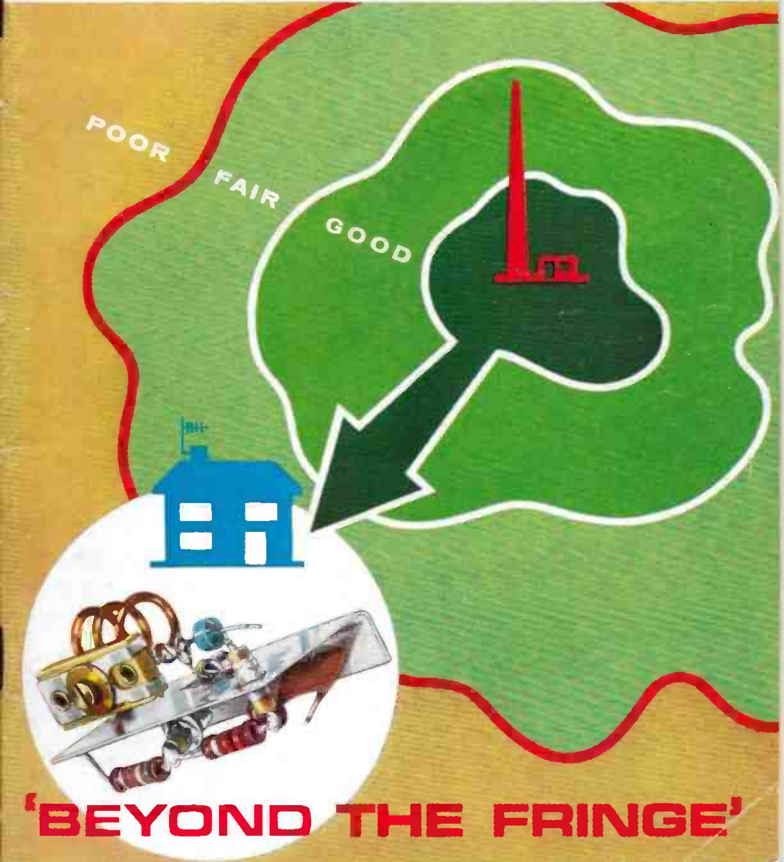
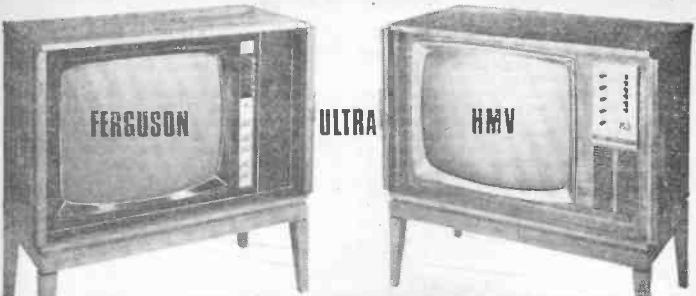
Practical TELEVISION

JULY 1967

2/-



'BEYOND THE FRINGE'



BRC LAUNCH ALL-TRANSISTOR COLOUR SETS

A FEW days after the Philips colour demonstrations, the British Radio Corporation summoned us to see their colour sets, chanting "ours are all-transistor". Our correspondent was impressed with the black-and-white compatibility, being the best he has so far seen. Colour, however, is a difficult thing to tie down, but that appearing on the face of the BRC demonstration sets was extremely good. The only criticism was that the colour seemed over done in much the same way as some colour slides tend to exaggerate the original colours.

'will put Britain ahead'

BRC—a subsidiary of Thorn Electrical Industries, who are Britain's largest radio and television manufacturers—claim that their breakthrough "will put Britain ahead of any other country in the world in TV receiver design". Quite a claim for a British company, considering the Americans have had a colour service for more than ten years and are undisputed leaders in most branches of the electronics industry!

Revolutionary techniques

Ninety silicon transistors are used in the Thorn 2000 chassis which is common to all three models. Even the high-power circuits, such as the line and field timebases, make use of semiconductors. This major change in design has been accompanied by major alterations on the mechanical side, for the receiver employs a simple rectangular frame chassis into which ten circuit boards plug-in. Each board, which has a separate circuit function (example i.f. amplifiers), can be changed, without reaching for the soldering iron, in a matter of a few seconds. The other electronic assemblies (the tuner, power transformer, deflection and convergence coils, e.h.t. rectifier assembly, blue lateral assembly and the loudspeaker) also unplug and are easily replaced.

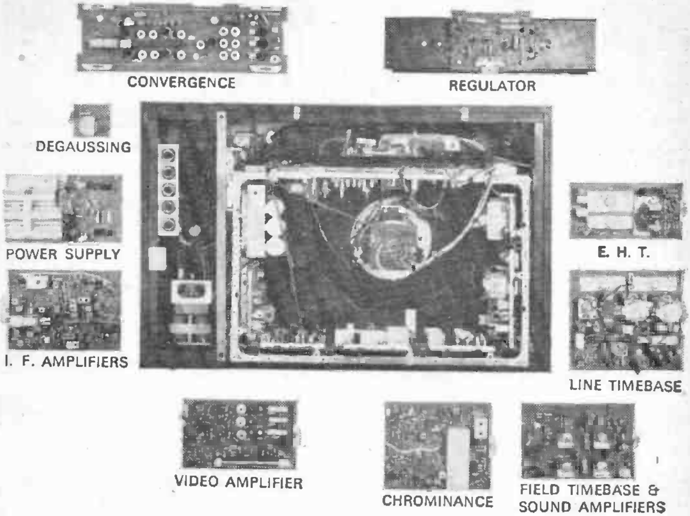
Many automatic circuits

Other circuit features include automatic chrominance for optimum colour performance. automatic gain control, automatic degaussing (even after channel changing), isolated chassis from the mains supply, stabilised line timebase, and an exclusive Thorn Jelly Pot transformer. This is used with a voltage tripler to achieve the 25kV needed to drive the 25-inch colour tubes.

Two colour controls

So far as the user's controls are concerned, there are two extra controls for colour—saturation to permit the depth of colour to be altered and tint. In addition to providing adjustment to tint level, this control also helps the viewer correct for the different types of ambient light hitting the face of

The Thorn chassis slides out on runners for ease of servicing. In this photograph, the chrominance board is being removed. The Thorn Jelly Pot e.h.t. rectifier assembly can be seen mounted on top of the picture tube.



Rear view of a BRC colour television receiver. This complete receiver is surrounded with the ten main circuit modules relative to their mounting positions. The power transformer can be seen in the lower left corner of the receiver.

the tube. Channel selection is by six push buttons. Back panel controls are in line with most dual standard receivers—405 and 625 line holds and contrasts, and a common field hold.

Another model to come

All three receivers stand on short legs and two of the models have folding doors. Recommended retail prices are: 330 gns. for the Ferguson Colourstar, 330 gns. for the HMV Colourmaster and 295 gns. for the Ultra Bermuda Colour. Details of a fourth Thorn colour receiver (Marconiphone) are to be announced later this year.

A PRACTICAL TELEVISION *request for a specification of the Thorn 2000 colour chassis was refused.* ■

the image orthicon

K.T. WILSON

FOR the last fifteen years, the camera pickup tube used for high quality TV pictures has been the image orthicon. As far as black and white is concerned, the image orthicon is practically unchallenged at the moment, though the larger 4½in. image orthicon has replaced the older 3in. types. In colour, the more recently developed Plumbicon (and its imitations) seems likely to supersede the 3in. IO's, but the 4½in. IO is still found in several types of colour cameras, which use Plumbicons for the colour channels and a 4½in. IO for the monochrome channel.

Invented just before the war, the IO represented a radical advance, in terms of sensitivity, linearity, signal-to-noise ratio, and freedom from unwanted signals, over all previously used tubes. It is classed as a charge storage tube, implying that the signal is allowed to accumuate between scans, the whole accumulated signal being released at a scan, instead of simply the value received at the instant of scanning. It is to this action that the IO owes its sensitivity and good signal-to-noise ratio.

The IO is probably the most complex electronic tube in production, so much so that some features of its operation are not fully understood. Fortunately, for the purpose of understanding its action, the tube may be studied in three sections, since the action of each section is fairly independent of the other two. These three sections are the image section, the scanning section, and the multiplier section. Once we have examined the action of each of these sections, we shall be able to appreciate the ingenious and intricate operation of the tube as a whole.

THE IMAGE SECTION

The IO is a photoemissive tube. Any TV camera tube must start with a photosensitive layer of some sort, to convert light directly or indirectly into electrical energy; the type used on the IO emits electrons when it is struck by light, hence the name. Such layers have been known for a long time, and most of them depend on the formation of a compound of Antimony and Caesium, sometimes with a dash of oxygen. This compound must be kept in a vacuum if it is to remain photoemissive, and it is usual to prepare it inside the tube itself while the air is being pumped out. The layer is made by evaporating the metallic substance, Antimony, on to the face plate, or front glass plate, of the tube, and then treating it with the hot vapour of the metal, Caesium, at a temperature of about 150deg. C. If the layer formed can be kept at a negative voltage with respect to other metal components in this section, then a current of electrons from the *photocathode*, as the layer is termed, can be measured. This photocurrent is proportional to the amount of light falling on the photocathode, and so the image of a picture projected on the photocathode by means of the camera lens causes an electron image to be formed, as the electron current coming from each point is proportional to the amount of light at that point. One of the tasks performed by the image section is to preserve the beam of electrons in the precise shape in which it left the photocathode—preventing it from spreading out, twisting, deflecting, or scattering.

The shape of the image accelerator and the target cup electrodes shown in the drawing of the image section in Fig. 1, along with a flat coil placed over the faceplate of the tube when it is in the camera, are all arranged to minimise distortion of the electron stream. It must be emphasised that there is no scanning at this stage; the image is present on the photocathode as long as the camera is in action and the corresponding electron stream is leaving the photocathode all the time.

We have said earlier that the IO is a charge storage tube, implying that the electrons released by the photocathode are accumulated in some way. The reason for this is that high sensitivity and low noise depend on a good amplitude of signal. The photocurrent from the photocathode is extremely small, and as this illumination corresponds to having the tube close up to a lamp-bulb, it is very much more than is obtained when a picture is being televised, especially when it is remembered that the image on the photocathode is formed by the reflected light from a scene which may not be brightly illuminated.

The storage process which turns this into a usable signal is performed by what is known as secondary emission charging of the surface of an insulator. In the case of the IO, the insulating surface, known as the *target*, is made of glass 0·0001-in. thick supported on a metal ring. Between the glass target and the photocathode,

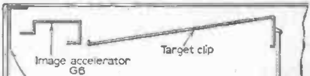


Fig. 1: The image section of the tube.

and spaced only about 0·001-in. from the target is a copper mesh, called the *target mesh*.

The function of these components is as follows. The electron stream from the photocathode has a fair energy, since the photocathode is anything from 600 to 1000 volts negative to the target, since electrons flow from negative to positive. When electrons with this sort of energy land on the surface of an insulator, they knock off more electrons from the surface; because of this, the surface, instead of being charged negatively owing to negative electrons landing on it, it actually charges positively, and continues to do so until it has reached the voltage of the nearest most positive point. This positive point is provided by the target mesh of the IO which prevents the voltage on the target rising above two or three volts. The target mesh has another, even more important function—there is a capacity between it and the target, which is charged up by this process. The closer the target is to the target mesh, the higher the capacity, and the better the signal-to-noise ratio, and the poorer the sensitivity, since more electrons are needed to charge up a high capacity to a given voltage than are needed for a low capacity. The spacing of 0·001-in. mentioned is a good compromise, but for special applications requiring sensitivities much greater than those used for domestic TV, the spacing between target and mesh can be increased so that the capacity is lowered, and charging may be carried out with a much lower current.

We can now look at the whole image section and trace its operation from the light beam to the voltage on the target. The camera lens, which must be a large high-quality one capable of excellent definition over the whole of the photocathode area, images the scene on the photocathode. In a bright area, the current of electrons leaving the photocathode is high, and this current stream is guided to the target by means of the image accelerators and target cup. To reach the target it must pass through the target mesh. Since the target mesh has about 1000 holes per lineal inch, the electron stream passes through, although about 50% of it is lost by striking the metal portions of the mesh. The mesh performs an additional function of "straightening-up" the electron stream so that it hits the target perpendicular to the target surface. When the electron stream hits the surface of the target, more electrons are released than strike, and the target charges up to a voltage which must not exceed that of the target mesh; we assume this to be set at two volts. This charging process does not go on indefinitely. As we shall see later, the scanning process which takes place on the other side of the target has the effect of reducing the target voltage to zero at each scan. The *exposure* (compare this with that of exposure in photography) must be set so that a highlight just manages to charge the target right up before scanning takes place. An area of lower illumination on the photocathode gives rise to a lower electron current, which charges the target more slowly. In the same time, therefore, the target must have reached a lower voltage where this electron stream is striking it.

The light image on the photocathode causes, by this elaborate process, a voltage image to form on the extremely thin glass target. The glass is so chosen that, at the working temperature of the camera, it conducts very slighty across its surface, enough to let much of the charge leak away in a field time (1/25 sec.). If this were not the case, it would not be possible to change scene, or to televise a moving scene, since the stored charge picture of one scene would be superimposed on the new picture being built up.

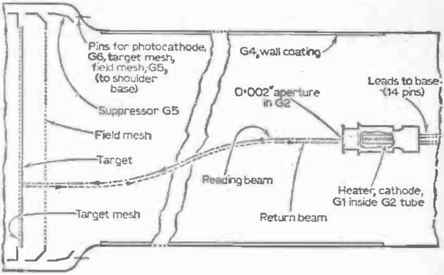


Fig. 2: The scanning section of the image orthicon.

THE SCANNING SECTION

Since scanning is an essential part of the process of televising a picture, the charge image on the target must somehow be scanned to produce an electrical signal, the *video waveform*, whose amplitude at any instant is proportional to the voltage on the target at that instant. The scanning section is shown in Fig. 2, and is composed of the electron gun, the beam focus electrode (which is a coating of aluminium on the wall of the tube) the decelerator, field mesh, and the opposite side of the target. This latter point is one of the features which distinguishes the IO from all its predecessors—the fact that it uses both sides of its target. Previous tubes used only one side, and had the difficulty that the electron gun and the photocathode had somehow to be offset from each other so as to aim at the same side of the same target.

Dealing with the action of the target first, since we have reached that point, we mentioned that the glass of the target was slightly conductive. It is a curious property of glass that its conductivity increases with rising temperature, unlike the conductivity of metals which decrease with rising temperature. The conductivity of glass is not due to the movement of electrons, but of larger particles known as *ions*, which can move more freely as temperature increases. This conductivity of the glass means that the voltage image which

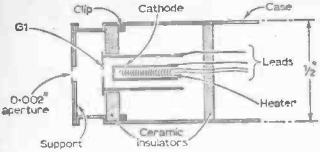


Fig. 3 (left): The gun assembly.

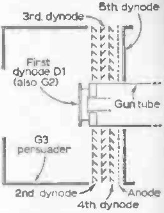


Fig. 4 (right): The multiplier section. Although the dynodes look as though they are touching one another, they are in fact isolated.

was built up on the image side of the glass must be present also on the scanning side. So thin is the glass that the two sides may be regarded as electronically connected, and if the voltage should be removed from the scanning side of the target, then it is removed also from the image side to a very considerable extent.

The process of converting the voltage image on the scanning side of the target into a video waveform is known as *reading*, and the action used is by no means straightforward. We have said already that the target can attain a maximum voltage of three volts if the target mesh be set at this voltage. Since the cathode of the electron gun of the IO is earthed, this means that, whatever accelerating voltages used between cathode and target, the electrons arriving at the target from the gun have been accelerated by a potential of only three volts; they are "slow electrons". Now when electrons approach an insulating surface so slowly, they may be absorbed on it, if the voltage of the surface is fairly positive, or repelled if the surface is nearly at zero potential. Where electrons land, they charge the surface negative (since they are negative particles) until the voltage at that part has returned to zero, when the electrons must stop landing and are reflected. Note that this is quite different from the behaviour on the image section, where the electrons were accelerated by a high voltage, and knocked off so many "secondary" electrons that they charged the surface positively.

Due to this absorption/reflection action at the scanning side of the target, there is a *return beam* of electrons at portions of the target where the voltage is low, and none, or very little, at portions of the target where the voltage is high. It is this *return beam* which is the *signal* of the IO and it is in the opposite phase to the original electron signal leaving the photocathode. Looking back, it can be seen that a highlight causes a positive charge to appear on the target, and this positive charge causes the beam to land, hence there is no return beam and no signal. A dark area on the photocathode causes the target to stay at zero potential, the beam does not land but is reflected back as a signal of full strength. It is this feature which is the weakest point of the image orthicon, because the maximum return signal occurs in the black areas. Since the noise of the IO is caused mainly by the beam, it is at maximum when the beam is maximum, which is in the black areas; the places where noise is most noticeable in the picture.

Having discussed the action of the target at some length, we must now turn our attention to the formation of the electron beam which is used to read the voltage image on the target, and the path of the return beam from the target. The reading beam is formed by an assembly of cathode, control grid, and beam forming grid, shown diagrammatically in Fig. 3. The cathode and the control grid are fairly conventional, and might well be taken from a receiver c.r.t., but the beam forming grid, or G2, is peculiar to the image orthicon. The beam is restricted to a very small diameter by making the aperture in the top of the G2 very small: 0·002-in. or less. The surface of the G2 facing the target is also specially treated, as we shall see when we consider the multiplier section, but it is the aperture which is of interest at the moment, as it determines the size of the reading beam and hence the resolution of the tube. The beam from this very small aperture is focused both magnetically by focus coils in the camera, and electrostatically by the beam focus electrode, G4, which is a wall coating on the glass of the tube. This combined magnetic and electrostatic focusing system causes the path of the reading beam to be exceedingly complex, spiralling from one focus to another on its way from the G2 to the target. As a result, there are several voltages of G4 which focus the beam on the target. Which focus is best depends very much on the design of the camera in which the tube is used, but the G4 voltage used is usually about 180V.

Besides focusing at the target, there is another important requirement for the reading beam, it must approach the target along a line which is exactly at right angles to the target. This is extremely difficult to achieve by any simple means and two methods are simultaneously employed. First of all, it is impossible to ensure *normal landing*, as it is termed, unless the beam leaves the electron gun exactly on an axis which is perpendicular to the centre of the target. This might be achieved by very exact placing of the gun during the manufacture of the tube, but with normal production tolerances and with the difficulty of exactly positioning a gun which is mounted on a glass base which must be sealed into the rest of the tube at a high temperature; it is easier to accept that the gun is likely to end up off-axis and correct for it.

The correction consists of a set of miniature deflecting coils, called *alignment coils*, the current in which can be adjusted so that the beam, before deflection, approaches the target exactly on the central axis. As a further step to ensuring normal landing, a *field mesh* is used to straighten out the electrostatic field near the scanning side of the

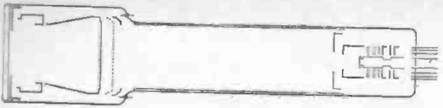


Fig. 5: The whole tube, showing the position of the elements that comprise the image orthicon.

target. This mesh must be as transparent as possible and like the target mesh, must be as fine as possible to avoid causing a mesh image in the signal. The use of the second mesh, which greatly improves the quality of signal in the IO, also causes some complications, apart from those caused by the need to mount the extra structure. When light is viewed through two meshes, an additional coarse mesh pattern can be seen, even if each individual mesh is so fine that it looks like a sheet of translucent material. As one mesh is rotated with respect to the other, the *moire* pattern, as it is called, becomes alternately coarser and finer. It is particularly coarse when the meshes are nearly lined up, and finest when they are at an angle of rotation of 45deg. In order to avoid coarse mesh pattern in the signal, therefore, the meshes must be set so that one is rotated 45deg. with respect to the other.

The introduction of the field mesh causes another problem. Any electrode which intercepts part of an electron beam must emit secondary electrons. The mesh is usually run at a voltage slightly less than that of the G4 beam focus electrode, and this is in the voltage region where electron bombardment causes more electrons to be emitted than are bombarding. It is behaving much as the target did, and under similar conditions. The secondary electrons produced come off at all sorts of angles and therefore do not land normally on the target; they produce shading and other unwanted effects. To meet this objection, another electrode, the *suppressor*, which performs the same function as the electrode of the same name in a pentode, to suppress the secondary electrons by repelling them away from the target. This is done by running the suppressor at a low voltage.

The action of the scanning section, then, is as follows. The electron beam, restricted in diameter by the very small aperture in the G2, is accelerated in the gun tube. It is focused by the combination of electrostatic and magnetic fields, there being more than one focus. It is made to land perpendicular to the target by the action of alignment coils and by the use of a field mesh. The effect of secondaries from the field mesh is reduced by the use of a suppressor, and *moire effects* are reduced by suitable alignment of the field mesh. The beam approaching the target is reflected if the target is near zero volts, and is absorbed if the target is at a positive voltage. The various degrees of reflection or absorption constitute the shades of grey which the tube can portray. The reflected beam, which is still in the form of a beam, forms the signal, and is called the return beam.

THE MULTIPLIER SECTION

The return beam is not a high current beam. It started out as a reading beam which was squeezed through a 0·002-in. aperture in the G2, some of this reading beam has been intercepted by the field mesh, and some of the return beam must be intercepted also. Some has been lost at the target, and the remainder is the return beam which goes back down the tube more or less retracing the path of the reading beam. As it stands, it would be very difficult to obtain a good usable signal from this beam; the amplification required is so much that the signal-to-noise ratio would be very poor. Some form of noiseless amplification is required, and it is this which is provided by the multiplier section.

We have mentioned secondary emission several times in this article. It has occurred as an essential effect at the target, and as an unwanted effect at the field mesh. It now occurs again as the means by which high-gain, noiseless amplification of the order of 100,000 times may be obtained. Suppose that the return beam is allowed to fall on a surface whose voltage is set and whose material is arranged so that the secondary emission ratio is very high. By that we mean that for each electron striking this material, many more are knocked off. Such an arrangement is termed an *electron multiplier*, it is performing the job of amplification, since the electron current coming from it is several times the current reaching it. It is quite feasible to prepare such materials and run them at an accelerating voltage such that a current gain of ten times is produced in the stage. If a series of such multiplier stages is arranged so that electrons leaving one are intercepted and multiplied by the next they are said to be *cascaded*, and such a series of cascaded stages is the electron multiplier. It is fortunate that the materials which form the best electron multipliers are also the materials which are photosensitive and are used for forming photocathodes. Each stage, or *dynode*, is nickel-coated with various materials, the most prominent of which is the metal, Caesium, which was also responsible for the formation of the photocathode.

The arrangement of the dynodes is of great importance. Apart from the first dynode which is the one which the return beam strikes first, all the dynodes are arranged rather in the form of turbine blades with coarse sections of mesh between. Figure 4 is a representation of the *pinwheel* structure as this type of dynode arrangement is called. Other types of dynode structure are used in photomultiplier tubes. The first dynode is the problem portion of the tube, and the one over which more time and effort has been spent than all other parts put together. First of all, the return beam has to be persuaded to strike the first dynode so that the process of electron multiplication may start. If the tube were perfectly symmetrical, the return beam would return along the path of the reading beam and disappear down the hole in the G2! This, fortunately, does not happen, but to ensure that the return beam does strike the first dynode fairly on a useful part of its surface, an electrode known appropriately enough as the *persuader* is used. On camera control units, this control is labelled the *multi-focus*, and it acts as a focusing electrode for the return beam striking the first dynode.

Having arranged for the beam to strike the first dynode our worries are just beginning. As the tube cannot be made to be completely symmetrical, and that the magnetic fields used for deflection and focusing are not completely uniform; the return beam, instead of hitting the first dynode at one spot, scans a roughly rectangular patch of it. Any variations in the secondary emission of the material of which the first dynode is made cause variations in the current leaving the first dynode, and those variations are multiplied up by the rest of the dynodes as if they had been caused by a genuine signal. When this dynode signal can be seen clearly, it is said that the first dynode is in focus; and much time and money has been spent to try to avoid this condition interfering with the picture. One expedient which has been tried with some success is that of mounting the first dynode at an angle to the return beam, so that no more than a small portion of the first dynode is likely to be in focus at one time. Most of the work has been devoted to trying to make more uniform dynode surfaces which show very little variation in their secondary emission along the surface. Materials which are most used are pure nickel or an alloy of silver and magnesium. Some materials give good uniformity and short life; others poorer uniformity and very long life; in general, the manufacturer tries to make a variety of tubes using different materials.

The remainder of the dynodes behave in a fairly straightforward way. The beam which reaches them is neither focused nor deflected, since the secondary electrons from the first dynode are released in all directions; all they have to do is to multiply the current. The position of the final electrode, the anode, is rather interesting; it is a mesh set between dynodes 4 and 5, so that electrons pass through it on the way to the last dynode—this makes the most of any multiplying effect that the anode itself may have.

The signal, a current whose value at any time depends on the charge on the portion of the target being scanned, is taken from the anode through a load resistor, and is then amplified by the video amplifier, which must also correct for the loss of the higher frequencies at the anode load, which has to be high because the output impedance of the tube is very high.

The video circuitry is worthy of an article to itself, and is also the method of setting up and adjusting the tube to obtain a picture, let alone the complexities of its manufacture. Space does not permit discussion of these matters, but one final comment must be made. The IO is a tube of incredible complexity. This complexity causes severe manufacturing difficulties, and few tubes survive the rigorous testing schedule which is necessary to ensure the quality of the transmitted picture, a quality which makes most pictures on domestic receivers look like the first efforts of Baird. Despite all this, the IO has kept its lead as the only tube seriously considered for high quality TV transmissions. The only tube, that is until the advent of the Plumbicon—but that is another story! ■

Half-wave wire for TV

F.G.Rayer

THIS aerial was erected when removing a conventional type for repair. It gave satisfactory reception at 40—45 miles. Its main advantages are almost negligible cost and ease of preparation, so it may be used as a temporary measure. Its main disadvantages lie in the fact that it is bi-directional, and that only in certain cases will the same V do for two bands.

MATERIALS

The aerial was made of 7/26 wire, but other fairly stout copper wire, such as single 14 s.w.g., would do. Three or four small aerial or egg insulators are needed, and polythene line for suspension. The feeder was already present, but if not, it should be purchased long enough to reach the conventional aerial, if the V is only temporary.

METHOD OF WORKING

An ordinary dipole is one ½-wave long, Fig. 1. Current is maximum at the centre and minimum at the ends, so a low impedance feeder approximately matches when connected at X-X. (The dipole is folded with multi-element arrays but this can be disregarded here.) If the aerial is an *odd number* of ½-waves long there is still an approximate feeder match at the centre. Figure 1 shows five ½-waves with feeder connected at X-X.

If the wires are arranged in a V, Fig. 2, directional lobes combine so that maximum pick-up is as indicated. When the wires are several ½-waves long, gain in the favoured direction can approach that of a conventional H or similar aerial.

If two bands have a frequency ratio of about 3:1 the same aerial can be made to work on both if a common direction is suitable. If the aerial in Fig. 1 is five ½-waves on 61Mc/s it will be approximately fifteen ½-waves on 183Mc/s. In other cases (not 3:1 ratio, or common direction) the aerial is good for only one channel.

With the aerial made, Y ran to a cord at a bedroom window, X-X was at a tree, and Z only a few inches above ground, anchored with a peg. Subsequently Z was tied to a pole and raised to reduce the V-angle. Z was also carried from side to side, producing different V-angles and tilts. This showed maximum results with the angle near that first adopted, but reception was reasonably good with some departure from this.

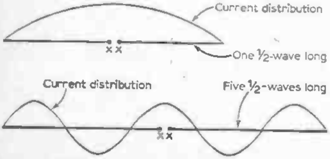


Fig. 1: Method of working of multiple ½-wave aerial.

AERIAL LENGTH

If N is the number of ½-waves for the whole aerial, then the length in feet is: 492 (N−0.05)/f in Mc/s. Suppose the wanted channel is 58·25Mc/s sound and 61·75 vision. Say 60Mc/s. Number of ½-waves five as Fig. 1. Then 492 x 4·95/60= 243·53/6=40·6ft. nearly. Then each leg, Fig. 2, is 20.3ft. Add 2in. to the wire at X-X, Y and Z (8in. in all) to bend back round the insulators.

Where the 3:1 ratio is to be used, calculate for the higher frequency. Suppose frequencies are 181·25 and 184·75—say 183Mc/s. Fifteen ½-waves are in view. Length is 492 x 14·95/183= 7355·4/183=40·2ft. nearly. This is a little shorter than the five ½-waves at 60Mc/s, but longer than five ½-waves at 61Mc/s, so means the frequency lies between 60 and 61/Mcs on this channel, which is satisfactory.

The aerial actually used was this number of ½-waves (5 and 15) but other numbers are in order, to suit space etc. The aerials may seem very long and appear to have no resemblance to usual TV aerials.

GAIN AND ANGLES

For comparison, the gain of an "H" or similar aerial is assumed to lie around 5dB and that of an aerial with director and reflector around 7dB. The gain of a V is around 3dB for five ½-waves overall, 4½dB for nine ½-waves, 5dB for eleven ½-waves and 6dB for fifteen ½-waves.

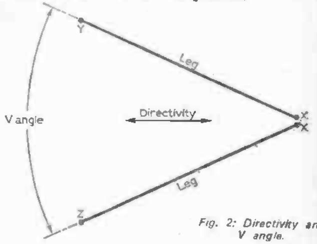


Fig. 2: Directivity and V angle.

The V-angle Fig. 2 should properly be about 90 degrees for five ½-waves overall, 70 degrees for nine ½-waves, 60 degrees for eleven ½-waves and 50 degrees for fifteen ½-waves.

If the aerial is for one channel, the angle can be chosen to suit. But when it is for two channels in a 3:1 ratio it is necessary to adopt some intermediate angle, or to favour the weaker channel. With the aerial made, reducing the angle well below 90 degrees made little apparent difference. Though this aerial was low for easy manipulation, added height improves reception, as with other aerials.

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

CONDITIONS

GOOD news at last! Or, perhaps, not nearly so bad as the dismal tales that I have had to relate for a very long time now! The slight improvement in Sporadic E reception reported last month has gained in momentum, and by mid-May there was a fair amount of activity, even if of very short duration and requiring a lot of patience and viewing time to identify the stations. However it can now be done, and after the long wait the sight of a USSR test card really is "a sight for sore eyes" produced by long periods of staring at the "goggle box"!

The Tropospherics have been good at times (particularly at the end of April and the middle of May). I am due for a spot of leave at the end of the month, and from previous experience I find that as soon as I go away we get the best openings, so conditions should be very good indeed soon!

Here is a run down of the results to date, as received in Bournemouth.

Period 16/4/67 to 12/5/67. Sporadic E.

16/4/67 to 30/4/67: Nil.

1, 2, 3, 5, 6, 7, 9, 10, 11 and 12 May: USSR on R1.

4/5/67: Czechoslovakia R1.

3, 5, 9 and 11 May: Austria E2a.

3, 6, 9 and 11 May: W Germany Grünten E2.

Same period Tropospherics:

16/4/67: Easily the best day here. Ch. 21 Lille, Ch. 21 Brest, Ch. 25 Caen, Ch. 34 Metz, Ch. 43 Le Havre, from France. Ch. 27 Lopik, Ch. 29 Goes, and Ch. 32 Goes, from Holland (always a difficult area from here), plus a number of unidentified West Germans.

Bands I/III were good on 16/4/67, 26/4/67, and 9/5/67, and the u.h.f. stations were back on 26/4/67, 3/5/67, and 9/5/67, with quite good reception of many French stations. In all I would feel that we have less cause for complaint this time.

NEWS

(1) We thank I. C. Beckett for the following list of T.V.E. Spain u.h.f. stations, now in service. Remember that Madrid Ch. 24 has already been received in the South of England.

In Service: Madrid Chamartin Ch. 21 100kW. Bilbao Ch. 22 60kW. Valencia Ch. 22 60kW. Madrid Nav Ch. 24 1,500kW. Barcelona Ch. 31 300kW. Zaragossa Ch. 33 250kW. San Sebastian Ch. 40 100kW.

Projected: Alicante Ch. 32 100kW. Oviedo Ch. 39 100kW. Seville Ch. 52 100kW. La Coruna Ch. 22 100kW.

(2) Roger Bunney reports that the following new stations are now in operation:

R.T.P. Muro Portugal E2. 40kW. Vert. (Already received here—see readers' reports below.)

R.T.F. Besancon France F4. 30kW. Vert. (This one is situated in Mid-Eastern France and is a possible Sporadic E signal in UK but it is going to present some identification problems since the Carcassonne transmitter is on the same frequency and also vertically polarised, and is a good Sporadic E signal as well in this country.)

(3) Pakistan. Mr. Bunney has just heard that as yet there are no transmitters in operation in Band I, in spite of reports to the contrary from some sources. This latest news comes from the Pakistani TV chief engineer, so he should know!

PROPOGATION

A few more precise details of meteor showers due during 1967; these could well produce some useful DX/TV reception:

Perseids 27 July to 17 Aug. 1967, Peaking 12 Aug.

Orionids 15 to 25 Oct. 1967. Peaking 21-22 Oct.

Taurids 26 Oct to 16 Nov. 1967. Peaking 1-7 Nov.

Leonids 15 to 17 Nov. 1967. Peaking 16 Nov.

Geminids 9 to 14 Dec. 1967. Peaking 13 Dec.

Ursids 20 to 22 Dec. 1967. Peaking 22 Dec.

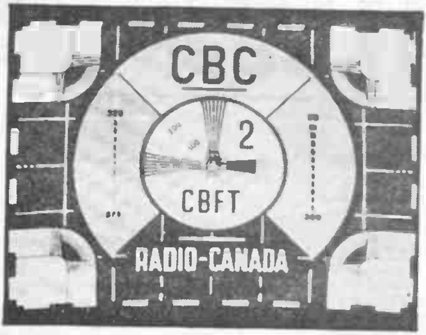
SOLAR ACTIVITY

Apart from the well-known sun-spots, and the 11-year cycle of maximum activity that we are now approaching, there is another form of solar phenomena that is conducive to DX reception. These are solar flares, which take the form of enormous clouds of incandescent gas ejected from the sun at intervals, and which reach heights of many thousands of miles above the sun's surface. They are visible on earth if certain techniques of observation are applied. There are two main ways of observing these flares: (a) the direct method, and (b) the projection method.

Firstly the direct method, but a very severe word of warning here. Do not attempt to look at the sun directly, either with the naked eyes or (even more important) through binoculars or a telescope.

DATA PANEL-22

C.B.C. CANADA



Test Card:
The photograph shows the normal Canadian test card, but we understand that the Red Indian Head type of test card (like that of the USA) is used on occasions.

Channels:
Details of channels for the Canadian English and French networks were given on pp. 401 and 423 of the June, 1967, issue.

It is absolutely vital that a dark screen *sufficiently opaque* is introduced into the optical system to obviate any risk of permanent damage to the eyes. However, having taken the necessary precautions, it is often possible to observe solar flares near the solar perimeter.

The second method, and a much safer one from the point of view of safety for the eyes, is to project the sun's image through a darkened lens on to a sheet of ground glass, or even paper, but watch that the paper does not catch fire if the lens is not dark enough, or you may wish that you had never thought of it!

Assuming that observations on a certain day and hour show that solar flares of large dimensions are present, then after a delay of some 28 hours they will cause either auroral effects in the earth's atmosphere or produce ionospheric storms, both of which will cause the reflection of DX signals.

READERS' REPORTS

As noted above, we have a most interesting report from D. Kelly of Castlewellan, N.I., on his reception on 4/5/67 of the new R.T.P. transmitter at Muro, Portugal, on E2. He saw this on test card before the programme opening. He also reports reception of USSR R1, Czechoslovakia R1, Switzerland E2 and E3, Portugal E3, and Austria E2a.

Our old friend Mr. Papaeftychiou of Cyprus has had more F2 layer reception, apart from Enugu, E. Nigeria, received again. He has had another on E3, which he thinks is Kenya. Magnificent work, and we eagerly await more news.

Welcome to a new correspondent, R. S. Parkin of Canvey Island who reports two Dutch u.h.f. stations. If he would care to let us know the channels, we will be pleased to identify them for him.

COLOUR TV AT THE RECMF

At the RECMF Exhibition at Olympia this year, many exhibitors showed for the first time new components for colour TV and all of them are aiming to help setmakers reduce receiver costs. Colour was transmitted to Olympia, by the BBC, for eight hours a day so that exhibitors could demonstrate the effectiveness of their equipment.

Mullard featured their Colour Screen picture tubes and the company will have the capacity to produce them at the rate of 120,000 a year at its Simonstone factory where a £1M colour glass making plant was recently installed. Both the 19 and 25in. tubes are rectangular 90-deg. types which eliminate the need for a protective shield. A new unipotential electron gun has enabled the neck to be reduced to only 36mm diameter. The tubes provide high brightness due to specially Europium activated rare earth red phosphors coupled with green and blue phosphors of the sulphide type that maintain their hues at high light outputs.

Details of other Mullard colour TV components will be given next month.

Mazda displayed their 25in. CTA2550 (A63-11X) shadowmask tube being made at their Brimsdown works. It has a grey faceplate glass with 50% light transmission and a Rimguard I metal shell protection with mounting lugs.

Some hundred companies are in full production with components for colour TV. Set makers, however, still remember the poor response from the public to the 625-line u.h.f. programmes and since no company is willing to sink huge capital sums in production until the consumer demand becomes more apparent, colour sets will inevitably be very costly for some time.

Servicing TELEVISION Receivers

No. 136
RADIO RENTALS (BAIRD) 460 series
—continued

by L. Lawry-Johns

Flywheel sync unit

Provision is made for fitting a flywheel sync unit to the timebase panel by removing V7 and inserting a nine-pine plug into the V7 socket. The fly lead from the unit has a small socket which fits on to a pin near the V7 socket. The V7 valve itself is now fitted into the vacant valveholder on the unit.

Some care is required in setting up the hold control or line sync will be lost on changing channels. The makers recommend the following procedure be carried out.

(1) Set main line hold control to its midpoint.
(2) Set the preset control on the unit to one end and slowly turn it back towards its midpoint until the picture just locks. Note position of slot.
(3) Turn the auxiliary hold control to other end and repeat toward midpoint noting the position of the slot when the locking point is reached. Reset so that the slot is midway between these two positions.

Change channels to make sure the picture locks each time. If the preset control has to be near one end interchange the ECC82 valves as one may give better results.

Bottom compression

If there is a gap at the bottom of the picture and the lines are compressed (giving the impression of short legs and long heads, etc) check V15 (PCL82) and C91 (500μF) pin 2 to chassis. If the bottom of the picture is folded up or ends in a white line check V15, the value of R89 (360Ω) also C98 if necessary.

Lack of height

If the loss of height is even top and bottom check R88 (2·2MΩ).

Lack of width

While the h.t. voltage could be low to cause lack of width (and this point should be checked) the usual cause is a low emission PL36. It is as well to check V7 (ECC82), associated anode resistors R43 and R44 and R52 (under V8 valve platform) for correct value. The PY81 should receive attention if the above points are in order.

No picture

Listen for the line time base whistle. If absent check V8 (PL36) which may be faulty, possibly with a cracked envelope which may come apart when removed. The indication of this is that the heater does not visibly glow even though the remainder of the chain does.

If the PL36 is not at fault check the ECC82 and associated components.

In these receivers the boost line capacitor is connected to chassis (C61 0·25μF). When this shorts, V9 is virtually shorted to chassis possibly causing a heater-cathode short in this valve or/and the fuse to fail.

There is no reason why a replacement should not be wired to h.t. instead of chassis; in fact some receivers may be found so wired. In any case the voltage rating as marked should be observed.

Variation of focus and size

While this fault, i.e. variation of size and focus as the brilliance is advanced is nearly always due to a low emission EY86 it should be realised that an improperly supplied valve will give similar or the same effects.

In these receivers a 47kΩ resistor (R56) is included in the anode supply to the top cap. This resistor can decompose due to the high pulse voltage applied and become a virtual open circuit, causing a drastic drop of voltage across it as the beam current increases.

No picture, e.h.t. normal

Check tube base voltages, particularly at pin 10 of the base. Lack of voltage will almost certainly denote a shorted capacitor C60. This is a 0·5μF decoupling the 1st anode. If the 1st anode voltage is correct (about 400V) check at pins 2 and 11. Pin 2 is the control electrode or grid and should record from zero to 160V as the brilliance is advanced. Pin 11 is the cathode which normally stands at something like 100V depending upon the vision signal.

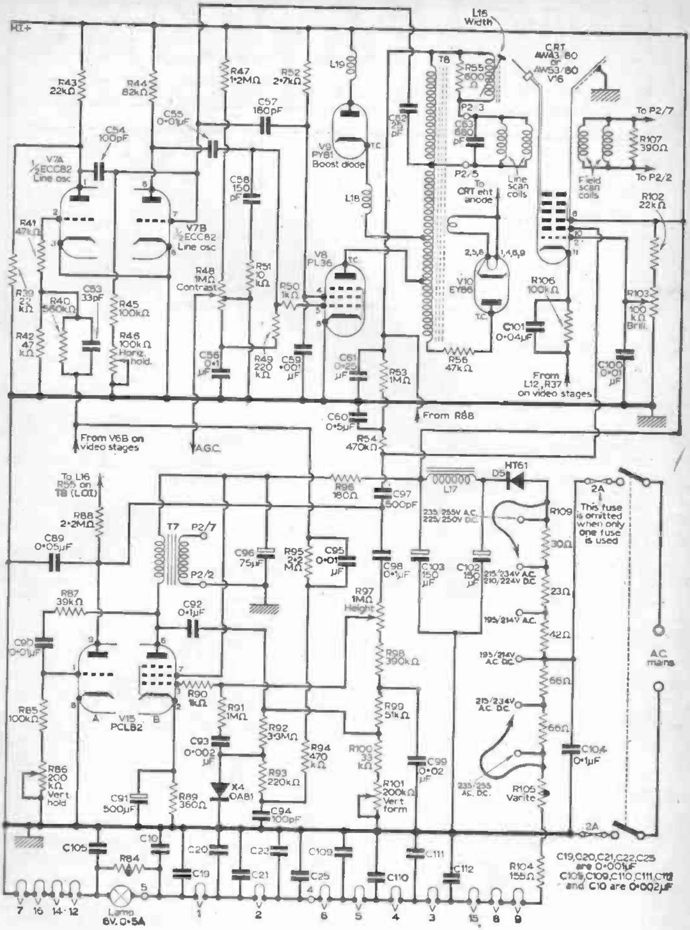


Fig. 4: Line and field timebases and power supplies.

RADIO RENTALS 460 series (non-f.m.) voltage check chart

Voltages checked with set on 215-234V tap using a.c. input of 230 volts. Rectified volts 200V. H.T. volts 184V. Turret h.t. 158V. E.H.T. 12.7kV. Tube blacked out. Boost rail 450V.

Pin No. / Voltage on pins	1	2	3	4	5	6	7	8	9
V1 PCC89 R.F. amplifier	90	80	150	49 *	41 *	—	0·83	0·83	90
V2 PCF86 Mixer	—	−2·75†	—	49 *	57·5*	—	38	158	111
	test	point							
V3 EF183 1st i.f. vision & sound	1·85	—	1·85	95 *	88 *	—	171	90	—
V4 EF183 2nd i.f. vision	1·9	—	1·9	88 *	81 *	—	170	85	—
V5 EB91 Video diode	119	—	81 *	74·5*	—	—	5·5†	—	—
V6 PCL84 Video output and sync	—	145	—	57·5*	74·5*	102	4·9	—	181
V7 ECC82 Line osc. and clipper	46	—	—	6·4*	6·4*	123	−58 †	—	—
V8 PL36 Line output	—	112 *	—	103	−28 †	—	139 *	—	—
V9 PY81 Boost diode	—	—	—	139 *	158 *	—	—	—	186
V12 EF183 1st sound i.f.	1·1	—	1·1	38 *	31·5*	—	170	75	—
V14 PCL82 Audio amp. and output	—	13	—	13·5*	31·5*	180	184	1·3	100
V15 PCL82 Field osc. and output	−24 †	12·5	—	95 *	112 *	170	179	—	42†
Pins	1	2	4	6	10	11	12		
C.R.T. AW43/80	6·4*	0–150‡	100	189	420 †	80	13·5*		

* A.C. voltages
† Measured with 20,000 ohm/volt meter
‡ Varies with setting of brilliance

Voltages on vision receiver taken with no signal input
Voltages on time base taken with locked picture
All other voltages measured with 1,000 ohm/volt meter

If the voltage at pin 11 is up to 180V check the PCL84 video amplifier; R31 and R32 if the PCL84 is not at fault.

If the voltage at pin 2 remains at zero check C100 (0·01μF) and the brilliance control track which could be damaged.

Striations

These are vertical rulings down the left half of the screen, severe at the extreme side, fading toward the centre—check R55 (600Ω).

White line across screen

This, of course, denotes complete non-functioning of the field deflection. First check the PCL82 (V15) then the voltage at R96 (180Ω) and pin 6 of the valve base. If the voltage (h.t.) is present at both sides of R96 but not at pin 6 check the continuity of T7 the field output transformer.

No sound

Apply a hum test at the volume control. If there is no response check V14 and associated voltages —PCL82 pins 6, 7 and 9 for h.t., bias volts at pin 2.

If there is no voltage at pin 6 of the V14 base check the continuity of T6 the sound output transformer.

Distorted sound

If more severe on strong signal check the 2·2MΩ resistor R80 to X6 (OA71) if a PS5 sound panel is employed. Otherwise check the noise limiter components (associated with OA81 on main circuit diagram).

If the distortion is constant check V14 and C76 0·02μF (non f.m. circuit).

Weak or no signals

If the picture is grainy, particularly on the weaker of the two stations, check the PCC89 (V1) assuming the aerial is known to be in order. Check the aerial plug and socket if there is any doubt and the aerial itself for corrosion if necessary.

This again could be due to a faulty PCC89 but the PCF86 is not above suspicion and the voltages to both stages and to V3 EF183 should be checked.

Sound and raster—no picture

The PCL84 (V6) is the first suspect but if the video stage is in order (R31—R32—R35 to be checked), check V5 EB91 and the V4 stage (including decoupling capacitors C42 and C41).

Hum bars

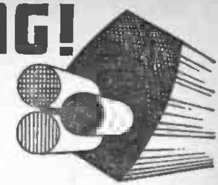
If almost one half of the screen is black with the other bright white check V5 EB91 for heater—cathode shorts.

Badly curved verticals, hum on sound

This is usually an indication of insufficient smoothing and attention should be directed to the 150μF + 150μF electrolytics C102—C103.

COLOUR IS COMING!

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



by A. G. PRIESTLEY

PART 2 — WHY RED, GREEN, BLUE?

Last month we had a general round-up of the present state of the colour TV art and what we can fairly expect in terms of performance, price, and serviceability. Now it is time to get down to business, but first of all there is a very important point to be made.

There is no doubt that when one first begins to look into the theory of colour television it is rather easy to become a little overawed by its apparent complexity. Many of the circuits are unfamiliar, and the diagrams are often badly drawn to a small scale with a maze of interconnecting leads that defy anyone to unravel them. Let us start off with a word of encouragement to the uninitiated by stating quite categorically that anyone who understands black-and-white television can also understand colour. It just needs a little more determination.

COLOURED LIGHT

Any system of colour television starts at the object in front of the camera and finishes, not at the screen of the c.r.t., but at the eye of the beholder. Since the system is built around the characteristics of coloured light and those of the human eye it is very desirable that we should know something about light and how it appears to us. Light is a form of electromagnetic radiation similar to radio waves, heat, gamma and x radiation. The difference is simply one of wavelength. Whereas u.h.f. television transmissions have a wavelength of about half a metre, light has a wavelength of only about half a μ ($1\ \mu = 1/1{,}000$ of a millimetre $= 1/1{,}000{,}000$ of a metre). The whole visible spectrum extends from about 0·4 to 0·8μ or 400 to 800mμ. In this context it is more convenient to talk about wavelength rather than frequency, since the frequency of light corresponds to about 600 million megacycles. Figure 1 shows the spectrum of electromagnetic radiation and the small part of it occupied by visible light.

The wavelength of a particular source of light determines the colour (or hue to give it the proper technical term) seen by the eye, and radiation of say 700mμ looks red, whilst light of 470mμ looks blue. Our source of light can be described in terms of *brightness*, *hue* and *saturation*, and since these terms keep on cropping up in colour television we had better describe them. The brightness of light is a measure of the amount of energy radiated, thus a 60W bulb is brighter than a 40W one of the same colour. Hue describes the sensation of colour seen by the eye and is quite independent of the brightness of the source. It depends only upon the wavelength of the light, as we saw earlier, and may be a pure colour corresponding substantially to one wavelength, or it may comprise a mixture of light of several different wavelengths. Saturation is a measure of the "depth" of colour. A pure deep red corresponds to 100% saturation, whilst equal quantities of red light and white light give pink; i.e. red light at 50% saturation. Note: pink is still a red hue, but at a low level of saturation. All pastel colours have low saturation. So to sum up in nice loose terms, hue tells you the colour of the light; saturation tells you how much white light has been added to it, and the brightness is an indication of whether it is a dim light or an intense one. All three qualities are independent.

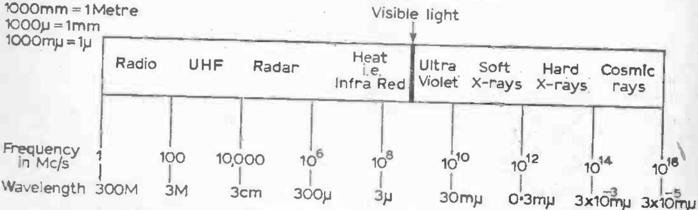


Fig. 1: Spectrum of electromagnetic waves; light waves fall between the heat and ultra-violet bands.

THE HUMAN EYE

The eye consists basically of a lens which focuses the light received from the object being viewed on to a vast number of nerve endings in the retina at the back of the eye ball. These nerve endings are of two types—rods and cones. The rods are very sensitive and respond to light of any colour, and so the object is seen only in terms of its brightness, i.e. in black and white. The cones are less sensitive but respond to colour, and they analyse the light from an object into its red, green and blue components. If a red object is viewed for example, the energy of the light falling on the cones excites the nerve endings and a train of pulses is transmitted to the brain. The result is a sensation which we call "red".

Any colour which can be recognised by the brain is therefore identified by the amplitudes of the sensations caused by its red, green and blue components. These are the three *primary* colours from which all other colours can be derived. Any other primary colours could have been used, but these are the ones with which nature has endowed us. Colour blindness is caused by the eye having inadequate sensitivity to one or more of the primary colours, and so the overall sensation of colour is distorted. Another feature of human vision is that we do not need detail in both colour and brightness changes in a picture. If we superimpose slightly blurred colour on to a sharp black-and-white picture we see an apparently sharp coloured picture.

The behaviour of the human eye is very important to the whole system of colour television because its characteristics—namely its independent brightness and colour reception; the use of three primary colours, and the absence of any need for fine colour detail—are all made use of and exactly paralleled in the transmitted signal and the colour receiver.

WHITE LIGHT

If you take a prism, such as a piece of an old candelabrum, and shine white light through it on to a piece of white paper you will get a rainbow effect containing all the colours of the spectrum—red, orange, yellow, green, blue and violet. The reason for this is that white light is not a hue in its own right, but a mixture of hues, and depending upon their wavelength some get bent during their passage through the glass more than others, and so they get separated (see Fig. 2). However, the sensation of white light can be obtained from more simple mixtures. For instance if you mix blue and yellow, or green and magenta, you still get white. And here we come to the term *complementary* colours. Magenta is the complementary of green: i.e. the colour which added to green produces white. A knowledge of complementary colours is sometimes useful in home decorating to help in the choice of colour schemes. Another way of producing white light is to mix the right proportions of red, green and blue, and this fact lies at the heart of colour television.

From this discussion it is clear that we can get different sorts of white light depending upon the individual mixtures. It is well known that artists like to have a studio facing north, although in the home this light appears cold, and a south facing aspect is more pleasing. Similarly we prefer incandescent bulbs to fluorescent tubes. These different white lights are important to us because the colours of a picture seen by a camera in a television studio or displayed on the screen of a c.r.t. is biased by the light falling upon it, and by the colour of its surroundings.

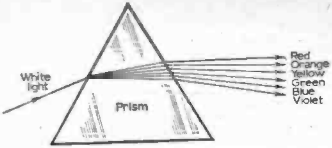


Fig. 2: A simple method of breaking up white light into its different wavelengths (different colours) is to use a prism

Black: True black is the absence of any light at all. However, this seldom occurs completely in practice as virtually all surfaces reflect some light. What we more commonly see is a dark area surrounded by a light one, so the dark area looks black by comparison. The screen of a c.r.t. is a greyish green colour, but when a picture is switched on we see it in terms of white, grey and black areas. The eye adapts itself to the brightness of the highlights and is unable to distinguish any sensations, colour or brightness, received from the dimly illuminated parts of the picture.

Brown: This is one of nature's little jokes because it simply does not exist. When the eye sees a very dim area of yellow or orange light surrounded by a bright area, or in the presence of white light, it is deceived into seeing the yellow or orange as brown.

Mixing Light: When an artist wants a particular colour he often obtains it by mixing the appropriate pigments on his palette until he gets the desired effect. In printing a number of coloured inks are used in much the same way to reproduce as accurately as possible the wide range of colours present in the original picture. The accuracy achieved depends largely upon the number of primary colours used and the precise choice of hues; ideally these should be tailored to suit the particular picture.

In colour television we want to be able to reproduce all colours visible to man. Although it is clearly impossible to achieve a perfect result, we must aim at the best engineering compromise available to us. So we face the same problems as the printers and other workers in colour: which primary colours do we use?

CHROMATICITY

There is a rather interesting diagram that we can draw which illustrates the answer to our problem quite simply. It is called a "chromaticity diagram"—i.e. a diagram pertaining to colour—and is shown in Fig. 3. You will notice that it is shaped rather like a horseshoe with its open end closed by a straight line. The numbers along the periphery refer to the wavelength of light in the visible spectrum from 470mμ to 700mμ. Now we know that the wavelength describes exactly the hue of a coloured light, so we can write down the

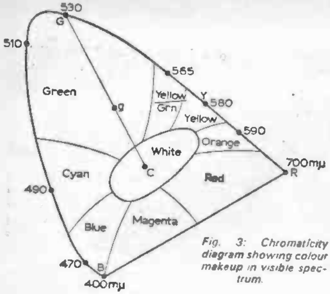


Fig. 3: Chromaticity diagram showing colour makeup in visible spectrum.

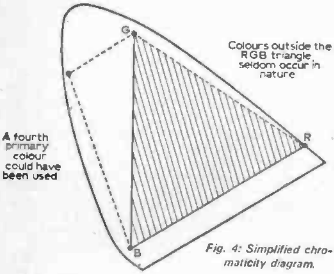


Fig. 4: Simplified chromaticity diagram.

spectral colours at the appropriate points of the curve. The line joining the ends of the horseshoe from red to blue includes the various shades of magenta obtained by mixing these two. Magenta itself does not occur in the natural spectrum and can only be obtained by mixing.

The point C near the middle of the diagram represents a mixture of all hues in the right proportion to give white light. Between C and any point on the periphery, say G, we have all the shades from white, passing through pale and mid greens, to pure green itself, corresponding to light of 530mμ wavelength. Similarly we can get all other colours by choosing the appropriate point in the diagram. The key point to note is that the chromaticity diagram encloses *all* colours visible to the human eye. These are the colours that we would like to reproduce in colour television.

ADDING COLOURS

In order to solve the problem of choosing primary colours we must first see what happens when we add colours together. We have just seen that if we choose a point g between C and G we are in effect adding white light to pure green light and the result is pale green. In other words light of a green *hue* but at low saturation because the green has a lot of white light added to it. In the same way if we take a point Y between G and R we can either regard it as a pure yellow hue of 570mμ wavelength, or we can obtain the same effect as far as the eye is concerned by adding green and red light in the right proportions. Taking the argument a stage further, we can draw a straight line on or in the diagram between any two colours we choose, and any point on the line represents a mixture of those two colours. The exact colour we get depends upon where that point is: i.e. upon the relative amounts of the two chosen colours we started with. These two colours are "primary" colours.

CHOOSING OUR PRIMARY COLOURS

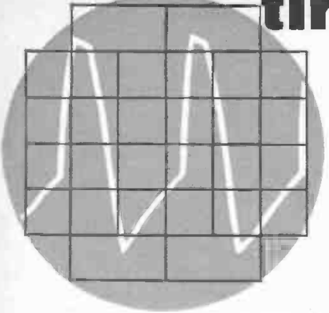
Let us suppose, as in fact is the case, that we can produce really good red, green, and blue phosphors for the screen of a c.r.t. They are not perfect because they emit a small amount of light of unwanted hues and so they are slightly desaturated—diluted with a small amount of white light. If we redraw Fig. 3 to avoid the diagram getting too cluttered, we can plot the positions of the light emitted by these phosphors as shown by R, G and B. Any colour between R and G can be produced by exciting the R and G phosphors to the appropriate extent by a beam of electrons in the c.r.t. Similarly we can get any colour on the other two sides of the triangle by exciting the G and B or the B and R phosphors. If we excite all three suitably we can get any colour *inside* the triangle. We cannot however get any colour *outside* the triangle.

Having chosen three arbitrary primary colours our diagram tells us at a glance which colours we can reproduce and which ones are barred to us. It should be noted that the colours inside the triangle include all *hues*, but we cannot reproduce any of them at full *saturation*. All of them will be diluted to some extent with white light. The colours outside the triangle represent highly saturated colours (with very little white light added) which very seldom occur in nature. So we have a viable system of colour reproduction. Any other three primary colours could have been chosen, but in practice the choice of red, green and blue enables us to reproduce the widest range of colours which occur commonly in nature, and to which the human eye is most sensitive. We could have chosen four primaries, as illustrated in Fig. 4, to increase the range, but this would introduce engineering difficulties in both transmission and reception. The fact that the human eye works in terms of red, green and blue primary colours predisposes us to use them in our television system, but if good phosphors could not have been manufactured the choice of primaries would have been different.

We have discussed the chromaticity diagram in some detail as it neatly shows which of the colours occurring in nature can be reproduced by colour television. The range is considerably greater than can be obtained by printing or photography. However, most colours can be reproduced by mixing the right proportions of red, green and blue light obtained from typical c.r.t. phosphors. We could get somewhat better coverage by using four primaries, but this would introduce unjustifiable engineering difficulties.

to be continued

timebase tr



K. ROYAL

THE oscilloscope is a "natural" for timebase testing, for it virtually X-rays the circuits, displaying on the screen for all to see the antics of the currents and voltages while barely imposing any load at all on the source. An elaborate oscilloscope is by no means necessary for timebase testing, and the simplest of instruments will yield an abundance of useful information. The surplus instruments, advertised at "give-away" prices, are perfectly suitable for timebase analysis, and even more value is given to the exercise by constructing one's own instrument. However, here we are concerned with application in TV timebases—not with construction in any way.

FEATURES

Let us examine a few of the features of the oscilloscope before proceeding further. The heart of the instrument, for instance, is the cathode-ray tube with electrostatic deflection, as distinct from magnetic deflection of TV picture tubes. Magnetic deflection can be used, and there are some designs for converting old TV sets into oscilloscopes, but this type of deflection is unusual.

Horizontal deflection of the spot on the screen is provided by X plates and vertical deflection by Y plates. The X plates are connected to an internal timebase whose repetition frequency can be regulated by front-panel controls, and for TV timebase work a frequency range from about 25 to 50,000c/s is desirable. The timebase signal is of conventional sawtooth nature, giving linear deflection of the spot from left to right of the screen and then a rapid flyback.

The timebase controls are calibrated either direct in repetition frequency or in time that it takes the spot to move linearly over 1cm of screen surface. A timebase setting, then, of 5mS/cm means that the spot moves 1cm in 5mS. If the screen diameter is, say, 6cm, the spot takes 30mS over its forward trace at this timebase setting. This "sweep speed" can be converted into frequency simply by dividing the number into 1000 for mS and into a million for μS. A sweep of 30mS thus converts to a frequency of about 33c/s. Similarly, a sweep of 20mS converts to a frequency of 50c/s. This is easy to realise by considering a 50c/s sine wave. Fifty occur each second. Thus, one occurs in one-fiftieth of a second, which is the same as 20mS. Many oscilloscopes have a transparent screen on the tube face calibrated in centimetre squares, called a graticule, allowing a complete waveform to be timed relative to the setting of the timebase sweep control.

Only strong signals are fed direct to the Y plates. Low-level signals pass through a Y amplifier and thence to the plates, and most instruments feature a built-in Y amplifier. The front-panel Y terminal accepts the test signal and applies it to the Y amplifier via a switched attenuator calibrated either in "times amplifier gain" or in voltage per centimetre of spot deflection. The latter is becoming more common, and here a setting of, say, 1mV/cm means that the spot will be deflected vertically over 1cm by an input of 1mV. A calibrated graticule enables the amplitude of any signal within the range of the attenuator to be assessed. For instance, with the attenuator set to 3mV/cm a deflection of 4cm would indicate a signal amplitude of 12mV.

DEFLECTION

Spot deflection is directly proportional to the peak-to-peak amplitude of the test signal. On sine wave signals, therefore, half the indicated value is peak and 0·707 of peak root mean square (r.m.s.) value. With the X timebase running at not less than about 20c/s, the spot traces out a horizontal line. Below 20c/s, flicker is bad and as the speed is reduced so the spot can be seen moving across the screen.

Let us say we apply a 50c/s sine wave input to the Y terminal with the timebase running (sample signal from the mains, for instance) so that the sweep exactly matches the time of one complete cycle of input signal. That would be 20mS or 4mS/cm with tubes of 5cm screen diameter, and so adjusted, one complete cycle of signal would be traced on the screen over the full trace. If the timebase sweep time is halved (frequency doubled), only half the waveform would be displayed, while doubling the sweep time (halving the frequency) would give two complete waveforms side-by-side on the display.

OTHER DEVICES

This is the fundamental action of the oscilloscope, but other devices are featured for locking the display on the screen (sync) for altering the vertical and horizontal position of the display (shift) and, on some instruments only, for increasing the X deflection (expansion). This latter effect, incidentally, opens up the display horizontally to facilitate closer examination of detail. It is rather similar to increasing the sweep rate on the same timebase setting.

Armed with this information and an oscilloscope we can get to work on a faulty TV set. If we have the classic symptom of a bright, horizontal line, indicating total failure of the field timebase, we can quickly discover whether the oscillator or amplifier is responsible by connecting the output

traces PART 1

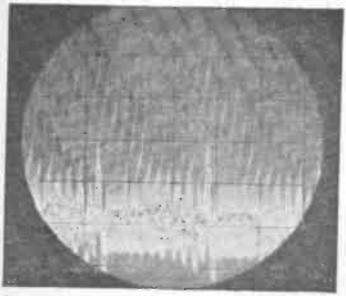


Fig. 1: Display confusion resulting from a "floating" 'scope E terminal.

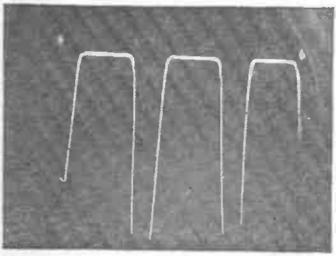


Fig. 2: This display is clipped due to overloading in the Y amplifier.

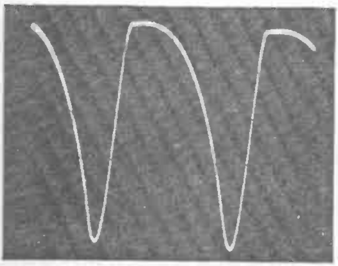


Fig. 3: This exponential drive waveform is obtained by the charging of a capacitor through a resistor and its sudden discharging through a low resistance circuit.

of the oscillator to the Y terminal. If the oscillator is working we would then get indication of the field signal on the screen of the 'scope. If this remains undeflected vertical and we have adjusted the Y attenuator correctly, we can be pretty certain that the field amplifier is okay and that the oscillator is responsible.

OTHER ASPECTS

Before we go on let us consider one or two practical aspects. The signal should be taken from the output of the field oscillator to the Y terminal through 0·1μF isolating capacitor, and the lead should be as short as possible to avoid picking up too much line signal or ripple voltage. If it is necessary to run a fairly long lead, then this should be screened, the inner conductor used to carry the signal.

It is also necessary to connect the 'scope's E (earth) terminal to the set's negative line or chassis. This can give rise to complications owing to the modern a.c./d.c. techniques connecting this line or chassis direct to one side of the mains supply. The best plan is to power the set through a 1-to-1 ratio mains isolation transformer of about 150 watts, and then earth the set's chassis or h.t. negative line as well as connecting it to the E terminal. If screened cable is used for the signal, the braid should be connected to E and the set's "earth". However, since such isolating transformers are costly, it is permissible to connect the h.t. line or chassis of the set direct to the 'scope's E terminal without mains isolation provided (i) *the set is not truly earthed* and (ii) *care is taken to ensure that the h.t. line or chassis of the set is connected to mains neutral.* Many practising service technicians work and test without mains isolation, but they are fully aware of the severe damage to person and equipment that could occur with the chassis or h.t. negative to mains "live". So beware! One will not get far with oscilloscope testing by leaving the E connection floating, hoping for greater safety without isolation. The oscillogram in Fig. 1 gives some impression of the confusion that can result on the screen without the E terminal connected.

Returning to the main theme, let us us suppose that we get a big deflection from the oscillator. The waveform trace may convey little for two reasons (i) the Y attenuator may be incorrectly set and (ii) the sweep speed may be wrong for the signal frequency. Too little attenuation will give a trace of insufficient vertical amplitude, while too much will cause overloading of the 'scope, as shown in Fig. 2. If the sweep is wrong a confusion of waveforms will result, giving either a part of the waveform greatly expanded horizontally (sweep too fast) or a multiplicity of waveforms side-by-side (sweep too slow). It is best to adjust the sweep for a display of two or three complete waveforms and then turn on the sync for solid trace lock. Remember, too great a sync setting will tend to distort the waveform display.

On the field timebase, the 'scope's timebase should be set at about 25c/s or 40mS full sweep, equal to a sweep of 8mS/cm on a tube of 5cm diameter. Most instruments have a fine sweep adjustment in addition to the switched sweep control, so it is easy to obtain the exact sweep velocity for correct trace lock. A sweep of about 6·6mS/cm will be required on a 'scope with a 6cm diameter tube to give a full sweep of 40mS.

This may sound complicated, but it is easy in practice; and that is what is required—practice on a real 'scope.

When we have set everything correctly for the field signal frequency and amplitude, we may resolve a trace something like that in Fig. 3. This shows that the field oscillator is delivering signal, at least. The amplitude could be wrong, of course, but this would affect the picture height and not mute the vertical scan completely. It is necessary to know the approximate amplitude for a correct scan when investigating for troubles like reduced height, and this is often given in service manuals. An average amplitude (peak-to-peak) at the field oscillator output is about 90V. Thus, when checking in this region, the attenuator should be set to about 20V/cm (with a 6cm tube) and the display will then be approaching full screen size vertically.

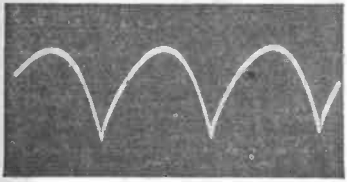


Fig. 4: This parabolic waveform is developed at the cathode of the field output valve and is used for linearity correction and for dynamic convergence in colour sets.

THE AMPLIFIER

Having established that the oscillator is working, the next move is into the amplifier, and here it is best to monitor the signal across the cathode resistor. A typical display at this point is shown in Fig. 4, which represents a parabolic waveform of the kind used in colour sets for dynamic convergence! An average amplitude across a resistor of about 330Ω is 1·4V, so with a 6cm tube we would set the Y attenuator to about 300mV/cm to obtain a trace towards full screen size. If we get no signal at the cathode, either the drive is failing to get to the amplifier's control grid from the oscillator or the amplifier valve is inactive. This could be caused by an open-circuit valve (zero emission, heater failure etc.) or an open-circuit feed component, like field output transformer primary or screen grid resistor. We can make sure that the drive is present at the control grid by monitoring here, and the waveform should be similar to that at the oscillator output. If all right, a few simple d.c. tests will prove that the valve electrode voltages are correct or otherwise. If correct, but zero cathode volts, the valve is dead.

It is not good policy to monitor waveform direct on the anode of the amplifier as the high peak voltages here can cause trouble to develop in the 'scope unless adequate coupling attenuation is employed. However, it is perfectly in order to monitor on the field scanning coils coupled to the secondary of the field output transformer. One side is usually "earthed" to set's chassis, so all we have to do is connect the Y 'scope's lead to the tag or termination on the other side of the winding. Waveform amplitude comparable to that across the cathode resistor of the amplifier valve should be expected, but shorting turns in the field output transformer or scanning coils will have the effect of severely reducing the display amplitude. It is the current waveform in this circuit, of course, which is important, and this is not monitored correctly simply by connecting *across* the coils. The best plan is to introduce a small value resistor (about 33Ω) in series with the field coils and then monitor the *voltage* developed *across* this resistor. The voltage across the resistor is a function of the current through it, so the display will be directly related to the scanning current in this test. The signal current in the scanning coils is equal to the signal developed across the series resistor divided by the resistor's value, in volts, amperes and ohms. This current monitoring test can be useful when checking for field non-linearity faults.

So far we have assumed that the timebase oscillator or generator, as it is sometimes called, is delivering drive signal, but what if our first test shows that there is no signal at the output? The move, then, is to concentrate on the oscillator circuit and valves, testing these in the usual manner. We will explore the oscillators waveform-wise shortly, but before we do this let us briefly consider the line generator and output stage. The former is virtually the same as the field generator in many sets, the essential difference being frequency of operation. The field generator runs at 50c/s and the line generator at 10,125c/s on the 405 standard and at 15,625c/s on the 625 standard. However, the line output stage is barely comparable to the field output stage (or amplifier), apart from the fact that both output stages translate the scanning drive *voltage* into scanning current in the coils on the tube neck.

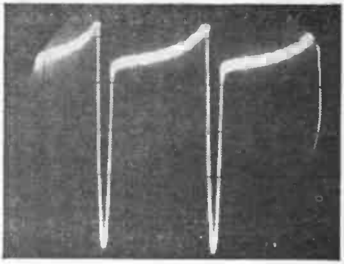


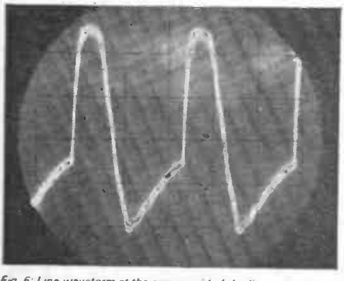
Fig. 5: The waveform at the line output stage when the Y lead is oosely coupled to the insulation of the lead to the anode of the line output valve.

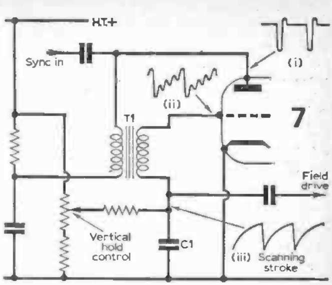
Line timebase failure mostly results in a collapse of e.h.t. voltage, giving the classic "no raster" symptom. When this happens the line whistle may still be present with the set running, heard more clearly as the line hold control is turned with the aerial unplugged. This indicates that the oscillator is working, at least, and technicians then concentrate their attention on the line output stage. It is not always possible to hear the line whistle for various reasons, and this is where the oscilloscope again shows its immediate worth. As in the field timebase, the signal should be monitored at the line oscillator output (or at the control grid of the line output valve), but to display line waveforms correctly, the oscilloscope's timebase (sweep) must be increased. A frequency of about half the line timebase frequency will resolve two waveforms, as we have already seen. This means that a 10,000c/s signal will show two complete waveforms on a 200μS sweep, and a 'scope with a 6cm tube should lock two waveforms with the main sweep set to 30μS/cm, somewhere within the range of the "fine sweep" control. The time in microseconds is obtained by dividing 1,000,000 by the signal frequency in c/s.

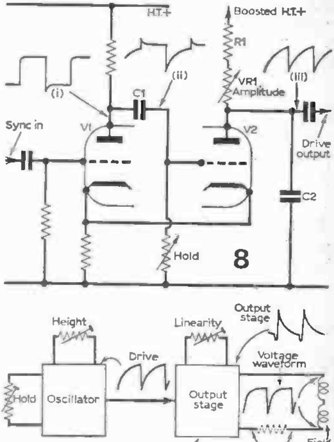
LINE SWITCHING WAVEFORM

A non-linear switch sawtooth drive waveform reveals the presence of line oscillator activity, and the drive amplitude is generally greater than that in the field timebase, a typical value being 150V peak-to-peak. The line output valve is switched on (into conduction) by the latter part of this waveform, since the first part of the scanning stroke (current in the line scanning coils) is provided from energy reclaimed from the line output stage. More will be said about this shortly.

If line drive is present, then attention should be directed to the output stage. On no account should the signal at the anode of the line output valve be monitored direct. Indeed, the peak voltage here is so great that a correctly working line output stage will give a more than adequate trace amplitude when the Y lead is simply clipped on to the outer insulation of the wire to the top cap (anode) of the line output valve. A trace obtained in this way is shown in Fig. 5, where the positive peaks rise relatively to well over a thousand volts. A similar trace, Fig. 6, is generated at the screen grid of the line output valve when this is fed from the h.t. line through a resistor. The overall amplitude is less here, rising typically to about 120 volts when the screen grid resistor is about 2·2kΩ. The high amplitude peaks on the line output valve







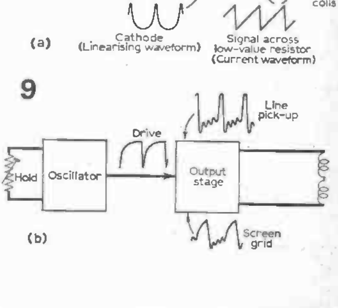


Fig. 6: Line waveform at the screen grid of the line output valve.
Fig. 7: The chief waveforms in a blocking oscillator.
Fig. 8: The chief waveforms in a cathode-coupled multivibrator.
Fig. 9: Important waveforms generated in the field timebase (a) and the line timebase (b)

Practical Television

JULY 1967
VOL. 17 No. 10
issue 202

COST VERSUS QUALITY

CHANGES in servicing techniques do not happen very often but it appears that colour is to bring about the changes, for the manufacturers realise that there are not enough first-class service engineers in the country to provide the after-sales service needed to back-up a regular colour service. All the manufacturers are providing crash training courses to ease the situation and some are adopting new methods. The BRC group, for example who manufacture under the brand names Ferguson, HMV, Ultra and Marconiphone, have opted for modular construction.

This method of separating the receiver into a number of circuit functions has its problems, but certainly makes dealer servicing very much easier since the field serviceman simply substitutes modules to clear faults and returns the unserviceable modules to the maker, who employs a band of highly-skilled engineers specialising on the various modules.

A similar method of servicing has been in operation in the British armed services for many years and is thus proven. However, money is no object in the services, so we ask ourselves — is this method going to put up the costs of consumer servicing? The answer is complex and only time can tell. We think colour servicing charges will be more expensive, for the dealers costs will be much higher

Big strides have been made by the manufacturers in reliability and it is pleasing to see that the colour set makers are competing on quality and not the cost of the finished product. This is encouraging but cannot last for cost is the important factor once demand increases.

In the main, the rental companies are responsible for the general poor quality of black-and-white receivers, because the manufacturer who can produce the cheapest set often gets the fat order. It is up to the public, and in particular readers of this journal, to see that this does not happen to colour receivers.

Many people spend at least twenty hours in front of a television receiver every week, so why should they have to tolerate an inferior product, which for a few more pounds would give them so much more pleasure?

W. N. STEVENS—*Editor.*

THIS MONTH

OUR NEXT ISSUE DATED AUGUST WILL BE PUBLISHED ON JULY 21 anode are stepped up even more by the line output transformer e.h.t. overwind to generate the final anode voltage for the picture tube.

GENERATOR WAVEFORMS

Basic waveforms generated in two most popular timebase oscillators are shown on their circuits in Figs. 7 and 8. The first is the blocking oscillator and the second the cathode-coupled multivibrator. The drive waveform from the blocking oscillator is often that produced across the charging capacitor, C1 in the circuit. The valve is forward-coupled for oscillation by the blocking oscillator transformer T1, but the oscillation is *blocked* periodically by the charge across C1 cutting-off the valve action. The capacitor then discharges through the resistors connected to C1 (hold control etc.) to provide the scanning stroke. When the valve "fires" the flyback occurs and the capacitor is again charged almost instantaneously. Waveform (i) shows the anode voltage pulses, (ii) the ringing effect in the blocking oscillator transformer and (iii) C1 charge/discharge action.

The multivibrator works by the two valves alternating in conduction and cut-off (i.e., switching on and off alternately) by the charging/discharging action of C1 in Fig. 8. Here V2 is cut-off and V1 conducting while C1 is discharging and V2 conducting and V1 cut-off while C1 is charging. During the time that V2 is cut-off, C2 charges from the boosted h.t. line through R1 and R2, and this gives the scanning drive stroke, but as soon as V2 conducts C2 is immediately discharged and the flyback action takes place. Waveforms in Fig. 8 are (i) the on/off switching of V1, (ii) the charging/discharging action of C1 and (iii) the charging/discharging action of C2. Without C2 connected, the waveform at V2 anode would be the converse of that at V1 anode.

The repetition frequency of all timebase oscillators is controlled by the charging/discharging action of a resistor/capacitor circuit. This is a simple time-constant circuit which effectively *times* the oscillator. Change in value of a time-constant component could put the correct repetition frequency outside the range of the hold control. Similarly, the drive waveform may be created by the charging/discharging action of a separate time-constant circuit or, in some instances, as in Fig. 7, the action of the frequency-controlling time-constant also produces the drive waveform.

To sum up our discussion to date, Fig. 9 shows at (a) the block diagram of a field timebase with waveforms at various points and similarly for the line timebase at (b). It is not possible to detail the oscillator waveforms here, since these depend on the type of oscillator used (see Figs. 7 and 8). The drive to the field output stage is usually exponential in make-up, but the current waveform in the field scanning coils is linearised by the application of some of the parabolic waveform produced at the amplifier cathode circuit. The amount fed-back is adjusted by the field linearity control(s). The waveform in Fig. 3 drives by the discharging of a capacitor from a positive value towards a less positive (negative) value.

The output stage waveform in Fig. 9(a) is new to us so far. It has been mentioned that direct connection here, as to the anode of the line output valve (and, indeed, the anode of the e.h.t. rectifier!), can be dangerous. However, since many sets feed a pulse back from this circuit to the grid of the picture tube for field blanking, the nature of the waveform can be important when diagnosing for trouble resulting in the show of flyback lines on the picture. Figure 11 shows an oscillogram of the signal voltage at the anode of the field output valve, obtained via an attenuator probe. Here the 'scope's Y attenuator was set to 100V/cm, so the amplitude of the display shown corresponds to

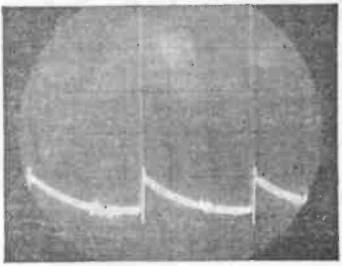


Fig. 10: Voltage waveform at the anode of the field output valve. Note the steeply rising pulse due to the flyback. This is processed by the set to blank the flyback lines.

flyback pulses in excess of 500 volts. It is possible to trace these pulses from the timebase to the grid of the picture tube by using the 'scope as a "signal tracer". This technique speedily reveals open-circuit in a resistor or capacitor in the feed circuit, often being a cause of the flyback lines showing on the TV picture itself. Another vulnerable component here is the capacitor across the signal pulse source. The drive waveform in Fig. 9(a) may have a slightly different character from that in (b), since this signal holds the line output valve at cut-off during the first part of the line scan, when the scanning current is being provided by energy drawn from the inductive elements of the line output stage, and pushes the valve into conduction during the second part of the scanning stroke to take over when all the inductive energy has been exhausted.

To conclude, mention should be made of the bandwidth requirements of the Y amplifier. This should be at least ten times the fundamental frequency of the timebase waveform to preserve its shape and character. For timebase work only, the Y bandwidth should be at least 200kc/s.

Timebase waveforms are given their particular shape by the integration of multiple harmonics to the fundamental frequency of the signal in specific phase relationship. If these harmonics are eliminated, severely attenuated or changed in relative phase, the displays will fail to be true signal shapes and will thus lose their diagnostic value. The bandwidth also influences the rise and fall times of pulse waveforms (such as the display of the field and line retraces). The relationship between bandwidth and rise time is that the bandwidth in Mc/s is equal to 0·4 divided by the rise time in microseconds. ■

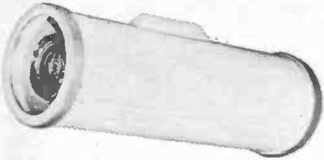
TRADE NEWS • TRADE NEWS • TRADE NEWS

TRADE NEWS • TRADE NEWS • TRADE NEWS

EEV VIDICONS LEAFLET

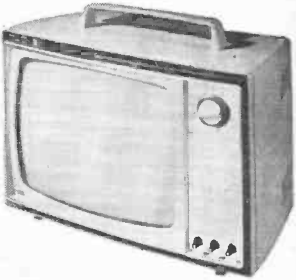
ENGLISH Electric Valve Company Limited, Chelmsford, have announced a leaflet summarising the vidicons made by their company, and describing the many advantages of each of these features. Copies of this free leaflet and more detailed information on all EEV vidicons, including operating conditions, characteristic curves and outline detail, is given in valve data sheets which are available on request from the Sales Department, English Electric Valve Co. Ltd., Chelmsford, Essex.

CONTINUOUS TV COVERAGE



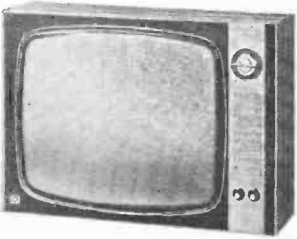
A NEW solid state TV camera for continuous reliable operation in unattended locations and under extreme environmental conditions has been introduced by the Raytheon Company. The RGS-20 camera is a commercially-available version of a similar camera developed especially for monitoring hazardous areas and for information transfer in the U.S. space programme. It measures 5¼in. in diameter and 10in. in length. Picture is 525-lines per frame with a 4:3 aspect ratio. Other scan rates are however available (625, 837, 975, or 945). Vertical sweep rates are either 50 or 60c/s and the unit may be installed with up to 3,000 feet of cable between camera and control.

IMP WITH THE '67 LOOK



ANNOUNCED recently by the British Radio Corporation is the 1967-styled HMV Imp, a 12in. portable TV set receiving BBC-1 or ITV programmes on 405-lines. The latest dark-faced tube is used for maximum picture contrast and it is guaranteed for two years. A socket is provided for a conventional aerial in fringe reception areas and the receiver is provided with its own 5-section telescopic aerial. The cabinet is of grey moulded polypropylene with a silver-coloured speaker grille. Price of the Imp 2644 is 39½ guineas plus 11s. 11d. Purchase Tax surcharge.

PYE-EKCO-FERRANTI TV



THE Pye Group announce 19 and 23in. receivers with rotary tuning under the brand names of Pye, Ekco and Ferranti. These models incorporate a new chassis and tuner. The tuner is a multiband rotary type and employs high stability silicon transistors. Any six channels drawn from any of the bands can be quickly chosen in any order desired on the six-channel selector mechanism by pressing and rotating a memory control. 23in. models cost 74 guineas and 19in. models 66 guineas.

UNDERNEATH

THE DIPOLE

PHEW! *What* a week in New York, with the SMPTE Conference (referred to elsewhere), a film and television equipment exhibition, a look around some of the television studios in the city, several looks at the American television scene at the receiving set end—and—not forgetting the warm hospitality of the many technicians who came from the West-coast show business centre, as well as the large number who live in or near New York itself.

The memory of some of that hospitality reminds me that even at 3 a.m. I was able to switch in four or five television programmes on the receiver in my hotel room, and at 7.30 a.m. I picked up six in all. The flow of commercials continued as "Station Announcements" appeared all day and all night, averaging for each station about ten minutes (or so) an hour, inserted before, during or after the usual live, filmed or taped programmes. Some of them even broke into the middle of news announcements, with disconcerting effect.

Quality of my black-and-white hotel set was very good, but the colour on most receivers I saw elsewhere (other than at television stations) was disappointing. Frankly, I was surprised that such poor quality could be tolerated. Seen on the monitors at the television studios, whether "live" from the stages or exteriors or from video tape or telecine, the colour was pretty good. Sometimes excellent.

When viewed on domestic off-air "colour" TV receivers, at the television studios, they were equally good. But I must have been unlucky with almost all others of the domestic colour receiving sets I saw. The results on most sets in the radio retailers' showrooms were mainly ruined by ambient light, in the same way as British retailers prefer to display the cabinets of their sets by flooding the rooms with fluorescent lighting.

Genuine antiques?

Mind you, some of the cabinets were quite impressive, worthy of Chippendale or Sheraton; but the pictures on them sometimes had the undisciplined nuances of a three-year-old at the Royal Academy of Arts. The information or detail of the pictures was about the same as the British 625-line picture, but being scanned at 60 fields instead of our 50 fields, was not subjected to the slight flicker noticeable at higher brilliances, or when there are large white areas of sky, etc.

Some of the millionaire's "swank" sets were, in fact, beautiful pieces of craftsmanship in woodwork, embodying colour TV, stereo radio and tape, disc play-off and store—all immaculately built-in to a genuine looking Queen Anne cocktail cabinet, New Orleans' julip style.

New York studios

The impression British technical visitors had of the New York television studios was mixed. The equipment and the operational engineers seemed to be of a high standard, mainly operating in studio stages of a type long considered to be out of date in Europe — and especially in Britain.

New York is dotted with television stages in converted theatres, music halls and sound radio

GUESS WHO'S BEEN TO THE STATES?

studios. They seemed to take one back to the "Wood Green Empire" period of British television, when the cheapest, quickest and smartest way of getting on the air was to take advantage of auditorium, dressing rooms, lighting and space for offices. Many of these improvised studios have been successful; some of them have been almost rebuilt while others have been scrapped.

It rather looks as though some of the big US TV networks will turn slowly over to centralising facilities with purpose-built television studio stages. Indeed, the Columbia Broadcasting System has already taken steps in this direction with a large studio centre complex not far from the Lincoln Center for Performing Arts, which houses the new Metropolitan Opera House, the Philharmonic Hall, the Vivian Beaumont Theater, and the Julliard School of Music, all modern attractive buildings.

There are so many New York transmitters running more or less simultaneously from the top of the Empire State Building, all battling by sheer weight of power to penetrate between the high buildings.

As for the New York television programmes, I quote what the new York *Sunday News* reported Burgess Meredith, star of Broadway stage, Hollywood movies and of TV, as saying about them: "*I must say that, as a viewer, I think TV is only one-fourth as good as it should be. Too much junk, too many blatant commercials. However, I think that after the success of such plays as 'Death of a Salesman' and 'Glass Menagerie', the Madison Avenue boys will gradually realise that high quality can be commercially successful.*"

Fair comment, I think. Perhaps British television is only just half as bad as Burgess Meredith says of the US channels.

American television commercials

These commercials are very well-made films which are put out from the New York stations on their 35mm. telecines, colour or black-and-white.

Quite a large film industry has grown up in this line of business, using all the trick photographic devices of film making. One of the most impressive commercials I have ever seen starts with a high aerial shot of New York City and draws slowly closer to the skyscrapers around Wall Street and the Statue of Liberty. It descends nearer to the Statue, ending with a very close shot of tourists looking out of the spectators' gallery in Liberty's crown, where one of them is starting to take a photograph.

It was a commercial for Kodak, involving flight in a helicoptor with special steadying devices on the camera mounting—an expensive job in production and camera operation. But whatever the cost, it was worth it! This equipment was shown to British viewers some time ago.

All US commercial filming is not so effective as this. It has the same "soft sell" and "hard sell" presentation gimmicks we see on ITA, the same types of interviews, the same irritating opticals, the same slap-happy film editing.

'Non-continuity' editing

Bad continuity in film editing may be tolerable in the short period of time in which a commercial has to put over its commodity or message. But when a full-length TV programme of a documentary type devotes itself to 55 minutes of disconnected glimpses of the American advertising world, it strains your eyes, bewilders your brain and bores you to tears.

Madison Avenue, USA was made by the BBC, purporting to reveal the mumbo-jumbo of pulsating salesmanship. As seen on BBC-1 just after returning from New York, I was astonished at the poor usage that had been made of good material, shots being joined together with little rhyme, and no reason, as though they were picked haphazard from a mess of footage—sorry—potage.

Unwritten rules

Film editing and vision mixing for television ought to be sister arts. Certain unwritten (and written) rules were set out for musicians, poets, painters, writers, playwrights and—yes, film makers years ago. Alas! The days of contrived, shapelessness are here displayed in the innocent paintings of three-year-olds and the obscene writings of pornographers.

The basis of film editing is not merely a matter of shuffle and cut. It is the grammar and punctuation of both visual and sound images. For every change of angle, for every zoom, for every long shot—there should be a reason. Cutting just for cutting's sake can be regarded as bad workmanship.

I have long been convinced that some film editors could not be trusted with the scissors to cut correctly a coupon from a newspaper any more than vision mixers who attempt to "punch up" a dramatic sequence could choose the right timing to press a fire alarm.

BBC biographies

If *Madison Avenue, USA* was a "miss" there must have been enough material filmed to have another try, another version, even if it merely meant cutting out the shots which are a sight for sore eyes.

The BBC have a penchant for the biographic technique, whether it is on the lines of Isadora Duncan's or their classic *Contours of Genius* with the impressive analysis of Michelangelo, the painter, sculptor, architect and poet who lived for eighty-nine years and died four centuries ago. Christopher Burstall tempered his scholarship of Michelangelo's work admirably, with material largely from an American NBC television film made by Tom Priestley.

This kind of joint venture was excellent, as was ABC's *Saga of Western Man* of which an episode entitled "Robert Scott and the Race for the South Pole" was beautifully produced by John Hughes.

This feature was made in colour, partly recreated by the ABC film unit in the Antarctic a few months ago but also including—in sepia tone on colour television—the unique cine films made by Ponting on the ill-fated 1910 expedition, using a wooden-box type Moy camera. A great deal of the commentary for the film was magnificently spoken by Douglas Fairbanks Jnr., credited in the title correctly—as *Sir Douglas Fairbanks.*

Strife on TV

In the BBC's round-by-round series of *Dispute* we have seen the wars of management and labour in 1967. Jack Gold has carried the *Candid Camera* technique to its logical conclusion, and has punctured the pomposity of the jargon used in the "disputes".

Some of the dialogue could have come from Galsworthy's *Strife*—and that work wasn't written in 1967! The *Candid Camera* technique and series was evolved in USA. Its British version was produced by ABC-TV.

TV exports to USA

There is no doubt that many old British cinema films plus films specifically made for television find their way to the American market these days. Not many video taped subjects seem to be showing. But the cinemas along Broadway and 42nd Street were almost monopolised by films made in British studios, many of them backed by American money! From one street corner I saw seven cinemas flaunting huge advertisements, five of which announced British film titles.

Not many years ago it was rare to see any British films in New York. The frequent transmissions of old British cinema films on American television has given viewers a taste for them, both in the cinema and on television.

And for the export of films made specifically for television, the ITC-Grade group has received the Queen's Award for Export Achievement, an award which, in another division, has also been won by Rank-Taylor-Hobson for the range of television zoom lenses. What about that puzzle, the Common Market and its influence on the export of British television films and equipment?

Iconos

IDEAS FOR..... amateur TV

M. D. BENEDICT.

Part XII

ALTHOUGH most of the effort in television engineering is usually directed towards the video side, it must always be remembered that without sound most programmes are incomprehensible. As with designing the video systems, one must bear in mind the maximum number of facilities which may be required.

Obviously the most important single item is the sound mixer and this is shown in Fig. 70, the general sound schematic. For most uses just one microphone and amplifier is required but anything more complex requires the use of a sound mixer. As there are many types of sound mixer available, the author does not propose to deal with any particular type of sound mixer. The sound mixer should have low level inputs for at least two microphones, and several high level inputs for telecine, sound, grams or tape.

Professional sound mixers usually feature meter indication of sound level to avoid overloading the transmitter, which results in distortion. Most sound mixers produce between 1 volt and 250mV. and the transmitter gain controls should be lined up to give 100% modulation when the meter is reading maximum. For CCTV the sound level out of the mixer remains normal and the individual gain controls on the audience public address amplifiers set to give the correct level for audibility and protection against howl-round.

Most mixers accept high level inputs of 100—500mV., which is satisfactory for film sound and most tape recorders, but a small transistor amplifier with suitable equalisation may be required for the gramophone pick-up, especially if a high quality, low output cartridge is used. Suitable amplifiers can be found in books and magazines about Hi-fi. For greater flexibility it is common practice to arrange that all input and output levels, except for microphones and power feeds to the loudspeakers, are at a similar level and use of such pre-amplifiers enables this.

Monitoring the output of the sound mixer is by high quality amplifier and loudspeaker which might well be part of the home Hi-fi installation. Other programme distributions feed the transmitter or, in the case of demonstrations, the audience loudspeakers.

"Talkback" is used to communicate with the studio from the control room. The simplest system of talkback is for everyone—cameramen, camera control operator—to wear a headset such as used by telephonists, thereby speaking to and hearing each other easily. This is not very satisfactory for those in the control room listening to programme sound, and a better system is to use this for camera talkback and to use a talkback microphone in front of the director. After an amplifier, this is fed to the talkback distribution and may be heard by the cameramen and anyone else wearing headphones, e.g., the floor manager, who controls the performers. If the power supplies to the talkback microphone amplifier are switched off this will mute the microphone. A small die-cast Eddystone box can be used as a base as well as containing the microphone amplifier. If it is not possible to obtain a headset, a carbon microphone as used in ordinary telephones, mounted on lightweight headphones with a short boom to bring the microphone near to the mouth is a suitable substitute. An induction coil from a battery telephone is also required. Telephones of the sort requiring a local battery to energise can be found on the surplus market and the induction coil and microphone from one of these could be used in the circuit of the original phone which is usually to be found on the inside of the telephone case. A typical circuit is shown in Fig. 71, which also shows the general arrangement of the talkback system. It is usual to mount the induction coil and associated components within the camera, connections to the headset being made by a 4-pin plug and socket.

Normally, all inputs and outputs to the mixer are made through sockets on the back of the sound mixer, but it is sometimes more convenient to remote these with multi-way cable to a GPO type jackfield mounted in the apparatus bay. These too can be obtained on the surplus market and form a very flexible method of making temporary con-

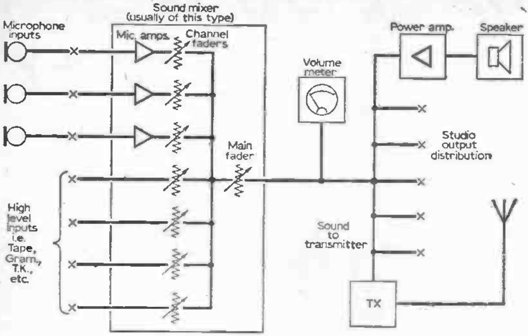


Fig. 70: Layout of the general sound system. The power amplifier and loudspeaker are used for monitoring.

nections with short lengths of cable with GPO type jacks on each end. Talkback distribution can also be handled through jacks and these are marked with crosses on the diagrams. Many permanent interconnections can be made by using the back of the jackfield as tags. The microphone inputs can be remoted to one extension box placed in the studio into which the microphones are plugged. Output from each microphone is then fed by shielded multi-way cables to the mixer, thus avoiding several separate microphone cables trailing from the studio to the control room.

Previous articles have described the various components of an amateur television studio so this article will attempt to show how they all work together in a complete installation. In fact, no such installation exists, as the studio and equipment as described have combined the most interesting features of several amateur (and some professional) studios.

One of the most important factors in deciding on the size and scope of the installation is the space available for use. Money is not quite such a problem, as this series has described the equipment in a logical order for construction. Thus one can wait till more money can be found for the next stage in construction, while the equipment already built will operate in a satisfactory manner, without any extra apparatus. However, space for operation is not quite so flexible and it is important to make the best use of the available room. For anything except the simplest studio, two rooms will be required, one as a control room, the other as a studio. As the studio room is only required for actual operational use, it can be rigged as required and the cameras moved in, cables plugged up, and the lights connected. If a bedroom is used as the control room, cables can be fed out of the upstairs windows and down to the studio on the ground floor. But a semi-permanent control room is most important. No doubt most constructors already have access to a permanent study, shack or den, and if this is not already too cramped it would be satisfactory. A compact arrangement of

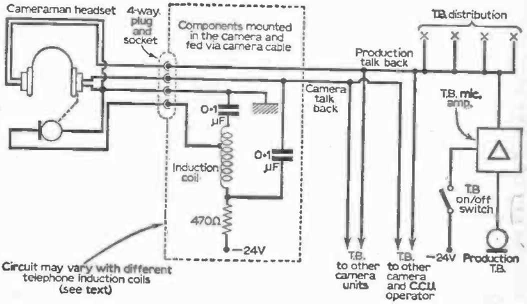


Fig. 71: Talkback schematic diagram. Production T.B. will be heard in left earpiece, camera control in right.

equipment such as shown in Fig. 73 occupies an area of about 8ft. x 8ft., although moving the apparatus bays behind the control desk and repositioning the Telecine/Caption Scanner bench would alter this to about 10ft. x 6ft. In this form the apparatus could be mounted in a 10—15cwt. van. Elderly versions of the Bedford or Commer vans can be obtained for about £20—£40, if one does not mind rusty bodywork, and reliability is not the prime consideration. These provide plenty of room and are very convenient for working at demonstrations and exhibitions. They can also provide space where an indoor control room is impossible.

Many other arrangements are possible and one of the factors to be considered is the scale of operation likely to be required. As most Amateur Television "epics" are done with a temporary installation using equipment built by several amateurs gathered together for the occasion, a mobile unit such as a van could form the nucleus of such an arrangement.

Transistor apparatus generally dislikes overheating and the consequent drifting that occurs. Power supplies which are mounted at the base of

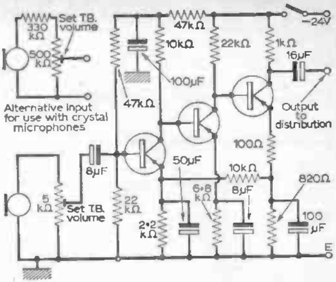
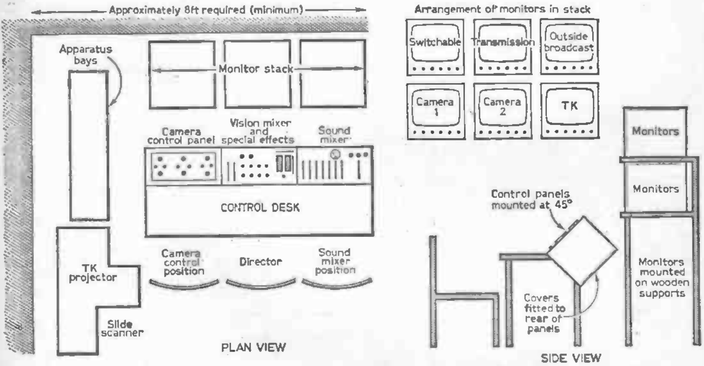


Fig. 72 (above): General purpose microphone amplifier, suitable for talkback.

Fig. 73 (below): Suggested control room arrangement, approximately 8ft. x 8ft.



apparatus bays should be fitted with covers that duct heated air to the rear. Monitors, too, suffer from overheating and the positioning and spacing the monitor stack is important in this respect. A window-mounted ventilator with its wide range of adjustment could provide sufficient draught-free ventilation for most applications but in extreme cases strategically placed fans may be required. In a van, a fan heater will give both heat and cooling as required.

As mentioned in previous articles much of the equipment can conveniently be mounted in apparatus bays. In professional studios such bays are about 7ft. high as are those used by the GPO. For amateur television a bay height of 3ft. 6in. would seem more suitable as the weight of a 7ft. bay would be excessive for handling. Also, this bay would fit conveniently into a van. The basis of a bay is a framework 19in. wide by the suggested height of 3ft. 6in. built from aluminium, such as Dexion or Handy Angle, or steel angle welded and then painted. A base also made of angle and strengthened by a triangular strut to support the frame, which is sloped back slightly in order that the centre of gravity lies well within the base, ensuring stability. If made strong enough, the bays can be used to support the monitors, especially if space is tight. Monitors converted from television sets mounted in this manner will, however, tend to be high for convenience.

With a complete installation the three camera control units could be mounted in one bay with the power supplies at the base. All the pulse feeds and the mixer output should be fed to sockets at the back of the bay. The ordinary sockets as made by Belling-Lee are standardised by the B.A.T.C. to allow the interchange of equipment between amateurs, but professional equipment uses F. & E. type sockets.

VIDEO CONTROL UNIT

Inter-connections (Fig. 74) are made with multi-way cable wherever possible. Using this cable reduces interference as all conductors are surrounded by unearthed outer conductors. All wires performing a similar function, or connecting the same apparatus should be connected by one piece of cable, so interference between the switched d.c. from the cut buttons and other supplies such as the d.c. controls for the camera, for example, is reduced to a minimum. Multi-core cable is fairly difficult to obtain so an alternative is to use 1in. plastic tubing as for the camera cable and accept the risk of some interference.

Pulse feeds to the vision mixer are looped through the c.c.u.'s first and then re-turned to the second bay and the vision mixer. This is done in order to equalise as much as possible the delays to the pulses going from the pulse generator to the vision mixer, and the total delays in the syncs and composite video going from the pulse generator to the c.c.u.'s and thence to the vision mixer. By arranging the video and pulse cables to follow the same routes these delays would be identical and the critical pulse timings for the clamps are not disturbed.

All the inter-connecting cables are fed to the backs of the bays where they are out of the way. In order to simplify the handling and moving of the equipment the connections are made through multi-way plugs, Painton or similar types. A mains distribution panel using 3-pin Belling-Lee mounting plugs allows each item in the rack to be connected. Panel mounting plugs and the corresponding cable mounting sockets allows removal from the bay for maintenance or development work. Great care must be taken with the mains distribution and the wiring must be up to the

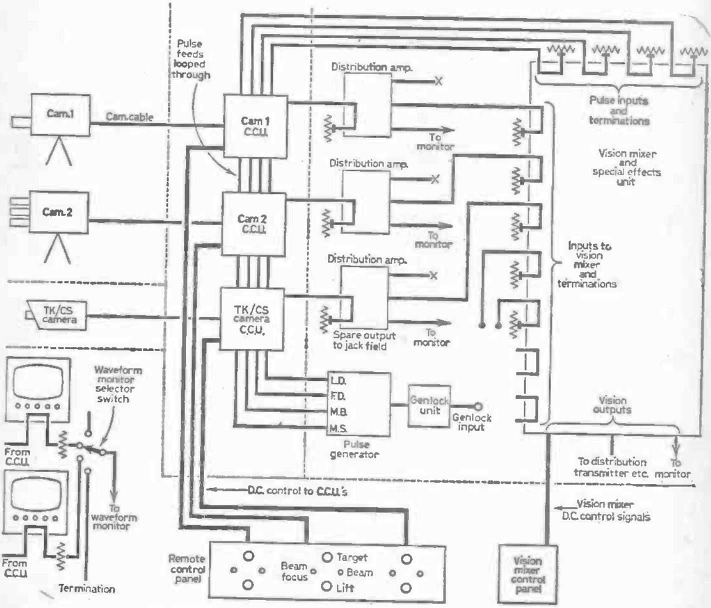


Fig. 74: Video and control schematic showing interconnection between units.

highest standards with attention to the correct fuse rating for the fuses on each bit of apparatus as well as a fuse on each bay. For convenience one main breaker of sufficient capacity allows all apparatus to be switched on and off together, the local ON/OFF switches being left in the ON position. Earth loops should be avoided by using different signal and mains earths which are only connected at one point.

recorders working on this principle have produced very interesting results, and this is a field that the more advanced amateur might well find himself breaking new ground.

Many amateurs concentrate a lot of their efforts in building transmitters and highly sensitive receivers in order to transmit and receive other amateurs' pictures. Using the maximum power allowed and directional aerial arrays, distances of over 200 miles may be covered when the conditions are favourable, although normally reliable communication is not very much more than 25 miles or line-of-sight in hilly areas. At demonstrations, especially those in the London area, it is often arranged to receive amateur transmissions from various licensed stations as part of the programme. Off-air receivers with a video output are used to do this as well as receive the national networks.

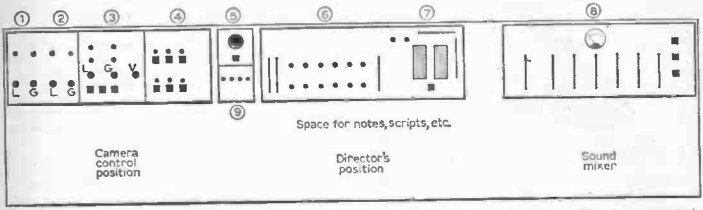


Fig. 75: Arrangement for the control desk. (1) Camera 1 control panel with beam current, beam focus, lift and target controls. (2) Camera 2 control panel as (1). (3) TV control panel: Shift controls, volume control (used as a preset control) motor run, lamp on, and lamp bright/dim switches. (4) Sundry switches and warning lights: Emergency stab. amp. changeover, emergency V.M., sawtooth generator to line (for identification and line up purposes). Transmission red warning lights and the p.g. function switches. (5) T.B. mic. or base with on/off switch. (6 & 7) Vision mixer and special effects control panel: Bank faders, cut buttons for each bank, main bias pot for inlay. Function selector plugs. Lift and gain for inlay/overlay, x and y bias pots., and function plugs, changeover switch. (8) Sound mixer with faders, meter and various function switches. (9) Pre-view selector button, and emergency vision mixing facilities.

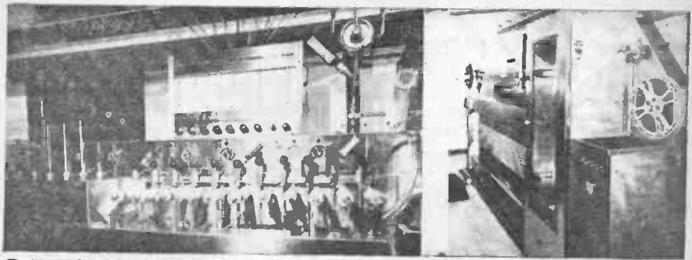
As may be seen in the layout for the control studio panel (Fig. 75), the operator controlling the cameras also operates the genlock controls as well as being responsible for any emergency action to be taken in the case of breakdowns. Naturally, professional studios go to great lengths to duplicate or provide spare vital equipment which is brought into action by changeover relays at the throw of a switch. No such duplication need be provided except that the stabiliser amplifier in the special effects unit and the main stabiliser amplifier could easily be interchanged should the main stabiliser amplifier fail. In this case the Inlay and Overlay facilities are lost but this is not as important as the operation of the vision mixer. A direct switching or relay operated emergency vision mixer could well be built and normally used as a switch for the preview monitor but in an emergency the output feeds direct to the studio output. Most other emergency facilities are either too complex or involve unnecessary duplication of effort.

Video tape recording is occasionally used by amateurs, the recorder being hired for the occasion, although some video tape recorders have found their way into amateur hands. As this is rather a new field for Amateur Television, it would be foolish to lay down any rules for operation and use. Video tape recorders for home use are available for £200—£300 and mostly use the helical scan principles as discussed by K. Royal in the February 1967 issue of PRACTICAL TELEVISION. The other principle of high tape speeds and fixed record heads (perhaps using crossfield biasing to improve the h.f. response) would seem to be a promising line of development for amateur use. Quadruple play tapes would give sufficient recording time with 8¼in. spools. The Wesgrove video

Transmitting from a mobile station on the move has its fascination and most of the equipment described is very suitable as it can be run off a car battery, although if it is run off the battery on the vehicle whilst the engine is in use interference from the ignition system might upset the camera and could actually damage the transistors.

What sort of programmes can the amateur expect to produce? When the programme is to be transmitted it must not be used for entertainment so that the transmissions are usually test cards, station identification signals and test films. For demonstrations at exhibitions the programme will be often interviews with the important personalities concerned with the exhibition, with a demonstration of facilities, short films to fill out a continuous demonstration. For an important demonstration, film might be especially shot to illustrate a point, in which case the film could be run in the negative condition to save the processing costs. Advertising gimmicks and amateur dramatics occasionally find themselves on Amateur Television. Nothing is worse than a blank screen or continuous test cards for losing the interest of the spectators.

Once again, for reference, the address for contacting the B.A.T.C.: The Hon. Secretary, White Orchard, 64 Showell Lane, Penn, Wolverhampton, Staffordshire. ■



SMPTE CONFERENCE REPORT

'Iconos' takes a look at the Society of Motion Picture and Television Engineers' 101st Conference, held in New York

IN 1917, when 27 film technicians in Hollywood formed the *Society of Motion Picture Engineers,* they could not have envisaged that in fifty years' time it would grow to a membership of over 6,000, in countries all over the world.

It was started by a few skilled lighting cameramen and gradually expanded the fields of its coverage to include sound engineers, still photographers, laboratory processing experts, special effects men. Then it added colour—followed by television. It even altered its name to the Society of Motion Picture and *Television* Engineers, a move which was copied later by the British Kinematograph Society, when it added "Sound and Television" to its title.

Then came an even greater acceleration in the growth of its membership in New York, Chicago, London, Paris, Berlin and Sydney. The SMPTE became the centre of motion picture trends, television progress, space age electronics and the principal arbiter on the parameters of each medium.

INTERNATIONAL STANDARDISATION

International standardisation of measurements, techniques, gauges, navigation and what-have-you are civilised trends in a modern world. Such progress takes time when many nations are still barely qualified to express an opinion. Some standards such as the width of railway lines became the normal "standard" gauge for steam 123 years ago, thanks to the 4ft. 8½in. gauge being related to the basic width of plate-ways for horse-drawn coal waggons in Northumberland.

Edison selected 35mm. wide film (with the present standard perforation) as the film gauge for the Kinetoscope, an early animated picture *What the Butler Saw* machine, patented only in USA in 1893. British and French motion picture pioneers invented their own improved versions—seen on a screen instead of a peep-hole—within a few months, with the same width of film 35mm. These standards often tally with one another, according to the requirements at their originating period.

Unfortunately, though many sound radio, television or electronic devices follow one another with great rapidity these days, Britain is paying a heavy price for re-establishing the 405-line standard too quickly after the war, when, within eighteen months a much better use could have been made of the interlaced lines, the bands and frequencies available for television, and for films with their multitude of width, aspect ratios, anamorphic optics and multiple sound tracks.

'NATION SHALL SPEAK UNTO NATION'

SMPTE of USA is leading the field in the International Standards Organisation in these fields, supported by the British Kinematograph, Sound and Television Society, whose activities mainly concern films for the cinema, education, instruction and their television application. Concentration on other television matters is dealt with by the Royal Television Society.

The gradual getting-together of the technicians and creative people who make feature films for the cinema or live or taped productions for television, plus the growing sector who make films specifically for television, is becoming closer as the weeks go by. The search for just the right medium suitable for the production of coloured "staged" programme goes on. And this was one of the main objectives put before the 101st Conference of the SMPTE in New York.

This was of sufficient importance to attract about thirty or forty technicians from England, mainly members of the British Kinematograph, Sound and Television Society, including several who were also members of the Royal Television Society. They took part in the five-day marathon of 112 papers about modern practices in film projection, theatre facilities, film laboratories, film and television techniques, electronics in medicine—and on film, outer space technology, etc.

All of these items had to be assessed in the black-and-white and/or colour. Or rather, in three colour separations: yellow, cyan and magenta for films and red, blue and green for television. Slight

One of the many items shown at the SMPTE Conference, held in New York, is illustrated at the top of this page. Known as the Filmatic colour processing machine, it is designed to run at 50 ft. per minute and can completely process 16mm. film (from dry-to-dry) in 26 minutes.

TELETOPICS

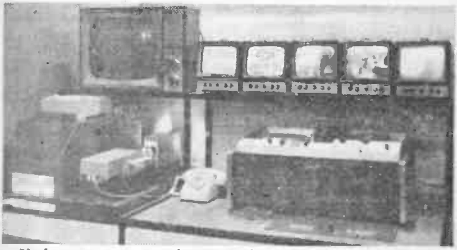
TV SET CONFISCATIONS TO END

THE penalty of forfeiture for unlicensed television sets is to be abolished from the Wireless Telegraphy Bill. Mr. Edward Short, Postmaster General, made an amendment to this effect in the Parliamentary standing committee considering the bill recently. He said that the Government recognised the objections of H.P. and rental companies and radio retailers to the forfeiture of their sets as a penalty for unlicensed use by their customers.

This amendment would apply to all installations. It would not be fair to exempt some classes of evader from liability to the penalty of forfeiture while leaving the evader who owned his set exposed to it. Either forfeiture should be a general risk for all those who did not take out broadcast receiving licences or it should not apply to any of them.

Mr. Short added, however, that the power of the courts to order forfeiture in respect of transmitting apparatus was to remain.

KEEPING AN EYE ON THINGS



Underwater cameras submerged 30 feet off West Pier, Brighton, recently relayed pictures by Videotape to the Hotel Metropole.

This special camera, which employs iodine-quartz lamps so powerful that they cannot be operated above the surface, was part of the equipment demonstrated by RR Wired Services at the Ports and Terminals Exhibition.

The underwater camera, 18in. long, is fully transistorised and, complete with all accessories, is offered by RR Wired Services (A Division of Radio Rentals) for £1,043.

At Brighton, underwater surveys carried out were video taped on a recorder offered by RR Wired Services for £736.

Additional equipment displayed included a document transmitter which, with monitor, is priced at £320; and a closed circuit camera with a 19in. Baird monitor set for £200 inclusive.

TV INSTALLATION COLOUR FILM

THE BBC and BREMA are working together on the preparation of a film on colour TV receiver installation. This will give helpful guidance on such subjects as degaussing, purity, and convergence adjustments. Also being invited to share in the sponsorship are the RTRA and the Electronic Rental Association.

It is hoped to have the film ready by the first week in July which is the start of the colour launch period, and it is to be shown during the morning and afternoon test periods on BBC-2, and it may also be shown on BBC-1.

The film is to consist of five parts, and although the film is in colour, and will be seen in colour on a colour receiver, it will be presented equally well on monochrome receivers.

LITTLE DEMAND FOR £250 COLOUR

SIR ROBERT FRASER, in his address to the 25th anniversary congress of the Radio Industry Club of Scotland recently spoke on behalf of the ITA of which he is director general.

He said that the ITA were hoping to open their u.h.f. transmissions in more or less the same order as their v.h.f. ones, and with the agreement of the BBC, London, Midlands, Lancashire and Yorkshire would be the first regions with colour.

Sir Robert said that u.h.f. was a liability to colour and it brought out two immensely important points—the absolute necessity for an outdoor aerial, well chosen and precisely aligned and the fact that people were at present trying to receive u.h.f. on dual standard sets.

Referring to the likely public demand for colour, Sir Robert said, "We have conducted surveys on interest in colour and likely demand for colour sets (these are to be treated with caution. You can only ask people to tell you what they think they will do when colour comes. When it does come, they may act differently, perhaps very differently). Firstly, people want colour—not all, but a great majority. Sixty-six per cent of viewers, two out of three, say they would enjoy colour more than black and white. Twenty-four per cent. however, one in four, say they would not. Still, 66 per cent is 11 million homes and that will do for a start."

He went on to talk about the demand for colour sets at various cost levels, saying that with colour on all three u.h.f. services, about 4 per cent (640,000) of all viewing homes said that they would be prepared to buy sets if they cost between £200 and £250. If the cost were less than £100, 24 per cent said they would buy and if the cost did not exceed £150, then 11 per cent said they would buy.

"So you see", said Sir Robert, "We are dealing with what the economists call a highly elastic demand. Go above 30s. for rental or £250 and the demand thins out quickly. Go below and it widens right out."

but important differences? Penny Plain or *Thruppence* Coloured as it used to be, 123 years ago. £100,000 in black-and-white and £320,000 coloured, in this day and age.

Members of the BKSTS were warmly received by the president of SMPTE and other officers, who later handed the visitors handsome medallions as souvenirs of the occasion.

Five members from Britain presented papers. On the first day, the second item in a session dealing with *Projection and Theatre Presentation* was by Bob Pulman, Chief Engineer of the Odeon Cinema, who presented a well-illustrated survey on the trends in *Modern Motion Picture Theatre Design*, its equipment, operation and automation.

Simultaneous sessions were held on the first afternoon on (a) *Laboratory Practices* and (b) *Film and Television Production Techniques* in different halls in the Hilton. In the latter, an historical flavour was introduced in *Milestones in British Film Studios and Production Techniques: 1897—1967 by Baynham Honri*, which traced the steady (but slow) progress from the original daylight glass-house studios up to the modern sound-proofed film factories with their complicated lighting techniques and photographic wizardry.

Interesting to note that at the very start of "staged" motion pictures, most of the studios seemed to be located at Brighton or Hove, and the main purpose of the studio was to protect the scenery and props from the rain! The actors and cameraman could use umbrellas!

It was a natural chronological continuity for this to be followed up by E. A. A. Herren's *New Developments in Stages and Equipment at Major Studios in Britain*, which referred to new techniques, some of them borrowed from television, which have been introduced at Pinewood Studios. This address was presented with splendid colour transparencies, illustrating the latest television-type lighting grid, the super-level television floor (and its mobile wooden covering, available as an alternative). Electronic aids were being gradually adopted.

It was a coincidence that on the very next day of the Conference, at the big "Get-Together" luncheon, the principal speaker, Jack Valenti, President of the Motion Picture Association of America, urged the film industry to take stock of its technical accomplishments and bring them into line with its artistic achievements.

He referred to the antiquated techniques and equipment still used in many studios in Hollywood, mentioning specific operations which had long needed attention, modification or replacement to attain better results with greater efficiency. It must have been of special interest to SMPTE members to remember that some of these suggestions are already adopted at Pinewood Studios, England, as revealed in Mr Herren's lecture on the previous day.

There were two other papers of BKSTS origin: *The Livingston Add-a-Vision System*, the British method of providing television monitors (and wave-form monitors) as an aid to motion picture photography, which was given by R. B. Hale, who also demonstrated the equipment in the technical exhibition.

Thursday afternoon's session included an informative paper by another BKSTS member, William Cheevers, who addressed an interested audience on *Planning Construction and Operation of a Commercial Television Station—Westward Television, Devon, England*, which was illustrated with colour transparencies of this purpose-built studio complex and its equipment.

Papers on the most diverse subjects continued until Friday afternoon, when the 112th item was turned into a panel discussion on a medical subject, for which both film and television had been a most valuable aid: *Miocardial Revascularisation.*

Mention must be made of the Equipment Exhibition, which comprised no less than 94 booths occupied by about fifty exhibitors, some of them taking up several spaces. The *Mellotron* sound effects device and the *Add-a-Vision* were British exhibits which attracted much attention.

It was a strenuous week for all of those taking part, especially the British participants who also took the opportunity of evening visits to various television studios in New York, including those of National Broadcasting Company, American Broadcasting Corporation and Columbia.

Television, and particularly coloured television, as seen on an hotel TV set, at a bar, in domestic circles and at a television studio in New York will be dealt with separately. ■

Aerials for ITA expansion

EMI Electronics have received contracts for the supply and erection of masts, towers and aerial systems in the first phase of the Independent Television Authority's three-year expansion programme completing its coverage of the UK.

The contracts include six new v.h.f. aerials in the west of England, Wales and Western Scotland, all expected to be in service by the summer, and seven u.h.f. aerials in the Emley Moor/Winter Hill areas, to be completed by the end of the year.

Two new 500ft. masts are to be erected at Ridge Hill, Gloucestershire, and Huntshaw Cross, Devon. The Ridge Hill aerial installation has an 80ft. aperture consisting of eight tiers of full-wave dipole panels, giving a directional radiation pattern with a maximum e.r.p. of 10kW towards the south east. Sited five miles south-west of Ledbury, the new aerial is vertically polarized and will improve ITV reception in Gloucester, Cheltenham and Hereford, transmitting on Channel 6.

At Huntshaw Cross, a semi-circular radiation pattern will provide an improved service for the low-lying coastal areas around Barnstaple and Bideford. Horizontally polarized, the new aerial has a 24ft. aperture of two tiers of Mesny panels, and will transmit on Channel 11.

The u.h.f. aerials to be mounted on 150ft. towers in the Winter Hill (Lancashire) and Emley Moor (Yorkshire) service areas, are a new annular slot aerial recently developed by EMI and successfully demonstrated at the Hayes aerial testing site. The aerials will be enclosed in a 3ft. diameter fibre glass-reinforced plastic cylinder, which reduces the wind loading effect by one-third and protects both the aerials and maintenance staff from the weather.

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.

TOP MARKS!

SIR,—Top marks for the April edition of PRACTICAL TELEVISION. The article "Decoding PAL" was in itself well worth double the price of the magazine.—OLD CUSTOMER (Preston, Lancashire).

ISSUES FOR DISPOSAL

SIR,—I have the following issues of PRACTICAL TELEVISION: April 1950 (first issue) to December 1950, 1951, 1952, 1953, 1954 complete, 1955 (except April issue), 1956 (except March/April issues), 1957 complete and January and March issues of 1958 only.

Any readers interested before I throw them out? Only postage required.—R. C. OUSLEY (22 St. Patrick's Road, Taunton, Somerset).

SIR,—I have copies of PRACTICAL TELEVISION, 1958 to 1965 for disposal. If any readers are interested would they please send s.a.e. to the following address.—R. L. KING (Point Cottage, Dale Hill, Sicehurst, Sussex).

ISSUES WANTED

SIR,—Would any reader be kind enough to supply me with the July 1959 issue of PRACTICAL TELEVISION, which dealt with the servicing of the Ferguson 306T.—G. F. BROOKS (11 Shakespear Crescent, Eccles, Manchester).

SIR,—I desperately need the following issues of PRACTICAL TELEVISION: May, June, July, October, November, December 1966, February and March 1967.—H. ALTMANN (New College, Oxford).

TV DECLINE

SIR,—Three factors may be partly responsible for the decline in TV sales (Editorial, May issue of PRACTICAL TELEVISION).

One is that more people have cars and are out and about much more; another is the increasng popularity of coloured films and slides projected onto a large screen.

Lastly, there have been no really significant changes in TV since the experimental service started 31 years ago, apart from minor improvements in screen size, cameras, reliability and 625.

Many viewers feel a sense of frustration in viewing a dull monochrome while the commentator, tantalisingly describes a "blaze of colour".

Colour long overdue, will be for the limited few who can afford the high cost of purchase or rental, and then only a very few hours a week will be given over to colour.

Despite experimental work, no reasonable system of, even partly, steroscopic reproduction has been achieved, the third dimension is left for the eye to calculate from a flat picture.—A. C. DEVERELL (Rickmansworth, Hertfordshire).

625 LINES IN 405 CHANNELS

SIR,—I have been reading Part 1 of Mr. A. O. Hopkin's article "625 Lines in 405 Channels". From this part of the article it is obvious what the system of picture scanning that he proposes will be (I have had this system in mind myself for some time). He is obviously going to advocate in Part 2 of the article the use of a quadruple interlace system, with approximately 625 lines per picture, and approximately 15 or 16 pictures a second. Each picture will be scanned in 4 fields, where the following lines will be scanned in each field to avoid line crawl effects: field 1: lines 1, 5, 9, 13, 17 etc.; field 2: lines 2, 6, 10, 14, 18 etc.; field 3: lines 4, 8, 12, 16, 20 etc.; field 4: lines 3, 7, 11, 15, 19 etc.

Such a system will satisfy his conflicting requirements of a rapid flicker rate (about 60 per second) with a slow picture renewal rate (about 15 per second), and will allow the number of lines to be increased to around 625.

Unfortunately I am not satisfied that such a system will be satisfactory, for the following reasons. It is an observed fact that the subjective definition of a picture is rather poorer than the number of lines would suggest (though Mr. Hopkin's attempt to explain this is probably wide of the mark, as the use of spot wobble to broaden the TV lines would invalidate his argument). The reason for this lies in complex intermodulation effects between the raster and original picture, and advanced maths, including two dimensional Fourier analysis, is needed to explain these effects properly. The ratio of the subjective vertical definition (measured in lines) to the actual number of picture lines is known as the kell factor. Normally the kell factor is around 60% meaning that a 405-line picture has an apparent vertical definition of only 243 lines.

It has been shown that for double interlaced pictures, the kell factor is about 10% less than for non-interlaced pictures. In other words, the act of interlacing lines reduces the apparent vertical definition, which means that bandwidth saved by interlacing lines is partly lost due to loss of apparent vertical definition. With the use of quadruple interlace this loss of apparent vertical definition will get even worse, and this might mean that a 625-line quadruple interlace picture might not appear much better than a conventional 405-line picture!

Another point is that very small detail covering less than 4 lines will be subject to flicker. This flicker is noticeable, as very fine vertical detail on 405- or 625-line double-interlaced pictures has a noticeable and objectionable flicker, which effect will be much worse or quadruple-interlace pictures due to the lower flicker rate and wider line separation in each field.

The smaller number of pictures per second and the larger distance between successive lines of each field also make it more difficult to make colour subcarriers of low visibility and high quality.

Finally, it should be mentioned that there are other important but less well-known wastages of picture detail and bandwidth. For instance, it can be shown that most fine detail in most pictures tends to be nearly vertical or horizontal rather than sloped at an angle. The human eye also is more sensitive to vertical or horizontal fine detail than to sloped detail. Yet present methods of scanning pictures actually transmit finer detail at an angle to the horizontal or vertical than is transmitted in horizontal or vertical directions. In practice this means that half the bandwidth of conventional TV transmissions is wasted in sending fine detail that cannot be seen by the eye! (Conventional colour subcarriers are so arranged as to be of such a non-visible nature, thus making use of this wastage.)

Before going ahead with any scheme of TV transmission which appears to be economical in bandwidth, much research is needed, due to the extreme complexity of the subject. Bandwidth economy will become important when ultra-high definition TV or video-telephone applications become practical. Until then, we should not rush into using any new system no matter how plausible it appears to be.—M. A. GERZON (Oxford).

* * *

SIR,—I read with interest the article of Mr. A. O. Hopkins, proposing a three-field television system. In this letter, I would like to extrapolate his arguments to postulate a four-field COMPATIBLE system.

I would agree that the phenomenon of scan overlay produces an undesirable wastage of video bandwidth. It also leaves unscanned the gaps between the lines, which makes the vertical image discontinuity more evident. But the solution is more simple than it seems: lower each alternate FRAME by an amount equal to one-half the line separation. It requires only a square-wave of less than a volt (dependent upon the tube), at half frame frequency, to be added to the vertical deflection timebase output. As an experiment, one could try two divide-by-two multivibrators in series, fed initially from the field-pulses.

If our friends at the BBC or ITV could oblige, one could try a system of Frame Shift Interlace in which the transmission is made up of such slightly displaced alternate frames and an oscillatory command signal superimposed upon the field-sync command pulse of each fourth field. As those who use unmodified receivers would not have any change in their scanning raster, the 12·5c/s vibration (much too fast to see) of the occasional vertical edge of a tone would pass unnoticed; the phenomenon is too rare to disturb.

Reception would be with a simple modification; the sync oscillation would be filtered and detected and then fed into the deflect side of the multivibrator. A divide-by-two multivibrator fed from the field-sync separator or flyback blanking signal would than reset the shift multivibrator after a count of two.

The prospect of doubling up the line frequency offers several advantages: even screen illumination, double the vertical definition (with the help of the television companies), minimum discomfort to users of the simple receivers and economy of conversion should they decide to keep up with the Joneses. A simple-to-fix kit could be marketed for about £1! Professional conversion should not cost more than £5 and Britain would again become a pioneer of television technology.

There would be 810 lines on 3·5Mc/s; 1250 lines on 5Mc/s. In colour there would be Volks PAL, Volks De-Luxe PAL, De-Luxe Volks PAL and DOUBLE De-Luxe PAL. Sharp 23in. screens, 25in. colour, even 30in., 40in., 50in. maybe. Compatability with Eurovision channels would be maintained as at present. Domestic programmes would tend to be sharper, though. Who knows, the others may even follow suit. In the Common Market there would be big markets for such a British invention.

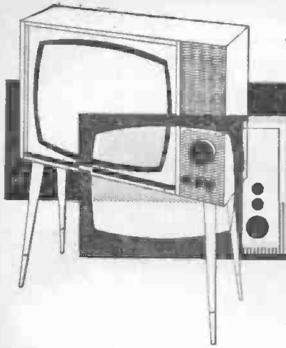
I have done a great deal of cine photography, and am quite aware of the phenomenon of image flicker. This has been overstated. Against the afterglow of the fading previous fields, the flicker of newly scanned lines would be quite inconspicuous.

So let us think seriously about Frame Shift Interlace. Those who wish to experiment could try the above mentioned experiment with two bistables. They can expect an ILLUSION of sharpness, and even more illumination. But there will be a 12·5c/s shimmer. And with the help of the broadcasting people, the ILLUSION could become reality, and the shimmer eliminated.—C. WEHNER (Fulham, S.W.6).

GEC BT1252

SIR,—On page 379 of the May 1967 issue under "Your Problems Solved", Mr. W. Corkish has some trouble with a GEC BT1252. I have had some experience with this model, and if after the components mentioned have been checked and no fault can be found in the circuit, might I direct you to the line output valve itself. I have conducted a test on a working version of this model, which consisted of fitting a new l.o.p. valve type N339 and adjusting the width so that on the test card the edge of the picture was just visible.

I have also replaced the N339 with a PL81, also a new valve. This valve gives a picture with width down about 30—40%, and the anode overheating so as it is a dull red. The answer lies in the fact that while PL81 and N339 are listed in many equivalent tables as being the same, they have the same pin connections, they do not have the same ratings. So if no fault can be found may I suggest that W. Corkish tries a N339. It is distinguished from PL81 by the absence of the white insulators which characterise the PL81. I hope this will be helpful to another reader of this excellent magazine.—A. BATCHELOR (Stevenage, Hertfordshire).



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 476 must be attached to all Queries and a stamped and addressed envelope must be enclosed.

SOBELL ST285 DS

I would like to fit a u.h.f. tuner. Could you let me know what type or make of tuner to use also what extra components are required? — H. Shepherd (Rotherham, Yorks).

Only the tuner is required and this can be obtained from a Sobell dealer or from one of the advertisers in this magazine.

MURPHY V310

The fault is a horizontal concertina effect which affects the whole of the screen, but principally the bottom two-thirds. The whole process is fairly slow and the movement between ½ and ¼in. It appears to be worse on ITV. The fault originated with the bottom of the picture progressively stretching but after the controls were adjusted to the minimum point the present fault appeared, the net effect of which is to give a picture varying between circular objects showing as a perfect circle, and egg shape.—L Harding (Hayes, Middlesex).

Your symptoms are due to hum within the frame timebase coupled with a synchronous transmission, since both broadcasters have now unlocked their 405 systems from the mains. We advise you to check the 30P12 field output valve, and the main and secondary smoothing capacitors. This is easiest done by obtaining a good electrolytic of about 100μF value, and bridging it across each electrolytic in turn.

DECCA DM22/C

Could you please inform me what is involved in converting my TV to receive BBC-2.? D White (Markethill, Co. Armagh, N. Ireland).

Although a u.h.f. tuner can be fitted with an i.f. panel with output to the c.r.t. and sound output the trouble is getting the line output stage to work on the 625 standard. Whilst the frequency change is quite easy the line output transformer and the scan coils do not take kindly to modification and we do not recommend it.

PYE C17

Over the past month the following fault has developed. An inch across the bottom of the screen is blank, above this there is a bright band approximately 4in. deep across the screen. When examined this looks like very narrow raster lines. When words appear on the lower portion of the screen in this bright section, they are upside down. I have changed the PL81, PY81, EY86 and the 100 + 200μF electrolytic but without any improvement.—T. A. Gillespie (Liverpool 12).

Your trouble appears to be in the field output stage, whereas you appear to be looking for it in the line output stage. We advise you to replace the PL83 (PCL82 in later models) field output valve which is at the back of the set adjacent to the loudspeaker plug.

PYE V810/A

I cannot get full width of the picture with the controls set at maximum. The sound is low and distorted. The picture takes four or five minutes to come on and I suspect the h.t. rectifier. Could this be replaced with a silicon rectifier. The line linearity control coil also gets very hot.—H. Mattinson (Cleator Moor, Cumberland).

You can indeed replace the h.t. rectifier by a silicon diode, but you may have to fit a 20Ω 5-watt surge limiter in series to prevent excessive h.t. The line linearity choke normally gets hot but not unduly so, and this may be contributing towards your low width. We advise you also to check the line output valve and its screen grid dropping resistor which may have changed its value.

K-B OV30

After collapse and loss of picture, sound remained normal. Only a weak spark could be drawn from the e.h.t. lead when removed from the c.r.t. The 50CD6G, PY83 and R19 were tested but pronounced all right.—A. W. Durn (Birmingham 14).

We would advise you to check the PCF80 video amplifier—line oscillator. Check the boost line capacitors if necessary (0·2μF 1kV etc.).

PYE CONTINENTAL 14

I cannot get any vision, raster etc., have tried the brightness control and nothing happens. PY81 is OK but not much spark on the anode of the c.r.t., also the voltage across its heater is 16 volts.—C. Maloney (Skelmersdale, Lancashire).

You have a variety of causes which would produce your symptoms. Suspect defective scancoils, line output transformer, or even a defective cathode ray tube. This latter may be the most likely cause since its heater voltage should only be 6·3, and not 16 as stated in your letter.

EKCO T380

I have replaced resistors as indicated and I now have the set working normally, except for the field output stage. When first switched on the set functions more or less normally with the picture top slightly stretched and the bottom slightly cramped. After ten minutes or so, this becomes worse leaving approximately 2in. at the bottom.—F. T. Osborne (Wood Green, N.22).

We would advise you to check the field output valve and associated components if necessary. The linearity control is a preset above the field output valve on the front side of the panel.

GEC BT302

I recently made a small repair to the timebase panel. On re-assembling same, a short occurred causing one of the 66Ω mains dropper sections to get red hot. After removal of the short, I switched on again but the set appeared dead. No sound or vision, all valve heaters were glowing except the U47, and there was no e.h.t.—J. W. Geoffrey (Upholland, Nr. Wigan).

It is possible that a short occurred in the h.t. rectifier. This would make the current surge limiter section of the dropper red hot. Replacement may then fail to restore h.t. voltage. This would, of course, result in total sound and e.h.t. failure in spite of the valve heaters glowing. Check between rectifier "anode" and the mains input.

BUSH TV 56

When the set is switched on there is only a small picture in the centre which gradually opens out but fails to fill the screen. Both the height and width controls are at maximum.—J. Watkin (Westbury-on-Severn, Gloucester).

The trouble is undoubtedly due to low valve emission. It would be a good plan to replace the h.t. rectifier and line timebase valves i.e. PL81, PY81, ECC82 and the two PY82's.

EKCO T293

There is no raster; the sound is quite good but there is quite a large amount of background hum when either ITV or BBC is correctly tuned. All the valves heat up and, after about two minutes, a blue glow develops in the line output valve. This valve has been changed for an older one from another TV but there is still no difference. The voltage on the c.r.t. first anode is 100V.—G. D. Sloan (Cobham, Surrey).

We suggest that you check the e.h.t. rectifier on the top of the line output transformer. Also, check the line timebase generally.

FERGUSON 743T

There are about four separate pictures side by side and there appears to be some foldover on end. It would appear that the line speed is therefore incorrect. The field timebase is not affected.—D Coates (Wallington, Surrey).

The trouble certainly lies somewhere in the line timebase generator circuit. A change in characteristics of a transistor or component is most likely responsible. However, before contemplating oscillator transistor replacement, check the components directly associated with the line hold control, for one of these may have changed value, putting the correct line speed outside the range of the hold control.

MASTERADIO 4002 DST

The fault is nearly complete loss of sound on channel 4, other channels remaining up to strength. Please indicate the position of the tuner slug in this type of tuner—it does not appear to be accessible from the front of the set.—F. J. Campodonic (Pembroke Dock, Pembs).

If you switch to channel 4 and remove the knobs you will find a hole through which a non-metallic trimming tool can be passed to adjust the oscillator coil core. An alternative tuner is sometimes fitted and the access may then be from the side. Check the PCF801 valve.

FERGUSON 245T

Several weeks ago, the picture began to flicker and a double image eventually appeared. This was later accompanied by cramping at the bottom of the picture.—P. B. Golding (Carlton, Nottingham).

Check the field timebase oscillator valve. If this is satisfactory and substitution fails to effect a cure, check the field sync feed from the sync separator to the generator section, especially the interlace filter diodes. If all is well here, suspect the field output transformer. That is, if you are absolutely sure that the field valves are okay.

PAM 802

It is not possible to hold the picture (field scan) for more than about sixty seconds. The sync separator valve has been changed, also field oscillator and output valves. A check on associated electrolytic capacitors was carried out without finding any fault. I have also tried to obtain a service sheet for this set without success. I would appreciate it if you could give me any information on this.—R. Palmer (Hanwell, London, W.7.).

The nearest equivalent to your Pam 802 circuit is the Pye V210, service sheets for which ought to be freely available. We suggest you check around V13 ECC82 sync separator stage, checking particularly C53 (180pF) for loss of capacity.

VIDOR CN4218

A short while ago whilst soldering two new leads to the loudspeaker I displaced the cores of coils L4, L5 and L6 and my efforts to realign them have proved unsuccessful. I suspect that in my efforts I have damaged one or more components since at one time I managed to tune in the BBC's f.m. transmissions, on which L4 had little or no effect. Could you please suggest a way of curing this fault?—A. H. McLean (Tresco, Isles of Scilly, Cornwall).

Misalignment can only be cured, of course, by realignment! Sadly, there is no easy way out of your problem. If the set is out of alignment due to core alterations, and this seems likely, then you will have to have it realigned by a dealer if you have no suitable instruments and service manual. It is impossible of course for us to say whether you have damaged other components in the set.

DECCA DR61

I am moving to Cork City, Republic of Ireland. I understand that BBC-1 and Telefis Eireann can be received in that area. Will the above set receive these programmes, or will it be necessary to have it adjusted.—E. E. McMahon (Birmingham 22A).

This receiver uses the THORN (Ferguson) 850 chassis. The turret is fully loaded for reception of all channels.

STELLA 1043A

No picture or line whistle. Replacement line output transformer fitted, plus associated valves DY 86, PL36, and PY800—no improvement from this. Prior to this, there was a reduction in sound on plugging in the armchair control unit.—J. Clare (Oldham, Lancashire).

The trouble could exist either in the line timebase generator or line output stage, and there is no clue at all in your letter with regard to this. Listen very carefully for the line whistle with the aerial removed and when the line hold control is operated over its full range of travel. If a weak whistle is heard you can be sure that the generator section is working. In this event, check the screen grid feed to the line output valve, booster reservoir capacitor and associated components. Otherwise, concentrate attention on the generator section.

QUERIES COUPON

This coupon is available until JULY 21st, 1967 and must accompany all Queries sent in accordance with the notice on page 473.

PRACTICAL TELEVISION, JULY, 1967

TEST CASE -56

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.

? *Faults on a Bush 135BRU chassis were described as the picture jumping up and down in time with the sound and the sound marred by the presence of a loud, rough buzzing noise. These symptoms at first appeared to simple sound-on-vision and vision-on-sound, and since the set was working in an area of abnormally high signal field crossmodulation due to overloading was suspected.*

However, the faults persisted even when the aerial signal was attenuated to the extent of noise (grain) appearing on the picture and it was eventually found that the buzz on sound was present without an aerial signal and that its tone varied as the field lock control was rotated.

Tests were made on the smoothing and bypass capacitors in the relevant circuits, since the sound buzz, at least, was due to some leakage or coupling between the field timebase and sound circuits.

It was discovered that the faults could be eliminated by pressing in the control knob of the volume potentiometer. What was the most likely cause of this coupling between the sound and vision and audio circuits?

The answer will be given in next month's PRACTICAL TELEVISION, *along with a further item in the Test Case series.*

SOLUTION TO TEST CASE 55

Page 429 (last month)

When any television fault has thermal connections attention should always first be directed to the components that themselves generate heat. This is why the valves—especially power-type valves that get really hot—should first be checked, preferably by substitution, since there are few valve testers that can claim to check a valve under full load and at full working temperature.

In the Test Case, however, the suspect valves were checked by replacing with good ones and the fault persisted. The next move would have been for the technician to investigate any components in the line circuits that run hot or fairly warm. In the chassis concerned the screen grid of the 30P19 is fed from the h.t. supply to two 1·5kΩ resistors in series, and these get quite warm.

In several cases they have been known to *reduce* in value, from their nominal 1·5kΩ down to about 400 ohms over about an hour. A test of their resistance when hot proved that this was, in fact, the cause of the trouble, replacements fully clearing the trouble.

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

SETS & COMPONENTS

OLYMPIC II TV. S.A.E. for itemised price list. AJAX ELECTRONICS, 18a Rumbold Road, Fulham, S.W.6.

BARGAIN PARCELS

Any 10 valves below for 14/- or any 100 Valves for £6.
PCF80, PCC84, PY81, PY800, PY82, PL36, PL81, PCL82, PCL83, EY86, ECL80, EF80, EF85, EF184, EB91, ECC82, EBF89, 30C15, 30PL13, 30PL14, 30FL1, 6—30L2, 30F5, 20P4, 30P4.
All valves tested. P. & P. 2/-. Three BY100 type Rectifiers 10/-. 50 Television fuses, mixed, 5/-, 100 mixed capacitors, 5/-

VELCO ELECTRONICS
49 Bridge Street, Ramsbottom, Bury, Lancs.

EX N.E.V. C.C.T.V. Camera and Monitor Circuits. S.A.E. for list. LOWE, 62 Brownswood Road, London, N.4.

TUBES, AERIALS, VALVES

U.H.F. aerials. Bands I, II & III aerials. U.H.F. transistorised boosters. I.T.V. boosters. Regunned TV tubes. Valves, etc. New and second-hand TV sets. Transistor Radios and all types of Electrical Appliances. Quotations without obligation. Coaxial cable, fluorescent light fittings, all at special prices to the trade and Home Engineers. S.A.E. for list.

G. A. STRANGE

BROADFIELD, NORTH WRAXHALL, nr. Chippenham, Wilts. Tel. Marchfield 236

STOP

FULLY GUARANTEED L.O.P.T. REWINDING SERVICE

A few of the types are listed below:—
BUSH TV 53-66.
K.B.P.V.P.20, etc,
PHILIPS 1768U, 17TG100U, etc. **All at 50/-**

NEW FROM STOCK

U25 Type EKCO, state model. PYE 200-400.
FERGUSON 306-308 305-307 **All at 45/-**
FERGUSON 406, 408, 416, 436, 438
S A E Enquiries *P & P 4/-, C.O.D. 6/-*

WITWORTH TRANSFORMERS Ltd.
26 All Saints Road North Kensington W.11 *Telephone:* 01-229 9071

RATES: 4/- per line or part thereof, average five words to line, minimum 2 lines. Box No. 1/- extra. Advertisements must be prepaid and addressed to Advertisement Manager. "Practical Television", 15/17, Long Acre, London W.C.2.

SETS & COMPONENTS
(continued)

THIS MONTH'S SCOOP!
HUGE PURCHASE
NEW **BRIMAR C17AF** BOXED
17", 110°, 0·3A Short neck
Can replace AW43-88, CME1705 etc.
£3-19-6
TELEVISION TUBE SHOP
48 BATTERSEA BRIDGE ROAD, SW11

MANSTONE LTD.

FOR LINE OUTPUTS AND DEFLECTOR COILS

WE have the Country's largest stock of Manufacturers' Original (or Authorised Replacement) Line Output Transformers for many "difficult" makes, including **Ambassador, Baird, Cossor, Ekco, GEC, HMV, KB, Masteradio, Peto-Scott, Philips, Regentone, RGD, Sobell, Ultra,** etc. Also deflector coils, output and oscillator transformers, inc. **Alba, Bush, Murphy.** Examples, L.O.P.T.s: **Murphy** 280, 89/6; 310/350/410/540/659/759, 85/-; **Bush TV53,** 79/6; 80, 95/-.

SPECIAL OFFER:

Ekco improved type for Model **T221** at 42/6, T231 at 46/-; T310 at 47/6d.

Terms: C.W.O. or C.O.D. (3/6). Post/packing 5/-, 2 or more L.O.P.T.'s Post/packing Free.

All enquiries answered but regret no lists available. Same day delivery on most types.

MANSTONE LTD.

28 BROCKLEY CROSS, LONDON SE4

Tel. TIDeway 5394 (*Day*) or 01-589 0439 (*S.T.D. Night*).

SETS & COMPONENTS
(continued)

R. & R. RADIO & T.V. SERVICE

Salvage Valves Good Emission Guaranteed.

EF 80	1/6	30P4	8/-	PCL 84	6/-
EF 184	5/-	EB 91	1/-	PL 82	4/6
ECL 80	4/6	EF 85	5/-	PL 36	5/-
30F5	5/-	6B W7	4/-	PCC 84	4/-
PCF 80	4/-	EY 86	4/-	PY 81	3/6
U191	5/-	30P12	5/-	PY 33	6/-

Speakers Ex T.V. 5 inch Rnd 3/6, 6 x 4 3/6. Post 2/6. 8 inch Rnd 6/- Post 4/6 for one or two. BY100 and equiv, with 10watt res 5/6 post paid. Ekco line O/P Trans, U26 type 35/-. U25 type 27/6. Push Button tuners, req valves type 30L15 and 30C15 rectangular buttons. 27/6 post paid.

Postage on valves 6d. Three and over post paid. S.A.E. with all enquiries.

51 Burnley Road, Rawtenstall, Rossendale, Lancs.

GUARANTEED IDEAL for ANY RECORDER

TAPE

World Famous make. **PRICES SLASHED. APPROX. HALF PRICE!**

By enormous purchase we can offer you fully tensilised Polyester/Mylar and P.V.C. tapes of identical HI-FI wave range recording characteristics as top grade tapes. Quality control manufacture. Not substandard in any way. TRY One for YOURSELF. They are TRULY WORTH A FEW MORE COPPERS.

STANDARD PLAY			DOUBLE PLAY		
3"	150'	2/3	3"	300'	4/-
4"	300'	4/6	4"	600'	6/-
5"	600'	7/6	5"	1200'	15/-
5¾"	900'	10/6	5¾"	1800'	19/6
7"	1200'	13/6	7"	2400'	27/-
LONG PLAY			**TRIPLE PLAY**		
3"	225'	2/9	4"	600'	13/-
4"	450'	5/6	5"	1800'	25/-
5"	900'	10/6	5¾"	2400'	34/-
5¾"	1200'	13/-	7"	3600'	44/-
7"	1800'	18/6	**QUADRUPLE PLAY**		
			3"	600'	8/-

Postage 1/- per reel.
Post free and less 5% on three.
Trade and quantity enquiries welcomed.

TECHNICAL TRADING CO.

All Mail Orders to Brighton please.
Devonian Court, Park Crescent Place, Brighton. 689722, 67606
350/352 Fratton Road, Portsmouth 22034
72 East Street, Southampton 25851
132 Montague Street, Worthing 2639

BRAND NEW TELEVISION TUBES — 2 YEAR GUARANTEE!

(CATHODEON AND OTHER LEADING MANUFACTURERS)

We hold large stocks of top quality tubes, why buy ordinary rebuilds? Some rebuilds available, 19in. upwards at 21/- off quoted prices, 12 months warranty. Colour, rimbands, etc. available. Lists. Rimband Types, 19in. £8.10.0; 23in. £11.0.0.

CRM121, 2, 3 & 4; MW31-16, MW31-74; C12FM; 121K, etc.	£3 0 0
AW36-20, 36-21; AW36-80; MW36-24, 36-44; CRM143, 4; CME1402; C14BM; C14FM, etc.	£4 0 0
CRM143, CRM144; SE14/70, £4.0.0 CRM141, 2; CRM151, 2, 3; 15EP4, etc. C17BM	£4 15 0
AW43-80, 43-88, 43-89; MW43-64, 43-69; MW43-80; CRM171, 2, 3, 4; C17FM; CME1703, 5; C17AF; C17SM	£5 15 6
AW47-90; AW47-91; CME1902; CME1903, etc.	£6 17 6
C19AH; CME1901; AW53-88, 9; CME2101, 4; AW53-80; MW53-20; MW53-80; CRM211, 2, etc.	£7 10 0
19in. Twin Panels A47-13W; CME1906, £9.17.6 (Carriage 15/-) 23in. Twin Panels A59-13W, CME2306 (Carriage 25/-)	£12 10 0

CARRIAGE AND INSURANCE. Up to 19in. 12/-. 21in. upwards 15/-. Twin Panels (see above). Lists, s.a.e. please.

SOME OLD TUBES WANTED 17" UPWARDS

PHILIP H. BEARMAN, 6 Potters Road, New Barnet, Herts. Tel: BAR 1934/7873 (Robophone)

LISTS BRITISH VALVES!

TELEVISION TUBE SHOP

THE

NEW TUBE Specialists

A47-13W	£12.10.0
A59-13 W	£15.10.0
AW36-20, 21	£5.12.6
AW36-80	£5. 7.6
AW43-80	£6. 7.6
AW43-88, 43-89	£6.12.6
AW47-90, 91	£7.10.0
AW53-80	£7.12.6
AW53-88, 53-89	£7.17.6
AW59-90, 59-91	£9.10.0
C148M, FM	£5.15.0
C17BM, FM, HM	£6. 7.6
C17LM, PM, SM	£6.12.6
C21HM, SM, TM	£7.17.6
CME1402	£5.17.6
CME1702, 1703	£6.12.6
CME1705	£7. 7.0
CME1901, 1903	£7.10.0
CME2101, 2104	£7.17.0
CME2306	£15.10.0
CRM93	£5.10.0
CRM124	£5.10.0
CRM141, 2, 3, 4	£5.17.6
CRM152	£5. 0.0
CRM153	£3.19.6
CRM171, 2, 3	£6. 7.6
CRM211, 212*	£8.17.6
MW31-16, 74	£5. 0.0
MW36-24, 44	£5. 2 6
MW43-64, 69	£6. 7.6
MW43-80	£6. 7.6
MW53-20*	£8.17.6
MW53-80*	£8.17.6
14KP4A, 141K	£5.12.6
171K, 172K, 173K	£6. 7.6
7201A, 7203A	£5.12.6
7204A	£5.10.0
7401A	£6.7.6
7405A	£6.12.6

Manufacturers' Reprocessed Tubes available at £1 each less than the above prices.

All tubes tested before despatch and guaranteed for 12 months

CARRIAGE 10/-, via B.R.S. or 15/- via passenger train. Add 2/6 for Comprehensive Insurance.

* Reprocessed tubes only of this type at present.

Midland Stockists:—

Amateur Electronics Co., 240 Lichfield Road, Aston, Birmingham.

TELEVISION TUBE SHOP

48 BATTERSEA BRIDGE ROAD LONDON S.W.11. BAT 6859

JUST SOUTH OF THE BRIDGE
OPEN SATURDAY UNTIL 4 p.m.

SETS & COMPONENTS
(continued)

TV SPARES fully guaranteed Makers Parts. Telephone orders sent same day C.O.D. Line O.P. Trans: Murphy V270/280 99/6. Ekco T311, 330, 221 231 327 series and Pye VT4 etc., all 62/6. Most types stocked Send S.A.E. for quote. Add 4/- p.p. Ekco/Ferr, Plastic Hsgs., 15/-. KING'S (ORPINGTON) LTD., 8 Cray Parade, Main Road, St. Paul's Cray, Kent. Orpington 30566.

SERVICE SHEETS

SERVICE SHEETS (75,000) 4/- each: Please add loose 4d stamp: callers welcome: always open: THOMAS BOWER, 5 South Street, Oakenshaw, Bradford.

SERVICE SHEETS, Radio, TV. 5,000 models. List 1/6. S.A.E. enquiries. TELRAY, 11 Maudland Bank, Preston.

RADIO 2/-, TV 3/-. Manuals 5/-. C.W.O. S.A.E. Model No. HOPKINS, 44 Dale Valley, Poole.

SERVICE SHEETS, with free fault finding chart, 3/-. S.A.E. LESMAR, 10 London Road, Andover, Hants.

SERVICE SHEETS

4/- each, plus postage

We have the largest supply of Service Sheets for all makes and types of Radios and Televisions, etc. in the country (speedy service).

To obtain the Service Sheet you require please complete the attached coupon:

Name: ....

Address: ....

....

....

To: S.P. DISTRIBUTORS
35/36 Great Marlborough Street, London, W.1

Please supply Service Sheets for the following:

Make: ....

Model No. .... Radio/TV

Make: ....

Model No. .... Radio/TV

Make: ....

Model No. .... Radio/TV

I also require new 1967 List of Service Sheets at 1/6 plus postage.

(please delete items not applicable)

I enclose remittance of ....
(which includes postage)

MAIL ORDERS ONLY (July PT.)

SERVICE SHEETS
(continued)

SERVICE SHEETS

For all makes of Radio, Television, Tape Recorders, 1925-1967. Prices from 1/-. Catalogue of 6,000 models, 2/6.

Free fault-finding guide with all Service Sheets.

Please send Stamped Addressed Envelope with all orders and enquiries.

HAMILTON RADIO
Western Road, St. Leonards, Sussex

FOR SALE

HIGH GRADE Vidicons. Used but in good working order. Data supplied £5 each. HARRIS, 59 Highbanks Close, Welling, Kent.

RECTIFIERS

SILICON TV 6/- or complete with instr. resistor-condenser, 7/6.

Rectifiers—Contact Cooled

14RA1282/FC101 13/6; 18RD2281/FC124FW, 18/6; EC1 12/6; EC2 12/6; FC116 7/6; 14RA/1283 (FC31) see Silicon.

Rectifiers—Fin Types

Equivs. for RM4 9/6; RM5 17/6; 14A97 13/6; 14A86 10/6; EK2 17/6; EK6 17/6; 14A949 19/-; LW15 19/-; LW7 19/-; 14A100 19/-; 14A989 10/-; FW12V-1A 5/-; 2A 7/-; 4A 10/6.

MULTIMETERS from 32/-

Stamped envelope for full latest selection and bargain offers in cheap meters, Radios, Baby Alarms, Inter-coms and Walkie-Talkies

Line O.P. Trans: all 30/- each

Murphy V350 and V230, Cossor 948, Philips 1446U/45 and 1746U/45 with EY51.

Under £1, P. & P. 6d. Over £1 Post Free, NO C.O.D.

DURHAM SUPPLIES
175 DURHAM ROAD, BRADFORD 8, YORKS.

VALVE CARTONS at keen prices. Send 1/- for sample and list. J. & A. BOXMAKERS 75a Godwin Street, Bradford 1.

WANTED

NEW VALVES WANTED. Popular T.V. and Radio Types. Best cash price by return. DURHAM SUPPLIES, 175 Durham Road, Bradford 8, Yorkshire.

WANTED—Popular Brand New Valves—R.H.S. Stamford House 538 Great Horton Road, Bradford 7.

SERVICE SHEETS purchased. HAMILTON RADIO, Western Road, St. Leonards, Sussex.

DAMAGED AVO METERS WANTED. Models 7 and 8. Any condition. Any quantity. HUGGETTS LTD., 2-4 Pawson's Road, West Croydon. Send for packing instructions.

AERIALS

TV AERIALS

Band I. H. Mast Fitting	£1 15 0
Band III. 5 Ele Mast Fitting	£1 10 0
Band I/III. S/D and 4-Array	£1 15 0
Band IV. 9 Ele Array	£1 10 0
Band V. 18 Ele Array	£2 18 6

Lashing Kits from 10/-; Poles, Co-ax 8d., Grade "A" 1/4. Plugs 6d.

P. & P. 4/6. C.W.O., S.A.E. for list.

TELEINDUSTRIES LTD.
BREAKSPEAR ROAD, RUISLIP, Middlesex

ITA CONTRACTS APPLICATIONS

ALL the existing programme contractors and 15 new groups have applied for the new six-year programme contracts with the Independent Television Authority.

The contracts take effect from July 30th, 1968. The closing date for applications was Saturday, April 15th.

The total number of applications to be considered by the Authority for the fifteen contracts, which were advertised in February, is 36.

ITV companies prepare for colour

IN preparation for the new ITV colour service, four programme companies have placed orders for colour television cameras with The Marconi Company. Twenty-nine Marconi Mark VIIs are to be supplied to ABC Television, ATV, Granada and Rediffusion.

Before the colour service begins, cameras will be used for making colour recordings for export; for example to the North American programme companies who have already an established colour service. Up to now, a number of British programme companies have been recording colour programmes on film or video-tape. The growth of colour television in North America and the complementary growth in the demand for recorded material, could mean a big increase in the quantity of exports from the United Kingdom in this field from now on.

FIRST LIVE COLOUR TV IN MEXICO

TELESISTEMA Mexicano S.A., who operate the three most important television networks in Mexico, are to start live transmissions in colour this summer, using Marconi Mark VII colour cameras. Telesistema Mexicano, who started regular telecine transmissions in colour early this year, will transmit live colour programmes on channels 2, 4 and 5, in Band I, in Mexico City, and these will also be relayed to repeater stations across the entire country. It is expected that colour programmes will also be recorded on tape, for sale to other countries.

Royal Television Society Awards

THE Royal Television Society has awarded the following Premiums for outstanding papers read before the Society in 1965/66:—

The Mullard Premium to C. P. Stewart and D. W. Burman of the University of Sydney for their paper on "Tertiary Education by Television at the University".

The Wireless World Premium to W. J. Morcom of The Marconi Company for his paper on "U.H.F. Translators".

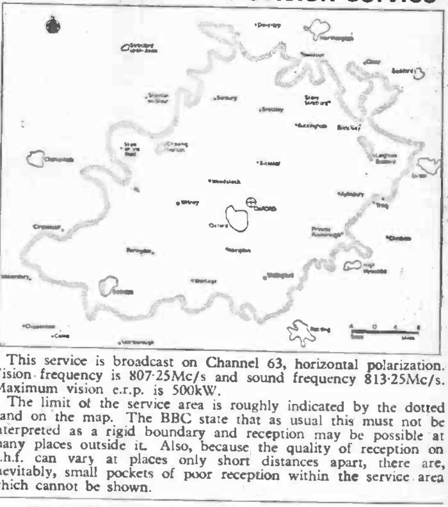
The E.M.I. Premium to W. Silvie (Ampex Ltd.) for his paper on "Domestic Video Recording".

The Electronic Engineering, Pye and T.C.C. Premiums are not awarded this year.

These awards were presented to the recipients at the Fleming Memorial Lecture on Friday, April 21st, 1967, by John Ware, Chairman of the Royal Television Society. The award will be sent to Messrs. Stewart and Burman who were unable to attend the presentation.

The Fleming Memorial Lecture was given by Dr. R. W. G. Hunt (Research Laboratories, Kodak Ltd.). The subject was "The Strange Journey from Retina to Brain". This meeting was held at The Royal Institution, Albermarle Street, London, W.1.

Oxford BBC-2 Television service



This service is broadcast on Channel 63, horizontal polarization. Vision frequency is 807·25Mc/s and sound frequency 813·25Mc/s. Maximum vision e.r.p. is 500kW.

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

INTERNATIONAL TRANSISTOR GUIDE

AVO (MI Group) has produced the third edition of its Transistor Data Manual. This international reference book gives in-line data for more than 8,000 transistors including those of Russian manufacture. A comprehensive list of transistor equivalents is included with commercial equivalents of Service transistors and connection diagrams. Copies of the manual are available from the Spares Department, Avo, Avocet House, Dover, Kent. Price in the UK postage paid is £2 5s.

MISCELLANEOUS

CONVERT ANY TV SET into an Oscilloscope. Instructions and diagrams 12/6. **REDMOND, 42 Dean Close, Portslade, Sussex.**

TECHNICAL TRAINING

CITY & GUILDS (electrical, etc.) on "Satisfaction or Refund of Fee" terms. Thousands of passes. For details of modern courses in all branches of electrical engineering, electronics, radio, T.V., automation, etc., send for 132 page handbook—FREE. B.I.E.T. (Dept. 173K) Aldermaston Court, Aldermaston, Berks.

SITUATIONS VACANT

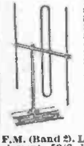
RADIO AND TV Exams and Courses by Britain's finest home study School. Coaching from Brit.I.R.E., City and Guilds Amateur's Licence, R.T.E.B., P.M.G. Certificate etc. Free brochure from British National Radio School, Russell Street, Reading.

ALDERMASTON COURT POSTAL TRAINING for B.Sc. (Eng.) Part 1, A.M.I.E.R.E., A.M.S.E., City and Guilds, pay and security as Technician or Technologist. Thousands of Passes. For details of Exams and Courses in all branches of Engineering, Buildings, Electronics, etc. (including latest information on C.Eng.), write for 132-page Handbook—FREE. Please state interest. **BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY** (Dept. 171K), Aldermaston Court, Aldermaston, Berks.

NEW RANGE U.H.F. AERIALS for BBC2 (625) line transmissions

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors. **Loft Mounting Arrays**, 7 element, 35/-. 11 element, 42/6. 14 element, 50/-. 18 element, 57/6. **Wall Mounting** with **Cranked Arm**, 7 element, 60/-. 11 element, 67/-. 14 element, 75/-. 18 element, 82/6. **Mast Mounting** with 2in. clamp. 7 element, 42/6. 11 element, 55/-. 14 element, 62/-. 18 element, 70/-. **Chimney Mounting Arrays. Complete**, 7 element, 72/6. 11 element, 80/-. 14 element, 87/6. 18 element, 95/-. Complete assembly instructions with every unit. **Low Loss Cable**, 1/6 yd. **U.H.F. Preamps**, from 75/-. State clearly channel number required on all orders.

BBC · ITV · FM · AERIALS



BBC (Band 1). Telescopic loft, 21/-. External S/D, 30/-. "H" £2.10.0. **ITV (Band 3).** 3 Element loft array, 25/-. 5 element, 35/-. Wall mounting, 3 element, 35/-. 5 element, 45/-. **Combined BBC/ITV.** Loft 1+3, 41/3; 1+5, 48/9; Wall mounting 1+3, 56/3; 1+5, 63/9; Chimney 1+3, 63/9; 1+5, 71/3. **VHF** transistor pre-amps, 75/-.

F.M. (Band 2). Loft S/D, 12/6. "H", 30/-. 3 element, 52/6. External units available. Co-ax cable, 8d. yd. Co-ax plugs, 1/3. Outlet boxes, 4/6. Diplexer Crossover Boxes, 12/6. C.W.O. or C.O.D. P. & P. 5/-. Send 6d. stamps for illustrated lists.

Quotations for special arrays available on request.

K.V.A. ELECTRONICS (Dept. P/T)
27 Central Parade, New Addington
Surrey (CRO-OJB)
LODGE HILL 2266

EDUCATIONAL

TV and Radio, City & Guilds, R.T.E.B. Certs., etc. on "Satisfaction or Refund of Fee" terms. Thousands of passes. For full details of exams and home training Courses (including practical equipment) in all branches of Radio, T.V., Electronics, etc. write for 132-page Handbook—FREE Please state subject. BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept 172K). Aldermaston Court, Aldermaston, Berks.

BECOME "Technically Qualified" in your spare time, guaranteed diploma and exam. home-study courses in radio, T.V. servicing and maintenance. T.T.E.B., City and Guilds, etc.; highly informative 120-page Guide—FREE. CHAMBERS COLLEGE (Dept. 858K), 148 Holborn, London, E.C.1.

PADGETTS RADIO STORE

OLD TOWN HALL

LIVERSEDGE, YORKSHIRE

Telephone: CLECKHEATON 2866

New Boxed TV Tubes. 14in. MW36/44 40/-. Carriage 10/-. 12 Months Guarantee.

90 Degree Tubes. 12 Months Guarantee. Slight Glass Fault. 30/- and 50/-. Carriage 10/-.

Reclaimed Tubes. 6 Months Guarantee. AW43/80. 30/-. MW43/80 30/-. MW43/69 30/-. CRM172 30/-. CRM142 17/-. 12in. Tubes 10/-. 17in. Tubes Perfect but without guarantee 17/-. Carriage on any Tube in Great Britain 10/-.

SILICON DIODE ONLY 250 Volt 250 MA 2/6 each. Post paid.

TOP GRADE DIODES 3/6 doz. Post paid.

VALVE LIST

Ex Equipment, 3 months' guarantee

10F1, EF80, EB91, ECL80, EF50, PY82, PZ30, 20P3. All at 10/- per doz. Post paid.

Single valves post 7d.

ARP12	1/6	PL36	5/-	185BT.	8/6
EB91	9d.	PL81	4/-	20D1	3/-
EBF80	3/-	PY33	5/-	20L1	5/-
ECC81	3/-	PY81	1/6	20P1	5/-
ECC82	3/-	PY82	1/6	20P3	2/6
ECC83	4/-	PZ30	5/-	20P4	8/6
ECL80	1/6	U25	5/-	5U4G	4/-
EF50	1/-	U191	5/-	6B8	1/6
EF80	1/6	U281	5/-	6K7	1/9
EF91	9d.	U282	5/-	6K25	5/-
EL38	5/-	U301	5/-	6P25	5/-
EY86	5/-	U329	5/-	6U4	5/-
KT36	5/-	U251	5/-	6V6	1/9
PCC84	2/-	U801	8/6	6P28	5/-
PCF80	2/-	10C2	5/-	EY51	2/0
PCL82	4/-	10P13	2/6		

New Valves ex Units. 1L4 2/-. 1T4 2/-. 1A3 2/6. 1S5 2/6. 12AT7 3/-. 3A4 2/6. EF91 2/-. EB91 1/3. KL91 2/-. Box of 50 ARP12 valves 22/-. Post paid.

TV Chassis. Transformers removed. But complete with Condensers, Resistors, Coils and Valve holders. 10 for 22/-. Carriage paid.

Untested 17in. TV Sets. Complete with all Channels. 50/-. Carriage 15/-.

Perspex TV Safety Screens. 2/- each post 4/- each. Dozen for 30/-. Post paid.

Speakers Removed from TV Sets. All 3 ohm PM, and Perfect. 6 x 4in. and 6in. round. 3/-. Post 2/9. Six for 22/-. Post paid. 7 x 4in.. 5/-. Post 2/9. Six for 34/-. Post paid. 8in. Round 6/6. Post 3/6.

New 12in. Speakers with Built-in Tweeter. 28/6. Post paid. 3 or 15 ohm Coil.

New Miniature Model Makers Motor. 6/6 Post paid.

New Miniature Blower Motor. 7/6 Post 2/-. Will run from 24, 12 or 6 Volts.

FIRST-CLASS RADIO AND T/V COURSES...

GET A CERTIFICATE!

After brief, intensely interesting study —undertaken at home in your spare time— **YOU** can secure a recognised qualification or extend your knowledge of Radio and **TV**. Let us show you how.

FREE GUIDE

The New Free Guide contains 120 pages of information of the greatest importance to both the amateur and the man employed in the radio industry. Chambers College provides first rate postal courses for Radio Amateurs' Exam., R.T.E.B. Servicing Cert., C. & G. Telecoms., A.M.I.E.R.E. Guide also gives details of range of diploma courses in Radio/TV Servicing, Electronics and other branches of engineering, together with particulars of our remarkable terms of

Satisfaction or refund of fee

Write now for your copy of this invaluable publication. It may well prove to be the turning point in your career.

FOUNDED 1885—OVER 150,000 SUCCESSES

CHAMBERS COLLEGE

(Incorp. National Inst. of Engineering)

(Dept. 854V). 148 HOLBORN

LONDON, E.C.1

NEW VALVES

Guaranteed Set Tested

24 HOUR SERVICE

1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94. SET OF 4, 16/3.
DAF96, DF96, DK96, DL96. SET OF 4. 23/6.

1R5	5/-	ECC83	5/6	PCL84	7/-
1S5	3/9	ECC85	5/3	PCL85	8/3
1T4	2/9	ECH35	5/9	PL36	9/-
3S4	4/3	ECH42	8/9	PL81	6/3
3V4	5/6	ECH81	5/-	PL82	6/9
6F1	6/3	ECH84	7/9	PL83	5/11
6L18	6/-	ECL80	5/9	PL84	6/-
10F1	9/6	ECL82	6/-	PY32	8/3
10P13	8/3	ECL86	7/6	PY33	8/3
20F2	10/3	EF39	3/6	PY81	5/-
20P1	8/9	EF41	5/9	PY82	4/9
20P4	12/6	EF80	4/9	PY83	5/3
30F5	9/9	EF85	5/-	PY800	5/11
30P4	11/6	EF86	6/-	PY801	5/11
30P19	11/6	EF89	4/9	R19	6/6
DAC32	6/9	EL33	6/3	U25	9/3
DAF91	3/9	EL41	8/-	U26	8/9
DAF96	5/11	EL84	4/6	U191	10/-
DF33	7/6	EY51	5/11	U301	11/6
DF91	2/9	EY86	5/3	U801	16/-
DF96	5/11	EZ40	6/-	UABC80	5/-
DK32	7/-	EZ80	4/3	UAF42	6/11
DK91	5/-	EZ81	4/6	UBC41	6/6
DK96	6/3	GZ32	8/9	UBF89	5/9
DL33	6/6	KT61	6/3	UCC84	7/9
DL35	4/9	N78	14/6	UCC85	6/-
DL92	4/3	PC97	5/9	UCF80	8/-
DL94	5/6	PC900	8/-	UCH42	8/6
DL96	5/11	PCC84	5/3	UCH81	5/9
DY86	5/6	PC86	7/6	UCL82	6/9
DY87	5/6	PC88	7/6	UCL83	8/6
EABC80	5/6	PCC89	9/9	UF41	7/9
EBC41	7/9	PCC189	8/3	UF89	5/6
EBF80	5/9	PCF80	6/3	UL41	7/9
EBF89	5/9	PCF82	5/9	UL84	6/-
ECC81	3/9	PCL82	6/3	UY41	5/3
ECC82	4/6	PCL83	8/3	UY85	4/9

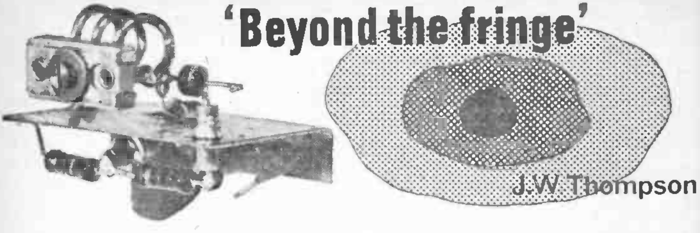
Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any parcel insured against damage in transit 6d. extra.

Office address, no callers.

GERALD BERNARD

83 OSBALDESTON ROAD
STOKE NEWINGTON
LONDON N.16

‘Beyond the fringe’



J.W. Thompson

THE television coverage in this country is by no means complete, especially on Bands IV and V. Lack of coverage is often due to the distance from the transmitter, but in many cases is caused by local shielding (hills, tall buildings etc.). These effects occur because v.h.f. and u.h.f. signals will not readily bend around obstructions. Direct signal reception from a television transmitter is possible only when a line-of-sight path exists between the transmitting and receiving aerials. The maximum line-of-sight distance, d, is given by the relation $d = \sqrt{H_1 + H_2} \times 1{\cdot}22$, where H_1 and H_2 are the heights in feet above sea level of the transmitting and receiving aerials. Beyond the line-of-sight range the signal is diffracted, though only to a small extent at ultra high frequencies, and the signal strength falls off exponentially with distance.

The graph (Fig. 1) is a plot of signal strength against distance from the transmitter, subject to the following conditions. Firstly, frequency and power considerations, designated f and p respectively. BBC-1: f=50Mc/s p=100kW, ITA: f=200Mc/s p=50kW, and BBC-2: f=700Mc/s p=0·5MW. Secondly, the height of the transmitting aerial above sea level is taken to be 500 feet, and the receiving aerial is a single dipole at a height of 30 feet, mounted on a standard chimney lashing on a two-storey house. Thirdly, there are no obstructions except for the natural curve of the earth between the transmitting and receiving aerials.

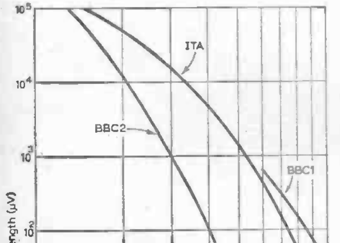


Fig. 1: Simple graph of distance versus signal strength.

UNFAVOURABLE CIRCUMSTANCES

Let us now consider what is going to happen if these conditions are not fulfilled. As far as frequency is concerned, I have taken fairly representative frequencies for each band. If the frequencies under consideration are different from these, it will make very little difference to the signal strength except on the u.h.f. channels. At 450Mc/s, for example, the signal at a given distance will be greater than it would be at 850Mc/s, and this should be taken into account. If the power is different from the nominal values taken, allowance should again be made, but as long as the value is not wildly different the rescaling need not be very drastic. An obvious case of when the graph will not be obeyed even approximately is the case of the low power "fill-in" station, which may only have a power of 10 watts. The height of the aerial is also quite important, particularly if there are any local obstructions. The new BBC-2 transmitting aerials which are currently being erected are nearly all higher than 500 feet, and have a correspondingly greater range.

Finally, the type of receiving aerial used. The graphs apply to a single dipole, and if, as will usually be the case, a more sensitive aerial is used, it will be necessary to multiply the signal strength by the "forward gain" of the array. Let us take a simple example.

The signal strength at a certain distance from the transmitter is 150μV on Band III for a single dipole. We want to know what signal level might be expected if a 3-element aerial were used. Now, the forward gain of a well designed 3-element aerial is about 8dB. Converting this to a voltage ratio, we get $\frac{V_3}{V_{dip}} = \text{antilog}_{10} \frac{dB}{20}$, which equals 2·8 approximately. Multiplying 150 by 2·8, we find that the signal level will be around 420μV, and as we shall see later, this signal would not be large enough to produce a satisfactory picture on the majority of valve receivers. It would be advisable to use a 5-element, or preferably an 8-element aerial in this case.

SIGNAL-TO-NOISE

The main limitation on good reception at low signal levels is noise, of which there are two main sources. One of these is the aerial of a television receiver, which picks up cosmic noise and man-made noise, such as that produced by the ignition system of a motor car. The second variety, and usually the more troublesome, is generated within the receiver itself. Any circuit element will generate noise, even an ordinary resistor, provided that it is at a temperature greater than absolute zero (−273 degrees centigrade). The amount of noise generated increases with temperature, and also, in the case of an amplifier, with frequency.

The effects of noise on television reception are far more disturbing on the picture than on the sound. The picture develops a grainy appearance, which in extreme cases may look as if the entire scene is obscured by a snowstorm. On the sound, there is a background hiss which is, however, rarely objectionable. In general, it has been found that the signal level must be one hundred times greater than the noise level if a noise-free picture is to be obtained. This minimum signal is often referred to as the *optimum threshold level;* increasing the signal above this level does not improve the picture (the excess signal is compensated by the a.g.c. circuits), but below it, noise becomes apparent.

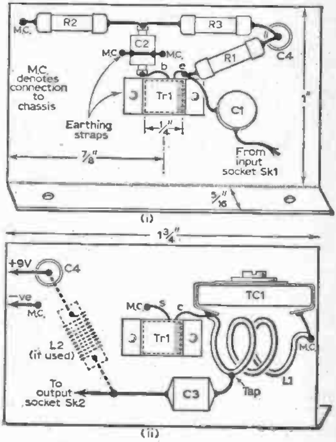


Fig. 3: Layout above and below chassis.

THRESHOLD VARIATION

The threshold level varies between different receivers; the noise contribution of the tuner unit is the main consideration. As an example, a receiver having a tuner with a noise level of 3 microvolts would require a signal of about 300 microvolts to produce a grain free picture. Typical threshold levels for a valve receiver are as follows: Band I —350μV, Band III—500μV, Bands IV/V—1 to 2mV. Valve tuners have a higher noise figure at a given frequency than a transistor tuner of similar gain. This is not really surprising when one considers that one of the elements of a valve is a red-hot cathode, which by virtue of its temperature is inherently far more noisy than a transistor operating at room temperature. Thus, in a fringe area, one is far better off with a receiver employing a transistorised tuner than one with a valve tuner.

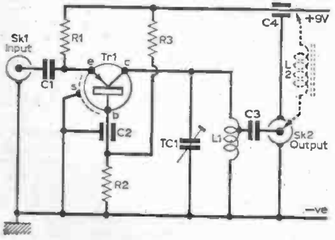


Fig. 2: Circuit diagram of the preamplifier.

SIMPLE PREAMPLIFIER

One way of improving the signal-to-noise ratio is to insert a suitable preamplifier between the aerial and the receiver. This can only be achieved if the noise generated by the preamplifier is less than that generated by the receiver tuner.

A single-stage transistor preamplifier is shown in Fig. 2. The transistor is a currently available inexpensive germanium mesa type (GM290A Texas) which will work efficiently as an amplifier or oscillator up to 1000Mc/s. The typical noise figure for this transistor is quoted in decibels as 2·2dB at 200Mc/s, and gain is about 18dB at the same frequency. As may be seen from the circuit diagram, the transistor is connected in the common base mode, and has a completely untuned input. This rather unusual procedure helps to cut down losses and a very high gain is obtainable in practice. The base of the transistor is biased and stabilised in the usual manner. The stabilising capacitors, C2 and C4, are of the "feed-through" type as used in television tuner units, and are obtainable through any Radiospares dealer. The principal reason for choosing this particular type of capacitor was for convenience in the layout of the preamplifier. Standard disc or ceramic capacitors may of course be used in place of the feed-through type, but the layout would not be as neat.

The mounting of C2 deserves some mention. A small angle piece is made out of the metal used for the chassis (tinplate, copper, etc. but *not* aluminium) and a hole is drilled in one arm of the bracket. The hole should just exceed the external diameter of C2. The angle bracket is then soldered to the chassis in the position indicated on the layout plan. C2 is inserted and soldered into place. Two further holes must be drilled in the chassis, one for the mounting of C4, and the other for the transistor. This latter hole should be square and have dimensions slightly greater than those of the transistor. Leave plenty of room at the top of the hole for the transistor leads.

SUITABLE IRONS

It must be pointed out that while a small instrument-type soldering iron will be perfectly adequate for soldering small component leads, all soldering to the chassis must be carried out with a heavier iron (40—100 watts). As far as general construction is concerned, the usual rules applying to v.h.f./u.h.f. equipment should be adhered to. All leads must be as short as possible, and it is strongly recommended that the wiring diagram be followed. TC1 may be of either the postage stamp or the beehive concentric type (the prototype uses a postage stamp) and should be adjusted for the maximum gain consistent with stability. It will almost certainly be necessary to compress or expand L1 so that the required signal comes within the range of TC1. There is a slight modification which can be tried if the amplifier is being used on u.h.f. channels; TC1 may be removed from the collector lead and connected directly between the base of the transistor and the chassis. In certain cases, this may lead to a slight improvement in performance.

To finish off the amplifier, it should be enclosed in a neat plastic or wooden box, with an on/off switch connected in the battery lead. When soldering-in the transistor, remember to use heat shunts on the leads, as this type of transistor is rather heat-sensitive. The stability of the prototype amplifier is unusually good, and this may be put down to the very effective screening of the input from the output circuits.

AERIALS

So far, no mention has been made of what may be the most important link in the chain, namely the television aerial. In or beyond a fringe area it is an unfortunate fact that the quality of the picture obtained is directly proportional to the amount of money spent on the aerial system.

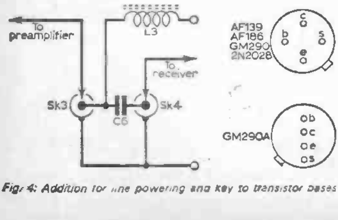


Fig. 4: Addition for line powering and key to transistor bases

COMPONENTS LIST

Resistors:
R1 820Ω
R2 6·8kΩ
R3 2·2kΩ
All 10% ½W

Capacitors:
C1 See table
C2 1000pF ±20%
C3 See table
C4 See table
C5 1000pF ±20%
C6 See table

Coils:
L1 See table
L2 } 10 turns 26 s.w.g.
L3 } Enam close wound on ½ in. ferrite rod.

Transistor:
Tr1 GM290A (GM290, AF139, AF186, 2N2028)

GM290A transistors are obtainable direct from Texas Instruments Ltd., Supplies Division, 12 Wellcroft Road, Slough, Bucks. The price is 13s. 6d.

TABLE 1

All capacitor values are in pF.

	Band I	II	III	IV/V
C1/C6	50	47	33	4·7
C3	0–30	0–30	0–15	0–8
C4	10	10	2·2	2·2
L1 turns	9	7	3·5	3·5
L1 dia.	[illegible] in.	[illegible] in.	[illegible] in.	½ in.

There are two main types of aerial system; one is the usual arrangement mounted precariously or otherwise on a chimney stack. The other type, and usually the more sensitive, is mounted on a 20-30ft. pole, guyed as necessary, and placed in the best possible position. For example, if hill shielding is the trouble, the remote aerial should be placed as far back from the hill as possible (Fig. 5). The same applies to tall buildings, although in this case it may sometimes be possible to displace the aerial sideways so that the building is no longer in the way.

DOWNLEADS

It is essential that the downlead be as short as possible, and the best quality cable must be used. (Cables are at present available with an attenuation as low as 4·5dB/100ft. at 600Mc/s.) When a remote aerial is necessary, and especially if good quality cable is *not* being used, a "masthead" amplifier is invaluable. It is thought inadvisable to mount such an amplifier actually at the top of the aerial mast, as this makes maintenance very difficult. The arrangement shown in Fig. 6 is recommended, because any repairs to the waterproofing, or retuning, may be carried out without having to take down the whole mast.

The amplifier described earlier in this article is ideal for this purpose, but if line-powering is to be used, a slight modification to the circuit will be required (see Fig. 4). The complete amplifier assembly should be enclosed in a watertight box. The amplifier will operate only on one channel at a time, so further amplifiers and/or diplexer systems may be required. If BBC-2 is being received as well, the system will become somewhat complex, to say the least. In any case, a completely separate downlead for u.h.f. is recommended.

If, for any reason, a remote aerial system is impracticable, the only answer lies in improving the existing chimney-mounted array. In one particular case, the author found that while a 5-element aerial gave a watery and unwatchable picture (on Band III), the substitution of a double-eight array produced a near-perfect picture. This was on a transistorised receiver twenty miles outside the fringe area.

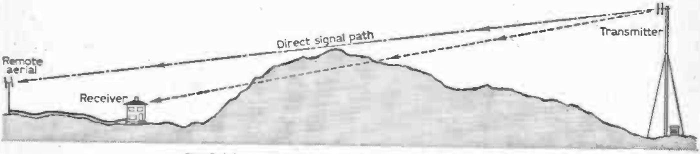
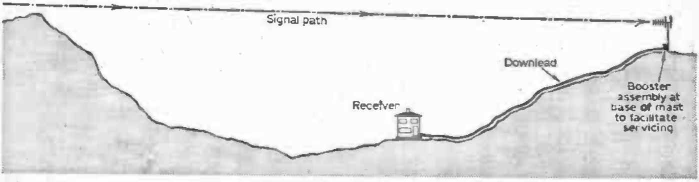


Fig. 5 (above): Resiting the aerial to avoid screening by hill.

Fig. 6 (below): Aerial taken to hilltop with booster at the base of the aerial mast.



INTERFERENCE PROBLEMS

A word must be said about various types of external interference; firstly car ignition interference, which can be very distracting in a fringe area. This is very difficult to combat, and if changing the direction of the rooftop aerial fails to make any improvement, a sensibly situated remote aerial is the only solution. Aerial preamplifiers only make matters worse, as they amplify the interference as well as the signal, leaving the ratio between the two unchanged.

Another type of interference which fortunately only occurs at cetain times of the year is co-channel interference, caused by abnormal signal propagation. If two television transmitters within a few hundred miles of each other are working on the same channel, there will be occasions on which signals from one transmitter will be propagated into the service area of the other transmitter. This manifests itself on the picture as a pattern of some form; either a horizontal bar moving up and down the picture, or a finely meshed wavering pattern which fills the entire screen. The sound is often completely obscured by an objectionable rasping buzz, caused by the vision from the interfering transmitter gaining entry to the sound channel of the receiver. Such occasions are a source of great delight to "TV-DX" enthusiasts, but are not favourably received by fringe area viewers, for obvious reasons. Sometimes the interfering signals are stronger even than the signal which is normally received. Unfortunately, there is really nothing that viewers can do in such cases, short of improving the directivity of their aerial systems. The BBC are, however, building a large number of low-power relay stations on Band I, and a few high-power stations on Band III. If co-channel interference is often experienced, it would be advisable to attempt reception of such a local relay, if there is one within range. ■