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NOVEMBER 1963

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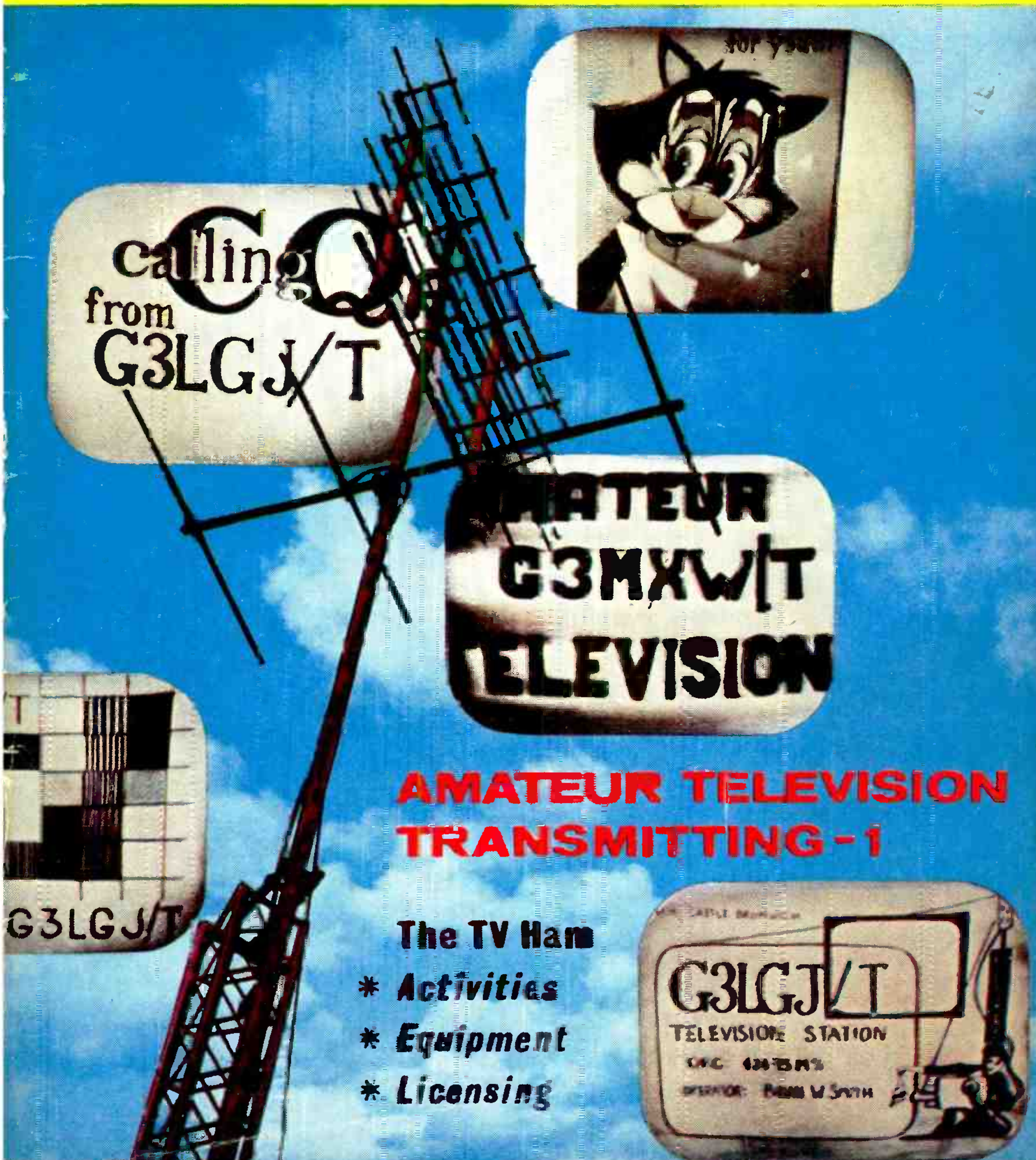

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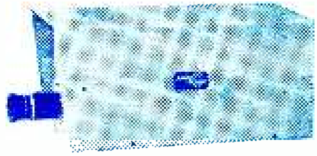

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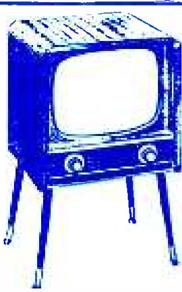

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PY33	10/-	U404	6/-	VP4	14/6	OC71	6/6
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PY800	7/3	UBC81	6/3	X41	15/-	OC77	12/-
PY801	7/6	UBF80	7/-	X66	7/6	OC78	8/-
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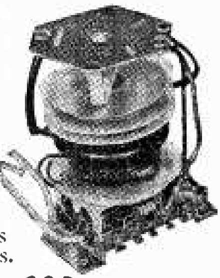

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Practical Television

AND TELEVISION TIMES

VOL. 14, No. 158, NOVEMBER, 1963

Editorial and Advertisement Offices:

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Contents

The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Television". Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for the manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed to The Editor, "Practical Television", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.

Owing to the rapid progress in the design of radio and television apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

Amateur Pathfinders

DUE acknowledgement has been given to the invaluable pioneering and exploratory work in the realm of radio communication performed by amateurs in past years. Nowadays it is perhaps all too readily assumed by some that the pace of technological development has accelerated so rapidly in more recent times as to reduce the amateur to a mere outsider. It would be idle to deny that this is true of certain fields of endeavour where the contest is clearly restricted to commercial and government organisations with their formidable resources. Nevertheless we feel sure that opportunities will always exist somewhere for the devoted amateur to carve his niche.

Considering now our own particular interest: with the approach of u.h.f. television broadcasts it has become clear that many problems remain to be solved especially in matters relating to radio wave propagation at these ultra high frequencies, not to mention the super high range of frequencies which complete the microwave spectrum. It may come as a surprise to some to learn that television amateurs in the U.K. and elsewhere have for several years been actively engaged in exploiting these relatively unknown regions of the radio wave spectrum and that extremely creditable achievements have been made in two-way picture transmission. We in this country have particular reason to be proud of our television amateurs, for it can be fairly claimed that in this field the British lead the world. To mention but one notable success, a recent two-way exchange of vision signals over a 200-mile path on 70cm represents a European, if not a world record.

The series of events leading to the establishment of amateur television in this country have followed a certain pattern, familiar enough to those acquainted with the story of its forerunner — amateur radio. Official recognition of the amateur television experimenter and the granting of licences to permit transmission of television signals by radio waves, came about only after prolonged agitation by a body of kindred spirits who formed the British Amateur Television Club in 1949. Subsequently the Radio Society of Great Britain, acting on behalf of the BATC, entered into negotiations with the General Post Office and these discussions lead in 1951 to the decision by the G.P.O. to issue television submitting licences to suitable qualified persons.

Naturally enough it is on the 70cm band that most amateur vision actively has to date been concentrated. Techniques and components not so very dissimilar from those employed in the v.h.f. bands are suitable on 70cm and, to a considerable extent, on 23cm as well. The shorter microwave bands on the other hand demand less-conventional techniques involving devices such as klystrons and travelling wave tubes, and here wiring gives way to plumbing. Assuredly many more exciting chapters have yet to be added to the saga of amateur television.

Our next issue dated December, will be published on November 22nd.

TELETOPICS

Plans for BBC-2 Announced

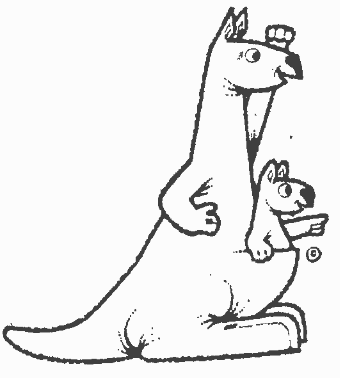
THE first programme transmissions of the BBC's second channel—BBC-2—will come from the Crystal Palace station in April next year. This will serve 10 million people in London and the Home Counties.

During 1965, it is planned to open other high-power stations in the Midlands, Central Scotland, South Wales, Lancashire, South Yorkshire, Northern Ireland, the Isle of Wight and North East England; bringing BBC-2 to over 60% of the population. By 1966, the percentage of the population within the service area of BBC-2 transmitters should be about 75 if all goes well with the plans to open a further nine high-power stations throughout the country.

After 1966, further stations will be built so that, by the beginning of 1969, there will be nearly fifty main stations and many relay stations. These low-power relay stations will be necessary to fill in "shadow areas" which will exist within the service areas of main transmitters.

Programmes for BBC-2 will be planned carefully to provide always an alternative to programmes appearing on the existing BBC channels. (In the future, the two channels will be known as BBC-1 and BBC-2.)

The organisers of the new service have chosen two cartoon kangaroos as publicity symbols: a mother kangaroo carrying a baby in her pouch representing BBC-1 and BBC-2 respectively.



Publicity symbols for the BBC's second programme are these two kangaroos.

CCTV FOR LONDON AIRPORT

THE main approach Control Tower and the Southern Air Traffic Control Centre of London Airport will soon be connected by a closed circuit television link.

Increasing air traffic has made it necessary to install a more efficient system of data transfer between the two control centres than that provided by the existing telephone link.

The contract to install the TV link has been awarded to Automatic Information and Data Services Ltd., by the Ministry of Aviation.

Three cameras in each centre will be linked to their respective monitors by G.P.O. cable across the 1½ miles which separates the two buildings. In operation, a camera will scan a flight progress sheet, which will then be displayed immediately on the appropriate monitor. This system should greatly speed the work of the control centres staff.

FIRST BAIRD SCHOLAR

WHEN the Television Society met at the Savoy Hotel in London recently, it was to present the first John Logie Baird Travelling Scholarship to the chosen candidate, Mr. W. P. Williams, B.Sc., of Nottingham University. This new scholarship is open to post-graduate students in the U.K. who are concerned with television engineering or an allied technology.

The Television Society will annually award the Scholarship, which is financed by Baird Television Limited and which was presented on this occasion by Mrs. Margaret Baird, widow of the famous television pioneer.

Mr. Williams's proposed study for the scholarship, is to make a detailed investigation of the Eurovision link, which will involve his travelling extensively on the Continent and presenting a report to the Television Society on the completion of his work.

Award for TV Paper

THE joint authors of a paper entitled "A Constant Luminance Colour Television System" have been awarded the Associated Rediffusion Premium for the outstanding paper in 1962 on advances in the technique of television broadcasting. This was announced recently by the British Institution of Radio Engineers.

The two authors, I. J. P. James, B.Sc., and W. A. Karwowski, B.A., are both with the Research Laboratories of E.M.I. Ltd., who recently gave a demonstration of colour television on this system to visiting members of the European Broadcasting Union in London.

NEW ROLES FOR UNDERWATER TV

THE growing acceptance of television as one of the best methods of making underwater investigations is illustrated by two recent operations, made possible by the use of Marconi television equipment.

One of these was at Lowestoft where the Fisheries Laboratories of the Ministry of Agriculture and Fisheries, are carrying out a series of underwater experiments to try to accumulate more information on the habits and movement of fish in efforts to help fishing vessels increase their hauls.

To provide a first-hand view of the fish and the actions of trawl nets, the Fisheries Laboratories are using a unique Marconi underwater TV camera. This camera, the series 321, has distinct advantages over previous systems, in which the control equipment was kept and operated on the surface and connected to the camera head by cable, as the control unit and camera are contained in the one pressure casing which can be lowered on to the sea bed and left to operate, completely independent of external equipment except for single power line and signal output cable.

On the surface, experts can study the television pictures on a 21in. monitor, which can be as much as 12,000ft above the camera unit on the sea bed.

In Norway too, Marconi underwater TV equipment has recently been put to good use, this time to investigate a damaged sluice gate in the Norwegian Hydro Electric Board's reservoir at Songa. However, on this occasion a standard Marconi-Siebe, Gorman system was used to relay pictures of the gate to experts viewing 14in. monitors on the surface.

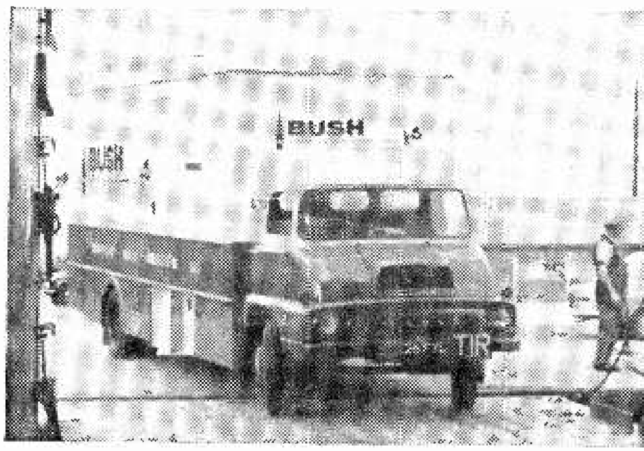
Three frogmen guided the supply cables and camera through almost 500ft of near-freezing water, to show the necessary details of the damage which ordinary photography had failed to reveal.

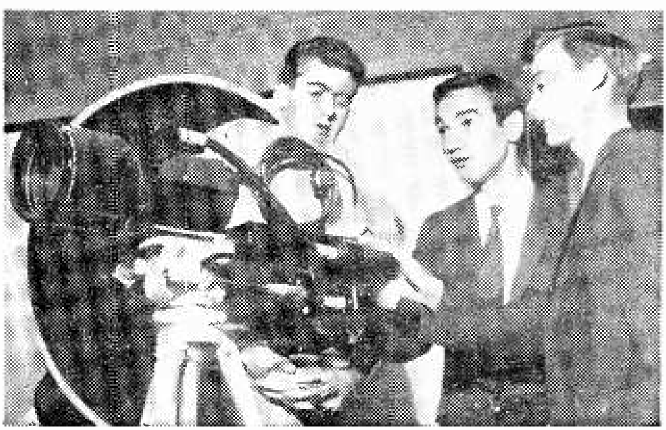
British Colour TV Unit Tours Europe

A THAMES lorry, designed to provide colour demonstrations on any TV system, left England recently for a tour of Europe. The first people to see the demonstrations were visitors to the British Industrial Trade Fair at Zurich, which the mobile unit made its first port of call.

After a two weeks stay in Zurich, the lorry which was equipped at the Chiswick laboratories of Rank-Bush Murphy Limited, began its tour of the Continent, to give demonstrations of colour television in several countries.

The photograph on the right shows the first Rank-Bush Murphy colour TV unit leaving London for Europe, where its first stop was the British Trade Fair at Zurich. Below, three visitors to the Fair inspect a television zoom lens.





FIRST COLOUR TV DEMONSTRATIONS IN ABERDEEN

COLOUR television was demonstrated in Aberdeen for the first time recently, when videotape recordings were used to illustrate a chemistry lecture given by Professor G. M. Burnett. This lecture formed part of the programme of the British Association's science conference which was held this year in Aberdeen.

The local ITV programme company, Grampian Television, relayed the recordings over a closed circuit network, to a nearby hall where the lecture took place.

CO-CHANNEL INTERFERENCE

By K. ROYAL

Almost unknown on the u.h.f. bands, this form of interference can cause considerable disturbance on Band I.

EXACTLY the same factor which is responsible for long-range television reception is the cause of so-called "co-channel interference"—sometimes called "tropospheric interference". Co-channel interference is confined to the v.h.f. channels, and more especially to those in Band I (e.g. channels 1 to 5), but there are also times when it "strikes" the Band III channels. However, it is less drastic in Band III and the trouble diminishes with increase in channel number, meaning that it can be really a problem on Channels 1 and 2 and much less of a problem on Channels 11 and 12. It is rarely known to happen in the u.h.f. channels of Bands IV and V.

V.H.F. and U.H.F. Channels

Television was put into the v.h.f. and u.h.f. channels because the vision signals require much more spectrum space than is available in the whole of the medium frequency broadcast bands. These high frequency signals, however, differ considerably from medium frequency signals in that the former have a range under normal conditions which is a little in excess of the line of sight distance between the transmitter and the receiver, while the range of the latter—depending upon time and exact frequency—is world-wide.

From v.h.f. to u.h.f. the signals behave more like light and the range virtually becomes the line of sight distance. Moreover, the signals find it increasingly difficult to penetrate large man-made objects and natural hills, so that many more "radio shadows" exist at the u.h.f. part of the spectrum than at the v.h.f. part, while at medium frequencies there are almost no shadows at all.

Bouncing Signals

The excessive range of medium frequency signals is mainly because the upper atmosphere above the earth "looks" to them as a mirror "looks" to light. Sky-going signals are thus reflected back to earth again, and on striking the earth they are bounced back to the sky. This process can be arranged to continue round the earth until the energy of the signals is completely exhausted.

The atmosphere directly surrounding the earth is called the "troposphere" and that above the troposhere is called the "ionosphere". The ionosphere plays the major part so far as medium frequency signals are concerned, and the signals bounce between this and the earth, as illustrated in Fig. 1.

Cause of Fading

It should be noted that neither the ionosphere nor the troposphere has a distinctive demarcation. These "upper atmospheres" are rather like clouds and they tend to drift around as such, which is one of the chief causes of long distance, medium frequency fading. Any drift of the ionosphere, of course, alters the point at which the reflected signal arrives back on earth, and then other things like phase of the signals come into play and cause the signals either to add together or subtract from each other, thereby giving stronger and weaker reception respectively.

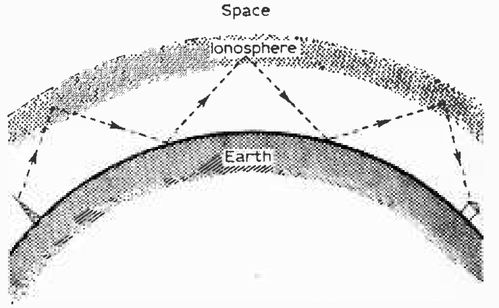


Fig. 1—Long-distance, medium-frequency transmission is possible by the signals "bouncing" along the earth from the ionosphere, as the illustration shows.

Under normal conditions v.h.f. signals penetrate both the troposphere and the ionosphere and disappear into space, and reception is confined to the "earth bound" signal which, as already mentioned, disappears a little after the line of sight distance.

Lost in Space

The idea is pictured in Fig. 2. Here transmitter A serves receiver a over the earth bound path A-b, while transmitter B serves receiver b over the earth bound path B-b. Sky-going signals from transmitters A and B go straight through the troposphere and ionosphere and get lost in space. This is a good thing since it means that isolated areas of transmission and reception can be set up at vantage

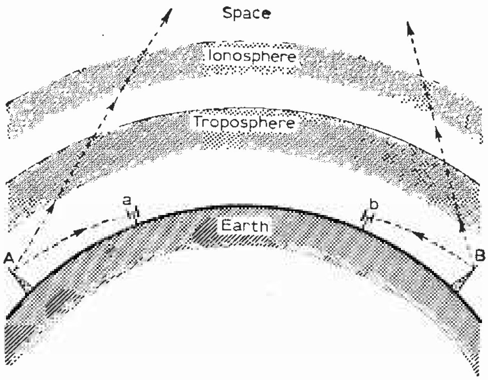


Fig. 2—V.H.F. and u.h.f signals pass through the troposphere and ionosphere and are lost in space, while local reception relies upon the ground wave which is rapidly attenuated a little beyond the line-of-sight distance.

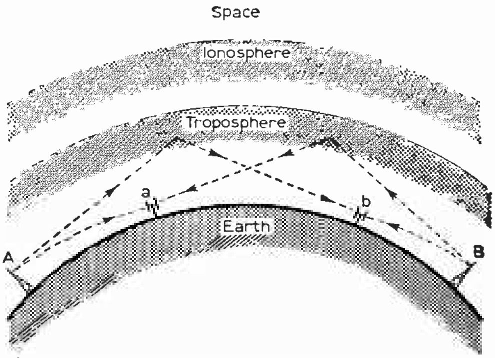


Fig. 3—Certain weather conditions upset the normal v.h.f. propagation theory due to ducting of the signals within the troposphere. The signals are then propagated well outside the local range and can cause severe interference on distance receivers sharing the same channel.

points all over the country on a channel-sharing basis. The sharing of channels in this way is carefully planned so that within the service area of any station, signals from the distant stations are normally so weak as to be imperceptible.

Table 1 gives some idea of the extent of channel sharing in Bands I and III to secure reasonable coverage. This table does not reveal all the stations sharing channels, for there are many small booster stations serving just a small community yet sharing the main channel numbers. It will be understood, of course, that to give country-wide coverage of two programmes many times more stations than the immediately available 12 v.h.f. channels are required—hence the need for channel sharing.

TABLE 1

Showing some of the main stations using a common channel number.

Channel	*Stations*
1	Crystal Palace; Divis; Thrumster; Sheffield.
2	Holme Moss; N. Hessary Tor; Rosemarkie; Londonderry; Brighton; Dover
3	Kirk-o-Shotts; Rowridge; Tacolneston; Blaen-Plwyf.
4	Sutton Coldfield; Meldrum; Sandale; Les Platons; Folkestone; Hastings
5	Wenvoe; Pontop Pike; Douglas; Orkney; Peterborough; Enniskillen
7	Kippure
8	Lichfield; Burnhope
9	Croydon; Winter Hill; Black Mountain; Stockland Hill; Durris
10	Emley Moor; Black Hill; St. Hilary; Dover
11	Chillertown Down; Mendlesham; Caldbeck
12	Mounteagle; Caradon Hill
13	Selkirk

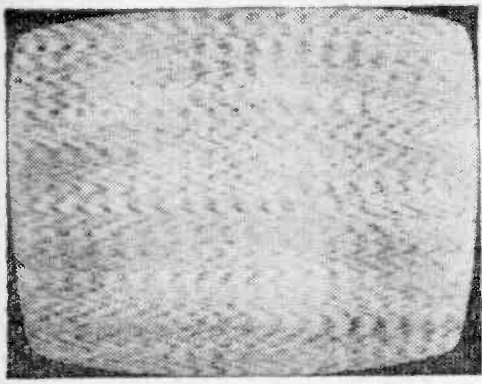
The BBC and ITA second programmes will be accommodated in the u.h.f. channels, so the v.h.f. channel sharing problem will not be aggravated, fortunately. Apart from Great Britain having to share channels in the v.h.f. bands, all other television countries have to do likewise. Clearly, then, widespread television is made possible only by the fact that v.h.f. signals are confined to areas very local to the transmitters. If v.h.f. signals were propagated as medium frequency signals (Fig. 1), then television as we know it today would be impossible.

Unfortunately, the ideal situation as shown in Fig. 2 does not always exist, for there are times of the year when the troposphere has a distinct influence on television signals and instead of letting the sky-going ones loose into space it tends to bend them back to earth, as shown in Fig. 3.

This can cause havoc, for now a receiver will pick-up not only its own local transmission but also a more distant transmission sharing the same channel due to reflection and bending at tropospheric level. Actually, of course, what happens is that v.h.f. signals are propagated over far greater distances than possible under normal reception conditions.

Abnormal Conditions

These abnormal reception conditions are brought about by the general weather creating specific upper air disturbances that ultimately "duct" or bend v.h.f. signals in such a manner that they may travel hundreds of miles before they are attenuated very



much. Just exactly how tropospheric ducting takes place, no one knows for certain. There are several theories which are very convincing; but it is known that the extent of the bending or ducting is related to variations of atmospheric pressure, temperature and moisture content with elevation above the surface of the earth.

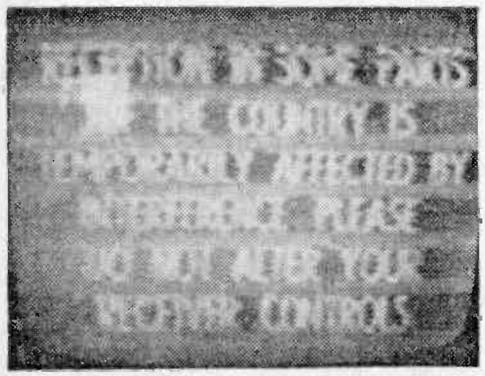
Certain areas seem to be more afflicted to tropospheric effects than others; but almost always the spring and autumn months are the most troublesome wherever the location. During the spring in particular television stations located many hundreds

Fig. 6—A less severe form of co-channel interference. While this may not cause line tearing it can impair the horizontal definition. On some recent dual standard sets the interfering co-channel signal may also either cause "blocking" of the vision a.g.c. system or a decrease in the vision channel sensitivity due to the production of extra a.g.c. bias.

of miles away may come sailing into the local picture amid distressing vision and sound interference. Indeed, the signal levels of the interfering stations may be equal to or sometimes stronger than the local signals.

Co-Channel Interference

Co-channel interference is the name given to the interference caused by a receiver picking up distant shared-channel transmissions along with the wanted local transmission. The interference comes in all kinds of forms (see the accompanying "Telephotos") and the affected picture is often described as "wavy", "distorted" or "rolling", and often superimposed upon the local sound is a low-pitched buzz or even Continental sound breakthrough.



Unfortunately, there is not a magic key available that can beat the co-channel interference problem,

Fig. 4—Very severe co-channel interference can completely destroy a picture, as this picture shows.

and most viewers have to live with it until the reception conditions improve. The broadcasting authorities give out announcements from time to time during a bad spell indicating that the disturbance is due not to the set but to external conditions, and requesting viewers not to adjust their sets which, of course, would not help matters, and possibly make them worse. If the interfering co-channel signal is arriving from a direction reasonably removed from that of the wanted local signal, some relief may be possible by orientating the aerial for the best possible signal/interference ratio or by the use of a more directional aerial system. Usually, however, this solution will not work if the offending

transmission lies anywhere within 30° to 40° of the local station.

Adjacent channel interference (the interfering station this time being adjacent to the wanted station and lifted in level due to tropospheric propagation) may also be aggravated during a spell of abnormal reception conditions, but under normal working of the set the adjacent channel filters will attenuate the signal sufficiently to prevent it causing excessive interference. Should the set's internal filters fail to do the trick for some reason, then external filters or coaxial stubs may be connected to the aerial input to the set.

Fig. 5—Co-channel interference often causes line tearing (see top of picture) and "flaring" captions.

What the BBC Says

The BBC and ITA are fully aware of the problems detailed in the foregoing, and since the BBC stations are most affected—being in Band I—an information sheet has been published on the

—continued on page 71

A CLOSED CIRCUIT TV Camera

By E. McLoughlin

PART TWO: THE VIDICON CAMERA HEAD UNIT

CONTINUED FROM PAGE 30 OF THE OCTOBER ISSUE

THE present article describes an amateur-built camera head using the EMI vidicon tube type No. 10667 introduced in the last article.

Basic construction details for this camera head are here given. Instructions for final trimming to obtain optimum performance will be given after subsequent articles dealing with the control unit have been concluded and the completed equipment is therefore available.

Mechanical Construction

The successful construction of a CCTV camera head depends upon the availability of a good metalwork lathe and ability to work neatly therewith. One is here dealing with a very short focus optical system, as the scanned image on the vidicon tube is only about 16mm. in diameter. It is therefore necessary to adjust the position of the vidicon target to an accuracy of better than a hundredth of an inch in relation to the focal plane of the precision lens. Furthermore, this operation must be possible from an external control knob, with the cabinet closed, and the adjustment must be free of backlash.

To satisfy these requirements in the simplest possible way from the point of view of construction in the average amateur workshop, the vidicon tube and its coil assembly were mounted on a simple carriage running in brass rails bolted to the chassis assembly. A micrometer drive is used, running in a ball bearing anchorage and having a pitch such that a quarter of a turn of the control knob moves the vidicon carriage about a hundredth of an inch. Figs. 4 and 5 show full details of this mechanism.

Note that the ball bearings should be of the "flexible" type, i.e. having no longitudinal play whatsoever, but slight angular play in any orientation to the main drive axis. This prevents the drive bushing being distorted or the entire drive jamming should the cabinet and insert be very slightly misaligned, by an amount otherwise of no disadvantage.

Figs. 6 and 7 show a mild steel chassis and panel design and cabinet design giving superior rigidity compared to the otherwise general practice of using simple aluminium chassis constructions. It is essential to use the more rigid construction here specified, as only this can guarantee the required accuracy of positioning of the vidicon tube and prevent the carriage jamming due to spurious warping as the equipment warms up, or for other reasons. It must be emphasised again that a flimsy construction without lathe work will very likely lead to disappointing results not justifying the financial outlay in building this equipment.

It must not be forgotten in this connection that, when using a sound channel with good bass reproduction from loudspeakers near the camera, bass vibration can cause serious jitter of the picture if a flimsy camera construction were used. The mechanical amplitude of vibration of the vidicon tube need only be very small and yet represent a large relative vibration for the tiny image with the very short focus optical system.

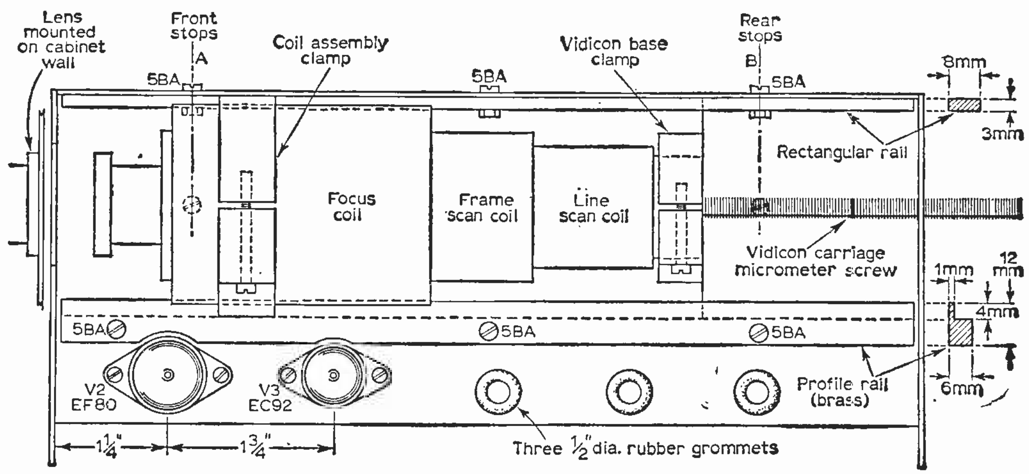


Fig. 4—Main chassis layout and assembly details of vidicon carriage in guide rails.

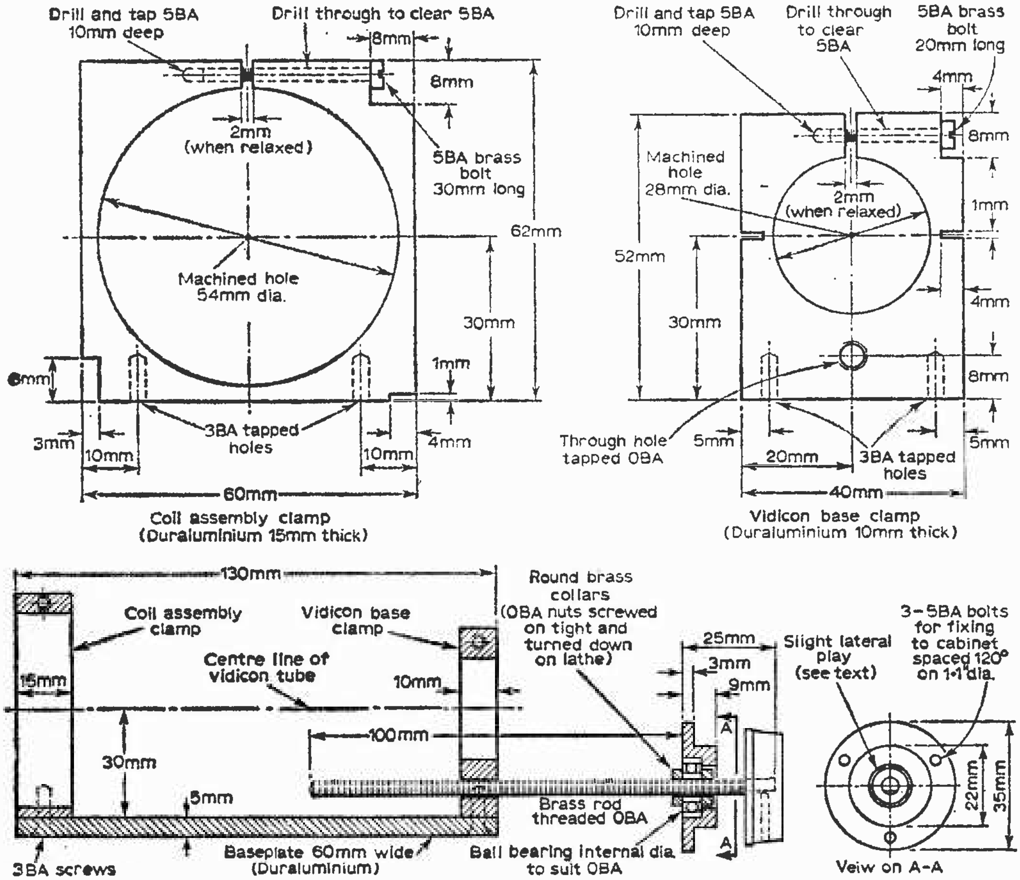


Fig. 5—The coil and tube-base clamp blocks for the vidicon, carriage assembly and micrometer transport mechanism of carriage.

Carriage Stops

Four bolt heads, as shown at A and B in Fig. 4, serve as stops for the limits of travel of the carriage. Two of these are on the panel rail and the other two on the chassis, in the middle of the track. The latter are simultaneously used to fix the long tagstrip for the underchassis wiring. The front two stop bolts should be so positioned that, when the carriage is moved back about a tenth of an inch from them, the vidicon target is in the focal plane of the lens set to infinite range. This position is best found by focusing the image of an object at least 25 yards distant on to the target, through the lens set to full aperture. This can either be done with the chassis-insert removed from the cabinet and the lens held in a suitable clamp, transferring the measured distance then with callipers to the construction, or a small observation hatch with slide-back light-tight cover can be fitted to the cabinet roof slightly in front of the target.

Having determined the position of the front stops, the rear stops should be such that at least one and a quarter inches of travel are given for the carriage, the exact positions being such as to suit the tagstrip used below the chassis. The back stops then allow the carriage to be driven back to at least twice the focal length behind the lens.

Although normal operation for televising indoor or outdoor scenes will require the target to be in the focal plane of the lens, i.e. near the front stops, there is an important range of extra uses opened up for the camera by the fact that the vidicon carriage can be driven back to bring the target to twice the focal length from the lens, namely *direct* use as a television microscope.

With the image plane (target) twice the focal length behind a lens, in this case 50 mm., we always have a 1 : 1 size, i.e. natural size, image of any object an equal distance in front of the lens. An illuminated specimen stage can thus be placed 50mm. in front of the lens, and any object about half an inch in diameter will fill the screen of the TV receivers used. Naturally, this arrangement can be used to televise small lantern slides, etc., and intermediate magnifications are possible at intermediate carriage positions.

When determining the front position stop positions, by means of forming an image on the target, do *not* use the sun or any bright lamp as object.

After having chosen the positions for the front

COMPONENTS LIST

Resistors:

R1	56k ½W	R10	4·7k 1W
R2	470k ½W	R11	1M ½W
R3	4·7k ½W	R12	270Ω ½W
R4	680k ½W	R13	4·7, 1W
R5	2·2k ½W	R14	2·2k ½W
R6	270Ω ½W	R15	33Ω 1W
R7	2·2k 1W	R16	47Ω 1W
R8	10M 1W	R17	2·2k ½W
R9	15k 1W		

All carbon, ±10%.

Capacitors:

C1	0·01μF mica or ceramic 500V
C2	1000pF ceramic 500V
C3	0·15μF paper 500V
C4	0·5μF paper 500V
C5	16μF electrolytic 350V
C6	0·01μF paper 500V
C7	16μF electrolytic 350V
C8	See text (approx. 2700pF ceramic)
C9	0·15μF paper non-inductive, 500V
C10	0·01μF paper 500V
C11	16μF electrolytic 350V
C12	0·015μF paper 500V
C13	0·015μF paper 500V
C14	See text (approx. 0·03μF, paper 500V)
C15	See text (approx. 0·15μF, paper 500V)
C16	0·05μF paper 500V
C17	0·01μF paper 500V

Valves:

V1	EMI 10667 Vidicon
V2	EF80
V3	EC92

Miscellaneous:

1 Ceramic Ditetrar base (Carr Fastener Co. Ltd., Stapleford, Notts. Cat. No. 79/502)
1 Ceramic noval base, 1 Ceramic B7G base.
Focus and scan coil set for V1 (E.M.I. Ltd., Hayes, Middlesex).
P1, P2 Two 3-pole +earth sockets (as on Grundig tape recorders).
P3-P6 Four coaxial sockets.
Lens: Schneider Cine-Xenon RX (Bolex) (or equivalent) f:1·4/25mm.
Bolts, solder, tagstrip, grommets, etc. Mild steel, duraluminium, brass (according to drawings) for mechanical construction. 6in. length OBA brass bushing. Flexible ball bearing for OBA. One instrument knob.

and back stops, check that in the front position the target does not hit or foul any part of the chassis and cabinet assembly and that in the rear position the front end of the micrometer bushing does not grind into the back of the focus coil. Make sure that the carriage hits both bolts of each stop simultaneously, so that definite arrest is immediately felt at the control knob when this position is reached.

Clamp Blocks

Note the design of the two clamp blocks mounted on the carriage baseplate, as shown in Fig. 5. This arrangement is reasonably standard practice in mechanics for achieving rigid mounts of tubular objects not themselves possessing any definite anchorage devices, and it here permits easy rotation of the complete assembly or of the component

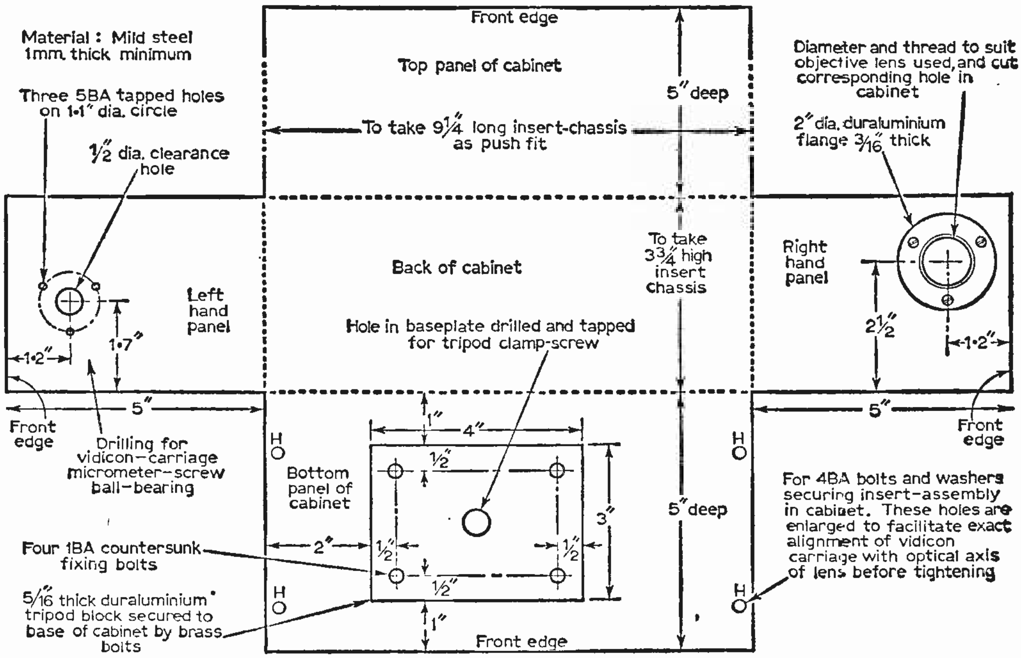


Fig. 6—Mechanical details of the mild steel plate cabinet, lens flange and fitting for vidicon carriage micrometer adjustment.

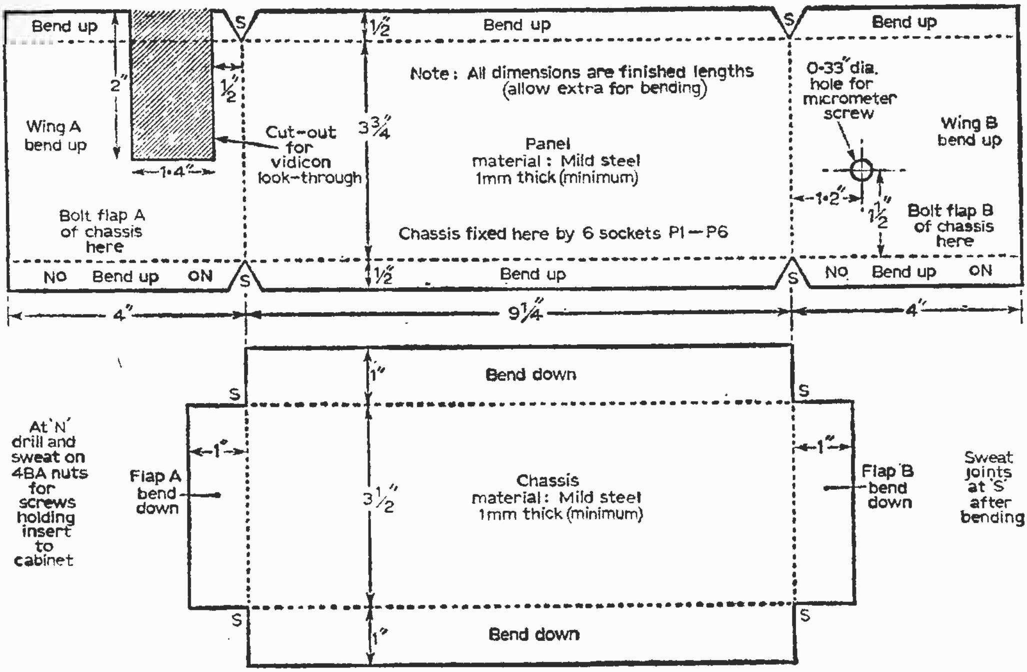


Fig. 7—Details of mild steel chassis-and-panel cabinet insert.

items relative to each other, as well as relative axial shifts of these.

For all these adjustments the pinch bolts at the top of the clamp blocks must be slackened, the necessary alignments made, and the bolts then tightened again. Although this arrangement of clamping gives a good grip over a large part of the circumference without undue local pressures, the pinch bolts should not be tightened excessively. The uniformity of large area grip is the better, the more accurately the relaxed diameter of the clamp hole matches the diameter of the item to be gripped, and individual trimming is here essential. If the outer surface of the focus coil departs too much from a true cylinder, a piece of slit paxolin tubing should be slipped over it first.

As a rough guide, the tube base should be orientated as shown in Fig. 5, bringing the glass-seal nose at the front of the vidicon tube horizontal and pointing at V2, V3. The front ends of the three coils should be roughly coincident and moved up close to the glass-seal nose. Final adjustments can only be made when the control circuit is complete and an actual picture can be observed on a TV receiver. The sense of connections to the deflection coils can then be determined by trial and error too, to get the picture the right way round and the right way up.

Note that the smaller clamp block, for the vidicon tube base, has to be slotted at the sides as shown. This is to achieve the correct "springiness" for the action of the pinch bolt at the top.

The minimum wall thickness at corresponding points on the larger clamp block, for the coil assembly, is much smaller in relation to the hole diameter, so that slotting is here unnecessary.

It has been found more convenient to give all dimensions for the precision elements in millimeters, as values in inches happened to come out to a confusing variety of fractions and tolerances are too small to allow rounding-off to the nearest "thirty-second" in most cases. The rougher sheet metal work, etc. has been marked-up in inches wherever possible. Note that individual trimmings to exact fits are generally more important than exact copying of all dimensions.

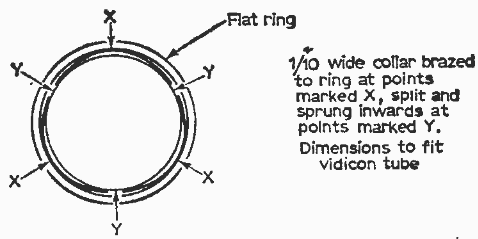


Fig. 8—Front connector for the vidicon target.

Particular attention should be paid to good angular alignment and true parellelism between vidicon tube and chassis. Slight lateral misalignment of vidicon axis and lens optical axis (leading to non-uniformity of optical focus over the picture) can be corrected subsequently while observing a picture on a TV receiver, by moving the chassis insert slightly relative to the cabinet before tightening the bolts H (Fig. 6).

The uneven focus effects resulting from such mechanical misalignment can be distinguished from similar effects possible by certain electrical misadjustments by noting that they are enhanced at large lens apertures and that adjustment of the micrometer knob causes a zone of best focus to travel right across the picture from left to right, or vice versa. Both these details can not arise from any wrong electrical adjustments.

Alignment Coils

Just before going to print with this article, we have received specific confirmation from Messrs. EMI of the correctness of experimental surmises made in the article that alignment coils will, in general, not be required. Indeed, the named makers advise against the use of such coils in amateur constructions, as improper adjustment can lead to picture deterioration rather than improvement. The space beween scan and focus coils, carrying the alignment coil in industrial designs, should be filled with a slit paxolin tube of suitable diameter, to hold all coils concentric with the vidicon tube.

Front Connector for Vidicon Target

This connector should be made of a flat ring and brazed-on narrow collar. The collar is only attached to the ring over four parts of the circumference, being slit in two over the remaining four intermediate regions to act as circumferential spring contacts around the circular target contact ridge on the vidicon tube. At one point a soldering tag should be brazed on. A suitable material for this contact cap connector is hard brass, as in the prototype. A suitable design is given in Fig 8. The makers are not able to supply this item, as it forms an integral part of their industrial camera body.

Circuit Diagram

Fig. 9 shows the complete theoretical circuit of the camera head. It is seen that this is quite simple, as everything possible has been removed to the control unit chassis in order to reduce weight and heat generation in the camera head. It is seen that no electrical controls whatsoever are located on the camera head, so that complete remote control is subsequently possible.

The two additional valves left in the camera head are designed to give a slight video preamplification and also to reduce the output impedance level, by means of cathode-follower action in V3, to suit a length of video cable to the control unit chassis.

It is thus clear that the problems in building a camera head are primarily mechanical and not electronic, which is the reason for having adopted the unusual procedure of discussing mechanical details before electrical circuitry in this article.

Details of the Electronic Circuit

Note that R1 together with the stray capacities at the target (as determined in Table 1, which will appear next month) represents a rather long time

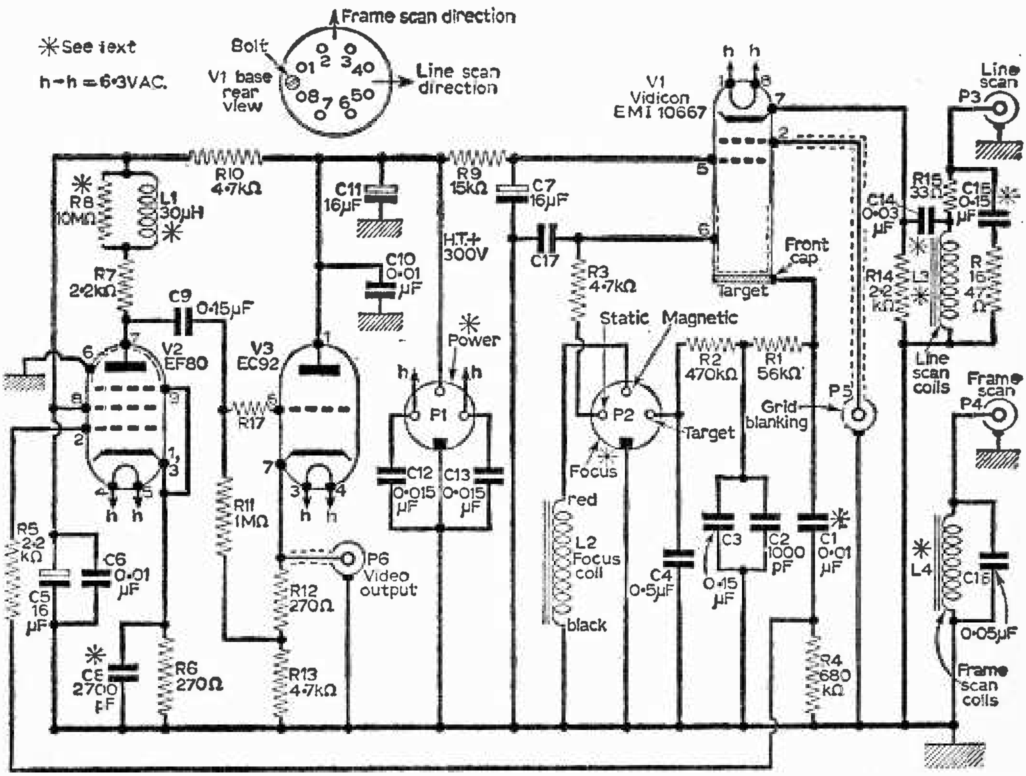


Fig. 9—The complete circuit of the camera-head using the EMI 10667 vidicon tube. Note: components marked with an asterisk receive special discussion in the text.

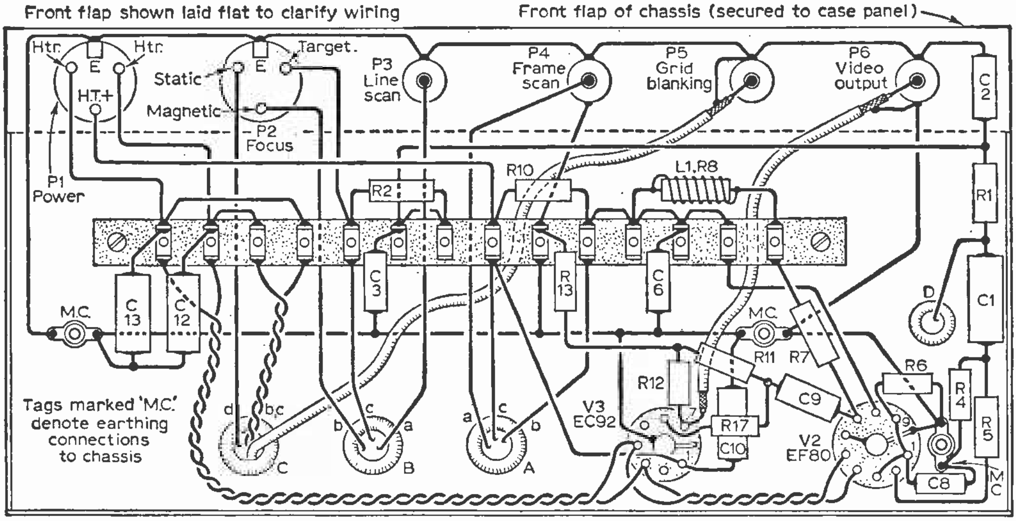


Fig. 10—Underchassis wiring diagram of camera-head. Do not use nut-and-bolt chassis connections, but earth the frame of bare wires by means of soldered chassis connections at the points shown, using a large iron, as quickly as possible.

constant, limiting the level response to well under a megacycle. Since this response is insufficient for a good video signal, compensation by means of over-peaking in the video amplifier chain is required.

This can be achieved in two ways. Firstly, by using a suitably small cathode bypass capacitor which is effective in removing negative feedback and thus raising gain only at the higher frequencies. Secondly, by making the anode compensating coil (such as L1) larger than the value determined by considerations explained in Table 1.

The first measure alone has been used in the camera head, in the form of suitable choice of C8 (see Table 1). The anode coil L1 is here dimensioned for just compensating V2, without regard to the vidicon. The larger coils will be used in the subsequent amplifier chain on the control unit.

However, there is no reason against experimenting with larger values for L1 too. Do not carry matters to excess in any single stage, as the high frequency phasing will otherwise suffer. (One of the cathode compensations in the control unit—after the same principle as for R6, C8 in the camera head here will be made preset variable with the help of a trimmer. This will allow optimum adjustment of

—continued on page 87

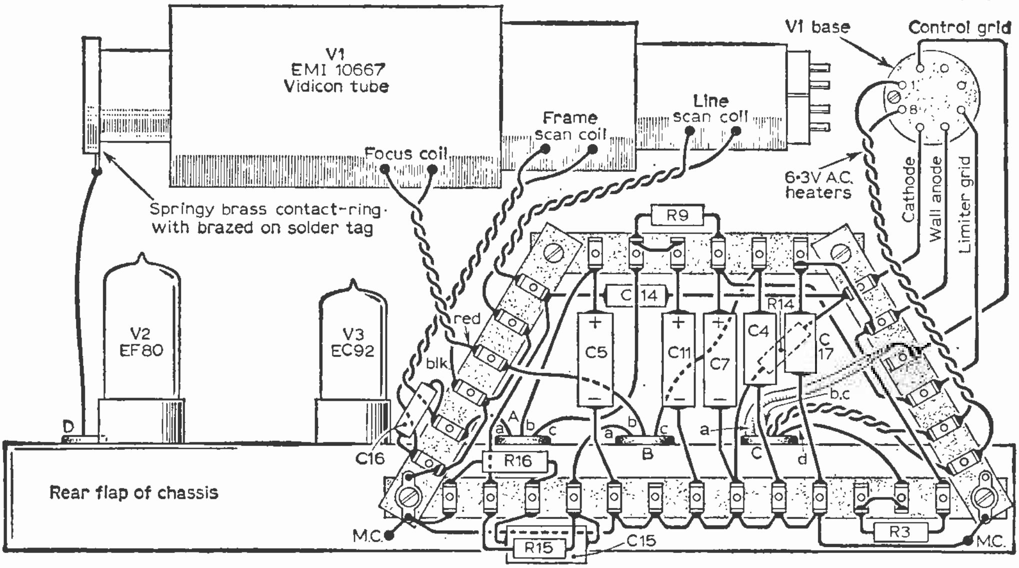


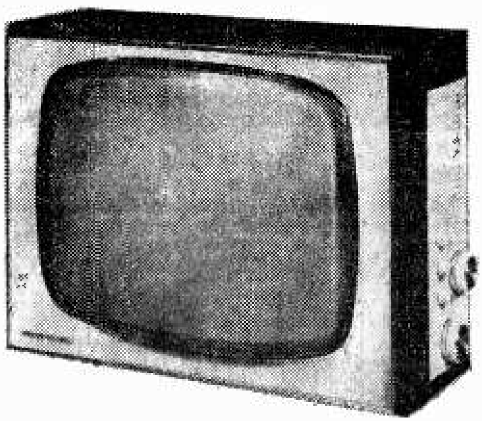
Fig. 11—The above-chassis wiring diagram.

Showtime Round-up

A summary of the new television models seen at the recent series of trade exhibitions. The tables show a selection of brand new models only and do not represent the complete range of the manufacturers concerned.

THERE being no National Radio Show this year (it is being resumed as usual in 1964), most manufacturers of television receivers held their own private exhibitions for trade visitors. From a tour of these trade shows we have gained an overall picture of what the new sets look like and what they do, and we have also prepared a list of receivers which we noted as being entirely new. This list does not, of course, incorporate the entire ranges of the companies concerned, nor does it necessarily include every new set; it does not incorporate information of products not covered by a trade show during the period.

For further information on any of the receivers mentioned, readers are advised to contact their local stockists of the brands concerned.



GENERAL IMPRESSIONS

The first thing that strikes the observer is, of course, the presentation. Although there are no major changes in general styling, the overall high standard of presentation continues. Most sets are housed in a polyester finished wooden cabinet with, in most cases, attractive contrasting front facias and tube surrounds in a variety of materials—constrasting wood veneers, plastics, leathercloth, silk, etc. Metal trim is used to set off features but on the whole is used tastefully and is not overdone to the extent of flamboyance. The general impression of the new sets is that they look good.

"Picture Frame" Look

As before, most sets are designed with a "picture frame" appearance, with the front being taken up mainly by the screen, but with the problems associated with dual-standard models many sets have some, if not all, controls on the front—usually arranged down a side panel.

Some companies have gone out of their way to feature the housing as such, *vide* the 'Furniture Look" of Decca, the Scandinavian styling of

This Cossor receiver, model CT1972A, is available with a stand/magazine rack at extra cost.

TELEVISION RECEIVERS

Model		*Tube Size*	*Style**	*Price*	*Notes on cabinet, etc.*
BUSH	T125C	19	C	90 gns. (82 gns.)	African walnut, tambour doors, P.B. tuning, front controls, 10 x 6" speaker.
	T128C	23	C	107 gns. (99 gns.)	As T125C.
COSSOR	CT1972A	19	T	67 gns.	Medium sapele, front controls, 6 x 4" speaker, quick removal panels.
DECCA	DR101	19	CE	86 gns. (79 gns.)	Medium walnut finish.
	DR303	19	C	92 gns. (85 gns.)	Traditional styling. All models have
	DR505	23	CE	100 gns. (93 gns.)	10 x 6" speaker.
DYNATRON	TV72	23	C	135 gns.	Queen Anne style. 10 x 6" speaker.
	TV72CH	23	C	135 gns.	As TV72 but Chippendale style cabinet.
	TV71	19	C	129 gns.	Queen Anne cabinet with full length doors.
EKCO	TC421	23	C	98 gns.	African walnut with leathercloth tube surround. Double doors. Concealed castors. U.H.F. push buttons.
H.M.V.	2614	23		105 gns.	With v.h.f. radio.
K-B	WV20	19	T	71 gns.	Front controls, two 5 x 3" speakers.
	WV70	23	T	79 gns.	As above.

TELEVISION RECEIVERS CONT.

Model		Tube Size	Style*	Price	Notes on cabinet, etc.
MURPHY	V873C	23	C	107 gns. (99 gns.)	Two-tone French walnut, tambour doors, front controls, 10 x 6" speaker.
	V879C	19	C	86 gns. (82 gns.)	As above.
PAM	5111	19	T	67 gns. (60 gns.)	Sapele cabinet, front controls.
	5112	19	T	70 gns. (63 gns.)	Afrormosia cabinet, front controls.
	5114	23	T	81 gns. (74 gns.)	As 5112.
	5116/U	23	CE	101 gns.	Figured walnut, folding doors.
PETO SCOTT		19	T	72 gns. (66 gns.)	Medium sapele, front controls.
PHILIPS	9152	19	CE		Medium sapele, side controls. 6 x 4" speaker.
	9153	19	T	72 gns. (66 gns.)	Medium sapele with leathercloth padded front. Quick removal panels.
	9155	19	T	70 gns. (64 gns.)	Same as 9153 but different cabinet.
	9133	19	T	74 gns.	Sapele. Converted version of Model 9123.
	9148	19	T	69 gns.	Dual standard version of model 9142.

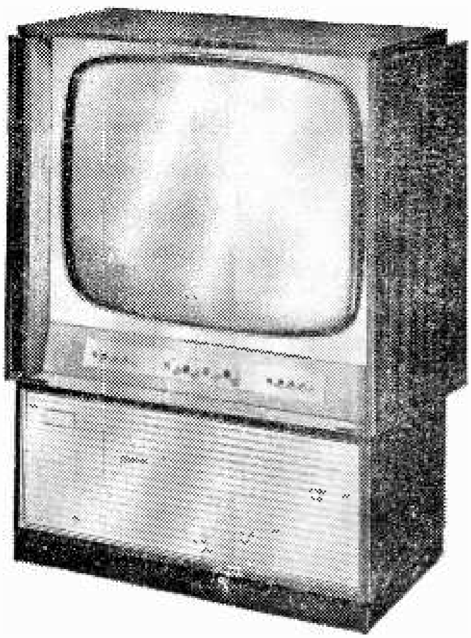
Ferranti, period styling by Dynatron, etc. In addition to the tambour doors of several makers (Bush, Murphy, Ekco, Pye, Ferranti, etc) more models are appearing with full length cabinet doors (e.g., Pam, Baird, Ekco, etc).

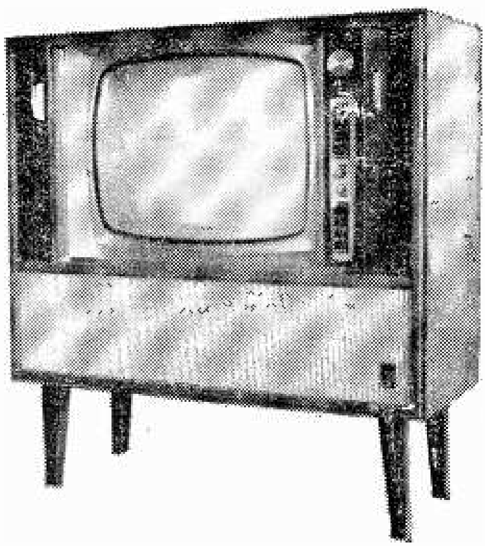
Better Sound

The quest for better sound reproduction is being pursued by many companies. Decca have one model with a 10in. x 6in. speaker in an acoustic chamber; Bush, Murphy and Dynatron have models with 10in. x 6in. speakers, the new Kolster-Brandes models have pairs of 5in. x 3in. speakers. There also seems to be a return to favour of sets with facilities to receive the Band II f.m. radio broadcasts—Sobell, H.M.V., Ultra showed examples. But the combined TV/radiogram seems to have had its day.

625 Lines?

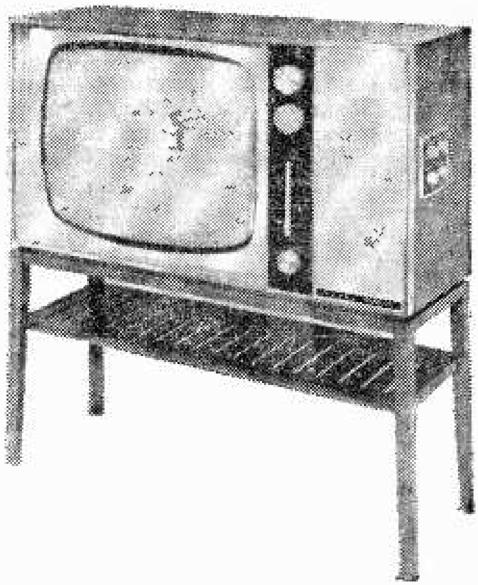
The main technical interest in the new sets revolves inevitably around the impending 625-line programmes. We are pleased to note that all the new models are either fully operational on 625 or





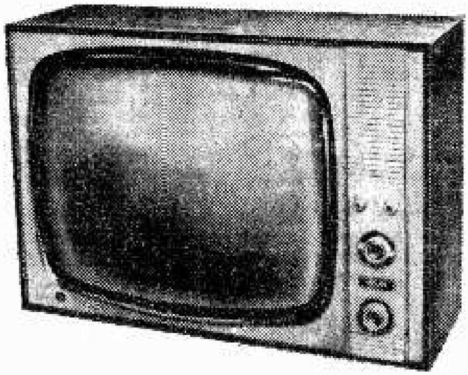
The receiver shown on the left is the Ekco TC421 console, and that shown above is the new Murphy V873C.

The photograph on the right shows one of the latest receivers from Ultra, the model 6622.



need only the addition of a u.h.f. tuner. Most models are offered with or without u.h.f. tuners but some companies (notably Dynatron, R.G.D. and K-B) will supply *all* their future receivers complete with u.h.f. tuner.

Most sets rely on manual tuning for u.h.f., with a long tuning scale—this and the tuning knob are located on the front of the set. Some, however, have incorporated push-button selection of u.h.f. channels (e.g., Ekco, Pye, Bush, Murphy, Ferranti).



This illustration is of the Pam 5114.

Few new technical features were noted, but, no doubt with a thoughtful eye on a possible repetition of last winter's load shedding, most of the new sets incorporate scan stabilisation to reduce the effects of mains voltage fluctuations. ■

TELEVISION RECEIVERS CONT.

Model		*Tube Size*	*Style**	*Price*	*Notes on cabinet, etc.*
PYE	Model 12	19	T	64½ gns. (57½ gns.)	Continental moulded wood finish.
	Model 14/U	23	CE	95 gns.	Dark sapele with walnut tambour doors. Front controls.
REGENTONE	198	19	T	70 gns. (63 gns.)	Sapele cabinet. 5" speaker.
	197	19	T	67 gns. (60 gns.)	As above.
	298	23	T	82 gns. (75 gns.)	As above.
R.G.D.	626/UHF	19	T	70 gns. (63 gns.)	Dark or light wood finish.
	627/UHF	19	T	66½ gns. (59½ gns.)	
	726/UHF	23	T	81 gns. (74 gns.)	
SOBELL	ST197	19	T		Paldao veneer. With v.h.f. radio facility. UHF controls on front, others at side.
STELLA	ST2149	19	T		Sapele cabinet. Front and side controls.
ULTRA	6622	19	CE	68 gns.	Front and side controls.
	6623	19	CE	71 gns.	With v.h.f. radio.
	6621	23	C	105 gns.	With v.h.f. radio.
	6611	23	C	102 gns.	

Notes: * T=table model; C=console; CE=consolette. Where two prices are quoted these are for versions with or without u.h.f. tuner. Where only one price is given, the receiver is supplied complete with u.h.f. tuner.

Many of the table models can be fitted with legs; in most cases these cost 2 gns. extra.

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

THIS month I would like to deal with some of the basic requirements for DX reception and to discuss what is probably the most important single item, the aerial. Let us start at the point where the signal reaches our particular location.

With a relatively strong sporadic E signal you will find you either get it or not—there are seldom any half measures about it. But with tropospheric reception the signal is often fairly steady, but infuriatingly weak, and it is for this type of signal that we really do require the very best aerial installation. It must have the highest possible forward gain, coupled with good directivity, in order to reject any unwanted local or near-local signals.

The aerial system must produce a sufficient signal input to the receiver in order to provide a good signal-to-noise ratio. Preamplifiers help a great deal, as do sensitive receivers, but increased gain here will only result in "snow" on the picture, so we must begin with a reasonable input signal. May I stress this most forcibly as failure to appreciate this will only lead to disappointing results on tropospheric signals. What must we do about it?

Firstly, forget the average domestic installations on the rooftops in the form of combined Band I/III aerials. These are "out" for tropospheric work because their overall gain is too low.

In Belgium, where I am writing this month's notes, many of the DX enthusiasts are bilingual and rely on their regular alternate programmes from three countries—France, Belgium and Holland (and in many cases from West Germany as well). To achieve this aerial installations are at least 50ft high in many cases; in fact the Belgian DX/TV "ace" with whom I have been staying has a 150ft pylon for his arrays.

This does not imply that it is necessary to erect miniature "Eiffel Towers" in our back gardens but merely stresses that the aerial must be as high as possible for tropospheric work. For reasonable success the minimum height should be 30ft and the aerial array should consist of not less than 11 elements in line or a double array.

Remember, too, that with high arrays the length of coaxial cable will be appreciable and the best low-loss cable available should be used to minimise feeder losses. Mast-head preamplifiers can be useful too.

The most interesting and successful tropospheric reception from the Continent is generally in Band III and most Continental TV services are horizontally polarised. Therefore the first objective is a good coverage over the whole of Band III with horizontal arrays.

Broad-band high-gain aerials are not easily obtainable commercially although constructional details will be given in a later article. An alternative is two separate 11-element arrays, one cut to channel B8 and the other to B11. These will give reasonable coverage over the entire band.

I also suggest one similar vertical array cut to centre-band channel B10 for use on more local British Isles stations. If regular reception is available a vertical aerial can be cut for the appropriate channel.

As a start for Band I a four-element aerial cut to channel B3 and mounted horizontally is suggested; alternatively two four-element arrays, one cut to channel B2 and the other to B5 to give reasonable coverage over the whole of Band I. A vertical channel B3 is useful for the British Isles.

When erecting the arrays suggested, as high as possible, arrange that each has a 5deg.-10deg. uplift, for in order to avail ourselves of their directional properties we must be able to point them in the direction required. There are three ways of doing this. One way is to arrange a large number of fixed arrays at various points of the compass, but although the installation might look impressive it is not an easy structural proposition.

The answer is to use the *minimum* number of arrays required and arrange to rotate them either by means of an electric motor or manually from ground level. This can be done by arranging that the guys are anchored to the mast by means of collars through which the mast passes and which permit its rotation. It is important to use enough guys. The arrays on top of the mast may not look very big but the projected surface area against which the wind blows may be considerable.

For Sporadic "E" very long distance reception, high-gain aerials are not generally required because the reflected sporadic signal can be of very high intensity, and because it reaches the aerial at a much steeper angle to the ground than the tropospheric one it will not be in line with the directors and reflector of the tropospheric four-element aerial at 5deg.-10deg. tilt. No matter! The signal will be picked up by the dipole only and the results will be quite successful.

NEWS ITEMS

(1) The mystery Polish station we have all been receiving on OIRT1 channel is Bydgoszcz 100kW. A tough one!

(2) Programmes received appear to confirm that Yugoslavia is now operating two stations in Band I channels E2 and E4 CCIR. Next month European TV standards, and receiver requirements.

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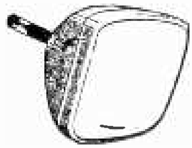

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PRINCIPLES AND PRACTICE OF COLOUR TELEVISION

PART 5

By G. J. KING

CONTINUED FROM PAGE 23 OF THE OCTOBER ISSUE

SO FAR in this series we have seen how the televised scene is analysed by the colour camera in terms of the three primary colours and how these three colours—red, green and blue—are integrated at the receiving end by virtue of the "red", "green" and "blue" signals from the camera to produce a picture in full colour.

We have also seen how the actual "painting" of the colour picture at the set end can be accomplished either by a tricolour picture tube or by the use of three separate tubes, each giving individual colour separation pictures, in conjunction with an optical system and a common viewing screen.

Luminance Signal

The luminance part of the colour picture is produced by the addition of the "red", "green" and "blue" picture signals in correct proportions. This, of course, is by the token that by adding red, green and blue lights in appropriate proportions white light is produced (see Part 1 in the July, 1963 issue). It follows, therefore, that by adding the signal voltages corresponding to the red, green and blue picture elements also in appropriate proportions we will secure a composite signal voltage equal to that which would be obtained by a monochrome ("mono" for short) camera "viewing" the same scene.

In other words, suitable addition of the red, green and blue signals gives a mono signal, even though a colour camera is employed at the studio end. The mono and luminance signals can, at this stage, be considered as one of the same thing.

In contemporary colour systems the mono signal is produced by the addition of the colour signals, but two main corrections are given to the signals before they are added. The corrections are for signal level and "gamma". Let us deal with gamma correction first.

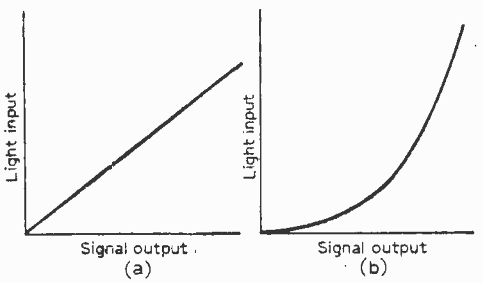


Fig. 21—To achieve a "natural" gamma or contrast expansion of the displayed picture, a colour television system must have a linear relationship between light input and signal output, as shown at (a). There exists in practice a non-linear relationship, the light input/signal output following a power law, as shown at (b).

Gamma

The term "gamma" has its origin in the world of photography and it refers essentially to the extent of "contrast expansion" of a picture—that is, the black/white ratio. To achieve a "natural" gamma or contrast expansion, a television camera system must have a linear relationship between light input and signal voltage output, as shown in Fig. 21(a).

Unfortunately, the relationship is not linear and in practice it follows a power law something like that shown in Fig. 21(b). This means that without gamma correction a mono picture would have stretched highlights and compressed dark or shadow areas. Correction is provided by feeding each colour signal from the camera tubes through an equalising network whose response is approximately equal to the mirror image of the curve in Fig. 21(b). The overall effect is to give a linear relationship, as at Fig. 21(a).

Gamma correction really applies to the mono signal of a colour television system, since each colour separation signal is corrected *before* it is added. This means that while almost perfect correction is applied to black and white pictures, there is still a little distortion colour-wise, but in practice it is not observed.

It is rather like using a photographic film which is not fully panchromatic to take pictures of highly coloured views. Most modern films are, of course, fully panchromatic, meaning that the correct gamma (black/white ratio) is maintained in black and white of a coloured scene.

The red, green and blue picture signals from the camera are usually signified as capitals R for red, G for green and B for blue. Now to reveal that these signals have been corrected for gamma, the R, G and B are followed by a small dash. Thus, we should know that R′, G′ and B′ signals have been corrected for gamma.

Level Correction

The colour television camera system features preset controls which allow the levels of the colour signals to be accurately adjusted for optimum colour rendering and luminance. At this stage we must realise that contemporary colour television systems are fully "compatible". This means (a) that a colour television transmission must be receivable in black and white on an ordinary mono receiver and (b) that a colour television receiver must give normal pictures in black and white from a mono transmission.

To make these things possible, therefore, it is essential that the colour camera system produces signals which can be arranged to be acceptable to both mono and colour sets. For mono sets, then, a proper mono or luminance signal must be created.

This is accomplished simply by adding the three primary colour signals after first having set their levels to produce a "compatible" mono signal. Let us go back to "square one" for a moment. In Part 1 of this series (Fig. 1) it was shown that white light is produced by adding lights of the three primary colours. To secure such a "white light" display the "brightness" of the individual primary colours need to be carefully adjusted.

Now, let it be supposed that extra special care was taken in adjusting the brightness of the three lights to give the purest possible white light, what would we see by looking at each coloured light separately? It would be immediately obvious that all the coloured lights do not appear equally bright. This means, then, that to produce white light each coloured light must have a specific number of "lumens" or a specific relative "luminosity".

There is really no need for us to become highly technical to understand "lumens", "luminosity" and "brightness". These things have been explained in Part 2 of this series (August, 1963 issue), and it may be as well to look them up again if mental continuity at this stage is difficult.

Response of Eye

The three carefully adjusted coloured lights do not appear equally bright because the response of the eye to colours is not uniform (see Fig, 12 in Part 2). We have seen that by adding the three primary colours in appropriate brightness we get our basic mono picture, but here it must be remembered that the various elements of the mono picture are viewed really in terms of relative luminosity.

We have also seen now that a true panchromatic picture is secured firstly by gamma correction, and this feature can be retained only as long as the colours remain added in their correct proportions not only for "white", but also for every other shade between white and black.

At this juncture we could easily get bogged down in a host of mathematical formula, but as this is a practical series on colour television we want to avoid mathematics as far as possible. With this in mind, then, we can say that by adding red, green and blue signals in the proportions of 30%, 59% and 11% respectively we secure a true mono signal.

Let us suppose, for example, that a colour camera is televising a pure white sheet, and we have some means for measuring the relative values of the red, green and blue signals from the corresponding camera tubes, we would find that they coincide fairly closely to the foregoing proportions to reproduce a pure white display at the receiving end of the chain. If the proportions are not accurate, then the reproduction, instead of being pure white, would be tinted with red, green or blue or some intermediate hue depending upon the exact nature of the signal unbalance.

These proportions indicate that the green separation picture appears almost twice as bright as the red separation picture, while the red separation picture appears about three times as bright as the blue separation picture.

If we were to employ a colour display device consisting of three separate colour tubes in an optical system to produce a pure white display as described, and it was possible to look at the screen of each tube separately, we should perceive the apparent relative brightnesses as detailed above. That is, of course, provided our eyes have characteristics reasonably close to those of the "standard eye". If we suffer from some colour defect, then the brightness ratios would probably appear differently.

Y′ Signal

When the colour signals are added in the above proportions we get the mono or luminance signal, signified by the capital letter Y′, with the dash again indicating that the signal is gamma corrected.

The Y′ signal is endowed with all the characteristics of the signal which is produced from the output of a mono television camera, and it is this which allows a colour television transmission to produce the picture in black and white on a mono set. If the colour separation signals were not resolved to mono, then compatability would be impossible.

The Y′ signal is thus equal to $0.3R' + 0.59G' + 0{\cdot}11B'$ (the signal proportions here being represented by decimal fractions rather than direct percentages). The Y′ signal also carries all the other characteristics of the mono signal, like frame and line sync pulses, front and back porches and so on which, of course, are essential if the signal is to work an ordinary mono set.

Colour Signals

So far, we have simply discovered how we can get the three signals from a colour television camera to work a mono set. We must now learn how these three signal (four, including the Y′ signal) are resolved to pure colour signals for introducing the colour information to a proper colour receiver.

If we were concerned only in transmitting colour pictures, and compatibility was not important, we could easily send three three colour signals either over three independently isolated circuits (closed-circuit arrangements) or as three sets of modulation on a common carrier. However, we must be concerned with the Y′ signal, but, unfortunately, there is no need for us to send three three colour signals (e.g., R′, G′ and B′) as well as the Y′ signal. Provided we send the Y′ signal, then we need send only *two* of the colour signals to eventually obtain the three colour signals at the receiver.

We must send three signals which contain known proportions of R′, G′ and B′. Thus, we could send Y′, G′ and B′, or Y′, G′ and R′ or Y′, R′ B′ etc. Y′, of course, contains full information on all the colour signals, so Y′ and any other two could be sent. In practice, however, so-called "colour-difference" signals are sent, since these make it easier to derive the true R′, G′ and B′ signal *voltages* for working the three guns of the colour display device at the receiver.

Colour Difference Signals

The colour-difference signals are obtained by subtracting the Y′ signal separately from the R′, B′ and G′ signals. The colour-difference signals for red, blue and green are then $R'-Y'$, $B'-Y'$ and $G'-Y'$ respectively. Any two of these, along with the Y′ signal, will give the three colour signals (e.g., R′, G′ and B′) by a system of decoding at the set end for working the tricolour picture tube.

The two difference signals chosen on contemporary colour television systems are R′−Y′ and B′−Y′. Simple algebra shows that the missing green colour-difference signal (G′−Y′) can easily be restored at the set end. Similarly, the original R′, G′ and B′ signals can be reproduced at the set end, by a process of decoding, simply by *adding* Y′ to the colour-difference signals. This is obvious, of course, since R′−Y′+Y′=R′. The red and blue colour-difference signals chosen for the NTSC colour television system are usually called chrominance signals (meaning quality of a colour, and spoken "chroma" for short).

The advantages of using colour-difference signals instead of the two colour signals direct are (i) that over the grey scale (e.g., from black to white) the signals are zero and (ii) they contain no luminance information at all since they are signals associated only with colour. If there is no colour in the televised scene, just grey, then there are no colour signals.

If two of the colour signals were used instead of colour-difference signals, colour channel signals would always be present, irrespective of the nature of the scene being televised.

In effect, then, we now have two channels in a colour television system, the luminance channel which gives the full mono characteristics of the signal *plus* the colour channel which gives *only* the chroma information.

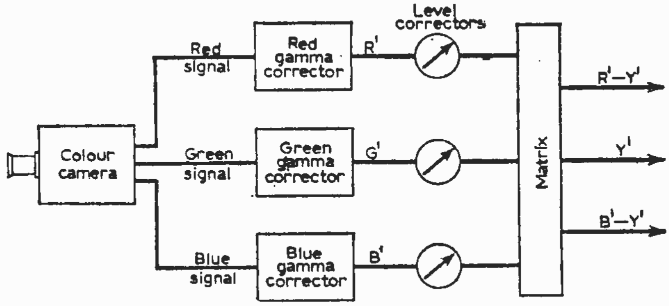


Fig. 22—The red, green and blue signals from the camera tubes are each corrected for gamma and level before being applied to the "matrix". The matrix is a network which adds the R′, G′ and B′ signals to form the "luminance" signal Y′ and which subtracts the Y′ signal separately from the R′ and B′ signals to form the "colour-difference" blue and red signals of B′-Y′ and R′-Y′ respectively.

The "dash" above the signal signifies that it is corrected for gamma and the signal levels are adjusted in the proportions of 30% red, 59% green and 11% blue on a mono scene. The Y′ signal is present on all televised scenes, but the colour difference signals appear only when there is colour in the scene. Over the greys from black to white, therefore, the colour output is zero.

Fig. 22 illustrates the factors that we have this month discussed; it should be understood that when we refer to R′, B′ and G′ colour signals, we are really considering signal voltages. To be theoretically correct we should write E_R', E_B', and E_G', instead of R′, B′ and G′ when we are talking about actual signals, the "E", of course, symbolising signal *voltage*. Provided we understand this, then there is no harm at all in omitting the "E".

PART 6 OF THIS SERIES WILL APPEAR NEXT MONTH

Co-channel Interference

—continued from page 56

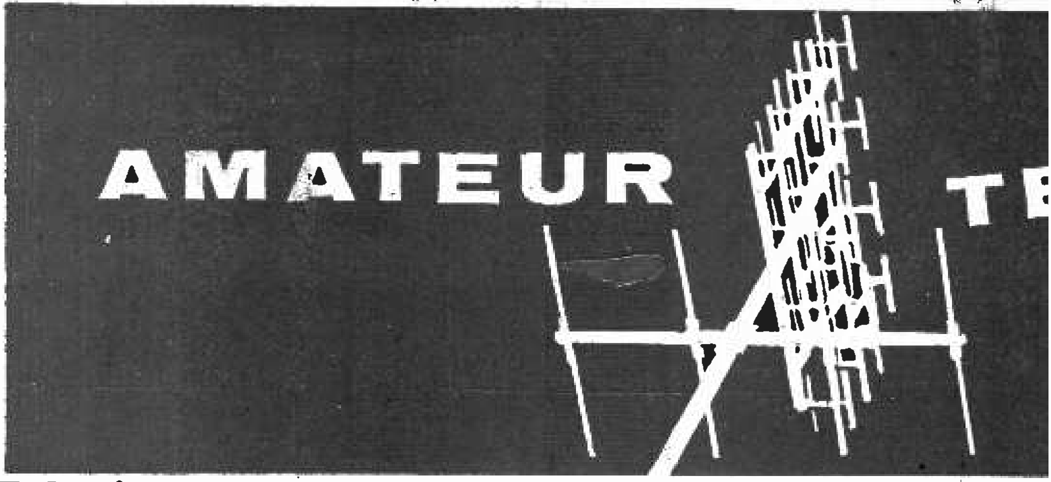
subject. This makes it clear that . . . "sharing of frequency channels is essential if full use is to be made of the limited number of channels available—the alternative would be drastically to reduce the number of television stations in this country and on the Continent, leaving large numbers of people with no television service at all".

The type of interference is explained . . . "it may take the form of regular horizontal bars moving up or down the receiver picture (Venetian blind) or it may form moire patterns (watered silk). There may also be interference on the sound channel".

The sheet goes on to say . . . "the interference does not affect all the television channels equally. It tends to be less intense on the higher frequency channels and it is, therefore, advisable in areas where there is a choice of reception between two or more BBC stations to tune to the one using the higher numbered channel."

After explaining that the directional properties of multielement aerials may be used to advantage to reduce the interference, the form goes on to say . . . "it is a matter of great concern to us (the BBC) that the reception of the BBC programmes is at times spoilt in this manner. Unfortunately, the interference is brought about by natural causes over which the viewer, the radio dealer and the broadcasting organisation have no control. The BBC, however, is building a number of additional stations, details of which are announced in the Press from time to time. Because these stations will have to share channels in television Band I, their power and range will be limited but they will provide local improvements in television reception in many of the areas where it is at present unsatisfactory and will help to reduce the effect of interference from foreign stations.".

Since the publication of this form many local booster stations have been put into operation up and down the country. Co-channel interference is, nevertheless, a great problem, and this is one of the reasons why America is contemplating pushing all of the television signals into the u.h.f. bands where tropospheric effects are far less troublesome. Conditions differ in this country from those in America, but we in this country have interference from relatively near Continental stations to consider, so there may be a case in the future to put all television in Great Britain into the u.h.f. channels, in line with the current American thought . . . !



Telecine • Mobile Operation • Slow Scan

THERE are two distinct spheres of activity in amateur television. These are the designing, building and operating of equipment for use firstly over closed circuit link or secondly for transmission by radio.

Closed circuit television, as the name implies, is not transmitted for general pick-up by television receivers, but sent by some form of cable (for example, coaxial cable) to the display television monitors. A Post Office transmitting licence is not required and there is no restriction on the subject material.

Amateur television signals, on the other hand, can only be transmitted by amateurs who hold a G.P.O. television transmission licence. The equipment used for transmitting is shown in block diagram form in Fig. 1. A closed circuit installation can be converted into a transmission system with the addition of a vision modulator, r.f. transmitter and aerial.

Reception of amateur TV transmissions does not require any extra licence if an ordinary domestic TV receiver licence is held. Fig. 2 shows a block diagram of the receiving system.

The block diagram of Fig. 1 requires further explanation and the function of the individual units is described in the following paragraphs.

Synchronising Pulse Generator (S.P.G.)

The most important part of a television system in the "sync" plus generator. The s.p.g. ensures that the scanning of both the camera tube and the television tube in the receiver are timed together or, in other words, synchronised.

Imagine an ordinary TV receiver receiving a picture where the line hold and the frame hold are not locked to the picture; line tearing and frame rolling will result and this is the effect that would be produced if synchronising were not provided.

The s.p.g. produces basically two sets of pulses, line sync pulses and frame (or field) sync pulses. The repetition rates of the two sets of pulses depends on the standards adopted by the country concerned. There are four major standards used in the world today. These are the 405, 525, 625 and 819 line systems respectively. The standard adopted by this country in 1936 was the 405-line system, although the new Band IV and V transmissions, when they begin, will use the Continental 625-line standard.

In the 405-line system the line sync pulse repetition frequency is 10,125c/s and the frame frequency is 50c/s. The interlace is achieved by a divider chain counting down from twice line frequency (ie. 20,250c/s) by 405 to 50c/s

$$\frac{20{,}250\text{c/s}}{405} = 50\text{c/s}$$

The first frame period will thus only have $202\frac{1}{2}$ lines

$$\frac{10{,}125\text{c/s}}{50\text{c/s}} = 202\tfrac{1}{2}$$

The remaining $202\frac{1}{2}$ lines to make up the full 405 are obtained on the second frame period, and these second $202\frac{1}{2}$ lines, because of the timing, will be interlaced with the first set. Thus a full picture with 405 lines requires two 50c/s frame periods, i.e. occurs every 25c/s.

The 405 divider chain is necessary in a generator producing interlaced syncronising pulse, and many amateurs build this type of generator. However a very much simplified s.p.g. can be designed without the divider chain to produce a system of 202 lines approximately, at 50 frames per second. This form of sync generation is often called random interlace, and is used by many amateurs and cheaper industrial closed circuit systems. The line frequency is approximately 10kc/s, and the frame is usually locked to the mains; the system will lock any television receiver that has been designed for 405 line system, but the vertical resolution is roughly half that of the true interlace picture.

Picture Monitors

Television amateurs in this country almost invariably use the British 405 line interlace or random system, so normal domestic TV receivers

LEVISION Transmitting

• Flying Spot Scanners • By B. W. Smith

may be used as picture monitors without complex modifications. The line and frame sync pulses are mixed to produce a single set of pulses called "mixed syncs". These "mixed sync" pulses are also mixed with the vision signal to produce the composite video: Fig. 3 shows a composite vision signal. The sync pulses are such that they do not interfere with the vision waveform except during the line and frame flyback times, when of course the vision should be "black", and black will not be seen anyway. The TV receiver or monitor has a sync separator which not only separates the sync waveform from the video, but also separates the line pulses from the frame pulses, so that they can be used to lock the appropriate time bases in the receiver.

The s.p.g. is also used to generate another set of pulses known as the suppression or blanking pulses. This mixed blanking consists of line blanking, having the same repetition rate as line sync, and frame blanking, the latter having repetition rate of 50c/s—the same as the frame sync. The blanking pulses are used for suppressing the line and frame flyback on camera tubes, TV tubes, etc., which would otherwise produce spurious effects on the final picture.

Fig. 3a shows a video waveform at line frequency. Note that the line blanking width is wider than the sync pulse and starts about 1·5μs before the line sync. This is called the front porch, but this is not necessary in simple amateur equipment. The trailing edge after the sync pulse is called the back porch. It is possible to use line sync as line blanking in amateur equipment for simplicity, without sacrificing too much picture quality.

Fig. 3b shows a video waveform at frame frequency from a random interlace s.p.g. The frame blanking pulse starts at the same time as the frame sync but finishes after the sync.

A very simple amateur sync pulse generator could use only six transistors. On the other hand, a complete interlace generator could use up to forty or more transistors, producing the better vertical resolution. Perhaps it would be as well to mention that the vertical resolution depends on the line standard, e.g. 819 interlace has about twice the resolution of 405 interlace. The horizontal resolution depends on the video bandwidth, for example a 3Mc/s bandwidth will have twice the resolution of a 1·5Mc/s video signal.

In broadcast TV stations and studios all pulse and vision signal amplitudes are carefully controlled and conform to recognised standards. This greatly facilitates the transmission of such signals to various pieces of equipment within the building by means of coaxial cable. Amateurs usually employ the same standards and this ensures that equipment loaned by several members for an exhibition, etc., will work together without any trouble.

These standards are in addition to pulse width standards, which are an integral part of the 405-line system, and are as follows:

All pulses, line, frame, mixed sync and mixed blanking; pulses to be negative and 2V peak-to-peak when terminated into 75Ω. Composite video: positive peak white, negative syncs (see Fig. 3) and 1V peak-to-peak when terminated into 75Ω, picture/sync ratio 70/30.

The Camera or Video Source

The vision signal itself can be generated by any one of the following methods:

1. CAMERA TUBE. The camera tube is the only practical device for converting live scenes into video signals. There are a variety of different types of camera tubes, the two most common being the vidicon and image orthicon.

The scene is focused onto the camera tube target by a suitable lens, and the tube electron beam scans the target, in a similar manner to the scanning of a cathode ray tube in a TV receiver. The tube video output, which will only be about 1 millivolt, is then amplified in a wideband amplifier (video amplifier), and mixed with the sync pulses to produce a composite video signal, which then feeds the distribution amplifier.

The vidicon camera tube is the type usually selected by the amateur because of its small size and simple operation. The lower grade of industrial vidicon tube is available to the amateur for about £10.

More ambitious amateurs use the image orthicons, which are very much more complicated and certainly not recommended for the novice. Three and a half inch image orthicons can be obtained for amateur use through the British Amateur Television Club at £25.

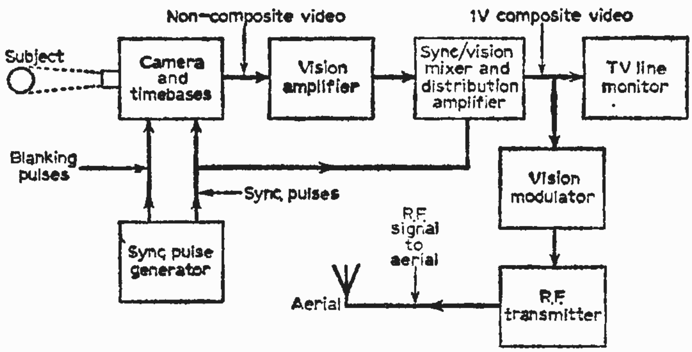


Fig. 1—A block diagram of equipment needed for TV transmissions.

2. FLYING SPOT SCANNER. With this method a c.r.t. is scanned in the conventional manner and produces a bright raster on its screen. A suitable photocell is positioned in front of the c.r.t. so that the light from the raster falls on to the sensitive target of the photocell. A lens or reflector is usually used to increase the illumination of the photocell by the c.r.t.

If a transparency of suitable size is placed on the front plate glass of the c.r.t., a video output can be obtained from the photocell, which, after amplification and processing in a video amplifier, can be used to display a picture of the transparency on a monitor.

Flying spot scanning can also be used to produce vision from cine film by means of a suitable lens-and-mechanical system, the whole mechanism being known as a telecine machine. Even today with the wide choice of camera tubes that can be used in telecine machines, flying spot scanners are still used and do give more pleasing pictures than the vidicon telecines.

Most amateurs make a flying spot scanner (F.S.S.) as their first piece of amateur television equipment, since the cost can be quite small. A suitable photo-electron multiplier is the 931A which costs about £2, and the scanner part is usually a television receiver modified for the job. A useful 35 mm slide scanner can be made by replacing the projection bulb with the photocell, and pointing the projector at the c.r.t. scanner. Excellent pictures are obtained by this method even from dense colour slides, in black and white only, of course.

3. MONOSCOPE. A monoscope tube is a similar device to a camera tube; however in place of the photo-sensitive target there is a specially engraved target, usually a test card. Light is not required to produce pictures from a monoscope and, as the name implies, only the picture on the target can be reproduced as video.

A monoscope is used where a test picture of known standards is required, and it needs only simple maintenance and setting up. Test card C monoscope tubes are available to amateurs through the BATC for about £5.

4. ELECTRONIC METHODS. Video can be generated by electronic methods, but these vision signals are not pictures such as are obtained by the previous methods described. However these waveforms are used for testing vision equipment, and can be very necessary even to the amateur. The following are a list of the more common wave-forms.

(a) Sawtooth: Picture over one line period increases progressively from black to peak white in a linear fashion, probably the most common waveform. This waveform is used to check amplifier linearity distortion. The BBC and the ITA quite often radiate this vision signal just before the opening caption is due.

(b) Pulse and Bars: Used to check frequency performance of equipment. The G.P.O. use this waveform for checking line performance; also radiated occasionally, by BBC and ITA.

(c) Grating: Equally spaced sets of vertical and horizontal bars or lines, used to check TV monitor frame and line scan linearity.

(d) Arc Bar or Cross: A black cross which is used to check amplifier l.f. response and picture streaking (which is usually due to poor l.f. response.) Another waveform sometimes used instead of the cross is the window, i.e. a black rectangle surrounded by a white border. There are of course many other waveforms used for checking equipment. The two most useful waveforms for the amateur are the sawtooth, and the grating.

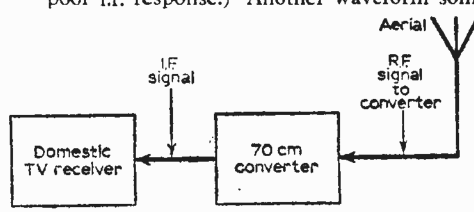


Fig. 2—Equipment for receiving amateur TV transmissions.

The Vision Amplifier

The output of a camera tube or other video source contains frequencies from d.c. to 3Mc/s or more. At first glance, there seems no reason to expect frequencies lower than the frame sync pulse repetition rate. Consider a picture of mainly peak white displayed correctly on a vision monitor; if the vision is now faded to black, the vision monitor screen should also fade to black. If the d.c. component of the video signal has however been lost by using r.c. coupling, the monitor may momentarily go black, but will brighten up to display a grey raster. This effect can sometimes

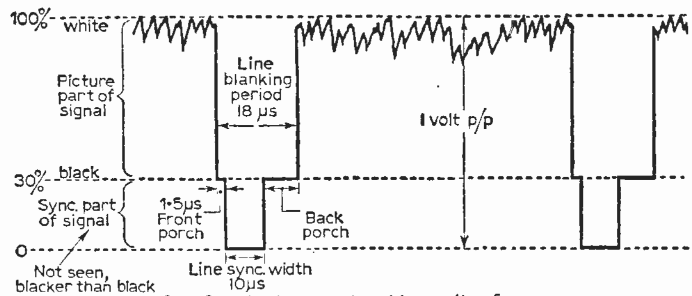


Fig. 3a—Standard composite video at line frequency.

be seen on BBC or ITA signals, depending on the TV receiver in use. Most modern TV sets do not have this black level response, due to the extra circuit complication when a.g.c. is used, and the effect described can be seen on these sets.

Since the camera vision output is at a low level, about 1 millivolt, amplification by a d.c. coupled amplifier would be very difficult. The vision amplifier is therefore a.c. coupled, and the d.c. level reinstated when required by use of a d.c. restorer or a more sophisticated circuit called a line clamp. The line clamp circuit can be used to clean up the vision signal quite considerably, by clamping out 50 or 100c/s hum and poor i.f. response which would have caused streaking.

Fig. 4 shows the effect of a fade from white to black through an a.c. coupled amplifier. Fig. 5 shows the same amplifier output after d.c. restoration or clamping.

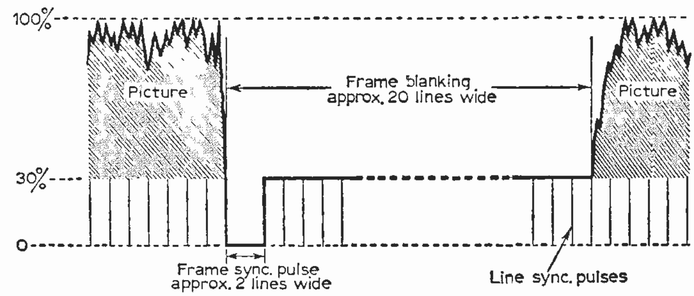


Fig. 3b—Composite video at frame frequency of a sequential or non-interlaced pulse generator.

Vision signals eventually have to be distributed to various places over lengths of cable up to several hundred yards. Low loss coaxial cable of 75Ω impedance is used to prevent r.f. radiation of the higher video frequencies. The coaxial cable must be terminated with 75Ω for correct performance, and this requires a special vision power amplifier with a 75Ω output impedance capable of providing a 1V video signal into 75Ω (1V is the normal level used for vision distribution.)

This amplifier is quite often called a vision distribution amplifier (v.d.a.) and may have several outputs, since each output coaxial cable requires a 75Ω drive.

Vision Monitor

A vision monitor is used to take a 1V feed of video from a coaxial line. This monitor is similar to a domestic TV receiver but without the r.f. and i.f. amplifiers; instead it has a video amplifier which will accept a standard 1V 75Ω feed.

Ordinary TV receivers can easily be adapted to work as a line monitor or normal TV, by the addition of one or two valves. If the TV receiver has an a.c./d.c. chassis as is the general rule, an isolating transformer will also be necessary to avoid disaster.

G.P.O. Regulations

The equipment so far described is for closed circuit use, and does not require a G.P.O. television transmission licence. However before transmission of TV pictures on any of the authorised bands can be contemplated, a G.P.O. amateur TV licence is required. So before proceeding further with the description of equipment, it is worthwhile to explain briefly some of the points relating to the issue of TV transmission licences.

Before a licence is granted, the applicant must have passed the Radio Amateurs Examination and be a British subject. The amateur TV licence costs £2 a year.

As in the case of amateur sound transmissions, amateur TV transmissions are limited to specific frequency bands. The lowest and most commonly used band for television transmission is the 70cm band, 425Mc/s to 445Mc/s wide. The TV amateur can use morse c.w. phone or vision modulation, either a.m. or f.m. Amplitude vision modulation is usually used in 70cm, but frequency modulation may be more useful on the higher frequencies when using klystrons.

There is a power limit on the transmissions. The d.c. power input to the p.a. stages in full modulation condition, e.g. peak white in a positive a.m. system, is limited to 150 watts.

All phone or c.w. transmissions must relate only to technical matter connected with the vision signal.

One point which is not very clear in the G.P.O. literature, is the question of sound transmissions with the vision signal. For a TV amateur who also holds a sound transmission licence there is no problem, the vision transmitter is operated with his TV call sign and the sound transmitter with his sound call sign. This point may be clarified in the future as the amateur TV licence conditions are under review.

The G.P.O. publish a useful pamphlet entitled "How to become a Radio Amateur", which can be obtained from the Radio Services Department, Radio Branch, General Post Office, London E.C.1.

The Transmitter

Returning to our consideration of the block diagram Fig. 1, it will be seen that the trans-

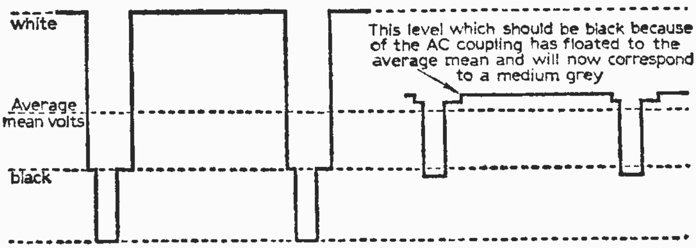


Fig. 4—A fade from white to black after a.c. coupling.

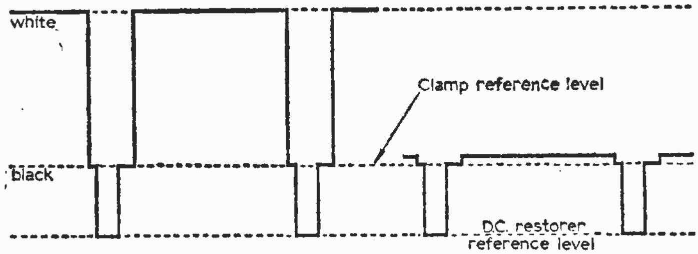


Fig. 5—Effect of either a line clamp or d.c. restorer on an a.c. coupled fade from white to black.

mitter is made up of two parts, the r.f. generation section, and the vision modulator. The 70cm band is generally used for transmission. There is no reason why the other u.h.f. and s.h.f. bands should not be used, although less orthodox circuit techniques become necessary at these higher frequencies.

For operation on 70cm, the r.f. carrier is generated in the same manner as an a.m. phone transmitter. A crystal controlled oscillator is preferable so that the transmission will then be stable on a known frequency, causing least interference to other users of the band. It should be explained that the 70cm band is a shared band on a non-interference basis, that means that amateurs share the band with other users, and must not cause interference to such.

There are a large selection of valves suitable for transmitter operation on 70cm, ranging from the 6I6 which will deliver about 1W of r.f., to the 4X150A which can be run to the full 150W maximum permitted. The vision modulator works on the same principle as a sound modulator, but of course, modulation transformers cannot be used for vision. In the British system, the video frequency extends from d.c. to 3Mc/s, as has already been mentioned. The modulation amplifier will use normal r.c. coupling, but the d.c. must be restored by a d.c. restorer or a line clamp before the r.f. power output stage is modulated. The modulator will normally take coaxial line feed of 1V composite video and will be required to provide a 100V coaxial, or so, peak-to-peak output.

There are various methods of amplitude modulating an r.f. stage; these are anode, screen grid, grid or combinations of these. Grid modulation is very popular because very little modulation power is required. However it is a little tricky to set up, and a sawtooth video source is certainly needed so that linear modulation can be achieved. Screen grid modulation is fairly straight-forward, but needs more modulator power than grid modulation. Anode modulation can usually only be used on the lower power r.f. valves, because of the excessive video power requirements. The r.f. output from the transmitter is then fed to the aerial through low loss coaxial cable.

Location plays a most important part in the transmission and reception of u.h.f. signals, and in general the greater the altitude the better the results. However, another important effect at these high frequencies is local screening, this can be reduced to a minimum by careful siting of the aerial; for example an aerial which clears surrounding rooftops will give superior performance to one that does not.

The Aerial

The aerial itself is usually a multi-element type and such will have a high gain over a simple dipole. A half wave dipole aerial at 70cm is only 12in. long. Unfortunately high gain aerials tend to have narrow beamwidths, necessitating a rotational system to turn the aerial into the required direction. The effective radiated power (e.r.p.) of an amateur station can be very high, for example using a transmitter that delivers 50W peak white r.f. into an aerial of 16dB gain gives an e.r.p. of 2kW.

A sound transmission simultaneous with the vision is certainly worth having, but this needs a phone transmitter of lower power and probably another 70cm aerial, unless a displexer is used. If the sound and vision transmissions are to be received on a domestic TV receiver, the sound transmitter will be the lower frequency transmission, separated by the standard 3·5Mc/s, used for the 405-line system, from the vision carrier.

The Amateur Television Receiver

The receiver used by the amateur normally is a domestic receiver, which has been selected for good line and frame lock even on weak signals, and with plenty of r.f. and i.f. gain. A convertor is used ahead of this receiver, converting the 70cm signal to a Band 1 channel not in use by the BBC in that particular district; e.g. for an amateur in the London area where the BBC transmits on channel 1, channel 3 or 4 would be used for the convertor output. The convertor will need a high gain rotatable aerial similar to the transmitter aerial; usually one aerial combines both functions.

Distances covered by amateur TV signals can be considerable, but depend on the signal path over which the transmission passes, and for long distances the current propagation conditions are all important.

The reader by now is probably bewildered by the amount of equipment that is required to build an amateur television station; however the novice can make a simple start, and gain experience by constructing the television receiving equipment first. A great deal of pleasure can be derived from the construction and operation of a simple convertor for the domestic TV enabling amateur 70cm transmissions to be received. There are over 100 licensed television operators in this country, and the 70cm band is also well populated with "sound only" amateurs.

The British Amateur Television Club (B.A.T.C.) caters for the amateur needs, and publishes a quarterly magazine called CQ—TV which covers technical topics, news of amateur television activities, and other items of amateur interest. Membership of the B.A.T.C. is certainly desirable, enabling the enthusiast to meet fellow enthusiasts.

A Hobby With Many Facets

The scope available in amateur television is so vast that even persons with widely diverse interests can find satisfaction in participating in one or more facets of the hobby. Obviously a great deal of the work involved will be the design and construction of the electronic equipment; however this is certainly not the full story, since operation and production with all their associated problems also form a part of amateur TV. In the following paragraphs, I hope to whet your appetites with a brief description of some of the various aspects of amateur television as a hobby.

A very controversial subject in television these days is colour television. In this field the amateurs are not lagging, several in fact have their own colour cameras and associated equipment. The first amateur television colour transmissions took place several years ago on the 70cm band, this was a combined effort using equipment constructed by several amateurs.

The BBC radiate colour test signals on Band V on two channels, 34 and 44, using different colour standards. Needless to say there are now many amateur colour receivers receiving these pictures.

The equipment for colour TV picture generation can be rather expensive for the amateur, although a flying spot slide scanner system could give very good results and still be comparatively cheap.

Where several licensed TV operators are situated in the same area, television "nets" can be established where one TV signal can be received and retransmitted several times, covering long distances with short inter-station hops of 10 to 30 miles. Probably the ultimate on the transmission aspect is the transmission of sound and vision, while at the same time receiving the sound and vision from the amateur with whom contact has been established. This is the true video telephone so often prophesied for the future which has been accomplished by a few amateur TV operators now.

LANDMARKS IN THE HISTORY OF AMATEUR TV TRANSMITTING

1950 The first public demonstration of amateur TV in the United Kingdom given at Shefford by G2DUS/T.
1951 The G.P.O. agree to issue amateur TV licences.
1952 The first two-way TV contact in the world—G5ZT/T and G3BLV/T.
1953 The first amateur colour pictures.
1961 Slow scan pictures transmitted from WA2BCW near New York to G3AST in Yeovil.
1962 Two-way TV contact over 200 mile path — G3NOX/T and G3ILD/T.

Public Participation in CCTV

The general public never seem to tire of watching themselves on a closed circuit TV system or watching the camera operators and the equipment; because of this, organisers of carnivals, exhibitions, and other suchlike events often approach the local amateur TV or radio club asking for support of the function. Television amateurs as a rule are usually only too pleased to take part in these events since they provide unique opportunities for extravagant set ups. By pooling equipment a complete studio can be set up with say three cameras, a telecine channel, lights, sound, etc., complete even to a producer. Some of the events can be similar to an O.B. (Outside Broadcast) installation, with cameras situated in strategic positions, a control room with producer, and monitors in the beer tents, etc., for the public viewing. Having an appreciative audience at this type of function can make all the hard work involved in the preparation of the equipment worthwhile.

Amateur Roving Eye

The BBC roving eye TV camera is very well known, and there is no reason why the amateur cannot have a mobile TV camera and transmitter in a car or van. Special G.P.O. permission is required for using a transmission of this sort.

The first success achieved in the amateur field was by a group of amateurs in Cambridge a few years ago, who used an old London taxi called "Matilda". The camera was mounted on the roof, complete with operator. This vehicle appeared on the BBC television programme "Panorama", where pictures taken by the amateur camera were transmitted by the BBC.

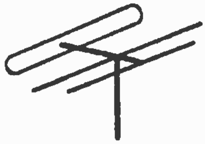
There have been other amateur roving eyes since "Matilda", but transmission on the move generally can only take place over about one mile, depending on the number of obstructions to the r.f. signals. However, for the amateur with a poor location, such a transmitter would be ideal, it only being necessary to drive to the top of a local hill for excellent transmission and reception.

Slow Scan TV

One aspect of television which is perhaps a field of its own is slow scan TV. This is basically similar to normal television but as the name implies, the scanning rate is very slow. The line scan is at 25 c/s and with 120 lines per picture the frame scan is 1 per 5 seconds. Only still shots can be transmitted in this way, but because of the much lower information rate the signal occupies a very small bandwidth and can be recorded on tape for playback at a later date.

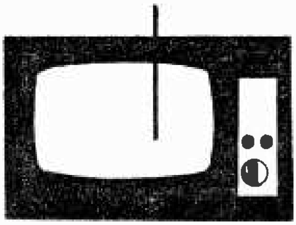
As can be seen from the very brief resumé of amateur TV progress today, the scope of experimentation is almost unlimited. The equipment may use valves exclusively or may be completely transistorised, or perhaps a hybrid. Whatever form the equipment takes, one thing is certain, the sight of the first television pictures from one's own equipment will never be forgotten and makes the effort so worthwhile.

Next month we shall describe the construction of a 70cm convertor and a simple 16-element stack aerial. This equipment used in conjunction with a standard TV broadcast receiver will provide reception on this popular amateur band.



A MONTHLY COMMENTARY

Underneath the Dipole



BY ICONOS

THERE is a nostalgic charm about old automobiles and old locomotives. I am beginning to think that there might be the same magic in some of the real old television sets. The car fetish started with the "Old Crocks" on the annual Brighton run, a name now angrily rejected by owners of "veteran" motor cars, which has been followed by the proud owners of well-polished "vintage" cars of the nineteen-twenties: Bugattis, Bentleys, Frazer-Nash, etc.

Veteran TV Sets

What would constitute a "veteran" or "vintage" TV set? If one takes the hocus-pocus of the old automobile craze as a precedent, then the set must be capable of working, must be unmodified with modern gimmicks and must be capable of reproducing a 405-line picture for, say, an hour without breaking down. This rules out the early low definition mechanical contrivances of Baird, though there were a number of mechanical scanning sets which could cope with 405 lines, made by Scophony in 1936. It would be interesting to see a 1963 picture projected on one of these equipments. I say "projected" because the system was fundamentally a big-screen projection equipment which made use of an arc lamp. The light beam was modulated with a Kerr cell, and the flywheel effect of the mirror drum gave occasional bouncing effects, rather like some of the modern sets with electronic flywheel circuits, when reproducing pictures that are transmitted from video tape. Anyway, I thought that those Scophony pictures looked wonderful at that time, reproducing pictures sent out from the BBC's transmitter at the Alexandra Palace, which were originated on the first Emitron cameras.

Vintage TV Sets

If mechanical scanning sets are veterans, what constitutes a "vintage" set? I would think that the early long-tube sets with electrostatic controls, particularly those with vertically placed cathode ray tubes, which were viewed via a mirror. Early magnetically focused tubes also came into this category, and there must be a large number of these which are still giving very good pictures. All of these early sets had full d.c. restoration circuits, and were capable of reproducing very good, but not bright, pictures, which had a reasonably good grey scale and blacks were truly black. It was then accepted practice to lower or extinguish the lights in a room before settling down to viewing, so the dimness was not apparent. Vintage sets, I would say, could be selected from a fairly wide range of sets manufactured up to, say, 1958. There are certainly a few long-tube consoles of that year, with excellent sound reproduction on forward-facing, man-size loudspeakers, with d.c. restoration, spot-wobble and other refinements, which would put most of the modern slim-line, a.g.c. sets of today to shame. Vintage and veteran car enthusiasts call modern mass-produced cars "heaps". Is your television set a "heap"?

Standards Conversion

The change-over from 405 to 625 lines has brought with it many knotty problems, especially as the present 405-line transmissions will continue for some years. This means that whatever the origin of the picture-studio, outside broadcasts, tape or telecine—it will be simultaneously broadcast on the two line standards. Up to now, conversion from one standard to the other has been accomplished by reproducing the original picture on a high-quality monitor tube, in front of which is placed a television camera operating on the different line standard. The Eurovision and Telstar transmsisions have been mainly carried out by this method. Though these transmissions have been acceptable, nobody has claimed that the final result was technically excellent. Some of them, in fact, have been terrible; but the importance or topical interest of the subject matter has justified the means of carrying out a very difficult and complicated operation. Something had to be done about improving standards conversion, and the BBC have done it.

The Research Department of the BBC have tackled the problem from an entirely different angle. The old method relied upon a whole chain of contrast factors in camera, lens, tube, video tape (if used), transmission circuits, monitor, second-standard camera and camera tube—and again to transmission circuits. Every single link in this long electronic chain had to have a "spot-on" adjustment, and any errors multiplied enormously. The new BBC method entirely avoids the "re-photographing" technique. The 405-line picture structure information is detected, examined and the information translated into 625-line equivalents by computer methods. Full technical information is not yet available, but the preliminary demonstrations have shown conclusively that this computor transfer system is a big advance on anything previously seen. There have been rumours floating around the television industry for some time that the BBC hoped to achieve a break through on this problem, and that they had reached a point where a small section of a picture has been successfully standards converted. But the first demonstrations of complete picture conversion on the system came much earlier than anticipated. The BBC are to be congratulated. Viewers with sets that cannot be converted to 625 lines can rest assured that they will continue to receive a good picture, even if the studio from whence it came has changed to 625 lines.

"The Bargee"

There are many television directors and producers who started their working life in film studios as assistant directors, cameramen, directors or even producers. The boot is now beginning to be transferred to the other foot. A few television directors and technicians are now trying their hand at feature films for the cinemas. Probably the most important capture by the British film producers to-date is the signing up by A.B.P.C. Studios of the top-line script writers, Galton and Simpson, television director Duncan Wood, and actor Harry H. Corbett for a comedy called "The Bargee".

Set in and around the canals of England, it will give plenty of scope for the fruity situations which made the same team's "Steptoe and Son" so memorable. Galton and Simpson's names stand high with viewers for their fine scripting of "Comedy Playhouse" series, "Hancock's Half Hour" and many other top-line TV programmes. Others in the film, also well known on TV, are Miriam ("Everybody Out") Karlin, Eric Sykes, Eric Barker, and Hugh Griffith.

"Gurney Slade"

Time flies! It must be getting on for three years ago that we first saw the A.T.V. series, "The Strange World of Gurney Slade", an unusual mixture of off-beat ideas by Dick Hills and Sidney Green. Centralised around the equally off-beat type of performance we have come to expect from Anthony Newley, it seemed to indicate new trends in situation comedy. The fact that it did not quite catch popular taste at that time in no way detracted from its importance—especially if introspective fantasy develops as a form of comedy entertainment. Some viewers liked it enormously—and many were bored. I thought then that it just missed being first-rate, being too slow and repetitive for my taste. Since then, the stage play and the film "Billy Liar" have been seen, in which the principal part was brilliantly played by Albert Finney and Tom Courtenay respectively. Billy Liar is an ordinary young man whose vivid imagination transports him (and the audience) to his dream-world of heroics and high drama. In a sense, it is a development of the "Gurney Slade" idea, with a story line added, and both subjects are along the lines of Danny Kaye's "The Secret Life of Walter Mitty" film.

It was, therefore, doubly interesting to see "The Strange World of Gurney Slade" again. Though I usually like Anthony Newley shows, I regret to say that I now find "Gurney Slade" a painfully slow and somewhat self-consciously precious character, entirely lacking the robust attack of "Billy Liar", or the full-blooded dash of Newley's own "The Small World of Sammy Lee". It only goes to show that a dramatic or comedy television series cannot survive on an idea alone—it must have shape, a climax, an ending, and, most of all, a story.

Conversion to 625 lines

The penny is beginning to drop with viewers that if they want to view 625-line standard pictures, they will have to spend money on additional bits-and-pieces, including a new aerial. Many had thought that having purchased a set which was said to be convertible to 625 lines, that was the end of it—that they merely had to wait for the 625-line service to start, and then to switch on. Having got over the shock that more money has to be spent, however, it won't take them long to appreciate the additional lines (or rather their apparent absence from the picture!). I hope that when the radio industry settles down after the 625-line upheaval, they will pay a little more attention to the sound side of their receivers.

Compared with recent importations of sound receivers from the U.S.A. and Japan, the sound side of the average British mass-produced television receiver of today shows up badly. In several other parts of the world, hi-fi sound and stereophony are commonplace. Really good stereophonic reproduction heard under the right acoustic conditions is quite exciting, and sets are made in both the U.S.A. and Japan, which incorporate every modern refinement of hi-fi and f.m. radiogram, with provision for tape recorder, in addition to 23in. television.

After Dinner Speeches

We now approach the season of after-dinner speeches in the TV programmes; live, videotaped or filmed for the television newreels. It's a chancy business this post-prandial chatter, with port and brandy circulating and the participants trying to remember the "impromptu" remarks they intend to make! At their best, they are highly entertaining—and one remembers the good natured banter of Tommy Trinder and the thoughtful wit and wisdom of the late Lord Birkett. I wonder if there is any truth in the rumour that the BBC are considering a TV broadcast of the Vaudeville Golfing Society Dinner, an occasion when various personalities of show business let their hair down and pull one another's legs unmercifully. Insults fly around in salvoes. The air is blue with cigar smoke, and stories that would not be suitable for Aunt Edna.

SERVICING TELEVISION RECEIVERS

By L. Lawry-Johns

No. 95: PHILCO 1,000

A TYPICAL fault which may be expected is delayed fuse failure. Quite often the complaint is that fuse fails only after the set has been switched on for a minute or so, the sound coming through quite normally before the set goes dead with a blown fuse. Observation may show that a moment before the fuse fails, the PY32 heater lights extremely brightly.

Normally the PY32 is not responsible for this condition and it is the PY81 efficiency diode which should be replaced. The explanation is that the PY81 developes a heater-cathode short when it reaches operating temperature. As its construction is such that the cathode is slow to warm up, the delay period allows normal working until the line timebase starts to function, whereupon the high voltage then appearing at the PY81 cathode breaks down the insulation causing heavy heater current through the PY32.

A PY32 which is failing normally, that is, losing emission, produces symptoms of a small picture, insufficient to fill the screen although the controls may be at their maximum. The sides (width) and bottom of the picture, being cramped are usually affected first.

When the PY32 is Not Guilty

When the picture is lacking in width but the height is not affected or indeed may even appear to be elongated, attention should be directed not so much to the PY32 as to the line timebase valves PL81 and ECC82.

The PY81 is not so often at fault but should be checked to be sure. R73 (1·8kΩ) should also be checked when the PL81 is found to be of low emission as this resistor affects the life of the valve as it *falls* in value.

These faults also give rise to the symptoms of large variations of picture size as the brilliance varies due to the EY86 being under-run to a point where the brilliance (or contrast) has a critical point at either side of which a picture is unobtainable.

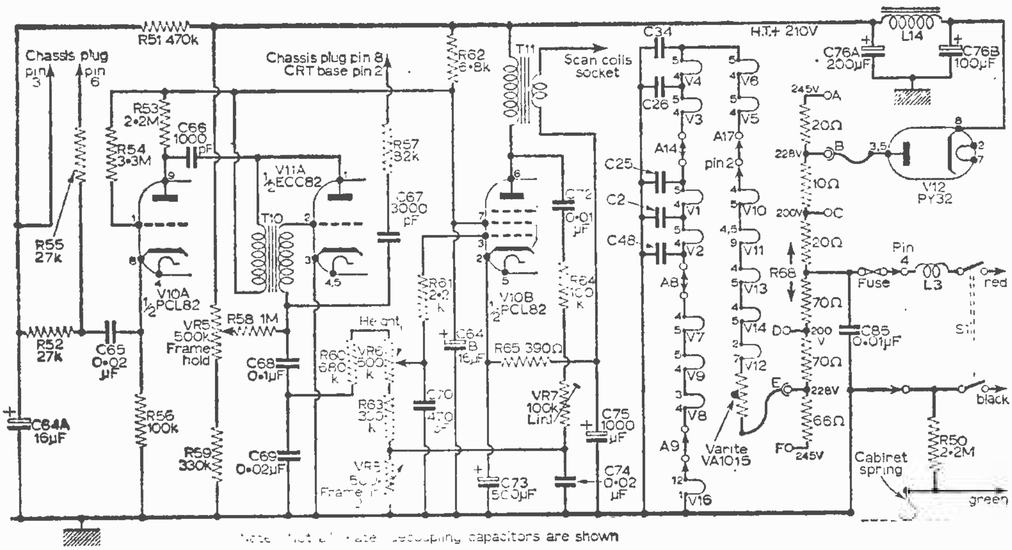


Fig. 4—The frame timebase and power supplies.

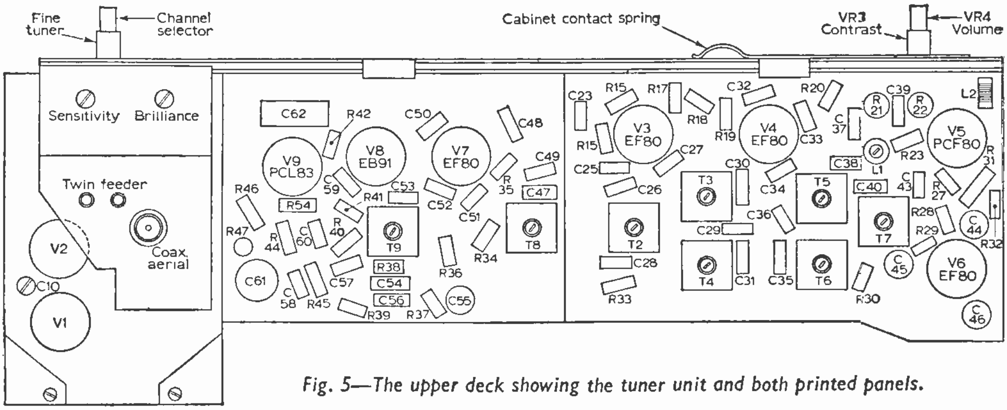


Fig. 5—The upper deck showing the tuner unit and both printed panels.

If close examination of a dark picture shows no lack of width, the EY86 should be changed before checking V13 and V11.

Lack of Height

If the width is adequate and the brilliance quite controllable but the height is not satisfactory, attention should be directed to V10 (PCL82) if the bottom is more seriously affected than the top. R65 (390Ω) C73, C75 and C64B should also be checked. Reset VR7 and VR8 as necessary to regain even scanning over the whole screen area with VR6 set to bring the edges within the mask. Reset VR6 when the other controls and the picture shift have been properly adjusted.

If, however, the lack of height is even top and bottom, it is R60 (680kΩ) which should receive attention. This is in series with the height control and necessarily affects the overall height.

Frame Hold

If the hold is erratic, check V10 and V11, also R53 and R54 (2·2MΩ and 3·3MΩ). If the hold is at the end of its travel and V11 is not at fault, check R58 (1MΩ) which sometimes "goes high".

Line Hold

Here too the ECC82 (V11) is to be suspected if the hold control requires constant adjustment, but if

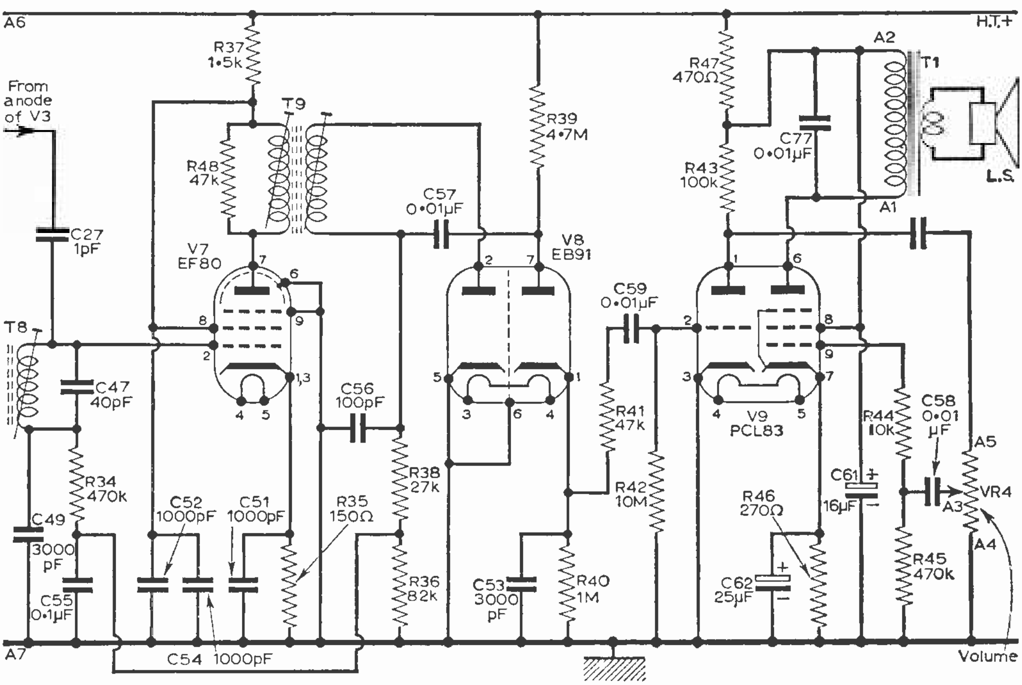


Fig. 6—The audio stages.

a new valve does not help matters it is essential to check R69 (120kΩ), R70 (160kΩ) and the control itself VR9 (100kΩ) which is capable of surprising variation.

No Sound

Usually when the picture is present but no trace of sound is evident one need look no further than the PCL83 (V9), and sometimes a sharp tap on the envelope of this valve will give evidence of its guilt.

There are of course times when V9 is quite up to standard and a certain background noise from the loudspeaker shows the audio stage to be in order. It is then necessary to check V7 and V8 and the supply to V7 through R37. This resistor may be found burned out and if this is so a close check should be made on C52 and C54 (0·001μF), V7 itself and the insulation inside T9. If there is a positive voltage at pin 2 of V7, check the insulation of C27 (1pF) and C57 (0·01μF).

Distorted Sound

If the sound distortion is constant at all levels of contrast and sensitivity, check V9 PCL83. If the distortion is severe on strong signals but tends to clear on weak, check R39 (4·7MΩ). Also check R43 if necessary.

Sound In Order: No Picture

Advance the brilliance control (next to sensitivity at the rear left side) and note whether there is any illumination or raster lines on the screen.

If there is no raster at all, and no whistle audible check the line timebase valves V11 and V13. If there is a whistle but the EY86 does not light up, check this valve. If there is a good whistle and the EY86 is glowing normally, check the position of the ion trap magnet on the rear of the tube neck and the tube base voltages.

If there is a raster but no modulation or signals, check V5, V4 and V3 although the latter is also common to the sound and cannot be too far gone if the sound is normal. Therefore a quick check of the valves and the supplies to V4 (via R20 decoupled by C33 and C36) and V5, noting the condition of R21 and R23, should reveal the cause of the trouble; but if these stages seem in order check X1 (GD12).

No Sound or Vision Signals

With the raster showing when the brilliance is advanced and a satisfactory background hum from the loudspeaker is present, attention should be concentrated on the tuner unit, checking valves by replacement (PCF80 top, PCC84 lower) and of course the aerial input, sensitivity setting etc. Also check V3 and again the supply resistor R17, decoupling by C24 and C29.

If the valves are in order and all seems well on the outside and there is some evidence of life as the turret is rotated, with perhaps weak sound from a strong signal, check the 6·8kΩ PCF80 triode load resistor inside the tuner near the front, which can and does go " high " in value. It must be replaced by a similar sized resistor in the same position to avoid detuning effects.

Control Knobs

It is rarely necessary to remove the top knobs as even the oscillator coil cores can be adjusted through the holes in the fine tuner (2 o'clock position) with a fine trimming tool. They can however be pulled off, if necessary eased up by a screwdriver inserted from the rear as the springs are a tight fit. ■

CIRCUIT PRACTICE AND DESIGN PRINCIPLES FOR

OSCILLOSCOPE TIMEBASES

BY
M. L. MICHAELIS

CONTINUED FROM PAGE 45 OF THE OCTOBER ISSUE.

THE Sanatron is very easily converted to trigger operation by taking the Miller suppressor to a d.c. negative bias sufficient for resting cut-off. The circuit then rests with the triode conducting and the Miller cut-off; a train of negative triggers to the triode grid will cause the usual flip-flop response pulse during which the Miller operates. A simple bias switch on the suppressor, as shown, can select trigger or synchronised operation at will. Sync pulses required will be negative at the triode grid or positive at the Miller suppressor.

When using trigger operation it is essential to bias-off the c.r.t. when the Miller is not running to avoid the brilliant spot at the left end of the trace when the circuit is waiting for a trigger. As this waiting time is vastly greater than the running time when viewing transients with trigger operation the intensity of the waiting spot would be enormous in comparison to the useful trace. The cathode-ray tube is thus normally biased beyond cut-off and is lifted to the desired degree of cut-on by a positive squarewave pulse applied to its grid during the Miller run. This "bright-up pulse" must be d.c. clamped in such a fashion that the positive peak is clamped to the potential selected on the brilliance control. Suitable points in the Sanatron yielding a bright-up squarewave are the screen of the Miller and the anode of the left-hand triode.

When the Miller is cut off at the suppressor all cathode current goes to the screen, so that this is resting at low voltage. When the Miller runs, anode current is drawn, so that the screen current is low, also because of the Miller step, thus the screen voltage is much higher during the run. The result is a squarewave of positive polarity at the screen, coincident with the duration of the Miller run, as required for bright-up purposes. The left-hand triode is cut off during the Miller run, thus the anode voltage has risen for the duration of the run. The quality of a bright-up squarewave from this position is particularly good if a pentode in the electron-coupled arrangement of Fig. 9(a) is employed here in place of a triode.

The Miller-Transitron

The Miller-Transitron is a most popular one-valve arrangement supplying its own relaxation drive, i.e. capable of free oscillation without external assistance. It is the only known one-valve free-running linear sawtooth oscillator and is very common indeed in small oscilloscopes having only sync facilities. The circuit is not satisfactory for trigger operation without auxiliary circuitry representing no improvement over a Sanatron, yet under free-running or synchronised conditions it is exceptionally stable. Performance is remarkably uncritical as far as layout is concerned, even at high frequencies of up to 30kc/s, where quite tiny Miller capacitors (around 100pF) are required. For even higher frequencies, of course, layout becomes critical. At normal frequencies the arrangement is virtually foolproof.

Anode, grid and cathode are used as the Miller triode and by using a pentode valve and employing multivibrator coupling between screen and suppressor the same single valve provides its own positive relaxation squarewave drive. This as present at the screen may be used for bright-up of the c.r.t., but it is advisable to shape it before application, as described and exemplified in the recent publication of the "Auditron" in PRACTICAL WIRELESS.

Fig. 14(a) shows the basic Miller-Transitron timebase and the detailed action of the circuit is as follows: Consider the end of a typical Miller run of the Miller section of the circuit when the anode voltage has just bottomed and thus the grid has no further control over the anode current. The grid voltage can then rise suddenly, as there is no further change at the anode to be fed back to check it. As the anode is bottomed, however, it is already drawing maximum possible current, so that the increased cathode current brought about by the sharp grid rise after anode bottoming must go to the *screen* entirely. This causes a sharp drop of voltage across the screen resistor, which is coupled via C2 to the suppressor, driving the suppressor well beyond anode current cut-off. The anode current is thereby diverted entirely to the screen, giving a further drop of voltage across the screen resistor, coupled in turn to the suppressor, assisting the suppressor cut-off by the usual cumulative multivibrator process.

The new condition with heavy screen current and cut-off anode current persists until the suppressor has recovered to cut-on on the time constant of C2 and the suppressor leak resistor to chassis. As soon as the suppressor reaches anode current cut-on a small portion of current is drawn away from the screen to the anode, so that a voltage rise at the screen is produced, which is coupled via C2 to assist the rapid re-establishment of full cut-on at the suppressor by the usual multivibrator action. The valve is then "open" again for a new Miller run after the fashion already familiar from the basic Miller circuit.

It is clear that this arrangement combines a multivibrator operating merely on the screen and suppressor electrodes of the same pentode in which the remaining electrodes are used as a basic Miller-Integrator. This gives an extremely simple yet highly efficient free-running sawtooth-timebase, using only one valve. It is seen that there is no waiting at all at the end of the run when bottoming is reached at the anode, as the arrival of the bottoming condition *immediately* triggers off the flyback by initiating the suppressor cut-off multivibrator stroke.

There is thus no need to adjust the length of the relaxation drive pulse so as not to exceed the time of run to bottoming, as in an externally driven Miller-Integrator, because a waiting time at the end of the trace, producing a brilliant resting spot on the c.r.t. screen, is impossible in the Miller-Transitron. This is an important advantage, greatly simplifying the matching of timebase capacitors C1 and flyback capacitors C2 in a practical circuit. This makes the circuit particularly easy for relative beginners.

Design considerations for Miller-Transitron Circuits

Considerations for choosing C1 and R (Figs. 14(a) and 14(b)) are in no way different from those already described under the heading of the basic Miller-Integrator. The time of run on each sawtooth stroke is somewhat less than the time given by C1 (μF) multiplied by R (megohms), the result being in seconds. R should be chosen at least 10 to 20 times larger than the anode load of the pentode, giving then the same good ratio of run time to flyback. The anode load should be as small as possible consistent with proper bottoming action and is to be determined in the manner already discussed above. If, for any reason, R is not large in relation to the anode load, then the sawtooth stroke is in no way impaired; it is merely the flyback time that is then unduly long in relation to the stroke time. Having fixed R according to these considerations (values 470kΩ to 2MΩ are common), values of C1 should be selected roughly according to the above rule to give the required ranges of timebase speeds, final trimming being undertaken by trial and error.

The values for C2 also need careful consideration. C2 must have such a value that the time it holds the suppressor cut-off is *at least* as long as the Miller-section requires for flyback. In other words, the product of C2 (μF) and suppressor leak (megohms) should not be less than the product of C1 (μF) and the anode load (megohm). As anode load and screen leak may in most cases be made approximately equal it is clear that C1 and C2 will also need to be about equal. Thus it is quite common to find, in practical circuits, that the coarse-control range-switch has two ganged wafers, selecting various equal-value pairs for C1 and C2.

If C2 were made too small, then the Miller anode flyback would not have time to go to completion before C2 allows the suppressor to cut-on again. The result is then simply a loss of output amplitude from the anode. If, on the other hand, C2 is too large in relation to C1, then it will hold the suppressor cut-off much longer than the time required for anode flyback. This means that the circuit waits a long time after completing a run and immediate flyback, before commencing another run

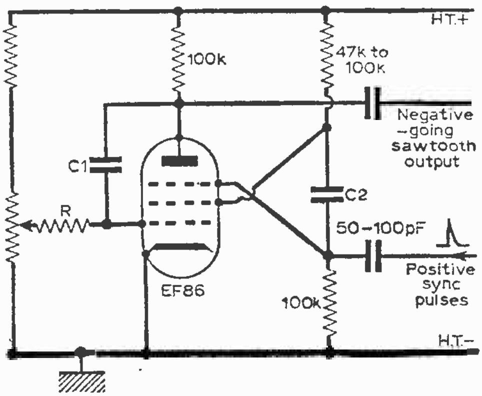


Fig. 14a—The basic Miller-Transitron timebase (self-excited Miller-integrator).

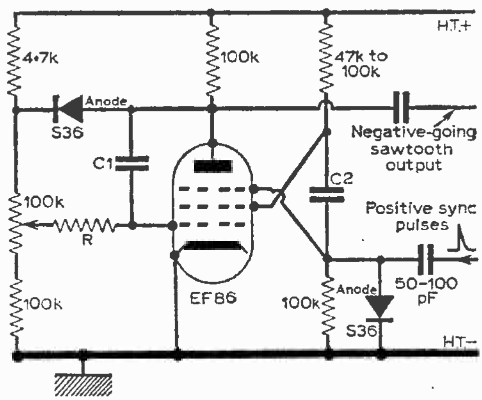


Fig. 14b—The improved Miller-Transitron circuit. This is the only known one-valve self-oscillating sawtooth timebase with good linearity.

and immediate flyback. This may in some cases be desirable, for if we make C2 very large in comparison to C1, and/or increase the suppressor leak resistance, then the time of sawtooth-run is very short in comparison to the intermediate waiting time, i.e. the entire run takes only a small portion of each cycle. This would enable transients to be displayed under synchronised conditions, without resorting to triggering, which is not very successful with the Miller-Transitron.

This useful method of transient display is adopted in the "Auditron" published recently in

PRACTICAL WIRELESS, the suppressor leak being switched over for the "long flyback" condition to a higher value.

In all normal cases, where we want a new run to commence as soon as possible after end of the previous one, we make C2 no larger than necessary. For those who want to be quite exact here, the procedure is as follows. After selecting and trimming the required capacitors C1 for the various range switch settings, smaller values for C2 should be inserted in each position initially, and gradually increased in each case until increase of output amplitude *just* ceases. This then represents optimum matching. The improved arrangement of Fig. 14(b) should be used in practice, which includes the diodes at anode and suppressor. The diode at the suppressor is simply to prevent the suppressor going positive under any conditions, as otherwise secondary emission disturbances, etc. could give trouble. The diode at the anode is a "flyback catch". Its cathode is taken to a point on an h.t. bleeder which is well positive compared to the bottomed anode voltage of the pentode. During flyback the anode aims exponentially back to full h.t. voltage, but is caught and arrested at the cathode potential of the "catch" diode, as soon as this potential is reached on the flyback. Thereby the flyback is terminated *abruptly* after a *definite* time, instead of tailing off indefinitely in an exponential manner. This gives clearer and more definite conditions for optimum choice for C2 in the manner discussed above.

The exact voltage chosen for the cathode of the flyback catch diode influences largely the output amplitude; the lower this voltage, the smaller the amplitude. The values shown for the h.t. bleeder are generally satisfactory, but others could be tried. The optimum value for C2 will naturally depend on the catch-diode cathode voltage, as the effective flyback time is also thereby influenced.

Provisional Timebases

The circuit is certainly not critical in any of these points; very stable performance is generally obtained by almost any reasonable set of component values selected by mere rule-of-thumb. The above details are for those who wish to trim the circuit to absolute optimum performance.

In all this work, on this and other timebase circuits, it is essential to possess or borrow another working oscilloscope for the necessary observations. Otherwise exact trimming of circuits according to instructions given in this article is not possible in many cases However, there is no objection to making up an untrimmed, rule-of-thumb Miller-Transitron for temporary operation of the c.r.t., for trimming observations in making an optimalised final timebase, which is ultimately to be substituted into the oscilloscope one is building.

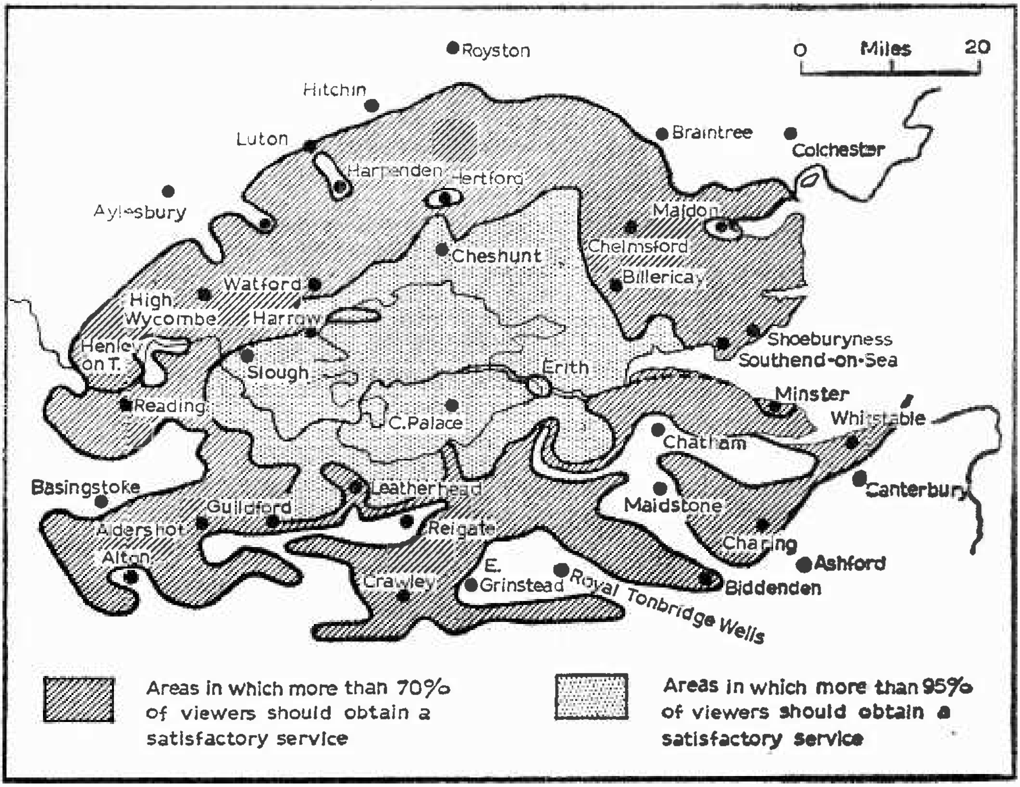
The non-critical nature of the Miller-Transitron in giving usable performance even if built up only *very roughly* according to the instructions here given makes it most suited for this method of getting finally trimmed timebases when one does not possess or have available a second oscilloscope for observations.

TO BE CONCLUDED

BBC-2 LONDON COVERAGE

This map shows the anticipated coverage of the BBC-2 Crystal Palace transmitter which is scheduled to commence operation in April next year.

The contours enclose areas where 90% and 70% of viewers, respectively, may be expected to obtain good reception of these u.h.f. transmissions.



CLOSED CIRCUIT TV CAMERA

—*continued from page 62*

the peaking while observing a picture on a TV receiver, to get best resolution of fine detail and to compensate for the exact length of video cable used between camera and control unit chassis).

C1 *must* be mica or ceramic. The value of C14 should be roughly correct for 625 line operation; a value of about 0·05μF will be needed for 405 line operation. Optimum values should be selected (line-sync stability) by final trial and error. Similar remarks apply to C15, which influences line linearity. The value shown will be about right at 625 lines, whereas about 0·25μF will be needed for 405 line operation.

Note that both wires of the heater supply come in at P1, where they receive high frequency earth through capacitors, but no d.c. earth path is provided on the camera head. In order to prevent hum loops, the heater line is earthed d.c. wise only at the power pack section on the control unit chassis.

The duplication of bypass capacitors by electrolytics in parallel with small paper capacitors is to improve effectiveness at high frequencies.

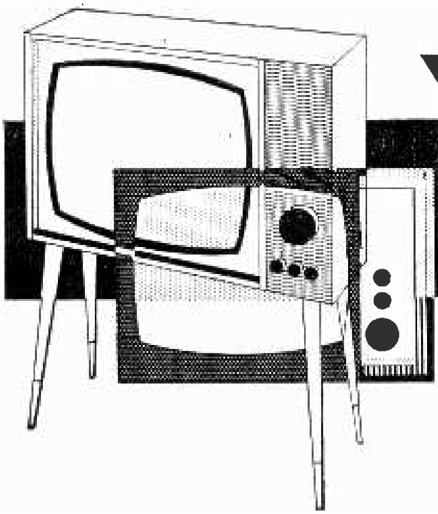
P1 or P2 may be combined to one 7- or 8-pole plug, but such types are less common.

Make the chassis connections via a frame of bare wires soldered direct to the steel chassis at the points shown on Fig. 7, using a high-power soldering iron quickly and before the other wiring is in place.

Ventilation

No great heat is developed within the camera head, so that a cabinet without holes is usable, and simplifies problems of keeping the interior *dark* when operating outdoors in sunshine. Cooling is aided if a pattern of small holes is drilled in the cabinet top, and tin foil backed with black paper (such as obtainable from photographic paper packages) is pasted on the inside. The tin foil should face inwards.

TO BE CONTINUED



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 92 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

FERRANTI 17T4

I have just acquired this receiver and although it receives a fairly good BBC picture, the tuner has been damaged with the result that it is impossible to switch to an ITV channel. I would therefore like to install a new tuner and would appreciate your advice in this matter.

The only fault with the reception at the moment, is a dark band, 2in. wide, which is permanently present at the top of the screen. I think that neither the tube nor the setting of the ion trap magnet are to blame for this fault.—S. Lewis (Prestwich, Manchester).

You could fit one of the advertised turret tuners to this set and the Cyldon P16H would be suitable. The tuner virtually connects in place of the existing tuner and uses the same leads and connections and the same PCC84 and PCF80 valves —if these are still in good order.

The dark section at the top of the screen could be due to a heater-cathode leak in one of the vision valves, but you should check this simply by reversing the mains input socket at the rear when the dark band would then go to the bottom. Also check electrolytics associated with the video amplifier valves, if necessary.

K.B. MV 50

A few minutes after switching on, the picture starts to break up and then gets progressively worse. Heavy lines appear across the picture and a bright, broken, vertical line is present in the centre of the screen.

The horizontal hold control is at the end of its travel and any adjustment to it has no effect.— —J. Gallacher (Aberdeen).

We would advise you to change the ECC82 (12AU7) situated in the centre of the chassis under the tube neck. Also check the line hold control and its associated components if necessary.

R.G.D. "SEVENTEEN"

When first switched on the picture is perfect. However, after about five minutes, the bottom of the picture gradually becomes compressed until a black band, 3in. in width, occupies the lower edge of the screen.

I have replaced the PCL82, PY81 and PL81.— H. G. Smith (Tetbury, Gloucestershire).

Replace the PCL83 valve and check the 680Ω cathode resistor which connects between pin 7 of this valve and chassis.

FERGUSON 506T

I cannot remove the $1\frac{1}{2}$in. border which appears on both sides and the bottom of the picture.

I have replaced the PL81 line output valve and the PCL82 frame oscillator and frame output valve. I have tested the PY32 h.t. rectifier, the PY81 boost diode, and the EY86 e.h.t. rectifier, but have not discovered the faulty component.— W. H. Moody (London).

The symptoms denote low h.t. voltage which should be checked. The correct h.t. line voltage is 185V. If this is low, replace the PY32 and check the 100μF electrolytic.

BUSH TV 66

On switching on, a picture appears in the centre of the screen, but only covers an area 9in. x 7in. It then slowly expands to fill the screen only to contract once more to its original size. It then remains the same for the rest of the time the set is switched on.

The picture is not distorted and the whole process takes about three minutes.

I have changed the ECC82, PL81, PY81 and two PY82's. The screen feed resistor (R36) to the PL81 was discoloured by heat and so this was

replaced. However, none of these alterations has cured the fault.—A. H. Rumary (Bedford).

You should check the 0·1μF boost line capacitor and the series 12Ω resistor. Also check the 140pF width capacitor (6kV) from the PY81 top cap to the coarse width selector on the rear of the transformer.

FERGUSON 992

To get a picture on this set, it is necessary to turn the contrast control fully clockwise. The left-hand half of picture is then perfect but the right-hand half lacks contrast and flyback lines are visible. If the brilliance control is retarded to remove these lines, the left-hand half disappears leaving the screen blank.

I have replaced the PL81 and PY81 valves and have had the tube tested. I have checked for obvious faults without revealing the cause of the trouble.—T. Hook (Birmingham, 29).

You should check the capacitors associated with pins 10 and 2 of the tube base socket.

Trace the lead from pin 10 to a 0·01μF capacitor (which connects to chassis). Connect a 0·01μF or 0·05μF component of about 750V to 1000V from pin 10 to chassis to check this.

Then check the 0·01μF and 0·002μF capacitors associated with the pin 2 supply from the brilliance control (schedule C, D and E versions) or connect an 0·1μF capacitor from pin 2 to chassis in the case of a schedule A or B model.

BUSH TV 85

The picture cannot be made to fill the screen and at same time remain viewable. The permanent black border which surrounds the picture varies from 1in. to 3in. in width.

When the brightness control is advanced the picture expands, becomes negative gradually and finally blows up completely.

A new EY86 was tried with the result that the screen remained permanently blank. I suspect the rectifier and so I would like to know the type used in this set.—L. Pearson (Redcar, Yorkshire).

The rectifier type is LW15 but before replacing this you should check the h.t. voltage which should not be less than 175V if the rectifier is in order.

If the voltage is up to standard, check the ECC82 valve above the right side section and the PL81 inside it.

COSSOR 945

The faults present in this receiver first appeared six months ago and have gradually got worse. Firstly, the volume control has to be fully advanced to make speech audible, and at the same time it is necessary to advance the fine tuner, with the result that the picture fades, leaving a blank screen.

Also, on occasions, black lines descend from the top of the screen, gradually covering and obliterating the whole picture. Furthermore it is very difficult to lock the picture with the horizontal hold control.

These faults occur on the ITA channel only, however a thin horizontal line, 2in. from the top of the screen is present on all transmissions.

I have replaced two PCF80's, an ECL80 and a PCC84 in an attempt to correct the fault, but have so far failed to cure the sound problem although picture quality has been improved. Although I live in a weak signal area I have had good reception until recently. The aerial has been checked and found to be in order.—H. Young (Barrow-in-Furness, Lancashire).

We would advise you to check the PCL82 sound output valve and its 25μF cathode bias resistor (pin 2 to chassis). Also try tuning the three sound i.f. cores for maximum, with the fine tuner adjusted for best picture.

PHILCO 10 10

The picture fails to fill to the correct width by about 1in. on either side of the screen. The only adjustment I have made which affects the width of the picture is alteration of the contrast control. I have changed the PL84 and also the PL81 which appears to overheat.

This set also howls and oscillates whenever the fine tuner is adjusted (a small screwdriver inserted into the core of L8 reduces this noise).—C. Murphy (Belfast, 15).

Check the 1·8kΩ resistor under the timebase chassis, which connects via a 270Ω resistor to pin 8 of the PL81. This resistor (1·8kΩ) often changes value resulting in the PL81 overheating. Check the ECC82 if necessary.

To correct the howling, reset T8 and T9 and if it still continues, check C52 and C54.

EKCO T164 B

If this set is switched on from cold with the contrast control set near its maximum position, no picture will appear, only a bright raster. After about 20 minutes, and by adjusting the line control, a picture can be obtained which will then last for the remainder of the evening.

If, however, the set is switched on with the contrast control less far advanced, a picture is obtained almost immediately, although it is fairly dark.—H. V. Powell (Lydbrook, Gloucestershire).

These symptoms are those of a faulty c.r.t., with an inter-electrode short or disconnected cathode.

REGENTONE 173

Recently the picture brightness on this set decreased on both BBC and ITA and the contrast control had to be advanced to make the picture viewable. Now however, the fault has worsened and the picture is hardly visible at all.

I have tested by substitution the PCF80, the EB91 and the EF80's, but the fault remains.—D. M. Flatters (Norbreck, Blackpool, Lancashire).

You should check that the ion trap magnet on the neck of the c.r.t. is set for maximum brightness of picture. This can be adjusted by rotating the magnet and moving it to and fro along the tube neck, while observing the screen with the brightness control two-thirds on. If this does not improve the brightness, yet the picture (as dim as it is) is in good focus, the tube may be low emission.

MURPHY V250

Replacing the smoothing capacitors failed to cure the hum which is present in this set and which is much worse on the BBC channel.

Also I tried to correct the rolling of the picture by replacing V9 and V17 ("Trader" service sheet), however it will still only lock for a short time. A dark band across the screen is always present, moving up and down.—R. Mulligan (Banbridge, Co. Down).

Suspect a heater-cathode leak in the r.f. amplifier (30L1) or frequency changer (30C1) in the tuner. Check also that the leaf contact on the left of the voltage selector disc, which disconnects the reservoir capacitor on d.c., has not become corroded.

COSSOR 932

White, horiontal lines continuously flash across the screen in a random manner. Sometimes they extend over nearly the whole screen, while at other times only part is affected. The picture itself remains steady.—S. A. Fisher (Birmingham 19).

This fault could be caused by an intermittent fault in the tube, or one of the vision chain of valves. We suggest a gentle " disturbance " test with an insulated probe to try to isolate the offending stage.

PYE RTL

On first switching on, a weak picture appears which is upside down. After a few minutes, it folds up into a thin, bright, horizontal line across the screen.—T. D. Girvan (Liverpool 12).

You should replace the PCL82 frame scan generator, which is at the back of the set, on the right-hand side.

QUERIES COUPON

This coupon is available until NOVEMBER 22nd, 1963, and must accompany all Queries sent in accordance with the notice on page 88.

PRACTICAL TELEVISION, NOVEMBER, 1963

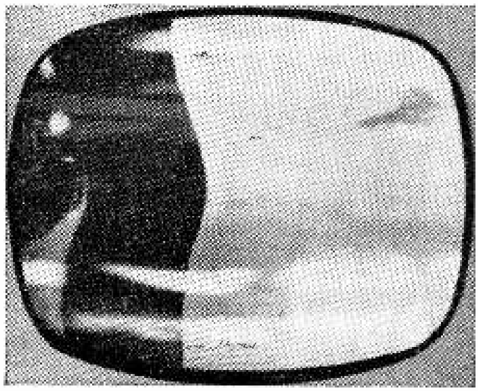
TEST CASE -12

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.

? *An experimenter bought a semi-vintage television receiver from a surplus supplier and after replacing several definitely-faulty valves managed to obtain a picture as shown in the accompanying photograph. The sound was perfect, but adjusting the line hold control in an endeavour to correct the symptom only made matters worse and caused the picture to break up completely. Two pictures side-by-side and in line lock were obtained with the line hold control at approximately range centre.*

What was the cause of the trouble and what steps should the experimenter take to restore normal working?

See next month's PRACTICAL TELEVISION for the solution and for another problem.



This month's test case fault gives rise to this kind of distortion.

SOLUTION TO TEST CASE 11

(Page 42 last month)

Sound distortion in a television set is often caused by the sound interference limiter valve failing to conduct properly as a result of the resistor connected to the diode anode increasing in value. This resistor is often in the range of 3·3MΩ, and is connected from the anode of the interference limiter diode to the h.t. line.

A rise in value of this component prevents the diode from conducting normally, and as the conduction of this valve provides a path for the audio signal to the a.f. stage, incorrect conduction is bound to result in clipping of the signal and distortion—rather like that attributed to lack of output valve bias.

The resistor is easy to locate on most models and a quick test as to whether its rise is responsible for the distortion can be performed by connecting the test prods of a multimeter adjusted to the 250V a.c. range across the suspect component. If the distortion clears, then the resistor should be replaced.

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