or an outside broadcast may be transmitted direct, or recorded on to tape for future use, or both. Almost invariably three or more cameras are used to allow the programme director to change the shots and move from area to area and give flexibility in operation. This is because a complete sequence will be recorded or a complete programme transmitted in a continuous show.

The film camera is used singly, and the action stopped at the end of each shot, when the camera would be moved, the lighting altered, and the next shot taken. Only continuous events covered for news and current affairs would use two or more film cameras. Later the processed film would be physically cut and joined in the correct sequence to give a continuous performance.

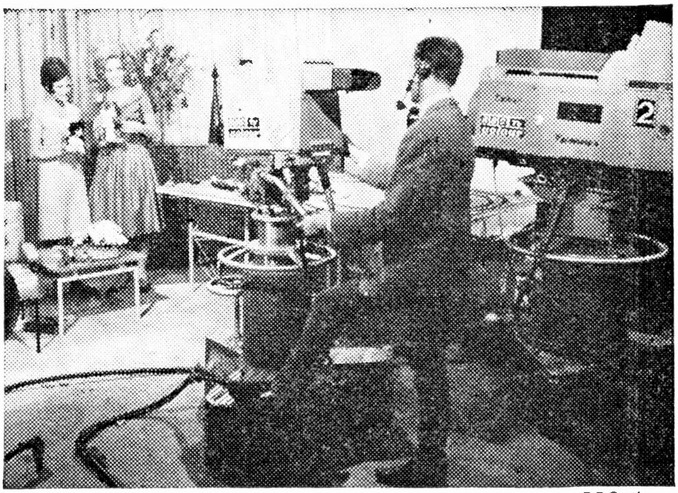
The television camera, recorded on to tape, can also be used in this manner but video tape editing is much more complex and tedious and less flexible than film editing, so is avoided if possible. Filmed programmes, then, have the flexibility of action which is impossible for the television camera, but the continuous performance and immediacy of the television performance has an atmosphere which is impossible to capture with the film camera.

Most television programmes combine some film with action from the studio, so outside shots, special action, fights and difficult or dangerous effects will be filmed and run into the rest of the programme. The costs of filming are extremely high even compared with the £3,000 a day for a television studio with full facilities. Film costs are high largely because filming is much slower than television camerawork and more, highly skilled personnel are needed.

A television studio should produce about 30 minutes per day of complete programme material but a single film stage will produce two to three minutes.

Television, then, revolves around the television camera, so next month we will look at the television camera in greater detail.

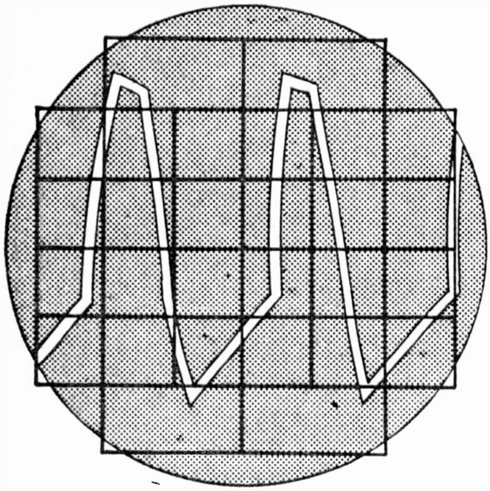
Part II next month



BBC photo

Colour cameras—a 3 plumbicon tube type camera on the left, 3 image orthicon on the right.

timebase traces



PART 3

K. ROYAL

MANY set makers are now including sketched details of signal and pulse waveforms to be expected at various points in the circuit on their diagrams and in their service manuals. These are extremely useful, and more manufacturers will have to join in now that colour television is here, to make servicing in the decoder and dynamic convergence circuits rely less on guess work.

While these waveforms contain most of the essential information, like time and amplitude values, they are not the same as the real display seen on the screen of a connected oscilloscope; there is a lot to be said, psychologically at least, for reproductions of real, live, off-screen displays.

This article features waveform displays actually photographed direct from the screen of the oscilloscope. These can thus be reproduced by anyone with an oscilloscope suitable for television applications.

So far, these relate to monochrome sets, but it is hoped later to prepare articles along similar lines based on the waveforms in colour sets.

PULSE AND BAR DISPLAYS

An interesting video waveform, taken from the cathode of the picture tube, is shown in Fig. 21. This is of the pulse and bar test signal transmitted outside programme hours by both authorities; Fig. 22 shows what it looks like on the screen of the television set.

The waveform can easily be related to the display on the screen of the set, bearing in mind that the video signal is negative-going at the output of the video amplifier. Shortly after the positive-going line sync pulse is a short pulse of negative-going video signal, giving the thin, vertical line on the television screen. The waveform returns to black-level for a short period of time, then rising to peak white for about half the line period, giving the broad white band on the television screen.

This test signal is very useful for it displays defects like overshoot ("ringing"), multi-path interference ("ghosting"), poor horizontal definition (by the way that the thin, vertical line is reproduced) and so forth.

The 'scope display of the waveform reveals how well the set is handling pulse and square-wave signals, and gives a good impression of the set's rise-time performance in the video stages. Note in Fig. 21 the slight tilting of the flat top (bottom) of the half-line "bar", indicating a very slight shortcoming in video low-frequency performance.

Another interesting waveform is given in Fig. 23 This is also taken from the cathode of the picture tube with the set receiving a BBC-1 transmission. The 'scope is set to field frequency and the Y amplifier adjusted to obtain the required vertical amplitude. The trace here shows the field sync pulse period on the video signal, and 'scope expansion was used to open it out a bit horizontally for more detailed study.

Again, the video signal is negative-going (going downwards on the picture), and the interesting feature is the thin, vertical pulse placed within the field sync pulse period. This, in fact, is another test signal transmitted, mainly by the BBC, during actual programmes. This pulse does not normally show on the picture because it occurs during the time that the screen is blanked by the field pulses. Normally, therefore, the pulse can only be seen by reducing the vertical amplitude or by slipping the field lock, and then it is visible in the black part between the two fields, as shown in Fig. 24.

The BBC are able to check the video response of the system at any time during transmissions by analysing these displays.

It is possible that similar test pulses will be transmitted on the signals of colour programmes and also, eventually, on monochrome u.h.f. signals so as to allow the performance of colour sets to be judged on a monochrome transmission. In this case, the pulses are likely to be placed relative to the line sync (or colour-burst) pulses to give colour bars in the line blanking, black intervals at the sides of the picture.

While the field period test pulses are invisible on well adjusted sets with correctly operating field timebase circuits, they do sometimes appear actually on the picture at the top of the screen on sets having a small fault in the field circuits. A curious aspect of this is that two sets of pulses are displayed, one set a little below the other. This happens because a complete picture is composed of two interlaced sets of lines, and *each* set of lines carries its own blanking and sync data with these test pulses.

DELAYED FIELD RETRACE

The reason that they sometimes show is because of a delayed field retrace or flyback. Normally, the retrace should be finished by the time that the

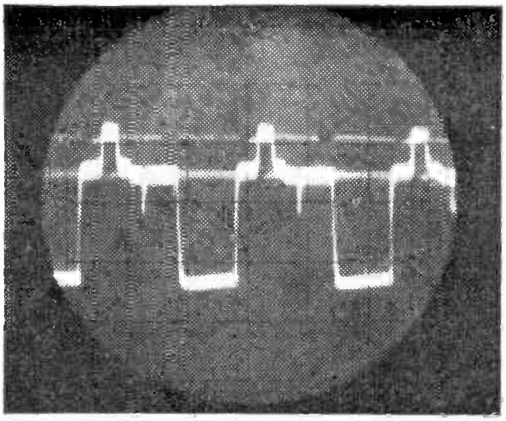


Fig. 21: Video waveform taken from the cathode of the picture tube of the pulse and bar test signal sometimes transmitted outside programme hours for network tests.

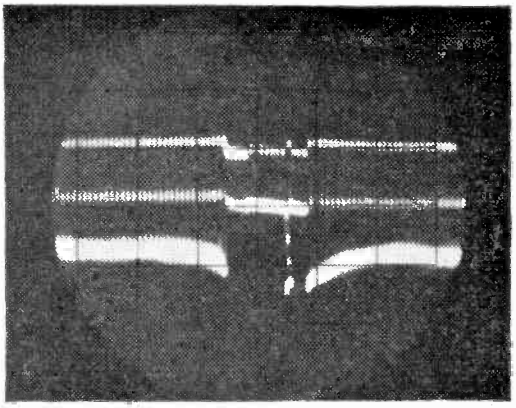


Fig. 23: Showing the test pulse transmitted by the BBC during the field sync period.

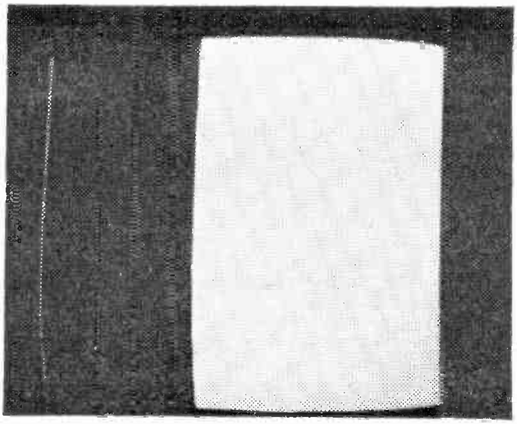


Fig. 22: The appearance on the television screen of the pulse and bar signal.

Fig. 24: Display of the test pulse shown in Fig. 23 in the black region between slipped fields.

picture information starts again on the next field; but if it is delayed the picture information starts before the set is ready for it. Thus, the pulses in the black level are made visible at the top of the screen. The picture on each field may not be distorted due to this, but the test pulses make it necessary for the field retrace to finish *before* the end of the field blanking/sync period.

Figure 25 shows the field blanking/sync period from an ITV transmission, without the test pulses. Comparing this with the pulsed waveform in Fig. 23 reveals that the pulse reduces the effective blanking period by about 20%.

It is interesting to observe the composition of the field sync period itself. The field sync proper occupies four line periods (405 standard), then there is the post sync blanking period which occupies ten lines, using up fourteen lines in total. The field information which occurs during *each* line period throughout the field period as a whole, consists of two $40\mu S$ field sync pulses proper and two $10\mu S$

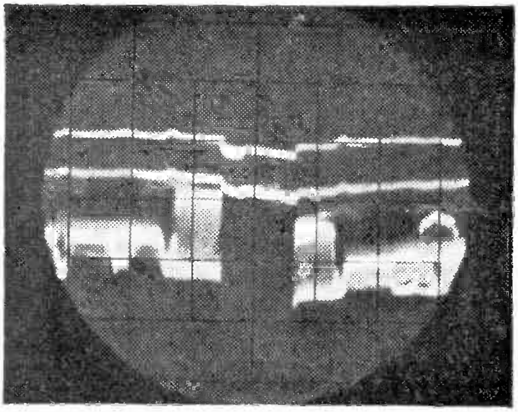


Fig. 25: The field sync period from an ITA transmission, without the test pulse.

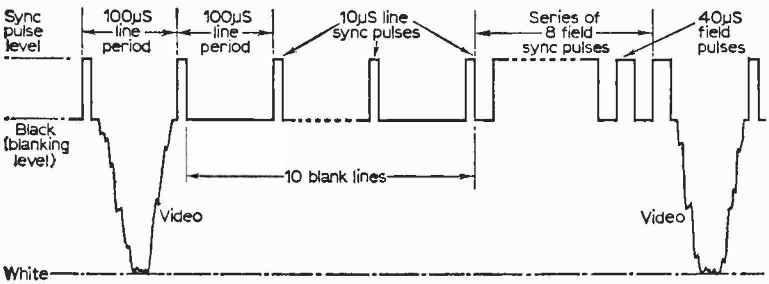


Fig. 26: Details of the pulses on the 405 standard during the field sync period.

intervals between them. On the four lines carrying field sync, therefore, there is a total of eight pulses.

The 10μS intervals are important because to the sync circuits in the set they resolve in the same manner as the line sync pulses and so keep the line timebase synchronised during the field sync period. The series of black, unmodulated lines during the post sync blanking period allows time for the circuits to settle down after the disturbance of the field synchronising.

Traces in Figs. 23 and 25 cannot define individually the 40μS sync pulses nor the 10μS intervals, but close examination of the traces will reveal the shorter line of eight sync pulses and the longer line of post sync blanking. These are visible at the top of the trace, actually in the field sync period as a whole, and are represented by the thickish, white horizontal lines. The line of this nature at the top left is the series of sync pulses and the longer line at the right below is the series of post blanking lines.

Figure 26 shows the theoretical representation of the sync and blanking trains of an "even" 405 standard field. This will clarify the above description of the field sync period.

Viewers troubled with the test-pulse display at the top of their pictures may be interested in hints to clear the trouble. In some older models it is virtually impossible to delete the lines without serious modifications to the field timebase. Of course, when these sets were made the pulses were not transmitted and the designed-for retrace time was adequate for the full field pulse period. To clear the trouble requires the field retrace to be cut by at least 20%.

More recent sets suddenly displaying the lines should firstly have their field timebase valves tested, preferably by substituting with valves known to be in good order. Some field timebases use a double-triode in the generator, and it has been known for this valve to be responsible for the delayed retrace in several cases. The valve fails to show "low emission" on a tester, but the fault clears when it is replaced. If a double-triode of a slightly different type is used the fault may appear, even though the valve used operates the timebase correctly otherwise.

Trouble in the transformer of sets using a blocking oscillator is another possibility—again, the timebase action generally being unimpaired. In multivibrator circuits the resistors in the anodes of the generator valves may go a little high in value and result in the symptom. Another cause is change in value of the "charging capacitor" at the output of the field generator. This capacitor charges through a resistor in the valve anode circuit, from h.t. positive, and the "switching" action of the generator discharges it on the retrace. The top of the capacitor feeds into the control grid circuit of the field output valve, via a capacitor, and probably through the field linearity control circuit.

It has also been known for leakage in the field output transformer to increase the retrace time; and it is as well to check any capacitors on the anode in obstinate cases of the symptom.

DEVELOPMENT OF THE COMPOSITE FIELD SYNC PULSE

Now let us see what happens to the chain of field sync pulses when they are applied to the integrating circuit of the sync separator. The trace in Fig. 27 shows the pulses "added", so to speak, at the anode of the sync separator valve, prior to entering the integrating circuit. The broad, horizontal line, making up most of the trace, are line sync pulses very close together (remember that the sweep of the oscilloscope is set to match the field frequency). The development of the field pulses can be seen on the "pulse" effect at the break in the middle of the trace.

Figure 28 shows what happens to the pulse after its journey through the integrator, between the sync separator anode and the field timebase generator. It will be recalled that this network is essentially a low-pass filter, letting through the 40μS field pulses while attenuating the 10μS line pulses. Actually, the integrator effectively "adds" successive field pulses, producing one big pulse to "fire" the field generator Integration means "adding."

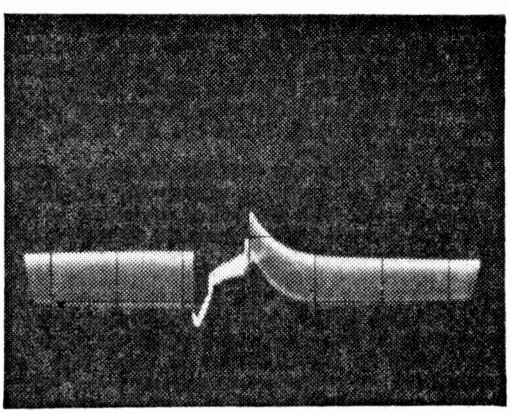


Fig. 27: The field pulses at the anode of the sync separator valve.

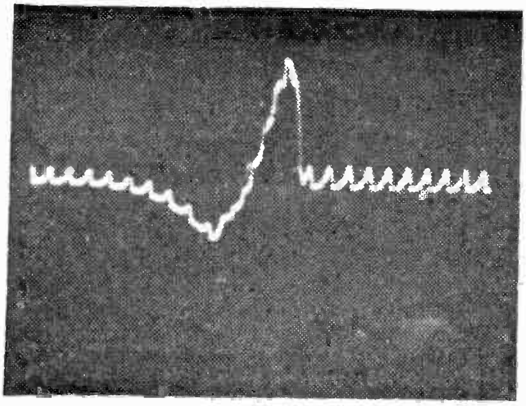


Fig. 28: The field pulses after passing through the integrating network. The line pulses are greatly reduced in amplitude as this waveform shows.

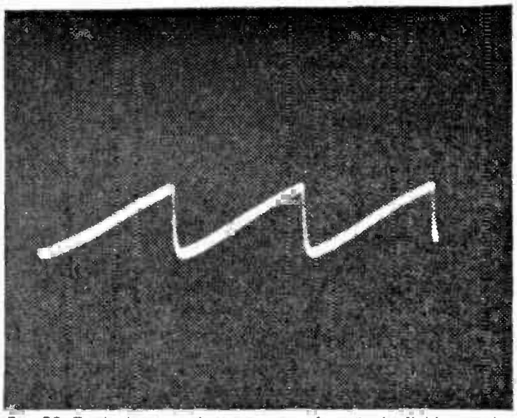


Fig. 29: Typical sawtooth current waveform in the field scanning coils, monitored in terms of the voltage developed across a series-connected resistor.

While there are still line pulses present on the waveform developed here, they are of relatively small amplitude (compared with the amplitude of the integrated field pulse). Many modern sets employ further filtering circuits, arranged with a diode, to delete all traces of the line pulses.

Conversely, the line sync pulses are fed to the line timebase generator through a differentiating network. This is a high-pass filter which lets through the line pulses with little attenuation while heavily attenuating the longer duration field pulses.

SCANNING CURRENT WAVEFORMS

Many enthusiasts and service technicians gaining acquaintance with the oscilloscope in television circuits are keen to "look in" at the sawtooth waveform in the scanning coils. This is a *current waveform*, since a sawtooth current needs to be driven through the scanning coils to obtain the linear deflection sweep and the rapid retrace, and since an oscilloscope monitors voltage—not current—some method of monitoring the current in terms of voltage has to be employed.

This is not as difficult as it may seem, for a resistor in series with the coils to the coupling transformer will pass the sawtooth current and develop across it a sawtooth voltage waveform of exactly the same characteristics. This is possible because a resistor is non-reactive.

The value must be as small as possible to avoid loss of scanning power and unbalance in the coupling. However, since the sawtooth current is in the order of amperes, quite a small value resistor will develop adequate voltage for operating the oscilloscope, especially since the majority of instruments designed for television applications can be switched to a sensitivity of at least 100mV/cm on the Y amplifier. Thus, it requires only 500mV to provide 5cm of vertical deflection (peak-to-peak). With a current of, say, 1 ampere flowing this magnitude of voltage will develop across a mere 0·5Ω—barely enough to affect the timebase working or its coupling to the scanning coils.

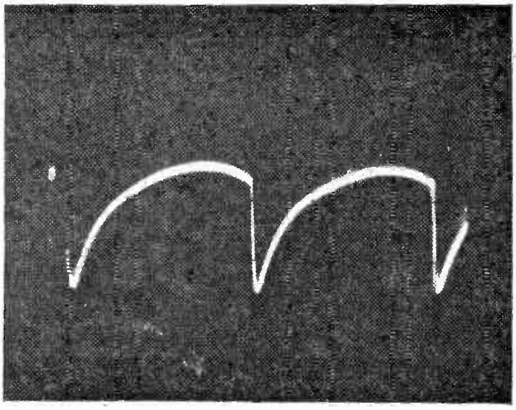


Fig. 30: Waveform derived from the same set-up as Fig. 29, but with the field linearity controls out of adjustment.

Extreme caution must be exercised, however, when this technique is adopted in the line timebase, for here quite high potential pulse voltages occur during the line retrace. These can cause electric shock, burns and damage to the instrument if wrongly utilised.

Figure 29 shows a typical field sawtooth current waveform obtained in this way, while Fig. 30 reveals how the waveform becomes distorted when the field linearity controls are maladjusted. The waveform is reduced from pure sawtooth to exponential, and it is distortion of this nature that is responsible for compression at the top of the picture, at full field scan.

Now that television sets are becoming more complicated and difficult to get at due to printed circuit and module techniques, coupled with the advent of colour, there will be greater need to call in the use of the oscilloscope for fault diagnosis work. It is hoped that this, and the other waveform articles mentioned earlier, will encourage greater use of this most versatile instrument. ■

UNDERNEATH

THE DIPOLE

NOW that the ITA's franchise "dust up" is over, it is possible to hazard a few guesses as to where the "gold dust" (if any) will finally settle. Before the announcement of the television contract awards for all the areas, many knowing nods, nudges and winks accompanied "inside information" tic-tacked to Fleet Street. Without recourse to a "D" notice or any other ritual censorship, Lord Hill, Sir Robert Fraser and the top brass of Independent Television Authority succeeded in maintaining complete secrecy on their choice of contractors for the golden plums of the electronic world.

No frying tonight!

Plenty of rumours, lots more rumours of rumours, together with a spate of red herrings were served out by Fleet Street journalists and eagerly consumed by you and me from the newspapers—vinegar and all! There was no leakage. While there were disappointments, particularly for TWW, the organisation of the selection board, its mode of operation, and its speedy decisions were carried out most efficiently.

If only the Pilkington-Hoggart Committee had been as efficient, when they made a number of decisions four or five years ago which have since proved unfortunate, British television would now be in a healthier state, with BBC-2 transmitting on frequencies more suitable for colour TV broadcasting, instead of being restricted by the black-spotted, short ranges, achieved (if lucky) with outside aerials.

New structure

The whole structure of ITA regions will have to be reconsidered when ITA turns over to colour TV on u.h.f. Their present allocation of v.h.f. transmitters covers a number of areas which only require one or two transmitters. Indeed, the transmitters often cover parts of their neighbouring ITV company's "territory".

How many u.h.f. transmitters will have to be built in Northumberland and Durham Counties to provide Tyne Tees with exactly the same coverage achieved by the ITA's transmitter at Pontop Pike? And what will happen to the overlap between Tyne Tees, Anglia and the new Yorkshire Television Company, when such transmission overlaps are to be reproduced on colour u.h.f. signals in the delightful hills and dales of Yorkshire or the wide open spaces of Lincolnshire?

Will every cosy little sheltered village in an otherwise black-spot of colour TV reception, need its own little transistorised transmitter, neatly erected by the ITA on a bracket to the sole oil-lighted lamp post near the village smithy? You can be sure that these counties will bristle with all shapes and sizes of transmitters, probably a hundred of them, all requiring programmes to be networked or relayed to them by a series of microwave hiccups. This applies to colour TV on BBC and ITA. There'll be as many black-spots in a year's time as there are on the roses growing this year in our gardens.

Flying colours

There is no doubt that viewers in the London area who can receive a good picture from BBC-2—and who were also fortunate enough to have or to see a colour television receiver, enjoyed seeing the Wimbledon tennis. This was a suburban oneupmanship talking-point for days. Many colour receivers gave a much better picture than current model black-and-white domestic sets, even when dealing with black-and-white programmes too. This is because these sets include —sch-h-h, circuitry with d.c. restoration, the well-known family remedy for making bad pictures good. BREMA, please note!

The rush for buying, or preferably hiring colour television receivers is starting in no uncertain manner, and will continually overtake the supply. Those I have seen have all been very good, and some of them cost as much as the selling price, awaiting the time when mass production, cutting corners (even at the expense of good picture quality) and the old-old-lyric of "cabinet quality is more important than picture quality", the theme song of BREMA, this is where we came in on black-and-white, wasn't it?

Logic and acoustics

Architects have a difficult job these days to design auditoria which satisfy musicians and their audiences. Take the Festival Hall, that clinical all-purpose concert hall which was designed with no stage and no projection box and with reverberation which was described by most musicians as being "too hard", "too vivid" or "too plastic", according to the adjective fashionable in their particular circle. And so, an elaborate electronic reverberation turbulence device was added and the *décor* of the building was made more clinical than ever.

Architects of film and television studios are not faced with this kind of reverberation problem when they are building either types of studios, but terrible acoustic mistakes do arise, time after time. Studios are built often without adequate sound-proofing between stages, so that the noises of hammering when a setting is being constructed on one stage is likely to ruin a scene that is being shot on the other. This is due to the stages being built too close together, or worse still where their steel frames are connected by RSJ's which might, for instance, be supporting control or other rooms between them.

There is one pair of studios in England where it is said (with a certain amount of exaggeration perhaps) that you can hear a man change his mind in the other stage every few minutes. Other outside noises which are unwelcome are the sounds of a large orchestra playing *fff* in a scoring stage which (by chance) is adjacent! Or the noise of a garage underneath the stage from which can emanate through the floor the roar of motor bikes being driven by (colour blind?) riders in spite of red "SILENCE" warning lights! How the possibility of these disturbances is overlooked doesn't seem to have any logic. Sabine's formulae for reverberation are regarded with contempt, while the possibility of noises being structure-borne is virtually ignored.

Oscar Hammerstein 1st

But, come to think of it, acoustic wizardry was an old wives' tale, the formula of which has long been lost. The *very best* auditorium for a musical play in London was the old London opera house, later called the Stoll Theatre, Kingsway. This was built in 1911 to the ideas and designs of Oscar Hammerstein 1st. This great American impresario had already built nine theatres in New York, Philadelphia, Chicago and Boston. All of his theatres "held" sound beautifully, but he was never able to explain how he achieved this acoustic warmth, nor the illusion of the audience being closer than at Covent Garden or at New York's Metropolitan Opera House, where the auditoria were acoustically and visually cavernous and deep by comparison.

He experimented with various types of wood, of course, and made great use of hollow hung plaster ceiling pieces, elliptical in shape, which usually followed the contours of the tops of his proscenium arches. Hollow plaster ceiling beams and plaster cupids abounded, plus wood and papier mâché embellishments of various other types, all precisely placed. Beneath the hardwood floor of the orchestra pit there was first put down a layer of broken glass 1ft. 6in. deep, the whole length and width of the pit!!! Oscar Hammerstein, and the British theatrical architects, Frank Matcham and Bertram Crewe, all seemed to have special talents which enable audiences in their theatres to hear actors speak and sing long before microphones became a necessity.

Theatre-in-the-round (originally intended for actors on horseback), clinical "functional" walls (rather like a hospital operating theatre) and buildings of which the front elevation is usually reminiscent of the ugliest Maginot fortress, complete the modern idea of some of today's functional inspirations by the Arts Council!

Every frame a Rembrandt!

Most film directors and lighting cameramen like to think that every frame they shoot is a work of art. A full length feature film includes many thousands of Rembrandts and a few Grandma Moses too—but it is in the TV commercial sphere that each frame really does count. When a director is working against a stop-watch, everything must be exact. He has only 15, 30, 45 or perhaps 60 seconds to sell a product successfully—which means constant trimming of a script which has to obey the rules laid down by the ITA for commercials, be convincing and above all, to entertain.

Directors of commercials often shoot up to 3,000 feet of film to obtain the vital 60 feet for the filmlet. As far as costs are concerned frame for frame a TV commercial can cost more than some feature films have done. The Advertising Agency produces a script that the manufacturers decide on—it might feature cartoons, children, racing drivers or a world-famous personality endorsing the product. It can be shot in a small room—or involve a foreign location with a full film unit. In fact, no two commercials are really the same—even if the viewers think there are similarities!

It is interesting that more and more well-known actors and actresses show their faces in a TV commercial and don't just do the "voice overs"—but then there are repeat fees payable each time a commercial is shown varying from region to region. So Hancock "sells" eggs, Milligan promotes petrol, Ronnie Corbett biscuits, Kathleen Harrison bread, Patrick Cargill cigars and Braden soups. TV commercial families come and go but the Oxo ones go on for ever, and of course the Randalls.

Before a commercial is networked, it is test-shown in one of the smaller regions, and the Advertising Agency checks that those watching absorbed the intended copy points, based on the age and social group who should buy the product. Whatever our views on commercials and advertising in general, it is as well to remember that these filmlets pay for Independent Television, and pay a levy to the Chancellor of the Exchequer.

Sometimes they are the most witty and entertaining snippets in a programme. The BBC has its equivalent to ITV's commercials; advertising the *Radio Times*, other programmes and trailers of forthcoming offerings on BBC-1 and BBC-2. Why not?

Iconos

COLOUR TV AND DEALERS' LICENCES

The PMG announced recently that the £10 licences for colour television and the special demonstration licences for radio and television dealers will be brought in on January 1st, 1968.

The White Paper on Broadcasting (Cmnd. 3169, December 1966) said: "24. It is the Government's view that the cost of colour programmes, which are likely at the outset to be available only to a small minority of viewers because of the cost of receivers, should not fall upon viewers in general. Accordingly a supplementary licence fee of £5 will be required to receive colour programmes."

The colour licences which will cost £10 will, of course, also authorise reception of monochrome television and of sound radio.

The Postmaster General announced on May 4th in the House of Commons this decision to introduce special licences for radio and television dealers. These licences will apply only to dealers' showrooms. Any dealer with combined business and residential premises will still require the ordinary broadcast receiving licence: and dealers will, of course, also require ordinary licences to use broadcast receiving apparatus in their homes. The demonstration licences, which will cost 5s. will be valid for seven years. Dealers should obtain them on renewing licences expiring on or after January 1st, 1968.

all transistor colour sets

WE are now able to publish fuller details of the first fully transistorised colour television receivers reported in the July issue. The Thorn/B.R.C. 2000 chassis is already in production and being distributed to various parts of the country. Models announced are Ferguson *Colourstar* Model 3700, Ultra *Bermuda* Model 6700, H.M.V. *Colourmaster* Model 2700 and Marconiphone Model 4700. All are fitted with a 25 in. shadowmask picture tube. Silicon transistors are used throughout and the sets carry a one-year guarantee.

Modular construction

The use of transistors throughout has enabled a reduction in weight to be achieved, but even so a colour receiver is inevitably weighty and installation or removal for servicing is a two-man job. With this problem in mind the 2000 chassis has been designed as a series of modules which can easily be removed and replaced so that most servicing can be carried out in the field.

The chassis comprises a basic rectangular framework with a wiring harness into which are plugged ten printed circuit boards which make up the main circuitry. There are seven other units which, like the plug-in boards, can be removed and replaced in under two minutes. These include the integrated v.h.f/u.h.f. tuner unit, mains transformer, deflection and convergence coil assembly, e.h.t. tripler rectifier assembly, blue lateral assembly and loudspeaker. The ten plug-in printed boards are located in channels to enable them to be simply slid out, with an edge connector at the far end. The circuit has been split into these ten units to simplify servicing; all that is necessary being to determine the source of the fault and replace the appropriate board, complete sets of boards being supplied to dealers.—See page 440/441, July.

A number of departures from what have come to be accepted as standard practice are to be seen. To begin with a double-wound mains transformer with fully isolated chassis is used, something we have not seen for many years. This means that a three-core mains cable is used, with the chassis earthed via the third lead in the mains cable. The use of a double-wound mains transformer is a convenient way of obtaining the various supply lines required in the receiver—270 volts for the video section, separate 60-volt lines for the field timebase, line timebase and e.h.t. sections and a 30-volt supply for the small-signal stages—and also improves the safety factor of the receiver.

Automatic feedback control techniques are widely used throughout the receiver. Thus an efficient a.f.c. circuit is incorporated in the u.h.f. tuner using a variable-capacitance diode coupled to the oscillator circuit an automatic chrominance control (a.c.c.) circuit is incorporated in the decoder, and feedback stabiliser circuits are incorporated in the field and line timebase supply circuits and in the e.h.t. generator stage.

Perhaps the most surprising departure at first glance is the use of a separate e.h.t. generator stage instead of the combined line output/e.h.t. stage that has been in universal use since shortly after the war. The e.h.t. generator stage, however, works on the same principle as the well-known line-flyback system, but operates in conjunction with an elaborate stabilisation circuit

The video drive for the picture tube is derived from three cascode pair video stages which drive the cathodes of the R, G and B guns in the picture tube. This is a change from the usual technique whereby the luminance signal is applied to the three cathodes and colour-difference signals are applied to the three grids so that the tube itself acts as the final true colour recovery device in the set. Instead of this the true colour signals are obtained by matrixing in the video output stages (see later). Advantages claimed for this technique are absence of the need for a separate high-power luminance video output stage and the fact that the tube grids are free for blanking circuits and can be kept low impedance so that picture transients applied to the cathodes are not impaired.

Automatic degaussing is effected whenever the receiver is switched on and also when changing to a different line standard.

A user-operated tint control is provided. This enables the viewer to adjust the balance between the red and blue outputs to vary the background of colour or black-and-white pictures from neutral to a very light red or blue tint to give the picture a "warm" or "cold" background. It also provides the viewer with a means of compensating for the effect on the picture of ambient light which is not neutral.

To reduce the possibility of interference with the operation of the picture tube from magnetic fields within the receiver, output transformers have been eliminated from the field and audio output stages.

An advantage of complete transistorisation is the absence of x-ray radiation from the receiver. With the high e.h.t.—around 24kV—required by shadowmask picture tubes, this radiation may occur from the e.h.t. rectifier and associated triode stabiliser tube used in hybrid designs so that the line output/e.h.t. stage then requires special screening.

Power circuits

The primary of the double-wound mains transformer is provided with 10-volt tapping points to enable the set to be accurately set for the mains input—an important point in ensuring long tube life. Separate secondaries and full-wave bridge rectifier circuits feed the line and field timebases, with separate series regulator circuits to stabilise these supplies. The line regulator is provided with an electronic cut-out, comprising a complementary pnp-npn pair of transistors which switch on very rapidly to short out the series stabiliser transistor in the event of a fault in the line timebase.

Separate h.t. supplies are taken to the e.h.t. generator stage, which incorporates its own stabilisation circuit, and to the video stage, which requires a 270-volt supply. The 30-volt supply for the small signal stages is stabilised by two zener diodes.

Line timebase and e.h.t.

The line timebase and e.h.t. generator stages are shown in block schematic form in Fig. 1. A blocking oscillator is used as the basic line generator, and is controlled via a variable reactance circuit by a flywheel sync circuit. A driver stage follows the blocking oscillator, and this is coupled by the driver transformer via separate secondaries to the line output stage and the e.h.t. generator stage.

The driver transformer is of rather special design, being required to provide a square-wave output to switch the line output transistors and e.h.t. generator transistor on and off very rapidly. To achieve this the transformer requires high inductance with very low capacitance, and is thus a specially wound component.

This square-wave input to the line output stage will be a further surprise to those used to thinking in terms of sawtooth timebase waveforms. A sawtooth waveform is of course, still required for linear scanning, but is obtained here by making use of the non-linear characteristics of the line output transformers and the scanning coils. A square-wave drive to the transistors in these stages is required because of their limited power handling capacity, which means that they must be switched very rapidly between their on and off conditions. The demands made upon the driver transformer are particularly stringent in this respect, the leading edge of the square-wave output required being particularly sharp.

The e.h.t. generator and line output stages use three jelly-pot transformers of similar design to the standard jelly-pot line output transformer used in recent black-and-white Thorn television chassis, two of these jelly-pot transformers connected in parallel being used in the line output stage to match the relatively low impedance of the line output transistors to the standard deflection coils that are used for scanning.

Two line output transistors connected in series are used in the line output stage. This presents certain problems, the main one being to ensure that they share equally the flyback voltage pulse when it occurs at the end of each line scan period. To overcome this problem the parallel connected output transformers are centre-tapped and fed via an RC series network to the junction of the two transistors.

Thus, during the flyback period, voltages of equal magnitude appear across each half of the centre-tapped primary windings and are connected to the junction of the transistors via the low-impedance network to ensure that the voltage across each transistor is equal.

The e.h.t. generator consists of a switching transistor and jelly-pot transformer working on the same principle as the line-output-flyback-e.h.t. system. The "flyback" pulses occurring when the transistor is switched off by the square-wave drive applied to it are of about 8kV, and these are rectified and stepped up to the 24kV required by the shadowmask tube by a voltage tripler circuit which is mounted directly on the tube anode button to eliminate high voltages within the chassis and increase the safety factor. E.H.T. regulation is achieved by means of a feedback amplifier. using a differential amplifier input stage, which samples the final anode voltage.

Video stages

The video section of the receiver is shown in block schematic form in Fig. 2. The luminance signal obtained at the video detector is amplified

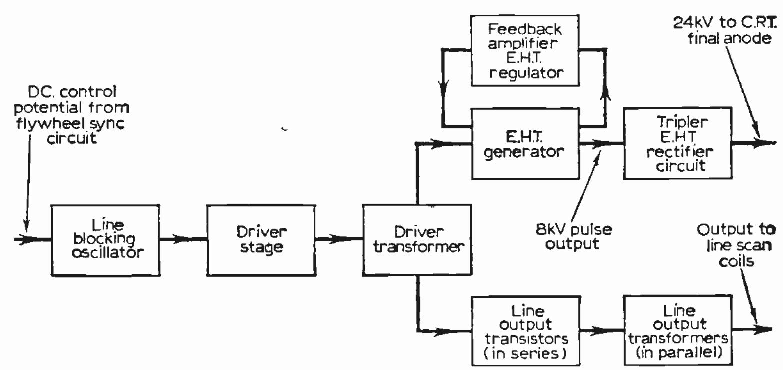


Fig. 1: Block diagram of the line timebase and e.h.t. generator sections of the receiver.

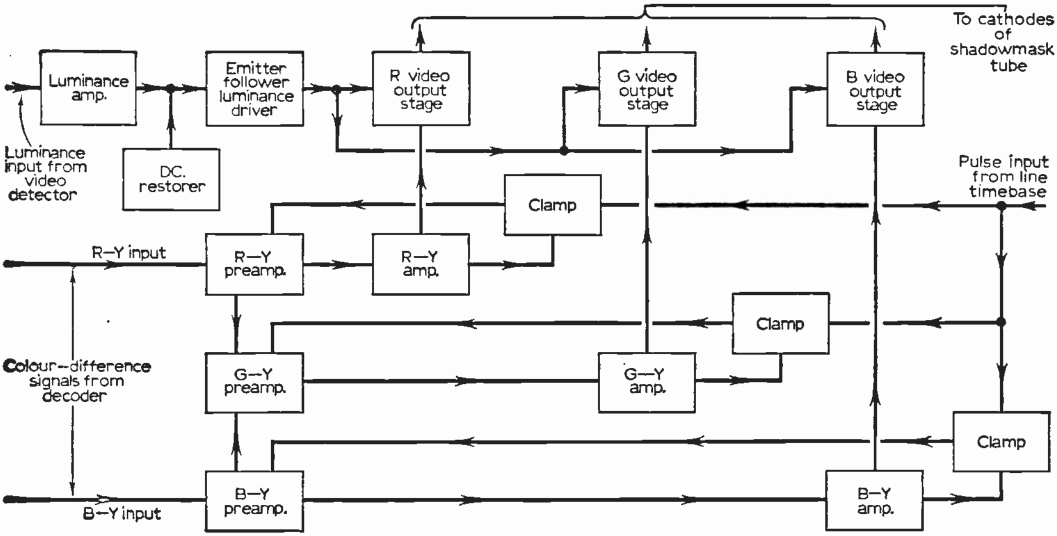


Fig. 2: Block diagram of the video sections of the receiver.

and fed via an emitter-follower driver stage to the three video output stages (R, G and B). D.C. restoration, an 0.6μS delay line (to keep the luminance and chroma signals in step) and an electronically switched in 4·43Mc/s trap are included in the luminance channel.

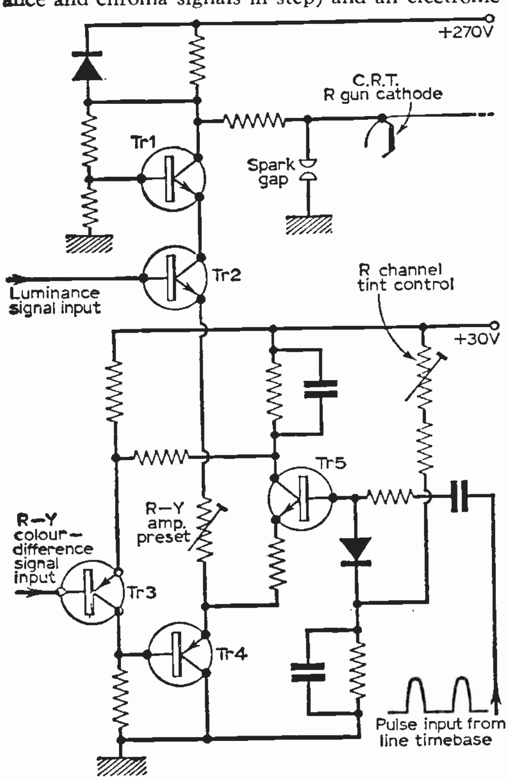


Fig. 3: Simplified circuit of one channel—the red one—of the video section of the receiver.

The R—Y and B—Y colour-difference signals from the decoder (chroma board) are fed to separate preamplifier stages. The outputs from these are fed to the appropriate colour-difference amplifier stages and also via a matrix network which recreates the G—Y signal to a G—Y colour-difference preamplifier and amplifier.

Clamp circuits associated with each colour-difference preamplifier and amplifier ensure that the luminance and colour-difference signals are clamped to the same d.c. levels. The colour-difference amplifiers then feed the R, G and B video output stages. Thus each video output stage is fed with the luminance signal and a colour-difference signal.

The operation of these stages will be more clearly understood by referring to the simplified circuit of a single video output stage with colour-difference preamplifier, amplifier and clamp shown in Fig. 3. Here Tr1 and Tr2 form a cascode-connected video output stage. The luminance signal is applied to Tr2 base and the colour-difference amplifier stage Tr4 is connected in its emitter circuit. The result of this is that the video stage achieves the necessary matrixing and a true colour signal is fed from Tr1 collector to one of the shadowmask tube gun cathodes.

Internal flash-overs in picture tubes are a common problem that requires extra attention where transistors are used to drive the tube. The circuit shown in Fig. 3 incorporates three protective techniques to protect the video output stage. First a spark gap close to the tube cathode, secondly a series resistance to limit the current and thirdly a diode across the collector load.

Tr3 in Fig. 3 is the colour-difference preamplifier stage, and it can be seen that the transistor clamp Tr5 is connected between the emitters of Tr3 and Tr4. The base of the clamp is fed with a series of

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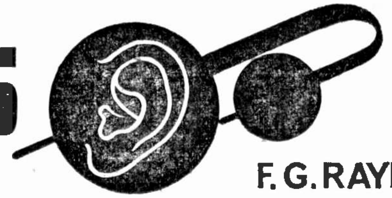
HEADPHONES



FOR TV SOUND

F. G. RAYER

TELEVISION is enormously important for persons with impaired hearing. Sometimes viewing is reduced because they need the receiver volume set too high for others, or because the continuous use of a hearing-aid is not wanted. An extension circuit for headphones or a miniature receiver may be the best solution, and can be fitted up at small cost. This also allows anyone to listen without disturbing other members of the household, which is occasionally useful.

The type of headphones to use depends on personal choice. The individual may prefer a complete change from the usual miniature insert and like lightweight headphones with headband. One of the various personal earpieces may be purchased. or a plug-in earpiece with cord taken from an old unwanted hearing-aid of a large type. The important points are comfort, and suitability for the person concerned.

Some receivers have output transformer and speaker electrically isolated from other circuits, but numerous receivers return these to chassis and negative feedback circuits. The receiver chassis is expected to be alive or common to one mains lead. So complete and reliable isolation of the extension circuit should always be arranged, even if chassis goes to mains neutral.

The isolating transformer is connected as in Fig. 1. It must be of reliable manufacture, with sound insulation adequate for mains voltages between primary and secondary.

Inside the receiver, leads run from the speaker matching transformer secondary to tags near the speaker cone, Fig. 1. Flexible pigtails pass to the speech coil. Take two well insulated leads from these tags, or from the speaker matching transformer secondary, if more convenient. Run them to the isolating transformer primary, Fig. 1.

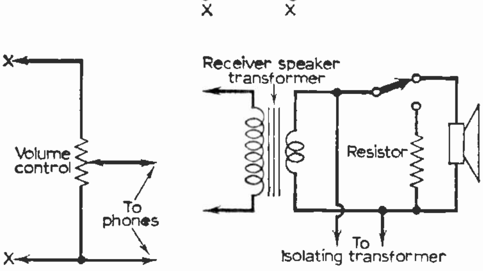


Fig. 1 (top): Isolating transformer connections.
Fig. 2 (bottom left): Volume control for headphones.
Fig. 3 (bottom right): Optional speaker silencing.

Mount the transformer inside, so that it and its connections cannot touch the receiver chassis or metal parts. It can be bolted to hardboard fixed to the chassis, or screwed directly inside some cabinets.

Fit two sockets, X-X, on the insulated back of the cabinet, again well clear of chassis and metal parts. Use soundly insulated wire, clear of valves, resistors, or other sources of heat. The isolating transformer and leads are all remote from the cathode ray tube and its connections.

TRANSFORMER RATIO

This depends on the impedances to be matched, but some mismatch seems unimportant. In any case the d.c. resistance is quoted for phones, and not the impedance.

For high resistance phones (around 2,000 ohms) a ratio of about 30:1 to 35:1 is suitable. For somewhat lower resistance (say 1,000 ohms) this can be dropped to about 20:1 to 25:1 or so. For 500 ohms, something around 15:1 is suitable. Magnetic personal earpieces are around 60 to 100 ohms, and a ratio of about 6:1 to 4:1 will do for these.

This assumes a normal speaker impedance of about 2 to 3 ohms. The higher ratios can be found on speaker matching transformers. The low resistance winding (used as the secondary when speaker matching) is the primary when used for isolating as shown in Fig. 1. A tapped transformer allows changing the ratio.

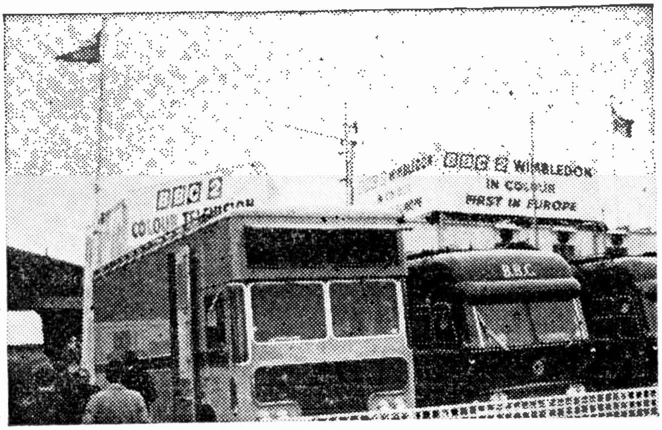
Insulated leads run from X-X in Fig. 1 to the volume control Fig. 2. If the user always sits in one position in the room, leads can follow a picture rail, or be otherwise fixed out of the way. If not, use a convenient length of good quality twin flex.

For best control, the potentiometer is a little higher in value than the phones, but a very high value gives abrupt control near one extreme. For 2,000 ohm phones, a 10 or 15kΩ potentiometer is suitable, with 5 to 10kΩ for 1,000 ohm phones or about 2 or 3kΩ for 500 ohms, and a 500 ohms or 1kΩ control for miniature 100 ohm and similar personal earpieces or low resistance headsets.

The volume control is in a small plastic box, with sockets for the headphone cord plugs. Connect for conventional clockwise increase, and mark clearly for off (zero volume) and maximum volume.

The receiver speaker is set at the level wanted by others and the headphone user then adjusts his control. If wished, the receiver speaker can be silenced by adding a 2-way switch, Fig. 3. This interrupts one lead to the speaker, and brings a 1-watt carbon resistor into circuit. Its value is chosen to agree with the speech coil impedance it replaces—often 2 to 3 ohms. Slightly higher and perhaps more readily available resistors can be used in parallel. For example, two 4·7 ohm resistors give about 2·35 ohms. ■

New BBC COLOUR O.B. Unit



IN ACTION FOR THE FIRST TIME FOR THE COLOUR SWITCH-ON AT WIMBLEDON

The spectacular preview of colour television which began on July 1 from Wimbledon served as an admirable opportunity to try out the new Colour Mobile Control Room and its ancillary vehicles. The new OB unit is the first of three new colour mobile control rooms to be built and installed during the consolidation of the colour service.

The unit consists of the CMCR itself plus rigging tender, camera van, runabout van, power van. Four Peto-Scott three-plumbicon cameras are used, each fitted with a Rank-Taylor-Hobson zoom lens, and modified for BBC head amplifiers incorporating f.e.t.s. The CMCR is designed to work on 625/50 PAL but 525/60 NTSC facilities are available.

The vision apparatus area contains equipment for sync generation, colour coding, test signals, preview matrix and vision and sound distribution. A circuit line-up and test position can call on colour bars, staircase, picture line-up, grille, augmented pulse and bar, non-linearity test and sawtooth and bar tests. Derigging is simplified since all equipment is built on 19-inch racks divided into internally-connected sub-racks.

The production and vision control area follows conventional layout. The vision mixer has ten channels and the colour reference burst is maintained at constant amplitude and phase when the output signal is faded.

Each camera control unit is in a self-contained console and has "contours out of green" facilities which utilises the green signal to provide vertical and horizontal aperture correction and a linear matrix to improve colorimetry.

The picture monitor rack contains two colour and six monochrome monitors. One colour monitor is coded and displays the transmission or preview picture; the other is switchable to R-G-B or coded operation and is used for colour matching on the camera pictures. Four of the monochrome monitors are used for channel preview, one for a compatibility check, the other as switchable preview monitor.

A Solartron waveform monitor and a BBC channel waveform monitoring unit is available for each pair of camera channels. This unit displays sequentially the outputs of the red, green and blue channels and a sawtooth and bar for calibration, and is used to match gamma and to ensure constant grey scale tracking between the three tubes.

The 23-channel sound mixer is designed around the EMI encapsulated amplifier 839/1 and is about the size of a plug-in relay. Normal talk-back, prefade listen, clean feed and echo facilities are available. A Studer A62 tape recorder is available, remotely controlled from the sound desk. Two radio microphone receivers are fitted and a u.h.f. radio check receiver, the output of which can be fed to the commentator's position, etc. The sound desk is powered from 24-volt batteries which are floated across a stabilised 24V supply.

A LOOK AT TRANSISTOR TV CIRCUITS — PART 1

S. GEORGE

WITH the increasing use of transistor v.h.f. and u.h.f. tuner units, transistor receiver sections, plus the emergence of more than one fully transistorised receiver, the time is opportune to take a closer look at the circuitry and changes involved in the transition from valves to "solid state" techniques.

Undoubtedly, the first impression one gets in looking at transistor TV circuits is of the larger number of semiconductor devices required, compared to the equivalent valve circuits, to fulfil similar functions, plus the use of stages not necessary in valve designs. As an example, excluding mains and auxiliary power rectifiers, and a voltage reference diode, the transistor Philips T-Vette has 44 semiconductors plus one valve, the DY51 e.h.t. rectifier. The set incorporates three transistor i.f. amplifiers, two sound i.f. amplifiers, four a.f. amplifiers, a video driver stage in addition to the video amplifier and, in the power supply circuit, a feedback amplifier, differential amplifier and power regulator.

Then the need for the transitors in some stages to be drawn "upside down" in TV circuits, for example where there is a mixture of pnp and npn stages, requires at first some mental readjustment: the use of both pnp and npn types in the one model can lead to much difficulty in quickly assessing stage functioning, although, as in radio practice, the majority of the transistors used at present are pnp types.

The Pye 40F hybrid model, however, which uses mainly npn transistors with the emitters connected to the negative chassis side of the supply and the collectors returned to a positive l.t. rail, follows the conventional practice used in drawing valve circuits and is thus easy for the newcomer to transistor TV circuits to follow, for undoubtedly after years of interpreting TV circuits with the valve cathodes taken to a negative chassis and the anode loads taken to the positive side of the h.t. rail at the top of the circuit a reversal of this layout, particularly when the biasing and a.g.c. feeds to transistors are so very different to those employed in valve circuits, can give rise to considerable difficulty in "reading" circuit diagrams.

POWER SUPPLIES

With hybrid models, while care must be taken to ensure that the transistor supply voltage does not rise above a certain maximum, there is no need for the full stabilisation that is necessary in all-transistor models where variations in power supply become immediately evident in picture size variations.

In those receivers that employ transistors only in the tuners, the l.t. supply is simply obtained by means of a series resistor from the main h.t. rail with a suitable v.d.r. shunting the transistor feed in similar fashion to the method employed for height stabilisation in current valve field timebase designs. If the h.t. rail voltage rises, the internal resistance of the v.d.r. drops so that an increased current flows through the common resistor feeding both the transistors and the v.d.r., the applied voltage then remaining reasonably constant.

Of course in receivers which take a transistor l.t. supply from the h.t. rail, the greatest need for stabilisation is from immediately after switch-on till the valves start passing current, and when the h.t. output from the silicon power rectifier is at peak value. Two examples of an l.t. supply for transistorised tuners are shown in Fig. 1.

Where the entire receiver section up to the output stages is transistorised the power supply may conveniently be taken from the unidirectional valve heater supply by the inclusion of a resistor or resistors in series with the heater chain, and across which the required potential is developed. Then after smoothing by extremely high value capacitors —up to 3,000μF, because of the low impedance of the source—the supply is tapped off for the receiver section. The heater supply is made unidirectional by incorporating in it a silicon rectifier, e.g. type BY114.

A typical example is afforded by the Pye Model 40F, see Fig. 2(a). The voltage developed across the

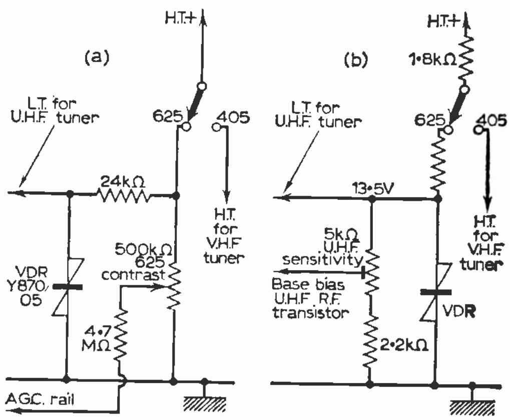


Fig. 1: L.T. power supply circuits for transistorised u.h.f. tuner units. (a) Thorn 950 series models; (b) Philips Style 70 receivers.

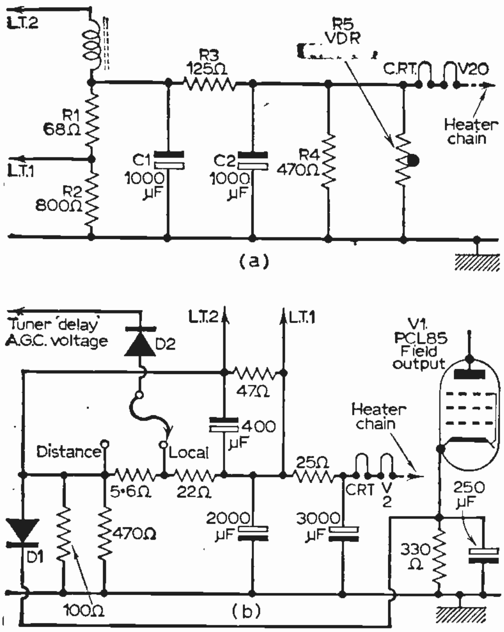


Fig. 2: Transistor power supply circuits used in current hybrid television receivers. (a) Pye Model 40F. R5 v.d.r. has a positive temperature co-efficient. R4 should be 420Ω. (b) G.E.C. Model 2012. In (a) voltage stabilisation is effected by the v.d.r. type E220ZZ/13, while in (b) voltage limitation is achieved by the action of DI and VI cathode current.

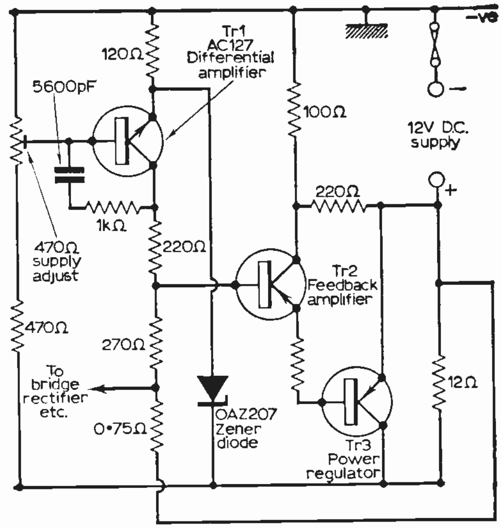


Fig. 3: Voltage regulation circuit used on both battery and mains operation in the Philips T-Vette to maintain the transistor supply voltage constant at 11V. Tr1 senses changes in voltage and these are applied, via Tr2 which amplifies them, to Tr3 to alter its conductivity and thus its emitter-collector voltage to then increase or decrease the supply voltage.

combined resistance of R4 and R5 is smoothed by the pi filter C1, R3, C2, with the fixed potentiometer R1, R2 providing a reduced voltage for the integrated tuner unit. Voltage stabilisation is effected by including the shunt v.d.r. type E220ZZ/13, which has a positive temperature coefficient. This means that it has a low resistance when cold, i.e. when the set is first switched on, so that it reduces the potential then developed for the l.t. supply.

A basically similar principle is used in the GEC 2012 receiver, but here protection for the transistors in the receiver stages when the set is first switched on is afforded by limitation rather than stabilisation in a simple but ingenious system utilising a diode and the cathode circuit of the PCL 85 field output pentode (Fig. 2(b)). As with sets employing transistorised tuners, the greatest need for voltage limitation occurs soon after switch-on when heater current may temporarily exceed normal working current thus producing an excessive voltage across the heater circuit resistors that supply the transistor power requirements. To prevent this, the diode is connected from one of the l.t. output points to the PCL85 cathode, the diode "anode" being connected to the positive l.t. point. Thus until the pentode passes anode current the l.t. power supply circuit is effectively shunted by the forward conductance of the diode plus the 330Ω resistance of the pentode cathode bias resistor. The l.t. output is thus severely restricted until the PCL85 pentode begins to conduct, when the potential developed across the cathode resistor, 18V, exceeds the 12V from the l.t. rail and the diode is thus reverse biased preventing further conduction.

ALL TRANSISTOR MODELS

When it comes to completely transistorised models, power stabilisation becomes all important to maintain raster size, and in the case of the Philips T-Vette, for instance, the l.t. rail is designed to remain constant at 11V whether connected to a 12V battery or to the a.c. mains. In this model, the d.c. supply when mains connected is derived from an eight-unit bridge rectifier, and taken via the voltage regulating circuit which employs three transistors and a zener diode.

The prime voltage sensing device in the regulator circuit, Fig. 3, is the AC127 npn transistor in conjunction with the OAZ207 zener diode, which maintains Tr1 emitter voltage constant at 2·0V. The base of this transistor is biased from a potentiometer (in series with a limiting resistor) connected across the l.t. supply, and the setting of this control determines the l.t. voltage by subsequent regulator action. Once set, any variation in the l.t. supply will appear partially across the base, and wholly between the emitter and collector since the emitter is held constant at 2·0V by the zener diode. This first transistor in the power control circuit, or "differential amplifier" as it is termed, as well as sensing the voltage variations amplifies the detected changes and applies these to the base of the AC128 transistor Tr2, termed the "feedback amplifier" in this application, which directly controls the base voltage of the AD149 power regulator transistor Tr3.

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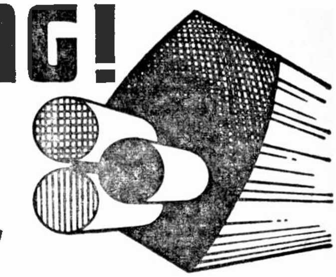
COLOUR IS COMING!

A SHORT BASIC COURSE ON COLOUR TV FOR THE TECHNICIAN AND AMATEUR ENTHUSIAST



by A. G. PRIESTLEY

PART 4 — THE SHADOW MASK TUBE

ALL the colour television transmission systems that have been proposed or introduced over a period of many years are capable of being used in conjunction with any of the existing types of colour c.r.t. or any that are likely to be devised in the foreseeable future. Quite a number of different display tubes have been developed, amongst the better known ones being the chromatron, apple, banana and shadow mask tubes. All these use the same general principle of exciting very small areas of red, green, and blue phosphors so that the human eye cannot distinguish the individual sources of light, but instead adds them together to get an impression of a single colour obtained from the R, G, B mixture.

In the early days of colour television an attempt was made to use three separate c.r.t.s with red, green and blue phosphors respectively, combined together in an optical projection "base". This idea proved to be rather impracticable because of the mechanical complexity involved.

The chromatron, apple and banana tubes all have narrow stripes of three primary colour phosphors which have to be excited to the right amount in turn so that the correct single colour is seen by the eye. However, all these tubes suffer from various disadvantages in connection with manufacturing difficulties, complex external circuitry and, in the case of the banana tube, problems caused by the need to rotate synchronously, silently and at high speed. Eventually, no doubt, a single gun striped phosphor tube will win the day, but not just yet.

At present the shadow mask tube is in almost universal use and it is safe to predict that all the first generation colour receivers designed in Europe will use it. Most of them will be 25-inch 90° rectangular models, but a few 19-inch versions are likely to appear as well.

THE SHADOW MASK TUBE

In this series of articles the similarities between colour and black-and-white techniques have from time to time been emphasized, and the same approach is helpful here. The shadow mask tube consists of three separate electron gun assemblies each of which is very similar in principle to those used in ordinary monochrome tubes. Matters are so arranged that the beam of electrons from one of the three guns can only impinge on the vast number of minute dots of red phosphor which have been deposited on the inside of the faceplate (or screen) of the c.r.t., the electrons from another gun can only land on dots of green phosphor, and electrons from the third gun can only hit blue dots.

Each gun can be driven separately, and so three independent colour pictures can be obtained, one red, one green and one blue. When these three pictures are correctly superimposed a single picture is produced which is complete in both colour and image.

If we feed a monochrome signal in suitable fixed proportions to each gun, the red, green and blue light output from the screen will add up to give different shades of white light—i.e. a black-and-white picture. If, however, we drive each gun separately with colour picture information, a complete colour picture is reproduced from the sum of the three individual red, green and blue pictures.

The fundamental problem in connection with this type of tube is how to arrange matters so that electrons from, say, the red gun can only land on

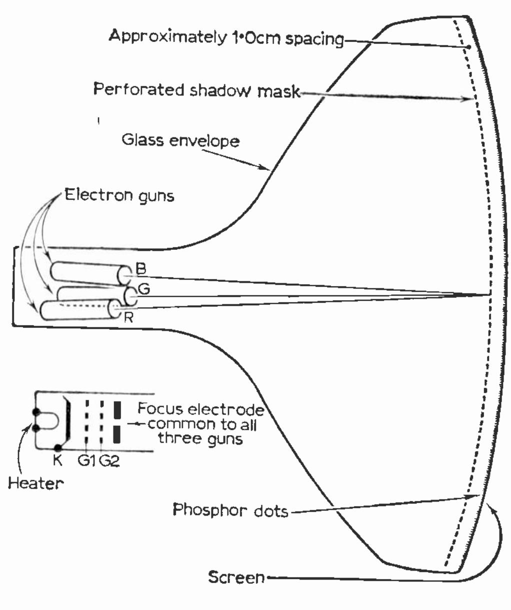


Fig. 13: Basic construction of the shadow mask colour display tube.

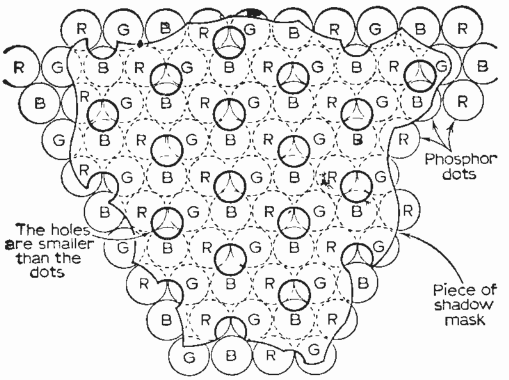


Fig. 14: Phosphor dots on the inside of the screen of the tube seen through a portion of the perforated shadow mask. Note triad grouping of the red, green and blue phosphor dots.

phosphor dots which will give out red light, without also impinging on green and blue dots and thus spoiling the purity of the red image. It is here that we come to the principle of the shadow mask from which the tube derives its name.

THE SHADOW MASK

Figure 13 shows the general construction of the c.r.t. with the three electron guns, the shadow mask, and the coating of phosphor dots on the inside of the faceplate. The shadow mask itself is a thin sheet of steel carefully shaped to match the curvature of the faceplate, and pierced with innumerable small holes.

Figure 14 shows the pattern of phosphor dots deposited on the faceplate, and how the holes in the mask are aligned with each "triad" of phosphor dots. From this it can be seen that if each of the three beams of electrons come from the appropriate direction—different for each beam—they can only land on phosphor dots of a particular colour. This is shown in Fig. 15. Since the electron guns in the neck of the c.r.t. are inevitably spaced apart from each other, it is possible by careful alignment during manufacture to aim the beams of electrons so that they tend to converge upon the mask from the right direction. This state of affairs cannot be achieved with complete accuracy, and so a subsidiary adjustment has to be provided in the form of "purity" magnets to complete the process. We shall be discussing these later.

In order to obtain fine picture detail it is clear that the phosphor dots must be exceedingly small, and in fact a 25-inch c.r.t. has some hundreds of thousands of triads carefully located all over the inside of the faceplate. The holes in the mask must be even smaller, so that the electrons from a particular gun which pass through a hole land upon the correct dot only and do not spread over on to the neighbouring dots of the wrong colour.

This means in practice that the mask intercepts a large proportion of the electrons, and in point of fact only about 20 per cent pass through. The remainder are absorbed by the mask and their energy is dissipated in the form of heat. The mask can therefore get quite hot and the resultant expansion creates a problem because it tends to upset the alignment of the holes and triads.

To get an adequate light output needs an e.h.t. of about 25kV and since only 20 per cent of the electrons do a useful job a large beam current is necessary. This is commonly of the order of about 1mA for an average picture, and so the spot size is quite large. We must think not in terms of a small spot passing over each hole in the shadow mask in turn, but rather of a beam of electrons cutting a swathe across the mask and covering a group of holes as it passes.

The total e.h.t. energy required for an average picture is 25,000 x 1mA = 25 watts, and of this about 20 watts is dissipated in the mask. Hence the problem of heating mentioned above. Under high drive conditions the average current may rise to about 1·5mA, and in small areas of peak brightness the peak beam current may reach a figure of 7mA or so.

MAKING A SHADOW MASK

We have seen that the successful operation of this type of colour c.r.t. depends upon the design and construction of the shadow mask itself. If the holes in the mask are not of the correct size, spacing, or profile; or if the mask itself is not correctly matched to the profile of the faceplate, or gets distorted during assembly, the electron beams will not land on their appropriate phosphor dots and so an impure picture will be produced. The mask has therefore to be mass produced to a standard of accuracy not often encountered in mechanical structures of this type.

The starting point in making a shadow mask is

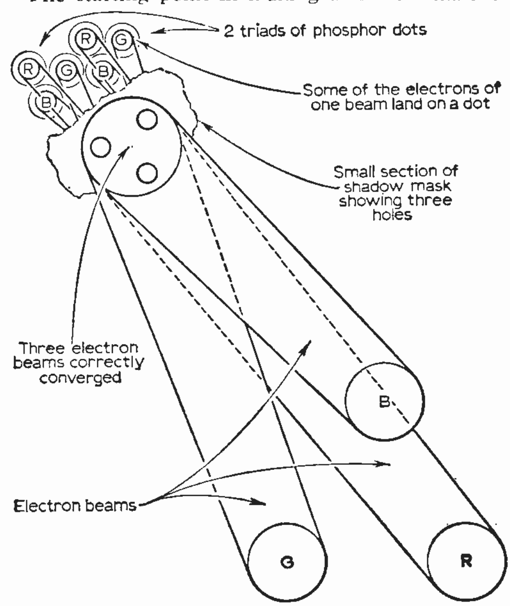


Fig. 15: Correct purity is achieved when electrons from each gun land only on phosphor dots of the appropriate colour.

the production of a pair of matched raster negatives covered with a pattern of hundreds of thousands of minute dots of the right size, shape and spacing. This is no mean feat in itself. A sheet of mild steel a few thousandths of an inch thick is then cut to size, chemically cleaned, and covered on both sides with a coating of photo resist material similar to that used in the preparation of copper clad printed circuit boards. The two negatives are next placed in close contact with the steel sheet in careful registration, one on each side. When the assembly is exposed to ultra violet light the photo resist is hardened except in the areas screened by the opaque dots on the negatives. The mask can now be washed to remove the still soft resist corresponding to the dots and then placed in an etching bath. After carefully controlled etching has been carried out, and the remaining resist has been cleaned off, a correctly perforated mask is obtained ready for pressing into its final shape to match the curvature of the faceplate. This whole series of processes demands the utmost care and accuracy, and also scrupulous cleanliness, as otherwise some of the holes may not be produced at all, or will be partially blanked off. An imperfect mask is just an expensive piece of scrap metal.

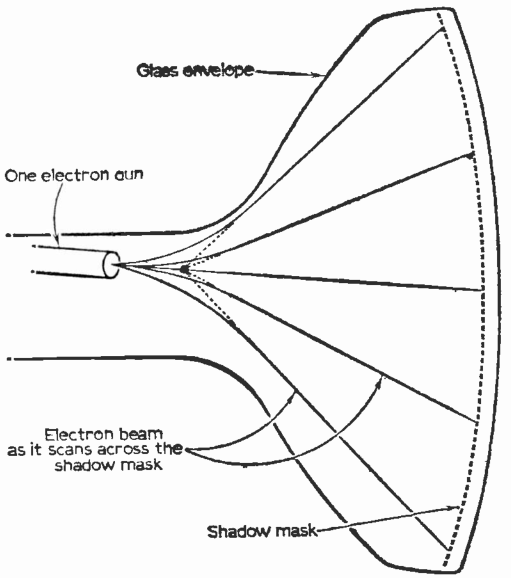


Fig. 16: Each beam of electrons appears to originate from a single point in space.

DEPOSITING THE PHOSPHOR DOTS

From now on a particular mask is married to a particular faceplate, although in a demountable form, so that each phosphor dot can be deposited in exactly the correct place.

Figure 16 shows how one of the three beams of electrons emitted from a gun follows a curved path as it scans across the faceplate under the influence of the magnetic field from the deflection yoke. The important point to note here is that however much the beam is deflected, it still appears to originate from the same point in space inside the neck of the c.r.t.—a different point for each beam of course.

The next step in the process is to deposit a mixture of green phosphor and photo sensitive resist on the inside of the faceplate. If this is exposed to ultra violet light through the mask, directed from the point from which the electrons of the green gun appear to originate, a hardened dot pattern of green phosphor will be left firmly adhering to the inside of the faceplate. The mask is then temporarily removed and the surplus but still soft green phosphor is washed away. If the mask is replaced the whole process can be repeated with a blue-phosphor mixture, and finally repeated again with the red phosphor. The screen is thus completely covered with red, green, and blue phosphor dots in their correct relative positions for the particular mask used. A thin aluminium backing is then deposited over the phosphors.

FITTING THE ELECTRON GUNS

After the cone has been welded on to the faceplate the three guns are fitted into the neck using a precision jig of extreme accuracy. Not only must the guns be carefully matched for operating characteristics, but they must also be so aligned that the three beams converge on the plane of the shadow mask and are correctly spaced relative to each other in the c.r.t. neck. External purity magnets can then be used to move all three beams simultaneously so that they appear to originate from the three points in space which were previously assumed when laying down the three patterns of red, green and blue phosphor dots. With correct alignment of the guns, and correct setting of the purity magnets, electrons from each gun can only impinge on phosphor dots of the appropriate colour. Thus complete colour purity is obtained. See Fig. 15 again.

OPERATING THE ELECTRON GUNS

As we mentioned earlier, the three electron guns are very similar to those used in single gun monochrome tubes. However, the requirements of colour operation impose certain additional or more stringent conditions. Considering d.c. operating potentials first, the three cathodes are likely to be at about 180 volts above chassis; the grids at about 70 volts, with a range of between 400 and 700 volts on the second anodes. The focus voltage will be 4-5kV and must be held very constant. A variation of even 100 volts will cause a change of focus quality. The final anode is normally stabilised at 25kV and any change here will upset the convergence of the beams of electrons, and result in misregistration of the three coloured images.

The luminance drive on the cathodes, and the colour difference drive signals on the grids, are superimposed on the d.c. potentials described above. The cathodes are driven negative for increased luminance, but the grids can carry either positive or negative colour difference voltages depending upon the particular hue being transmitted.

—continued on page 561

B—K interference

by Gordon J. King

BARKHAUSEN-KURZ was an engineer who discovered a kind of electron oscillation (now called B-K oscillation) many years ago in a triode valve when operated under certain conditions. We shall see that this same type of oscillation can trouble today's television sets; but before we see how this is so, let us find out something about the oscillation itself.

Figure 1 shows a simple triode valve circuit in which the grid is at a positive potential, and the anode slightly negative, *with respect to the cathode.* So connected, electrons emitted from the cathode are strongly attracted to the grid and some of them pass into the grid circuit as grid current, while others pass straight through the grid-wire mesh owing to their high initial velocity.

Once past the grid, the electrons enter a rapidly falling grid-to-anode potential gradient caused by the anode being negative with respect to the positive grid. This puts a brake on the electrons, and they soon come to a stop and change their direction of travel to follow the potential gradient. As they approach the grid again they increase speed and either hit the grid wires to make grid current, or as before pass through its wires but this time into the falling grid-to-cathode potential gradient, once more changing direction back to the grid.

Oscillating electrons

The electrons continue this mode of oscillation about the grid at reducing amplitude until the free electrons are ultimately removed from the valve by impact against the grid wires. The path taken by an oscillating electron is shown by the curve in Fig. 1, and it should be understood that as electrons are absorbed into the grid circuit new ones are emitted from the cathode.

All this may seem to be far removed from television sets; but is it? Fig. 5 shows the basic connections of the line output valve in a television set. The anode and screen grid are connected to positive potentials, of course, while the control grid is driven from the line oscillator. Now, the valve is suddenly "switched on", so to speak, by the drive waveform at the control grid, which results in a substantial instantaneous drop in anode voltage. In some circuits this anode voltage drop means that the screen grid is then more positive than the anode.

Thus, electrons which, at that instant, are travelling between the screen grid and anode are subjected to a "braking" force since they enter a falling potential gradient. Some of them do reach the anode, but others follow the potential gradient back to the screen grid and are absorbed by it (giving high screen grid current) or pass through its mesh, according to their fate.

At that instant, however, the line flyback occurs and the control grid of the valve swings highly negative—due to the drive signal switching "off" the valve. The anode of the valve then goes highly positive owing to back e.m.f. across the inductive elements of the stage, which means that the relevant electrons are now subjected to a reversed pull. Hence they change direction towards the anode, but before they are all absorbed by the anode circuit, the back e.m.f. collapses, the anode goes much less positive and the electrons are once more attracted by the screen grid to produce the oscillatory motion, shown in Fig. 5.

Clearly, then, the effect in the line output valve has very much in common with that of basic B-K

Fig. 2: A form of B-K oscillation can develop about the screen grid of a line output valve, as shown.

oscillation in the triode valve of Fig. 1. Indeed, the electron oscillation in a line output valve is called B-K oscillation, but what effect does it have on reception?

The oscillatory motion of the valve's electrons sets up oscillatory currents in associated wiring and components at a frequency that can be influenced by lead lengths and by the nature and value of the components in the line output stage. Moreover, the oscillation is affected by the repetition frequency of the timebase. That is, the oscillation is synchronised to the line frequency (10,125 c/s on the 405 standard and 15,625c/s on the 625 standard). Thus, any display of the oscillation on the picture is

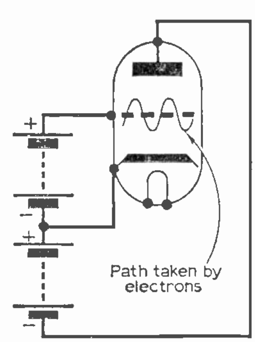


Fig. 1: Basic B-K oscillation in a triode valve. This is explained in the text.

generally locked to the picture, assuming that the display is originating from the set's own line output stage.

It sometimes happens that the B-K oscillation has a fundamental frequency component in the vision passband of the set on one or more channels in the v.h.f. bands. Owing to its synchronous nature, therefore, it shows up on the picture as a thin, rope-like vertical white line, often to the left-hand side of the screen. Fig. 2 shows the display actually on a picture, while Fig. 3 is an enlarged photograph of a small section of the line on a picture. This clearly shows how it is made up.

Aerial matching

Sometimes the fundamental frequency and harmonic components of the oscillation may fall outside the acceptance channel of the set and yet still appear on a picture. This happens because the B-K signal beats with the fundamental or harmonic signal from the set's local oscillator (in the tuner) and

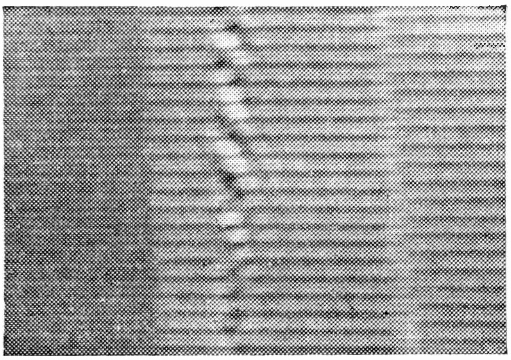


Fig. 3: Display of typical B-K interference. When this dodges from side to side across the picture it is known as windscreen-wiper interference.

produces a new signal which is within the pass band or acceptance channel.

Most sets generate some degree of B-K oscillation, but recent-generation models have thoroughly screened line timebases and B-K suppressors fitted which minimise the effect unless the aerial signal happens to be pretty weak or a set-top aerial is in use. Even in an area of high signal field the effect often shows when a set-top aerial is used because then the aerial is very close to the B-K radiation.

Mismatching between the aerial's downlead (coaxial cable) and the set's aerial socket also emphasises the display because under this condition the feeder itself can pick up the spurious signal from the line timebase. Thus, when the effect is continuously present on one or more of the v.h.f. channels, special attention should first be directed towards making sure that the set is receiving adequate aerial signal and that the aerial system is corrected matched. One can always expect the symptom if just the "odd bit" of wire is used instead of a proper television aerial system.

A check for B-K oscillation is to hold the pole of a powerful bar magnet close to the envelope of the line output valve, making sure that it is sufficiently removed from the top cap to avoid a pulse discharge and an electric shock through the magnet. The latest ceramic magnets prevent these possibilities.

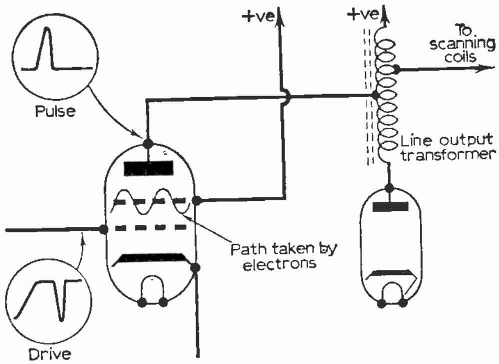


Fig. 5: Symptom of corona in the line output stage. Not to be mistaken for B-K interference.

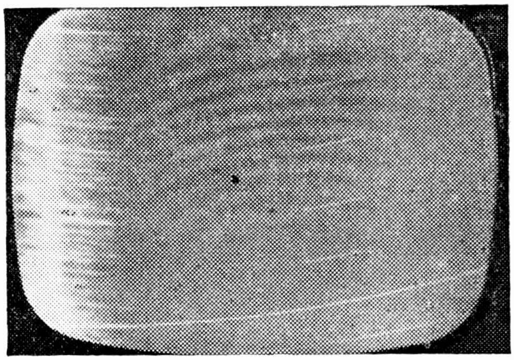


Fig. 4: Close-up of a section of the B-K effect on the screen of a TV set.

The magnet field alters the transit time of the electrons in the valve and, hence, modifies the nature of the interference display on the picture. Sometimes the effect can be deleted by judicious orientation of the field relative to the valve. Indeed, some sets feature a small clip-on magnet round the valve's envelope, rather like the old-time ion trap magnet, which can be adjusted to clear the symptom.

When the trouble is serious, replacement of the line output valve may be indicated. Just why valve replacement can clear the effect is not perfectly understood, but it is akin to the interference to television from fluorescent lights being cleared by fluorescent tube replacement.

It may happen that the magnetic field concentrated into the line output valve fails to alter the symtom display; but this usually indicates that the symptom is resulting from some other kind of fault in the line output stage, such as poor insulation in the line output transformer or in an inductive element in the stage causing internal corona discharges during the line retrace (flyback). Symptoms from such causes, however, are rather more severe, as shown in Fig. 4.

B-K oscillation can originate in one set without showing and yet cause bad interference on a neighbour's set. The offending set often radiates B-K interference on a Band I channel when it is tuned to a Band III channel. This is why it fails to show on the offending set. For instance, a good Channel 9 picture may be received by a viewer whose set is radiating a strong B-K signal on, say, Channel 2, Nearby viewers on Channel 2, therefore, will get the interference symptom.

The cure

Now, when this is the case, as it often is, the B-K signal is not perfectly locked or synchronised to the timebase of the set which is displaying the interference. While the line repetition frequency is the same (10,125c/s) on both BBC and ITA programmes, of course, the phase of the line sync pulses of the two transmissions tends to drift relative to each other. This causes the B-K display also to drift from side to side across the picture at a random speed. The effect is then called *windscreen-wiper interference.*

Fortunately, this interference is only radiated over relatively small distances, between adjacent neighbour's or, at most, a distance of three houses from the affected viewer's house, so it is not difficult to locate. Neighbours rarely mind switching their sets off for a couple of minutes to check whether they are causing interference.

When the source of interference has been located how does one go about suppressing it? This is not really such a big problem as may first be thought. In a large percentage of cases investigated by the author complete success was achieved by connecting a small TV suppression choke (a 2A component marketed by Belling & Lee Ltd or Radiospares Ltd, available through a dealer) in series with the cathode (top cap) of the booster diode. Some cases required the choke to be connected in series with the booster diode anode or the line output valve anode. Rarely was it necessary to use more than one choke in one of the positions mentioned. One or two obstinate cases required a choke in series with the line output transformer lead to the e.h.t. rectifier anode.

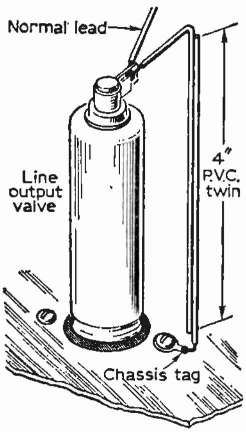


Fig. 6: Showing how a small value of capacitance of high voltage rating can be connected to the anode of the line output valve.

If one has difficulty in obtaining a suitable choke, it is not much of a job to make one. All that is required is a ¼-in. diameter former and 30 turns, close-spaced, of 30 s.w.g. enamelled-covered wire. Remember, however, and this is very important, that where the choke is to be connected very high pulse voltages exist, so sufficient clearance from metalwork and good insulation are major requirements.

If the choke technique fails to clear the trouble, a very small capacitor between the anode of the line output valve and set chassis can be tried. As the pulse voltage here is very high, an ordinary capacitor would quickly collapse and short-circuit. A good way of obtaining the required capacitance at adequate insulation is shown in Fig. 6. Here the capacitance is formed from a 4-in. length of p.v.c.-covered twin cable, such as mains cable, connected between the anode and chassis, one conductor acting as one plate, the second conductor as the other plate and the p.v.c. insulation as the dielectric. ■

Book Review

MATHEMATICS FOR RADIO AND ELECTRONIC TECHNICIANS
By Dr. -Ing Fritz Bergtold. Published by George Newnes Ltd. 304 pages. 8¼ x 5½in. Hard Covers. Price 50s.

PRACTICAL television engineers and hobbyists are finding the going much harder as colour comes around that elusive corner and begins to gallop down the home straight. Practice alone was never much good, and for the colour-conscious technician the groundwork of theory will extend to embrace a fair amount of mathematics. The problem is to brush up one's fading knowledge while continuing with one's practice. Here is a book written expressly for that purpose.

The title really does mean what it says. Although the subject is mathematics, from simple equations right through to calculus, taking in algebra, trigonometry, differentiation, intergration, series, polar co-ordinates and vectors on the way, the emphasis throughout is on the application of mathematics to electronics.

Each example—and the book abounds in good examples—is a kind of practical problem such as may be met in any go-ahead workshop. In fact, the final 60 pages of the book are packed with worked solutions to problems given in the previous 24 chapters.

What makes this mathematical book so different is the way it touches briefly on subjects that normally waste pages (and hours) in the average textbook, while dwelling at length on the particular aspects of maths, that apply to electronics. The author has been closely engaged on radio and television development, and more especially in the field of semiconductors and microtransformers, so is well qualified to know our needs.

No special knowledge is required to use this volume as a course of study. Any technician or television enthusiast with the grasp of fundamentals that he must already have to be interested in the subject will find a half-hour or so a day with Dr. Bergtold to be a rewarding experience. The style and presentation are both impeccable, making such a course of study deceptively easy.

It is rare that a book on maths. can be recommended without reservations, but here is a case in point.—*HWH.*

Servicing TELEVISION Receivers

No. 138 - PYE V210 series–*continued*

by L. Lawry-Johns

Less common faults

We would now point out some features which should be borne in mind when faced with stubborn or unusual faults. We have already mentioned the absence of cathode bias on the field output. There is likewise no cathode bias on the sound output. The bias is obtained from the line output grid, being divided across R51 and R52. C41 25μF is there to stop an earsplitting whistle of 10kc/s getting into the volume control circuit. Note it must be connected positive to chassis. A loud whistle which builds up as the valves warm up obviously directs attention to this component. What is not so obvious is the effect of C20 (500μF 6V) becoming open circuit. This is in the video cathode circuit and although it produces a loss of contrast the effect on the sync is far more drastic. The picture rolls around with very little lock and the picture also pulls sideways in sections similar to the effect produced by ghost reflections on an aerial. So don't recommend a new aerial without first making sure ghosting is actually present!

The video amplifier (V6) cathode circuit may be different from that shown and the later circuit had a 100Ω resistor inserted between pin 7 and R20 bypassed by a 0·0018μF capacitor. The screen pin 9 circuit then has a 5·6kΩ resistor included, decoupled to chassis by a 270pF capacitor.

No control of contrast

Check V3 EF85 and V7 (M3). If necessary check the PCC84 and the 0·1μF a.g.c. line capacitors.

Sound distortion

Check V11 ECL80 and if this is overheating check C41 which may be shorted and C40 which may be leaky.

Poor brilliance and lack of height

Check C60 1μF which may well be shorted to the main h.t. line.

Line hold

If the picture cannot be resolved horizontally. Check V13 ECC82 and if necessary V14 PL81. Then check R73.

Line time base inoperative

Check ECC82, PL81, EY86 and PY81. If the valves are not at fault, remove the PY81 top cap. If the line whistle starts replace C65 0·1μF.

Note the effect of disconnecting C66. If the line whistle starts check C66 and if this is in order suspect shorted turns in the deflection coils. If there is still no results carefully check the ECC82 components R72, R71, C54, C55, C56, C57 and C58. If this circuit is in order check the remaining line output transformer components before suspecting the transformer itself.

Single white line across screen

Check V12 PCL82 then the h.t. to pin 6 (panel point 16), h.t. to the height control, PCL82 (panel point 15) screen supply pin 7. The h.t. supply to pin 9 is derived from the linearity control wired between the h.t. and the boost line via R57. If the fault remains and the voltages are about right check the VA1054 thermistor in series with the field deflection coils which sometimes fractures. Short it out to prove the point.

Voltages

The smoothed h.t. voltage at C28 (h.t.1) should be around 210V. If this is low first ensure the picture is present though it may be lacking in

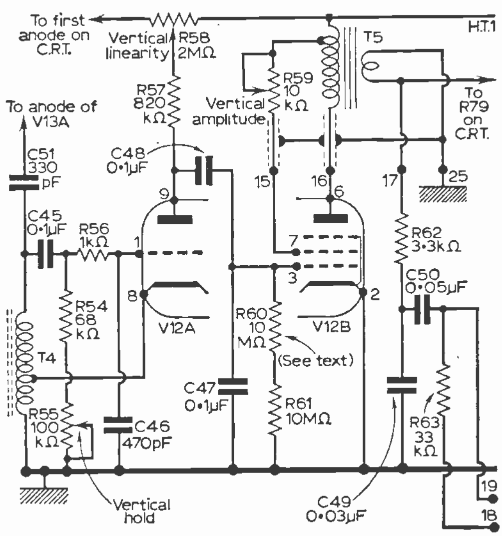


Fig. 5: Circuit of the field oscillator and output stage.

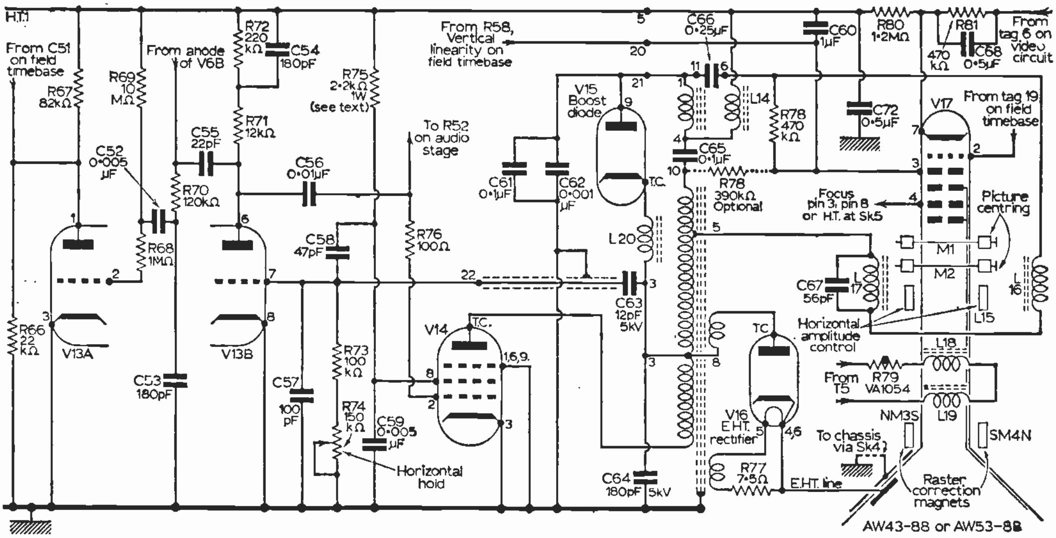


Fig. 6: Line oscillator, line output and c.r.t. network.

width. If there is no picture at all the PL81 may be drawing excessive current thus causing the voltage drop which will become normal when the line timebase fault is cleared. Most other h.t. shorts will give more obvious signs of their presence.

If the h.t. is very low, say under 150V, check the reservoir electrolytic C27 100µF which may have dried up, before suspecting the metal rectifier.

The boost voltage at pin 3 of the c.r.t. base should be around 450V using a 20kΩ per volt meter. This voltage should also be present at one end of the linearity (vertical) preset R58. Check the value of this preset if the picture is dark and distorted vertically as well as C60 (previously mentioned).

Valve change

In some late versions V11 is a PCL83 not an ECL80.

All Transistor Colour Sets

—continued from page 544

pulses derived from the line output stage. These bias the clamp on for a short period during each line flyback period so that the d.c. level of the colour difference stages is brought back to the blanking level of the television waveform.

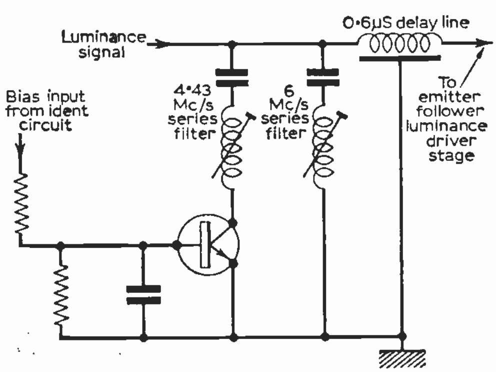


Fig. 4: The electronic switch controlling the 4·43 Mc/s filter.

The tint controls are incorporated in the red and blue colour-difference clamp stages, the position of one being shown in Fig. 3. As can be seen, these provide a variable bias so that the clamping level can be adjusted by the user.

Returning briefly to the luminance channel, Fig. 4 shows the ingenious method of electronically switching an additional 4·43Mc/s (the decoder reference oscillator frequency) filter into the luminance channel when a colour programme is being received. This notch filter is not required on black-and-white, when the only trap required is the 6Mc/s trap to prevent interference from the 6Mc/s intercarrier sound signal in the receiver.

The transistor in series with the 4·43Mc/s series filter circuit is fed with a bias potential derived from the ident signal. This potential biases the transistor fully on when a colour signal is being received (and the ident signal therefore present) so that the transistor represents a very small resistance and the filter is in circuit.

On black-and-white there is no bias to the transistor which is therefore cut off, representing a very high resistance which heavily damps the filter so that it is rendered inoperative. ■

LETTERS TO THE EDITOR

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

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

COLOUR TELEVISION RECEIVERS—DEMONSTRATIONS IN SHOPS

SIR,—The Royal Television Society has received some comment in the last few weeks as to the manner in which colour television receivers are being demonstrated to the public. This applies particularly to demonstrations in retail shops. Examples have been quoted where receivers on display have not presented their performance to the best advantage.

To demonstrate a colour television picture, which is comparatively low in brightness, it is essential that the ambient lighting be correspondingly low. The colour of the surrounding illumination also requires careful attention, as does the colour of the decoration of nearby objects, a neutral background being desirable.

This letter, however, does not purport to do more than bring about an awareness of the importance of displaying colour television receivers properly at the outset of this new field of commerce.—JOHN WARE (Chairman of Council).

TV STATIONS

SIR,—In the August edition of PRACTICAL TELEVISION you have published a list of BBC-1 and BBC-Wales TV stations. May I point out the following mistakes:

Bath, Channel 6H not Channel 16H; Belmont, Channel 13V not Channel 3V; Llangollen, Channel 1H not Channel 11H; Llanidloes, Channel 13H not Channel 3H.

Apart from these small errors, yet another excellent edition of your fine magazine.—R. ALLEN (Westbury-on-Trym, Bristol).

[*We would like to thank Mr. R. Allen for pointing out these errors.*—Editor]

625 LINES IN 405 CHANNELS

SIR,—The two letters (PRACTICAL TELEVISION for July) commenting on my article were of great interest. I feel sure many other readers are dissatisfied with visible scanning structure, and have ideas about curing it and saving our v.h.f. services from closure.

Mr. M. A. Gerzon (before reading Part 2) expected still another plea for quadruple-interlacing, and is correct in believing it unsuitable. Whether the field frequency is 50 or 60, the spacing of the line succession between four fields is too wide to support kinetic linkage. The faster renewal, $16\frac{2}{3}$, and the closer line succession of three-frame scanning, overcome the fault while suppressing "structure" and leaving no gaps for patterning. The Kell factor (between 0·6 and 0·7) for vertical quality is really line-thickness, as I proved by closing up the lines to find the scanning point is a half-element.

Mr. C. Wehner will be interested to know that the idea of shifting the twin-interlaced picture, upward or downward alternately, occurred to me when I first read of "spot wobble". I tried "frame wobble", with different ratios of "shift", and found that the "even" pair of frames must trace their lines centrally along the separation strips left by the "odd" pair. The correct drop is by half the "elemental" spacing; every line is then half-overlapped, a quarter at top and at bottom. Although better than the present crude separation, the overlap wastes bandwidth, and since it does not convert to "625" definition, does not qualify the system for colour, so cannot prevent the close-down of the v.h.f. network.

Our present 400 lines need another 200 to fill the gaps, and by coincidence 625 lines are now essential for monochrome and colour. Two fields are not enough, how else to perfect the scanning than by tracing the missing field?—A. O. HOPKINS (Worthing Sussex).

PTV ISSUES WANTED

SIR,—I urgently require a copy of the October 1966 issue of PRACTICAL TELEVISION. Could any reader sell me this? I will pay full price, plus postage.—S. D. CREE ("Edzell", 10 Campbell Road, Sale, Cheshire).

★ ★ ★

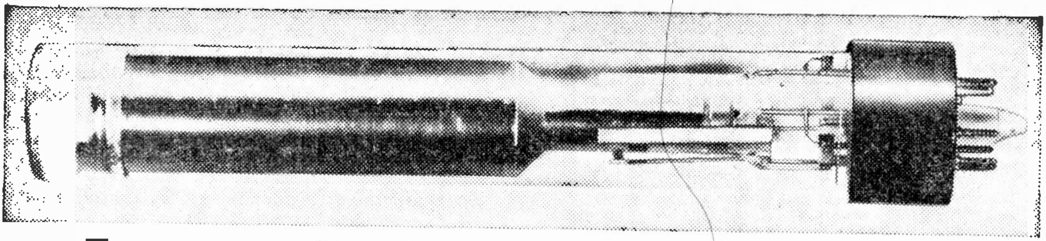
SIR,—Would any reader who has a copy of July 1963 PRACTICAL TELEVISION in good condition and who would like to sell it at cost price (with postage paid), please write me as soon as possible. —D. J. RUNDELL (227 Deeds Grove, High Wycombe, Buckinghamshire).

BOOKS WANTED

SIR,—I would be very grateful if any reader has copies of *Radio and Television Servicing*, which they wish to dispose of. I particularly require all yearly volumes from 1956-7 up to and including the 1966-7 volume.—E. G. FALLOWFIELD (Corn Close, Dent, Sedbergh, Yorkshire).

★ ★ ★

SIR,—I would like to know if any reader wishes to sell any radio and television servicing books from 1960-1966 inclusive.—J. HOPTON (330 Wetmore Road, Burton-on-Trent, Staffs).



plumbicon tubes

Ian R. Sinclair

FOR the last fifteen years, the image orthicon has been virtually unchallenged as a camera tube for high quality television broadcasting despite its disadvantages of large size (the trend has been to larger image orthicon tubes, not smaller), complexity, high cost, and sensitivity to operating conditions. At one time it was hoped that the small, easily operated and cheap vidicon could compete with the image orthicon, but this hope is now seldom expressed. Vidicons of the conventional type perform adequately only at high light levels, such as can be used in telecine work; at normal studio light levels the pictures are unevenly shaded, and moving objects leave a smeary track caused by the slow response of the tube to changing light levels.

PHOTOCONDUCTIVE TUBES

The operating principle of the vidicon is outlined in Fig. 1. The image is focused on to a photoconductive layer through a glass faceplate which is coated with a transparent conducting layer of tin oxide connected to a positive voltage. Any given small section of the photoconductive layer behaves like a resistor in parallel with a capacitor, the value of the resistor depending on the brightness of the light falling on that area. When the electron beam from the gun strikes the area, the potential on the gun side drops to cathode potential. While the beam is elsewhere, the capacitor discharges through the resistor and the potential of the side facing the electron gun becomes more positive by an amount which depends on the value of the resistor, this, in turn, depending on the brightness of the light on the area. Fig. 2 shows this equivalent circuit.

There is no theoretical or practical reason why this method of operation should not give high quality pictures. The properties of the vidicon depend not on the method of operation but on the photoconductive material used. The conventional vidicon uses antimony trisulphide, and it is the behaviour of this material which makes the vidicon unsuitable for high quality broadcast use. There are few materials suitable for use as the photoconductors of a vidicon, and antimony trisulphide was, until recently, the only one which could be satisfactorily used. Unfortunately, antimony trisulphide has a fairly large, variable and temperature sensitive dark current — the current which flows even when the material is not illuminated. The lag in response appears to be caused by the slow movement of the charge carriers. Both effects are familiar in semiconductor work, but the study of the semiconductor physics of antimony trisulphide has not yet yielded any useful solutions.

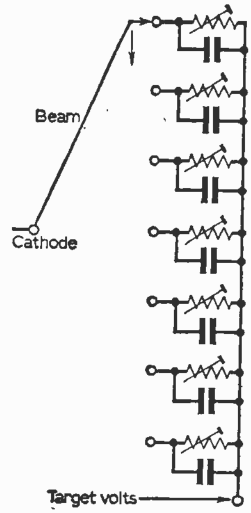


Fig. 2: Equivalent circuit of scanning the target of a photoconductive tube.

There are, however, other semiconductor materials which have been intensively studied, and of these selenium and lead oxide have yielded working tubes. The selenicon, developed by R.C.A., has not so far made much impact on the camera-tube market; but the lead-oxide tube, the plumbicon, developed by Philips of Eindhoven, has been outstandingly successful and may well replace the image orthicon as soon as production capacity can match the demand.

The behaviour of the plumbicon is so unlike that of the antimony trisulphide vidicon that it can justifiably be regarded as a different tube, though the operating difference is, in fact, only in the photoconductive layer. The diameter

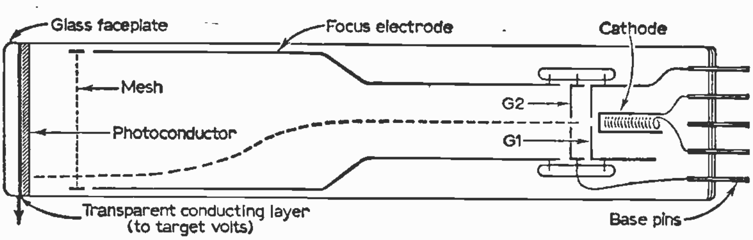


Fig. 1: Structure of the vidicon photo conductive camera tube.

of currently available plumbicons is rather greater than the one inch diameter of the vidicon to increase the resolution capability of the tube to a level which makes it as much of a match for the image orthicon in this respect as it is in others.

As is true in the case of all other semiconductors, it is the method of preparation of the semiconductor layer which is of maximum importance. The coating of lead oxide is applied on top of a conductive coating of transparent tin oxide, the transparent conductive layer material which is also used in the conventional vidicon in which the photoconductive layer is antimony trisulphide. See Fig. 3.

In the case of the plumbicon, however, the transparent layer also seems to play a part in the photoconductive effect. The tin oxide is, physically, an n-type semiconductor (i.e. it has a surplus of electrons). The lead oxide in contact with this layer is intrinsic, that is pure undoped semiconductor in which the number of electrons and holes is equal. In manufacture once the lead oxide layer is in place the surface facing the electron gun is doped with p-type material (electron-deficient). Both this p-layer and the n-layer of tin oxide are very thin, so that the intrinsic layer of pure lead oxide forms most of the thickness of the layer.

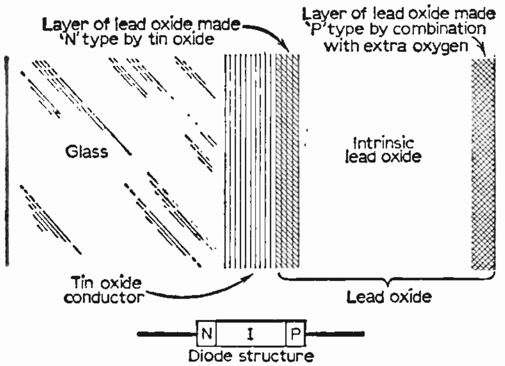


Fig. 3: In the plumbicon tube the photoconductive layer forms a semiconductor p-i-n diode.

In semiconductor terms, therefore, the structure of the plumbicon photoconductive layer is that of a p-i-n diode, and it is this diode structure which is responsible for the properties which distinguish the plumbicon from the vidicon using antimony trisulphide layers.

DARK CURRENT

Since a positive potential is being applied to the transparent conductive coating of n-type tin oxide, and the electrons from the cathode are striking the doped p-type layer of lead oxide, the diode is reverse biased while the tube is in operation. In a conventional vidicon, this reverse biased diode structure is not present, and an appreciable current flows in the photoconductive layer even when there is no illumination. This current is termed dark current, and the amount of dark current varies from one part of the tube face to another in a random fashion. It is the high variable dark current of the conventional vidicon which limits its use to very high light levels, where the strong signal swamps the shading signal caused by the dark current variations. In the plumbicon, however, since the photoconductive layer is in effect a reverse biased diode, any dark current must flow in the reverse bias direction and is therefore extremely small (about one nano-ampere) and variations in it are thus not noticeable.

SENSITIVITY

The second feature of the plumbicon resulting from the diode structure of the photoconductive layer is high sensitivity. The effect of light on a photoconductive substance is the generation of electron-hole pairs. The energy of the light is concentrated in packets called quanta (light in this respect behaves very like a stream of electrons), and each of these quanta can release an electron from a portion of a crystal molecule, leaving a region deficient in an electron (forming a hole) which behaves rather as if it were physically a positive particle. In the type of photoconductive material used in the conventional vidicon, these electrons soon recombine with the molecules they have left unless they can be accelerated away rapidly from the region where they have been freed from the molecular structure. Electrons which rapidly recombine in this way cannot contribute to the photoconductivity, so that the number of electrons which actually passes through the material is very small compared to the number freed as a result of the action of the light. In the concise language of the solid-state physicist, "the recombination of electron-hole pairs in an area of low field strength causes low quantum efficiency".

If we wish to accelerate electrons rapidly, experience of vacuum devices indicates that we must use a high voltage between cathode and anode, or a short distance between them, or both. Voltage divided by distance gives field strength, and it is high field strength which causes high acceleration of electrons. Now semiconductor p- or n-type conducting layers cannot have high field strengths across them because, being conductive, a high voltage across them would involve the passage of a high current. An intrinsic semiconductor material, however, has a high resistance so that application of a high voltage to a thin layer of such a material results in the high acceleration field which is required. Since the photoconductive layers of the plumbicon are separated by an intrinsic layer, the electrons and holes generated by the light can be accelerated away from each other by the high field strength across the intrinsic layer, and most of the generated electrons and holes form useful photocurrent. The effect of this is to make the sensitivity of the tube considerably greater than that of the vidicon, a typical quoted figure being 210μA per lumen of light input. Under comparable conditions the vidicon might have a sensitivity of 0·25μA per lumen, but direct comparison is difficult because the conventional vidicon has a sensitivity which varies widely with the strength of the light.

COLOUR RESPONSE

The thickness of the various layers of the photoconductor also controls the characteristics of the plumbicon. Lead oxide does not absorb all light colours equally, the blue portion of the light spectrum being much more completely absorbed than the red portion. At the thicknesses used, a large part of the red portion of the spectrum hitting the lead oxide layer passes straight through. If the layer is made thicker, more red light is absorbed and the sensitivity of the tube to red is increased.

The sensitivity to blue can also be controlled. Since it is the light absorbed in the intrinsic layer which is the cause of photoconductive current, the more blue light which reaches this region, the greater the sensitivity to blue. Blue sensitivity may therefore be increased by *decreasing* the thickness of the n-type layer next to the tin oxide.

It is possible, therefore, to make plumbicons with a fairly wide range of colour sensitivity, and tubes may be produced in which the colour sensitivity is approximately the same as that of the human eye. This makes the plumbicon particularly well suited for both monochrome and colour TV, though for colour work a plumbicon with rather greater red sensitivity than standard is preferred. This enhanced red sensitivity, along with very little variation of sensitivity from one tube to another and the simple relation between output voltage and input light has made the plumbicon the preferred pickup tube for all the latest colour TV cameras, although some designs using four tubes retain an image orthicon for the monochrome signal.

LAG

The thickness of the photoconductive layer also affects another important feature, lag. Since the basic action of the tube is the variation of the voltage across a dielectric material (the intrinsic region of semiconductor material), the capacitance between the two sides of the photoconductive target must affect the speed at which this voltage may be varied. If the capacitance of the target is very high, voltages change slowly, and light information is stored for several scans. Under such conditions, moving objects leave streaks behind them and rapid changes of background scene are impossible. It is rather like trying to photograph fast action with a box-camera.

Since capacitance decreases as the conducting plates of a capacitor are separated, increasing the thickness of the intrinsic target layer decreases the lag effect due to capacitance. This process can be overdone, causing a loss of sensitivity; in general a value of total target capacitance between 800pF and 2,000pF is suitable.

RESOLUTION

The resolution of the plumbicon is similar to that of the vidicon but varies more with colour. The blue resolution is better than the red resolution, and does not vary with target thickness. This is because of the penetration of red light into the target (previously mentioned) which causes the red light to scatter within the material. This could be reduced by decreasing the target thickness, but this is undesirable for the reasons outlined above, and is unnecessary unless very high resolution plumbicons are required—the resolution of the standard tube is more than adequate for all TV broadcasting purposes. Where greater resolution is required, e.g. for closed circuit work, the problem may be tackled by modifying the intrinsic lead oxide layer so as to increase its absorption of red light.

LIFE

The life of a plumbicon appears to be as long or longer than that of any other type of camera tube. It is limited by changes in the structure of the target, just as is the life of other types of tubes, but in a different way. We have seen that the desirable properties of the tube depend on the p-i-n diode structure of the tube, the p-type layer being formed by doping the i-layer (with oxygen). During the life of a tube the effect of electron bombardment is to remove oxygen from the p-layer and release it as gas which is soaked up by the getters. This has the effect of gradually changing the conductivity of the p-layer, slowly converting it to an i-layer. If this process goes too far, the tube starts to show lag and excessive dark current and has come to the end of its useful life.

Due to the fact that the layers are porous, electrons from the scanning beam also penetrate to the i-layer, tending to change it to n-type material. Such a change is undesirable, and is minimised by making the i-layer slightly p-type initially and reducing the p-type doping by running-in the tube at the factory.

MANUFACTURE

The manufacture of the plumbicon presents formidable difficulties even to organisations accustomed to conventional vidicons and image orthicons. The photosensitive layer is easily destroyed by heating and the methods devised to deal with this follow those used for the vidicon. Early vidicons had the glass endplate heat-sealed to the tube before insertion of the gun assembly on its glass base. The base was then sealed in, leaving the tube complete and ready for pumping, except for the antimony trisulphide layer. The layer was then deposited during the pumping process by inserting a small spiral of wire (coated with the antimony trisulphide) into a small side tube set into the main body. After pumping, this side tube was sealed off.

This method of construction had several disadvantages. Since the layer was produced in a finished tube, any defect meant that the whole tube had to be rejected. There was no way of inspecting the layer before use, and the sealed-off end of the side tube made it difficult to fit a set of scanning and focus coils closely round the tube. This method of construction was abandoned when it was discovered that the photosensitive layer could be evaporated on to the endplates separately, inspected, and then sealed to the tubes, without heating, by "gluing" them with the soft metal indium.

Early plumbicons were made by sealing on the endplate, and then introducing an evaporator into the tube instead of the electron gun assembly. The preparation of the lead oxide layer is a complex one, involving the evaporation of lead oxide at a carefully controlled temperature on to the endplate, the whole operation being done in an atmosphere of the rare gas argon. A small amount of oxygen has to be introduced, the endplate heated to allow the oxygen to react with the lead oxide to form the p-type layer, and the plate cooled rapidly whenever the p-layer has reached the required resistivity. The tube has to be kept filled with argon while the electron gun is introduced and sealed in.

LATEST TECHNIQUES

Though this method works well, it is difficult to adapt to mass production, and efforts have been made to duplicate the methods used for vidicons. A large number of endplates can be processed in one operation in one sealed evaporation unit; they can be inspected and checked for resistivity while still in the argon atmosphere, and the best specimens can then be cold-sealed on to the argon-filled tubes into which the electron guns have already been sealed. The method used for preparing the transparent conducting layer on the endplates is identical to that used for the endplates of vidicons; the hot (500°C) plates are sprayed with a solution of tin chloride which decomposes to form a tough conductive transparent coating. Pumping and testing techniques are similar to those used for vidicons.

THE FUTURE

It is likely to take some time for plumbicons to percolate to the amateur TV market. At the moment, every plumbicon which can be made is sold, mainly to users in the U.S.A. where plumbicons have been outstandingly successful for colour TV transmissions. Even tubes which seem to have completed their life are still of use in experiments on the changes which take place in the layer. However, as large organisations in the U.K. and the U.S.A. work hard with their own versions of lead oxide layers, there seems to be a prospect of such tubes being available in large numbers within the next two years.

The price of a first class studio tube is likely to place it well beyond the pockets of amateurs (the same can be said of the vidicon) but there is every possibility that low grade tubes may be available in the same way as vidicons have been in the past and at comparable prices. If this should coincide with the availability of components for video tape recording, the possibility of a really high-grade video system for amateur TV use will become a reality.

The author is grateful to the Philips Research Laboratories and to the Editor of "Philips Technical Review" for illustrations and information used in the preparation of this article. The name Plumbicon is a trademark of Philips Ltd. The U.S. television industry warded an Emmy to Philips for the development of the Plumbicon at the National Academy of Television Arts and Sciences annual award ceremonies in June this year.

COLOUR IS COMING

—continued from page 551

Figure 5 shows a typical deflection and convergence yoke assembly. It is quite a bulky structure because the neck of the c.r.t. has to be large enough to house three guns and consequently has a larger diameter than in the case of a monochrome c.r.t. The deflection yoke itself needs a considerable amount of deflection energy in order to maintain the correct magnetic field across the much larger air gap, and this has to be taken into account in the design of the field and line timebases. The actual construction of the deflection yoke does not depart much from established practice.

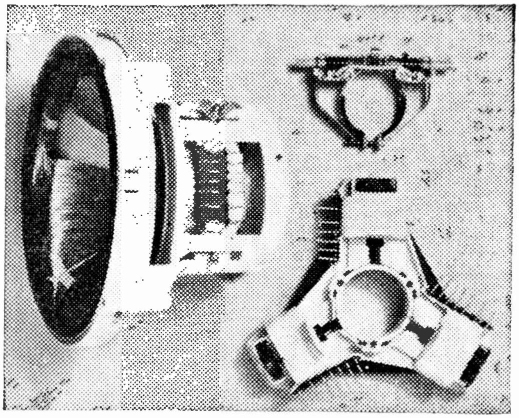


Fig. 5: Mullard deflection and convergence yoke assembly for a shadow mask tube. Left, deflection coils; above right, blue-lateral assembly; below right, convergence coil assembly

PROBLEMS OF CONVERGENCE

One of the most important points in operating a shadow mask c.r.t. is to achieve good convergence —i.e. accurate registration of the three coloured images. It is only possible if the tube has been assembled with the most meticulous care and is used in conjunction with the control exercised by the convergence yoke. This is an interesting and fundamental feature of colour TV, and we shall be describing these problems and how they are overcome later in this series. Suffice it to say for the present that what we have to ensure is that all three beams of electrons meet at a single point, on the shadow mask, at all angles of deflection inside the overall screen area.

It is worth noting that as the three beams pass through the field and line deflection fields they are spaced some little distance apart. If the fields are not uniform the beams will be deflected by different amounts, and so they will fail to converge at the correct point in space. The design and manufacture of the deflection yokes is therefore a highly skilled art and the degree of accuracy needed in the assembly, and in the choice of wire gauge and insulation thickness, might seem little short of impossible to the layman.

To be continued

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

CONDITIONS, both for Sporadic E, and tropospheric propagation, have continued to be reasonably satisfactory, and few should have reasons to complain.

It is still a little difficult at this stage to assess the merits of the current season in comparison with those of the past five years, but although activity has been pretty good, it has not been quite up to the standards set by earlier years, particularly those of 1961 to 1963.

My main comment is that the duration of the signals has on the whole been shorter. In 1961 and 1963, TVE, for example, could almost be relied upon to give an evening's entertainment in sound and vision, at times from 1400 to 0100 with only slight fading, and we certainly have not had good reception like this recently. This tends to lend support to the theory that S.P.E. activity declines as we approach a sun-spot maximum, and the much hoped for F2 layer extreme DX reflections. Now to the usual "run-down" of reception for the period 17/6/67 to 15/7/67. The only day that there was no S.P.E. reception at all was 27/6/67; activity was pretty good on all other days, the following being the best.

17/6/67 (too late for inclusion in our last issue), Azana, Canary Is., E3. Very good reception at 1458 onwards. TVE Spain on programme, Azana with opening clock one hour behind BST, then the announcer followed by "Teledario".

This was indeed a very good day for reception. Eastern Europe was good in the morning, with southern stations from Spain, Canary Is., and Italy good in the afternoon and evening. And just to contradict the theory that S.P.E. and Trops. do not come in well at the same time, the late evening produced E4 Holland, and E2 Belgium, as well as good Trop. reception from France. All told the 17th was a DXers dream!

18/6/67 was nearly as good, with Norway, Spain, Portugal, and Italy, and at 20.04 ORTF Caen F2 had at least two "floaters" on it, and allowing one of them to be Limoges, either by S.P.E. or Trop. the other must have been Bastia, Corsica, a new one for me, but already reported by other DXers, and well worth watching for.

19/6/67. Good to N.E. Norway, and Sweden in, but still no sign here of Denmark.

20/6/67. Good to the East, Czech., Poland and USSR.

23/6/67. Italy, Spain, and Canary Is., plus Bastia, Corsica again, I would deduce that Bastia is a possible when Spain and Italy are coming in well.

30/6/67. Spain, Portugal, and Canary Is.

2/7/67. Spain, West Germany, and once again good Trops. to Belgium.

4/7/67. USSR, R1 and R2, Czech. R1, and R2, W. Germany E2, and E3, Yugoslavia E3, and E4, Swiss E2. A very good day.

6/7/67. USSR R1, and R2 exceptionally good reception.

8/7/67. USSR, Czech., (R1, and R2), Poland, and W. Germany.

10/7/67. USSR, Czech., Spain, Portugal, and good trop. Belgium.

11/7/67. Spain, Canary Is., and Portugal.

12/7/67. Czech., Austria, Hungary, and Spain (late evening).

Tropospheric reception was good, too, on many days in all Bands including u.h.f.

NEWS

(1) RTP Coimbra, Portugal E3, noted here as using Test Card "E" on 10/7/67, and not "D" as previously.

(2) The Swiss Test Card. R. Bunney has the following from Switzerland referring to the letters in the small square on the card, and should clear up the recent queries.

"B"=Bellerive, the studio of the German language section.

"U"=Uetliberg Transmitter on E3.

"D"=La Dôle transmitter on E4.

"Z"=Zurich studio.

"Q"=Experimental transmission.

MYSTERIES

(1) R. Bunney reports that the USSR test card was seen carrying some small lettering in Russian characters at the bottom, not clear enough to read. Has anyone seen this and if so do you know what the letters were?

(2) A new test pattern received here on R1 on 8/7/67 at 08.35 consisting of narrow black and white horizontal lines, with three small black rectangles and one white one at the bottom forming "steps", I feel that this may be Czech., but has any other DXer any comments to offer?

READERS' REPORTS

From a good batch of reports this month, lack of space limits us to the following selection:

(1) A. R. Currie of Ardrossan, Scotland reports reception of E2 Grünten, E2 Spain, R1 USSR, R1 Czech., and has also obtained details of programme times for USSR, and Rhodesia, and we will give details of these in the near future.

(2) R. Bentley of Huddersfield has been doing excellently with IB Italy, E2, 3, and 4 Spain, E4 Switzerland, E4 Austria (a difficult station at Patscherkopfl), and F4 France (I would suggest Carcassonne).

(3) We have a most interesting report from Ian Rose of Blackburn, about his reception on E3 of a photo of a man with the letters "AMMAN" above it. This has put us all in "a bit of a flap" for on the face of it this looks like Amman, Jordan, and we are asking a good friend in Cyprus for his opinion here. There is one question, however: why was the written word in Western script and not in Arabic type? This does not preclude the possibility, a most interesting one, that it is Jordan, Mr. Rose confirms "smearing" to the right, so it could be F2 as well!

(4) G. Parnell of Bath has some good gear installed, he has a six element Band 1 array with rotator mounted on a 35ft. tower, and he has been rewarded with R1 Czech., E3 W. Germany, E2a Austria, E2 Switzerland, IA Italy, E2 Spain, and E3 Sweden all confirmed on test card.

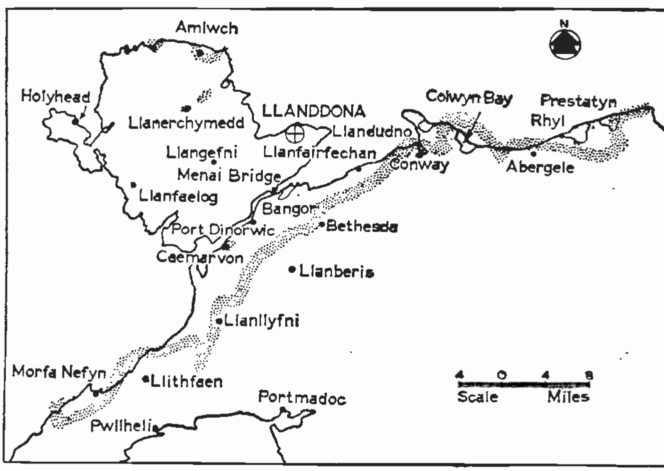
(5) D Bowers of Saltash has once again been very active, and his new list includes E3 Canary Is. again on 11, and 15/6/67, received for two hours on the first occasion with weather maps of the island, and for one hour the second time. He has also had E3 Denmark, E3 Switzerland, E2, 3, and 4 Spain, E2a Austria, and the E4 as well, R2 Czech., and R1 Poland. He comments and we agree, that Canary Is. has been much better this year than last.

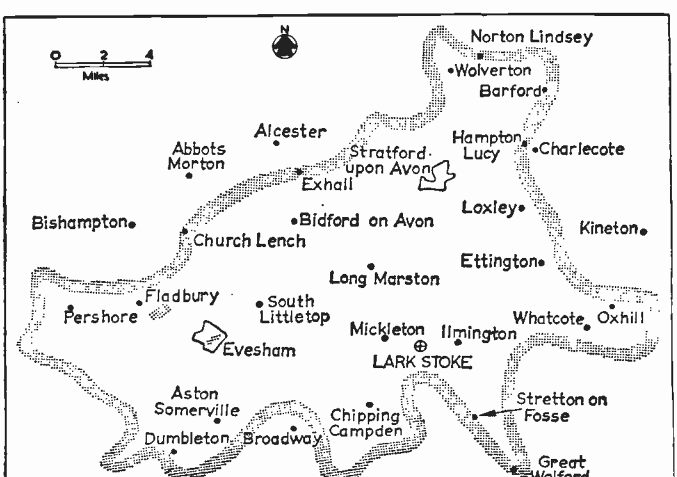
(6) W. H. French, headmaster of Roscommon Technical School, Eire, has done very well with Sweden, Spain, Portugal, Czechoslovakia, Austria, W. Germany, France, Italy, and Hungary all in his log. He is now hoping to install a rotator motor, and this should help still further.

(7) Our old friend D. Kelly of Castlewellan, N.I. has been logging all the usual ones, and now mentions reception of E4 Austria, E2 Finland, and E2 the new Portugese station at Muro. From his log and the reports of other DXers, it would seem possible that E4 Patscherkop, Austria has increased its power, but I have no confirmation of this as yet.

TWO NEW BBC-2 TELEVISION STATION MAPS

The limit of the service area is roughly indicated by the dotted band on the maps. This must not be interpreted as a rigid boundary and reception may be possible at many places outside it. Also, because the quality of reception on u.h.f. can vary at places only short distances apart, there are, inevitably, small pockets of poor reception within the service area which cannot be shown.



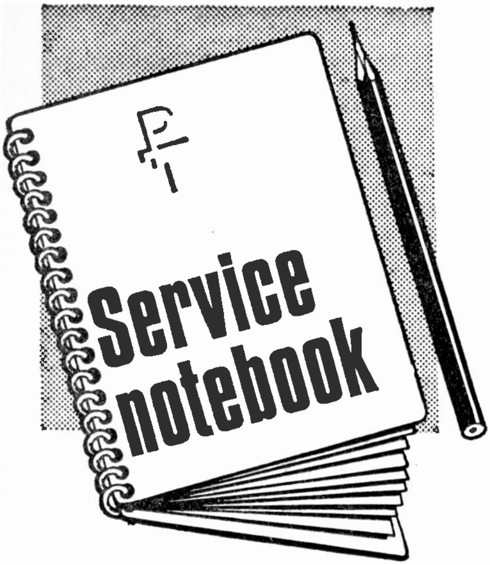


▲ LLANDDONA

Transmissions are on Channel 63 and horizontally polarised. The vision frequency is 807·25 Mc/s and the sound frequency 813·25Mc/s. The maximum vision e.r.p. is 100kW (directional aerial).

◀ LARK STOKE

Transmissions are on Channel 26 and vertically polarised. The vision frequency is 511·25Mc/s and the sound frequency 517·25 Mc/s. Maximum vision e.r.p. is 2·5kW (directional aerial).



by G. R. WILDING

EVERY professional Service Engineer has his own and often vociferous opinion of what constitutes the most time consuming and downright disagreeable fault to clear. It may be weak fly-wheel sync, generally low sensitivity intermittency, screen cleaning, or inadequate width making it necessary to clear every other possibility before going to the trouble and expense of fitting a new l.o.t.

My own "least liked" fault is field circuit trouble requiring component replacement in a PC chassis, for especially if the symptoms are intermittent or cause gradual raster distortion over a period of time, it is very difficult to identify the culprit "cold". The only economic way to remove the fault is to replace all "possibles". However, as so many components are involved in the field generator and output circuits, and as their replacement is always tedious, a few guiding principles on how to reduce the number of possibles may not be amiss.

Where insufficient height is the complaint, always check the triode generator anode feed resistors. These are invariably low wattage, high value types that most commonly change in value after some years of service. Field generators of any type usually operate with quite low anode voltages and are very sensitive to voltage variations, and of course in many receivers, the height control is a high value potentiometer connected in series with the h.t. supply.

Remember too, that to improve the sawtooth waveform, anode supply to these valves is taken from the boost h.t. rail so that a line fault resulting in low boost voltage, or an increased drain upon it, can thus indirectly affect height.

A classic case is the focus control in many earlier Philips receivers which sometimes reduced in value and thus imposed a heavy load on the boost rail to reduce height by up to a third. Where there is any degree of non-linearity which cannot be rectified by control adjustment, always check the cathode bias resistor of the pentode output valve and its associated electrolitic decoupler.

These last 2 components probably cause more time-base complaints than any other. The former usually reduces after years of service, or by the excessive current of a slightly "soft" valve, while the latter just dries up with the constant warmth of the cabinet interior.

The next step depends on the nature of the raster distortion—whether "top" or "bottom" excessive expansion or contraction, but if as is usually the case, there are 2 separate linearity controls, their operation should immediately help to localise the root of the trouble. Always unhesitatingly change any capacitors connected to valve grids from voltage carrying points, since even the slightest "leak" in these vital components can upset valve biasing. Where the raster distortion is small but constantly varying, the cause is often a badly contracting miniature pot. These are difficult items to clean and adjust to give a smoothly varying control, and as always, replacement is the best cure. However, if the track wear is mainly on one spot, sometimes reversal of the outer connections will enable the slider to contact a fresh area and

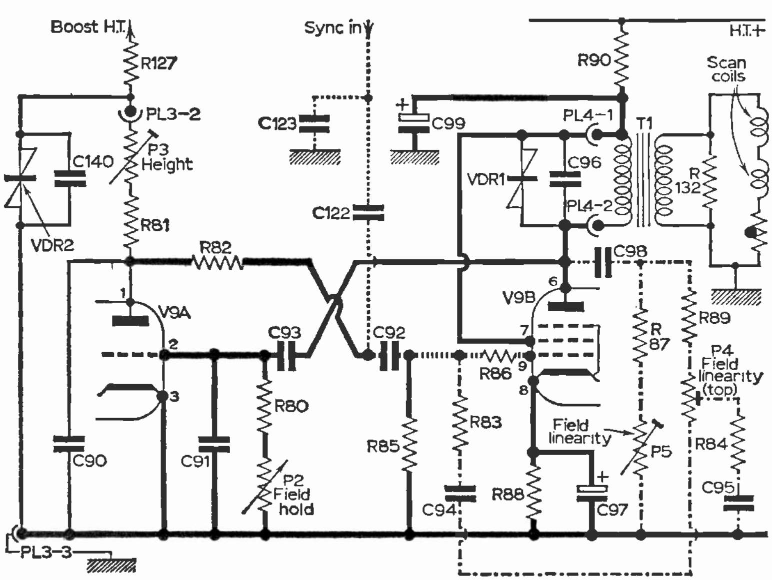


Fig. 3: Typical Modern Field Circuit (GEC/Sobell). For rapid fault diagnosis the circuit should be divided into 3 sub-sections. (a) sync injection and integration (dotted). (b) Sawtooth generation/amplification (thick). (c) Waveform shaping. N.F. (dot dash).

permit further use.

Complete failure of the stage to produce a saw-tooth output are generally easily cleared. Injection of a small a.c. voltage to the grid of the output pentode or even the application of a small d.c. voltage from a battery will show if the valve circuit is "live"!

Most field generators are now of the multi-vibrator type, with the necessary feedback from one valve to the other being by either 2 grid/anode cross connected capacitors or by 1 anode/grid capacitor plus a common cathode resistor. In the latter instance, a short circuit in the cathode decoupling capacitor will completely prevent oscillation.

Finally, the VDR's used in field circuits for height stabilisation in the generator section and across the primary of the output transformer to limit fly-back pulses, only very rarely break down, but the miniature thermistors mounted on the scan coils to compensate for temperature changes in the windings sometimes go o/c. Should the application of a meter to the pentode anode fail to produce any agitation of the horizontal trace, thus suggesting that the scan coils may be o/c—first check the thermistor as well as the fine "leading out" connections.

Power Rectifiers

Whenever we have a TV for service with a high resistance older pattern finned h.t. rectifier, we invariably find it more convenient to substitute a BY100 silicon type. Not only are they much smaller and easier to mount—often permitting fitting without chassis removal, but their extremely low forward resistance gives an extra little h.t. which in turn produces extra e.h.t. often giving a welcome fillip to an ageing tube. However, precautions must be taken as was brought home to us the other day working on a 19in. Sobell.

Having checked that there was ample surge limiter resistance in circuit we switched on. Very soon after e.h.t. appeared however, a bright stream of sparks pierced the plastic anode cap of the EY86 to chassis. In these particular models the EY86 is mounted very close to chassis metalwork, and the extra e.h.t. produced by the fitting of the new rectifier had managed to bridge the clearance.

We then fitted a rather better type of anode connector with heavier insulation, covered the adjacent metalwork with a strip of insulating material and experienced no further trouble. However, we have known elderly l.o.t's. break down when given this e.h.t. boost by these really excellent rectifiers. So in older receivers, make sure that the mains voltage tapping is correctly set and that there is sufficient surge limiter in circuit—the latter of course being determined by the value of the reservoir capacitor. Also, connect a 1,000 pF capacitor of high working voltage directly across the rectifier to absorb any transient mains borne impulses that could possibly cause damage.

While mentioning "spark-overs", I should add that aerosol cans of "Damp-Start" and similar proprietory compounds made to spray over the ignition leads and distributors of cars to prevent the ingress of moisture are very effective when sprayed over line output transformers that show signs of insulation breakdown. They form a thin layer of plastic over the area sprayed and are very good for combating any form of corona discharge.

TRANSISTOR TV CIRCUITS

—continued from page 548

This third transistor, from emitter to collector, connects the receiver's positive l.t. rail to the positive battery or power supply lead. Its internal resistance, and thus the voltage developed across it, depends entirely on its base voltage, which is in turn dependent on the output voltage of the feedback amplifier developed by the first voltage sensor transistor.

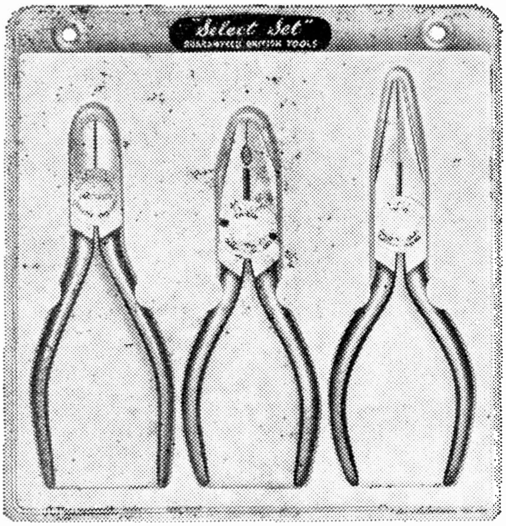
Thus assuming a reduction in voltage from the specified 11V the npn sensor transistor would then feed an increased current to the base of the feedback amplifier which would then increase the forward bias to the heavy duty power regulator transistor Tr3 so that it conducts more heavily and the voltage drop across it decreases restoring the l.t. supply voltage to the correct value.

Eleven volts is chosen as the operative figure because it fulfills normal transistor requirements and also permits regulation from the 12V battery to maintain this figure. This power regulating circuit is also self-protecting since if the normal current consumption of 1·3A on v.h.f. or 1·5 on u.h.f. rises to exceed 2A the l.t. voltage drops drastically due to the feedback and power regulator transistors being virtually cut-off by decrease in forward bias from the AC127 sensing transistor.

To be continued

TRADE NEWS • TRADE NEWS • TRADE NEWS

HANDY TOOLS



ELLIOTT-LUCAS have produced an attractive red PVC wallet containing three of their top selling tools, 5in. Engineers Pliers (PW 216), 5in. Diagonal Cutting Nippers (PW 77) and 5½in. Long Chain Nose (or Radio Pliers PW 58). The tools are easily removed and replaced by means of two clips and the complete pack can be hung from the reinforced eyelets in the top corners of the pack to any convenient shelf or table in a workshop or garage.

TECHNICAL BOOKS

ELECTRONIC SERVICES-STC, the fast-despatch organisation which supplies electronic components by return of post, has extended its distribution activities, and those of its retail organisation Electroniques (proprietors STC Ltd.) into the field of technical books.

Agreements have been concluded with five major publishers of technical and reference books whereby the STC organisation will market selected books from their respective current title lists.

The publishers are Iliffe Books, Foulsham-Sams, R.S.G.B. Publications, Editors and Engineers, and David Rayner Associates. About 170 titles are involved.

RANGE OF INSTRUMENTS CRT's

SEVEN key types of instrument cathode ray tubes released by Mullard form the nucleus of a new range that will provide tubes for applications extending from simple work-bench oscilloscopes and data display systems to the most sophisticated wide-band instruments now used.

Round-faced tubes type D7-19GH, D10-16GH and D13-48GH have screen diameters of 7, 10 and 13cm. respectively. These are intended for inexpensive oscilloscopes and data display systems.

Two new tubes for transistor oscilloscopes are the D10-17GH and D14-12GH. Both have a frequency response of up to 30Mc/s. The first tube is round-faced, has a useful scan area of 80 x 60mm and is only 315mm long. The other tube has a rectangular face, a useful scan area of 100 x 80mm and is 365mm long. A tube designed for use in oscilloscopes with a frequency response up to 250Mc/s is the D13-45GH/01.

PYE GROUP COLOUR SETS

THE Pye group has announced that they will be marketing 25in. colour receivers under the Pye, Ekco, Ferranti, Invicta and Dynatron brand names. Recommended price for the first four brands is 312 guineas, with a slightly higher price for the luxury Dynatron version. The receivers are fitted with Mullard A63-11X shadowmask tubes, the chassis being of unit construction comprising a main chassis on which the line timebase, e.h.t. and receiver power supplies are mounted and seven easily detachable plug-in sub-units as follows: multi-band tuner using silicon transistors with a.f.c. on u.h.f.; transistorised vision and sound i.f. panel including luminance preamp, a.g.c., sync separator and a.f.c. discriminator stages; transistorised colour decoder panel with a.c.c.; transistorised field timebase panel; viewer control panel including transistorised audio stages; valved luminance and colour-difference signal output panel; convergence panel. The hybrid circuit uses 36 transistors, 49 semiconductor diodes and 10 valves. Automatic degaussing demagnetizes the shadowmask tube and its shield each time the receiver is switched on, and an automatic c.r.t. beam current limiting circuit prevents e.h.t. supply overloading if the brightness and contrast controls are maladjusted. Pye state that it is intended to keep the chassis in production for at least two and a half years at their Lowestoft factory. A comprehensive six-month guarantee is proposed, and the discussions on this are at present being held with dealers.

One of the new Pye Consolette colour receivers.

TECHNICAL HONOURS LIST —B.K.S.T.S.

TELEVISION and films are technically drawing together, in spite of sharp differences of opinion between the die-hards of films and the *avant-gardes* of television. Cautiously, the British Kinematograph Society—now known as the British Kinematograph Sound and Television Society—has announced that "Fellowships of the Society are awarded to persons who have reached a position of eminence within the cinematograph industry or *an allied contributory industry* [my italics] or by research and invention have materially advanced the science of cinematography or *its allied subjects* [also my italics].

Many people in the film production manufacturing industry are realising that electronic aids can keep film production competitive and complementary to television, quite apart from tremendous steps forward in existing techniques. There are, however, many film producers and technicians with inevitably closed minds who instinctively and automatically oppose any form of progress.

At the presentation of a number of Honorary Fellowships, the President of the Society, Mr. I. D. Wratten, said "Our aim is to improve the knowledge of every technician in our industry for the good of each and the prosperity of all." *Ignorance is the common enemy!*

Six new Honorary Fellowships were then awarded for the following achievements:

Lord Thomson of Fleet—*In recognition of the establishment, through the Thomson Foundation of a television training college at Kirkhill, Glasgow. The College is equipped to give practical experience in every department of a television broadcasting station. In providing this comprehensive service to trainees from emergent countries, Lord Thomson has earned our admiration and set an example to others.*

E. A. R. Herren—*Mr. E. A. R. Herren is responsible for creating the first practical dual purpose stages at Pinewood Studios for the production of films for both cinema and television. In recognition of this and for his general promotion of greater productivity in British film studios this Honorary Fellowship is awarded.*

Howard Thomas—*The Honorary Fellowship is conferred upon Howard Thomas for his services to the Industry by promoting and directing an independent assessment of colour television systems. The results of this assessment have proved of international importance.*

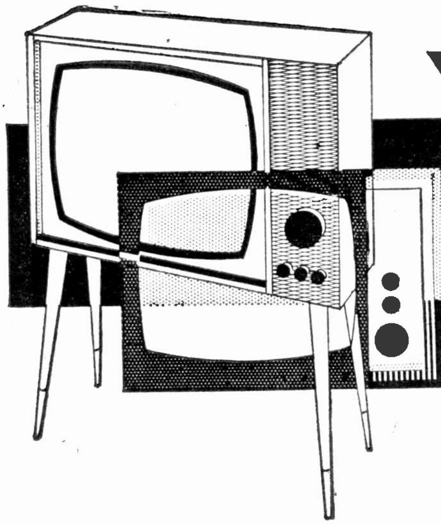
M. J. L. Pulling, CBE—*For his many contributions to the effective maintenance of quality standards for sound and picture in BBC transmissions. His work has extended from the early use of recording in sound broadcasting to participation, as Deputy Director of Engineering of the BBC, in such complex projects as the Eurovision system currently in service.*

J. H. Mewett, OBE—*As Head of the Film Department of the British Broadcasting Corporation, Mr. J. H. Mewett, OBE, has been responsible for supplying film production facilities for broadcasting on a scale hitherto unknown. This Honorary Fellowship is conferred in recognition of the success with which he has met the technical, administrative and servicing demands placed upon his Department and for the prestige that the products of his Department enjoy at home and overseas.*

The names of the newly honoured Fellows and the wording of the citations clearly indicate that B.K.S.T.S. is carrying out its aims and objects. By the way, they coincide with the aims and objects of PRACTICAL TELEVISION and its readers! That means *you!*

ICONOS

I. D. Wratten, President of the B.K.S.T.S., with five of the six new Honorary Fellows of the Society. Left to right are, J. H. Mewett, Howard Thomas, E. A. R. Herren, Lord Thomson of Fleet, I. D. Wratten and P. A. T. Bevan.



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 572 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

FERGUSON 2406

After the set has been operating for about half-an-hour, the picture disappears and no raster is visible.

The EY86 does not light up but the line whistle is normal.—A. Anderson (Aberdeenshire, Scotland).

This fault could be caused by shorting turns in the line output transformer. While this fault might not deaden the pulse potential at the rectifier anode completely, it will reduce its amplitude considerably and thus deliver insufficient power to energise the rectifier heater. However, check the boost reservoir capacitor, the line output valve and efficiency diode.

PHILIPS 3156

This set has a thick black line top and bottom of the picture. The top of the picture has also gone slightly "egg-shaped".—A. Moonie (Manchester, 4).

This is the symptom of insufficient vertical amplitude of scan, and nearly always caused by a faulty or weak field timebase valve. Have these valves tested and replace if below "70% good". If the valves are in order, check the condition of the electrolytic capacitor connected to the cathode of the field output valve. The rounding at the top of the picture could be caused by faulty scanning coils on the tube neck or incorrect adjustment of the pin-cushion correction magnets.

ALBA T717

The picture started jumping up and down. As the bottom half was going up, the top half was going down. As this symptom ceased, a 2in. cramp at the bottom of the screen appeared. I have changed V12 (PCL82) and several other components.—E. Forward (Carshalton, Surrey)

If V12 is in good order and is properly supplied (including heater current) we can only assume that C41 –C43, 44 or 45 are defective.

K-B VV10

On switching on, the picture commences to roll. This can be locked but after a few seconds, it starts all over again. This goes on for about ten minutes before it finally settles down.

Valves PCF80 and PCL85 have been changed but this has made no difference.—G. Owen (Rotherham, Yorkshire).

Check the OA81 interlace diode if the hold point is critical. It may also be necessary to check the associated components back to the video cathode 350μF 12V capacitor. If the hold position is not too critical, check C74 and R82.

ULTRA VP1772

This receiver has stopped working on band 3. Band 1, channel 5 is still O.K., but channel 10 (ITV) has gone.

I notice that when I switch to any band 3 channel, the video valve, 30FL1, lights up and the screen grid gets red hot.—R. Morgan (Bristol 3).

It seems from the overheating video valve that the set goes unstable on band 3 channels. This could be caused by a faulty tuner or tuner valve or by the band 3 aerial (or diplexer) failing to "load" the aerial circuit correctly. A defective aerial system is thus a possibility here.

FERGUSON 406T

Could you please explain where the actual position of the flyback or step-up for the h.t. in the line output transformer is?—A. Denby (Pitsea, Essex).

The normal operation of the line oscillator feeds a sawtooth voltage waveform to the grid of the line output valve. The amplified waveform consisting of the slow build-up of the scan and the rapid collapse of the flyback causes a very high pulse voltage in the overwind of the transformer which is rectified by the e.h.t. rectifier EY86.

FERRANTI 21K6

The picture will not stop rolling. I have changed V13 (PCL82) and several resistors and capacitors but the fault still persists.—T. Crawford (Manchester, 21).

The oscillator transformer T1 is the probable cause of the trouble. You may find it possible to overcome the trouble by changing the value of R112 and/or R116.

AMBASSADOR TV20

After the set has been on for about ten minutes, the picture begins to slip down.—D. Fallows (Stockport, Cheshire).

Check the setting of the vertical hold control. This control serves to "lock" the picture on the screen. If the slip can be corrected progressively by turning this control as the set warms up, suspect change in characteristic of the field timebase valve.

STELLA ST5721U

Picture "tears" at bottom but can be corrected for a while by increasing brightness. Wavy lines then appear horizontally across the centre of the picture. Controls will not correct fault, nor substitution of valves.—C. Brown (Grimsby).

Check the video amplifier electrolytic capacitors, particularly the cathode circuit 100μF. Then check the ECL80 (V11) pin 6 components.

SOBELL TPS147

The sound and picture is very good until the set has been on for about 45mins. when the picture suddenly closes to about 3in. wide, with a narrow picture upside down. I have changed valve PCL83 and PCF80.—A. Simpson (Walsall, Staffordshire).

We would advise you to check the cross coupling capacitors 0·01μF and 0·02μF pin 1, 2 and 9. Check associated resistors if necessary.

FERRANTI T1055

The sound is O.K. but there is no picture. I bought a new e.h.t. rectifier (U26 Mazda), but now I get blue flashes from inside it. I have replaced the boost capacitor. Please advise me of a possible cure.—J. Heath (London, S.E.12).

Try another U26. Note effect of disconnecting tube clip and Metrosil.

STELLA ST2149A

The picture has been very slow in appearing and when it has been operating for a few minutes the picture contracts until it is only half its normal width. No amount of adjustment will remedy this fault.—E. G. Cox (Leicester).

The PL36 line output valve is most likely to be at fault. Check the PY800 if necessary.

PHILCO 1019

The first indication of trouble was loss of frame hold, movement of the height control stopped it for a short time. I have two pictures, one at bottom, one at top. The PY81 and c.r.t. have a blue glow.—J. Armitage (Crewe).

The PY81 and tube glow effects are not significant so far as the field sync fault is concerned. Your trouble lies between the sync separator and sync input to the field timebase generator. Check the resistors, capacitors and diode in this circuit, as one or more of these is faulty.

REGENTONE 10-17FM

I wish to take set out of cabinet to clean C.R. tube. How is this done?—E. Smith (Woodlands, Doncaster).

Release front centre knobs by slackening grub screws. Pull off outer knobs. Pull off loudspeaker clips. Remove two rear side screws and pull out chassis.

STELLA ST8617U

Bottom section of the longest dropper resistor has burnt out. The PY81 also overheats. —S. Johnson (Hull, Yorkshire).

R106 is the bottom section. This is the 30 ohm 3 watt surge resistor of the PY82 (pin 9) V16. This valve is probably faulty. The PY81 overheats then the PL36 draws excess current or there is a short to chassis. Check ECL80 and PL36. Check line oscillator (ECL80) circuit and line output capacitors etc.

BUSH TV83

If I turn the brilliance up, the picture disappears, the picture is darker at the bottom. It is seven years old and has not had any new valves or c.r.t.—W. Coulson (Northallerton, Yorkshire).

Replace the rectifier on the lower right side or wire a BY100 (or equivalent silicon rectifier) across it. Check ECC82, PL81, PY81, and left side PCF80.

FERRANTI T1027

The fault developed on my receiver after fitting a new CME2101 tube. The top ½ inch of the raster has collapsed and a few fine white horizontal lines are present below the collapsed scan. There was a certain amount of cramping at the top of the picture with the old low emission tube.—P. Rowley (East Finchley, London).

The linearity control is a preset situated at the extreme top right of the chassis and front side. If adjustment does not clear the fault check the 0·02μF capacitor C82—R77 470kΩ and C77 0·01μF. Check 30PL13 if necessary.

BUSH TV56

Sound is O.K. Picture—plenty of brightness in hand but insufficient contrast or black. Old contrast control was out of order and I therefore replaced it with a new control. With this at its extreme position, there is insufficient depth of black resulting in a weak picture.—A. Massey (Eccles, Manchester).

We suggest that you check the video amplifier PCF80 on the left side and associated components.

DECCA DM55

This set is rather "mean" on white with subsequent poor black. Adjustment of brightness and contrast control is very critical, a slight over adjustment tends to make the picture negative, irrespective of the spot limiter and sensitivity controls adjusted. The mains dropper and h.t. smoothing capacitors have just been replaced and the voltages appear to be correct as per manual.—M. Gilicz (London, N.W.6).

The fault could be due to low tube emission. However, if the heater voltage is correct across pins 1 and 8 it is essential to check the first anode supply to pin 3. Check video amplifier and associated resistors (PCL84).

PHILIPS 1768U

The set has good definition but the fault appears to be triggering on picture. I have changed V13, the sync separator and PCF80 and most components around this stage. The picture is also noisy down the left-hand side of the raster.—R. Martin (London, E.8).

This trouble is possibly caused either by a weak aerial signal or a mismatch somewhere in the aerial system. This will give rise to random triggering symptoms and vertical "noise" bars down the screen. Check the aerial and its coupling to the set, including diplexer, outlet box, etc.

RGD 610

The fault on this receiver is that the picture is extended at the top and cramped at the bottom. I have changed V2 (30PL13), V6 (ECL80), C52, R60, C51 and C50 but there is still no improvement..—D. Park (Bradford, Yorkshire).

Cramping at the bottom of the screen means that the field output valve is failing to deliver full scanning current linearily. If the valve is definitely up to standard, check the feedback components in the vertical linearity circuit; also the capacitor on the control grid of the output valve (from the generator) for insulation resistance.

K-B PVP20

There is complete absence of e.h.t. The rectifier was found to have verdigris on the pins and on cleaning, the e.h.t. was restored for about two days but now the e.h.t. is again almost negligible. Renewing the rectifier has no effect and the line output transformer seems O.K.—H. Parkin (Newcastle upon Tyne, 7).

If the e.h.t. is normal to the top cap of the e.h.t. rectifier but the heater does not light, check the heater winding on the transformer.

If the e.h.t. is low to the top cap, check the line output valve and the boost diode, capacitors, etc.

QUERIES COUPON

This coupon is available until SEPTEMBER 22nd 1967, and must accompany all Queries sent in accordance with the notice on page 568.

PRACTICAL TELEVISION, SEPTEMBER, 1967

TEST CASE -58

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

? *A GEC 2019 was being investigated for lack of raster, and tests indicated the absence of pulse potential at the anode of the line output valve, the cathode of the booster diode and the anode of the e.h.t. rectifier valve. A check for h.t. voltage at the input of the line output transformer was made with a voltmeter, and a very low reading (just tens of volts) was obtained.*

Examination of the circuit showed that the h.t. supply was fed to the transformer (and line output stage) through a wire-wound resistor, and tests proved that this was virtually open-circuit. A replacement resistor was fitted, and after the set had warmed up on test this replacement resistor started smoking due to overheating, and there was still no raster or e.h.t. pulse voltage.

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

SOLUTION TO TEST CASE 57
Page 524 (last month)

When the sound channel suffers an intermittent fault, the best plan is to apply a generator signal at the sound i.f. to the input of the first (common) i.f. amplifier valve grid. The signal should be modulated and its level adjusted to provide a reasonable sound output with the volume control turned about half on. If the symptoms occur on this signal, then one can be reasonably sure that the sound i.f. channel is in trouble.

A sound i.f. valve making poor connection between its pins and the sockets of its valveholder often causes the volume of the sound to jump up and down, but this can easily be proved by rocking each sound valve in turn in its holder while the channel is carrying a signal, being monitored on the speaker or output meter.

Bad valve connections were disproved in the set under examination, so further checks had to be performed. When the sound output fell due to the symptom occurring, quick adjustments were made to the cores in the sound i.f. transformers, and it was found that the output could be restored by adjusting the core in one transformer quite a few turns. After this adjustment, the fault cleared and this time the output *fell* and could be restored by returning the core previously adjusted to its original position.

This made it clear that the tuning of the i.f. transformer was changing due to the fault, and investigation indicated that a small, fixed tuning capacitor was connecting in parallel with the transformer winding. This was replaced and the fault was completely cleared.

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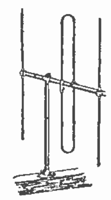

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