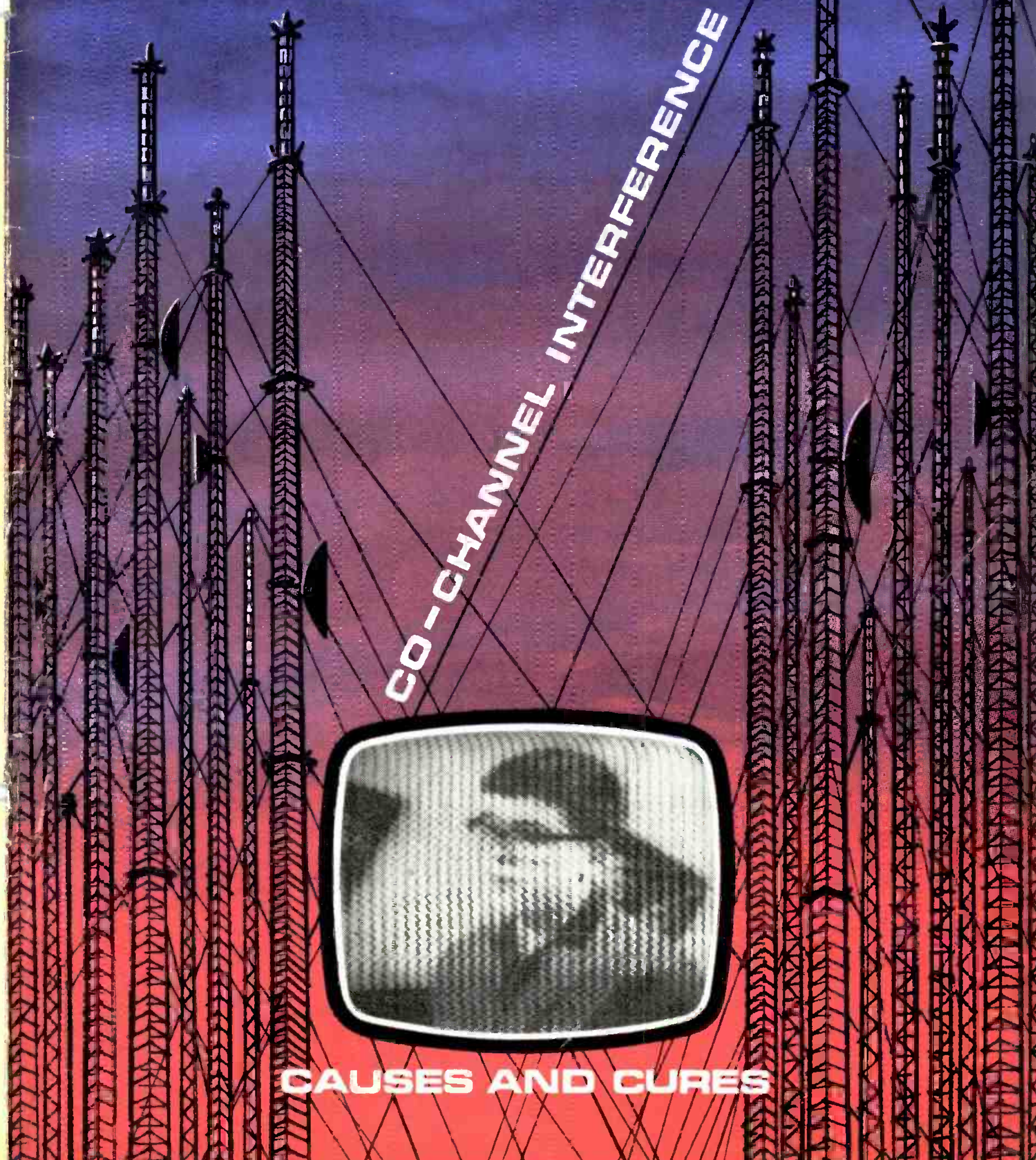
Practical TELEVISION

NOVEMBER 1967

2/-



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DF92	3/-	EY86	6/3	PY81	6/-
DF96	6/11	EZ81	4/11	PY82	5/6
DK92	7/9	PC86	10/9	PY800	6/-
DK96	6/9	PC88	10/9	PY801	6/-
DL94	5/9	PC97	7/3	UABC80	5/3
DY87	6/3	PCC84	5/6	UCH81	6/3
EABC80	6/3	PCC89	10/-	UCL82	7/-
EB91	3/-	PC189	10/10	U25	12/3
EBC90	4/3	PCF80	6/2	U26	12/3
EBF89	6/6	PCF82	7/7	30C15	11/3
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ECH42	9/3	PCL82	7/-	30FL1	13/9
ECH81	5/-	PCL83	8/6	30L15	14/9
ECL80	6/9	PCL84	7/6	30P12	8/11
ECL82	6/3	PCL85	8/11	30P19	12/9
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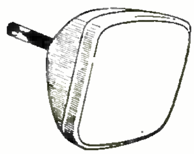

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EY87	5/9	PCF801	8/6	U16	15/-	UF89	5/6
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AC107	3/6	BCY39	5/-	OA81	1/9	OC83	2/-
AC126	2/-	BCZ11	3/6	OA90	2/6	OC84	3/-
AC127	2/-	BD119	9/-	OA91	1/9	OC123	4/6
AC128	2/-	BF154	5/-	OA95	1/9	OC169	3/9
AC156	4/-	BF159	5/-	OA182	2/-	OC170	2/6
AC165	5/-	BF163	4/-	OA202	2/-	OC171	3/4
AC166	5/-	BF167	2/6	OAZ210	7/-	OC172	4/-
AC168	7/6	BF173	2/6	OC19	25/-	OC200	6/6
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AF116	3/-	BY236	4/-	OC30	7/-	MAT100	5/9
AF117	3/4	BY238	4/-	OC35	10/-	MAT101	8/6
AF118	3/-	BYZ12	5/-	OC36	7/6	MAT120	7/9
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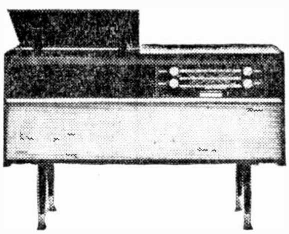

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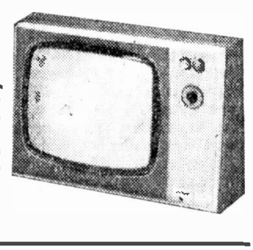

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Practical Television

NOVEMBER 1967
VOL. 18 No. 2
issue 206

NO CHOICE

JUST about two decades ago, there were twenty or more independent companies producing television receivers for the domestic market. Since then, some of these companies have given up producing domestic equipment, others have gone out of business, some have been swallowed up by larger concerns. Even some of the old names, preserved as alternative brand marks for the larger companies, are now beginning to disappear.

As a result of this snowballing of the industry we enter the colour era with about six survivors, larger and more compact and able to plan highly concentrated mass production and more streamlined marketing. It is a remorseless and inevitable process, common to most manufacturing industries in this modern world.

As we see it, there are two outstanding consequences, one desirable and the other rather dubious—and representing a nice study in incompatibility. Despite soaring costs of labour, raw materials, services and overheads, prices have been pegged to a remarkably low level. Even considering improved production techniques, it is surprising to reflect that the retail cost of the latest average dual-standard monochrome set is, if anything, *less* than its single-standard counterpart of 10 years ago!

This price stabilisation, perhaps unequalled by any other comparable industry, has been achieved mainly by the concentration of available manufacturing facilities and to the fierce competitive spirit pervading these companies.

But the price the consumer has to pay for all this is inevitably a lack of choice. Whereas at one time, Brand X could offer, say, a cheap, medium-price and a de luxe model, the most one can hope for these days is the same chassis in a variety of cabinets and fittings to represent a "range".

The philosophy of mass production does not take too kindly to the conception of a "hi-fi" TV set, with its reduced market appeal. It is, therefore, heartening that earlier this year Decca had the commendable boldness to introduce their "professional" receiver. Designed to make the optimum use of the available signal the specification makes delightful reading. Of course, the price is nearly double that of the average set (£131) but it does put into perspective the remarkably good value of the mass-produced family sets in the shop windows.

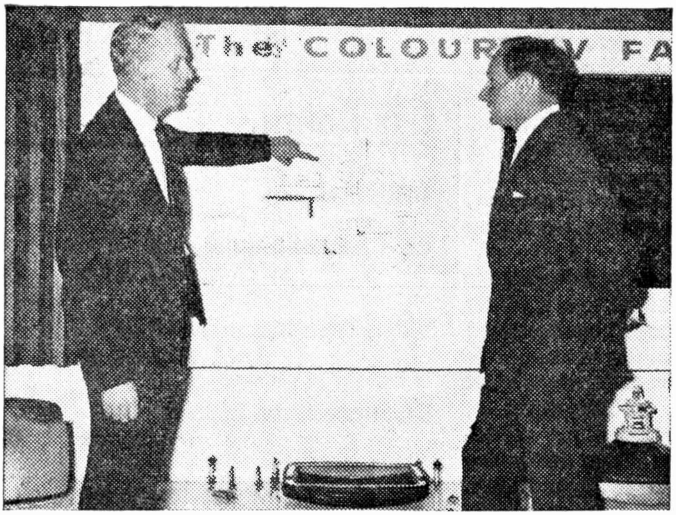
Our only regret is that there are not more sets available for the more discriminating viewer.

W. N. STEVENS, Editor.

THIS MONTH

THE NEXT ISSUE DATED DECEMBER WILL BE PUBLISHED ON NOVEMBER 24

THE COLOUR TV FAIR



Gordon Jackson, exhibitions officer (left) and Peter Yate, head of advertising Mullard Ltd. (right) discuss the plan of The Colour TV Fair.

TEN set manufacturers, representing fourteen brands, will be taking part in The Colour TV Fair which is being staged by Mullard Ltd. at Mullard House, Torrington Place, London, W.C.1 (November 17—December 2nd).

Sets by Alba, Baird, Bush, Decca, Derwent, Dynatron, Ekco, Ferranti, GEC, Murphy, Philips, Pye, Rediffusion and Stella will be seen working in the individual booths in the main section of the Fair in the Mullard House Electronics Centre.

Plans are also being discussed for an Aerial Information Centre where visitors can obtain expert advice on the types of aerials needed to receive the colour service.

As well as normal "on the air" colour programmes by the BBC the sets on view will also display material carried by special GPO landline from the Lime Grove Studios. Colour programme material is also being supplied by the independent television companies.

In addition the output of the Interview Studio at Mullard House, which is likely to be one of the Fair's main attractions, will be fed into the system from time to time.

In the Mullard House Theatre (seating 75) there will be continuous showings of the company's 16-minute film "Colour Television". This deals with the subject in fairly simple terms and explains the functions of the camera and picture tube.

The Fair will be open to the public from 10 a.m. on Friday November 17th and will close at 8 p.m. on that day. Thereafter public opening and closing times will be as follows:—November 18th, 20th, 21st, 22nd 10 a.m.—8 p.m. November 23rd 10 a.m.—6 p.m. November 24th, 25th, 27th, 28th 10 a.m.—8 p.m. November 29th 10 a.m.—6 p.m. November 30th, December 1st 10 a.m.—6 p.m. December 2nd 10 a.m.—To be announced when the official opening time of the colour service is known.

There will be a special all-day preview for the trade on Thursday November 16th and two trade evenings on Thursday November 23rd and Wednesday November 29th from 6.30 p.m. until 8.30 p.m.

Public admission to the Fair will be free of charge.

£250,000 ORDERS IN 3 HOURS

AFTER taking orders totalling more than £250,000 in the first three hours of their trade show at Grosvenor House, Park Lane, Pye Group (Radio and Television) Ltd. announced recently that they were speeding-up plans to transfer all radio production from their Lowestoft factory to make more space available there for the manufacture of both monochrome and colour television receivers.

"It is already obvious that we could not meet the demand from our present production lines at Lowestoft and new lines will be set up as quickly as possible", said Richard King, sales director, Pye Radio and Television.

Pye car radio production is being switched at once from Lowestoft to a factory already owned by the Group at Malmesbury, Wiltshire. Transistor radio and record player production will be switched as quickly as possible.

TELEVISION EXHIBITS FROM EAST GERMANY

TELEVISION tubes with protection against implosion are the latest development in East German TV industry, and were shown at this year's Leipzig Autumn Fair (September 3rd—10th).

New from VEB Fernsehgeraetewerke Stassfurt is the 47cm. Model 5051 "Donja", which has a flat safety shield. Other "Donja" Models, 1001, with implosion protection or plastic shield; 1501, with a u.h.f. tuner and flat safety shield and 1301, with implosion protection, will also be on show.

Other newcomers are the 47cm. implosion-proof console set Model 1001 "Ilona", which has a multi-purpose lower compartment, and the 59cm. console set Model 1001 "Clarissa", with flat safety shield and "Intimo" radio unit.

Improved versions include the Model 108 "Sybille", a 59cm. table set with implosion protection.

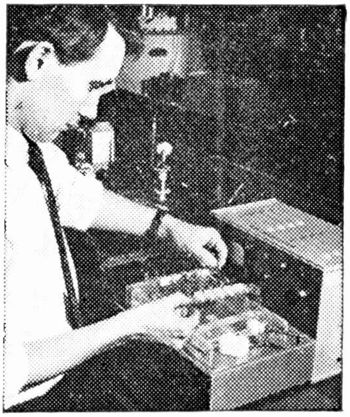
NEW COMPONENTS FOR COLOUR TELEVISION RECEIVERS

AN alternative to the use of two valves in a colour television receiver is provided by a Voltage Multiplier Assembly developed by the Wound Components Division at the Titchfield, Hampshire, factory of the Plessey Components Group. Additionally, the assembly enables the Line Output Transformer to be rendered far more simple and reliable.

By eliminating two rectifier valves an important source of unreliability is removed.

The Voltage Multiplier has been designed around selenium rectifiers which, it is considered, provide the most economic method of e.h.t. generation, and will do so for some time to come.

The more expensive silicon rectifiers, however, will be incorporated in an alternative version of the Voltage Multiplier which will shortly be available.



Stringent testing and performance assessment of Voltage Multiplier units for Colour Television Receivers is necessary to ensure long and safe life during use.

Right, an engineer in the Plessey Components Group's Wound Components Laboratory at Titchfield uses the special test gear designed for this purpose.

'ORBIT' SPACE TV SYSTEM

A SPACE television system is being created in the U.S.S.R. which will enable viewers of Siberia, the Far East and the Far North to see telecasts from Moscow over distances of some 5,600 miles.

This year over 20 standard relaying stations called *Orbit* will be erected in these places. They will receive Moscow programmes via the *Molniya-1* communications satellite and relay them to local TV centres.

Each station will have highly efficient dish aerials with rotating and programming devices and tracking systems. As long as the satellite is in radio visibility range, the aerial will be precisely aimed at it and according to a prescribed programme track its movement. Special equipment will amplify the signals from space and reduce to the minimum the accompanying noise.

Mr. Vladimir Minashin, one of the designers of the *Orbit* project, says that the construction of these stations was less expensive than that of radio relay lines, the servicing of which is very difficult in thinly populated areas. *Molniya-1* is capable of sending television signals to any point on one-third of the earth's entire surface area.

Molniya-1 can also maintain multi-channel radio and television communications of superlong ranges. The period of rotation (12 hours) provides reliable communication for a long period of time.

Experiments have proved that sound and television signals received via the sputnik are of high quality. An exchange of colour television programmes between Moscow and Paris in November, 1965, proved this.

A graduate of the Moscow Institute of Communications, Minashin was awarded a Lenin Prize for his part in the radio scanning of Venus, Mars and Mercury.

BBC/ITA TRANSMITTER BOOKLET

THE 2nd edition of a handy pocket reference listing all BBC and ITA TV transmitters, with latest amendments and additions, has been produced by Belling-Lee Aerials.

All BBC-1, and BBC-2 u.h.f. stations are listed with channels and frequencies, and are located on maps. The BBC-2 list and map also gives details of future transmitters with their expected service dates.

All ITA transmitters are listed with channels and polarisation, a location map again being provided. A chart details all television channels with frequencies.

BBC and ITA authorities cooperated closely with Belling-Lee Aerials throughout the production of the booklet, supplying accurate and up-to-date information.

Copies are available from Belling-Lee Aerials Ltd., Heysham Road, Netherton, Bootle 10, Lancashire.

Colour TV at International Broadcasting Convention

A FULLY equipped colour television studio including production area, control room, telecine and slide scanning equipment was built by EMI Electronics for the IBC. The studio was used for a 25-minute presentation of fashion fabrics by Courtaulds. The display, which has been produced for EMI by ABC Television, demonstrated the capabilities of EMI's 2001 colour camera.

Film clips from ABC Television's colour series "The Avengers", featuring Diana Rigg and Patrick Macnee, and colour television commercials linked the live sequences and demonstrated EMI telecine equipment. There was also a demonstration of EMI video recording tape.

Image orthicon booklet from English Electric

ENGLISH ELECTRIC valve Co. Ltd. announce their new booklet "Image Orthicons". This covers both their 3in. and 4½in. types for both colour and monochrome pick-up. Sufficient details are given for tube selection to be made; an equivalents index is also given.

E.E.V. will be pleased to send a copy of this booklet upon request to any readers, if they write to English Electric Valve Co. Ltd., Chelmsford, Essex.

Gordon J. King

CO-CHANNEL INTERFERENCE

TO ensure that virtually everyone in Great Britain is within good reception range of the BBC-1 and ITV-1 transmitters, it is necessary for more than one station to work on the same channel number. This is because more stations are required than there are channels to satisfy this condition. It may come as a surprise to discover that there are as many as twenty stations in this country working on Channel 1 and eighteen on Channel 4. In fact, all the channels in Bands I and III are heavily loaded as shown in Table 1.

The numbers in this Table include BBC-1 stations working in Band III and occupying Channels 10, 12 and 13.

In Europe, too, as well as in countries farther afield, Bands I and III are used for television and these are divided into channels but with different widths and sound/vision carrier spacings. This is because the v.h.f. channels in Britain at present carry only 405 standard signals while the channels of other countries carry signals of different standards. Even so, the sound and vision frequencies of foreign stations, although not coinciding exactly with those of matching channels in this country, often fall within the vision or sound passband of our 405 standard channels.

The channel-sharing problem is not so bad at the moment in the u.h.f. bands because they are carrying only BBC-2; but they will soon be called upon not only to carry ITV-2, but also BBC-1 and ITV-1, for the plan is eventually to run-down transmission on the v.h.f. bands and re-engineer all programmes into Bands IV and V. This is certainly not going to happen overnight and will take at least a decade to get going, so readers with v.h.f.-only sets have no need to panic!

TABLE 1
NUMBER OF STATIONS PER CHANNEL

Channel No.	*Number of Stations Sharing*
1	20
2	13
3	13
4	18
5	17
6	5
7	3
8	9
9	7
10	6
11	8
12	4
13	6

It is possible that all the main stations will have u.h.f. channels, while re-engineered 625 standard channels in the v.h.f. bands will serve small local areas which, owing to screening by hills and large buildings and the general nature of the terrain, cannot successfully be reached by the quasi-optical u.h.f. radiations.

It is now well known that regional areas throughout the country have been allotted groups of four channels. In areas where u.h.f. is already active only one channel of a group is operational for BBC-2. Later on a second will be in use for ITV-2, leaving two channels in each group for possible BBC-1 and ITV-1 on the 625 standard, transferred from the 405 standard v.h.f. channels. All these channels will eventually carry colour signals as well as monochrome ones.

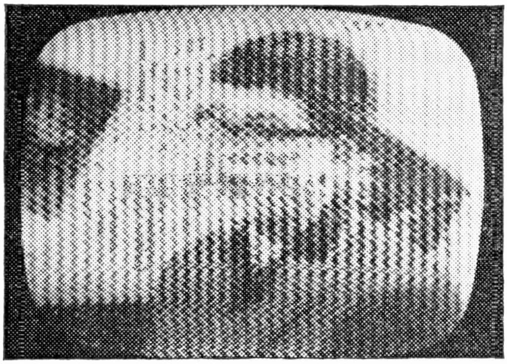
RECEPTION DISTANCE

The distance over which satisfactory u.h.f. reception can be expected for 100 per cent of the time from a transmitting aerial, assuming that the receiving aerial is adequate and of reasonable altitude, is at most 35 miles, which is about 20 miles less than the v.h.f. reception expectations. However, no hard-and-fast rules can be laid down in this respect because so much depends on the nature of the terrain along the transmission path, on the noise performance of the receiver and on the efficiency of the aerial and its effective height above sea level.

Nevertheless, it appears that in the order of 1,000 u.h.f. stations will be needed to provide a coverage of about 95 per cent of the country, and many more smaller translator (or booster) stations will be required to fill up the gaps and to give the almost total coverage of the v.h.f. stations. On this basis, therefore, there will certainly be a great deal of sharing of the u.h.f. channels, possibly on an even greater scale than existing on the v.h.f. bands.

When a single channel is used by more than one station there is always the possibility of distant stations causing interference on the local, stronger station which is servicing the area. Just look at the interference possibilities on Channel 1, for example!

When a shared-channel station does cause interference, it is known as *co-channel interference.* Its effect on a picture varies from barely discernible to severe, making viewing pretty well impossible. On sound the effect can be equally as diverse and when severe it can cut out the wanted sound altogether and introduce a loud, raw buzz or rough whistle in its place, especially when the interference is originating from a Continental television station. This is because the vision signal sidebands of a



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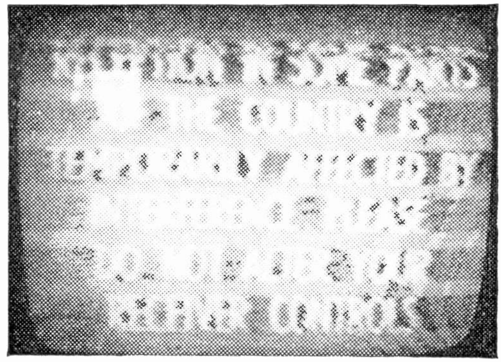

(c)

Fig. 1: Off-the-screen photographs of co-channe interference on Channel 2.

Continental station often fall within the sound passband of the British 405 standard. Some idea of the effects of co-channel interference is given in Fig. 1, which consists of photographs taken direct from the screens of affected sets.

Looking at Table 1, one might well wonder why it is, in fact, possible to receive any v.h.f. station without interference from one or more of the stations sharing its channel. There are several reasons why co-channel interference is not as troublesome as seemingly it should be. The main reason is that for television we rely on what are called *space waves*. These are radiated outwards from the top of the transmitting aerial almost parallel with the surface of the earth, and their path of radiation is almost, but not quite, straight. An analogy is a lighthouse which emits straight-line light radiations from its peak and these are seen by ships all round.

TELEVISION SIGNAL PROPAGATION

The optical system of a lighthouse is designed to concentrate the beams of light along the surface of the sea, and the distance over which the light can be seen is dependent directly on its altitude. This is why lighthouses are built on tops of cliffs and tall rocks in the sea.

So it is with a television aerial sending out its v.h.f. or u.h.f. signals. The aerial system is designed to concentrate the waves into fairly thin beams along the earth and it is mounted as high as possible on top of a lofty mast to obtain the required coverage in terms of horizon distance, as shown in Fig. 2.

Unlike light rays, however, v.h.f. and u.h.f. waves bend a little with distance from the transmitting aerial, and to some extent this causes them to hug the earth's surface. This means that the waves are active some distance beyond the horizon. This bending effect is caused by the influence of the lower atmosphere and its gradual rarefaction with height above the earth's surface. This bends the waves in rather the same way as glass, water and optical lenses bend light rays. The net result of this is that television signals can be received fairly consistently a little in excess of the line-of-sight distance between the transmitting and receiving aerials.

Nevertheless, the height of the transmitting and receiving aerials is a prime factor governing the distance over which television reception can be expected. The signal strength, however, gradually weakens with distance even within the line-of-sight path, and this weakening follows the same laws as the weakening of light rays. After the line-of-sight distance, the weakening becomes more rapid, depending on the frequency of the signal, and in this respect u.h.f. signals suffer greater attenuation than v.h.f. ones.

Thus, from the propagation aspect, v.h.f. and u.h.f. signals weaken at about the same rate within the line-of-sight distance, while u.h.f. ones fade out much more quickly than v.h.f. ones outside the line-of-sight distance. There are other factors involved, such as transmitter power, the nature of the earth and so forth, but from the point of view of the present discussion these need not be brought in.

Under normal reception conditions, therefore, we can say (albeit, roughly) that a v.h.f. station will give reception up to 50 or 60 miles and a u.h.f. one up to 30 or 40 miles. Outside these distances, assuming normal conditions of reception, the signal field is very weak and soon falls almost to zero with greater distance. That is the main reason, then, why we do not get a lot of interference from shared-channel stations, often several-hundred miles removed from each other.

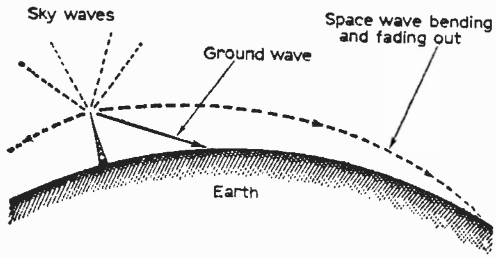

Fig. 2: The three types of wave radiated from a television transmitting aerial showing how the space wave bends slightly while reducing in intensity.

DIRECTIONAL AERIALS AND OPPOSING POLARISATION

Indeed, the channel planners have ensured that shared stations are the greatest possible distance away from each other. As another precaution the transmitting aerials are made directional, so that minimum power is radiated in the direction of a station sharing the same channel, as shown in Fig. 3. And as a further precaution against co-channel interference, the shared-channel stations nearest each other have their signals opposingly polarised. This means that if the main Channel 2 station, for example, has vertical polarisation, a translator station a hundred or so miles away and also on Channel 2 would have horizontal polarisation.

This point relates to the plane of polarisation of the transmitted signal. It is rather technical and we need not dwell on it too much, but from the practical point of view a vertical dipole and elements are required to receive a vertically-polarised signal while an aerial horizontally mounted is needed for a horizontally-polarised signal. If a horizontal aerial is used to pick up vertically-polarised signals there will be very little signal voltage at the end of the feeder, as some readers have almost certainly discovered for themselves.

Everything, then, is set up nicely for the maximum discrimination against unwanted shared-channel signals; but in spite of the nature of television signal propagation and the precautions mentioned co-channel interference is still very much of a real problem. Why is this?

TROPOSPHERIC AND IONOSPHERIC RECEPTION

Well, the reason is that the television signals sometimes escape, so to speak, from the local areas they normally serve. This happens because some of the signals radiated from the transmitting aerial are radiated at relatively high angles and are bent back towards earth due to reflection from the earth's atmosphere, called the *troposphere*, and from ionised layers above the earth's atmosphere, called the *ionosphere*. A certain amount of high-angle wave radiation occurs in spite of the aerial design being for space-wave radiation. These high-angle radiations are called *sky waves* (see Fig. 2). There are also *ground waves*, but at v.h.f. and, particularly, u.h.f. these are speedily attenuated by the earth's losses and they tend to influence the space-wave signal, due to cancellation effects etc., close to the transmitting aerial only—this, in fact, being one reason why poor reception is sometimes experienced close to a transmitter.

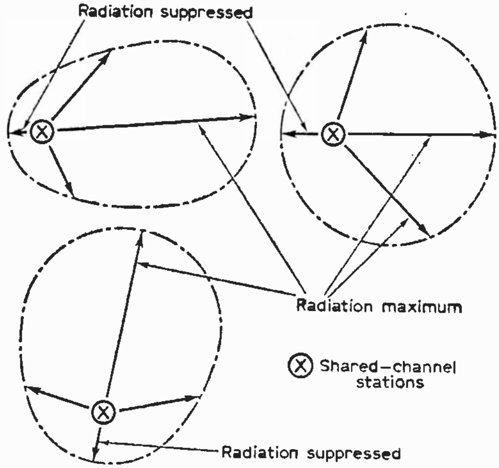

Fig. 3: Directional aerials are used by shared-channel stations to minimise co-channel interference. Added precautions are given by opposed planes of signal polarisation (see text).

Anyway, to get back to the sky waves: under normal reception conditions these waves penetrate the troposphere and ionosphere and dissipate themselves in space—lost for all time—and thus have no effect on local reception. However, during certain weather conditions and abnormal ionospheric conditions the waves fail to penetrate the local and upper atmospheres but instead are brought down to earth again at distances outside the normal service area, as shown in Fig. 4.

Even during such conditions u.h.f. waves are less influenced by the upper atmosphere than v.h.f. ones, and the lower the frequency of the TV signals the greater the bending effect. V.H.F. signals in Channels 1 and 2 (Band I) thus suffer most, and it is on these channels that the majority of co-channel interference is experienced. The trouble is aggravated by Channel 1 having the largest number of shared-channel stations.

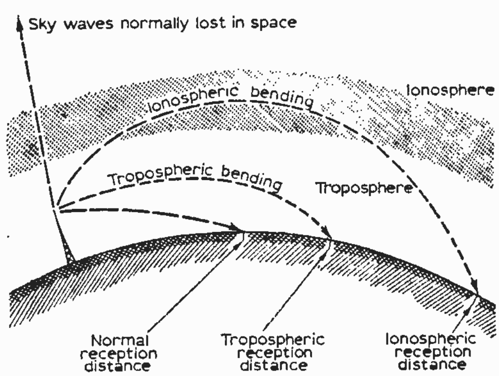

Fig. 4: Showing how TV signals are propagated over greater-than-normal distances due to tropospheric and ionospheric bending.

Fig. 5: Untouched photograph of Channel 24 received at a distance of over 100 miles.

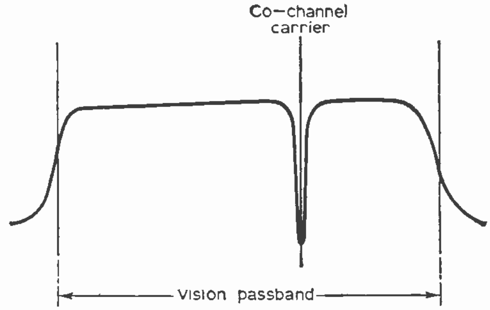

Fig. 6: How the Bovill filter "notches out" the interfering co-channel carrier.

This is not to imply that reception via the troposphere and ionosphere does not occur on the higher-frequency channels. Indeed, the author has experienced quite excessive "bending" and "ducting" due to tropospheric effects in the u.h.f. bands, especially on Channel 24. Proof of this is given in Fig. 5, which depicts an untouched, off-the-screen photograph of the BBC-2 colour test card transmission over a distance in excess of 100 miles. This knocks the 35-mile maximum theory on the head! The author has also received u.h.f. signals on Channel 33 over a distance of 200 miles.

Nevertheless, at present the main trouble occurs on the lower-frequency Band I channels and the co-channel effects shown in Fig. 1 are all on Channel 2. Reception on Channel 1 via the troposphere has been reported over several-thousand miles, and Continental transmissions frequently cause trouble to viewers in coastal areas during spring and summer. These, too, are via the ionosphere in the main, and the effect is sometimes referred to as *Sporadic E*. The letter "E" identifies a specific layer in the ionosphere, and the effect is often of a sporadic nature as the ionospheric conditions can change in this layer in a like manner.

As already mentioned, co-channel interference has not so far caused much trouble in the u.h.f. bands, but the potential will exist when all the channels are energised and the whole country covered. Fortunately, though, u.h.f. aerials are highly directional and, provided the offending transmission is arriving well off the main-station beam, it will fail to give much of a response at the set.

The important aspect here, therefore, is for the u.h.f. aerial to have a high front-to-back ratio (virtually no rear pick-up) and if there are side lobes these must be as small as possible. The latest u.h.f. aerials from reputable manufacturers are designed with parameters fully satisfying these conditions which, incidentally, are highly important on colour, where a co-channel colour subcarrier could well cancel out the subcarrier from the main station, thereby deleting or diluting the colour information. Even if total cancellation does not occur, the subcarrier could be distorted to an extent that even the PAL system would have difficulty in correcting. The message, then, is to make sure that the best possible u.h.f. aerial is installed at the beginning; this will surely save expense and avoid poor colour reception later.

While we are in a position to make sure that co-channel effects do not cause us too much trouble on u.h.f., the effect on the v.h.f. channels will sadly remain with us until the v.h.f. bands are eventually abandoned for the main services. We can ensure that the greatest discrimination is given to co-channel signals by using a three- or four-element Band I or eleven-element Band III aerial of good design and making sure that this is orientated not for the pick-up of most wanted signal

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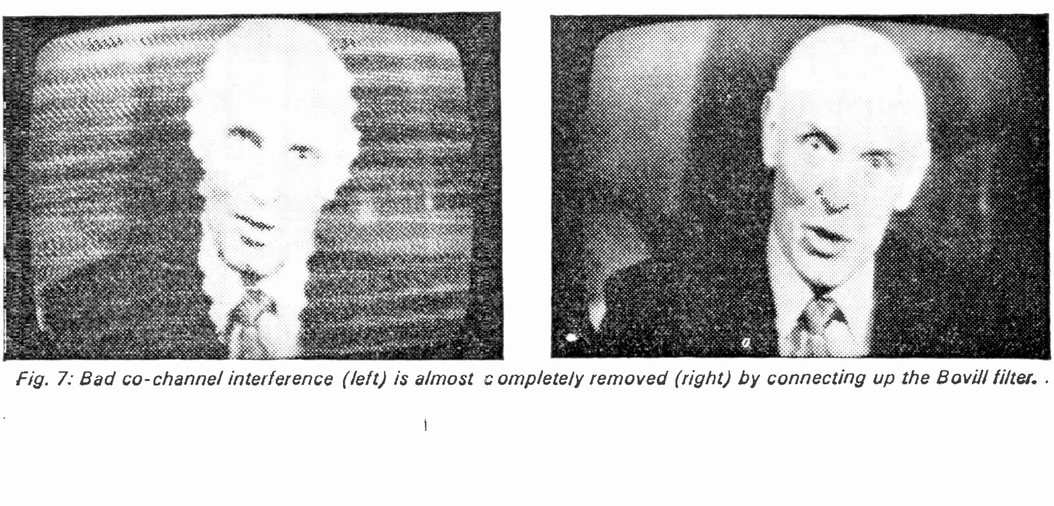


Fig. 7: Bad co-channel interference (left) is almost completely removed (right) by connecting up the Bovill filter.

VIDEO TAPE RECORDING

PART 2

H.W.HELLYER

WE have outlined in the first part of this series the techniques employed by the leaders in the video tape recording market. If that survey did nothing else, it should have convinced some of our indefatigable correspondents that a home-builder's kit is as yet something of a dream. Cost alone would militate against anyone less than a pop star assembling a modern helical scan machine with the servo circuits and some of the other necessary complexities that we shall discuss. (And he would probably not want it unless it had built-in distortion and echo!)

Ampex had a head start in this business, and it is hardly surprising that many of their ideas have been adapted by other makers with an eye on the potential domestic market.

There will be a domestic market, make no mistake. The author has been playing about with home video outfits for several months, adapting them for monitor screens, trying out various links into closed-circuit television and demonstrating the vidicon camera, helical scan recorder and monitor to school teachers, public services and industrialists. The amount of real interest is surprising, and when colour takes a firm hold we shall probably have a minor boom to contend with. Some idea of what can be done in the 'commercial' field may be illustrated by details of the Ampex video home-trainer given later in this article.

But first, let us consider a few of the basic design principles that make video tape recording possible. A high relative speed of head to tape is necessary to ensure adequate bandwidth. This can be obtained by transverse scan, with a number of heads scanning across the width of a fairly wide tape as it travels longitudinally. The opposite alternative, longitudinal travel across a fixed head, used in early types of machine, has limitations because of the high speed factor. The amount of tape needed with this alternative, wear of heads, tape and other transport surfaces are also very real limitations, quite apart from the necessarily restricted bandwidth. Nevertheless there continue to be experiments along these lines.

Helical scanning

The compromise system, which enables high speed—that is high relative head-to-tape speed—to be attained while conserving tape length, is to employ helical scanning. In this system, both tape and head move, but the head revolves laterally within a drum across the outer surface of which the tape is driven helically. The helical scan is obtained by means of tapered or spaced guides which cause the tape to move in a diagonal around the section of the drum with which it is in contact. This causes the heads to scan diagonal tracks (as shown in Fig. 4) on the tape. Exact timing is needed to ensure playback in synchronism with the original recording, and this is the reason for the apparent complication of the servo circuits. In fact, as can be seen by comparing Figs. 5 and 6, the block diagram of the servo circuit is almost as elaborate as that of the signal channels!

These block diagrams are of the Ampex VR6000, a machine which serves as a good example for our discussion. The drive system was described in the last article, and needs only a brief mention. The tape is 1in. wide, and 3,000ft. of 1·4mil thickness is contained on reels of 9¾in. diameter. Tape speed is related to the line standard of the system on which this versatile machine is used, being 10·42in./sec. on the 405-line system and 9·45 in./sec. on a 625-line system. Similarly, speed of head rotation depends on the field frequency (only one head is employed in this type of machine). Thus for the 405-line system the head rotates at 50 c/s, giving a relative head-to-tape velocity of 833 in./sec.

As a matter of interest, the head is a plug-in replacement with an estimated life of 500 hours.

A full-track erase head is used, and two lateral tracks are recorded on the tape after the video scan. At the top a control track of synchronising pulses takes up a small space, while at the bottom the audio signal is recorded, with narrow guard bands to prevent interference. Figure 4 shows the relative dimensions of the recorded tracks as made on a 60c/s television system. The video recording is made with the protection of a frequency modulated carrier. This is a common video technique which eliminates the need, and much of the complication, of a high frequency recording bias.

Magnetic non-linearity

Readers will recall that magnetic tape is non-linear, but in a peculiar way which produces a type of distortion that would defy correction circuits if some way of bringing the recording signal

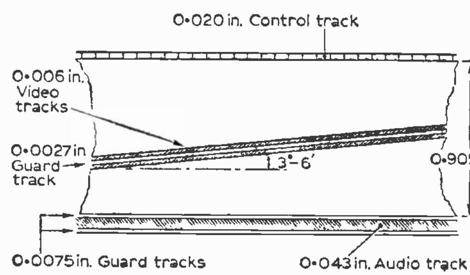


Fig. 4: Track disposition on the video tape with the Ampex helical scan technique.

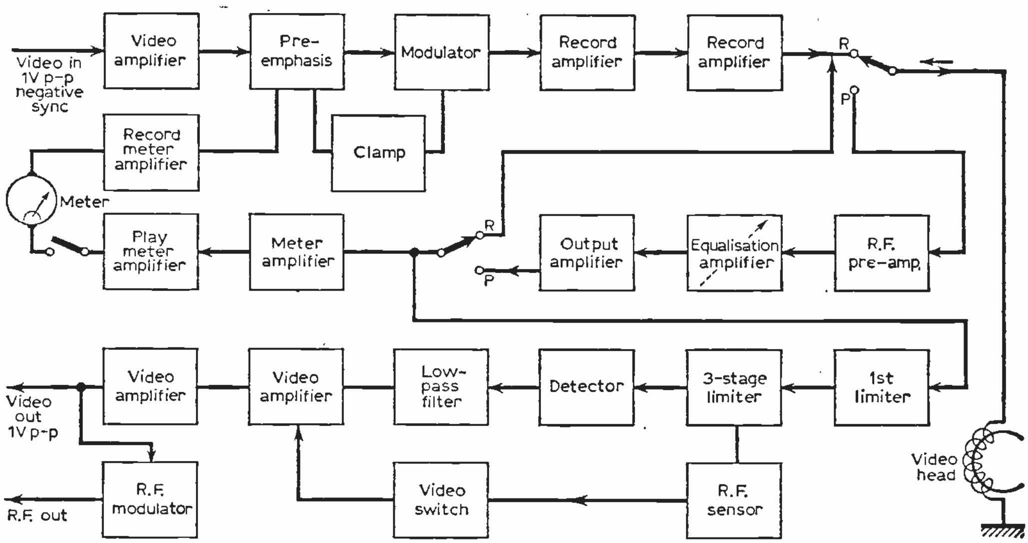


Fig. 5: Block diagram of the video signal circuits, Ampex Model VR6000.

on to a relatively straight portion of the magnetising curve could not be found. High frequency bias is one method—there are others, but they need not concern us here. By adjusting the magnitude of the bias for the recording medium, i.e. to suit the tape oxide, the relatively straight portions of the curve can be employed. Because the bias is at high frequency, the magnetisation produced by it is self-cancelling. That is, the "magnets" formed on the tape are of very short wavelength and immediately demagnetise themselves. But this means that the bias has to be of a frequency some five times or more that of the highest frequency signals to be recorded. We can use this technique for the relatively narrow bandwidth of audio signals, employing a bias signal of 60 to 100kc/s, but the video signal is a very different proposition, extending as it does from zero frequency (d.c.) to 3Mc/s and more, depending on the system, so that a different technique is required.

Video signal circuits

As we can see from Fig. 5, the video signal to be recorded is applied to a modulator stage after a bit of shaping, pre-emphasis and sampling for monitoring and metering, then amplified in special limiting record amplifiers and finally applied to the recording head.

Thus the playback signal coming from the head on replay is a radio frequency signal, and has to be equalised to compensate for the recording characteristic before being demodulated. Note that limiters are again used, just as in a v.h.f./f.m. radio. It is vital that any amplitude variations, that would show up as noise, are kept to the utmost minimum.

A common record/playback video head is used. This has the advantage that head characteristics, which can vary with uneven wear and cause stabilisation problems, will be common to both record and playback, and can be allowed for by adjustment of the playback equalisation circuits. The output from the head on playback is amplified and equalised before being limited. It is obvious then that the pre-amplifier circuits must be of the highest quality or unwanted distortion will ruin the signal, and no amount of compensation can then remedy things.

The equalised signal is then passed through the limiting chain. Remember, this is still a frequency modulated signal. Interference, and the small variations of tape-to-head contact which result in changes of amplitude, can be "chopped" off by the four stages of limiting and the signal is next passed to the detector in the usual way. Note, however, a small refinement to augment this limiting action. This is the sensing circuit, which samples the signal level and uses this sample as a control to clamp the video output section of the circuit. The clamp is normally set to a mid-grey level, and the principal reason why this additional complication was considered necessary was to allow for the small differences in level that occur when the head leaves the tape and re-enters the tape path with each revolution.

The video output circuits are fairly conventional except for the inclusion of some strict filtering, but another refinement is the use of an r.f. modulator. This small piece of equipment, which other makers are now producing as an extra with cheaper domestic machines, uses the video signal to amplitude modulate a carrier which can be applied to the normal aerial socket of a television receiver so that this can be used as a monitor. The modulator can be pre-tuned to any of the standard broadcast bands.

The bandwidth of the machine described is from 20c/s to 2·5Mc/s, video, with a signal-to-noise ratio of 40dB. The audio channel, which is not shown in the block diagram, is a conventional tape recording system used with microphone or line inputs. The VR6000 has an internal loudspeaker for moni-

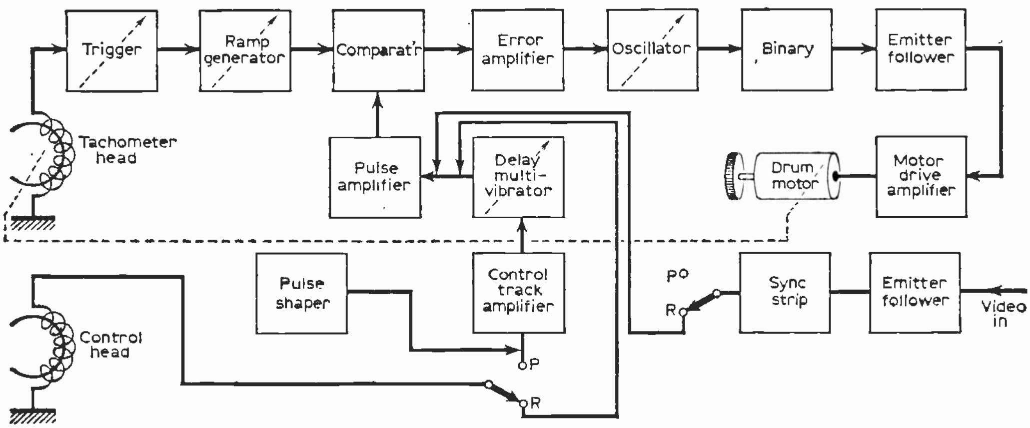
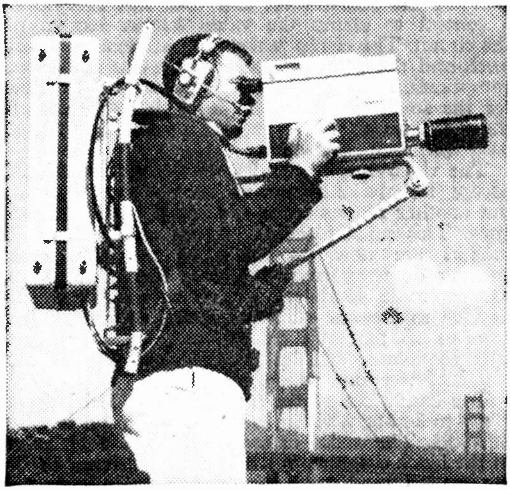


Fig. 6: Block diagram of the servo circuits used in the Ampex VR6000 video tape recorder.

toring. Response of the audio channel is good by domestic standards, extending to 12kc/s with a signal-to-noise ratio of 46dB.

Speed control

Speed control is extremely important with a video machine, where the closeness of the adjacent video tracks and the need for synchronism to lock the timebases of the recording camera or the replaying monitor, or the actual video recorder to the incoming video signal, mean that any small variation in speed plays havoc with the reproduced picture. For example, the replaying of a still frame may be noted on some machines accompanied by an unmistakable judder. Whereas this can be eradicated on the very expensive transverse scan machines, it becomes noticeable on helical scan machines merely because the angle of head travel relative to the recorded tracks is very slightly different with a moving and with a static tape. Thus



Ampex VR3000 lightweight portable video recorder.

the head tends to skip from one track to an adjacent track as it travels around inside the drum. Hence the small "jump" in the picture at the point of changeover. An additional reason, too, for the video switch in the replay circuit to ensure that the disturbance when the tape begins moving is kept to the minimum.

This disturbance is, in fact, one of the drawbacks to less ambitious machines, where the settling down time runs into several seconds each time the machine is switched from record to play, or from neutral to either mode.

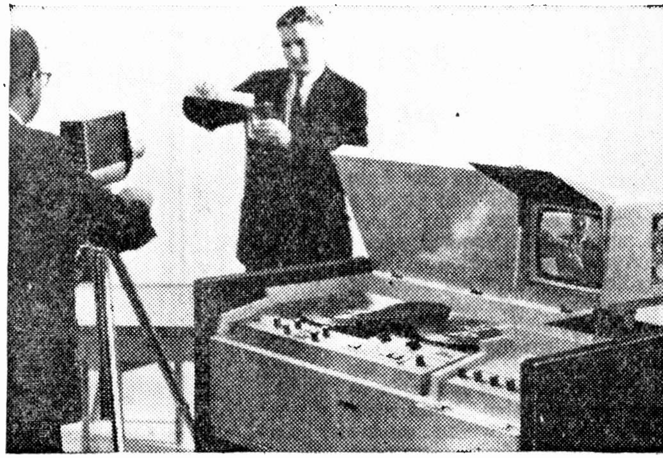
Servo system

This need for exact synchronism helps explain the apparent complexity of the servo system, roughly shown in block form in Fig. 6 (and this block diagram is itself a considerable simplification). Note that the servo system is tied entirely to the action of the drum, with its head drive motor—not to the capstan. The capstan tape drive has its own motor which is locked to the mains frequency all the time. And, in fact, the wow and flutter figure for the VR6000 is stated to be less than 0·2 per cent r.m.s. The later CV7000 model has the better figure of 0·15 per cent.

On record, the field synchronising signal is the reference. This is taken off at the sync strip and fed to a pulse amplifier and thence to the comparator stage. From the tachometer head mounted on the head drum a signal proportional to the drum rotation is obtained. This signal is used to generate a ramp waveform whose slope is proportional to the angular position of the motor (and thus of the head itself).

The two signals are compared and the error read off. This again is a simplification, for the two signals are very dissimilar. The ramp has a long time-factor in comparison to the field pulse, which is sharpened to sit in the null points of the ramp. If, then, the sampling pulse (shaped field pulse) arrives too soon, it is on the positive side; and if too late it provides a negative output. When in step, the pulse is centred, giving zero output. The resultant error voltage is amplified and used to control an oscillator which drives the motor through a power amplifier so that the speed of the motor is directly related to the control pulse arrival.

On playback, the action is rather different. The field pulse is also used on record to provide a control pulse which is recorded on the track along the top of the tape (see Fig. 4). This control signal is employed on playback as the reference. It is amplified, then delayed by being applied to an adjustable multivibrator, and then becomes the sampling pulse which is compared with the tachometer signals. The delay is made adjustable to allow the operator to align the video head on the previously recorded tracks. This is necessary not only to achieve synchronisation but also to obtain the best possible signal-to-noise ratio.



"In the classroom": Ampex videotrainer with monitor.

Portable models

The VR7000 is a development of this system as a portable machine (size 29 x 18 x 15in. and weight 80lb., which in the world of video tape recorders comes into the "portable" class!). Our photograph shows a further development of this machine for classroom work; and this machine, which contains a video tape recorder, television camera, 9in. monitor receiver and all the necessary accessories for closed-circuit television is classed as a "mobile" machine. It is self-contained and the monitor is mounted so that it can be elevated and swivelled for ease of viewing, though of course the usual monitoring facilities allow coupling to external receivers.

For a really portable machine, the VR3000 is the latest answer. Our photograph shows the operator shooting an outdoor scene. This pack, which is a recording machine designed to be played back through any compatible system, weighs only 35lb. complete with harness. It is a slightly different class of machine, using a four-head system with transverse recording at 15 in./sec. speed, the 8in. spools giving 20 minutes' recording time. Much of the circuitry is automatic, allowing the operator full range-finding and viewing control as with other types of picture recording devices. The camera itself is a very special piece of equipment—but more about cameras later.

to be continued

CO-CHANNEL INTERFERENCE

—continued from page 57

but for the best ratio (biggest difference) between the main station and the co-channel station. This applies particularly to those viewers living at high altitudes by the sea.

FILTERS

Readers often ask whether it is possible to filter-out the offending co-channel station. The answer is generally no, because the signals causing the interference are actually within the passband of the wanted signal. However, of recent years attention has been given to this problem (on the Band I channels) by a colleague, C. Bovill, who has developed a filter, based on a design by the Post Office, for "notching-out" the offending co-channel carrier without badly affecting the main channel information. This is a "bridge-type" filter with a rejection ratio in the order of 100 times over a few kc/s within the vision passband (see Fig. 6). The filter is designed for connecting between the set and the Band I aerial downlead and then has to be very carefully adjusted (tuned and balanced) to delete the co-channel interference.

The author has been conducting a series of tests with this filter, since he is located in a good co-channel interference area (at a high site by the sea), and some idea of the effectiveness of the device is given by the untouched off-the-screen photographs in Fig. 7. Here (a) shows the reception badly affected by co-channel interference, while (b) shows what happens as soon as the filter is connected and adjusted. It is truly remarkable.

Arrangements are in hand to manufacture and distribute this filter up and down the country to radio and television dealers, especially in those areas which suffer most from the disturbance. More details about this will be published later in these pages.

In conclusion it should be mentioned that some of the pictures in Fig. 1 and those in Figs. 5 and 7 are taken from the author's *The Practical Aerial Handbook* (Odhams Books Ltd.) which covers TV aerials, signal propagation, interference and its suppression and the choice of u.h.f. and other aerials. ■

UNDERNEATH THE DIPOLE

BRITISH sport is being exported — by television — to the U.S.A. It all started with an interest taken in Association Football ("Soccer" to you and me) by the American fighting forces which led to a growing interest in the game by the American public (which also means the TV public).

It didn't take long for Lew Grade, head of ATV to detect a possible new market for filmed and taped British football games on American television. These recordings appeared on some of the networks, clicked satisfactorily on the audience ratings and encouraged the spread of the sport itself. Soccer is fine for television because it is simple to watch in long shot, lends itself readily to rapid vision mixing cuts and the use (with discretion) of the zoom lens.

Zoom Lenses

After all, the 10 to 1 ratio lens of, say, 28mm. to 280mm. variable focal length can expand from a close shot of the referee to a wider angle long shot of an entire football pitch. Long before film producers took it up or the ITA came into existence, the BBC encouraged the use of the zoom lens, the first really successful example of which was made by Taylor and Hobson of Leicester before the war, had a 4·5 to 1 ratio and was initially aimed at the film production industry. It didn't at first cut much ice in film studios as, obviously, you don't need many football pitch sized shots in the average interior scene. However, the T.T. & H. Company, world leaders in fixed-focus motion picture camera lenses, soldiered on with zoom lenses for television cameras of various types. They have now attained such an importance that camera designers are beginning to plan film or television cameras around these lenses, instead of fixing the lens on the camera. These British zoom lenses are not only incorporated in the design of Marconi, Pye and E.M.I. television cameras, but also in TV cameras built in other countries. They are beginning to be used in film studios too; not just for zooming but as variable focus lenses in place of the usual turret of several fixed lenses.

Persistence of Vision

When I was in New York recently I became conscious of the absence of flicker when looking at pictures on TV monitors at the studio or on television receivers as compared with the pictures on British television. This is more noticeable when the brilliance is well up and the ambient room-light well down. The absence of flicker is accountable, of course, to the 60c/s American mains supply compared with our 50c/s supply.

I was reminded of this phenomenon when browsing over a volume of *The Optical Lantern and Kinematograph Journal* of the year 1906, in which the late Theodore Brown wrote an article about the then standard speed of 35mm. motion picture film— sixteen frames per second. He put forward a cogent argument in favour of the film transport speed being increased to 24 frames per second on the following grounds: (1) projection would be practically flickerless; (2) jerking movements in near subjects would be eliminated; and (3) overall results would be more realistic.

At this particular time 1906, flicker in its worst form had been reduced by adding one or two equally spaced small blades to the shutter which usually revolved in front of the lens, supplementary to the blade which covered the movement from frame to frame of the film in the gate. The increased number of phases ironed out a lot of the flicker.

Lime light

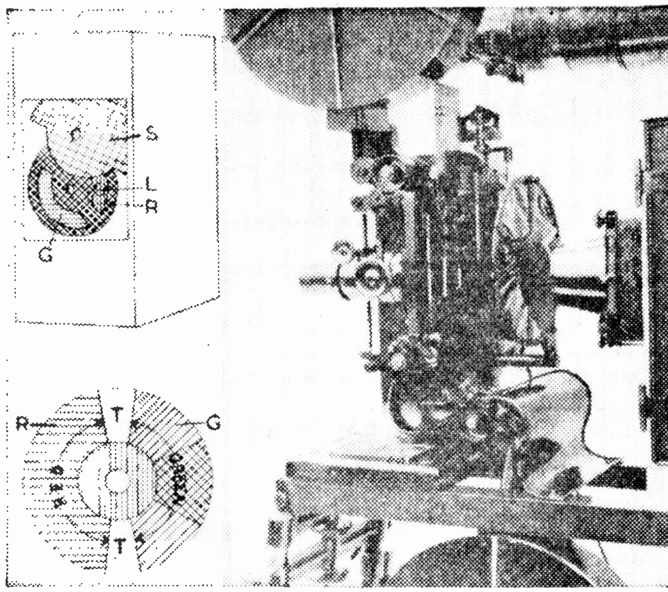
This reduced the light reaching the screen, which was already weak — necessitating very light film prints, known as "limelight" prints. That was an accurate descriptive name because many travelling fairground film shows used lime light, a perfect white illuminant evolved with a special gas-jet device for spraying the flame of a mixture of oxygen and hydrogen (or, sometimes coal-gas) on a lime cone. It was a fine white light, beautifully steady, but there was not enough of it. Improvements were made with a thorium pastel, a kind of lozenge like a wireless crystal detector gripped in a holder in much the same way. The electric arc superseded the lime light—but film transport speed on cameras and projectors remained at 16 frames per second until 1928, when it was at long last increased to Theodore Brown's suggested speed of 24 frames per second.

It only goes to show that the fundamentals of persistence of vision persist, from the days of Edison's Kinetoscope, the street cinematographs and the fairground shows of 1906 through the progress of modern widescreen cinemas and CinemaScope right up to the flying-spot colour TV telecines of this day and age. Interesting, too, to notice that some of the fundamental optical principles of the twin-lens flying-spot telecine of today were foreshadowed to some extent in the flood of patents based upon optical illusions made possible by persistence of vision. At that time, in 1906, patent applications in this field were almost as numerous as those for perpetual motion—and almost as feather-brained!

Kinemacolour

Browsing on in Theodore Brown's 1906 notes on "Possible Improvements in Living Pictures", I was interested in his further comments on flicker-reduction improvement noticeable in the reproduction of colour motion pictures of the great Indian Delhi Durbar. It so happens that these spectacular ceremonial events were photographed on the Urban-Smith "Kinemacolour" process, a two-colour system in which the film frames were photographed alternately through magenta and blue-green filters. The same filters were fitted to the revolving shutter on the projector, the appropriate frames on the black-and-white print being synchronised in threading up the film. Wrongly threaded, it would be possible to reproduce a green-coloured cow on a red field!

Kinemacolour film cameras, made by the Moy and the Vinter companies (still very much alive!) were hand-turned at 32 frames per second and reproduced on projectors at the same rate. Persistence of vision carried over the basic image at this fast rate and the two colour separations at 16 frames per second. The great difficulty of the system was the large amount of light required for exposure on the insensitive orthochromatic negative film of that period and the limitations of a two-colour system. It would be interesting to see an old black-and-white Kinemacolour print on colour television, played off on a film projector type of colour telecine equipment fitted with the necessary two-colour filters on the shutter.



Left: Kinemacolour Film Camera, 1906. Right: Kinemacolour Film Projector, a two-colour filter process using black-and-white negative and prints.

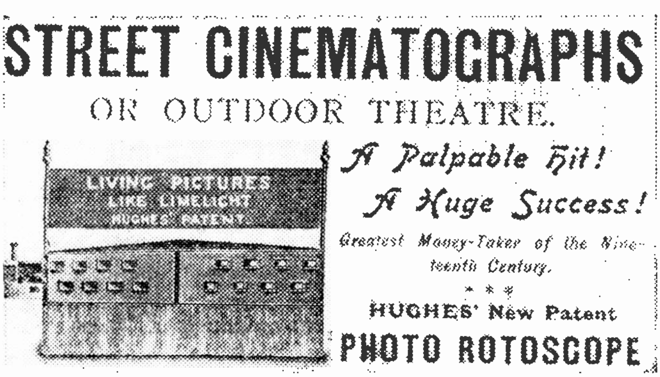
Before their Time

Some of the more sensible ideas that were patented in the search for motion pictures sixty or more years ago don't seem so feather-brained after all. In 1906, Eugene Lauste patented the idea of photographing sound on the same film as the picture. But thermionic valve amplification hadn't arrived and the first primitive talking pictures had to rely on the feeble sound from an Edison-Bell phonograph or a gramophone below the screen, synchronised to the distant projector with weird and wonderful Heath Robinson type electro-mechanical devices.

Early Sound

For years, sound amplification had to fall back on Brown microphone relays or on compressed air super-charging into the tone arm of a Stentorphone. Some of the oldest and, at the time, ill-fated ideas come to life again sooner or later. The original Edison Peep-hole Kinetoscope used 35mm. film with four perforations on each side per frame. Virtually the only difference from the 1889 Edison gauge to that of today is in the detailed shape of the actual perforations. Edison didn't bother to patent the Kinetoscope in England or Europe, so Lumière in France and Robert Paul in England copied it, developed it and turned it from a peep-hole machine into one which could project pictures on to a screen.

Iconos



As used at fairgrounds—Street Cinematograph of 1897. The audience viewed through the peepholes shown.

Servicing TELEVISION Receivers

No. 139 - BUSH TV135R/MURPHY V929 series —*continued*

by L. Lawry-Johns

Valve			Anode volts		Screen volts		Cathode volts	
			405	625	405	625	405	625
2V1	EF183		215	205	50	80	0·5	0·2
2V2	EF184		220	225	60	50	0·2	0·2
2V3	EF184		160	160	160	160	1·5	1·5
2V4	PFL200	a	183	92	192	126	4	0·5
		b	85	100	56	60	—	—
3V1	PCF80	a	102	102	—	—	5·5	5·7
		b	140	120	60	45	5·5	5·7
3V2	PL36		—	—	185	177	—	—
3V6	PCL85	a	28	28	—	—	—	—
		b	175	175	180	178	14	14·5
3V7	PCL82	tri.	95	95	—	—	—	—
		pen.	195	195	200	200	16·8	16·5

2V2 sound i.f. amplifier/limiter; 3V7 audio amplifier/output.

I.F. unit total current 60mA (405), 80mA (625). Main chassis total current 269mA (405), 286mA (625). E.H.T. 15·5kV. C.R.T. first anode 675V (405), 690V (625); cathode 227V (405), 220V (625).

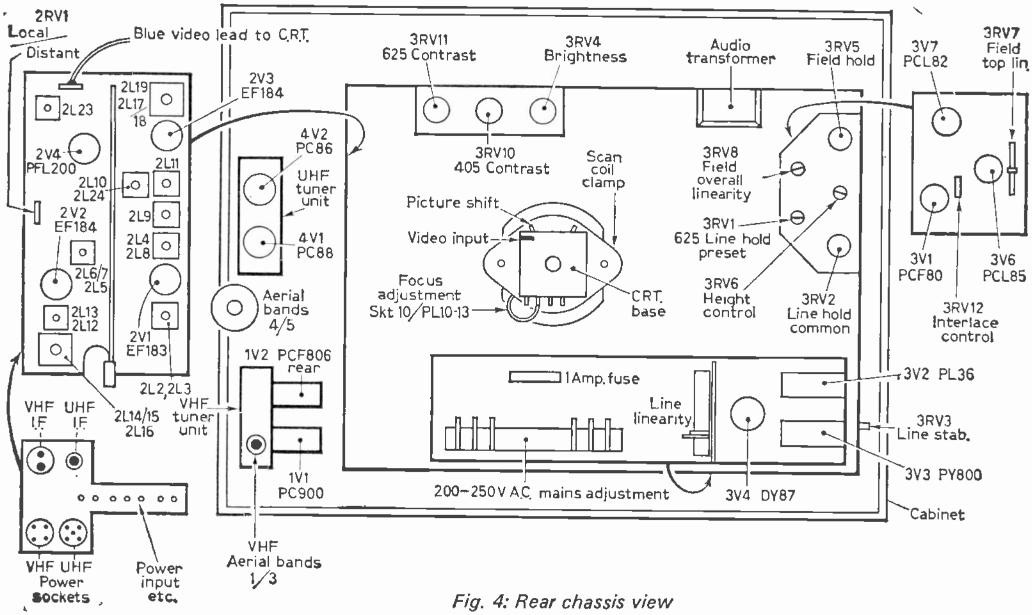


Fig. 4: Rear chassis view

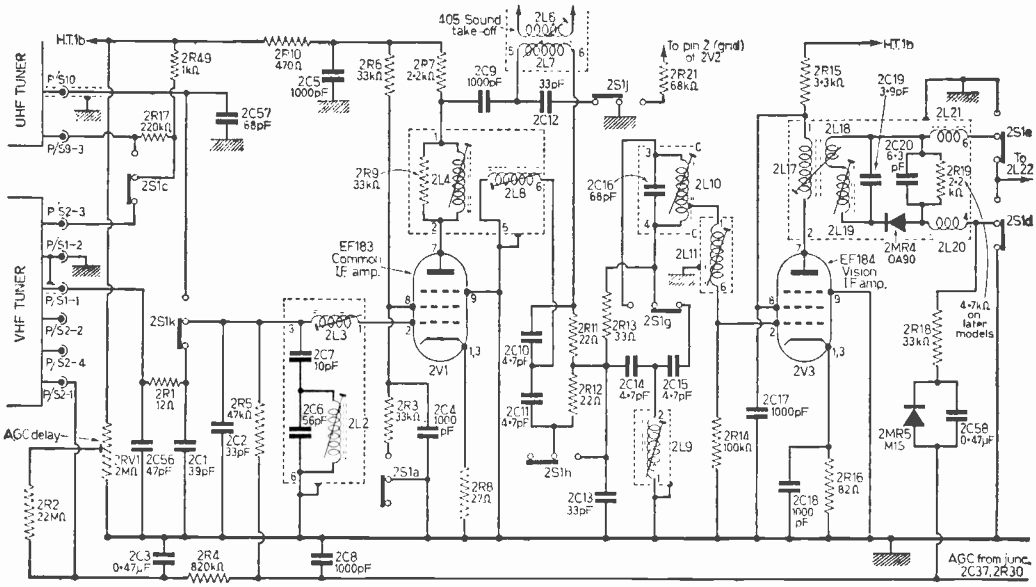


Fig. 5: The vision i.f. stages.

Tube removal

First remove the tuner units as previously described and then release the main chassis as follows. Remove the volume control knob, slacken the two nuts securing the volume control bracket and remove the control.

Disconnect the deflection coils plugs and loudspeaker leads. Remove the c.r.t. base socket and e.h.t. clip from the side of the tube. Disconnect

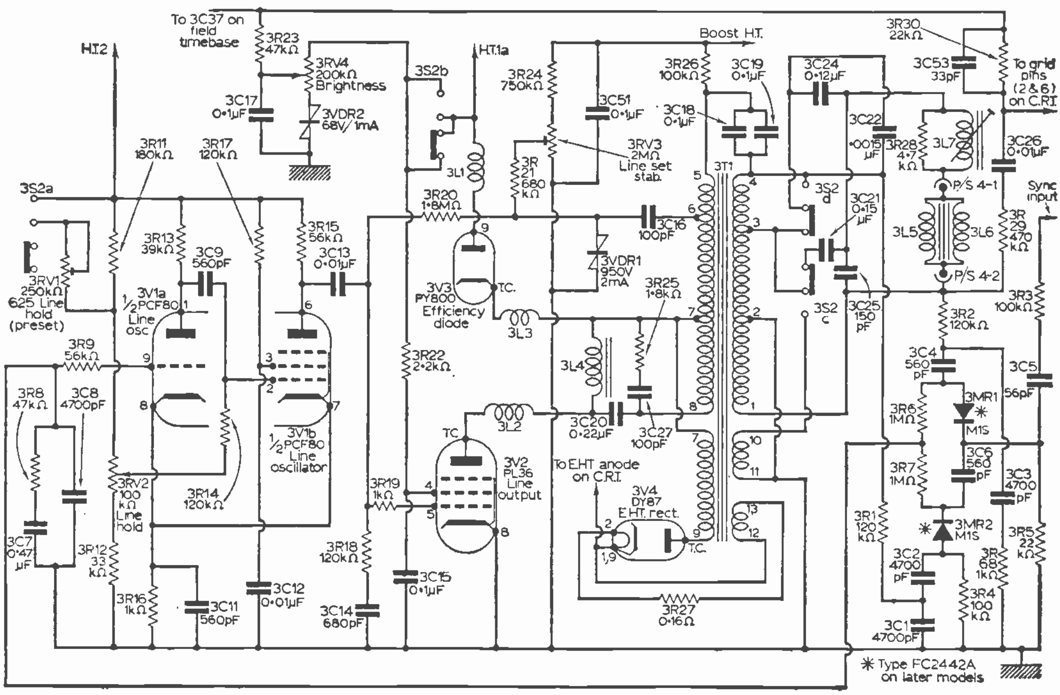


Fig. 6: Circuit diagram of the line timebase.

the wire clip and let go the system switch cable from the i.f. unit on the left side.

Remove the two 2BA screws securing the top of the main chassis and slacken the screws (two) securing the fibre clamps which hold the bottom of the chassis. Lift out the chassis and disengage the wire clip and system switch cable from the underside of the chassis.

To remove the tube, place the cabinet face down on a soft surface. Slacken the scan coils assembly clamp and remove the assembly. Remove the earthing lead and spring. Remove the four corner bolts securing the tube lugs to the cabinet brackets and lift out the tube.

The receiver unit (i.f. plate, etc.) can be separately removed from the main frame. To do this remove the socket strip and four plugs from the bracket on the rear of the printed panel. Disconnect the i.f. system switch operating cable by releasing the wire clip with the switch in the 625 position.

Unscrew the two screws securing the i.f. unit to the main chassis and carefully withdraw the printed panel. When replacing note that one of the securing screws also retains a chassis connection from the seven-pin socket strip.

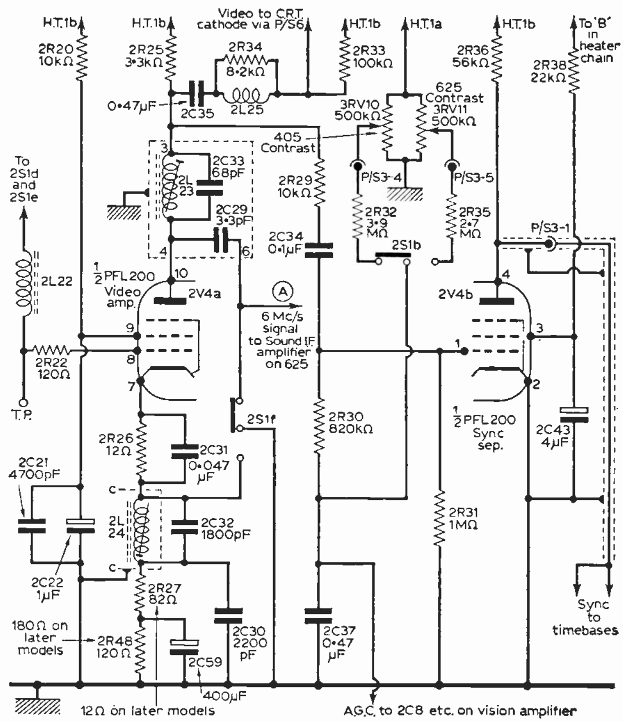


Fig. 7: Video amplifier and sync separator stages.

Setting the presets

A.G.C. Delay: This is for 405 only. This control is mounted on the i.f. strip (2RV1) and should be adjusted for freedom from overloading on local signals, consistent with a grain-free picture.

Interlace: 3RV12 is the interlace control which only requires adjustment when line pairing is obvious, i.e., the line structure is coarse and objectionable. Check effect on both systems and readjust if necessary.

Line Stabilising: 3RV3 is the stabilising control and is set during production. It should only be reset when line output components are replaced. The following procedure is advised.

Set height control for correct height on a test card. Reset 3RV3 for correct line scan amplitude so that the centre ring of the test card is circular (ignore the sides). Some side overlap (5—7%) is necessary.

This setting should result in a first anode voltage (boost line is higher) of 690V at pin 3 of the c.r.t. base.

Focus: The focus flylead is connected to whichever clip on the lower of the c.r.t. base panel gives optimum focus.

2V4 PFL200

This is the video amplifier-sync separator valve 2V4. Due to the reduced cathode bias when working on 625 this valve can show many fault symptoms when working on this standard but few, if any, when working on 405.

Typical symptoms are weak sync, overlight picture lacking contrast and dark and light bars across the screen denoting poor heater-cathode insulation.

Stubborn cases of weak sync may respond to a 25μF electrolytic wired across the 10kΩ 2R20 (negative to pin 9), deleting the 1μF to chassis. Other possible component changes to improve gain are indicated on the relevant diagrams and in the modifications list below.

Line hold

If line hold trouble is experienced first change the PCF80 line oscillator. If the trouble persists check the discriminator diodes, changing them as indicated on the circuit.

If the line hold is way off check 3C4 which may be shorted. Use only a high voltage component for replacement since it is subject to pulse voltages.

Narrow picture

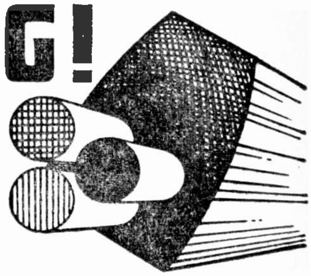
A picture which lacks width normally calls attention to the PL36 line output valve 3V2.

E.H.T Rectifier

The e.h.t. rectifier is a DY87 which occasionally suffers from an o/c heater, thus producing a "no raster" condition even though the whistle is fully audible on 405 standard. Check the heater pins for corrosion.

—continued on page 86

COLOUR IS COMING!



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

by A. G. PRIESTLEY

PART 6 — COMPLETE PAL RECEIVER

IT is now time to discuss the make-up of a complete PAL colour receiver and to see how it differs from an ordinary monochrome one. Because this is the point: a colour receiver is not a completely different piece of electronic apparatus. It is a monochrome receiver with extra circuits added to provide the colour information, together with certain auxiliary functions. Of course there are numerous differences in circuit detail and performance specification, but in this series of articles we are thinking in terms of general principles and discussing the functions of the various groups of circuits that comprise our basic building bricks. Let us continue this theme, and avoid the temptation to confuse the issue by exploring all sorts of interesting pieces of circuitry which are in any case much easier to sort out once the operation of the receiver as a whole is understood.

Figure 27 shows a simplified block diagram of a colour receiver. We have omitted such details as dual-standard switching, a.g.c., controls of all kinds, and have simplified the c.r.t. electrode structure. Notice that the chrominance and convergence circuits are shown dotted: take them away and you are left with an ordinary monochrome receiver. Of course this is an over simplification, but it is true as far as it goes and it helps to put things in perspective and to remove some of the "mystique" surrounding colour TV.

The chrominance and convergence circuits are described in separate articles in this series so we will regard them as electronic "black boxes" and content ourselves with summarising their functions.

The chrominance circuits accept the PAL colour signal, process it, and provide the three R—Y, B—Y and G—Y colour-difference output signals at a high level for driving the grids of the c.r.t. This is the information which, when added to the luminance signal (i.e. black-and-white or brightness information) at the cathodes of the three guns provides effective R, G and B drive voltages. These in turn give red, green and blue light outputs in the same proportions as those seen by the TV camera, and hence a true colour picture.

The convergence circuits provide current waveforms to the convergence yoke, and are adjusted so that the three electron beams in the c.r.t. all arrive at a single point anywhere on the shadow mask. This ensures correct registration of the three individual red, green and blue colour pictures.

We will now discuss each of the blocks of Fig. 27 in turn and see how they differ from ordinary monochrome receiver practice in their performance requirements and supplementary functions.

TUNER UNIT

Most colour receivers coming on to the British market during the next year or so are likely to be dual-standard models fitted with an integrated tuner. That is to say the tuner will handle all channels in Bands I, III, IV and V with bandwidths suitable for 405- and 625-line transmissions, as appropriate. Two coaxial inputs will be provided for separate v.h.f. and u.h.f. aerials.

So far the requirements are exactly similar to those of a monochrome receiver, but for colour reception a higher degree of oscillator stability is called for. This is because the chrominance passband is much narrower than the luminance one, and so an amount of r.f. detuning which is reasonably acceptable on monochrome may well cause an almost total loss of colour information. The total detuning produced after correct initial setting is the sum of the tuner oscillator drift due to heat, ageing, and changes in mains voltage, plus errors caused by inaccuracies of the tuner push button resetting mechanism if this kind of device is used. Some manufacturers are overcoming tuning errors by using a.f.c. at added cost and complexity. Another approach is to fit some kind of visual tuning indicator so that the customer can easily re-tune his receiver when necessary.

I.F. STRIP

Here again little difference will be found in the early circuit stages of most dual-standard i.f. strips. Transistors will probably be used in nearly all designs and the i.f. response curves will be much the same. The 405-line sound take-off, sound i.f. amplification and a.m. detection need not be affected by colour requirements, but the 625-line f.m. sound may be extracted from any one of several different circuits. The main divergence from monochrome practice is in the various possible detector arrangements which enable separate luminance, chrominance and f.m. intercarrier sound outputs to be extracted. The overall i.f. response will depend upon how these three outputs are obtained.

At this point we have to begin to generalise.

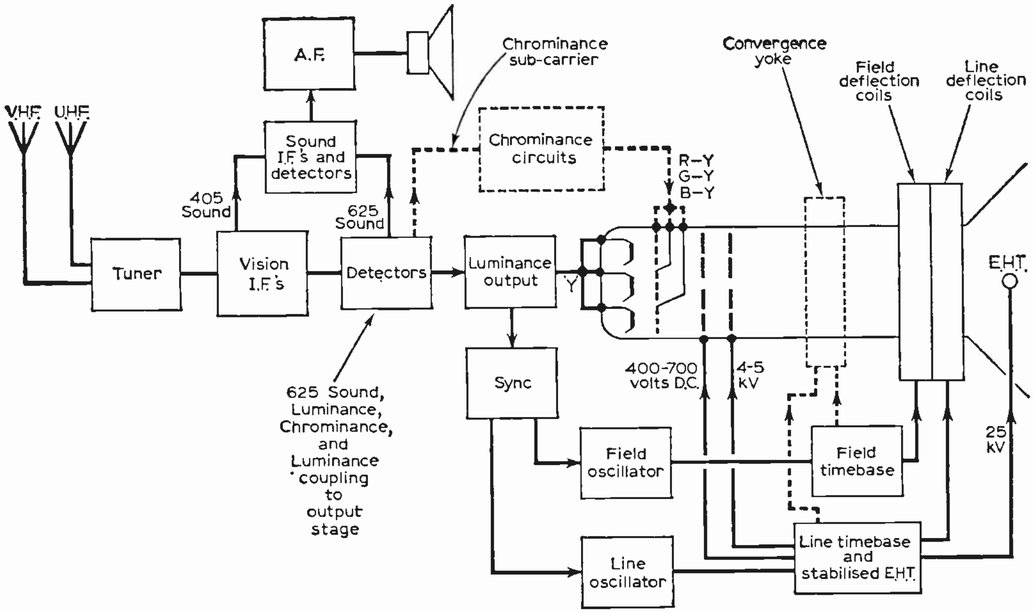


Fig. 27: Simplified block diagram of a colour receiver, omitting dual-standard switching, a.g.c. circuitry, all controls and the grey-scale tracking circuits.

because it would be difficult, and confusing, to list all the possible circuit configurations likely to be met in practice, although the circuit techniques involved are quite straightforward. Let us first summarise the requirements for 625-line operation.

The response at the input to the luminance output stage needs to be much the same as in a monochrome receiver, but with substantial attenuation in the region of the decoder reference oscillator frequency to avoid unpleasant 4·43 Mc/s patterning on the picture in areas of high saturation. The chrominance circuits need, ideally, a flat response extending about 1Mc/s above and below the subcarrier frequency. Suitable luminance and chrominance i.f. responses are shown in Fig. 28, together with a normal 405-line i.f. response. Bear in mind also that the 625-sound ledge in the luminance channel must have high attenuation in order to avoid a 1·6Mc/s sound/colour subcarrier pattern which has an unpleasant appearance on the picture. The intercarrier f.m. sound can be extracted conventionally.

A quick look at Fig. 28 seems to indicate that separate luminance and chrominance detectors are needed, possibly fed from separate i.f. stages. In fact this technique has been used on some NTSC receivers. It has the advantage that it is easier to obtain the good phase response that is so important if good colour performance is to be achieved.

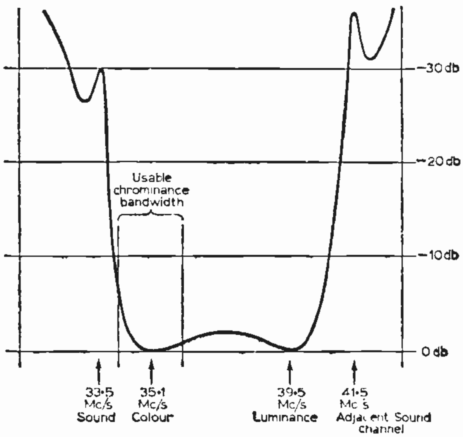
However, there is one circumstance which makes this unnecessary, the fact that the PAL system has a certain inherent robustness, particularly if a delay line is used in the decoder, which enables liberties to be taken in the i.f. and detector stages. In practice it is quite possible to use a single vision detector from which chrominance and both 405- and 625-luminance outputs can be obtained from a compromise i.f. response. The only penalty is that the r.f. tuning becomes a little critical, but good overall performance can still be obtained. A possible approach to the problem is illustrated in Fig. 29, together with the coupling arrangements to the luminance output stage. The requirements for adjacent channel sound and vision rejection are the same as in a monochrome receiver.

LUMINANCE OUTPUT STAGE

This stage has to accept switched 405- and 625-line luminance signals, both in the same polarity. The 405-line case presents no new problems, but on 625-line operation a special requirement has to be met. This arises from the fact that if you pass a signal through a tuned circuit, or a series of tuned circuits, it will be delayed by a time interval inversely dependent upon the bandwidth. Now the chrominance carrier has a usable bandwidth of about $\pm$1Mc/s, whereas the luminance signal has a bandwidth in excess of 4Mc/s. Other things being equal, the colour-difference information would arrive at the picture several millimetres after the luminance information to which it relates.

To correct this state of affairs a delay of about 0·6μS has to be introduced in the 625-line luminance channel, and this is done by means of a delay line. It usually takes the form of a piece of spirally wound coaxial cable specially designed for the purpose, or a bobbin with a single layer winding or a printed conducting pattern. This luminance delay line should not be confused with the PAL decoder delay line which serves an altogether different purpose.

The luminance delay line commonly has a characteristic impedance of 1—3kΩ, and must be



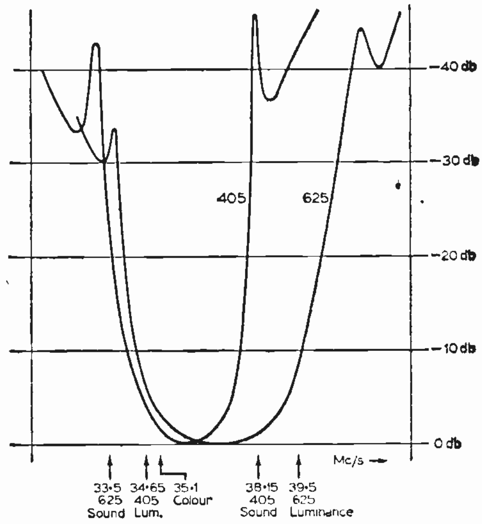


Fig. 28 (a) Suitable chrominance response for a separate chrominance detector. (b) 405-line response and a 625 compromise response using a single chrominance/luminance detector.

carefully terminated to avoid reflections up and down the line which would cause ringing effects on the picture.

The maximum peak beam current in a shadow mask c.r.t. is about 7mA, and a luminance drive of about 100V peak-to-peak is needed at the cathode. Add the sync pulses and the total signal excursion becomes about 130V p-p. This is much more than in the case of a monochrome c.r.t. and of course the extra capacitive load of three cathodes in parallel together with sundry associated components and wiring complicates the problem still further. It calls for a high slope pentode with an anode dissipation of at least 5W in order to allow for end-of-life conditions.

Due to problems in connection with grey-scale tracking which are discussed in another article in this series, brightness control may have to be obtained by varying the anode voltage corresponding to black level. This can be done by a d.c. control of the effective grid bias operating point. The anode voltage swing used for brightness control has to be added on to the 130V swing mentioned above, and so the requirements become still more stringent.

At some point between the luminance detector output and the cathodes of the c.r.t. sync pulses have to be extracted and fed to the sync separator. If they are taken off before the output stage some crushing can be allowed at the c.r.t. cathodes, which eases the luminance output problem, but the sync pulses are at a low level at the sync separator.

Another problem concerns d.c. coupling to the cathodes of the c.r.t. If the d.c. component of the signal is not well maintained the black areas of a picture will change depending upon the amount of bright highlights present. We have grown accustomed to this on dual-standard monochrome receivers, but on colour pictures it has a bad effect. This indicates that mean-level a.g.c. is rather unsatisfactory on 625-line operation in a colour receiver, although it may be adequate on 405 lines.

We have now compiled quite an impressive list of interdependent requirements in the signal channel between the luminance detector and the cathodes of the c.r.t. They are summarised in the block diagram of Fig. 29. The only basically new technique not found in monochrome receivers is the introduction of a luminance delay line, together with the problems of its correct termination at all frequencies in the passband.

The design of the luminance output signal channel is a neat example of true engineering. None of

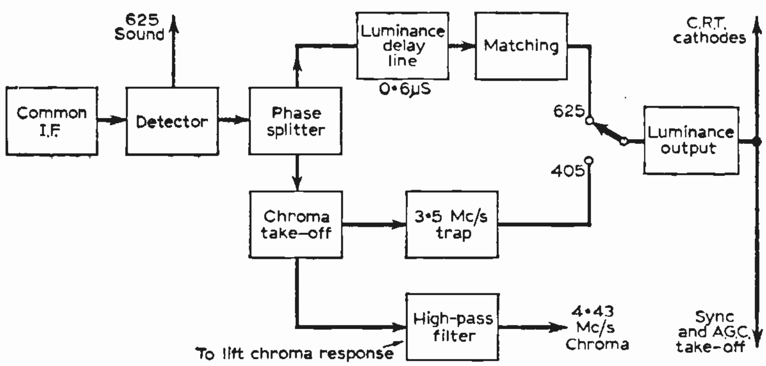


Fig. 29: A possible means of extracting luminance and chrominance information using a single detector, with suitable coupling arrangements to the luminance output stage.

the individual problems are very difficult, but to produce an overall design which meets all the electrical requirements and yet is economic, efficient, simple and reliable is no mean undertaking.

A.G.C.

We have just mentioned the importance of maintaining good d.c. coupling to the c.r.t. This can be done either by using 100% d.c. coupling at every stage between the luminance detector and the c.r.t. cathodes, or by using a.c. coupling followed by d.c. restoration at the luminance output stage. However, most of this comes to nought if we use mean-level a.g.c., because the black level will change with picture content.

This means that on 625-line operation colour receivers should have proper gated a.g.c., which measures the peak carrier amplitude, or a "sync tip" system which in effect measures the height of the sync pulses. A full dual-standard gated a.g.c. system is a difficult circuit to engineer, for one thing because of the considerable system switching needed. Consequently some receivers are likely to use some form of mean-level a.g.c. on 405-line operation in the interests of simplicity, cheapness and reliability. This has been common practice in the U.S.A.

FIELD SYNCHRONISATION

The basic synchronisation requirements of a colour receiver are the same as those in a monochrome one, but as in all the other building bricks of the block diagram of Fig. 27 there are one or two extra features or points of special interest which are worthy of discussion.

In the case of the field timebase the quality of synchronisation needed differs little from normal practice. However, there is one alleviating circumstance and one additional hazard. Due to the relatively large spot size of a shadow mask c.r.t., caused by the addition of three separate electronic beams with a high total current, it is not easy to see small amounts of imperfect interlace. The same amount of imperfection on a normal 19- or 23-in. monochrome c.r.t. would be easily visible. So, if needs be, there can be a slight lowering of standards without loss to the viewer.

The hazard consists of the extra amount of line flyback pulses which may get fed back to the field oscillator and thus cause interlace problems. Due to the large diameter of the neck of the three-gun c.r.t., and the consequent bulk of the deflection yoke, a considerable stray leakage field exists which will cause line pulses to be coupled into the field deflection coils, and also to be picked up on the wiring. These will tend to be fed back to the field oscillator either via the field output stage and linearity feedback network, or else directly via sync connections. A further feedback mechanism exists if a transductor is used with line and field scan current coupling to provide raster correction at the top and bottom of the picture. Here of course a direct path is provided for line flyback pulses to reach the field timebase.

Undoubtedly a problem exists, and a number of unobtrusive features will probably be found on colour receivers which have not so far been needed on their monochrome counterparts.

LINE SYNCHRONISATION

Line timebase synchronisation presents rather different problems. The PAL decoder needs a number of keying, gating and trigger pulses at line rate. If line sync pulses are used for this purpose they must have a high degree of immunity to random noise or interference in order to obtain satisfactory keying, etc. under fringe conditions. This suggests that special line sync processing must be provided in the form of clippers or ringing circuits, or even noise-cancelling arrangements.

If, on the other hand, line flyback pulses, which contain no noise, are used, the line sync and oscillator circuits must be designed so that virtually no picture movement occurs with change of line hold control setting. If this is not done the timing of the keying and gating pulses in the decoder will vary, and poor colour performance may be the result.

It is likely that all commercial colour receivers will use flywheel-sync controlled line oscillators, and it will be interesting to see how the various designers tackle the problems of obtaining good sync.

FIELD TIMEBASE

The choice of field oscillator may well be largely determined by the interlace problems mentioned earlier. There are a number of possibilities and we shall just have to wait and see what turns up.

The output stage presents few problems except that more scanning power is needed, and so a buffer valve (or transistor) may be used. More care must also be taken over linearity in order to avoid convergence problems. For the same reason it is desirable to achieve good stability of the scanning current from which the convergence control currents are derived. It is possible that a stabilised output stage will be used in some cases.

LINE OUTPUT STAGE

There are two major differences in the requirements of the line output stage when compared with monochrome practice. Although the basic scanning technique can be the same, the power requirements are greatly increased. In an all-valve circuit the total h.t. drain may be of the order of 100W. Consider the e.h.t. If the c.r.t. mean beam current is 1·3mA at 25kV, this represents a power dissipation of 32·5W without including the losses. When you include the scanning energy, e.h.t. and focus diode heater power, core and copper losses, boost h.t. drain, line convergence control current drain and sundry line pulse feeds you get a pretty formidible total. Pity the poor designer!

The other important point concerns the e.h.t. This must be maintained at a nearly constant voltage in order to avoid changes in the quality of convergence with changes of beam current, caused by varying picture content or different settings of the brightness or contrast controls.

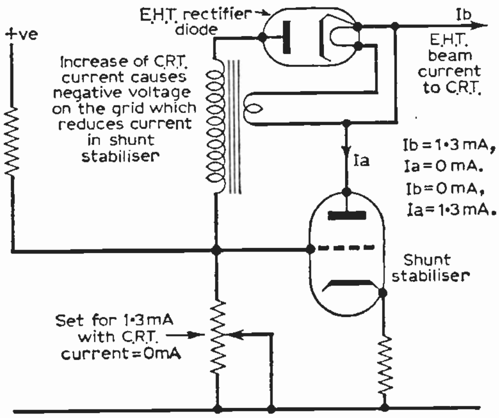


Fig. 30: Typical triode shunt stabiliser circuit which maintains a constant e.h.t. current drain, and hence a constant e.h.t. voltage.

One way of overcoming the problem is to use high voltage silicon e.h.t. rectifiers in a voltage trippler circuit. This gives good e.h.t. regulation—i.e. little change of e.h.t. with change of c.r.t. beam current. Another solution which has been almost universal practice in the past is to add a shunt stabiliser to the e.h.t. line as shown in Fig. 30. This maintains a constant e.h.t. current drain of the order of 1·3mA. If the c.r.t. is not drawing any beam current, 1·3mA flows through the shunt stabiliser. If on the other hand the c.r.t. draws 1·3mA, the shunt stabiliser is cut off by the control circuit. Between these extremes the current is shared between both loads to give the same total drain, and therefore a constant e.h.t. Other features of the line output stage will normally include v.d.r. stabilisation and a source of 4-5kV for the common c.r.t. focus electrode.

There are a number of subsidiary circuits and problems omitted from the block diagram of Fig. 27 in the interests of clarity. Some of these are mentioned in other articles of this series, but let us list briefly a few remaining items here.

C.R.T. FLASHOVER

Ordinary monochrome c.r.t.s operated at final anode voltages of the order of 18-20kV are prone to the occasional interelectrode flashover. Accordingly, simple circuit precautions are taken to prevent damage to components in the electrode circuits, and all that happens is that a sharp "crack" occurs from time to time.

In the case of colour c.r.t.s with a final anode voltage of 25kV and a much larger amount of stored energy the problem is more difficult, because the operating characteristics of the three guns may be slightly altered by a flashover, causing changes to grey-scale tracking and convergence, in addition to damage to various components. It is normal practice to fit spark gaps from the focus and first anode electrodes to chassis so that the very large instantaneous peak current on flashover is shunted safely to chassis without causing any damage whatever. Due to the high currents, and the inevitable inductance of the earth connections, the earthing arrangements are critical and once established they must not be altered. (Warning to service engineers!)

Perhaps another warning is timely here. On monochrome receivers 18kV will give you a nasty surprise and scorch your finger. On colour receivers with 25kV and much more stored energy *the e.h.t. is dangerous. Do not touch!*

VALVES OR TRANSISTORS?

The choice between valves and transistors, or a mixture of both, is not an issue of primary importance to the viewer. The choice is made on the basis of engineering considerations such as circuit cost; the ease of fitting groups of circuits together; heat; space; design know-how; established production techniques; problems of h.t. and l.t. supplies; company policy and the like. The all-important point is the quality of the engineering that is built into the complete product.

MAINS SUPPLIES

The power consumption of a dual-standard colour receiver is likely to be about 400 watts. Normal a.c./d.c. technique is suitable for the h.t. line, which will probably be of the order of 280V in order to ease line scanning problems. Separate l.t. supplies will be needed for transistor circuits, and in some cases these will be v.d.r. stabilised.

PICTURE CENTRING

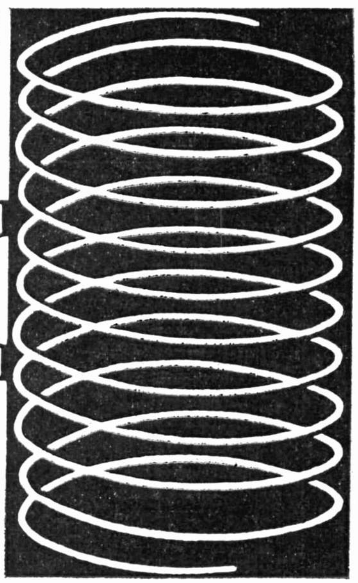
Due to the presence of extra magnetic fields around the neck of the c.r.t. to control purity and convergence it is not practicable to use centring magnets without upsetting purity and convergence. As a result, centring is achieved by passing d.c. currents through the field and line deflection coils, these currents being controlled by wirewound potentiometers. The control action is much easier than in the case of centring rings.

X-RAY RADIATION

Because of the high e.h.t. voltage that has to be provided a small amount of X-ray radiation will be emitted from the screen of the c.r.t. and from the e.h.t. diode and shunt stabiliser triode (if these are used). However, it can be stated with confidence that all receivers will be absolutely safe in the hands of the general public, and also during normal servicing operations provided the line transformer screening can is not removed. Without this screening, and under certain fault conditions, the X-ray radiation is increased and common sense indicates that precautions may be advisable in certain cases. Reference should be made to the manufacturer's service manual to find out whether any safety routine is recommended.

To be continued

HELICAL UHF AERIAL



JOHN D. BENSON

IN an unusual but efficient u.h.f. aerial which is widely used on the Continent the active element takes the form of a helix the construction of which is well within the capabilities of the amateur. The design given in this article is for an indoor or loft aerial as it was felt that an outdoor array called for constructional details outside the scope of the average experimenter.

It is not impossible for an outdoor array to be devised but it should be pointed out that for outdoor aerials the factors of windage and weight must be taken into account. If the present design is used for outdoor erection the woodwork supporting the helix should be lightened by drilling large holes along its length and the wooden framework must also be impregnated or varnished to provide protection against the weather.

The positioning of u.h.f. aerials is critical whether indoor or outdoor. Very often variations of the site by a matter of inches can mean the difference between good and bad reception. It has also been found that the highest point available is not always the best: it all depends on whether the received signal is in-phase or out of phase.

From these remarks it will be gathered that extra time spent on positioning the aerial by trial and error can be well repaid. In siting loft aerials particular attention should be paid to the position of the aerial relative to service pipes and water tanks, and during the selection of a suitable position for the aerial it should be ascertained that both sound and vision are equally well received. Cases have been known where the aerial had to be tilted several degrees from the horizontal to receive both sound and vision due to phase shift.

Feeder

Before proceeding to constructional details attention must be drawn to the type of feeder used for connecting the aerial to the receiver. It is well known that as frequency increases so do losses in associated equipment. This is particularly true at u.h.f., so it is of paramount importance that *super* low-loss feeder is used. The type to use is the air-cored variety and is available from most television dealers. If standard co-ax such as is used for Bands I and III is used, the loss in the feeder will probably reduce the received signal below usable level.

Gain

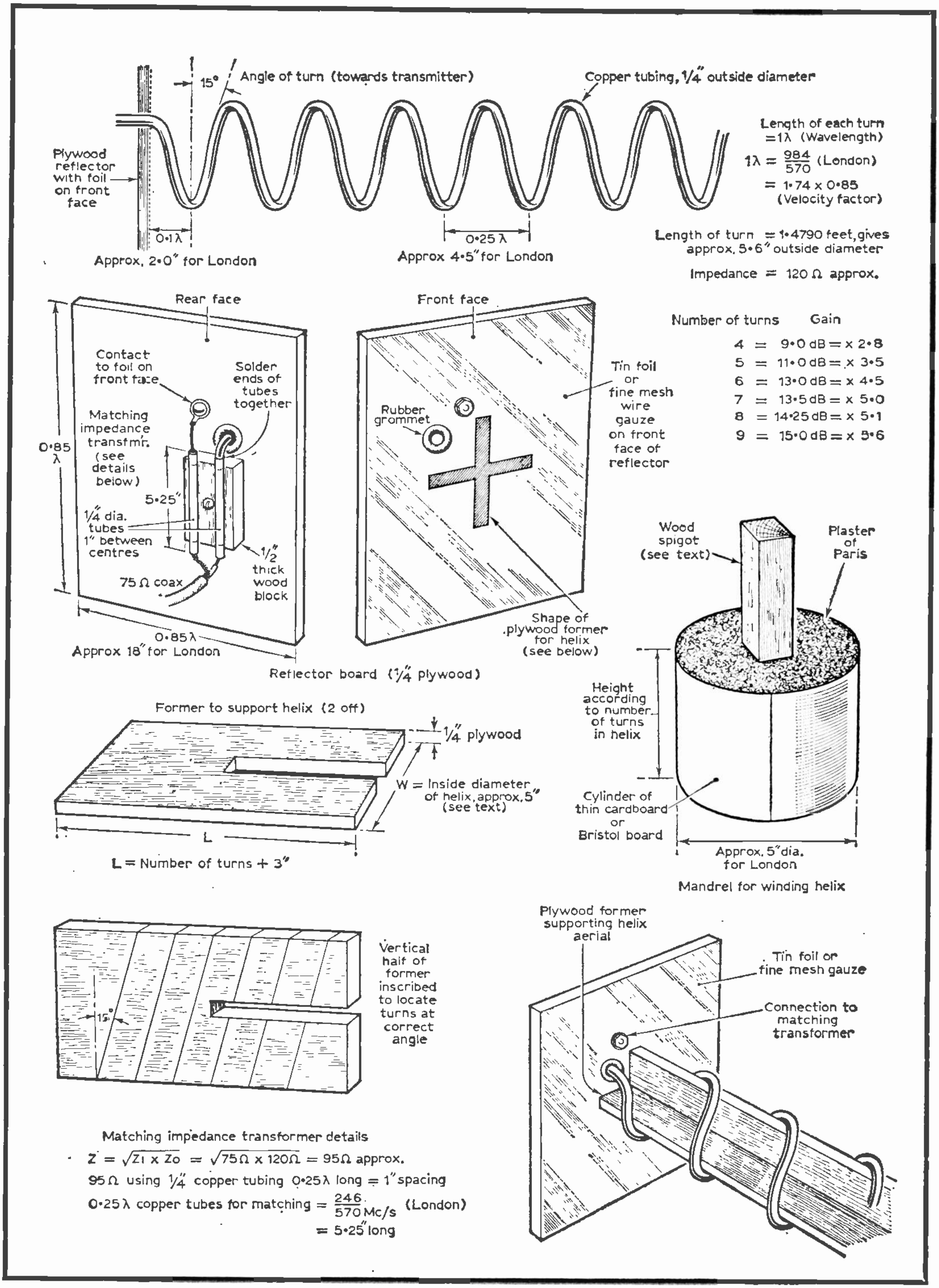
The gain of a helical aerial is governed largely by the number of turns in the helix and varies from 9dB for four turns to 15dB for nine turns. This represents gains of approximately 3 and 5.5 respectively. The diameter of the turns and spacing with relation to the frequency for which it is designed all contribute to the final gain as does the angle of the turns to the horizontal. The reflector increases the front-to-back pick-up ratio in the interests of reducing interference from sources behind the aerial.

Matching

The impedance of a helical aerial of the type we are discussing is approximately 120Ω, so it is necessary to introduce a means of matching this impedance to the nominal 75Ω feeder impedance. A simple quarter-wave matching section has been included in the design.

Construction

For indoor use, where weight is not important, the helix is constructed of ¼in. (outside diameter) copper tubing; this makes joining easier. For outdoor use aluminium tubing could be used in which case bolted joints, varnished to protect them against the weather, are advised. Having decided on the number of turns for the helix the length of tubing required can be calculated and two courses are open to the constructor. Either he can have the helix made for him by a friendly plumber or he can follow the instructions given for home construction.



Complete constructional details of the Helical Aerial.

From the measurements given it will be seen that the diameter of each turn is 0·31 x wavelength which for the London mid-band frequencies is approximately 5½in. The length of each turn is a wavelength. Allowing for the tube diameter a mandrel of about 5in. will be required on which to form the helix. If a suitable object cannot be found in the workshop or house a former can be made by first making a cylinder of thin cardboard the diameter required, and then filling the centre of this with plaster of Paris, having first inserted a wooden spigot in the centre to enable the former to be held in a vice whilst winding the helix. To prevent the tube kinking whilst being bent the tube should be filled with fine silver sand well tamped down and then plugged. After forming the helix the plugs can be removed and the sand shaken out. For outdoor use the tubing should be plugged after the sand has been removed, to prevent the ingress of rain.

The helix is supported by an X-shaped wooden former made from ¼in. or ⅜in. laminated board. A thinner section wood could be used but, if so, care must be taken with anchoring the turns of the helix to prevent splitting the laminated board.

It will be seen that the turns of the helix are inclined 15° from the vertical; this is important. The 15° incline reduces the internal bore of the helix. The turns of the helix have also to be separated so that the distance between turns, centre to centre, equals 0·25 x wavelength. The helix can be adjusted for distance between turns and angle, and from it the exact size of the former can be determined. Before fixing turns to the former, read the installation notes at the end of this article.

At the reflector end of the aerial the tubing passes through a ¼in. rubber grommet or alternately through the wood, making sure that the foil with which the reflector is covered does not make contact with the tubing.

In calculating the dimensions of the helix the formula (984 x 0·85)/f (Mc/s) was used; this gives the measurements in *feet*. The factor 0·85 is the velocity factor which must be included for tubing of the dimensions used (it will also hold good for other diameters of tubing). The quarter-wave matching section is made of the same tubing as that used for the helix and is calculated from the formula shown with the drawings. The spacing of the matching stubs for all frequencies is 1in.

The reflector is quite straightforward being made of light plywood covered on one side, that nearest the helix, with tin foil or fine mesh gauze. The matching section is fastened to the reflector on a block of wood which is in turn glued or screwed to the reflector on the side behind the helix.

Matching section

One tube of the matching section is soldered to the helix, the other being soldered to a lead which passes through the reflector board and is connected to the tin foil by a nut and bolt. The free end of the matching tube connected to the helix is soldered to the inner of the co-ax cable; the other matching tube free end is soldered to the outer braid of the co-ax. If the aerial is mounted

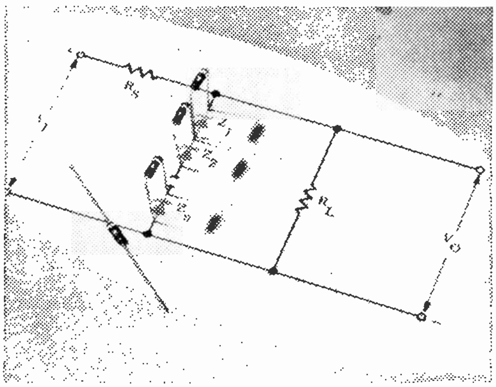
—*continued on page 80*

TRADE NEWS • TRADE NEWS • TRADE NEWS TRADE NEWS • TRADE NEWS • TRADE NEWS

NEW ZENERS FROM MOTOROLA

A NEW series of ½-W Surmetic "20" zener diodies is available from Motorola Semiconductor Products Inc., York House, Empire Way, Wembley, Middlesex.

Priced as low as 4s. 1d. (10% tolerance, 100 up), the IN5221-81 devices cover a zener voltage span of 2·4 to 200 volts and, although rated at ½-watt with normal mounting conditions, they have demonstrated excellent failure resistance when overstressed in 1-watt, 1,000 hour testing. All units are 100% oscilloscope tested and characterised at



six critical points including temperature coefficient, and have a 10-watt surge rating. All devices above 14 volts have a leakage current typically less than 100 nanoamperes.

High-temperature and high-humidity operation is possible as a result of flame and distortion resistant plastic DO-7 packaging. The 200 deg. C. operating temperature and the excellent results of repeated 50-day moisture resistance tests (5 times the exposure required for standard mil-type case integrity tests), offer high design confidence for severe environments. The leads are readily solderable and weldable.

All special requirements, such as non-standard voltages, matched sets, double anode clippers, and tight-tolerance types can be supplied.

SERVICE AID PRODUCTS FROM PHILIPS

A NUMBER of new service aid products, including an entirely new Tool Case priced at 8 gns. net, and new forms of storage packs for standard replacement electronic components, are announced by Philips.

The case itself is moulded from almost unbreakable charcoal grey polypropylene, with a moulded handle and four lockable satin-finish catches. An extremely flexible tool retention system is employed: two leaves, each containing a moulded grey polythene base pierced with hundreds of holes, allows for the insertion of specially-designed eccentric red polypropylene pegs. A skeleton outline of each tool to be retained is made with a small number of these pegs.

By rotating each peg, the gripping surface may be brought into contact with the contour of each tool. The design of the peg, and the spacing of the holes, is such that a vast number of differing shapes and sizes of tools can be accommodated.

A complete complement of electronic tools, essential for modern service practice, is being made available separately at £15 10s. net.

NEW B.L.P. SCOPE FOR COLOUR TV

A NEW instrument to simplify the work of engineers setting up colour TV receivers has been introduced by Philips. Called the Philips B.L.P. Scope (Beam Landing Pattern Scope), it is basically a periscope and microscope combined and enables the engineer to observe the beam landing pattern in relation to the phosphor mosaic on the cathode ray tube at x 30 magnification.

The image is viewed from the back of the set, allowing the engineer to adjust the controls there and observe simultaneously the effect on the pattern produced by control adjustments. This rear-viewing facility eliminates the need for repeated movement of the engineer between screen and controls or the use of two engineers to adjust and inspect the dot pattern.

Other features of the Philips B.L.P. Scope, priced at £25 net trade, include: a built-in battery-operated light to illuminate the mosaic; adjustable height, which permits the viewing of all parts of the cathode ray tube and use of the Scope with a variety of cabinet styles; excellent colour-corrected optics, giving a sharply-defined image; and the elimination of focus controls.

It is available from Amalgamated Electric Services Ltd., Waddon Factory Estate, Croydon.

INSIDE tv TODAY

PART 3   M. D. BENEDICT

IN this country over 100 television studios are operated by more than 20 different companies for many different uses. Obviously these studios will differ in many respects, but in this article a typical studio is examined.

Almost every aspect of a television studio design is unusual. Even the floor is special. It is smoother and more level than a billiard table, usually being made of special tiles not unlike linoleum in texture, laid on several feet of concrete base. The studio is usually very high with many beams to carry hanging scenery and lighting equipment. In fact, the usual ratio is around two units high to three units broad to four units long, so that a studio 100ft. long will be over 50ft. high. It is common to have a false ceiling of catwalks in order to enable the lighting equipment to be reached and to facilitate erection of hanging scenery. Large doors have to be able to accommodate huge vehicles or tall scenery flats, yet still provide a high degree of sound insulation from outside noises. The heat of the lights means that complex air conditioning is necessary, and this must be completely silent. When these initial requirements have been met, the ancillary rooms must be considered.

Foremost in importance is the production control room, sometimes called the *gallery*. Next to this, on either side, is the *sound control room*, where the sound is balanced and mixed, and the *vision control room*, where the lighting supervisor and vision engineer operate. The camera control units are to be found in the apparatus room, often called racks.

Signals from the cameras are fed to the camera control units (C.C.Us) via a special plugging system such that any camera can be connected via numerous points around the studio to its particular C.C.U. This allows the camera cables to be kept out of the way and reduces tangling of cables (which occurs during a production as each camera moves from area to area, unless special precautions are taken—on several occasions live programmes have been put off the air for this cause, when cameras could not get to the correct area in time). Other equipment in the apparatus room is the actual vision mixing unit and all electronic apparatus for the studio. After processing in the C.C.U., three vision outputs are fed (1) to the vision mixing unit, (2) to monitors stacked in the various control rooms and (3) for previews at various pluggable monitor points (see Fig. 4).

Vision Mixing

Vision mixing units (usually called *vision mixers*, not to be confused with the person who operates the unit, who is also called a vision mixer) are usually remote controlled from a control panel in the production control room, the actual mixing and cutting being performed in the apparatus room. Vision mixing units allow the selection of one (or more) cameras by switching (called cutting), dissolving or mixing (fading one camera out and another in simultaneously), or by wiping. Wiping is a particular form of special effect usually called *inlay*, this being a method of achieving a composite picture from two sources by switching from one camera to another within the picture. Where this switching occurs is determined by a signal generated electronically in the case of a wipe, or derived from a camera in other cases. With a wipe the switching point occurs at a horizontal, vertical or diagonal line, or a square or circle, as well as other geometric patterns. The position of the line and the size of the patterns can be varied by a control on the vision mixing panel. With a typical wipe, a vertical transition line would move from one side across the screen, until the new picture is completely revealed.

These effects are usually controlled from a vision mixing unit panel mounted in the production control room desk. On this panel are mounted rows of push buttons and special levers called quadrant faders. Depressing a push button selects the corresponding camera, telecine, video tape recorder or outside broadcast by cutting. The quadrant faders, a form of potentiometer, control the signal level of each source in a similar manner to volume controls in audio, and so control the mixing and superimpositioning of each source.

Early vision mixers featured a row of cut buttons above a row of faders, the output of these cut buttons being selected when cutting and the output of the faders when mixing or superimposing. Modern studio mixers favour a smaller mixer in which 8—10 channels are combined, but this forms only part of the complete vision mixing unit. Two banks, as these mixers are now called, are fed to a two or three channel combining mixer which can cut or mix between the complete banks as described and the third channel, which is usually a special effects or inlay bank. Each vision source appears on its corresponding button and fader on each bank.

To appreciate the use of the two banks of the mixing unit, consider a drama sequence requiring Camera 1 and Camera 2 to cover the final scene, then the superimposition of Camera 3 and then Camera 4, bearing the title and the writer's names respectively, to appear in the appropriate part of the scene from Camera 2's final shot. On one bank, A, the vision mixer will cut between Cameras 1 and 2. Meanwhile, on the other bank, B, the vision mixer will superimpose Cameras 3 then 4 and, by viewing his output, the director can see the resulting superimposition and align it by instructing the cameramen. When the scene finishes, the vision mixer will cut or mix from A bank to B bank with the correctly aligned composite shot.

Some studios have a special effects unit for the inlay and similar special effects appearing as a third bank, some as a source on each bank. Other simple mixers feature two rows of cut buttons, forming a bank, each bank feeding a fader, the output of the two faders being combined. Thus vision sources can be cut between each bank and when a mix is required the source being mixed is selected on one bank, which is faded down, and then both faders operated to mix through.

A disadvantage of this system as it stands is that superimposition of more than two sources is impossible. ATV, at their Elstree Studios, use an interesting version of this system in which two such units are used as banks, the output of each bank appearing as a source on the other bank. Although this sounds complicated these mixers are very easy to use with a bit of practice and such a mixer is ideally suited for special effects such as wipes. It is believed that colour television will require the use of wipes much more than mixes so that such mixers may well come into general use when colour becomes nationwide.

In the gallery: the vision mixer sitting at her vision mixing control panel. Wipe and special effects controls to the right, with one of the two banks in front of her. On her left sit the director and the production assistant with a bank of telephones. They face an array of monitors, a clock, and a monitoring loudspeaker. The desk is deep enough to carry scripts, stopwatches, sweets and other essential items. *Rediffusion photo.*

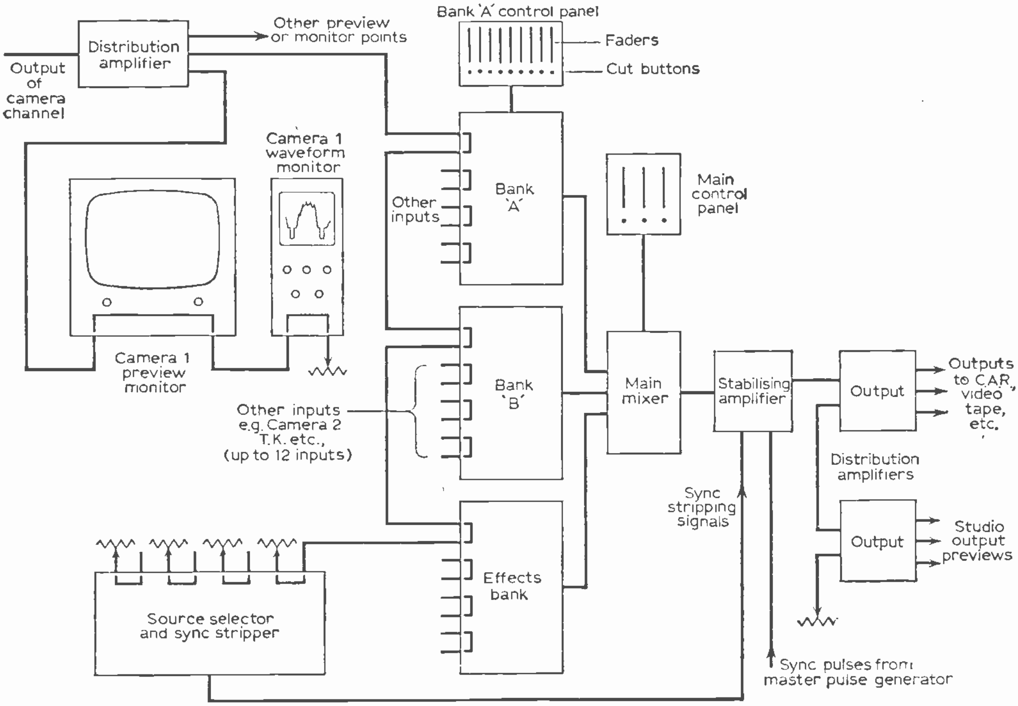


Fig. 4: Studio vision mixing arrangement.

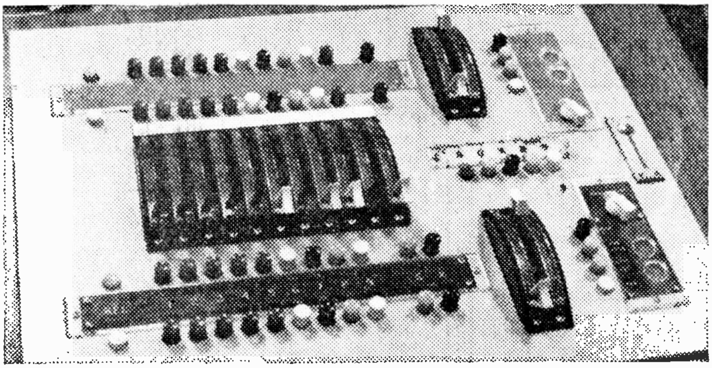
Mixing Units

Modern vision mixing units consist of variable gain amplifiers mounted in the apparatus room controlled by bias from the corresponding faders and cut buttons in the gallery. In order to produce a clean cut it is sometimes arranged so that this occurs only during field blanking. As a result, interference caused by the cut is minimised. Inlay is performed by a fast electronic switch which is brought into action at a particular point. Line and field sawteeth are generated and bias added to the various combinations of these. A voltage-sensitive circuit called a Schmitt trigger operates when the resultant voltage exceeds a particular value, driving this electronic switch and changing the picture source. As the bias is altered by the wipe control, the position of this switching will alter to be earlier or later in the line or field.

Patterns can be generated by more complex circuitry; but an alternative method of generation uses a special camera looking at a silhouette against a light background. At the edge of this silhouette the electronic switch will change over so that the shape of the silhouette determines the shape of the scene inlayed on the original scene. If an ordinary camera views a very brightly lit person against a dark background the edges of the person's image can be used to switch the image itself into a background scene. Thus a person can walk on air or change size and perform all manner of special effects. The source selection switch for inlay is performed by the push buttons associated with the effects bank or by a special console in the gallery containing the inlay camera.

Video Switching

Nowadays relays are avoided for switching video wherever possible. Dirty contacts and the slight discontinuity in syncs cause flashes and variation of signal level which draw attention to the switch. However, relays and uniselectors are often used to route the signals for previews and other non-transmission purposes as well as for transmission purposes when an "on-air" switch is not required.



The ATV network vision mixer: the main cut button selects the remote sources or the three banks, designated red, effects (X), or green. Red and green are the simple mixers described in the text and the effects vision mixer is the fader type. Each bank's output also appears as a source on each other bank, allowing great flexibility of operation.

Sync Pulses

After the vision mixing unit, a stabilising amplifier is used to remove all the syncs coming from the vision mixing unit as these will vary in amplitude along with the video when a fade is performed. Sync pulses direct from the master pulse generator are added to the vision signal so that correct amplitude sync pulses are always fed out of the stabilising amplifier no matter what is being fed into it. Unfortunately, some sources, notably video tape recorders and outside broadcasts, are not in step with those of the rest of the studio cameras and telecines. So if such sources, termed non-sync, are treated in the above manner, double sets of syncs would result, the original syncs and the station syncs, which, of course, are not in step with each other. The picture would field roll, line tear, and appear to run off lock. To avoid this, as the source is selected, the stabilising amplifier is switched to the non-sync condition in which syncs from the remote source are stripped off before the fader, and cleaned up and reinserted to give the same result. Non-sync sources cannot be mixed or wiped as the two pictures are not in step. Often logic circuits are used to prevent non-sync channels being mixed accidentally.

Signal Routing

From the vision mixing unit the signal is routed to its destination, be it network, a video tape recorder or simply a viewing room, usually via a central apparatus room (C.A.R.) whose function will be discussed in later articles.

Selection of the various sources is provided by preview systems operated by push buttons and switches controlling relays, allowing any source to be previewed by the director or to be fed to floor monitors for the guidance of performers and crew. Director's preview may be used in emergencies if the vision mixing unit fails. Various identification signals, e.g. sawtooth, may be fed out of the studio whilst rehearsal continues, but these are cancelled automatically, along with several other functions, when the transmission "red light" is selected.

Programme Direction

In the gallery, room on the control desk is provided for the vision mixer's script where each type of cut and comments on its timing (e.g. "As Alan moves to door cut to 3") are included. Sitting next to the vision mixer is the director, who instructs him during rehearsals, but during transmission most of the timing, etc., is left to the vision mixer. Sitting beside the vision mixer and director is the production assistant, usually a secretary to assist the director with the timing and calling of shot numbers to guide the cameramen.

Also present is a senior engineer to check on the performance of the camera crew, answer telephones to other engineering areas, outside broadcasts, and generally co-ordinate the engineering and operational activities, a make-up expert and the producer. These people sit at a large control desk facing a bank of eight or twelve monitors, one for each camera, with two or three for outside sources, such as telecine, video tape, and a preview monitor and transmission monitor.

Sound and Vision Control

Next door to the production control room is the sound control room, containing the sound mixing desk, grams and tape machines, and staffed by the sound supervisor and gram operator. (Television sound will be dealt with in the next article.)

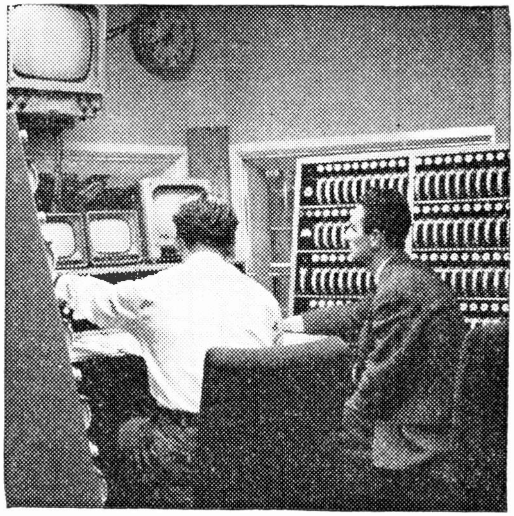
Also adjacent to the production control room is the vision control room, where the lighting supervisor and vision control engineer operate. As mentioned previously, the vision engineer adjusts the lift and gain or iris to match the pictures from the previous cameras. These are displayed on a bank of monitors in front of the engineer. A special test waveform, called P.L.U.G.E. (Picture Line Up Generating Equipment), is used to adjust the brightness and contrast of each monitor very precisely.

Studio Lighting

Sharing the vision control room with the engineer, as well as sharing many of his problems, is the lighting supervisor. He is usually the senior member of the engineering side, so he is responsible for the picture quality. Basically the job of the lighting supervisor is to light the performance, but this is an over-simplification. At a very early design stage the lighting supervisor will be called in to plan the lighting. Much of the atmosphere of a drama or the sparkle of light entertainment can be attributed to the lighting. So the art of the lighting supervisor is most important.

Luminaires, as the lamps are properly called, are usually suspended from the ceiling, but lights on floor stands, scenery flats or occasionally the camera mounting, are used when needed. Suspended lights may be hung from bars which can be raised or lowered by an electric winch, or counter-balanced lazy arms which can be pushed up or down by means of a pole. Poles are also used to turn or tilt a lamp when it is out of reach. Winches are often used for lifting scenery, monitors, or anything else that can be suspended off the ground to allow free movement for the cameras.

Lamps of two basic types are used; those which produce *hard* light and those producing *soft* light. Hard light, as from a spotlight, casts hard shadows and gives modelling to faces and texture to clothes and scenery. Soft light, usually diffused by a fibreglass screen, is used to soften the shadows caused by hard light and to provide the general illumination of large areas. Spotlights are usually 2kW but 500 watt and 5kW lamps are also sometimes used. Follow spots and arcs are occasionally



A lighting supervisor at his console: he can view the output of each camera on the monitors in front of him to balance the lighting for each scene. *ATV photo.*

used in light entertainment. Very occasionally lamps are mounted on the camera, but as this provides flat lighting it is avoided except when absolutely necessary.

The lamps are set to give an overall illumination level of about 50—75ft. candles (lumens per square foot), using the cameras, whose sensitivity is set during line-up, as light meters, and then adjusting the lighting rather than the camera. On transmission however, the vision control operator will adjust for any slight differences still left to be corrected. Each lamp is connected to a dimmer control so that the scene can be balanced at the correct level. To simplify complex lighting changes various memory facilites are provided so that a complete scene can be dimmed to give effects such as a street scene first lit bv daylight and then lit at night by street lights only.

Control of Lighting

Such effects are often controlled from a single control console with buttons for increasing or dimming the light from each lamp. A mimic diagram indicates the condition of each lamp. In the console are the memory facilities mentioned, which allow any light to be re-dimmed to a pre-set level. Most control consoles operate dimmers in a different room.

Most studios use saturable reactors or motor driven variable transformers to vary the voltage to the lamps, but as such arrangements involve rather bulky apparatus, the thyristor controlled dimmer is just coming into use. These use a thyristor which starts conducting at a particular point during the cycle of mains power. Varying this point alters the amount of power dissipated during the cycle. As the thyristor switches on or off little or no power is dissipated in the thyristor so that the unit can be very compact. Unfortunately the fast switching action of these devices causes interference, both by r.f. radiation from the leads to the lamps and by causing the filaments of the bulbs to "sing", or resonate. Microphone leads tend to pick up the r.f. interference, and the reflectors of some lamps direct the sound from the bulbs towards the set where they may be picked up by the microphones. Cameras are generally not affected. Cures for these troubles are provided by special chokes in the output of the dimmer and better screening for microphone cables.

Coupled with this development is a new control system using computer techniques. Developed by Thorn Electrical Industries Ltd., this features very complex "memories" to store the level of complete lighting plots for many programmes. For example, Southern Independent Television are installing a version which "remembers" the complete plot for 100 programmes, allowing accurate re-setting of the lights for weekly programmes.

With colour television, the lighting becomes very critical and only a limited range of dimming facilities can be allowed. A new dual power type of lamp, rated at 5 or 2½W has been introduced, thus doubling the range of adjustment. This unit uses quartz iodide bulbs and can be used as a soft or hard light source, a facility which reduces the amount of rigging required.

Studio Staff

Cameramen, trackers and cable clearers all work in a camera crew under a senior cameraman. Similarly the sound crew. Vision control, lighting, the engineer in the gallery and, in some cases, the sound supervisor are all allocated to the production, perhaps to the whole series, when planning commences and the studio is booked. Studio engineers, however, tend to remain with the studio. In case of breakdowns the studio engineers apply first line maintenance such as replacing a complete head amplifier, or changing a tube, but detailed maintenance is usually passed on to the base maintenance departments.

Incoming lines are routed to the studio from the central apparatus room and checked by the studio engineer in the apparatus room before being fed through to the vision mixing unit. Telecine, video tape and outside broadcasts are dealt with in this way. Remote control facilities for telecine and video tape can also be extended through to the studio in some studio centres.

Studio Facilities

Studio facilities include rooms for make-up and wardrobe. Also on hand are water, compressed air and gas to operate sinks and gas stoves that may appear on sets. D.C. at 110 volts is provided to operate electric dollies, arc lights and back projectors. Back projection is a technique for projecting a moving film on to a screen to provide background. A car, for example, placed in front of a scene shot from a camera driven down a street will appear to be driving down this street, but shots of the occupants are easily achieved by cameras around the stationery car in the studio.

Many other tricks of the trade are used. Using a huge photograph enlarged to give a scene several feet across is a simple way of producing a background. Cloud effects can be achieved with a special rotating disk in front of a spotlight and in a similar way various shadow effects can be produced. News and current affairs programmes often use slide projectors, epidiascopes, or sometimes projection television to give suitable backgrounds.

Smoke can be generated in vast quantities to give mist, fog, or "heavenly cloud" effects by mixing dry ice and water in a special container. Clouds and smoke made in this manner are dispersed easily when the mixture warms up, and do not smell; chemically generated smoke made by burning does not do this, so is rarely if ever used.

Audiences

Light entertainment shows usually have an audience, and to avoid the handling of several hundred chairs, and to comply with the local authority regulations, special folding section units are provided with chair units which can be folded flat so that they can be easily handled. Wheels are fitted so that they can be towed away after use. Monitor and directional loudspeakers are suspended above the audience so that they can see all that is happening, even if it is film or prerecorded.

Around the studio are dressing rooms, make-up rooms and wardrobe rooms, usually placed as near to the studio as possible if a very quick costume change is required. Some studios are provided with observation rooms for visitors to view the proceedings without interfering with the studio work.

to be continued

HELICAL U.H.F. AERIAL

—continued from page 74

outside the soldered joints should be varnished or covered with insulation to prevent corrosion.

Installation

If the aerial is hung in a roof loft precautions should be taken to prevent the aerial from swinging or turning as such an effect would introduce results at the receiver similar to fading or aeroplane flutter. It should not prove difficult to design a simple stand for the aerial once the best position has been determined. Constructors may favour other methods of supporting the helix and reflector: whatever method is used it should be such that the turns of the helix are held rigidly and cannot move.

During the installation it may be found possible to improve reception by alternately opening out slightly the turns of the helix or closing them up. If this experimenting is attempted it is obvious that it will have to be done before the turns of the helix are finally fixed in position. Extra time spent on installation and adjustment is well worthwhile.

In conclusion it should be noted that in general loft aerials should only be used in areas of high signal strength: in areas of low signal strength an outdoor aerial must be used. ■

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

IF conditions were not very good last month, they are certainly even worse this time, at least as far as Sporadic E reception is concerned. Last month I complained about too many days when reception was absent; this time it is about too few days when there was any reception at all!

The period 9/8/67 to 10/9/67 is shorter than usual, due to holidays. When I go away there is usually a good opening, so there may well be a late opening in September, but it is getting a little late in the season for anything very spectacular to happen via Sp.E.

Among this depressing news, there is one bright spot. The tropospherics have been making progress, and this could point to a bumper season from October onwards. The first real openings last year were about mid-September, but this time it is somewhat earlier at the third week in August.

Now for the Sp.E. received for the period 19/8/67 to 9/9/67. It is pretty thin:

19/8/67 to 24/8/67: Nil.
25/8/67: Spain E3 and E4.
26/8/67: Spain E3.
28/8/67: Czech R1 and R2, Sweden E3, Austria E2a, Italy IA and IB, Yugoslavia E3, West Germany E2, E3 and E4.
29/8/67: USSR R1, Sweden E2, Norway E2, and Rumania (?) R1.
30/8/67 to 8/9/67: Nil.
9/9/67: Austria E2a.
10/9/67: Nil.

Tropospheric reception, same period. There have been some very good openings here notably on 22/8/67, and 23/8/67, and 27/8/67.

U.H.F. reception from France was very good on these dates, but still not quite good enough for Dutch or West German reception to be worthwhile here in Bournemouth.

NEWS

(1) There is a new mystery test card on channel R1, noted by myself and Maurice Ophie of Poole. It was very weak on 28/8/67, the test card being on from 18.56 for about three minutes and followed by some sort of opening caption at 18.59, this caption having two concentric circles with an ellipse at each side. The signal faded at 19.00 BST.

The test card was vaguely similar to the D.D.R. East German card of last year (data panel No. 10, June 1966), except that it had the black rectangle with white insert above the centre circle. This card cannot be reconciled with any known R1 East European card, unless there has been some recent change, so this leaves two possibilities:

(a) The station of origin was Bacau Rumania R1 (I believe that this has been received here in spite of its low power). As already reported the Rumanians have deviated from the old USSR type card and changed to that shown on Data Panel No. 15 so they could have changed yet again.

(b) Possibly a new Band I station in either Bulgaria, or even Albania.

(2) There has been a new ORTF2 French u.h.f. transmitter on Ch. 30, received here on 22/8/67 and 27/8/67. The only listed one is St. Etienne (low power), but its direction is wrong, being just South of East from Bournemouth, which makes it look like a Channel coast relay in France or further inland if it is high power. Has anyone else seen this one?

READERS' REPORTS

L. Allsopp of Cardiff has been doing well in spite of the poor conditions, reporting USSR Kiev R1, Portugal Muro E2 (the new one), Poland R1 and R2, Swiss E2 and E3, Spain E2, E3, and E4, Norway E2 and E3, Yugoslavia E3 and E4. His best, however is Canary Is E3.

J. Dalby of Stroud has presented us with some mysteries and problems in the form of a test card on E3 with R21 on it, and another on E2 with a diagonally crossed square in the centre circle (I reported on this card some time ago but we never did find out its origin).

R. J. Bentley, of Huddersfield, has logged Carcassonne F4, Spain E2, E3, and E4, Swiss E4 (usually a difficult one), Austria E4, and Italy IA and IB. Nice going under present conditions.

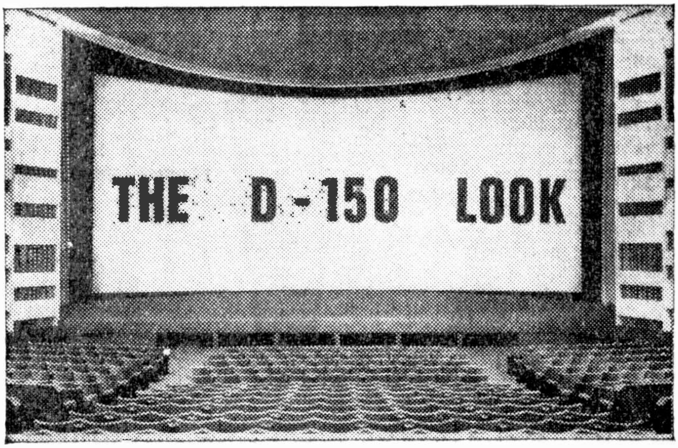
Stephen Ormondroyd, of Great Yarmouth, has entered our ranks as a u.h.f. DXer with a nice batch of N.T.S. Dutch stations, Lopik Ch. 27, Roermond Ch. 31, Goes Ch. 32, Wieringermeer Ch. 39, and either Wieringermeer Ch. 45, or Smilde Ch. 47 (I should think the first one). I feel sure that he will be looking even further afield in the near future.

Very sorry about this, but I am going to have to "read the riot act" again, on the old trouble of correct appreciation of the exact channel on which a signal is received.

I know only too well how easy it is to confuse say E2 and R1, and still easier with E3 and IA, but we are getting an increasing number of identification queries, where the channel is obviously incorrect, so please if you can sort yourselves out first, then our job of sorting *you* out will be much easier and the assessment of what you have in fact received will be much more positive.

U.h.f. is even worse. I know that commercial TV set calibration often leaves much to be desired, but when one is asked say to identify five French stations between Ch. 21 and Ch. 60, without even any information on aerial direction, it is to say the least a bit tricky!

Iconos TAKES A LOOK AT A NEW COMBINATION OF OPTICAL AND PHOTOGRAPHIC DEVELOPMENTS



MY eyes were opened almost to the full angle of acceptance, approximately 120°, when I attended the first trade demonstration of a new type of film presentation—D-150—at the Odeon Cinema, Marble Arch.

This new cinema is very new indeed, a new concept with a new look. It is an example of the kind of thing the film industry is proposing to do in order to recapture audiences it has lost to television. There is welcome all the way from the entrance to your seat. Escalators from the ground floor foyer take you to a large and luxurious circulating area, wherein people can meet and even partake of alcoholic refreshment. 'Come in, relax and enjoy yourselves' say the Rank Management. Americans would say 'Have fun!'

At one of the bars I noted immediately that the 'trade show' audience consisted of a great many television people, including engineers from ITV companies and the BBC. They were curious, and maybe most anxious, to see just what the cinema had to offer that could depress the TAM ratings.

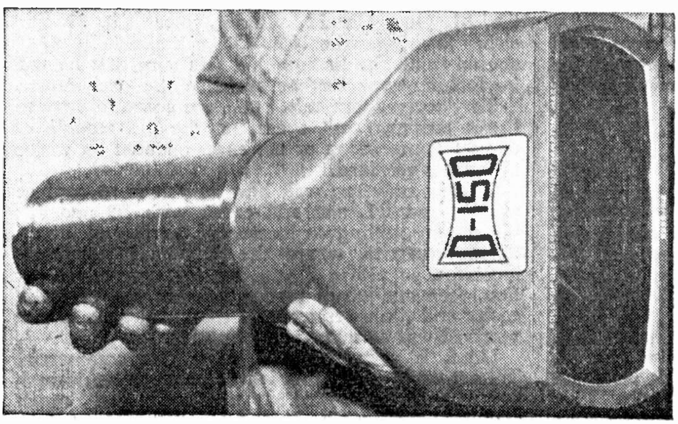
The ITV boys were openly envious of the amount of time devoted by the cinemas to their 'commercials' — advertising filmlets and clips, trailers for future films and ice cream announcements—which total anything up to 21 minutes per 3-hour programme. This averages out at 7 minutes per hour compared with 6 minutes per hour that the ITA allows its contractors. What secret weapon, they wondered, have cinema people evolved to perpetuate such generous advertising time and also to recapture their large audiences?

Multum in multum

D-150 is not just one single unit of photography, processing, projection and screening, neither is its success due to the smoothness of presentation that is accomplished by the virtuosity of the projectionists. It is, in fact, a combinaton of all these things, with differing types of presentation literally and instantly available at the tips of a projectionist's fingers, on the Cinemation control panel in the projection room. There are three Cinemeccanica Victoria '8' projectors capable of running both 35 or 70 mm film and presenting them in the following formats:

(1) Conventional wide screen (35mm film) Aspect Ratio 1·85:1.
(2) CinemaScope (anamorphic) (35mm film) optical sound 2·34:1.
(3) Conventional 70mm film 4 magnetic tracks stereo sound: 2·1:1.
(4) Full screen dimension, D-150 on 70mm film, 6 to 8 magnetic tracks for stereo sound, 2·1:1.

These aspect ratios indicate the shapes, not the sizes, which are large, larger, larger still and largest!

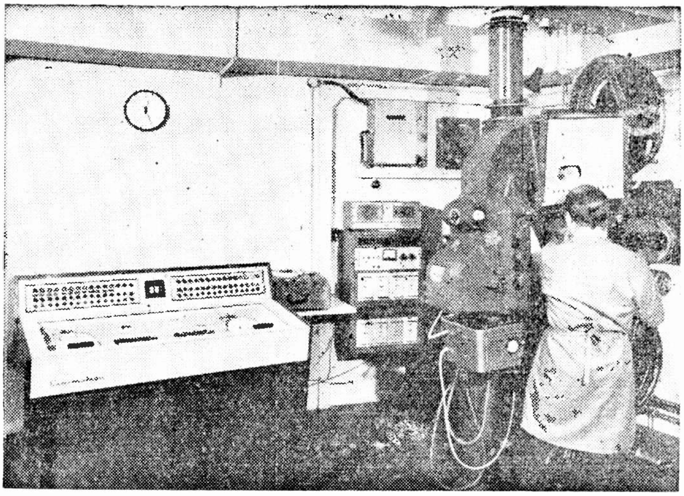


Lens for the D-150 incorporating backing lens of 5¼in. f1·9.

Sound Reproduction

The sound side of the equipment is almost as ambitious as the picture side. Each projector is provided with a twelve-module transistorised pre-amplifier, with system control and selector unit, which are fed (as selected) to power amplifiers and to the stage and auditorium loud speakers. Mono or stereo reproduction can be used for sound from film, disc records or tape, or microphones.

The film sound can be single track optical, four track magnetic or six track magnetic. In view of the trend towards the DIN system single track magnetic with normal 35mm film for television usage, this type of sound will almost certainly be available. Foxhole perforations on 35mm film will not be used, excepting when four-track stereo sound is used on CinemaScope and anamorphic picture presentation is used.



The projection room. To the left is the automated control system.

The screen

The screen at the Odeon, Marble Arch, like D-150 screens in other cinemas, is of huge dimensions deeply curved and with a special reflective surface which avoids the cross-reflection interference noticeable on previous attempts to used curved screens. Of course, with a big cinema, a big projection light source is required for a big screen. For this, the Ascroft Super-Core-Lite arc lamps have been installed, though for small auditoria, successful results have been obtained with 6·5kW Xenon bulbs.

With all this light and heat close to the film in the projector, cooling and ventilation problems are not easy to cure, but in the Cinemeccanica Victoria '8' projector these have been overcome with both air cooling and water cooling to ensure that the film gate and transport mechanism are kept at a low operating temperature.

Aspect ratios

All of these comments concern the projection side of the D-150 system. The system actually derives its name from the widest acceptance angle of the camera lens for the 65mm negative film used, which is 150°. On projection, taking into consideration the curvature of the screen and other factors, the angle of the beam of light is 120°. A special Andrew Harkness screen gives a fine and even reflection for all parts of the largest of screens. This type of screen is now being exported to USA for D-150 cinema installations.

At Marble Arch Odeon, the screen for the largest picture measures 79 feet round the curve and 62 feet 8 inches across the chord. It is interesting to note that in addition to four aspect ratios for wide screen, CinemaScope, Todd-A-O and D-150, the remote control variable aspect ratio masking a 1·37 rate border has been catered for—for wide screen television.

Incidentally, films which are photographed with a 'hard' black mask with a 1·85 to 1 ratio are disliked by television organisations. This results in a thick black frame line and may give trouble in teleciné and in processing. Films shot for composing only on a 1·85 shape, but also revealing lots of ceiling and floor are a poor and expensive compromise.

Automation

Perhaps the most important step is the ease with which varied aspect ratios and picture sizes can be adjusted. In a demonstration of several sequences, interior and exterior, of new films, the general effect was similar to Cinerama which achieved the huge curved screen in a somewhat different manner: hundreds of small oriented slats for reflection into the audience without reflecting at one another, and by the simultaneous use of three projectors the pictures have been cross-beamed to join up.

Cinerama was extremely effective for spectacular scenes, but even the slightest unsteadiness revealed the 'join'. D-150 might be called a poor man's Cinerama, in which one camera and one projector do the work of three projectors. The fact is, of course, that the absence of the picture joins is a tremendous step forward.

Blockheads and blackheads

The same success was not achieved on head close-ups. The overwhelming immensity of faces twelve feet high are revolting enough when you observe every little blemish on faces as seen from the front of the cinema's circle, but when you are in a stall seat near the front!

The enormous picture also reveals dirt, scratches and other faults in colour photography, particularly with low-key night scenes. These are overlooked when bright sunny exteriors are screened.

The anxious producers of television dramas on BBC and ITV will gaze at the D-150 system anxiously, thinking of the possible effect on the TAM ratings if cinema audiences go rushing back to the cinemas. D-150 is an exotic and sophisticated step forward in cinema presentation, for which credit must be given to Dr. R. Vetter (D-150), and Messrs. T. S. Harkness (Harkness Cinema Screens) and Robert Pulman (Chief Engineer, Odeon Theatres). ■

A LOOK AT TRANSISTOR TV CIRCUITS — PART 3

S. GEORGE

THE television video stage is basically an untuned amplifier designed to provide reasonably constant amplification of all frequencies from d.c. to 3 or 5·5Mc/s, on 405 and 625 respectively, and with negligible or at least frequency proportional phase distortion. The output voltage required from this stage to fully modulate the tube from black to peak white ranges from about 35V to 90V depending on tube sensitivity, and as the input to the video stage from the vision detector will be at most several volts only, obviously considerable amplification, averaging 20—30 times, will be needed from the circuit.

Until quite recently, valves were almost universally employed as video amplifiers even in those receivers that had transistorised i.f. circuits for three principal reasons: (1) their high gain enabled only one stage to be used; (2) their high input impedance imposed no appreciable load on the vision detector circuit; and (3) they provide a suitable high amplitude voltage output for operating valve sync separator stages.

However, there are now two all-transistor receivers in wide use, the Philips T-Vette and the Sony 9in. portable model, and the video circuits of these serve as an excellent introduction to solid state design in this part of the receiver. Undoubtedly the use of transistor video circuits will increase in the future, particularly in colour receivers, as the current Thorn/B.R.C. colour chassis is fully transistorised while the Decca colour receiver uses a hybrid video circuit employing two transistors to drive a PL802 final video amplifier.

EMITTER-FOLLOWER STAGES

Probably the most noticeable features about transistor video stages are the use of two or three stages and the general employment of common-collector (i.e. emitter-follower) operation instead of the more conventional common-emitter arrangements, except for the output stage.

This is mainly due to the fact that the conventional common-emitter stage, as used so extensively in radio receivers, although giving high gain has a low input impedance. If directly coupled to the vision detector, therefore, it would heavily load it and drastically reduce the detector output. An emitter-follower stage however has high input impedance, and, while it contributes little to the overall amplification of the circuit, matches the detector output to the low input impedance of the high gain common-emitter output transistor. In addition it provides a suitable driving source for a transistor sync separator, which, being current operated, is best fed from a low impedance source.

These common-collector or emitter-follower arrangements are analogous to valve cathode-followers inasmuch as the output signal is tapped from across the emitter (cathode) resistor.

Such stages may thus be regarded as buffer stages or impedance matching devices rather than actual amplifiers, since although providing a good current gain they give slightly less than unity voltage gain. Their main purpose is to free the vision detector from the low input impedance of the common-emitter output transistor, which is necessary to get the required wide voltage excursions.

SONY CIRCUIT

To take now the Sony circuit first, since its three-stage video line-up most closely resembles a conventional transistor amplifier. The feed from the u.h.f./v.h.f. vision detectors—note that two detectors connected with opposite polarity are used to demodulate the positively modulated 405 signals and negatively modulated 625 signals—is capacitively fed to the base of the first transistor, Tr1 (Fig. 7) which has a 6Mc/s i.f. transformer in its collector circuit to extract the intercarrier sound signal for subsequent amplification. The video output, however, is taken from across the emitter resistor so that from the video point of view the stage functions as an emitter-follower imposing negligible loading on the detectors.

Tr2 is a further emitter-follower stage handling the video signal only and feeding both the sync separator and the video output transistor. To ensure that no vestige of the intercarrier sound signal is passed on, a series tuned rejector circuit tuned to 6Mc/s is shunted across Tr1 output, shorting-out any remaining signal at 6Mc/s.

As previously mentioned because of the large voltage swings required to fully modulate the tube from black to peak white (35—90V) it is essential to operate the final video transistor in the common-emitter mode and with a supply voltage well up to this figure. In this Sony receiver, the supply voltage to the last stage is approximately 90V, and is derived from a point in the line output stage.

The actual video output transistor load is a series combination of an 8·2kΩ resistor and small inductor, and the stage feeds the c.r.t. cathode via an 0·2μF capacitor and compensating LR combination. This a.c. feed from the output transistor collector to the c.r.t. cathode prevents any possible variation in the "boosted" l.t. voltage (90V) or change in transistor characteristics from varying the correctly set brilliance level (the brilliance control is in the cathode circuit of the c.r.t.).

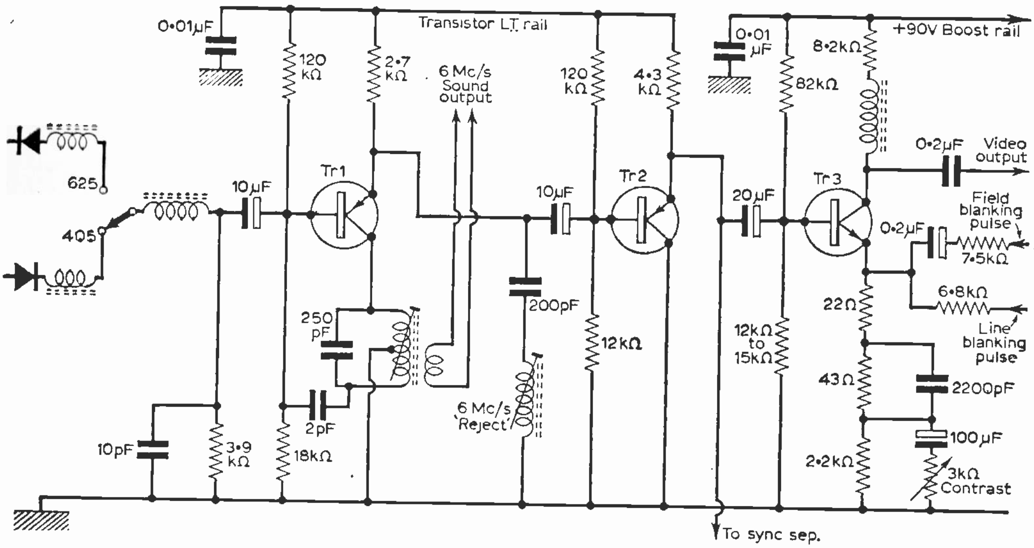


Fig. 7: Three-stage video circuit of the Sony Model TV-306UB a fully transistorised battery/mains portable receiver. Tr1 amplifies the 6Mc/s intercarrier f.m. sound and acts as emitter-follower to the video signal. Tr2 drives the sync separator and video output stage.

In complete difference to valve circuit technique, the contrast control is not linked to the a.g.c. line to vary the gain of the r.f. and i.f. stages—though there is a preset control for that purpose—but varies the video circuit response and emitter compensation characteristics. This is done by means of a 3kΩ variable resistor in series with a 100μF capacitor which together are shunted across the main 2.2kΩ emitter resistor.

In further contrast to established valve techniques, to achieve some measure of line flyback blanking, which is achieved by other tube biasing arrangements not shown, a 6·8kΩ resistor feeds a pulse to the top of the output transistor's emitter circuit from the line output stage. Field blanking is also carried out at this point.

This then constitutes the fairly straightforward video circuit of this fully transistorised model, two pnp emitter-follower stages driving an npn common-emitter output stage.

PHILIPS T-VETTE

A two-stage video circuit is used in the 11in. Philips T-Vette, the first stage being, as in the Sony model, an emitter-follower. This drives the common-emitter output stage and also an a.g.c. amplifier. However, apart from this basic transistor usage, and the fact that contrast control is again effected by means of a variable resistor in the emitter circuit of the output transistor, there remains little in common.

First of all, the input to the driver transistor from the OA90 u.h.f./v.h.f. vision detector is d.c. coupled on v.h.f. (via the 3·5Mc/s trap) and a.c. coupled on u.h.f. As the v.h.f. signal is positive-going at the output of the video detector, to maintain the same drive conditions on u.h.f. an OA91 diode provides a filtered positive-going bias additional to the a.c. signal capacitively fed to the

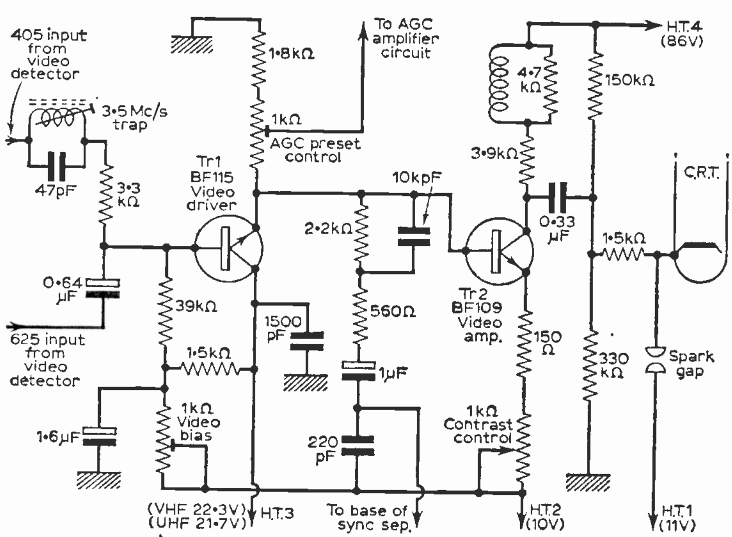


Fig. 8: Video stages of the Philips T-Vette. Tr1 acts as emitter-follower between the vision detector and output stage, and also drives the a.g.c. amplifier.

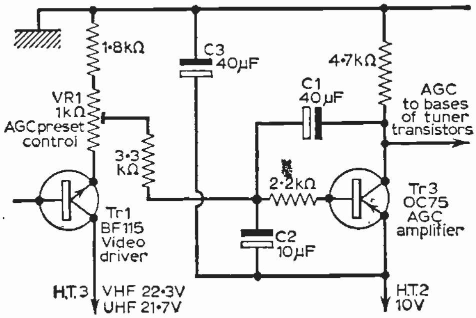


Fig. 9: In the Philips T-Vette the a.g.c. amplifier Tr3 is driven from the first video stage Tr1. Tr1 mean emitter current being dependent on signal strength on both systems, the a.g.c. voltage decreases with rising signal strength to reduce the gain of both r.f. amplifier transistors. Electrolytics C1 and C2 filter out the a.c. component of the video signal and stabilise Tr3.

driver stage. In this way the output from the driver transistor will have the same phase relationship on both systems. This is vital for both the output transistor and the a.g.c. amplifier.

As will be seen from Fig. 8, the driver's emitter load comprises two resistors in series, a 1·8kΩ fixed resistor plus a 1kΩ potentiometer. The setting of the latter determines the degree of drive applied to the a.g.c. amplifier, for current through the driver transistor will be proportional to the mean level of the signal on both systems, and, with the a.c. component filtered out, a.g.c. amplifier conduction will be dependent on the signal's average d.c. value. To clarify this dual video driver usage, since the use of multiple l.t. feeds tends to complicate the circuitry somewhat, the a.g.c. amplifier circuit has been drawn separately in Fig. 9 and will be described later.

Keeping, however, to the video amplification action of the circuit, it will be seen that the driver stage is directly coupled to the base of the output transistor Tr2. The feed to the base of the sync separator transistor is taken from the driver's emitter circuit via a capacitive link, again because the emitter-follower's low output impedance suits the sync separator input.

To provide the output stage with a sufficiently high voltage to fully modulate the tube, a separate power supply, HT4 in the diagram, is derived from the line output stage via an additional transformer winding and separate BYX10 rectifier. The actual video load is a 3·9kΩ resistor in series with a 4·7kΩ resistor shunting a small peaking coil, and the output is a.c. coupled to the c.r.t. cathode.

The potential divider (150kΩ and 330kΩ resistors) across the output serves only to establish the working potential of the tube cathode, so that variation of the brightness control (in the grid circuit in this model) is with reference to that point.

A.G.C. ACTION

On no-signal, the a.g.c. transistor (Tr3, Fig. 9) is virtually bottomed, that is passing near saturation current, so that there is negligible voltage drop between its emitter and collector, the voltages at these points being equal to each other and to that of the HT2 rail (10V). As the input signal strength, or the a.g.c. preset control setting, increases the base bias to the a.g.c. amplifier, however, (i.e. goes more positive) so its conduction decreases. This means that the voltage across the collector load (4·7kΩ) falls (i.e. is less positive). This negative going voltage is the a.g.c. rail control potential, and is used to increase the conduction of the controlled stages, decreasing their gain through forward a.g.c. action (see Part 2 in this series, PRACTICAL TELEVISION, October).

Control of transistor gain is always more difficult than the control of valve amplification, and it is therefore necessary in transistor television receivers to have an a.g.c. amplifier stage. In the Sony model referred to there are two a.g.c. amplifier transistors. The source of the a.g.c. however is a separate diode fed from a winding on the last vision i.f. transformer and is thus not a part of the video section of the receiver.

To be continued

SERVICING TV RECEIVERS

—continued from page 66

Modifications

The following modifications are additional to those indicated on the circuit diagrams which accompany these articles. A 4·7kΩ 10% resistor added between 2S1d slider and chassis to improve 405-line vision sensitivity. 2C30 in 2V4a cathode circuit changed to 0·33μF to increase vision gain. 2C48 in the a.m. sound interference limiter circuit changed to 0·033μF 10% 400V. 2MR6 a.m. sound demodulator changed from type BA115 to type OA81. 2C7 in the trap circuit in 2V1 grid circuit changed to 20pF 10% to improve adjacent sound rejection at 41.25Mc/s on 625 lines. 2R23 2V2 (sound i.f. amplifier) screen feed resistor changed to 33kΩ to increase sound gain and a 4·7Ω ±0·5Ω resistor added in series with 2V2 control grid to prevent spurious oscillation on sound.

Boost capacitors

There are two 0·1μF capacitors in parallel. If one shorts, the PY800 will immediately become red hot, 3R57 will overheat and 3F1 fuse will blow if it is correctly rated at 1A.

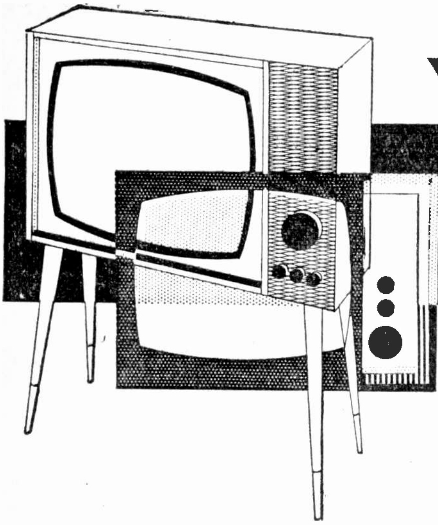
The voltage across the capacitors can exceed 850V under normal working conditions.

Striations

These are vertical rulings down the left side of the screen. Check 3R28 4·7kΩ across the line lin coil.

Bottom compression

Check 3V6 PCL85, its bias resistor 3R47 270Ω, capacitors 3C35 500μF and 3C33 0·022μF.



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 90 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

FERRANTI 20T4

This projection receiver (1955) has an excellent picture but there is no sound.—A. C. Norris (Dunbartonshire).

On the right hand side of the main chassis there are a number of electrolytic capacitor cans. Between these are two valves, an EB91 and an ECL80. These are the audio output valves. Check these and the h.t. to pin 6 of the ECL80. Also check the nearest EF80 to the ECL80 (on the i.f. plate) and the associated components.

RGD TV403

When the brilliance is full on I can only get a dark picture with the contrast fully adjusted. I have replaced the h.t. rectifier, line output valve and booster, also the e.h.t. rectifier, but the trouble still persists.—L. Stock (Gloucester).

The trouble is due to low first anode voltage (c.r.t. base pin 3). Check the resistors in this circuit and if necessary check the focus control (2MΩ). Shunt the 4·7MΩ resistor with a similar value to increase "A" voltage if necessary.

BUSH TV135RU

Would it be possible to fit a black-level correction device to this set? The vision gain is apparently controlled by the grid potential of the sync separator which is much better than the older method controlled by average picture content. There is however, a very noticeable drift away from true black, especially in panning shots where the proportion of white to black changes largely and quickly. Could the a.g.c. voltage be used, or part of the video signal be tapped off, rectified and applied? I believe Bush use a black level corrector in one of their models. Could this be used in my set or adapted to suit it?—J. Ford (Worthing, Sussex).

We have dealt with the subject of black level clamping in articles which have appeared from time to time. These circuits, of course, add complication to the circuit and necessitate the addition of extra valves and transistors

FERGUSON 206T

There was lack of brilliance, width and focus before the set finally gave up. Now, when it is turned on, all the valves light up, there is no raster and the sound is O.K. I connected a booster transformer to the tube which did not light up before and there was a glow of the heater but still no raster appeared. There is, however, a very loud line whistle.—J. D'Silva (London, S.W.17).

We would advise you to change the tube, which is doubtless of low emission. Also check the e.h.t. rectifier, line output and efficiency diode valves if necessary.

BUSH TV109

This set has given line oscillator trouble recently. The ECC82 has been changed twice and the PL81 three times.

The first PL81 was overheating (anode red-hot) and the ECC82 was changed which cured the fault. The second PL81 overheated so badly that the glass envelope melted!

There is now no oscillation at all and changing the PL81 and ECC82 has no effect.—A. Hardwick (Bedfordshire).

We would advise you to check the discriminator diodes which are the small round metal diodes or rectifiers above the ECC82.

K-B QV30

There is cramping at the bottom of the screen—about ¾in. I have changed valves 50CD6G, PY83, PCF80 and R19 but the results are no better.—J. Willetts (Cheshire).

Cramping at the bottom of the screen indicates failure of the field output valve to pass full-scan current. This is often caused by low emission of the valve. If you are certain the valve is in good order, check the components on its cathode, especially the electrolytic capacitor. Check also the setting of the vertical linearity control in conjunction with the height control. If the width is a little low, suspect a poor h.t. rectifier.

EKCO T441

Over the past two years, this set has had six PFL200 valves fitted to rectify the fault which is lack of brilliance. There is also slight horizontal pulling which seems to be more prominent on Band III.

The recommended R.T.S. modification for this fault has been incorporated and nearly all the components in the video amplifier and sync separator circuits have been checked or replaced in the case of capacitors.—P. Dancey (Haverhill, Suffolk).

This is caused by the lack of d.c. coupling in the video stage to facilitate ease of standards changing. Sadly, this seems to be a fault of more than one make and model. If you have incorporated the mods, then there is little else that can be done. You should be able to have the valves replaced under guarantee, however.

BUSH TV86

The picture is "waving" all the time. The wave starts at the top of the screen and travels downwards. It then starts at the top again. The picture edges are ragged as if there is not full width.—J. Watts (Co. Down, Ireland).

The fault may not be wholly in the receiver, but addition smoothing will undoubtedly help matters. Add an extra 200μF electrolytic across the existing smoothed h.t. line. Check valves ECC82 (right side) and PL81 inside screened box.

PHILIPS 19TG173A

The picture on this set is losing height top and bottom at the rate of about ⅛in. per day. The controls are at their limits.—E. Cross (Dorset).

We would advise you to check the resistors associated with the height control. These are a 1·5MΩ from the boost line and a 1·2MΩ from the PCL85 pin 1. Also check the 22kpF capacitor which decouples the 1·5MΩ and height control junction which could be leaky.

SOBELL TS17

There is occasional field slip. I have replaced the ECL80's (V7 and V10) and PY82 (V14) and EY51 e.h.t. rectifier but there is no improvement.

I would point out that the vertical hold control is quite critical. Also, is there any way of curing vertical striations on the left side of the picture on this model?—R. Bryant (London, S.E.9).

You should replace the 0·003μF capacitor wired from pin 1 of the ECL80 via a 47kΩ resistor to the interlace diode.

Regarding the left-side striations, replace the 3·3kΩ resistor associated with the line linearity coil.

MURPHY V310

The raster is good but the sound is very weak and there is no picture.—J. Smith (Yorkshire).

Your fault is within the tuner or the first common i.f. stage and we advise you to use a signal generator in the normal method to track it down.

BUSH TV135LU

The fault symptoms are evident on both u.h.f. and v.h.f. The vision signal seems normal but when correctly tuned in, where previously sound and vision was satisfactory, the sound level is poor and to get maximum volume the tuning has to be so near the sound channel that picture quality is affected.

This trouble is apparent immediately upon switching on and also there is a variation with the light or dark content of the picture.—M. Burford (Birmingham, 32).

Check the PCF80, 2V6 which could be failing. Also check the PCL82 audio output valve 3V8 and associated components. Realign the sound i.f.'s only if necessary.

PHILIPS 23TG170A

The bottom of the picture starts flicking upwards. I have changed the ECC82. On BBC-2, the brightness keeps building up and needs attention till it reaches the correct level after tuning down time after time. Also, the sound on BBC-2 is rough but is alright on BBC-1 and ITV.—J. Boyne (Liverpool, 13).

Check the seating of the field timebase valves. If poor, clean the valve pins and the holder sockets. Use Electrolube No. 1. Otherwise, check for poor soldered connections in the circuit.

Regarding the build-up of brightness, change the video output valve. The bad sound on BBC-2 is caused either by misalignment of the intercarrier channel or unbalance in the f.m. detector circuit.

EKCO T330F

This set was working perfectly on both BBC and ITV until a few nights ago. Now, when switched on, it works perfectly for about 10 minutes, then there is a click, like turning off a switch and the picture fades out and the sound becomes very faint. The raster remains perfect.—J. Duncan (Ayr).

This is probably valve trouble. Check in particular the line oscillator, the line output and booster diode. The latter is most likely the culprit.

STELLA ST1089A

The sound reproduction drops very noticeably and then suddenly jumps back to normal. This happens on both channels 2 and 10.— W. G. Pemberton (Sheffield, 14).

The audio output valve is a PCL83. Check this valve and the audio capacitors associated with it. Also check the i.f. stages if necessary.

REGENTONE T177

This set has good sound and vision but suffers from field jitter, two or three times up and down (about 1in.) each second.—K. Twells (Derby).

The most likely location of this trouble is in the field timebase stage—the oscillator section. Check the valve, and if necessary the time-constant components associated with this and the vertical hold control.

BUSH TV43

When the brilliance is turned up to about two-thirds the way on the control, the picture is quite good but suddenly it goes dark and then blanks out completely. Bringing the brilliance back, the picture returns.

I understand that the picture should go negative if the brilliance is advanced too far, but this does not happen at all on this set.

This receiver also seems to be off tune when it is first switched on and the signal has to be tuned with the control at the side of the cabinet. After about 20 minutes it has to be retuned again and then remains O.K. for the remainder of the evening's viewing.—C. Anderson (Sheffield, 5).

Set the ion trap magnet on the rear neck of the tube for maximum brilliance. If the picture still fades as the control is advanced, replace the EY51 e.h.t. rectifier, or if width is lacking, the PL81.

The tuning drift from cold to operating temperature is normal for this type of set.

PHILIPS 23TG173A

After I have changed over to BBC-2, the picture becomes increasingly bright until, after 2 or 3 minutes, it is impossible to see the picture even with the brightness control at minimum.—A. Perkins (Gloucestershire).

This could well be caused by drift in the video amplifier valve—giving grid current—on the 625 standard. We would suggest that you check this valve by substitution before delving too deeply into the circuit. This is the PFL200.

QUERIES COUPON

This coupon is available until NOVEMBER 24th, 1967, and must accompany all Queries sent in accordance with the notice on page 87.

PRACTICAL TELEVISION, NOVEMBER, 1967

TEST CASE -60

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.

? *A single-channel set was poor on the holds and although both line and field locked well within the range of the controls, the line hold was particularly weak and required critical adjustment throughout a programme sequence. Checking carefully on a test card showed that the vision channel was passing the full range of video frequencies, which ruled out misalignment and poor frequency response of the video output valve.*

Attention was then directed to the sync separator stage and to the circuits from this feeding the line and field timebase generators. Since both line and field holds were poor it was thought that trouble in the sync separator stage itself was most likely, but valve and component checks and substitutions in this part of the set failed to improve matters.

Substitutions of the components at the output of the sync separator stage to the generators were next carried out, but still no improvement. It was then thought that hum in the video or sync circuits may be affecting the sync performance, and although hum on sound was not abnormally high the electrolytic smoothing capacitors were changed and the valves checked for heater/cathode insulation. Still no improvement or clue as to the whereabouts of the trouble.

What component or stage was overlooked and which could well be responsible for the symptom? The solution to this problem and a further Test Case item will be published in next month's PRACTICAL TELEVISION.

SOLUTION TO TEST CASE 59
Page 43 (last month)

The set in question used a PL500 line output valve and a stabilising circuit working in the usual manner from a voltage-dependent resistor in the control grid circuit. This resistor serves to rectify some pulse potential at a tap on the line output transformer and apply this to the PL500 control grid as bias. In this way heavy loading on the line output stage reduces the pulse potential and hence the bias, thereby turning the valve on harder to combat the extra load.

A check of the PL500 cathode current indicated that it was almost 50mA above normal and the negative potential at the control grid was low, which was responsible for the high cathode current. The components feeding the line pulses to the VDR were in order, and since it is not easy to check a VDR, this was substituted and the correct grid bias was then obtained, which reduced the PL500 cathode current to about normal.

It is worth noting that there is a preset adjustment in this circuit for setting the boost potential. This adjustment alters the grid bias, and if incorrectly set both the line output valve and the line output transformer will be overloaded.

Published on or about the 22nd of each month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, London, W.C.2, at the recommended maximum price shown on the cover. Printed in England by WATMOUGHS LIMITED, Idle, Bradford; and London. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia) LTD. Subscription rate including postage for one year: To any part of the World, £1.9.0d.

LETTERS TO THE EDITOR

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

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

FERRANTI 21K6

SIR,—I refer to reader T. Crawford's query in your September 1967 issue under "Your Problems Solved" column, which referred to picture rolling on a Ferranti 21K6.

I have a Ferranti 17SK6 which had the same trouble persistently although the picture itself was very good.

After endless trouble and not much confidence in my knowledge of the subject I wrote to "Your Problems Solved" and received a reply very similar to that given to Mr. T. Crawford.

After weeks of delay trying to get a frame blocking oscillator transformer (due to obsolescence) I eventually obtained and fitted a new one, but it made no difference to the fault.

Having changed all relevant valves, it became necessary to try and decide which part was at fault and by good luck I decided at the first attempt that it was capacitor C89 $0{\cdot}5\mu F$. On the 17SK6 this couples the video amplifier to the sync separator valves, and changing this cured the trouble completely.

I imagine that the 21K6 circuit is similar to that of 17SK6 and if reader Crawford has no luck in other directions he might try changing this capacitor.

Frame oscillator transformers for 17in. Ferranti older models seem almost impossible to obtain, and, as a result of my own problem, I now have one spare and in good working order, which any reader requiring one can have free on application. —N. H. HODGSON (84 Lansbury Drive, Hayes, Middlesex).

625 LINES IN "405" CHANNELS

SIR,—Mr. M. A. Gerzon explains the optical fault of triple-interlacing very clearly; twin-interlacing also shows "line crawl" at too close a viewing distance. In both cases the optical effect is seen because the traced lines are clearly visible; the lines are visible because they are crudely separated.

In "three-field scanning" the traced lines fit tightly together, so there is no stationary structure, no dark grid, to make them visible. Twin-interlaced TV services throughout the world display the structure of their separated lines, and although "line crawl" can be lost at a distance which loses fine detail, the eye cannot escape *moiré* and other unpleasant patterning generated by the raster.

Mr. Gerzon does not comment on the inconsistency of scanning at elemental pitch with a half-element spot, after the channel planners calculate the "standard" in elements, fixing line totals and spacing on the unreal "chessboard" idea of the text-books. Reasoned thought makes it clear that an element-size spot cannot *define* an area its own size, but must smudge both ways along the scan; hence the half-element spot needing $1\frac{1}{2}$ diameters movement within a real scan unit.

I wish Mr. Gerzon luck with his interesting "off beat" quadruple-interlace, but fear it would still show optical faults if he calculates the scan in elements, and traces separated lines with the too-small spot set for too few lines.—A. O. HOPKINS (Worthing, Sussex).

CLUB FOR AMATEUR TV

SIR,—I am desirous of starting an Amateur Television Club in the Glasgow area and I would be grateful if you could mention this in PRACTICAL TELEVISION.

This club would meet on Wednesday evenings and meetings would be of purely practical nature —catering for the amateur dabbler rather than for the professional.

If any readers are interested would they please contact me, in the first instance by letter only.— JOHN MCDONALD (119 Maryhill Road, Glasgow, N.W.).

ISSUES WANTED

SIR,—Could any readers let me have issues of PRACTICAL TELEVISION for the months of July, August, September and October 1963 please?—L. ZAMMITY (3 Springlawn Road, Woodburn Park, Londonderry, N. Ireland).

SIR,—I would be grateful if any readers could help me to obtain the following issues of PRACTICAL TELEVISION: June 1965, July 1965, September 1965 and October 1965.—R. L. ROBSON (27 Caravan Site, Little Preston Hall, Swillington, Nr. Leeds, Yorkshire).

CAN ANYONE HELP?

SIR,—To complete my set of *Radio and Television Servicing* volumes, I require the following: 1960-1961, 1961-1962, 1962-1963, 1963-1964, 1964-1965. I would be grateful if any readers who are interested in disposing of their volumes would contact me.—H. BRIERLEY (77 East Stirling Street, Alva, Clacks., Scotland).

SIR,—If any readers have, for sale or loan, a copy of the handbook on the Bush TV62 or TV53, I would be deeply grateful if they would contact me.—D. BOWERS, BRS26760 (95 Grenfell Avenue, Saltash, Cornwall).

SIR,—I would be grateful if any other reader of this journal could tell me where I might obtain a manual or the graticule for the Erskine type 13A Oscilloscope.—D. PARRY (9 Sedburn Road, Southdene, Kirkby, Liverpool).

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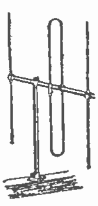

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