Practical TELEVISION

JANUARY 1964

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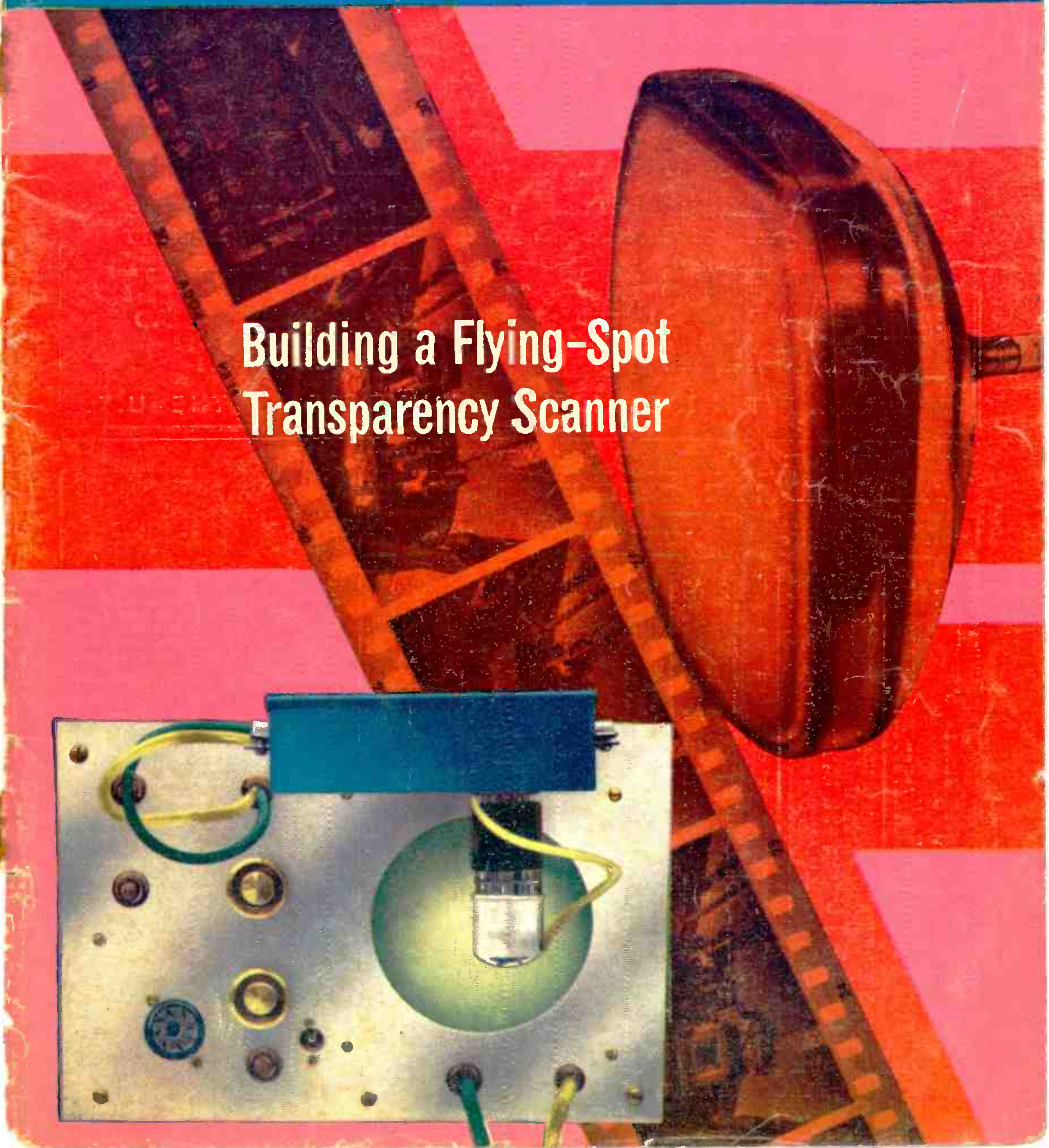

Building a Flying-Spot Transparency Scanner

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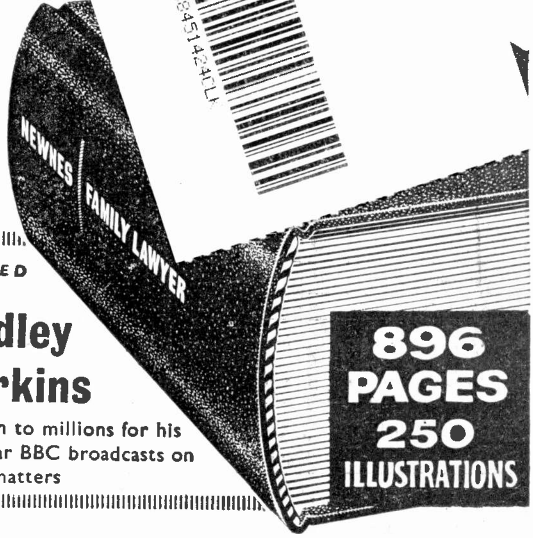

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Practical Television

AND TELEVISION TIMES

VOL. 14, No. 160, JANUARY, 1964

Editorial and Advertisement Offices:

PRACTICAL TELEVISION

George Newnes Ltd., Tower House Southampton Street, W.C.2.

Phone: Temple Bar 4363.

Telegrams: Newnes, Rand, London.

SUBSCRIPTION RATE

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Contents

One More Year

AT this time of year, it is traditional to reflect on the twelve months that have ticked by and to wax enthusiastic (and usually optimistic) on days to come.

Cynics might argue that the datum line of the year-end is purely arbitrary and that a more effective close season for reflection and resolution might be devised at any time. The fact remains, however, though the opportunity is always there, it never seems to materialise. Yet the calendar is irrevocable. One day it is December 31st. The next it is January 1st.

How do we, at PRACTICAL TELEVISION, react to this season of meditation? Looking over the last twelve issues, we feel some modest satisfaction, and this is justified by the reaction of readers.

Most tastes have been catered for, with constructional articles on Closed Circuit TV apparatus, equipment to receive amateur TV transmissions on 70cm, pieces of test gear such as the Henlow oscilloscope, a transistor pattern generator, a grid dip meter, and articles on building set top aerials, a TV deaf aid, attenuators, etc.

A quick flip through these pages shows a high level of authoritative supporting articles on aspects of fault finding and alignment, in addition to regular features and series of practical value—most of these being written by widely experienced professional contributors.

The subject of 625-line conversion and associated topics have been given the wide coverage they merited. So has colour TV, for though this is unlikely to be launched for at least another year, most TV enthusiasts will have to obtain at least a working knowledge of the principles involved.

And what of the New Year? We shall, of course, give you more articles on CCTV, on aspects of amateur transmitting and on the recently introduced activity of DX searching. We shall also continue to cater for those whose main interest is in the maintenance and servicing of domestic TV sets.

In short, we shall do our best to provide the kind of magazine readers want and our policy will be moulded partly by our own judgement and partly by comments and constructive suggestions received in our mail from readers. We look forward to another mutually satisfactory year in 1964.

Christmas 1963

Seasonal Good Wishes to all readers from the Editor, staff and contributors of Practical Television

Our next issue dated February, will be published on January 22nd.

TELETOPICS

INDUSTRIAL APPLICATIONS OF TV INCREASE

LAST month's Industrial Photographic and Television Exhibition had the effect of making it clear to anyone who remained uncertain of the importance of television in industrial concerns, just how seriously British Industry takes the introduction of TV into every aspect of production. To any visitors who took the role of CCTV, for example, to be merely a means of keeping an eye on things this Exhibition must have been something of a revelation.

The manufacturers of CCTV systems at the show—and there were many of them—illustrated such a variety of applications for their products, that visitors must have wondered how the country had survived before the widespread use of CCTV had become accepted. The simple, single-lens camera is apparently no longer sufficiently versatile to meet the needs of industry, and the manufacturers have done an admirable job in designing much more sophisticated equipment without making the units too large or clumsy. Remotely-controlled zoom lenses and motorised turrets have left the camera still compact and relatively easy to operate, and the adaptability of complete systems, which makes their operation possible under the most varied conditions, remove many of the restrictions which faced earlier equipment.

Much in evidence at this exhibition were special housings for TV cameras to protect them during heavy-duty operation, some of which included remote-control pan and tilt heads.

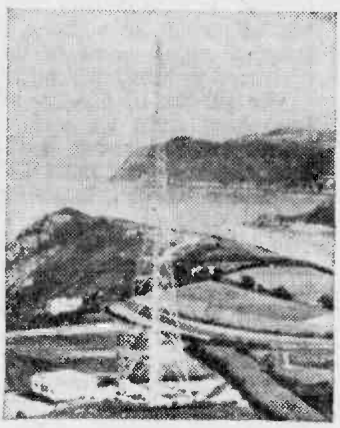
The value of a closed circuit TV system to relay documented information to one or more television screens, depends on the definition it is possible to achieve and some very impressive demonstrations of document transmissions were to be seen at the show.

CCTV has recently been introduced as an aid to television film making, where a TV camera mounted behind the film camera, views the same scene and relays a picture on to a monitor screen, so that the operator can see the scene as it will appear finally on television receivers.

One other aspect of television which is finding acceptance in industry is TV tape recording. Several equipments were displayed at the show, including one American-made portable unit which weighs only 75 lbs., and which uses tape only 1in. wide as opposed to the usual 2in. tape.

Transmitting Mast Re-erected

THE ITA's Channel Islands transmitting mast at Fremont, St. John's Bay, Jersey, was originally built at the Lichfield ITA station in Staffordshire. This 445ft. tower, which was erected eight years ago by British Insulated Callender's Construction Co., was replaced at Lichfield recently by a taller structure. However, when BIC Construction Co. dismantled the orignal mast, it was found that the metal was still sound and so its re-erection began at Fremont after the steelwork had received nothing more than a clean and a coat of paint.



The ITA's mast at Fremont, Jersey.

London Festival of Television

THE first London Festival of World Television ended on December 14th, after a period of nine days when televised tapes and films from countries throughout the world had been shown mainly at the National Film Theatre in London. The Festival was presented by the television quarterly *Contrast* (published by the British Film Institute) and arranged by the National Film Theatre Division of the Institute, in association with the BBC, the ITA and the ITV Companies. Towards the cost of the running of the Festival, equal cash contributions totalling £6,000 were made by the BBC, the ITA and the Companies.

Approximately 15 per cent of the total screen time was given over to British work.

CCTV in St. Paul's Cathedral

WHEN H.R.H. The Duke of Edinburgh attended the Dedication Service for the Most Excellent Order of the British Empire in St. Paul's Cathedral recently, four television cameras relayed pictures of the Service to 30 23in. receivers placed in many parts of the Cathedral. The complete system had been installed for the occasion by Kolster Brandes Ltd., using KB receivers and cameras supplied by Television Advisers Ltd.

£8,000 TV SYSTEM FOR LONDON COLLEGE

THE University College, London, is to have an £8,000 closed circuit television system installed to aid biological science studies. The Rank Audio Visual Division of the Rank Organisation has received the order to install this equipment in the new year.

The two vidicon cameras to be employed in the system are of studio type incorporating zoom and four-turret lenses. A mobile control unit will monitor the outputs to six 23in. 625-line receivers.

300 See Queen Mother on CCTV

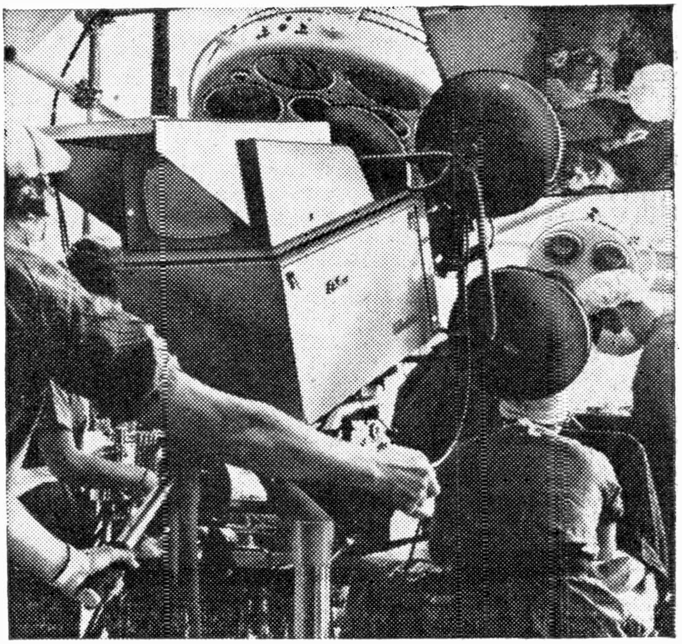
ON November 14th, Queen Elizabeth, the Queen Mother, opened the new Shire Hall in Gloucester. Four hundred and fifty guests had been invited to the ceremony, but because of the limited seating in the Council Chamber, 300 viewed the entire event on television receivers. Television pictures from three points in the building were relayed from three cameras to the 12 receivers, over a closed circuit link which had been installed for the occasion by EMI Electronics Limited.

OPERATIONS TELEVISED IN COLOUR

ONE of the most ambitious programmes of televised medical operations in colour was successfully carried out recently, when a Marconi vidicon colour camera channel relayed pictures from the operating theatre of Hammersmith Hospital in London to the Isaac Wolfson Institute adjoining the hospital, and to the Royal College of Surgeons at Lincolns Inn Fields. During the five days of the demonstrations, many operations were shown to the audiences which assembled in the two terminal points of the link, making it possible for a total of 1,300 people to watch any of the operations.

At each operation the surgeon gave a running commentary of his work, and members of the audience were able to put questions to him at any time throughout the operation. The audience viewed the televised scenes on 9ft. by 12ft. screens on to which the pictures were projected by Marconi colour projectors.

The camera took the pictures from the reflected image in a mirror suspended above the operating table.



A colour television camera televising an operation at London's Hammersmith Hospital.

"Dawn University" TAM Rating

THE first audience research figures reaching the ITA from TAM indicate that about 200,000 homes tuned in to one or more of the "Dawn University" lectures broadcast at 7.15 each morning during a week in October. These lectures were by way of being an experiment and were at first year undergraduate level.

Although no conclusions can be drawn from these figures until a more detailed assessment of the lectures has been presented to the Authority, it is interesting to note that 200,000 is nearly double the total university population of Great Britain.

Television Navigation Aid for Tanker

IN November this year, the largest tanker ever built in Norway was launched at Stavanger. An important part of the navigational equipment fitted to this new ship is a British-made CCTV system which will provide the ship's captain with an extra "eye" when entering harbours and docks. The equipment, which was supplied by the Rank Organisation, consists basically of a specially designed television camera and a viewing monitor.

A Flying-Spot Transparency Scanner

BY J. G. RANSOME

WHEN the writer first contemplated this television system he was advised by the wise-heads amongst his friends (those whose job was the designing and construction of television systems) that he might as well stop before he began as the problems involved were formidable and virtually insurmountable for the average amateur. Undaunted by this pessimistic counsel the system has been designed and built and the writer has had the satisfaction of seeing behind-the-hand comments turn into enthusiastic advice.

It must be emphasised from the outset that the picture quality is not that of the highest professional standards; however, this is not to belittle the performance of the system which is quite capable of resolving typescript legibly and is excellent for the display of black and white negatives.

Whilst the writer believes that the construction of the unit is beyond the absolute beginner, he is convinced that it is not purely the province of the advanced constructor, for in this design it is the "middle-man" who is being catered for and anyone competent with a soldering iron and willing to tackle simple radio-type circuits should be able to undertake the construction of this apparatus.

A block diagram of the complete flying-spot scanner is shown in Fig. 1.

As can be seen from this diagram, the unit is designed to feed an ordinary domestic television receiver; however, should this be inconvenient a simple monitor may be constructed. Subsequent articles will be devoted to the construction of two different types of monitors—one of simple design, and the other a more advanced design.

THE SYSTEM DESCRIBED

The basic operation of a flying-spot scanner is very simple. The timebases of the scanner and monitor are run in step. The photo-multiplier "sees" the trace on the scanner tube through the transparency and transmits a signal which is proportional to the light incident on its cathode and this signal is amplified and used to modulate the monitor tube.

To illustrate the point let us take a fairly simple example. Consider a scanner and monitor running in step each producing an eight-line picture the scanned transparency being a cross as shown in Fig. 2.

Starting at the top left-hand corner of the picture and looking at line 1, the sequence of operations is as follows.

The line and frame timebases fire and as the spot draws out the first section of the line (up to A) the photo-cell receives full illumination and holds the monitor tube (to which it is connected) at full brilliance. Then as the line is drawn from A to B the photo-multiplier receives no light and thus cuts off the monitor tube so that that part of the trace is not visible, then from B to the end of the line full brilliance is restored.

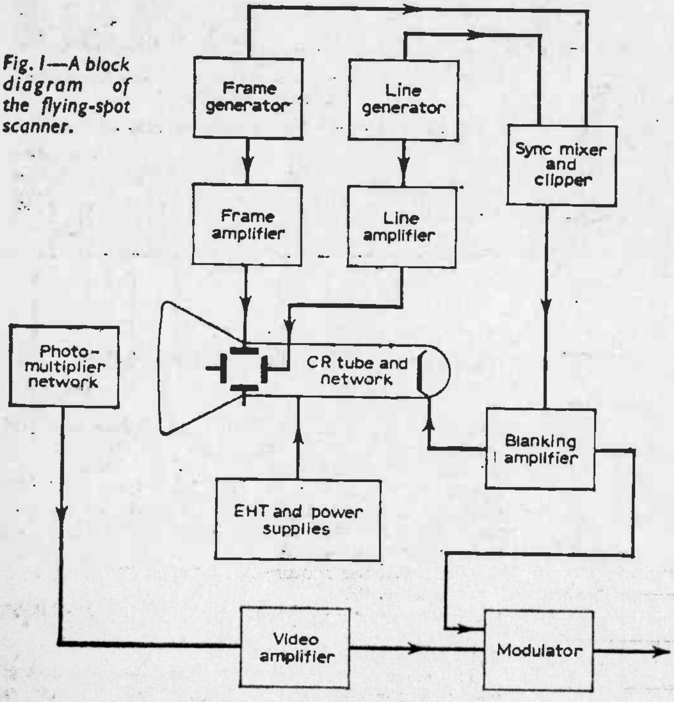


Fig. 1—A block diagram of the flying-spot scanner.

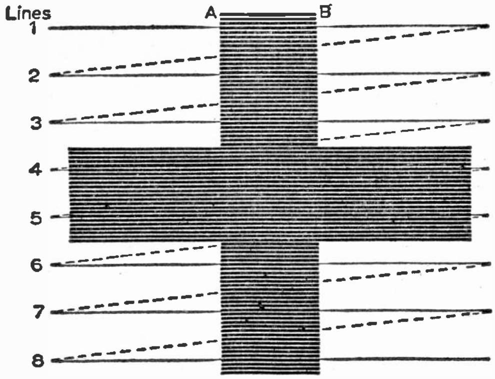


Fig. 2—This diagram helps to illustrate the principle of the scanner (see text).

A graphical representation of the photo-tube output is shown in Fig 3(a). The same series of events occurs for lines 2 and 3 but when we come to lines 4 and 5 we find that they are cut off altogether and so the monitor tube does not display these two lines. For lines 6, 7 and 8 a similar effect to that for line 1 is evident. The resultant trace on the monitor tube is shown in Fig. 3(b). If we imagine the lines as shown to be white then the places where the trace has been cut off will appear dark and so the eye will make out the outline shown by the dotted lines. The signal that appears at the photo-tube anode to modulate the monitor during one such complete frame is shown in Fig. 3(c).

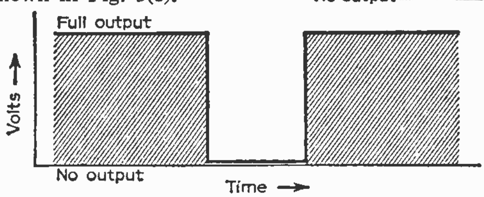
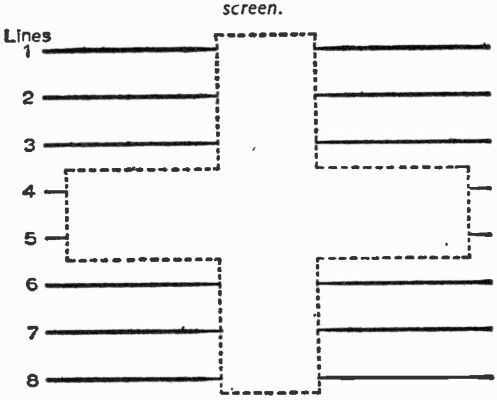


Fig. 3a (above)—The photo-tube output.

Fig. 3b (below)—The resultant trace on the monitor screen.



Unfortunately the situation is not quite as simple as this as we have to make sure that the timebases run in step; that is to say that each line has to begin and end at the same time on both the scanner and monitor tubes. Thus we need to synchronise the two traces. Fortunately television timebases can be designed so that we can cause a new line stroke to commence if we arrange a suitable pulse to be fed to the timebase at approximately the right time.

These pulses are available from the scanner timebases and are mixed with the video signal and fed into the monitor set. Such pulses are known as synchronising (sync) pulses. Thus a full composite signal containing all the information needed to reproduce the shape of Fig. 2 is shown in Fig. 3(d).

This then is the theory and a brief idea of what the design is trying to achieve. We now move on to the actual construction.

THE POWER UNIT

The circuit of the power unit is shown in Fig. 4 and there is little here that is out of the ordinary.

The main h.t. is derived from a 350-0-350V transformer T2, and is rectified by the 5Z4 in a full-wave circuit. As can be seen from the circuit, choke smoothing is employed and this is to be preferred to resistive smoothing because of the need for a fairly ripple-free h.t. line together with the best possible regulation. The stabilised h.t. line is

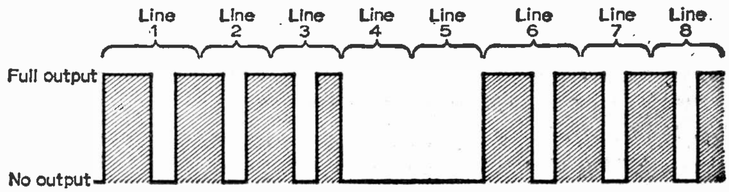
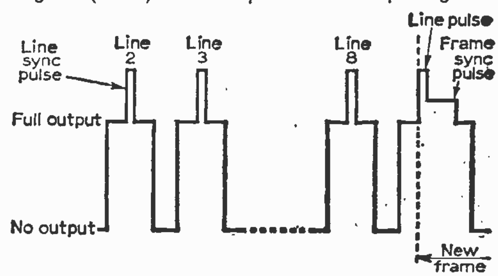


Fig. 3c (above)—The signal as it appears at the photo-tube anode.

Fig. 3d (below)—The composite video output signal.



obtained by use of the VR150/30 regulators. The series resistor, R2, regulates the current flow through the regulator system and the value of this resistor assumes a raw h.t. potential of 350V. Should the h.t. voltage exceed this value, R2 will have to be adjusted to limit the current drawn by the stabilisers to 40mA.

The resistance required is given by:

$$R2=\frac{V\ h.t.-300}{40}.\ \text{Where } V\ h.t.=\text{raw h.t. voltage}$$

this gives a value for R2 in kΩ.

The negative h.t. line is derived from one side of the transformer, and although the circuit is undesirable from a theoretical point of view it works in practice and is satisfactory for small current drains.

The metal rectifier MR1 must have a peak inverse voltage rating in the region of 1·5kV to cope with the worst possible conditions of the circuit.

The capacitors C5 and C6 should *NOT* be of the chassis-fixing can type, but should be of the tag-board mounting type, as the outer can will be at −300V with respect to earth—it is worth while noting the connection polarity of these two capacitors!

The e.h.t. section is straightforward and the only precaution needed here is to ensure that all high voltage points are well clear of the chassis to prevent arcing over. The capacitors C1 and C2 should be of the highest quality and should have a value of at least 0·1μF and preferably more.

Testing the unit is straightforward with a test-meter. The h.t. voltage is about 450V off load and 350V on load. The regulated voltage should be 300V irrespective of load. The negative h.t. rail reads 350V off load and 290-300V when on load.

The e.h.t. cannot be measured directly and must be measured by more devious means. The method employed is quite simple. The e.h.t. is loaded by 5 x 0·5MΩ ½W resistors wired in series, and in series with this load is a milliammeter. When the unit is switched on and the rectifier has warmed up the milliammeter should read between 0·7 and 1·0mA.

It must be emphasised that e.h.t. voltage can be lethal and a slip-up by incautious testing here will rarely result in a second chance for the tester to repeat the mistake!

Also, when the unit is tested off load it is well to remember that the capacitors retain their charge for some time and the circuit should be left to discharge for 1-2 minutes after switching off, before making adjustments.

A practical wiring diagram is shown in Fig. 5, with the above-chassis wiring diagram depicted in Fig. 6.

COMPONENTS LIST
POWER UNIT (Fig. 4)

Resistors:

R1	100kΩ ½W	R4	500kΩ ½W
R2	1·2kΩ 5W	R5	47kΩ ½W
R3	500kΩ ½W		

Capacitors:

C1	0·1μF (or larger) paper 3,000V
C2	0·1μF (or larger) paper 3,000V
C3	8μF electrolytic 500V
C4	8μF electrolytic 500V
C5	8μF electrolytic 350V (see text)
C6	8μF electrolytic 350V (see text)
L1	Smoothing choke 5H 150mA
T1	Mains transformer. Secondaries: 2,000V 5mA; 4V 1·5A insulated to 3·5kV
T2	Mains transformer. Secondaries: 350-0-350V 120mA; 5V 2A; 6·3V 5A
MR1	Silicon rectifier 3-4mA 1,000 p.i.v. (Westinghouse S10AR1)

Valves:

V1	R10	V3	VR150/30
V2	5Z4	V4	VR150/30

(Brimar or equivalents)

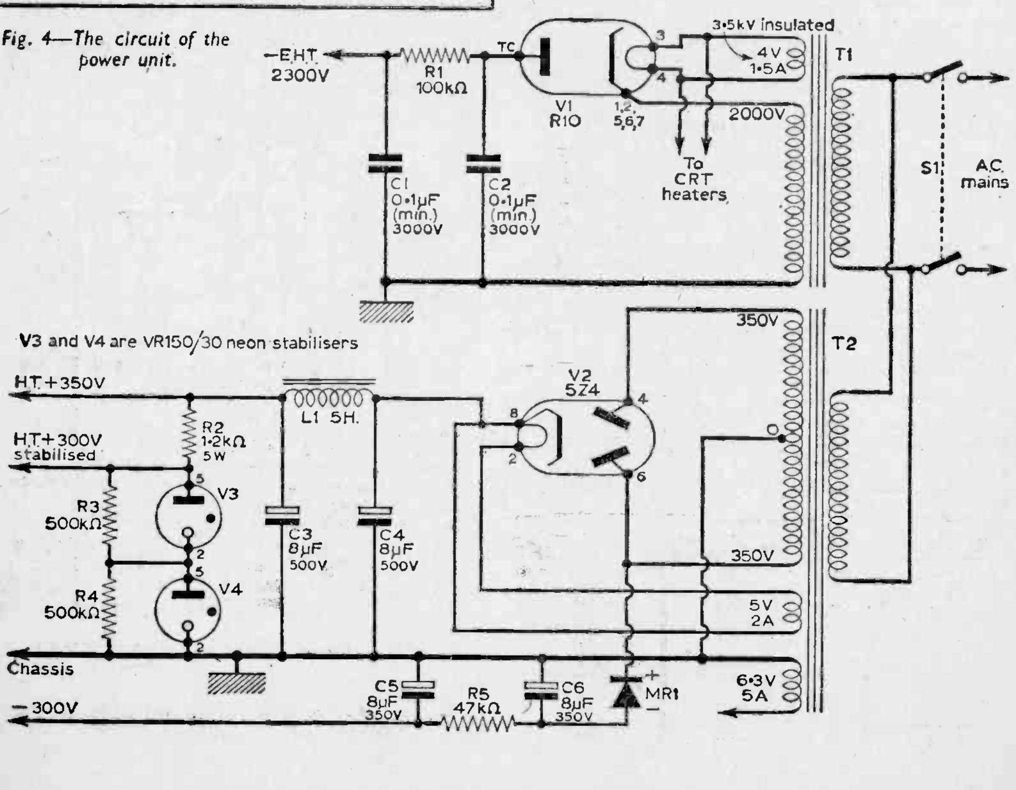


Fig. 4—The circuit of the power unit.

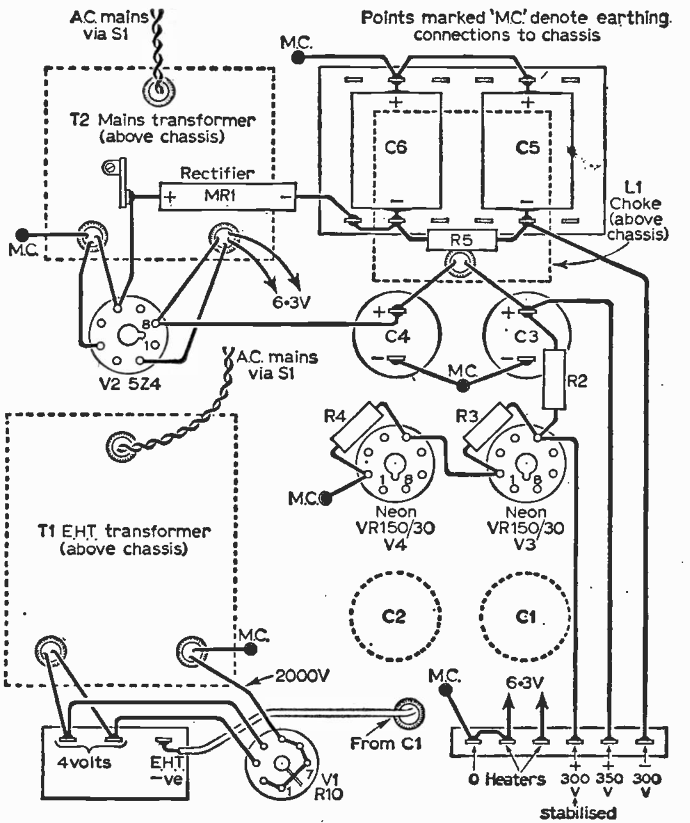


Fig. 5—The wiring diagram.

With reference to Fig. 7 the circuit description is as follows.

Point A is at −2,300V compared to the chassis and is the most negative part of the circuit. As we go up the chain from A the voltage becomes more positive with respect to A until we get to the h.t. connection which is 2,650V positive with respect to A.

Across this potential is connected the bleeder chain of R7, VR1, VR2 and R8. Grid bias (which controls the electron flow in the tube and hence the brightness) is

—continued on page 180

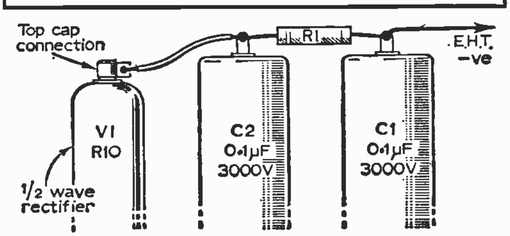
COMPONENTS LIST	
C.R. TUBE UNIT (Fig. 7)	
Resistors:	
R6 47kΩ	R8 3·3kΩ
R7 2MΩ (4 x 500kΩ—see text)	
VR1 500kΩ potentiometer	
VR2 100kΩ potentiometer	
Valve:	
V5 VCR517C	

THE C.R. TUBE UNIT

The tube unit and network is shown as Fig. 7. The tube used is the VCR517C which has a short persistence blue trace with a long yellow afterglow. The photo-cell is insensitive to yellow light and and extremely sensitive to blue, and thus the effect of the afterglow is eliminated so that only the very short persistence blue trace is used for the scanning and this is precisely what is required.

The characteristics of the VCR517C are shown below:

Heater 4V	1·0A
Va1 and Va3	2,500V
Va2 ("focusing")	260 to 470V
Vg ("brightness")	−1 to −100V



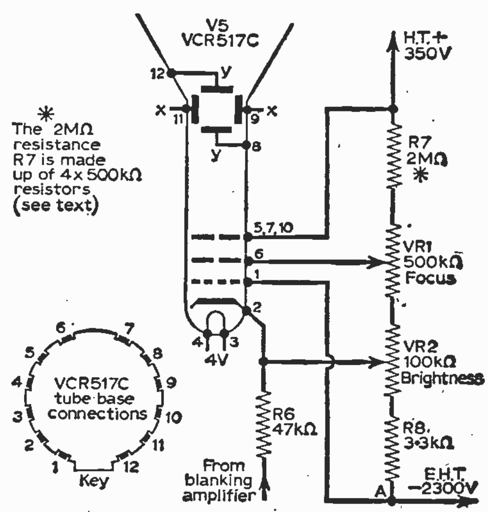


Fig. 7 (above)—The tube unit and network.

Fig. 6 (left)—The wiring of the rectifier and smoothing components.

How to Receive BBC 2

BY K. ROYAL

MOST of our readers are now well aware that the new 625-line television programmes will occupy channels in the u.h.f. bands, Bands IV and V. Eventually, there will be two extra programmes at 625-line u.h.f. The first is the second programme of the BBC, called BBC-2, and later there will be a second ITV programme.

The first London u.h.f. 625-line station is due to start a complete service on April 1st, 1964. This will be on Channel 33, and at the time of writing test transmissions are already being carried out on that channel from Crystal Palace.

U.H.F. Development

In addition to the London station, there has been Government approval for the building of seventeen u.h.f. stations in two stages. That is, eight stations by the end of 1965 and nine more by the end of 1966 or a little after.

Areas to be covered in the first stage are the Midlands, Lancashire, South Yorkshire, Central Scotland, North-East England, Northern Ireland and the Isle of Wight. In the second stage the Bristol area, Norfolk, Anglesey, North-East Scotland, South-East Kent, Nottinghamshire, North Yorkshire and Northamptonshire will be embraced.

These two stages of development will bring 625-line u.h.f. television programmes to about 75 per cent of the population, and small booster and relay stations will fill in the signal shadow zones around the areas mentioned. About 95 per cent coverage will be given by stage three of exercise 625-line u.h.f. This will take place after 1966, and by about 1969 will include almost 50 main u.h.f. stations and many boosters and relays.

Each u.h.f. station and aerial system will be engineered for four eventual u.h.f. channels, so that ITV-2 and extra programmes, up to a total of four, can be transmitted in any given area. This will include the possible changeover of existing 405-line programmes to 625 lines so that these could be broadcast together with BBC-2 and ITV-2.

Each u.h.f. channel is 8Mc/s wide and each station group is allotted a piece of u.h.f. spectrum eleven channels wide (e.g. 88Mc/s) into which its *four* channels are placed. Each of the four channels is identified relative to the lowest frequency channel of the group, where "n" signifies the lowest frequency channel. The London area group is n, n+3, n+7 and n+10, where n is Channel 23. Thus, the four London u.h.f. channels are 23, 26, 30 and 33 respectively. The highest frequency channel (n+10) is the first to be used on a permanent basis, as previously intimated.

Channel Identification

This method of channel identification makes it also possible to determine the frequency of a channel of the group provided the frequency of the lowest number channel is known. For example, the vision carrier frequency of London n (Channel 23) is 487·25Mc/s. This means, then, that n+3, for instance, has a frequency of 487·25 +(3 × 8)Mc/s, which works out to 511·25Mc/s. This, of course, is the frequency of Channel 26. The "times 8" factor of the formula simply relates to the fact that each channel is 8Mc/s wide. The "3" puts the channel being identified three channels up from n, or Channel 23, making it Channel 26, of course.

In many cases the u.h.f. transmitters and aerials will be co-sited with existing v.h.f. 405-line stations. This is desirable since it means that a composite receiving aerial need be adjusted only for maximum reception on the u.h.f. programmes, with the knowledge that it is also pointing in the right direction for the v.h.f. programmes.

It must be emphasised that the new programmes of BBC-2 will in no way affect the existing 405-line programmes of BBC-1. BBC-1 will continue for many years to come, and when the time eventually comes for the old 405-line system to be replaced completely by the better 625-line system, the 405-line programmes will probably be duplicated on the 625-line system during the period of the changeover. However, there is no absolute decision on this at the time of writing.

While the existing 405-line sets will continue to receive the 405-line programmes on the v.h.f. channels, a new type of dual standard set is needed to receive both the 405-line programmes *and* the new 625-line u.h.f. programmes of BBC-2.

Four Types

During the last year or so four types of sets have been sold. These are (i) 405-line-only, (ii) convertible to dual standard, (iii) dual standard without u.h.f. tuner and (iv) dual standard with u.h.f. tuner. Sets in category (i) are the original 405-line models which have been used over the years. These are not suitable for receiving the 625-line programmes on u.h.f., *and there is definitely no simple kind of 625-line converter or adaptor for this type of set.*

Experimenters with a spare, early type set to experiment with will no doubt try their hands at rebuilding for 625-line u.h.f. operation.

Full details of an experiment of this kind are given in the July, August, September and October, 1963 issues of PRACTICAL TELEVISION, under the title "Towards 625 Lines", by D. Elliott.

Sets under category (ii) are not immediately suitable for reception of BBC-2 as they stand. Early purchasers of these models may not be clear that, in some cases, substantial modifications are required to get them to work on both standards. These sets were sometimes called "convertible to switchable", since conversion is required to make them switchable from one standard to the other.

They need a u.h.f. tuner in addition to the internal modifications, and the overall cost of conversion, including a u.h.f. aerial (required by all dual standard sets) could well exceed £20. The method of this type of conversion varies between makes and models, and in many cases it was originally envisaged that a 625-line i.f. strip and video stage (plus flywheel line sync unit) would be installed by the side of the existing 450-line i.f. strip.

Slightly later convertible to switchable models were designed so that the whole of the original 405-line i.f. strip could be replaced by a single i.f. strip of the dual standard variety, as used in true dual standard models. It should be noted, however, that the original conception of conversion may not apply in practice with all models. There have been second thoughts on the problem by some makers, but viewers can rest assured that where a manufacturer has committed himself to convertibility when selling the set, the original or a new method of conversion is, or will be made, available.

Transistorised 625-line Strip

A new thought by Ekco, for instance, abandons the original idea of replacing the existing i.f. strip with a dual standard strip. Conversion of these models now adopts a transistorised 625-line-only strip, incorporating an f.m. sound detector. The strip is fed with signal from the u.h.f. tuner and itself supplies suitable signal direct to the video amplifier stage.

Sets under the Thorn banner (such as Ferguson, HMV, Marconiphone, Philco and Ultra) are converted by the addition of a 625-line-only strip with its own u.h.f. tuner. This works side-by-side with the original 405-line strip.

A similar technique is adopted by Phillips, Pye and Baird. Murphy uses a plinth unit beneath the cabinet where there is a mechanism which couples to a toggle-type standard change switch. Connection is essentially by plug-and-socket, as with Decca and others.

It is not possible within the compass of this article to provide details of individual conversions, but viewers in doubt about the convertibility of their sets would be well advised to consult their dealers as soon as possible, for once the new programmes are underway there is almost certain to be a rush for conversions, as when the ITV programmes started.

Plugs and Sockets

Sets under category (iii) are properly engineered for operation on both standards, but before the new programmes can be received a u.h.f. tuner and aerial will need to be fitted. The retail price of u.h.f. tuners seems to have settled around the seven-guinea mark, and for fitting them into the type of set now under discussion plugs and sockets are invariably provided. The actual fitting, compared with converting to switchable, is relatively inexpensive and should not present too many problems. Many of our readers should be able to tackle this job for themselves.

Sets under category (iv) are completely ready to receive the new programmes, and many of these sets are, at the time of writing, successfully receiving the 625-line u.h.f. test transmissions. Readers with this type of set need only instal a suitable u.h.f. aerial to get BBC-2, as well as the existing BBC-1 and ITV-1 programmes.

It is impossible to say just how much a u.h.f. aerial system is likely to cost, for very much depends upon the strength of the u.h.f. signals in the area and upon whether the receiving site is screened from the transmitter by rising ground or large buildings. The u.h.f. characteristic makes the signals behave rather more like light than the v.h.f. signals that we are used to. This means that u.h.f. signals find it more difficult to penetrate massive hills and structures than v.h.f. signals. There is also less bending of the signals at u.h.f. compared with at v.h.f., making shadow areas much more defined so far as the new signals are concerned.

There is no simple remedy for these problems, and if the signal is just not present due to an intervening hill, for example, there is no point in adding preamplification or extra aerial elements. The solution lies in increasing the height of the aerial so that it "looks" over the top of the hill.

In weak signal areas generally, however, improved signal pickup can often be secured by the use of extra elaborate aerial systems. At this juncture it should be noted that to avoid confusion when referring to the number of elements on a u.h.f. aerial British manufacturers have agreed that the reflector will always be counted as one, regardless of the form or number of rods used.

Reflector Counts as One Element

While ordinary v.h.f. aerials usually have just but a single reflector rod, u.h.f. aerials often have a reflector made either of four or more rods of wire or metal mesh. The overall gain of the former is probably not any greater than the latter, so it would be misleading to add the number of rods making up the *reflector* to the number of aerial elements.

As a rough guide in areas where the screening is average, a nine-element array will give reasonable reception within a radius of about 15 miles from the transmitter, a thirteen-element up to about 20 miles, an 18-element beyond 20 miles and in "difficult" locations nearer to the transmitter.

For extreme fringe area working and in extra difficult areas, stacked, broadside and "quad" arrays of the above aerials may well be needed. Fortunately, the length of u.h.f. aerial elements is around about a foot or a little under, so many of them can be used without the array becoming too unwieldy. In general, however, a u.h.f. array ends up with about the same amount of metal as a v.h.f. array operating in a "reasonable" reception area from a co-sited transmitter. This means that although the u.h.f. elements are smaller than v.h.f. ones, there are about four or five times as many of the former than the latter.

88Mc/s Wide

Whilst as a general rule v.h.f. aerials are tuned to a specific channel, u.h.f. aerials nearly always embrace a group of eleven 8Mc/s channels. The reason for this is two-fold. Firstly, the u.h.f. characteristic automatically endows the array with a relatively wide band and, secondly, the aerial must be suitable to receive the eventual four u.h.f. channels of a local group (see the first part of this article).

The relatively large number of u.h.f. elements in an aerial array, makes the array far more directional than an ordinary v.h.f. array. High directivity is desirable at u.h.f. since these signals are more easily reflected than v.h.f. signals. The directivity factor means that the array can be carefully orientated to provide the best possible signal/"ghost" ratio. It also means, however, that incorrect orientation over just a few degrees, which would have no effect at v.h.f. is likely to attenuate the aerial signal by two or more times.

It is essential, therefore, that the u.h.f. aerial is carefully set up in the first place, either on a transmission or, preferably, on a signal strength meter, for the maximum signal pickup. Sets (of all types) are less sensitive on the u.h.f. channels than on the v.h.f. channels. In general, this means that the set needs more u.h.f. signal to give a picture which is no more grainy than the v.h.f. picture. Sometimes the u.h.f. signal has to be about twice as strong as the v.h.f. signal to satisfy this condition.

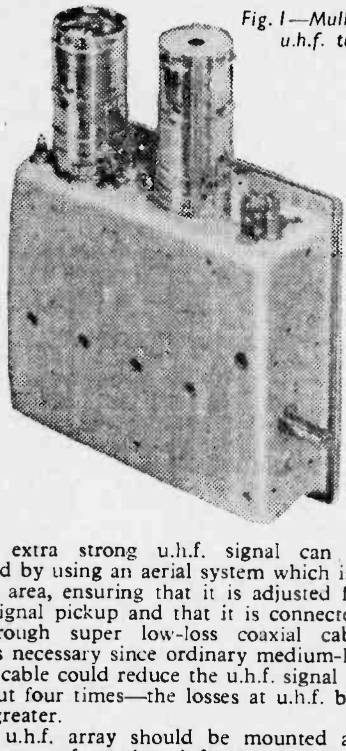


Fig. 1—Mullard's new u.h.f. tuner.

The extra strong u.h.f. signal can only be obtained by using an aerial system which is suitable for the area, ensuring that it is adjusted for maximum signal pickup and that it is connected to the set through super low-loss coaxial cable. The latter is necessary since ordinary medium-loss v.h.f. coaxial cable could reduce the u.h.f. signal relatively by about four times—the losses at u.h.f. being that much greater.

The u.h.f. array should be mounted as far as possible away from the v.h.f. array and other metal objects, for otherwise "proximity effects" could detract seriously from the u.h.f. signal pickup.

Separate Inputs

All dual standard sets (and converted models) have separate inputs for v.h.f. and u.h.f. This is good since it means that the ordinary v.h.f. installation and feeder can remain as it is and that an extra low-loss feeder can be employed on the u.h.f. aerial.

Later, sets will probably be made with a common aerial input socket, but this would not be very suitable for low signal working owing to the extra losses in the combining filter. A commercial combining filter is available, but it is recommended only in those areas where the u.h.f. signal is extra strong, so that it can be routed via the ordinary v.h.f. feeder.

In some locations very close to a transmitter a set-top u.h.f. aerial may be suitable. Normally, however, a good outside array will be the order of the day. If there is insufficient chimney room to cater for the extra u.h.f. aerial, it may be worth considering bringing the v.h.f. aerial indoors so that the chimney can accommodate the u.h.f. aerial without proximity troubles. These days, a set-top or roof-space v.h.f. aerial system generally serves quite well.

Signal Probing

Aerial positioning at u.h.f. is far more critical than for v.h.f. In fringe areas the presence of "standing waves" may make it necessary to "probe" for the signal. Merely changing the aerial from one corner to an opposite corner of the same chimney stack could make a great difference in signal pickup.

Most u.h.f. tuners have some kind of scale calibrated in channel numbers. The tuners employ ganged capacitive tuning (like ordinary radio sets) and channel coverage is continuous over the scale. The tuner spindle is coupled to the knob through a slow-motion drive. On no account should a u.h.f. tuner be dismantled, for even a small change of stray capacitance or inductance could swing the alignment out and reduce the overall sensitivity. A tuner of the new Mullard design is shown in Fig. 1.

This is continuously variable over the range from 470 to 860Mc/s. It incorporates two frame grid triodes: a PC88 operating as a grounded-grid r.f. amplifier and a PC86 as a self oscillating mixer with an i.f. output over the range 33·4 to 38·9Mc/s.

Remember that dual standard receivers have two line hold controls, one for 625 lines and the other for 405 lines. The appropriate control comes into operation when the front controls are set for 405 lines or 625 lines. On the u.h.f. channels the v.h.f. tuner is muted and the u.h.f. tuner is switched into circuit, and the opposite happens on the v.h.f. channels. ■

ON THE AIR
Amateur Band Topics

RECEPTION OF AMATEUR TV SIGNALS

THE following notes are intended to assist the enthusiast who has built the 70cm receiving equipment described in last month's issue of PRACTICAL TELEVISION.

When searching for 70cm signals always remember to rotate the aerial into the required direction because signals can be missed due to the directivity of the aerial (the 16-element stack array has a beamwidth of about 30 deg.). At some time during the operation of the receiver signals will be received which are not strong enough to please the operator and he may then wonder what improvement, if any, can be made. Obviously improvements can be made at the transmitter end as well as the receiving side to increase signal strengths, however only the receiving end will be considered.

The Basic Receiver

Before trying to increase signal strengths it is important to ensure that the television receiver is making the best out of the existing signal. The performance of television receivers with weak signals varies enormously, the locking qualities of the timebases being paramount.

The line frequency locking circuit should be reasonably immune from noise influence though still being capable of a good solid lock on noisy signals. The flywheel synchronising circuit used on some receivers can be excellent in this respect but may have undesirable features for other uses.

The frame lock circuit should be as solid as possible with weak signals. Good interlace, which is sometimes lacking in these sort of circuits, is not necessary for weak signals; anyway, many amateurs do not transmit 405-line interlace.

Assuming that the TV receiver has a good performance, as above, its signal-to-noise performance and that of the whole system can be improved by limiting the i.f. video bandwidth to about 1Mc/s. This should only be done using a wobbulator and after all other methods of improving the signals have been exhausted. The definition, of course, will be limited but the improvement on very weak signals is quite surprising.

A higher-gain aerial will give better signal-to-noise ratio although, depending on the particular type of aerial used, a narrower beamwidth usually results. As mentioned previously, the higher the beam is mounted the better; this is especially true until it clears immediate surrounding obstructions. Once clear there is still further improvement by going even higher—but at a smaller rate.

A Preamplifier Stage

The converter only uses a diode mixer and by using a preamplifier with a suitable valve or valves the signal-to-noise ratio of the converter can be raised by several dB. A suitable valve is the G.E.C. A2521 grounded grid triode, which at 70cm will improve the signal-to-noise ratio of the converter by some 5dB. There are other more expensive valves available but the improvement will only be marginally better than with the A2521.

However, before investing in a preamplifier it is worth trying a selection of diodes in V2 position, especially if they have been obtained from a Government surplus store. A rough check on the diode is to measure its forward and reverse resistance (do not pass more than a few milliamps through the diode). In general the greater the ratio the better the diode.

Readers may be wondering over what sort of distance signals can be expected. Apart from unusual conditions, the distance covered depends a great deal on the location of the transmitter and receiver and the terrain between. With very favourable sites 100 miles is a realistic distance. On the other hand, from very poor locations less than ten miles can be expected. However, when propagation conditions are very good, hundreds of miles may be expected even from poor locations.

—G3LGJ/T

AMATEUR TELEVISION BANDS

425— 445Mc/s	70·0cm
1,225— 1,290Mc/s	23·0cm
2,300— 2,450Mc/s	13·0cm
5,650— 5,850Mc/s	5·2cm
10,000—10,500Mc/s	3·0cm
21,000—22,000Mc/s	1·4cm

The maximum d.c. input power to the final stage is limited to 150W. Classes of emission permitted: A1, A2, A3, A5, F1, F2, F3 and F5.

BRITISH AMATEUR TELEVISION CLUB

THIS club was founded in 1949 to inform, instruct and co-ordinate the activities of amateur radio enthusiasts experimenting with television transmission. The BATC is affiliated to the Radio Society of Great Britain. About one-third of the membership reside abroad. Other countries where there is considerable amateur activity are Australia, Canada, France, the Netherlands and the USA.

In the U.K. there are local groups and activities range from constructional work to lectures. Public demonstrations of equipment at local exhibitions are frequently given by members of such groups.

Further information about the BATC can be obtained from the Hon. Secretary, c/o 4 Inwood Close, Shirley, Croydon, Surrey.

ELUSIVE PICTURE FAULTS

BY T. S. SMITH

MANY of our readers are now well able to relate particular picture symptoms to definite fault conditions within the set. As an example, the symptom of a bright, horizontal line on the screen instead of a picture or raster signifies to many that something fairly drastic has gone wrong with the frame timebase section of the set. Similarly, a lack of picture width is often correctly interpreted as low h.t. voltage due to a bad rectifier or as a low emission line output valve or booster diode.

There are numerous equally as well known "stock" symptoms which are mentioned time and time again in the literature. The difficulty is, however, when the symptom is one of infrequent display or is rarely written about. With this in mind, the author has taken a series of photographs showing the more elusive kind of symptoms as actually displayed on the screens of faulty receivers so that they and their remedies may be brought to the attention of our readers.

BEAM MODULATION

In Fig. 1 is shown the symptom of modulation of the electron beam in the picture tube with ripple. The alternate light and dark vertical bars at the left of the screen are best displayed on a blank raster. That is, with the aerial disconnected from the set, the contrast control turned right down and the brightness turned up sufficiently to give screen illumination (raster). The diagonal lines are not uncommon when there is no signal. These are the flyback lines, of course.

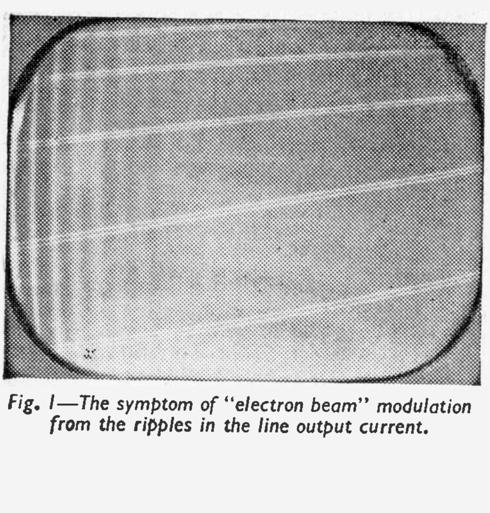


Fig. 1—The symptom of "electron beam" modulation from the ripples in the line output current.

On the line flyback, ripples may occur in the line amplifier causing rising and falling currents. These are sometimes radiated and picked up on the grid circuit of the picture tube, where they cause the *brightness* of the scanning spot to change as it scans the screen, and thus give rise to the symptom as shown.

Proof is readily available, all that being necessary is to connect the grid of the tube to chassis through a large value capacitor. If this causes the screen to clear or, at least, the severity of the symptom to decrease, the trouble is undoubtedly modulation of the electron beam.

The remedy lies first in establishing the whereabouts of the unwanted coupling. A misplaced grid lead hanging near the line output stage is one possibility. Another is incorrect earthing of the metal case of the brightness control potentiometer. If the receiver features frame flyback suppression (in which case the flyback lines as in Fig. 1 would not be displayed when the circuit is working correctly), attention should be given to the capacitors and resistors connected directly to the grid circuit of the tube to the brightness control.

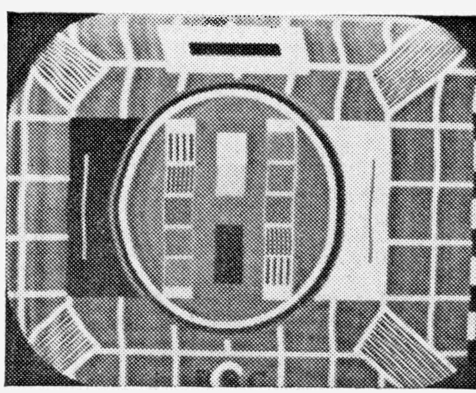


Fig. 2—Kinking at the top of the picture is caused by crosstalk due to coupling (or unbalance) between the line and frame scanning coils (see text).

VELOCITY MODULATION

Now should it happen that the symptom remains when the tube grid is connected to chassis through a capacitor (use a value of, at least, 0·1μF), modulation of the electron beam is *not* the cause of the symptom. Here, then, the effect would be caused by the *speed* of the scanning spot changing in sympathy with the line timebase disturbances as the spot scans from the left to the right across the screen.

This effect is often called "ringing" in the line timebase, and used to be very troublesome in early receivers. Indeed, in some of these models the effect is always present to some degree, even when the set is without fault. However, it can be aggravated by a faulty resistor and/or capacitor in a circuit shunting the width or linearity inductor of the line output stage.

Other possibilities are low emission line output valve or booster diode, low h.t. voltage necessitating full setting of the width control to give anywhere near a full line scan and trouble in the line scanning coils or in the line output transformer proper (check for a fractured core).

CROSSTALK

A similar kind of symptom is seen in Fig. 2; but here the line ripples are induced into the frame scanning coils, causing the kinking effect at the top of the picture. This is called "crosstalk interference".

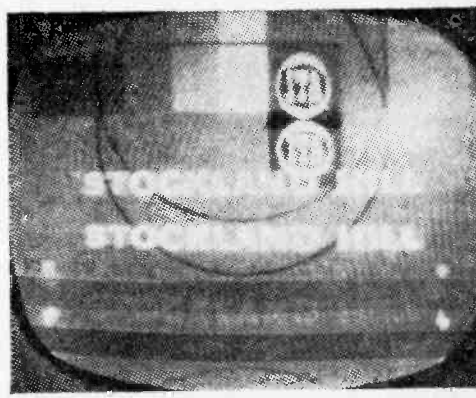


Fig. 3—Intermittent vibration of the picture.

A defective set of scanning coils can cause the trouble, but more likely is failure or value increase of one (or both) of the low value resistors connected across the frame coils. There are two resistors here, one connected across one half section of the coils and a like value component connected across the other half, with the two connected together at the centre. The value is usually in the region of hundreds of ohms.

On some models a so-called "anti-crosstalk trimmer" is situated on or near the scanning coils on the tube neck. The procedure is to adjust this very carefully until the effect on the picture is minimised. Where it is present, it is rarely possible to delete it completely! Note that a high pulse voltage may be present on the trimmer, so use a well insulated trimming tool, such as a suitably tailored plastic knitting needle.

Fig. 4—"Ringing" in the vision channel, a symptom which can be caused by mismatch or trouble in the aerial system, as described in the text.

In Fig. 3 we come to something with a different flavour. Here the picture is vibrating up and down at an intermittent and inconsistent rate. This is not really frame judder, which was explained in a previous article, and it may not appear until the set has been running for fifteen minutes or so.

The curious thing is that frame-wise the picture effectively locks, so adjustment to the frame hold control will not cure the fault but will cause it to be superimposed upon a rolling (unlocked) picture. In some instances, the height control may effect a temporarily cure, but then it may well be necessary either to suppress or expand the picture, thereby making it unviewable. Adjustment to the frame linearity control may affect the picture likewise.

Sets with triode-pentode frame timebase valves of the ECL80 and similar category may appear to be cured when the valve is replaced, but this is not always the case, for there is every possibility that the symptom may appear again after a frustrating pause. Resistor and capacitor checks in and around the frame timebase seem to indicate perfect order, and it is only when the frame blocking oscillator transformer is checked is the culprit brought to light. Tests of winding resistance and insulation of the defective part does not always give a clue as to the fault, and all that can be said is that the insulation possibly breaks down on the frame flyback when high voltage pulses occur across the windings.

It is worth mentioning that similar transformer trouble can affect the frame lock without disturbing the timebase action on certain sets. The photograph in Fig. 3 is taken from an English Electric model with a defunct frame blocking oscillator transformer.

The symptom seen in Fig. 4 is revealed best on pictures with sharp changes from black and white and vice versa in the horizontal direction. It can be caused to happen on some models and under certain conditions by carefully setting the fine tuning control close to the "sound-on-vision" point.

The symptom of Fig. 4 was taken from a receiver which suffered the effect only on the ITV programmes, but at all settings of the fine tuning control. It was noticed, however, that the set appeared to be almost on the verge of instability and, indeed, instabiliy could be promoted at high contrast settings with the downlead at the back of the set placed in a certain way.

The trouble was eventually traced to the ingress of moisture into the diplexer coupling the BBC and ITV aerials to the common downlead. Replacement of the diplexer effected a complete cure.

Similar trouble has been observed due to old coaxial downlead which was probably installed on the set before one! Damp or water in the downlead not only incites instability but it seriously reduces the signal applied to the set and is a big cause of picture grain, especially on the ITV channels.

AERIAL TROUBLE

One can be fairly certain that something is badly amiss with the aerial system if the symptom or picture is influenced by moving the downlead at

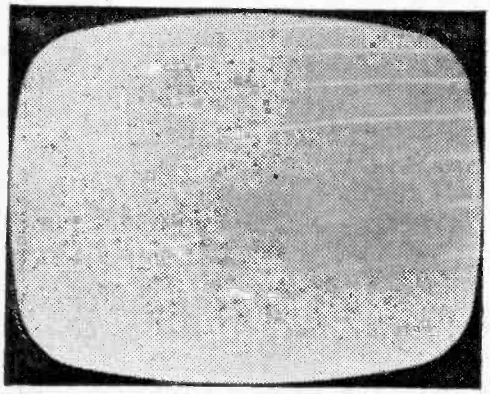


Fig. 5—Flyback lines on a plain but modulated raster.

the back of the set. Change of impedance at the aerial, reflecting back into the downlead and causing instability or "ringing", as the symptom of Fig. 4 is sometimes called, can also be the result of a next door neighbour putting up a new aerial on a shared chimney stack. This impedance change arises from "proximity effects" and is the cause of more trouble than is realised these days when it is necessary to have so many aerials close together. It will not be tolerable so much on the new u.h.f. bands which are used for BBC-2.

On all receivers without flyback line blanking, flyback lines will be displayed when the raster is produced without a signal present. As the signal falls from video into the sync region the grid of the tube (relative to cathode) is pushed hard negative, thereby cutting off the beam current and the flyback lines. This is the normal action. If the brightness control is set too high, then, in spite of the picture signal going negative. screen illumination will still be present during the flyback period and the flyback lines will be seen, as shown in Fig. 5.

If a set which features flyback blanking shows the symptom, then there is something very wrong with the blanking circuit. This was, in fact, the trouble with the set from which Fig. 5 was photographed.

The circuit consists essentially of a "hold-off" resistor between the tube grid and the slider of the brightness control, a resistor-capacitor potential-divider across a part of the frame circuit and a resistive and/or capacitive feed from the junction of the potential-divider to the tube grid.

The part of the frame circuit selected may be in the oscillator or amplifier. Some models have a tapping on the output transformer to take off a suitable blanking pulse. All that is necessary is to select a part of the frame circuit where the voltage pulses *negative* on the frame flyback, which then pushes the grid of the tube extra heavily negative (along with the signal as mentioned above) and makes totally sure that the flyback is suppressed.

If the symptom is present on models with a suppression circuit, the components in the tube grid circuit should be checked preferably by substitution, and the faulty one will soon be discovered. The symptom in excess on sets without a suppression circuit usually signifies that the tube is low emission and that an extra high setting of brightness is necessary to obtain a picture of viewable brightness.

However, another cause is the frame locking on hum instead of on the frame sync pulses. This can happen due to heater/cathode leakage in one of the vision valves or sync or frame valves. In some receivers only a slight hum is sufficient to shift the frame lock from the sync pulses to the 50c/s ripple voltage. The picture may then divide into two, with a wide, black, horizontal line at the top or bottom of the screen.

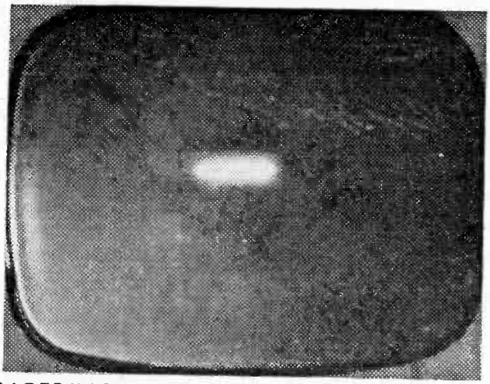


Fig. 6—A lingering spot of sufficient intensity can cause local discoloration of the screen phosphors. The text tells the main causes of this symptom.

LINGERING SPOT

Readers are sometimes concerned about the bright spot of diminishing brightness which may develop in the centre of the screen when the set is switched off (Fig. 6). There is the possibility that the spot may be of sufficient intensity and duration to cause localised phosphor discoloration.

The symptom results because of the high charge retained by the e.h.t. filter capacitance, and because of the reducing emission of electrons from the cathode, even after switch-off. The electrons are thus accelerated in the normal way, and since by this time the timebases have ceased working a spot is produced.

Two main circuit arrangements are adopted to minimise the effect. An early idea was to arrange for the tube to be cut off for a while immediately following switch-off.

—continued on page 166

PRINCIPLES AND PRACTICE OF COLOUR TELEVISION

PART 7

CONTINUED FROM PAGE 109 OF THE DECEMBER ISSUE

BY G. J. KING

LAST month we saw how the chroma information of the televised scene is added to the mono information at the transmitter and how the combined information is then applied to the v.h.f. or u.h.f. carrier wave.

At the time of writing colour test transmissions are actually taking place on 625 lines. While it is impossible at this time to say exactly when a colour service will be established, the situation now is much clearer than it was a few months ago. Tests have been made to find out the type of system which is most suitable for use in these islands, having in mind programme interchange between European and American stations.

Whatever system is finally decided upon, the basic principles will be as expounded in this series of articles. There are, at present, three systems under review: the American NTSC, the French SECAM and a German version known originally as the Bruch 3 system, but now colloquially termed the PAL system, short for "phase alteration line system". We shall be looking more closely at the differences between these three systems next month.

Compatibility

At this juncture it is necessary for us to see what happens to the combined chroma and mono signals when they arrive at the set end of the chain. The best way of looking at this first of all is to consider a colour television receiver working from an ordinary black-and-white television signal, of the kind that ordinary monochrome sets work from.

A domestic colour television system must be compatible. That means a colour receiver must be capable of producing a picture in black-and-white from a mono transmission and, conversely, a mono set must be able to give a picture in black-and-white from a colour transmission.

All the systems proposed for domestic colour are compatible and they incorporate receiver circuits which are similar to those used in mono sets. Actually, about 75 per cent of a colour receiver consists of circuits which are virtually the same as those in a mono set. There is the tuner, the i.f. stages and the detector. The *extra* 25 per cent relates to circuits which are designed specifically for the colour signal.

Compatibility starts at the transmitter. Fig. 23 in Part 6 shows how a televised scene is analysed in terms of the three primary colours to create the Y′ or luminance signal which is almost equal to the signal produced by a mono camera for a mono television system, as we have seen in past articles.

Colour Signal to Mono Set

The Y′ signal, it will be seen, is applied to the transmitter modulator along with the chroma information, and the sidebands of the latter are exploited at this time, the sub-carrier being suppressed (more about the sub-carrier and the carrying of the chroma information later).

Sidebands on their own "look" to a mono set as spurious signals which, as purposely arranged, do not interfere with the basic mono information. Thus, in a mono set the colour sidebands are bypassed to chassis in the detector circuit and only the Y′ signal is permitted to pass. This is processed in exactly the same way as a true mono signal,

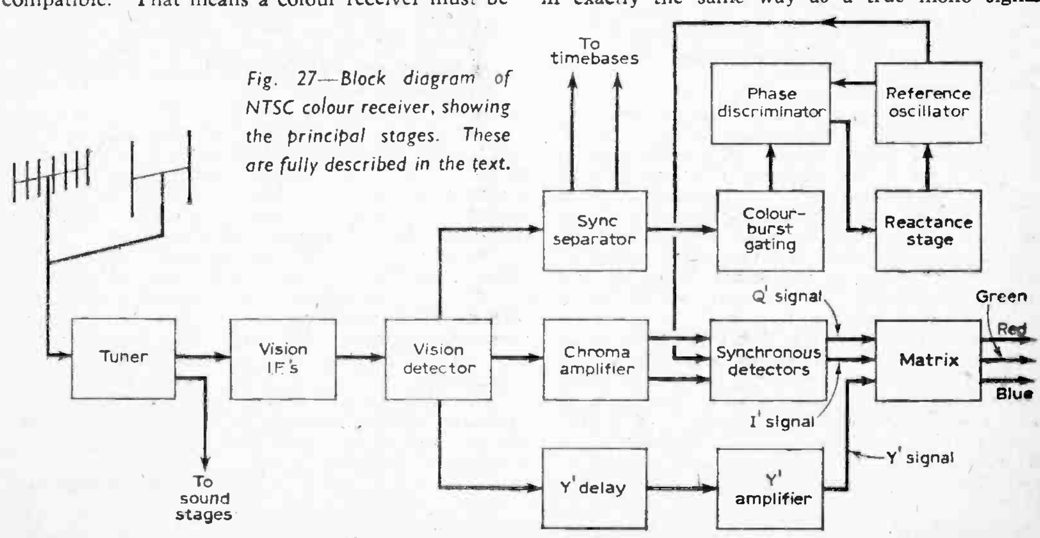


Fig. 27—Block diagram of NTSC colour receiver, showing the principal stages. These are fully described in the text.

thereby resulting in a black-and-white picture, even though the original signal carries information which is also capable of working a colour set.

Now let us investigate the happenings when a mono signal is fed into a colour set. Fig. 27 shows a block diagram of the principle elements of a colour receiver. The tuner, vision i.f. stages and the detector are common to both mono and chroma sets, and the sound signal is extracted either from the output of the tuner or from a common i.f. amplifier stage, depending upon the type of set. The receiver may be designed for 405-line, 625-line, or dual standard working, using a.m. or f.m. intercarrier sound in accordance with normal practice. The exact type of design at this juncture does not particularly interest us.

The demodulated vision signal from the detector is applied to a sync separator stage in the usual manner and to a Y′ amplifier (equivalent to the mono video amplifier). The latter is fed through a delay network to ensure the correct "timing" of the mono and chroma signals at the picture tube, bearing in mind that the chroma signals have to pass through a greater number of circuits than the mono signal and are thus delayed more than the mono signal. The Y′ delay compesates for this.

Mono Signal to Colour Set

Now, a mono transmission is carried by such a receiver quite normally. Sync pulses are produced for the line and field timebases and the video from the detector is fed to the Y′ amplifier just as it would be fed to the video amplifier in a mono set. The Y′ or mono video output, instead of being applied direct to the cathode of the picture, as in the case of a mono set, is applied to a "matrix" stage.

This, in effect, adds the I′ and Q′ signals when colour is being received to produce the correct range of red, green and blue signals, in conjunction with the Y′ signal, and when mono is being received it lets through the correct values of signals corresponding to the red, green and blue inputs of the colour tube so as to produce a display in monochrome without colour distortion.

Past articles have shown how a picture in monochrome can be derived from the three primary colours and displayed on the screen of a tricolour picture tube. Those readers who are still not sure of the principles of colour mixing, refer to Parts 1 and 2 of this series.

Colour Signal to Colour Set

Now to see what happens when a colour signal is applied to a colour set. The Y′ signal is fed through the receiver in the manner already described; but the sidebands of the chroma signals (I′ and Q′ signals) are not this time bypassed to chassis at the vision detector, but instead extracted and applied to a chroma amplifier (still referring to Fig. 27). This is really like a video amplifier, but is designed to handle the colour signals.

The I′ and Q′ sidebands are absolutely no use at all as they stand, since they have no carrier (this was suppressed at the transmitter). They cannot thus be detected in the usual manner. Before they can be processed the carrier has to be reinserted, and this is accomplished by a reference oscillator.

This has a nominal frequency the same as that of the suppressed subcarrier at the transmitter. The signal is applied to a rather special synchronous detector in the receiver along with the signals from the chroma amplifier. In the detector, the I′ and Q′ sidebands are added to the synthetically-produced sub-carrier and, provided the phase of the reference oscillator signal is within a few degrees of the phase of the original sub-carrier signal, detected I′ and Q′ signals appear at the output of the stage.

In practice, there are two synchronous detectors, one for the I′ signals and the other for the Q′ signals (only a single block is shown in Fig. 27). In order to ensure that the phase of the reference signal matches that of the original sub-carrier and, equally as important, that the phase of the colour sidebands relative to the reference frequency is maintained, the reference oscillator signal is "locked" to the colour burst signals which are carried on the back porch to the line sync signals (see Fig. 24, Part 6).

In effect, the colour burst signals control the reference oscillator in rather the same way as the sync pulses control the line and field timebases. However, the colour control is extremely critical from the colour rendering aspect. Deviation of phase will impair the colours and modify their hues.

Hue Control

While the line and field timebases feature hold controls, the reference oscillator has a hue control. This is a preset which is adjusted on installation of the set for the best colouring. Sometimes a user's hue control is fitted, and then the viewer himself is faced with the problem of its adjustment. This is best made by adjusting for the most natural "flesh" tones, but the difficulty is in knowing whether a particular face should be pink, brown or white!

The correct relative phase is maintained once the hue control has established the setting initially by the colour burst signals, as intimated. These signals are picked out from the sync pulses at the output of the sync separator and are then fed through a colour gating circuit. This deletes all traces of sync signal and leaves only the colour bursts.

The colour burst signals are fed to a phase discriminator circuit, which is akin to the same circuit used in flywheel sync circuits and in some f.m. receivers (also for automatic frequency correction), to which is also fed a sample of the reference oscillator signal.

Now, when the reference oscillator signal and the colour burst signals are in phase (or within the correct phase relationship) the output from the phase discriminator is zero (or a nominal prearranged value). Should the phase of the reference signal tend to alter from that of the colour burst signals, a positive or negative voltage, depending upon which way the relative phase alters (i.e., plus or minus), is produced at the output of the phase discriminator.

Reactance Control

The frequency of the reference oscillator is set initially by the normal LC constants of the tuned circuit in the conventional manner. However, across the tuned circuits is connected a "reactance valve". This is a triode or pentode valve arranged basically as shown in Fig. 28. From the aspect of the oscillator signal voltage applied as shown, the circuit "looks" like a reactance in the capacitive

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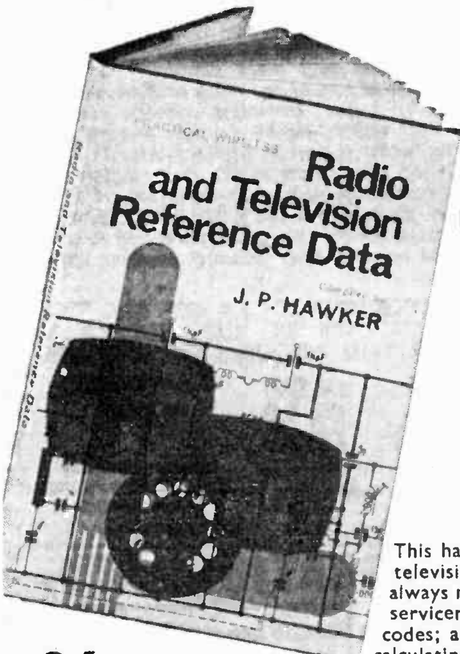

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sense. That is, the oscillator voltage lags 90° on the current.

If Fig. 28 is considered first without C and R, the oscillatory current *i* flowing in the valve will be in phase with the oscillatory voltage *e*. In other words the circuit is purely resistive.

The presence of C and R alters this condition, however, since by tapping of a portion of *e* and applying this to the grid, C gives a phase advance of almost 90°.

Owing to the amplification effect of the valve, the anode current produced by this out-of-phase voltage is greater than *i* and the valve passes an a.c. component 90° ahead of the applied voltage *e*. This is equivalent to a capacitive shunt across the oscillator tuned circuit.

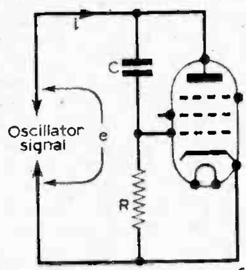


Fig. 28—Basic circuit of reactance valve, arranged to reflect capacitive reactance.

The value of this virtual capacitance depends upon the grid bias applied to the valve, and as the bias is altered so the capacitance value changes. This means, therefore, that the frequency of the reference oscillator can be varied simply by altering the grid bias on the reactance valve. This is where the hue control may be connected. As this control is adjusted so the grid bias is varied and hence the phase of the reference signal over a few degrees.

The oscillator is phase-locked and maintained in correct phase over long periods by the use of the voltage at the output of the phase discriminator as a control bias. Should the phase of the oscillator tend to drift away from that originally established by the hue control, correction is accomplished by the capacitance of the reactance valve altering in a manner to compensate due to the output of the discriminator rising in a positive or negative direction.

Obtaining the Colour Signals

When the synchronous detectors receive a reference signal of correct phase, relative to the I′ and Q′ sidebands, demodulated I′ and Q′ signals (corresponding to the red- and blue-difference colour signals respectively) are produced at the output of the detectors. Thus, we have the Y′ signal and the colour-difference signals applied to the matrix.

In this sense the matrix subtracts the Y′ signal from the red- and blue-difference signals, leaving just the red and blue signals. The green signal is derived, in effect, by the red and blue signals being subtracted from the Y′ signal.

The end result is that red, green and blue signals are produced which operate the tricolour display device in exactly the same way as if the three colour signals were carried over separate and isolated circuits, as in closed circuit television.

In this article we have seen how a mono set responds to a colour transmission, how a colour set responds to a mono transmission and how a colour set gives a correct colour display due to the modulation of I′ and Q′ signals, in addition to the mono luminance signal, upon the common vision carrier signal.

We must now see how it is possible to transmit the colour information without causing interference to the mono signal. The energy of a mono television signal is concentrated in small " packets " of energy instead of being spread evenly over the video bandwidth. Each packet of signal energy is separated from its neighbour by the line scanning frequency (10,125c/s 405 lines and 15,625c/s 625 lines), and at each packet there are energy components at multiples of the field frequency.

The energy is greatest at line frequency and the energy output falls fairly quickly at field frequency

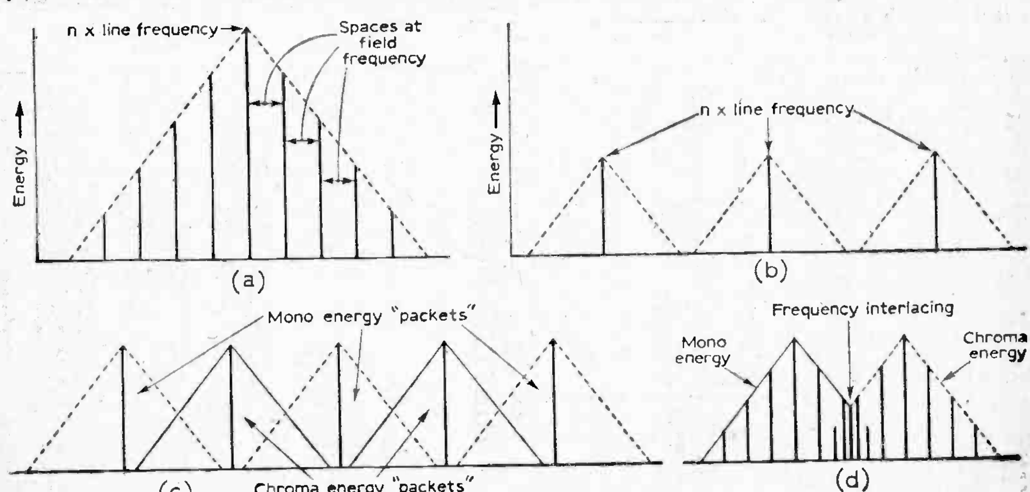


Fig. 29—Mono signals produce "packets" of signal energy over the video spectrum at line frequency intervals with components at field frequency as shown at (a) and (b). Similar "packets" of energy are produced by the chroma signals and by correct selection of the sub-carrier frequency these can be made to fall between the packets of mono energy as shown at (c). Frequency interlacing of the energy components then occurs as shown at (d).

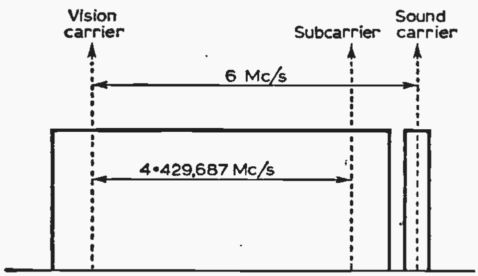


Fig. 30—Showing the position of the sub-carrier in the video passband.

spacings away from 1, 2, 3, 4, 5 . . . n times the line frequency. The idea is shown in Fig. 29 (a), while at (b) it is shown that very little energy due to the mono signal exists between the line frequency intervals.

The chroma signals also produce packets of energy of a simlar kind, also spaced at line-frequency intervals. The position of the chroma energy packets relative to those of the mono signals is governed by the frequency of the sub-carrier upon which the I′ and Q′ signals are first modulated at the transmitter.

Sub-Carrier Frequency

The sub-carrier frequency is towards the top end of the video spectrum (about 4·5Mc/s in the case of 625 lines). However, if the exact frequency is made an odd multiple of half the line frequency, the packets of chroma energy will fall exactly between the packets of mono energy, as shown in Fig. 29(c). Moreover, the energy components will interlace, as shown in Fig. 29(d). On the 625-line system this effect is achieved when the sub-carrier frequency is exactly 4·429,687Mc/s, as obtained by multiplying one-half of the line frequency by 567.

Other factors which include the sub-carrier frequency are dot pattern, which occurs if the frequency is too low and interference between the sound carrier and the sub-carrier. The latter is minimised by arranging for the sub-carrier to interlace with the sound carrier. We thus have a somewhat complex set of conditions to satisfy.

Fig. 30 shows how the sound, vision and sub-carrier signals are spaced relative to each other. The sub-carrier is usually made the "master frequency" from which the line and frame frequencies are derived, the master being held to an accuracy in the order of 0·0003 per cent.

On mono systems the master frequency is that of the power supply. That is, the field is locked to the power supply and from there the line frequency is obtained. On colour systems this is not possible, and as a consequence it is not possible to lock the field frequency to the power frequency. This results in so-called asynchronous working which, on some of the older type of receiver, produces slowly rolling hum bars due to residual hum in the vision stages. When the hum is locked to frame, of course, the hum bar is still present, but since it is stationary is is not usually discernible.

PART 8 APPEARS NEXT MONTH

Elusive Picture Faults

—continued from page 160

The latest, and best, idea is for the tube itself to discharge the e.h.t. capacitance on switch-off due to it passing a very high beam current. This is arranged either by coupling the tube grid back to the mains supply circuit (to the on/off switch), via a current limiting resistor, or by some other method causing the grid to go highly negative with respect to the cathode immediately on switch-off. With this technique the line and frame scans are in the process of collapsing when the beam is discharging the e.h.t. filter capacitor, so the illumination is spread over a greater area of screen and localised burning is avoided.

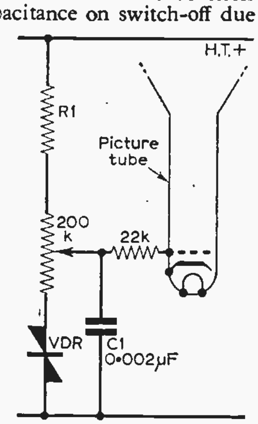


Fig. 7—In this circuit a VDR is used to hold the tube grid positive with respect to cathode on switch-off and thus discharge the e.h.t. filter capacitance due to excessive beam current.

Most modern receivers use this idea, and a prerequisite is that the first anode potential on the tube remains at a high value during the whole of the discharge period. This is necessary, of course, to maintain a high value beam current for the discharging action. A collapse of first anode voltage would reduce the beam density, the opposite to the requirements.

Thus, on sets which have suddenly exhibited the "lingering spot" symptom, attention should be given to the filter capacitor on the tube first anode, for it is this which charges and holds the anode at the required potential during the critical period. If this goes open-circuit or low in value, the discharge will not be complete at the final anode and the spot may well linger.

On earlier models, where the tube is pushed for a while into beam cut-off, trouble in the video amplifier stage or brightness control circuits can prevent the spot from being suppressed.

NEW CIRCUIT

A circuit by Mullard Limited to cause a rapid discharge through the beam current is shown in Fig. 7. Here a voltage-dependent resistor (VDR) is connected between the bottom of the brightness control and chassis. The action is as follows: capacitor C1 charges through R1, and the brightness control from the h.t. line. On switch-off the voltage across the VDR decreases and its resistive value increases, thereby preventing C1 charge from being quickly exhausted and holding the tube grid positive with respect to the cathode for the time required for the beam-discharge action. ■

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

THE choice of a receiver for DX TV is, of course, of the greatest importance. It might seem that the obvious plan would be to buy one of the new 625-line receivers now on sale, but don't do it!

Firstly, only certain models can be switched to 625 lines with the Band I/III tuner in operation, the rest are only operational on 625 lines in the u.h.f. position.

The second snag is the one already discussed; that the new u.h.f. system here is designed for a sound-to-vision separation of 6Mc/s, whereas our Continental friends mainly use 5·5Mc/s separation, so we will not be able to get sound and picture together even if we can use the 625 model for DX work.

In the relatively small area of the British Isles we are cluttered up with over 20 TV stations in Bands I and III, with powers of 100kW or over, apart from the numerous low power relays.

Our worst enemy for DX reception, in fact, is not going to be atmospheric conditions but local station interference.

The Continental channels fortunately lie between the British ones, and therefore provided our receivers are selective enough we should at least be able to separate them from our own.

The new 625-line sets have a vision bandwidth of approximately 5Mc/s, whereas the old 405-line set is only 3Mc/s, so an old 405 set is obviously preferable despite a slight loss of picture quality. I have tried a 625-line export model and have discarded it as useless for channels adjacent to the local channels.

There are five requirements for success.

(1) Continuous (incremental) tuning over Bands I and III to tune Continental channels lying between British ones. The spread of a fine tuner in a turret is about 1Mc/s only and continuous resetting of turret slugs is inconvenient and accurate calibration is out of the question.

(2) We want a set which can be run reasonably efficiently on 625 and 819 lines without too much loss of scan and e.h.t. Our 405-line set is likely to have a harmonic tuned line output transformer and this can be troublesome with some makes.

(3) It should have flywheel sync for weak signals.

(4) It should be reasonably easy to arrange switching for negative going pictures.

(5) It should have good overall vision gain with at least three vision i.f. stages.

In connection with (5) I suggest the "best buy" is a second hand Bush 14in. of the TV53, 62 or 63 range or the TV66 17in. model. In fact these types comply very well with our requirements and can often be purchased very reasonably.

Apart from arranging an inverting switch for the video diode and arranging for some adjustment of video amplifier valve bias for negative pictures, they will work quite well without further alteration, and I will be pleased to give details for switching for those who require them.

What are we going to do about sound? A separate sound receiver is the answer here, as this will overcome problems about the different sound-to-vision separations.

For a.m. sound from France, Belgium and Luxembourg any old set will do, provided the sound section is operative and it has incremental tuning. For f.m. sound we must employ other methods.

My solution is to use a continuous Band I/III tuner feeding into the i.f. stages of a broadcast f.m. set. Watch the i.f. frequencies however.

DX NEWS

Now for a few notes for established DX viewers. I hope you all profited by the wonderful tropospheric opening of October 10-12th. Here in Poole, 13 new ones were caught, including Tele Luxembourg, also received by at least two other viewers. Yes, it *can* be done on u.h.f. too, with London (Ch33) Paris (Ch22) and three West Germans picked up here in Poole.

Further East, scores of over ten West Germans have been recorded and the experts say that RAI/UHF Italy may well be possible, so if you are not yet active on u.h.f. get busy. It is worth it!

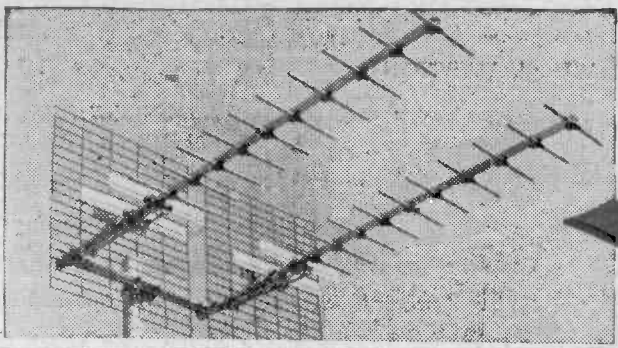
H. A. Ballard of Hastings writes to say that so far as he is concerned, our concluding remark (3) in the October issue, concerning DX u.h.f., has proved to be true. He writes:

"On August 15th I was able to lock three faint Continental stations—all different programmes—but was unable to identify them, although one was obviously Dutch. These were between channels 23 and 33. On October 12th I was more fortunate and secured the enclosed photos which may help in station location."

These photos showed that Mr. Ballard's station was Lopik, N.T.S., Holland on channel 27. Details are: 625 lines, negative modulation with f.m. sound, 250kW e.r.p. vision, 50kW e.r.p. sound, horizontal polarisation, omni-directional propagation, site at sea level but mast 1,170 feet high.

Mr. Ballard says that his receiver started life as a 14in. Bush Model TV53 but now bears little resemblance to the original as it has been progressively rebuilt over the past two years as circuit improvements have been introduced.

Unfortunately he did not give sufficient information to identify his stations between channels 23 and 33, but strong possibilities are Aachen, West Germany, on channel 24; Koblenz, West Germany, on channel 31; Wuppertal on channel 22.



NE[W] THOUG[HTS ON] T[V] AER[IALS]

HIGH definition television was put out on a regular transmission basis way back in 1936. Then came the war and a pause in its development. We are now in the second decade of the post-war television era. Television started in the very high frequency (v.h.f.) bands first in Band 1 on channel 1, then on channels 2, 3, 4 and 5, and in 1954 in Band III on channels 8, 9, 10, 11, 12 and 13. So it is today.

Tomorrow television will have graduated into the ultra high frequency (u.h.f.) bands (Bands IV and V) to give us BBC2, to be followed later by ITA2. Soon the test transmissions from the BBC's London u.h.f. station will be replaced by "programme test transmissions", to be followed later (April) by regular transmissions. The test programmes will be in addition to the BBC2 test card and will be advertised in the *Radio Times*.

Channel grouping is to be adopted for u.h.f. television in Great Britain. Each transmitter area is to be allotted a group of 11 consecutive channels and the London area has already been allotted the group comprising Channels 23 to 33. The immediate need, then, is for a revision of thoughts on aerial problems.

Unsafe

Some Band III aerials have been on chimney stacks and fully exposed to all weathers for nearly 10 years and some Band I arrays have been up longer than this. A country tour will reveal many old aerials in various conditions of disrepair and quite a few will be seen to be distinctly unsafe with elements missing and the masts leaning at curious angles, especially in exposed places near the coast.

The time will shortly come when more chimney adornments will be needed to get BBC2 and this aerial will be somewhat more critical both in choice and erection than the earlier v.h.f. aerials if good, consistent pictures are to be expected.

Local Booster

Some of the old, worn-out v.h.f. aerials are far more complicated than they need be for present-day reception, for it is probable that when they were erected, reliance had to be placed on a distant station, while of recent years (or months) a local, or a "booster" station may have changed the district from "fringe" to "service" area.

This could mean that the old, complicated aerial is working inefficiently not only off direction but also on the wrong channel for the local station. When a booster comes to town many aerials are left to work in that way, the signal field being so strong that the picture even on the wrong aerial is far better than what it was from the distant station before the booster arrived.

Set Factor

There is also the factor of the set itself. The aerial may have been erected high and in complicated configuration to do full justice to a relatively insensitive receiver of past ages and is left in use still for the new set which needs considerably less signal than the old one to give a good picture.

Modern sets are much more sensitive on the v.h.f. channels than their older counterparts, meaning that less elaborate aerials than of earlier days often do a far better job than is generally realised.

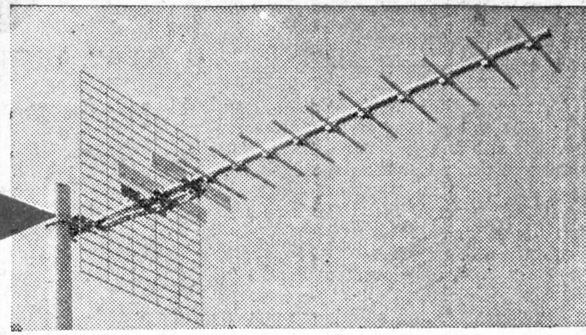
Signal/Noise Ratio

The lowest limit of signal pick-up is reached when grain (due to valve and circuit "noise") makes the picture difficult to view. The only way to reduce the grain is to improve the signal/noise ratio of the installation either by making the set less "noisy" or the aerial deliver more signal. Modern sets are less "noisy" than old ones, meaning that a picture of given grain can be maintained on a new set when the signal is some two times *below* that necessary for the same amount of grain on the old set.

Although an aerial may supply sufficient signal to give a reasonable signal/noise ratio, a more elaborate aerial may, nevertheless, be required to get rid of interference or ghosts due to the pick-up of reflected signals. The picture in Fig. 1 suffers

Fig. 1—A picture of poor signal/noise ratio (approximately 18dB) with a negative ghost towards the left-hand side of the main image.

EW HTS ON IALS



By J. Longrise

both from excessive grain due to a poor signal/noise ratio and from slight ghosting (seen vaguely to the right-hand side of the main image).

If the interfering signal (or reflected signal) arrives some 50 deg. or more off the bearing of the main signal an aerial with reasonable "directivity" can be orientated so that the maximum ratio of response of the wanted to unwanted signal can be achieved. A directional aerial requires a reflector and a number of directors in addition to the dipole; the greater the directivity the greater the number of elements required.

If a directional aerial is needed in a fairly high signal field area to reduce interference or ghosts, an attenuator may be necessary in the coaxial downlead to cut down the strength of the main signal, for directivity leads to extra aerial gain and too great a signal applied to the set may cause overloading, giving the symptoms of sound-on-vision and vision-on-sound.

Owing to the higher frequencies, signals in Bands IV and V are not quite so obliging as their v.h.f. counterparts, since they have trouble in penetrating massive objects and in bending. This means that the u.h.f. signals will require relatively complicated aerials, while the v.h.f. signals from a co-sited station may make do quite well with a simple array on the roof or even indoors.

To reduce interaction between a rash of aerials on a common chimney stack, the u.h.f. aerial should, if possible, be mounted in isolation, for this will be the most critical array of the group.

Simplified v.h.f. Aerials

At the time when the u.h.f. aerial is erected, however, attention should definitely be directed to the possibility of simplifying the v.h.f. aerials and the best way of doing that is by bringing them indoors! Having in mind the thoughts of the earlier part of this article it will probably be discovered that in many areas (especially with new sets) attic aerials will work quite well, leaving clear chimney space for the u.h.f. aerial.

Another angle on this—when a shared chimney stack is involved—is to share the v.h.f. aerials with the next-door neighbour. This, at least, will mean that only one set of v.h.f. aerials will adorn the roof. A small dual-band amplifier and a star network (Fig. 2) represent an inexpensive solution to the problem.

Unfortunately it will not be quite such a simple matter to share the u.h.f. aerial, since the losses are much higher and so far an inexpensive u.h.f. amplifier is not available. The amplifier used should be of the low-noise variety, for the sharing process should enhance, rather than detract from, the signal/noise performance of the system.

One of the new low-noise transistor amplifiers could, in fact, be used close to the set if necessary so as to raise the level of the signals from an indoor v.h.f. aerial system. It may also be a good idea to try one of the recently developed set-top aerials, for it may well be found that up to about 20 miles from a primary station nothing more elaborate is required for good pictures.

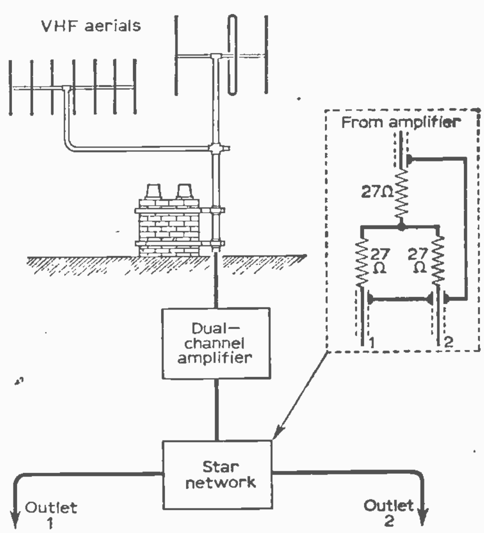


Fig. 2—To eliminate one set of v.h.f. aerials, the receivers of the adjacent neighbours are fed from a common aerial system via a dual-band amplifier and star network. The resistors of the "star" should be non-inductive, carbon type.

Set-top Aerials

Some set-top aerials are also designed for reception of the u.h.f. signals, but results on this band cannot be predicted with any certainty as much will depend upon the local signal field, height of house above sea level, screening over the signal path and local proximity effects such as metal pipes, electrical wiring and any other large (particularly metal) objects.

Moreover, the signal field on Bands IV and V will usually be less than that on the v.h.f. bands and the u.h.f. sensitivity of dual-standard sets is some two times less than the v.h.f. sensitivity. The signal/noise ratio may thus suffer slightly towards the u.h.f. fringe. At this stage it should also be noted that the u.h.f. signals are horizontally polarised but that over the transmission path, the wavefront may twist and end up almost as vertical polarisation at the receiving site.

Fortunately, u.h.f. aerials are considerably scaled-down versions of their lower frequency partners, making it possible to employ more elements per array than with v.h.f. aerials. The u.h.f. dipole is only about 10in. long, with the reflector elements (or mesh) about 5% longer (or square) and the directors about 5% progressively shorter, depending upon exact design and channel. It is not intended here to delve into design considerations as these have been given in the past and will be published in various forms in future issues of this journal.

There is a limit economically to the increase in gain which can be obtained simply by adding directors to a u.h.f. aerial, but owing to the small physical sizes involved there is no great difficulty in stacking arrays and making them co-linear.

One of the heading pictures shows two u.h.f. aerials mounted side by side to form a co-linear configuration. While this arrangement does not double the gain of a single array, also shown in the heading, it does improve the directivity considerably and provide two or three extra decibels of u.h.f. signal, which can most certainly be very important where one is fighting to get the last dB on the edge of the fringe or in a difficult reception area.

Folded dipoles are used for matching and in the Belling and Lee arrays in the photographs, the dipoles are formed by the cutting of slots in a piece of suitable metal (not to be confused with a slot aerial). Various artifices are adopted to balance the aerial against unbalanced coaxial feeder. This is rather important to avoid undesirable "feeder effects" which occur, as shown in Fig. 3, when coaxial cable is connected direct to a dipole which is arranged for horizontal polarisation. The "unbalance to balance" device is called "balun" for short.

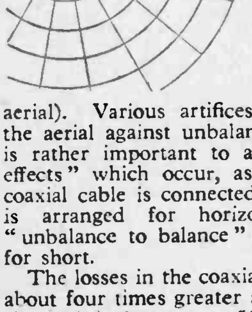


Fig. 3—Response polar diagram of Yagi u.h.f. aerial with the coaxial feeder connected direct to the dipole. The broken line curve reveals how the polar diagram is changed by the use of a "balun". The use of a "balun" also simplifies the positioning of the feeder by the aerial erector.

The losses in the coaxial feeder downlead are also about four times greater at, say, 800Mc/s (Band V) than what they are at 50Mc/s (Band I). It is of vital importance, therefore, that good-quality, low-loss coaxial cable be used to connect the u.h.f. aerial to the set and this, as with v.h.f., applies particularly towards the fringe of the station.

Choice of u.h.f. Aerial

While it is impossible to be specific regarding the type of u.h.f. aerial required at various distances from the station, a general guide is possible based on normal reception conditions. Abnormal conditions arising, for instance, from local screening, rising ground along the signal path, proximity effects and so on may well severely distort the guide.

It is assumed that all aerials considered below possess an efficient reflector system, a folded dipole and a balun arrangement. Thus seven directors should give good results within a radius of about 15 miles from the station, 11 directors about 20 miles, 16 directors (on a single "in-line" Yagi array) about 25 miles. Stacked and co-linear arrays will be necessary in certain cases around the 20-25 mile mark and such arrays with high directivity will be essential to eliminate ghosting due to multipath interference. Fortunately, attenuation of the ghost signal is greater than experienced at v.h.f.

Other points to remember are that car ignition and electrical interference is less troublesome at u.h.f. than at v.h.f. and that u.h.f. aerials have a natural embracement of about 11 channels (this being necessary, anyway, to cover the 11 channels of a station group).

Also the signal field falls rapidly at u.h.f. away from the "radio horizon", thereby considerably curtailing the "fringe" area. On Band I, for instance, the fringe may spread out some 20 miles from the radio horizon, while on Band V the signal field may collapse almost to zero at about two miles away from the radio horizon. It is for this reason, of course, that several times more u.h.f. stations are required to cover the whole of the country than v.h.f. stations.

Now is the time, then, to start investigating ways of reducing the complexity of v.h.f. aerials—preferably by taking them off the chimney—so as to make room for the more demanding u.h.f. aerial. It is obviously impossible to keep on adding to the roof-top ironmongery! ■

Using the BY100 silicon diode in Television Receivers

By K. Berry

THE BY100 silicon diode is primarily intended for use as a mains rectifier in television receivers and may be used to replace both metal rectifiers and valve rectifiers with a considerable saving in cost and greatly increased life.

When the BY100 is used in an a.c.-d.c. receiver to replace a thermionic rectifier (which has poor emission but whose heater is intact) it is convenient to leave the original valve in the receiver, using it as a "dropping resistor" for the heater chain. If, however, the rectifier heater has burnt out, then a suitable resistor must be added to complete the heater "chain" and preserve the correct current in the chain. This resistor should be mounted in a position where it will not overheat other components and will receive a reasonable air circulation. A list of resistors required to replace specific rectifiers is given in Table 1.

In addition to looking after the heater chain it is necessary to make some provision for reducing the voltage applied to the rectifier, since the voltage drop across the BY100 is only about 1V and direct replacement of a metal or valve rectifier results in the h.t. voltage increasing by up to 30 or 40V which, if not reduced, will rapidly lead to trouble elsewhere in the receiver. Unfortunately it is not possible to give any precise information regarding the value of the resistor required for this purpose, since its value will vary from receiver to receiver, depending, as it does, upon:

(a) the size of the reservoir capacitor;
(b) the current consumption of the receiver;
(c) the type of rectifier being replaced.

However, in practice, values of between 33 and 82Ω have been used at power ratings of 10 to 15W and this will give some guide as to what is likely to be required.

This resistor is connected in series with the diode (either side will do) and limits the rate at which the reservoir capacitor can be charged and hence the mean output voltage. The experimental approach is usually required to determine the exact value needed. Connect initially a 47Ω resistor in series with the diode, switch the receiver on and measure the *smoothed* h.t. voltage. This should usually be about 210/220V for most receivers. If the voltage obtained with the 47Ω resistor is lower than this then try a lower value, if it is higher then try a higher value of resistor.

The instructions earlier in this note concerning the positioning of the resistor possibly required to replace the rectifier heater apply, also to this surge limiting resistor.

It should be noted that this additional resistor is not always required; for instance, in some receivers the voltage applied to the rectifier is taken from an auto-transformer. In such a case it may be possible to take the rectifier feed from a lower voltage tap. In other cases, if the supply voltage from which it is desired to run the receiver is less than the highest input voltage tappings provided by the receiver manufacturer, it may be possible to use the additional (unused) resistor(s) provided for use when the receiver is worked off the highest voltage mains in order to drop the voltage applied to the rectifier.

For example, if the set is to be run from a 210V supply then the resistors provided for using the set from a 250V supply may be available for use in dropping the voltage applied to the silicon diode.

TABLE 1

Rectifier, Type BY100

Maximum Peak Inverse Voltage	800V
Maximum Forward Current at 50°C	550mA
Typical Reverse Current at 25°C	less than 10μA

Valve Type	Replacement Heater Resistor	
	Ohms	Watts
PZ30	180	15
PY32	100	10
2x PY82	120	10
PY82	68	5
U801	390	15

These notes so far have been mainly applicable to television receivers but, of course, the BY100 can equally well be used in some radios, amplifiers, etc. A single BY100 will replace half-wave rectifiers such as the 25Z4, 35Z4, 117Z4, etc., whilst a pair will replace full-wave rectifiers such as the 5Z4, 6X4, etc.—*provided that the r.m.s. voltage applied to each diode does not exceed 250V.* This means that when the rectifier is fed by a transformer, if the voltage applied is greater than 250-0-250 one *cannot* use a pair of BY100s. (Note: *Two* pairs of BY100s will handle 500-0-500V.)

When the silicon diode is used in radio receivers, amplifiers, etc., considerations similar to those outlined earlier in this article regarding the heater chain in a.c.-d.c. receivers and surge limiting resistors apply, excepting that the increase in h.t. voltage is often not so marked owing to the smaller value of reservoir capacitors used in radio receivers, etc.

One final word of warning: silicon rectifiers are unlike old soldiers in that they do not slowly fade away; make a mistake and they will "die" at once! So please check the circuit carefully and in particular ensure that the rectifier is connected into circuit with the correct polarity. ■

SERVICING TELEVISION RECEIVERS

By L. Lawry-Johns

No. 97 THE RAYMOND F93 AND BEETHOVEN B94

THE potentiometer VR3, is the frame hold control. If this control is at the end of its travel check V13 (ECC82) and R69 (470kΩ), which is in series with VR3 to pin 7 of the V13 base. A defective ECC82 in this position can also cause frame jitter, i.e. rapid vertical bounce not corrected by the controls.

Lack of Height

Loss of height which is even top and bottom should direct attention to the ECC82 and to R70 (1·8MΩ), which sometimes goes high.

Bottom Compression

If the bottom of the picture is compressed and the top appears extended (in relation to the bottom) check the ELC80 (V14) and if a new valve does not improve matters check the 250μF 25V bias electrolytic capacitor C80. This capacitor will probably be found to be open circuited. If the valve and capacitor are in order check the linearity capacitor C76, C77 and C78.

Hum Bars

Quite often a considerable amount of a.c. ripple is injected into the video circuit causing wide bands of light and dark areas across the screen making overall illumination of the screen impossible. Ths should direct attention to V9 (EB91) and V10 (PCF80), either of which may have heater-to-cathode leakage.

No picture, Charred Resistors

V10, the video amplifier, is biassed by R51 (560Ω). This resistor is held at a fairly constant current level by R49 (33kΩ). Quite often R49

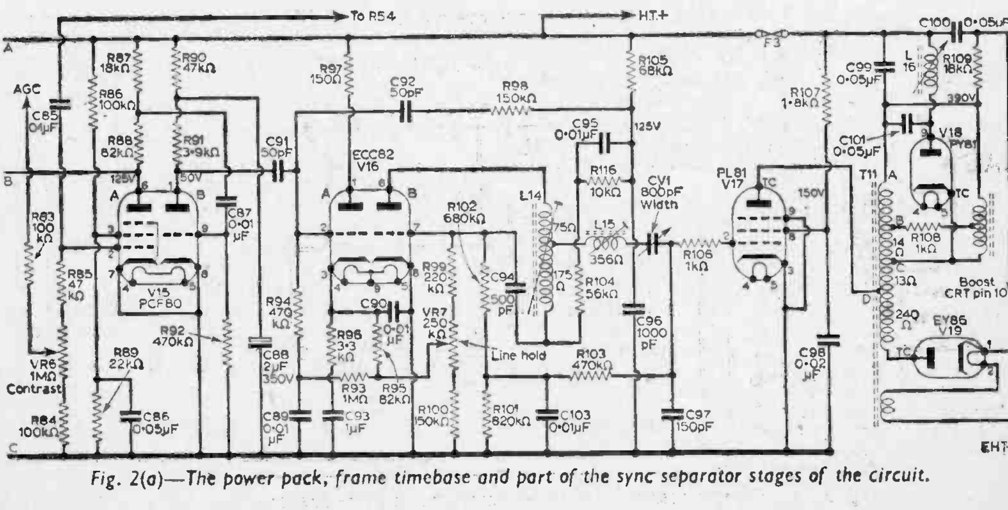


Fig. 2(a)—The power pack, frame timebase and part of the sync separator stages of the circuit.

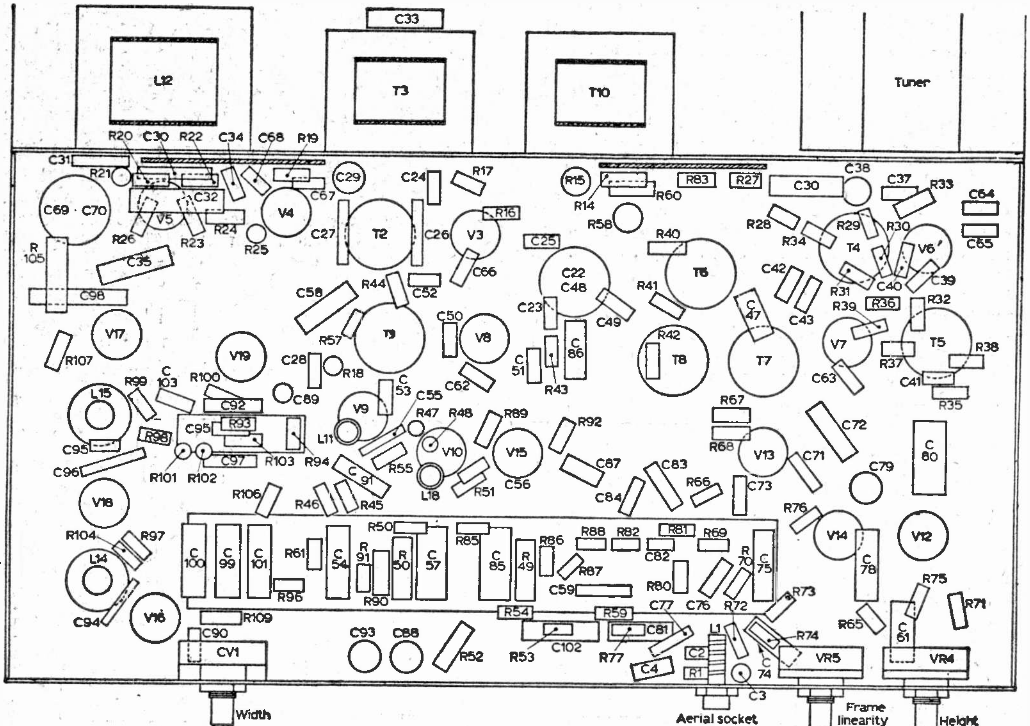


Fig. 3—An underchassis view of the receiver.

changes value thus causing excess current both through itself and R51 resulting in damage to both. This can cause R51 to become open circuit or, more seriously, to become a virtual short circuit with the result that the h.t. line is shorted to chassis, blowing one of the main fuses and/or damaging the PY82 rectifier which is normally run at its limit and is intolerant of overload.

Poor Contrast

If the contrast control functions but the picture is weak and lacking in "attack" although the overall brightness is good, check V10 which may be failing in emission, then check V6, 7 and 8, the resistors associated with V10 and the decoupling components of V7 and V8.

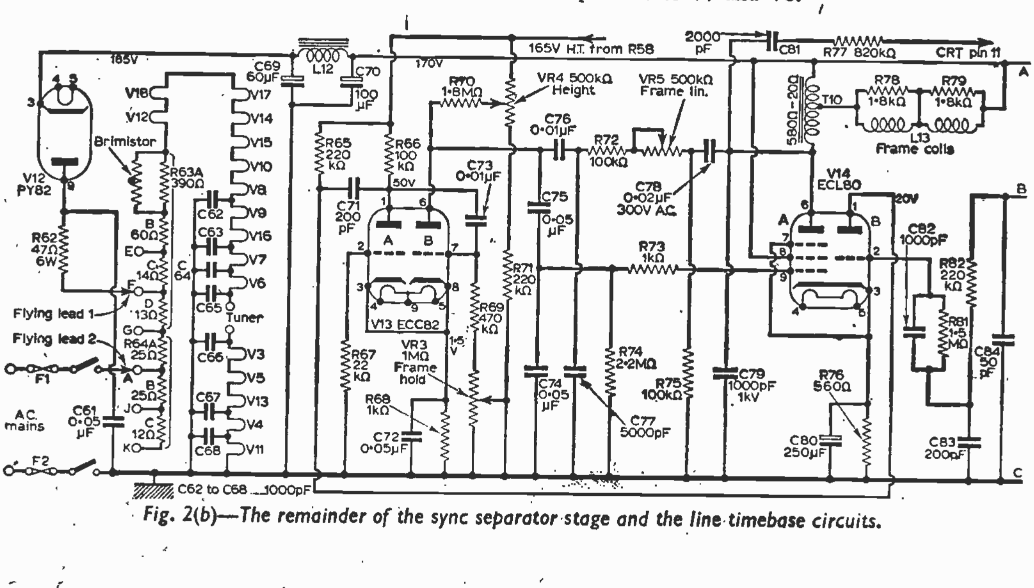


Fig. 2(b)—The remainder of the sync separator stage and the line timebase circuits.

If the contrast is poor with excessive gain (noise) check V1 (PCC84), the efficiency of the aerial V2 (PCF80) and both 4·7kΩ triode anode load resistors in the tuner unit.

No Signals, Sound or Vision

Check components and valves (V1 and V2) as above but note that if the 4·7kΩ resistors change value the Band III signals will be lost first, leaving BBC at first almost unaffected and then as the value rises, the vision signal may weaken and fade out with loss of sound, but faint sound may remain.

Persistent Fuse Failure

An intermittent spark over in V12 (PY82) is usually responsible for this trouble and with new fuses fitted, a sharp tap on the PY82 envelope will probably demonstrate this without doubt. A faulty PY81 can cause similar symptoms. The fuses are rated at 750mA and should be of the delay type F3 is rated at 250mA.

We trust these short notes have been helpful for owners of these Raymond and Beethoven models. We will try to present information on later models such as the F105/1 at a later date. ■

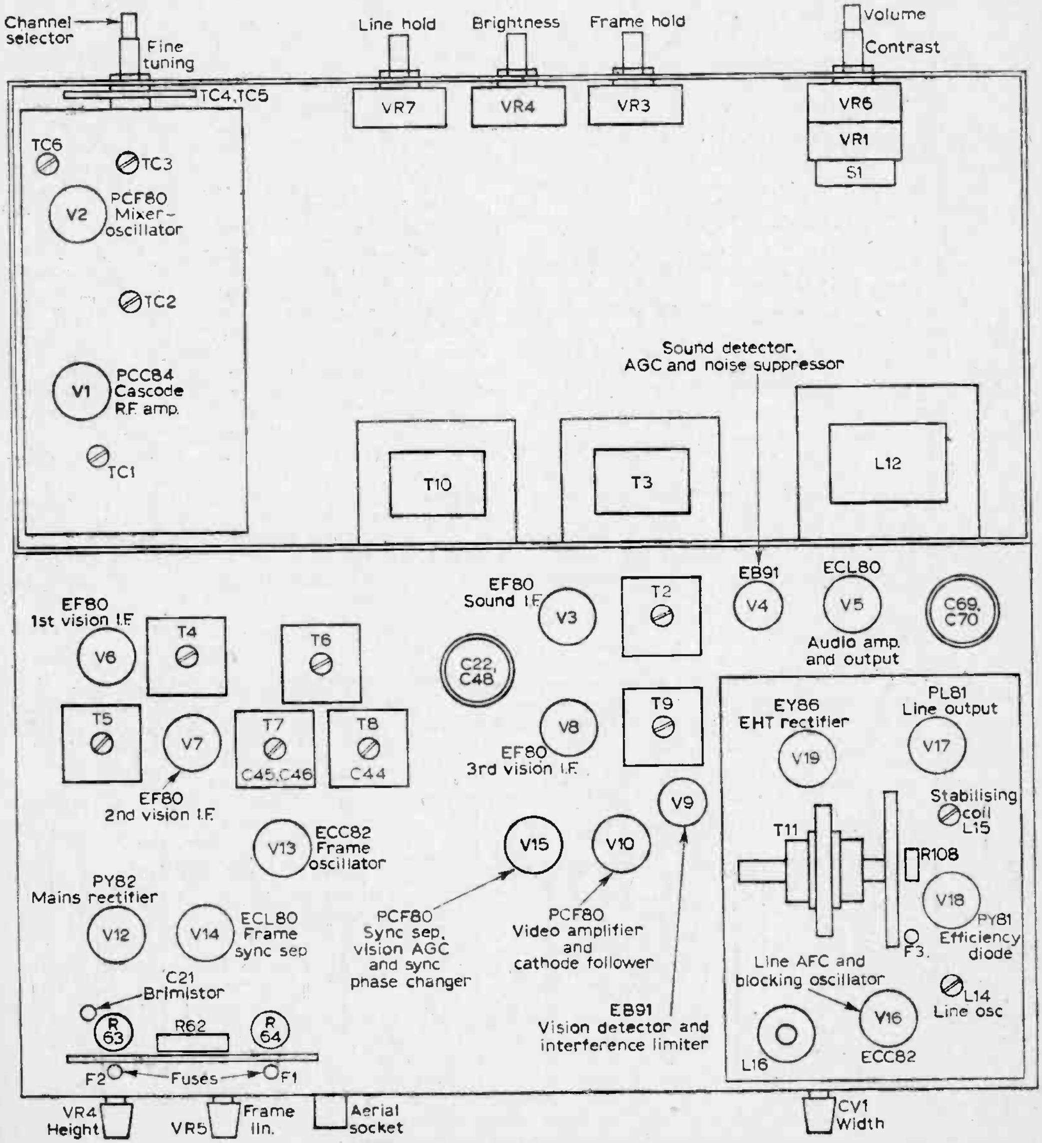


Fig. 4—The above-chassis layout of major components.

A CLOSED CIRCUIT TV Camera

By E. McLoughlin

PART FOUR: THE CAMERA CONTROL UNIT

CONTINUED FROM PAGE 119 OF THE DECEMBER ISSUE

TO give adequate ventilation for the control unit, the top of the chassis is covered by a perforated steel grid hood attached to the narrow sides of the chassis by means of two flanges and four self-tapping screws. This arrangement is exceedingly simple, provides all-sided ventilation as freely as if the chassis were entirely open, permits very rapid opening of the unit for work above or below the chassis and has a very pleasing and professional appearance.

It must be pointed out that this unit definitely requires an efficient forced-ventilation fan if housed in any form of semi-closed metal cabinet, as self cooling will then certainly be insufficient. A fan is not required in the arrangement as published, in which all major heat-producing components have been grouped above the chassis and can cool freely by convection through the steel grid hood.

Do not operate the unit standing in a narrow alcove, in a cupboard of small dimensions, or other confined space. Do not place papers, books, other apparatus or other combustible articles on top of the covering hood. This could lead to damage, overheating or fire.

Power Supplies

Fig. 15 shows the complete theoretical circuit of all power supplies for feeding the control unit and the camera head.

Two conventional fullwave valve rectifier and smoothing circuits, having only the mains transformer in common, are employed. Ample smoothing capacities and chokes are used. As a result, two separate main h.t. feeds, each capable of delivering about 75mA maximum, are available.

The whole video amplifier and preamplifiers in the camera head are fed from the one h.t. line and the entire scan and focus circuits and the r.f. section from the other. This gives minimum unwanted interference at the sensitive input stages to the video amplifier, the screening and layout adopted giving further assistance in this respect.

An important feature is, furthermore, the accommodation of all branch-decoupling components, for both h.t. systems, on an aluminium bracket above chassis. Respective "trunk" cables connect to the consumer circuits below chassis (Fig. 14).

This arrangement has several advantages. Firstly, it removes nearly all major-heat-producing components out of the sub-chassis wiring, permitting very compact layout of the latter. Secondly, it removes nearly all large components out of the sub-chassis circuits, particularly out of the video and r.f. sections, so that these can be wired in the compact form necessary for optimum stability and correct performance. Thirdly, it groups all h.t. check-points very conveniently together on the aluminium bracket, in an easily-accessible position above chassis.

Accordingly, the voltage and current measurements obtained for the prototype, once this was working as desired, are shown in Fig. 15. Constructors may find slight variations from unit to unit, but any gross departures indicate the need

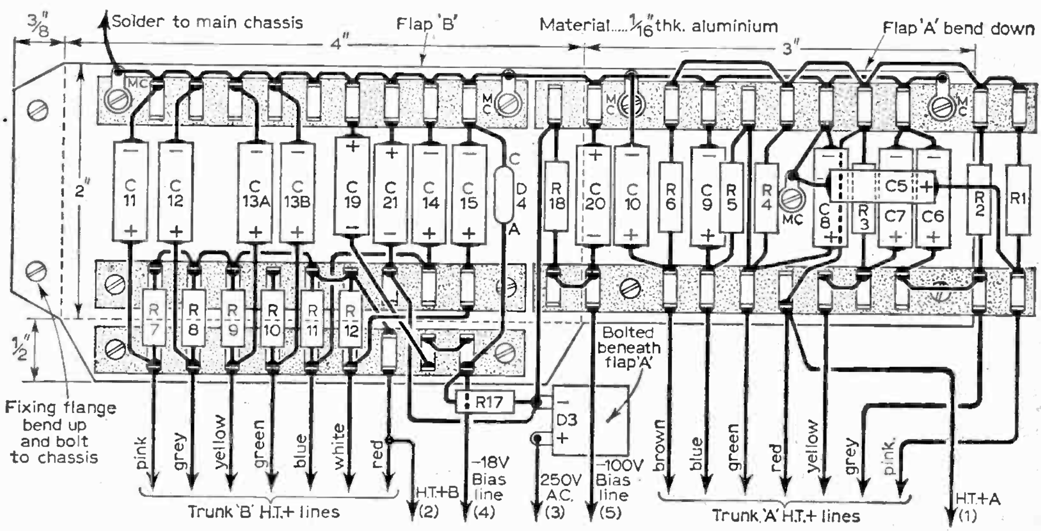


Fig. 14—The h.t. and bias distribution bracket.

for further investigation of the branch circuit concerned, to remove any fault conditions.

The trunk cables used in the prototype between the h.t. distribution bracket and the sub-chassis wiring were lengths of plastic-insulated multiway office telephone cable, with conductors covered with plastic insulation of various colours.

Bias Supplies

D3 is a metal rectifier in a halfwave circuit, for bias supply voltages. The vidicon grid bias line (−100 volts) receives extremely heavy smoothing through 8μF and 2·2MΩ, and the −18V bias line for other circuits is stabilised and well smoothed by the Zener diode D4 shunted with a high capacity. Such smoothing is essential, as any hum or fluctuations on the bias lines would be amplified directly in the amplifier chain.

The EZ80 type rectifier valve is designed for full h.t. voltage insulation (up to 500 volts working) between heater and cathode, and correct operation is with one side of the heaters earthed to chassis. This heater circuit must not be earthed both at the camera head chassis and at the control unit chassis, as such measures would create a hum-loop injecting hum into the video amplifier. On the other hand, earthing at the camera head chassis alone has the disadvantage that, should the camera power-feed plug be removed, the rectifier heaters "float" free, which is not permissible.

Thus earthing of this heater line at the control unit *only* has been adopted, *both* wires being taken *insulated* to the camera head and there grounded only for high frequencies via a pair of capacitors.

It is important to load the heater windings approximately fully, i.e. not to use heater windings

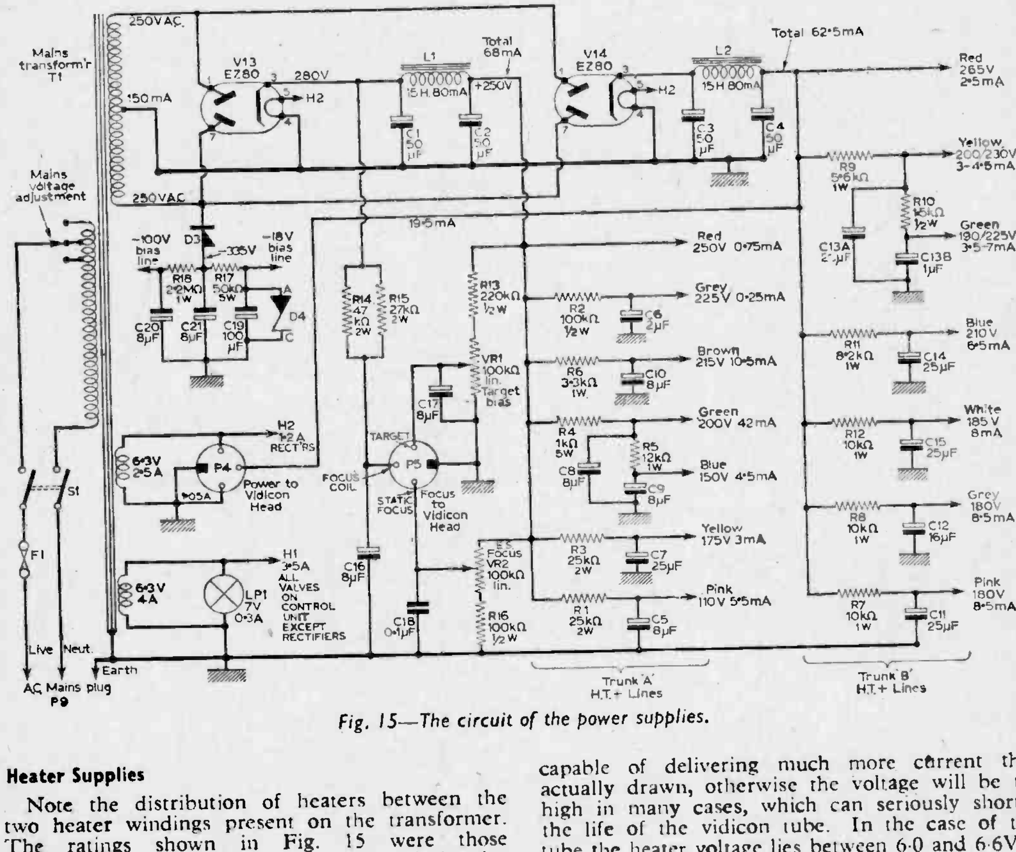


Fig. 15—The circuit of the power supplies.

Heater Supplies

Note the distribution of heaters between the two heater windings present on the transformer. The ratings shown in Fig. 15 were those actually present in the prototype and also represent those most likely to be found on the average mains transformer. A total of some 6A heater current at 6·3V is required for the entire equipment, including the camera head. All valves in the control unit (except the rectifiers) and the pilot lamp together correctly load a standard 4A winding. The rectifiers and the camera head heaters are run off a second 2·5A winding.

capable of delivering much more current than actually drawn, otherwise the voltage will be too high in many cases, which can seriously shorten the life of the vidicon tube. In the case of this tube the heater voltage lies between 6·0 and 6·6V.

Focus Supplies

The value of R14 may need to be varied once the unit is completed, to obtain correct focus action. The value shown for R14 and the focus coil current in Fig. 15 are the values obtained with the finally adjusted prototype. The ultimate criterion is to get the point of exact focus on the electro-static fine focus control VR2 into the approximate middle of the track of VR2, and the value of R14 should be adjusted with this aim.

The value of R14 requires reduction if the focus point is too near the bottom end of VR2, or if no focus point is present at all, merely " least confusion " resulting with VR2 slider at the bottom end—and vice-versa.

The Video Amplifier

The output signal from the camera head unit (see Fig. 9, November issue) is further amplified in the four-valve video amplifier chain shown in the top section of Fig. 16.

The output after the first three of these stages is a composite positive video signal of about $1\frac{1}{2}$V amplitude, suitable for feeding a video monitor unit. Details of a suitable monitor unit will be published later. The sync pulses generated in the scan circuits (Fig. 17) are inserted into the video signal at V6.

The fourth stage, V7, is operative only for modulating the r.f. section. It gives the slight additional gain required to match the circuit used, and, as shown in Fig. 16, inverts the composite video signal for achieving the necessary negative modulation of the 625-line CCIR standard.

If 405-line BBC standard is to be adopted, V7 must be driven at the cathode. The actual changes to be effected are then: remove C53 from pin 2 and connect to top of R90. Discard C55. Reduce R88 to a suitable value between 270Ω and 1kΩ giving satisfactory modulation depth. Make L7 similar to L5 instead of to L4. Connect two 0·05μF 500V paper capacitors between pins 2 and 8 and chassis respectively on V7. In addition, C52 may need to be increased to 0·05μF and R85 to 270kΩ; these two measures also being worth trying for 625-line operation if difficulty is experienced in obtaining satisfactory frame lock on the particular receiver employed. No other changes are necessary to the circuitry of V4—V7 when converting between 405/625 lines.

Amplitude Compensation

We pointed out in the introductory article on amateur CCTV, that a target load not exceeding about 4·7kΩ is required on the vidicon, if sufficiently linear response is to be maintained over

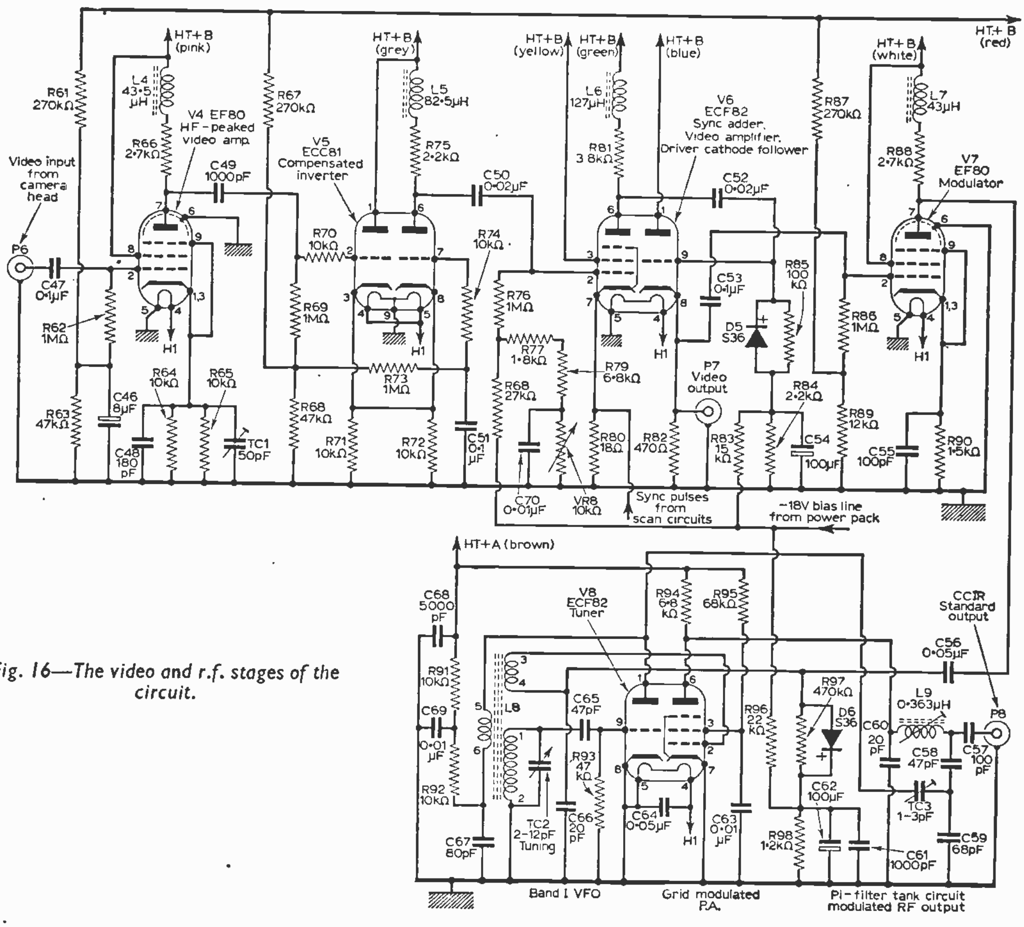


Fig. 16—The video and r.f. stages of the circuit.

the entire range of video frequences in the face or target stray capacities. At normal signal currents of about 0·25μA, such a load would give a signal of some 1mV amplitude, requiring an amplifier of reasonable gain. The amplifier itself would need to have as linear a frequency response as possible.

Now, whilst such an arrangement would certainly give optimum performance as far as phase response (see below) is concerned, it brings a number of practical disadvantages and complications. It is a better compromise to use a much larger target load on the vidicon (in our present actual circuit, twelve times as large). This gives severe loss of high frequencies in relation to low frequencies from the camera head, and the video amplifier chain must be arranged to have a compensatory frequency characteristic.

The design shown in Fig. 16 meets these requirements. The major disadvantage of the low target load condition is that the mean signal level is low compared with residual mains hum and other spurious injections at the camera. Now losses at the camera and compensations in the video amplifier do not affect the low and mains frequency response, so that use of a twelvefold larger target load means that only a twelfth of the low frequency gain is required in the complete system, improving the signal-to-noise ratio with regard to low frequency interference by a factor of twelve. Furthermore, it is possible to achieve some measure of improved general signal-to-noise ratio too by using the larger target load.

Phase Response

It is not sufficient in video amplifiers to cater for uniform amplification of the amplitude of signals at all frequencies (linear frequency response); the phase-shift must also be as constant as possible.

The first condition, that of level frequency response as far as amplitudes are concerned, is relatively easy to satisfy. Where compensations are required, suitable frequency dependent R/C networks are easy to arrange, yet by their very nature these produce severe phase shifts. Satisfactory phase response of a frequency compensated video amplifier is thus not possible with the use of capacitors and resistors alone; inductances must be used as well for a final net cancellation of undesired effects.

The design of an ultimately suitable amplifier is, as a result, a mathematically very involved operation and we cannot go into details here. It may merely be stated, that the actual version here used is based on a development by Messrs. EMI Ltd., and some general principles are easily understood.

Two forms of "peaking" (rising gain for high frequencies) are employed in a staggered fashion. V4 and V7 use the first kind at their respective cathodes. Here, very large cathode resistors are used (with corresponding return of gridleaks to a positive point on respective h.t. bleeders to re-establish Class-A operating points, a method of bias also very favourable for stabilising the operating points of high-slope valves), with very small bypass capacitors. Negative feedback is thus very great at low frequencies. At some cross-over frequency, determined by the value of the small bypass capacitor, the latter "begins to be effective", so that negative feedback falls and gain rises above this frequency.

For V4 alone, TC1 permits adjustment of the cathode crossover frequency between approximate limits 120 - 150kc/s; if the required value during subsequent adjustments lies outside this range, the value of C48 can be altered.

The crossover frequency in the cathode circuit of V7 is just above the top limit of the video passband, so that only very slight rise of gain to compensate losses in C66 in the modulation feed of the tuner results.

Peaking Coils

The second form of compensation uses peaking coils, and is here employed in the anode circuit of every stage contributing to the total amplification, i.e. it is absent only in the two triode sections functioning merely as cathode followers (V5, pins 1, 2, 3 and V6, pins 1, 8, 9).

The anode to chassis stray capacity in each case is effectively in parallel with the peaking coil and anode load resistor themselves in series and behaving as a coil of high resistance, i.e. low Q. The combination represents an extremely heavily damped tuned circuit, giving increased gain over a broad band of frequencies in the neighbourhood of the resultant resonant frequency.

TABLE 2
PEAKING COIL DETAILS

Ref.	Nominal Inductance ±10%	No. of Turns	Self Resonance	Resonance with 100pF in parallel
L4, 7	40μH	35	13·5 Mc/s	2·38 Mc/s
L5	80μH	55	8·5 Mc/s	1·71 Mc/s
L6	125μH	62	6·3 Mc/s	1·38 Mc/s

All cores are ferrite threaded slugs, 1in. long, ¼in. dia. Windings are single layer, closewound, except L6, where the winding consists of three sections of 21T, 10+10T (double layer) and 21T. 30s.w.g. enamelled copper wire is used for all these coils.

In the video amplifier for the present unit, we do not desire level response, but rising response. Accordingly, the resonant frequency of the peaking circuits is lower than for level response, i.e. the inductance values are greater. The resulting Q-values are greater.

Each peaking circuit has a second resonance of High Q at a much higher frequency, given by the self-resonance of each coil alone with its stray capacity. All self-resonances must lie above the video-passband of the complete amplifier, and, to prevent instability, they must be well staggered in frequency. It is of advantage to place the lowest self-resonance *just* outside the passband and the highest at about double that frequency.

Table 2 shows winding details for the four peaking coils found satisfactory in the prototype and in the layout of wiring shown later in this article. It is seen that not only are the inductance values important but also the self-capacities.

It is probably simpler to use the last two columns of check-values in Table 2, in conjunction with a grid-dip meter, as amateur grid-dip meters are generally more reliable than amateur r.f. bridges required when using the check-values in the other two columns. Grid-dip meter measurements should be made on the bench, before wiring the coils into their positions in the units.

Other Features of the Video Amplifier Chain

A total of four stages contributing amplification are required between vidicon and the video output socket, P7. As the signal polarity must undergo net inversion by the entire system, one amplifier stage (V5) is arranged to produce no signal inversion. The first triode of V5 is a cathode follower and the second a grounded grid amplifier; the complete stage has here been termed a compensated inverter.

V4 is a normal amplifier stage. The pentode section of V6 also serves as a normal amplifier stage, with a measure of variable-mu gain control by means of VR8. This gain control is placed at such a late stage in the chain in the interests of signal-to-noise ratio. V6 pentode also performs the further function of sync-addition to the video waveform.

The sync mixer stage, V12 in Fig. 17, cuts off about 10mA of current through R80 (cathode current, pin 3, of V12) during all sync pulses, thereby injecting a sync signal of 0·2V at V6 pentode cathode. The triode section of V6 is a cathode follower, and provides a low impedance output to permit transmission of the signal through considerable length of coaxial cable connected to P7. NOTE: Fig. 17 will appear in next month's article.

D5 restores the bottoms of the sync pulses to about −2V at grid pin 9 of V6, so that these become the reference level, as required, in the composite output signal. Speaking in the more usual terminology, this simply means that D5 clamps the black-level of the output signal, since R80 guarantees sync pulses of definite amplitude.

The Tuner

The great advantage of a CCTV circuit with r.f. output compared to one with only a video output is that much greater lengths of coaxial cable are permissible between "transmitter" and receivers.

A one-valve tuner is relatively simple to construct, and thus a definite asset unfortunately not found on all CCTV equipments.

Considerable numbers of unmodified domestic television receivers can be fed simultaneously (via suitable matching networks of resistors) since the output at P8 is 100mV in 60-80Ω.

The tuner signal output is quite ample and lengths of coaxial cable up to a mile would probably be usable. On the prototype, P8 is in the form of two coaxial sockets in parallel. When both sockets are in use, for feeding two receivers, an 80Ω resistor must be wired in series with the inner conductor in each plug inserted, as the matching is otherwise disturbed. A couple of short adapters containing an 80Ω resistor each have been made for the prototype. These can be inserted externally when required between the receiver lines and P8.

TABLE 3
TUNER COIL DETAILS

V.F.O. Coil L8

Former $\frac{1}{3}$in. approx. diameter, with v.h.f. slug.
Grid Winding 1,2: 12 turns of 20 s.w.g. tinned copper wire spaced over $\frac{3}{4}$in.
Anode Winding 5, 6: 4 turns of 24 s.w.g. enamelled copper wire, between first 4 turns of winding 1, 2—at end 2.
P.A. Drive Winding 3, 4: 4 turns of 24 s.w.g. enamelled copper wire between first 4 turns of winding 1, 2—at end 1.
All three windings to run in same sense, starting from 2, 4, 5 and ending at 1, 3, 6 respectively.
Wire 100pF ceramic capacitor temporarily in parallel with grid winding 1, 2 and adjust slug for resonance at 18 Mc/s with aid of grid dip meter.

P.A. Anode Coil L9

Former $\frac{1}{3}$in. approx. diameter, with v.h.f. slug.
6 turns of 20 s.w.g. bare silvered copper wire, spaced over $\frac{1}{2}$in.
Wire 250pF ceramic capacitor temporarily in parallel and adjust slug for resonance at 16·7 Mc/s with aid of grid dip meter.

The VFO Carrier Oscillator

The triode section of V8 is operated as an ordinary grid-tuned oscillator circuit with anode reaction of sufficient intensity to maintain oscillation without squegging. If squegging is observed (saw-tooth waveform observable on oscilloscope connected to junction of R91/R92 with C69 disconnected, and intense black bars in displayed picture; frequency probably around 100kc/s; black bars not locked to line scan), the values of C67 (increase) and R93 (reduce) may be adjusted.

It is important to use a good ceramic air-spaced shortwave tuning capacitor for TC2. With the specified capacity values and tuning range adustment as explained in Table 3, slow motion drive is not necessary, a small knob directly on the spindle of TC2 giving the right action for smooth tuning through all Band 1 channels.

An aperiodic third winding on the oscillator coil picks up the carrier drive signal for the pentode section of V8 functioning as grid modulated p.a. The modulation voltage is applied in series with the grid winding.

Modulation

Adjustments for optimum modulation must be carried out with care. Details given for L8 in Table 3 proved satisfactory for the prototype.

The arrangement shown is for 625-line operation. D6 restores the negative video signal from the modulator V7 so that it is entirely negative going from a voltage set by R98 (approximately −1V) and defining full carrier amplitude. Peak white video should drive the p.a. grid sufficiently negative for reduction of the carrier amplitude to 10% of peak value.

Static checks should be made with a wavemeter connected to P8 (r.f. valve voltmeter). Disconnect C56 from D6 and observe the wavemeter reading. Temporarily connect an additional resistor of value 2·2kΩ between the bottom end of R98 and chassis, and note the new wavemeter reading. If this does not lie between 10% and 20% of the former value, adjust the value of R98 if only small corrections are required, or the number of turns between connections 3 and 4 on L8 if larger corrections are required.

TC3, which neutralises direct-through coupling of unmodulated carrier between the two anodes, must be adjusted for minimum reading on the wavemeter before taking any readings. As an alternative to changing the number of turns on L8 (winding 3, 4) the modulation depth can be influenced by intermediate amounts by changing the value of R88 in the modulator anode circuit.

Modification if 405-line Standard Operation Desired

The modulation signal from V7 will in this case be positive, the necessary modifications to V7 circuitry to achieve this having already been discussed. The signal must now be d.c. restored at V8 pentode grid such that it is entirely positive-going from a reference voltage 1·8V more negative than in the case for 625-line operation.

This is simply achieved by reversal of D6 and increase of R98 to 3·8kΩ of 4·7kΩ, whichever value is found to be more satisfactory. For subsequent adjustments, temporarily disconnect C56 and note the wavemeter reading at P8 after adjusting TC3 for minimum reading. Then temporarily connect a 1·8kΩ resistor in parallel with R98. The wavemeter reading should rise to 5-10 times the former value if all is well. Otherwise make appropriate adjustments to R98, R88 (modified anyway) or, at a last resort, L8, winding 3, 4.

Note that TC3 must be able to pass through a definite minimum output setting under all conditions. If this is impossible, the capacity range covered must be changed—probably reduced, indicated by lowest output with TC3 at minimum capacity.

The Output Tank Circuit

The output circuit is in the form of a low-pass pi filter prototype section. Although having the appearance of a tuned circuit, it is not one, but rather a low-pass filter having the characteristics of a pure resistance up to a certain cut-off frequency, above which it gives high attenuation. The characteristic resistance over the passband is designed to be the output impedance matching ordinary coaxial cable. Table 3 summarises the design-formulae and criteria, and gives full details of the calculation of the filter used in the author's prototype.

The simple prototype section designed according to Table 3, with a cut-off frequency just above the top of Band II, proved sufficiently effective for reduction of harmonics to enable the receiver to be switched over to interference-free reception of Band III and IV broadcast signals (Continental site) with the CCTV equipment still feeding a full-power Band I signal in at the aerial terminals.

CONTINUED NEXT MONTH

A Flying-Spot Scanner

—*continued from page 153*

provided by varying the voltage to the cathode; this has the effect of making the grid more or less negative with respect to the cathode and hence suitable bias is achieved.

We now need to design the bleeder chain to produce the correct potentials at the electrodes. The tube itself takes very little current—in the order of a few microamps, and the e.h.t. rectifier is capable of supplying up to 5mA of current. The current flow along the bleeder chain is designed to be 1mA—this being well within the capabilities of the rectifier and satisfactory from the point of view of the tube. Also, this current is convenient from the point of view of calculation since we have a voltage drop of 1V across each thousand ohms of resistance (e.g. a 100kΩ resistor passing 1mA will have 100V across it).

The total resistance of the bleeder chain is given by:

$$R = \frac{E}{I}$$

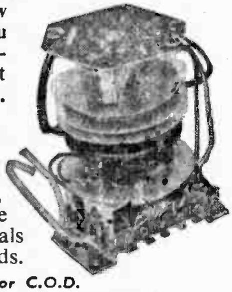
R = resistance
E = voltage
I = current

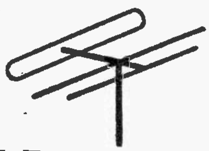
in our case E = 2,650V, I = 1mA and so R = 2.65MΩ.

Having arrived at this value we must now decide how it is to be made up.

From the table of characteristics of the tube we see that the minimum bias on the grid of the tube is −1V and the grid must not become more positive than this. The resistance R8 takes care of this and since it has a value of 3·3kΩ it means that there is a minimum bias of −3V at the grid of the tube which gives a safety margin for all possible conditions.

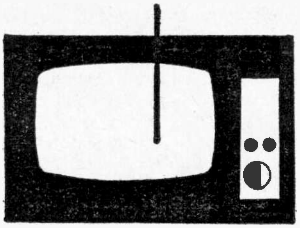
CONTINUED NEXT MONTH





A MONTHLY COMMENTARY

Underneath the Dipole



BY ICONOS

"BAD Taste Charges Split BBC's Top Men" was the shrill banner headline above a national newspaper's story of differences of opinion between Sir Arthur fford, chairman of the BBC, and Mr. Hugh Carlton Greene, the Director-General. It seems that, spurred on by Sir Edward Fellows, chairman of the BBC's Advisory Council, Sir Arthur has circulated to top executives a confidential 3,000-word document setting out the principles of broadcasting. This unprecedented step has been precipitated by the rapid decline of BBC standards during the last few months, the errors of taste and the smut, sneers, bad language, offensive interviewers and near-pornographic TV plays which have been broadcast. Ironically this decline has affected another branch of show business —the cinema. Certain film producers complain that the BBC has knocked the financial bottom out of the "near-the-knuckle" film market! Cinemagoers say why *pay* to see kitchen sinks and the vice dens of Soho when you can see them free on the BBC? The film censor has himself told me that the BBC regularly broadcasts scenes and dialogue that he would not pass, a fact which should be noted by Sir Arthur.

Misguided Hughie

One of the most respected Sunday newspaper TV critics addressed an "*Open Letter to Hughie*", his friend, Mr. Hugh Carlton Greene. In it he put forward in a most diplomatic manner views about the declining tone of BBC programmes which were along the same lines as those much more bluntly set out in the "*Open Letter to the Postmaster-General*" printed in these columns three months ago. It is not surprising that the BBC Advisory Council, which includes the Bishop of Manchester, Sir Stanley Rous, Sir Harold Grime and other eminent people, are not very delighted with the present trends. It would be a good idea if this confidential code-of-practice memorandum was accompanied by a copy of the Duke of Edinburgh's famous speech about the "rat race" of declining taste in broadcasting, newspapers, plays and films—a race in which BBC-TV is an easy winner. Statesmanship is required, not the feverish pursuit of TAM ratings, shock treatment for viewers and a lack of policy which would be more appropriate for an irresponsible scandal magazine.

There are already signs that the BBC is modifying its policy—or lack of it—by the abrupt termination of TW3. Attention should now be focussed upon the TV play department, and those current affair programmes which bend backwards to give undue publicity to anti-British points of view. After all, it is supposed to be the *British* Broadcasting Corporation, or *is* it?

The Telegoons

After this further instalment of nagging about the tarnished image of Auntie BBC it is pleasant to be able to pay at least one compliment to our blowsy old aunt. She has provided the children with a real treat in *The Telegoons*, a series of marionette films in which the puppets mime to the voices of Peter Sellers, Harry Secombe and Spike Milligan.

There are certain technical advances in these puppet films which are worth noting. The eyes and eyelids seem more life-like than on any other puppets I have seen and the synchronisation of dialogue and mouth movement is perfect. The story-line is excellent, too, based on real goonish scripts by Eric Sykes and Spike Milligan and produced by Tony Young for Grosvenor Films under a contract with the BBC for Saturday afternoon Children's Hour. *The Last Tram* episode must have amused and delighted children of all ages up to 90 and I understand that there are even more hilarious adventures on the way. I would like to see more about the fantastic lost London tram, which was marooned on Clapham Common for ten years, complete with passengers!

Royal Variety Performance

What a magnificent evening's broadcasting ATV gave us on the occasion of the Royal Variety Performance. Viewers who switched on early on the same evening for *About Religion* saw a special Remembrance Sunday programme, entitled *The Two Faces of War*, in which John Slater narrated to a series of films, stills and drawings. Beautifully edited and directed by Shaun O'Riordan, this production was a sincere and moving commentary on the follies and the heroisms of war. I have always thought John Slater was a fine actor, but in this instance he was not acting at all; he was speaking a magnificently written script in a manner which conveyed his intense belief in the words.

After a suitable "buffer" item of news headlines, the Royal Variety Performance recording was played off and what a splendid entertainment it was!

Everybody seems to have seen it and each has his own special favourite items. My own were: Dickie Henderson, the brilliantly professional compère, and the ubiquitous Steptoe and Son, Wilfred Brambell and Harry H. Corbett—with whom one must couple the unseen scriptwriters, Galton and Simpson. But it hardly seems fair to pick out two turns when all the performers were so good, the orchestra excellent, the production numbers slick and the television presentation smooth. Bill Ward, ATV's ace director (and head of light programmes) has a magic touch that never misses. I run short of superlatives when describing his shows.

Nice Break for the Boys

The direction of a television play is not always easy, particularly if there is a large cast. Add to this a script which calls for a lot of movement by the actors, small-part players and crowd in and around a number of settings and the director is faced with more problems, not to mention headaches. Add to these the complications of camera and microphone movements, the silent revamping of sets, lens changes, zooms, vision mixing, playback—all to be deployed in fairly long sequences of 15 or 20 minutes each—and you have a potential chaos.

Yet in the A.R. production of *Nice Break for the Boys*, director Ian Fordyce must have kept full control, because this fast-moving television play about the troubles which stirred and finally broke out at an approved school, moved with the smoothness of a motion picture that has had individual attention for every camera set-up and has taken weeks of shooting in a traditional film studio to complete. The play itself, by John Wiles, centred around the headmaster of the school, played with power and understanding by Leslie Sands. There may have been a message in the problems he was faced with and the way he tried to maintain discipline, but this rather got lost in the rapid build-up of events which culminated in rebellion. This did not matter. It presented quite clearly the difficult task of the masters at such schools, which could only be undertaken by dedicated men—and if this was the message it was a valid one. Since writing the above I have discovered that this complicated production was accomplished with ten days of rehearsal (in rehearsal rooms) and two days of "hot" rehearsals and recording on video tape on the Wembley stage of Associated Rediffusion. There were five main settings, three of which were "revamped" into other settings during the actual shooting. If this same production was made with traditional film studio methods, it would have occupied a fully equipped stage for three or four weeks at least. Yet film producers and technicians put up intense resistance to the adoption of any of the time-saving devices which are commonplace in British television studios. No wonder the film studios are closing down one by one—and in this National Productivity Year, too!

Video Tape Developments

One of the most interesting exhibits at the recent Industrial Photographic and Television Exhibition at Earls Court, was the first small portable television tape recorder to achieve its "production model" stage. This is an equipment made by the Precision Instrument Company, of the USA, which uses magnetic tape only 1in. wide, travelling at 6¼in. per sec. The equipment is fully transistorised and operates on a helical system with scanning across the tape, skewed so that the effective track width is about 12in. long. The 1in. tape carries a sound track $\frac{1}{16}$in. wide on one edge and a similar control track on the other edge. Aimed mainly at the rapidly expanding closed-circuit TV market in educational, industrial, medical and military applications, it does not achieve the quality of the large (and expensive) R.C.A. and Ampex installations. But its cost—in the region of £4,500—is about one-sixth of the cost of the larger professional equipments used in television studios. Nevertheless, I would think that it is a most useful tool for TV newsreel interviews and topical events. The quality on the demonstration reel I viewed was about the same as the average 16mm newsreel film, with negative film transmitted on vidicon telecine by phase reversal to turn it into positive.

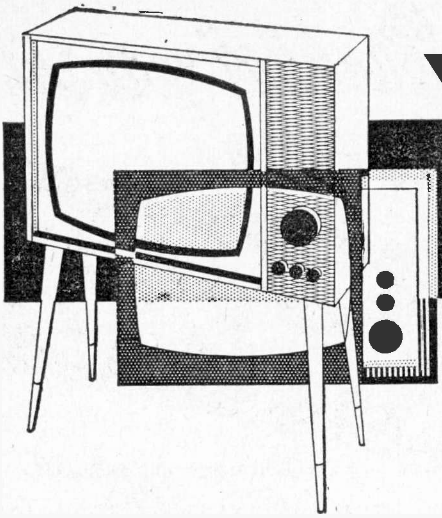
There are other makers who are proposing to make economical 1in. television tape recorders—about six of them—but they are still in their last stages of development. It is one thing to look at a prototype, but much more important to see a production model in operation with the knowledge that it has been time-tested and is backed with a full service of spare parts. I would say that it will not be long before this type of equipment is in regular use for news and magazine operation at regional TV stations, if not in London.

THE "PRACTICAL WIRELESS" AND "PRACTICAL TELEVISION" FILM SHOW

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

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

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



Your Problems Solved

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

PYE V14

When I advance the volume control, the sound increases as normal until the mid-way position is reached when volume drops suddenly. Further advancing the control again increases sound but with a considerable amount of distortion.

I have checked the volume control, the i.f. valves and output valve. The fault occurs on both channels but is more noticeable on BBC.—J. Morris (Swinderby, Lincolnshire).

We suggest you check for leakage the 0·04μF capacitor between pin 1 of the PCL83 and the upper end of the volume control.

COSSOR 938

The contrast control on this set will suddenly become inoperative, accompanied by an increase in gain so that the picture blurs and reduces in size. The sound improves in quality and strength at the same time. A picture may then only be obtained by reducing the contrast control setting or cutting brightness to a minimum. The resultant picture is then very poor with little contrast at all.

I have checked all the obvious components without tracing the fault.—T. Eckersley (Bolton, Lancashire).

We advise a check of the 9A8 a.g.c. valve on the left of the lower chassis, and also its associated M3 diode on the adjacent tagstrip.

PILOT TV110F

The picture fails to fill the screen leaving a 2in. gap at the bottom, with the height control fully advanced.—C. Meheffey (Belfast).

We would advise you to replace V9 (PCL83) and check associated components if necessary. V9 is virtually in the centre of the timebase chassis.

ALBA T644

On switching on, the picture does not appear for some time after the sound has come up. The picture then remains for about half-an-hour before it disappears leaving a dark screen. If the brilliance or contrast control is now advanced the picture will return once again but after a further hour or two will become too bright, when either of the two controls must be retarded to correct brightness.

The c.r.t. was replaced recently and nearly all the valves are new. The GEX34 diodes are also new.—D. Earle (Birmingham 21).

We are inclined to suspect the c.r.t. despite the fact that it is a recent replacement. If it is a regunned tube, we would advise you to send this back to the suppliers for their inspection. If the tube is brand new, however, you will have to check the video amplifier components with particular reference to R18 (3·9kΩ) also checking the voltage at pin 7 which, under normal conditions, should be 145V. Also check the bias voltage (3V) and the V6 and V7 pin 8 voltages.

EKCO TMB 272

This is a mains/battery set. The h.t. on mains reads 200V, while on battery it registers as low as 165V with a corresponding drop in performance. The battery consumption at 12·3V is also less than specified.

I have substituted the smoothing capacitor and checked the vibrator pins. I have substituted a Mallory 629 vibrator for the Plessey type 1214 which was the original, but have not improved the h.t.—J. C. Boylan (West Monkseaton, Northumberland).

This trouble is caused by a faulty pair of metal h.t. rectifiers which are sandwiched between the back of the chassis and the back of the set.

FERRANTI 17SK6

The picture on this set occasionally develops a vertical "shudder." Also the picture is subject to slipping downwards rapidly. This latter fault may be corrected for varying lengths of time by adjusting the hold control.

The valves in the sync separator and frame circuits have been changed but these same intermittent faults recur.

Both faults may appear as soon as the picture comes up after the set is switched on, or after a long warming-up period.—C. E. Carter (London, W.3).

Whilst a component associated with the sync separator or frame oscillator may or could be responsible, we have found that the frame oscillator transformer is more often at fault in these Ferranti models. We would, therefore, advise you to first check the small capacitors and resistors associated with the interlace diode and sync separator, and then change the oscillator transformer.

MURPHY V204

The fault on this set is poor focus at the sides of the picture. The areas out of focus extend inwards about 3in. The remainder of the picture is excellent.

The fault is worsened by increasing the brightness. The U281 has been checked and found to be in order.—L. Evans (London, S.E.6).

This fault could be due to low e.h.t, caused by low main h.t., or to a faulty picture tube.

BUSH TV66

Two faults have developed on this set. The first is that on switching on, a crackling noise is present on the sound. This disappears after about a minute leaving a slight hiss permanently on the sound. I have changed the PCL83 without curing the fault.

The other fault is on vision. When first switched on a picture very diminished in size appears. After a while, this picture gradually fills the screen. The two PY82s have been changed without success.— J. Culligan (Liverpool).

If you are sure that the front right side PCL83 is in order, check the associated bias components and the volume control. If the audio trouble persists, check the sound strip valves on the left-hand side of the receiver unit.

With regard to the vision fault, we would advise you to replace the ECC82 and the PL81 and also check the PY81 and the screen dropping resistor to pin 8 of the PL81 base.

PYE VT7

The screen is only very faintly illuminated when the set is switched on and only a very dim picture and no raster is visible. Also the picture is badly out of focus.

On advancing the brightness control, the heater of the e.h.t. rectifier dims and the timebase whistle alters slightly. Adjusting the ion trap magnet does not affect the screen.

The tube has been tested and found to be in good order.—C. H. Bateman (Norwich, Norfolk).

You should check the ion trap magnet by substitution as the appearance of the EY51 suggests that the e.h.t. unit is providing adequate e.h.t. and the tube is taking current.

ALBA T909

The fault on this set is excessive sound-on-vision on the BBC channel. This fault gradually clears after the set has been operating on the one channel for about half-an-hour.—B. Williams (Yeovil, Somerset).

If the fine tuner is at one end of its travel for optimum results, remove the channel selector and fine tuner knobs and insert a suitable trimming tool to adjust the channel 5 oscillator coil core.

If the fine tuner is not at the end of its travel and best results are obtained with the control set midway, and there is evidence that the signal input is excessive, you will have to fit an attenuator. If the signal input is not excessive, you will have to realign the sound rejector coil cores.

EKCO 330T

The picture suddenly faded away leaving a raster; the sound also faded gradually to a muffled, distorted sound. When next switched on no raster appeared but the sound came up at first, only to fade once again.

I have replaced the U26 and U191 and the line output transformer was renewed recently.—R. James (Dagenham, Essex).

You should check the line linearity choke, which frequently slides down the former to short to chassis. Also suspect a faulty new line output transformer.

ULTRA VT915

I am considering replacing the failing 14in. tube in this set with the 17in. MW34-69 c.r.t. I realise the obvious mechanical changes of course, but apart from these could you indicate any other difficulties involved in the operation.—K. Fordham (Fulbourn, Cambridge).

The CRM141 and CRM142 have smaller neck diameters than the MW43-69 and the scanning coils would therefore be a tight fit. The correct 17in. tube to be used is the Mazda CRM171.

INVICTA 126

After giving good service, it suddenly became impossible to obtain a good picture with this receiver. On both channels the picture tends to roll and tear and the BBC picture is also very weak. The tearing is worse on the ITA channel. Adjustment of either hold control only worsens the situation.

If the brightness control is advanced, the images become grey and "watery" with the raster becoming exceedingly prominent until finally the picture "blows-up" and disappears.

I have checked by substitution three EF80s and

the ECC82, but without improvement.—G. Aspin (Bessacarr, Doncaster, Yorkshire).

We would advise you to check both PCF80 valves on the top left side. If there is no improvement, check the crystal diode detector which is a CG12E inside the final i.f. coil can, beneath the lower PCF80, which appears to be faulty.

PYE V4

The receiver has given good service for a number of years but now the width of the picture has decreased leaving a gap of ½in. on either side of the screen. Adjusting the width control does not alter this situation.—A. Green (Barnehurst, Kent).

Check the PL81 line output valve, and its 3·3kΩ screen grid feed resistor.

BUSH TV43

There is a good raster but neither sound nor vision. I have changed the tuner unit valves without improvement. I have also tried alternative aerials but without any results.—W. Wilkinson (Belfast 13).

It would appear that there is a fault in one of the two i.f. stages common to both sound and vision, V3 and V4. Check the h.t. supplies to these stages, checking at pins 7 and 8 in each case, and replacing any burnt-out resistors and shorted 0·001μF capacitors.

RGD 1756

On switching on the picture is normal. After a few seconds, however, the screen loses contrast, leaving a picture which is almost negative. This fault will sometimes correct itself, very often remaining normal for hours. This trouble first presented itself after the picture positioning adjustment had been altered.—P. B. Fincher (Brighton, Sussex).

If the brilliance (as opposed to the contrast or signal strength) remains normal, check the crystal diode detector and the video amplifier circuit components. If the brilliance is also lacking and the whole effect is "washed out," check the tube heater voltage across pins 1 and 12. Tap the neck of the tube sharply to clear any particles or embers which may be partially shorting the heater element.

The tube may have to be changed.

TEST CASE -14

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

? *The receiver would work normally on sound and vision for almost an hour after switching on and then the picture would fairly quickly lose brilliance and the symptoms of a low-emission tube would develop. For example, the picture would tend to go negative on increasing the setting of the brightness control to counteract the previous loss.*

The geometry of the picture was not impaired, however, and the timebases as well as the sound remained unaffected. What was the most likely cause of this trouble and what simple method could be used to prove the trouble?

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

SOLUTION TO TEST CASE 13 (Page 138 last month)

Modern receivers use the energy recovery type of line timebase where a booster diode is employed, to reclaim some of the energy stored in the inductive and capacitive elements of the line output stage, at the finish of each scanning cycle. And it is the current which is circulating through the booster diode at the end of the line flyback which is used to deflect the scanning spot over the first half of each line scan.

Now, should a fault occur which prevents the line output valve from conducting when the booster energy has been exhausted—e.g. resulting in late conduction—the booster diode current will cease before the line output valve current starts, and the line scan will be cramped at that point as no source of current is available.

The symptom will also result should the booster diode fail to conduct and supply energy for sufficient length of time to cater for the first part of the line scan.

Thus, typical causes of the symptom are: low-emission booster diode or low value of the booster reservoir capacitor; incorrect operating conditions of the line output valve due to low emission or incorrect electrode potentials (e.g. low screen grid voltage); incorrect connection to the booster diode from the line output transformer after a servicing operation.

If the set features a line drive control, maladjustment here could well be responsible in upsetting the desirable mark/space ratio of the line drive waveform to the line output valve. Similarly, alteration in value of a component between the line oscillator and line output valve could produce the same effect.

QUERIES COUPON

This coupon is available until JANUARY 22nd, 1964, and must accompany all Queries sent in accordance with the notice on page 184.

PRACTICAL TELEVISION, JANUARY, 1964

Published on the 22nd of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, London, W.C.2, and printed in England by WATMOUGHS LIMITED, Idle, Bradford; and London. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia), Ltd. South Africa and Rhodesia: CENTRAL NEWS AGENCY, LTD. East Africa: EAST AFRICAN STANDARD LTD. Subscription rate including postage for one year: To any part of the World £1.9.0.

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