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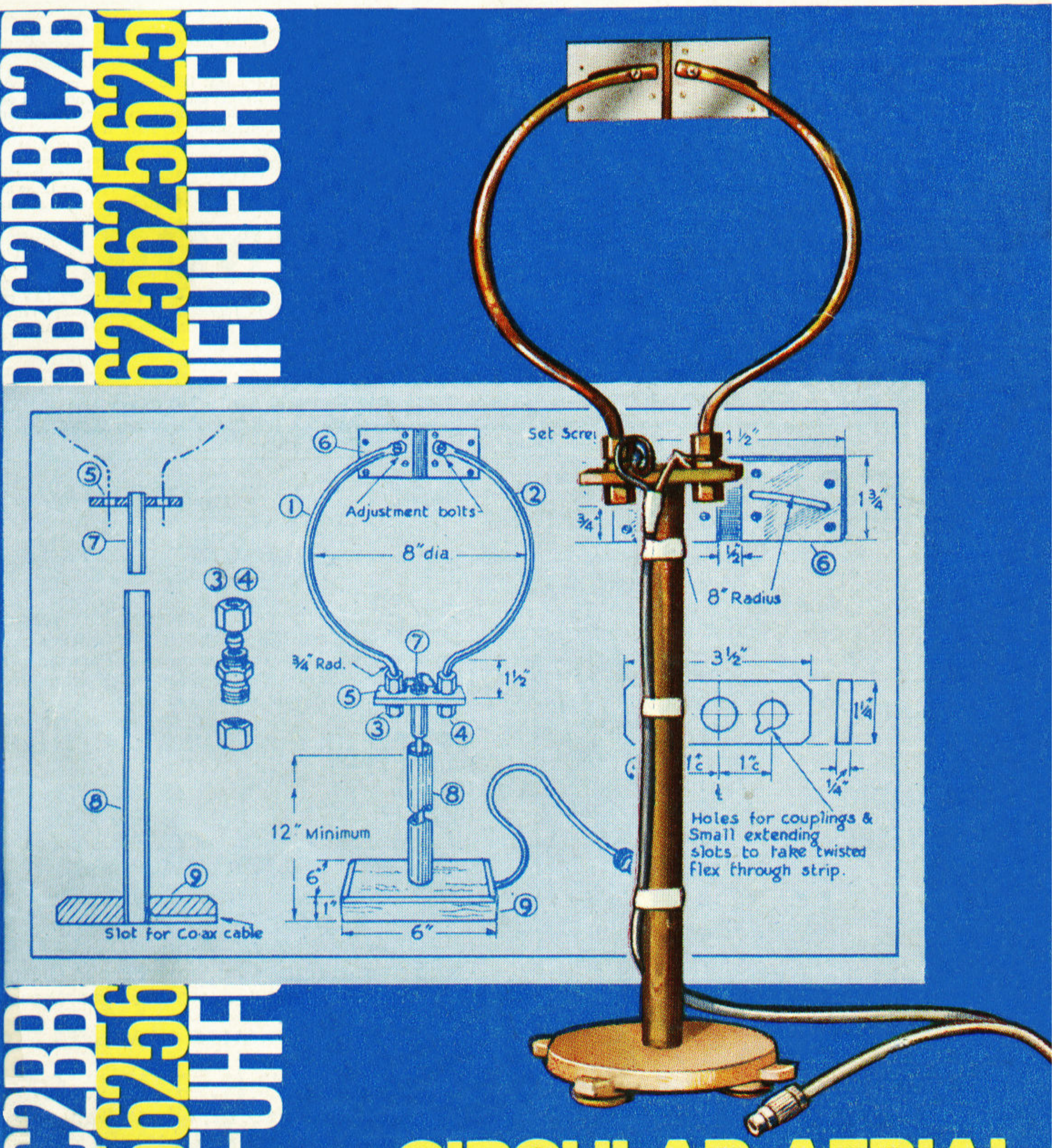

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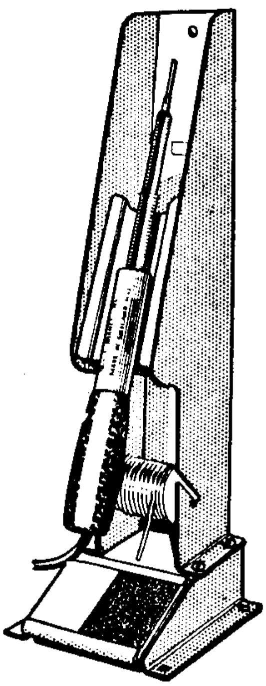

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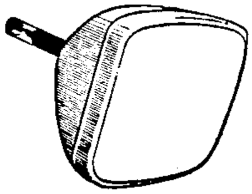

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Practical Television

DECEMBER 1965
VOL. 15 No. 183

THE EYE OF THE BEHOLDER

WHO looks at a television picture and who watches programmes? No, this is not the same thing. The engineer, technician or amateur hobbyist, view the domestic screen with a more critical eye than that of those uninitiated in the mysteries of flywheel sync and gated a.g.c.

Like the hi-fi fanatic who sits through a performance of Tocata and Fugue, oblivious to everything except the splendid bass response of his amplifier, the technical TV man is likely to be a victim of his own specialised knowledge. The enjoyment of a programme can be ruined by a spot of frame cramping; the thread of a play can be lost as he grapples mentally with an obvious case of sound-on-vision; a line jitter can induce a sympathetic nervous tic, embarrassing to all!

But while we technical people blink, shudder, worry and twitch when confronted with such irregularities, Mr. and Mrs. Average Viewer sit on unperturbed, blissfully unaware that their set needs adjusting or servicing.

Even where a fault is evident to all, the amount of misadjustment that the average viewer will tolerate is often incredible. We have seen them all—grotesquely distorted pictures peopled by actors like creatures from Planet X; sets with the brightness so high that the picture looks like a commercial for the latest blue whitener; sets with sound humming like a buzz saw. Often the owner will shrug his shoulders philosophically or—a common one this—will say "Oh! We're used to it!"

That many viewers are happy with almost any picture, providing it moves, is borne out by the many carelessly adjusted sets on display by dealers—and, moreover, by manufacturers at radio shows. And how about BBC-2? Apart from the prospect of another programme, one of the keystones in selling 625 lines to the public was the promise of "better pictures". Yet in practice the public has shown itself sublimely indifferent to such a bait and we would hazard a guess that no more than a handful have bought dual standard sets because of the higher definition.

And so, the next time you are discussing black level compensation and video bandwidths, it might be sobering to reflect that the ideal TV picture, like beauty, lies in the eye of the beholder!

THIS MONTH

OUR NEXT ISSUE DATED JANUARY WILL BE PUBLISHED ON DEC. 23rd

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Television", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 29s. per year to any part of the world.

TELETOPICS

COLOUR TV AIDS PILOT TRAINING

THE BOAC VC10 flight simulators, at the airline's training centre adjacent to London Airport, are now operating with a new three-dimensional closed circuit colour television system that enables pilots to practice take-offs, approaches and landings under any desired weather conditions by day or by night—without leaving the ground.

Designed and manufactured by the Flight Simulator Division of Redifon, of Crawley, Sussex, the visual system enables the pilot to look ahead through the windscreen and see the runway and the countryside around the airport in full colour as he would if flying a real aircraft. This is achieved by using a television camera with a special lens system that moves over a huge model landscape representing an area measuring 9 miles by 2½ miles. The camera lens system faithfully responds to the movements of the aircraft controls on the simulator flight-deck and the picture it sees is transmitted to a colour projector mounted on the roof of the simulator cabin. The picture is beamed on to a screen a few feet ahead of the cabin, and the flight deck and screen together move in harmony with the movements of the controls by the pilot.

The large vertical model landscape, 48 feet long and 13 feet high represents a rural scene with fields, hedges, woods, roads and small towns and villages. It is powerfully lighted by banks of tungsten lamps using some 180kW of electricity. The television camera is mounted on a gantry that travels on a railway track between the face of the model and the huge banks of glittering lighting reflectors.

A black and white monitor television screen is installed at the instructor's panel so that he can view the picture being seen by the pilot, and he can introduce drift to simulate cross-wind landings as well as determining the degree of visibility and the other conditions under which a landing is being made.

SIR IAN COMMENTS ON COLOUR

PHOTO shows Sir Ian Orr-Ewing, President of the Society of Electronic and Radio Technicians speaking at the 21st Anniversary Dinner of the Radio Trades Examination Board.

He said: "The decision on colour television cannot be postponed much longer. When a decision on the standards is given, the spread of colour will be extremely slow. It will be several years before 10% of the homes have a colour receiver.

The rest of the world is going ahead. Can Britain hang back and plead poverty whilst the USA, Russia, France and Japan all advance. I do not think we can opt out of colour television and disregard the civil and defence benefits from the colour techniques.

"The financing of colour television broadcasting may cause even more delays than the decision on colour standards".

SWEDISH TV RELAY TOWER

A TV relay tower costing £100,000 is to be built at Vaddo, in Sweden, to beam Swedish television programmes to the Finnish Islands of Aalund. The complete project is expected to take about two years.

A reciprocal plan by Finland to build a relay station in North Finland to beam programmes to Finnish-speaking areas of North Sweden is also being considered.

TV CONTRACT

THE contract for the supply of TV equipment to the Plymouth College of Technology, has been awarded to EMI Electronics (Broadcast and Recording Division).

The order includes a broadcast camera channel, and solid-state vision/mixing equipment with special effects facilities, as well as synchronising pulse generators and other items of test equipment.

TV VITAL TO DEVELOPMENT OF INDIA

THE importance of television in the future development of India was stressed recently by Mr. Y. A. Fazalbhoy, Managing Director of General Radio & Appliances Ltd., of Bombay. Use of television in the field of education, he thought, was the one vital way to improve the standard of living of India's growing population.

Mr. Fazalbhoy has just spent ten days in this country after touring Eastern Europe and has placed an order with Pye Limited for some 15,500 radio receivers to be manufactured at the National Ekco radio plant in Bombay. National Ekco is a company in which Pye of Cambridge Limited and Tata Limited are jointly interested. General Radio & Appliances Ltd., one of the largest distributors of electrical goods in India, have also undertaken to distribute the whole of this year's production of Pye and Ekco sets in India, an estimated 120,000.

SECAM DEMONSTRATED VIA EUROVISION

SECAM colour television was shown in London recently by the French company C.F.T. to demonstrate its compatibility and performance over long network links and magnetic recording media.

Originating in a studio in Paris of the French Broadcasting authority O.R.T.F., the signal was passed over a microwave link to the Lille Bouvigni transmitter. From there it was broadcast on channel 27 and picked up on a receiver at Tulsford Hill, Folkestone, and sent via the Eurovision microwave link to the BBC Television Centre in London, co-axial cable to the GPO TV switching centre at Mayfair exchange, and finally via ordinary telephone lines to the receiver, a total distance of about 350 miles.

REDIFFUSION SHOW WIRED COLOUR TV

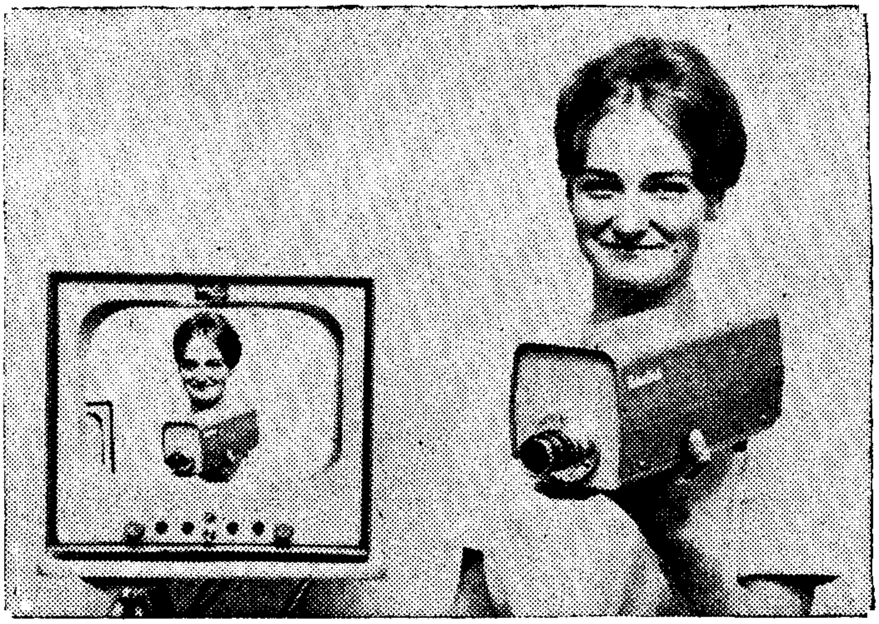
COLOUR TV by wire was a feature of the Rediffusion display at the 1965 National Housing and Town Planning Council's Conference and Exhibition at Scarborough last month.

A h.f. multi-pair wired TV and sound system demonstrated that Rediffusion networks can carry colour TV programmes without alteration to wiring or equipment. From a specially constructed studio, the colour signals travelled along 300 yards of cable to reach the network.

START OF BBC-2 IN SCOTLAND DELAYED

THE BBC regrets that the u.h.f. television transmitting station for BBC-2 at Black Hill, Lanarkshire, which it was hoped would be ready for service in December this year, cannot now be completed until the spring of 1966. This postponement of the starting date for BBC-2 in Scotland is due to cumulative delays in the construction of some of the other new BBC-2 transmitting stations. These delays have arisen because of bad weather conditions affecting work on high masts at exposed sites, and in meeting the particularly exacting requirements for some of the u.h.f. transmitting aerials.

BEULAH CCTV SYSTEM



THE photograph shows the new BEUVISION System which is a completely transistorised closed circuit TV system built to industrial standards. The "package deal" includes fully transistorised video television camera of completely new design, an f/1·9 25mm lens with fully adjustable focus and iris, an 8½in. transistorised monitor and 100 yards of co-axial cable.

The complete Beuvision system (camera and monitor) only consumes 45W. This enables the equipment to operate from low voltage supply, i.e., a car battery, using a small solid-state converter which can be supplied for 6 or 12V.

The price of Beuvision is £220 complete or £228 with a 14in. monitor. Beulah Electronics Ltd., 126 Hamilton Road, West Norwood, London, S.E.27.

International Conference on U.H.F. Television

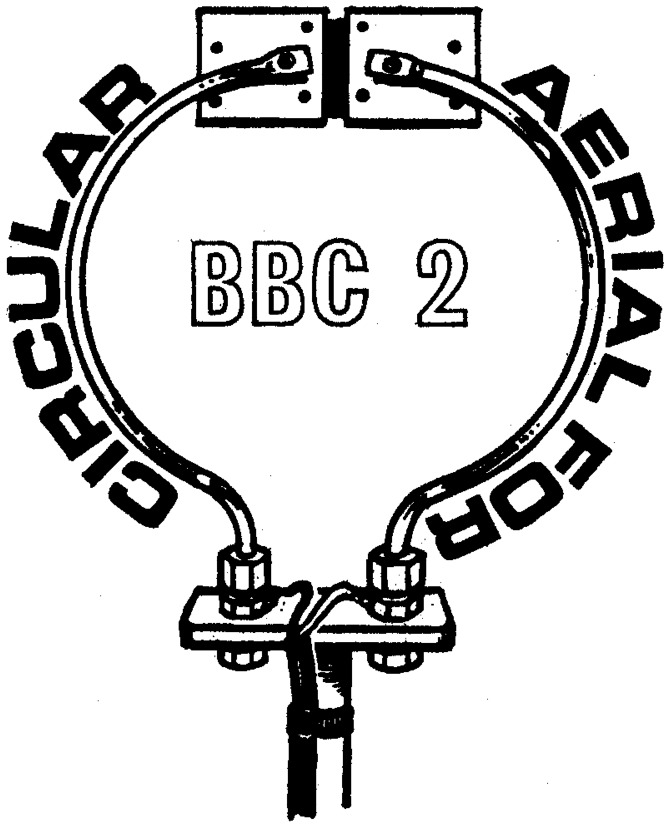
APPLICATIONS for registration forms, from 17 different countries have been received for the International Conference on u.h.f. television to be held in the Institution of Electrical Engineers building, London, on November 22nd and 23rd.

The two-day programme is based on 26 papers and contributions. The papers in the first Session are on planning and Propagation, the opening contribution being "Television Coverage on U.H.F." by Mr. F. C. McLean, the BBC Director of Engineering.

Session 2 covers Transmitters and Translators and includes papers by D. Ingle and G. C. Peel of Pye TVT on the design of the new high-power 25kW transmitters to be installed at Emley Moor and Winter Hill.

Two contributions of particular interest in Session 3, on Aerials, Feeders and Parametric Devices, come from Germany and describe the construction and testing methods for large diameter, low-loss continuous coaxial feeders, which have been developed for television masts of 1,000ft. and over, such as will be used at Emley Moor, Winter Hill and Sutton Coldfield.

The fourth and final session will be concerned with receivers and contains a paper by D. S. Grant of Associated Semiconductors on the design of transistors, with particular reference to television tuners and tuner design will be described by J. C. Beckley of Mullard.



A directional u.h.f. aerial for Bands IV and V in the form of a dipole with two semi-circular halves. Suitable for use in areas of high signal input.

by L. R. REPAGE

THE higher frequency, or shorter wavelength of Bands IV and V on which the BBC 625-line programme is transmitted allows conveniently smaller aerial sizes. In fact, in certain instances, small, compact set top aerials will work quite efficiently.

There are, of course, a few snags, such as interference in the form of "snow", and variations due to movements of viewers to and from the aerial, and such aerials do need very careful positioning in regard to the set itself. Its use is also really restricted to close reception areas a few miles from BBC II.

These small aerials can never, of course, be expected to give reception as efficiently as the highly placed standard aerial, but they are convenient where the temporary transfer of a set to another room is anticipated.

As will be seen, the aerial is in the form of the well-known Circular Aerial. It is directional, and needs to be rotated until the best reception is obtained. The aerial has been designed to allow a slight adjustment of diameter.

In the prototype, the top aerial assembly was intended to be easily rotatable in the pedestal, with the co-axial cable passing down the inside of the pedestal. However, the stiffness of the cable did not allow easy rotation, so the cable was strapped outside the tube support with tape. A higher stand or pedestal, could no doubt be arranged, using a standard lamp pedestal obtainable at good woodcraft shops. Electrical fittings are not required of course.

Construction

The aerial is formed with two equal lengths of standard ¼in. diameter copper tubing, the soft bendable type being chosen. About a 14in. length for each aerial element will be required, and this allows for the 1½in. straight section at the bottom.

The lengths of tubing (parts 1 and 2), are each bent over a hard circular object until the required curve is obtained. When placed 2in. apart, the two elements should form a circle of 8in. inside diameter. It is a good plan to describe a circle of 8in. diameter on a piece of drawing paper, to act as a guide when forming the elements.

These semi-circles are then gripped firmly in the brass couplings (3 and 4) which should be the standard used for ¼in. diameter tubing. Two ferrules are supplied with each coupling, but only the top ones for the aerial elements will be needed. The ferrules can be soldered to the tubes providing the nuts are first threaded on to the tubes.

The top ends of the tubes should be flattened in a vice for a ¼in.. and then drilled to take 4B.A. cheese head set screws.

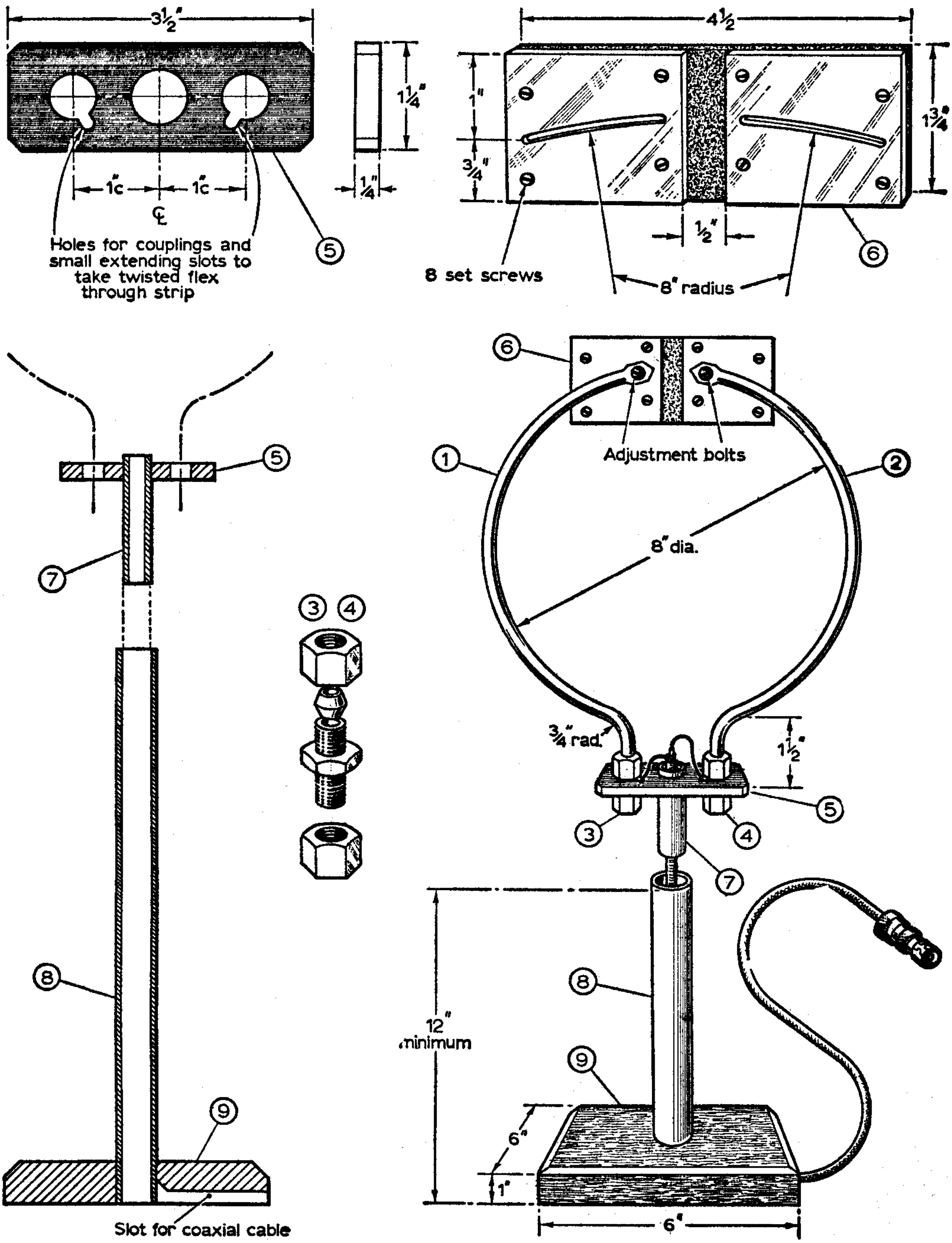
The bottom nuts of the couplings are used to fix the tube elements to the paxolin strip (5).

The construction of this strip is self explanatory. If ¼in. paxolin is not obtainable, perspex could be substituted, but more care is required when nuts are tightened. Perspex is, of course, one of the best insulators.

Adjustment Panel

The top adjustment panel (6) was really a temporary experimental idea used by the author whilst trying out different diameters for the aerial, and it could well be simplified. This panel was formed by fixing a pair of aluminium plates on to a paxolin panel with eight small set screws, the plates being spaced about ½in.

Two oval shaped slots, ⅛in. wide, were then cut right through the metal and paxolin as shown. These slots should allow the two tubes to slide



Constructional details of the prototype circular u.h.f. aerial described in the text.

easily along the plates though making contact with the metal all the way. It will be noted that in effect, each metal plate virtually increases or decreases the effective tube length according to the position of the bolts in the slots.

This adjustment of diameter of the aerial is only small and dependent upon the lengths of the slots. This panel could be lengthened but a certain limit will be reached. Bending slightly at the bottom curves will be found unavoidable and re-adjustment of the true circles needed for appearance will be found necessary, although a slight irregularity of circle should not affect results by any amount.

The Pedestal

The pedestal itself was made from light ⅞in. diameter paxolin tubing and the base cut from 1in. thick oak. A central hole was drilled to give a push fit to the tube, a slow setting glue giving a final firm fixture.

A good weighty base is necessary, otherwise the aerial is likely to be top heavy. The prototype was found lacking in this respect and needed weighting, therefore a much heavier base has been shown in the drawing. The underside can be covered with some non-scratch material.

The co-axial cable can be threaded through the tubing of the pedestal, or if desired can be strapped to the side by tape. This cable should be as short as possible. Important too is the use of low loss type of cable. The centre core should be of stranded wire, which incidentally is more flexible than the solid wire type. Always take great care in fixing the co-axial plug. Some designs of these plugs are rather lacking in providing good contact of the braided screen to the outside metal sleeving of the plug. Tests before plugging into the set can be simply carried out with a length of flex, a flashlamp and battery.

It would be impossible to solder connections from the co-axial cable direct to the couplings. Therefore the author twisted a length of bared flex around the groove in the couplings and passed it through the small slot adjacent (see 5). The braiding of the cable was also twisted around with flex, and then soldered to one of the aforementioned wires. The central core of the co-axial cable goes to the other element.

Performances

Various tests were made with the aerial. On a set 20/25 miles from London in Essex, only a slight signal pick up could be detected and no picture obtainable. A standard 625 aerial was also tried in the room but this, too, gave no picture. So at this distance for 625 reception a standard external aerial fixed to the highest point seems essential. In London, however, a few miles from BBC-2 an excellent picture was obtained immediately. The aerial position in relation to the set was found to be quite critical, and the best position was slightly to the rear and to one side of the receiver.

Directional properties were quite sharp. Interference in the form of "snow" could not be cured by direction or position, although it was not too worrying, moving one's hand to within 6in. of the aerial immediately affected reception.

Shortening the elements of the aerial at the top did not seem to affect reception markedly although directional properties were less.

Constructional Diagram

The drawing shows the aerial and its parts. The length of the pedestal tube has been shown foreshortened for purposes of block reproduction size. Parts 1 and 2 are the aerial tubes, 3 and 4 the brass couplings which fix the tubes to the strip 5; 6 is the adjustment panel, 7 is the paxolin tube swivel shank, fitting within the main pedestal tube 8. Base of pedestal shown at 9.

LIST OF MATERIALS

¼in. dia. copper tubing (soft) 3ft. length, 2 Standard couplings (brass) for above. $\frac{1}{16}$in. Paxolin sheet cut to 4½in. x 1¾in.

Aluminium sheet $\frac{1}{16}$in., 4in. x 1¾in. 12in. length of ⅞in. tubing (cardboard or Paxolin), piece of 1in. oak 6in. x 6in.

¼in. thick Paxolin sheet, or Perspex 3½in. x 1¼in.

Co-axial cable—low loss type. 36in. Plug to suit set.

4in. length of Paxolin tube to fit into ⅞in. ditto.

8 small set screws and nuts, say 8BA.

2 4BA set screws and nuts.

Some good thick flex for connection to couplings. ◻

IS YOUR TV REALLY SAFE

Conductor Spacing

Conductor spacing should always be generous between points of high potential in order to prevent tracking occurring and thus causing overheating. The following clearances are suggested as a guide to good practice:

Up to	30V	2·0mm.
„ „	400V	3·0mm.
„ „	500V	4·0mm.
„ „	750V	5·0mm.
„ „	1,000V	6·0mm.

Choosing Insulating Materials

One of the simple arts of ensuring good protection from fire is to choose the right sort of insulation and supporting materials throughout the whole chassis and its components. The main difference between the two special test receivers mentioned earlier in this article was that the first one used ordinary materials, whilst the second used materials chosen for their non-inflammable properties. Try to avoid using the following materials except in small quantities:

- Ordinary polythene (it burns like wax),
- Wood-filled phenolic resin mouldings,
- Waxes for impregnating coils and transformers.
- Wood.
- Paper.
- Components with an inflammable lacquer.

Use the following materials instead:

- Flame retardant polythene (for e.h.t. insulation).
- Flame retardant SRBP.
- Ceramic.
- PVC.
- Non inflammable plastic foil for coil interleaving.
- Air spacing.
- Non-flame safety resistors etc. (especially for h.t. decoupling).

Another reason for keeping to reasonable temperature limits is that some flame retardant materials tend to lose their properties after prolonged periods at high, but otherwise safe, temperatures.

By A. G. Priestley — Part 3

C.R.T. Implosions

It is very rare indeed for a c.r.t. to implode, and in fact there are probably only a few instances in the whole country in any given year. One such case came about with the aid of an angry husband and a 12 bore shotgun, whilst another involved the use of a sledgehammer. However, spontaneous implosions do occur from time to time, and so we must take adequate precautions. After all, every square inch of a c.r.t. has a force of about 14·7 lbs pressing on it, and so a lot of energy is involved, and large chunks of glass can be hurled considerable distances.

The cabinet and backplate of a well made receiver provide satisfactory protection from the sides and rear, but special precautions must be taken to prevent glass from coming out of the front. This is normally achieved by placing a tough transparent guard over the faceplate, or screen, of the c.r.t. The guard is normally made of glass or rigid plastic, and the common types are illustrated in Fig. 16.

When choosing a guard make sure that it is made of plastic or toughened glass made specially for the purpose, and of adequate thickness. Plate glass will *not* do. Furthermore, simply placing a guard in the front of the cabinet over the screen of the c.r.t. is not enough. The same guard fixed in several different cabinets will give good protection in some, and be largely useless in others. The implosion energy liberated is so great that care must be taken to mount the guard properly.

BS415 specifies that 12 c.r.t.'s be imploded in a cabinet, and in no case may pieces of glass be projected more than one foot in front of the cabinet, even if the guard itself breaks. Readers can hardly be expected to carry out this test themselves, but attention to one or two simple points will help to provide a greater margin of safety.

Probably the most important item, having first obtained a guard of good quality, is to make sure

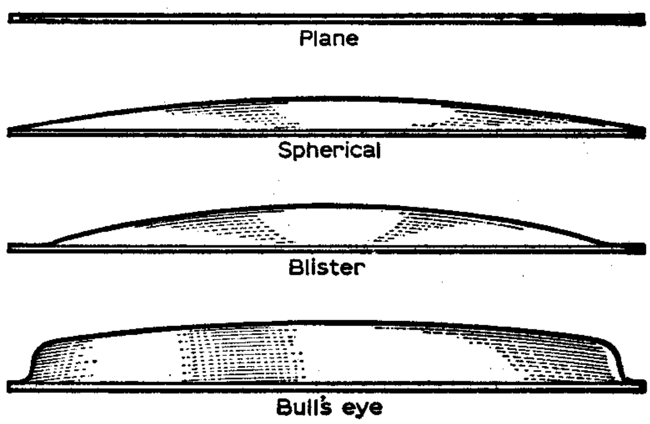


Fig. 16—Implosion guards.

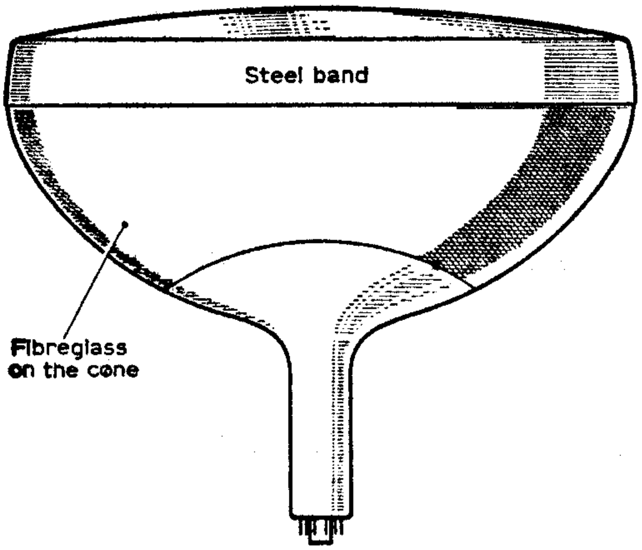


Fig. 17—An implosion safe c.r.t.

that it is adequately and evenly supported all round its periphery. In the case of plane or blister guards the glass or plastic should have a supporting margin of at least ⅜in., and it should be in evenly stressed contact all round.

Curved guards are normally supported by a plastic moulding, and this too should provide even support all round.

Bulls eye guards used with "push through" styling presentations are generally fitted with a lug at each corner, and good support must be provided for them in the cabinet. In all cases it is important that there is a clearance of about a ¼in. between the c.r.t. and the inside surface of the guard, whatever type is used.

It goes without saying that it is no use mounting the guard with great care in the front of a cabinet which has been poorly constructed. The front panel is commonly made of plywood, which has a certain inherent flexibility, and this must be securely fixed all round the edges to the front opening of the cabinet carcass. Either let the front panel into grooves in the sides, top and bottom of the cabinet, or else use a continuous line of screwed glue blocks, or a batten. The c.r.t., being heavy, is best supported independently if this is possible.

Incidentally good dust sealing between the c.r.t. and the guard is essential if frequent cleaning is to be avoided. This problem should be tackled as part of the whole design of the front part of the cabinet and c.r.t. assembly.

Two more types of c.r.t. protection remain to be dealt with. The first of these is known as a Cornehl hood. This is a thin but tough transparent plastic membrane stretched tightly over the faceplate of a c.r.t. and clamped in place with a steel band. This band is usually used for supporting the tube as well. The hood provides good protection and excellent dust sealing but causes a slight loss of picture detail due to scattering of light in the plastic. The edges of the guard should be restrained by steel clips which pass through the holes provided at the edges of the hood, and are then secured to the steel band. If an implosion occurs the hood will stay more or less in place, even if the clamping effect of the band is lost as the tube collapses. The hood must be in close contact with the glass all over the face of the c.r.t., and fitting will be greatly facilitated if the guard is first gently warmed in front of a fire or a fan heater.

Figure 17 shows a new type of c.r.t. which is inherently implosion safe, and so needs no extra guard. Incidental, but important, advantages of this type of tube are that saving in weight, the reduction of overall front to back dimension of the receiver, and an improvement in picture quality. The latter comes about because two extra air/glass or air/plastic interfaces are avoided, less light is scattered, and so the picture contrast is improved in areas of fine detail. It is safe to predict that this type of tube will soon be in almost universal use amongst setmakers.

The theory behind this form of protection can be described simply as follows. The pressure of the air is forcing the screen and the cone towards each other evenly all over, and so most of the glass is in compression. The edges, however, are being forced outwards, and so are in a state of tension. If a steel band is placed around the c.r.t. near the faceplate to cone weld line the edges are restrained, and the tube is much less likely to implode. A A resin bonded glass fibre coating on the cone completes the protection, and makes these tubes thoroughly safe. The glass may crack if hit with a hammer but no implosion occurs.

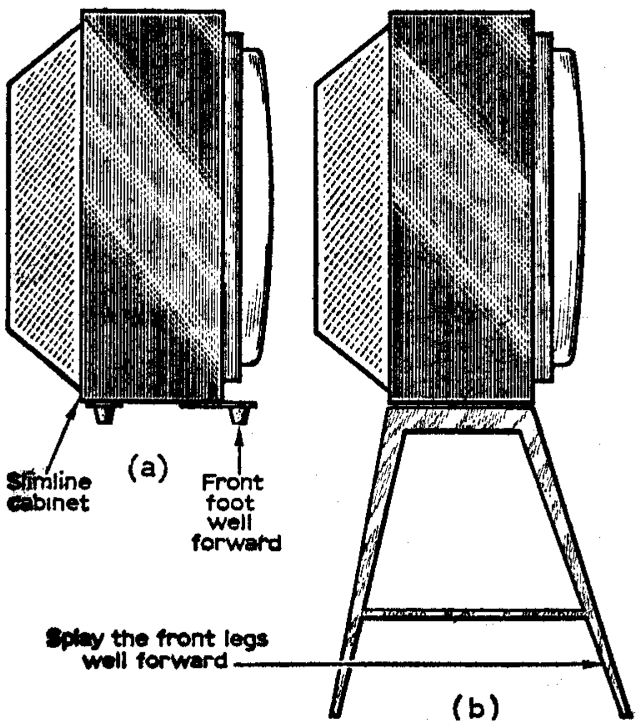


Fig. 18—Improving cabinet stability.

Handling C.R.T's.

When removing or installing c.r.t.'s always be careful to avoid holding them by the neck. Hold them around the edges of the faceplate instead. Before lifting a tube out of its carton, or from a receiver, make sure that you have a soft non slip surface nearby to put it on. This not only reduces the possibility of dropping it, but it also prevents the faceplate from becoming scratched. Scratches

—continued on page 127

Checking Performance

G. K. FAIRFIELD

OF EXPERIMENTAL RECEIVERS

MANY readers will have constructed their own television receiver and find difficulty in making the various specialised measurements that are necessary if the performance of the receiver is to be thoroughly known and checked.

Television manufacturers have their own methods and test apparatus for making measurements (some of which is extremely complex). While these satisfy the needs of mass-production, the methods used are by no means applicable to the requirements of the experimenter who may have little equipment although a great deal of enthusiasm!

Quite a lot can be accomplished however with a little ingenuity coupled with some fairly simple equipment. Several useful checks are described below, including a number covering that very difficult region of measurement — the television line scanning circuit.

The E.H.T. Diode

In the majority of modern line scanning circuits the e.h.t. for the cathode ray tube is derived from the rectification of high voltage pulses developed across the line output transformer. Since the e.h.t. potential may lie anywhere between 10 and 20 kV, the designer is faced with the problem of providing a sufficient well-insulated heater supply for the rectifying diode. This grade of insulation cannot be obtained easily with the average mains transformer design and the solution to the difficulty is to wind a few turns of polythene covered wire around the ferrite core of the line output transformer itself. (See April, 1964, issue of *Practical Television.*)

The problem then is, "How many turns?" The induced voltage is not a simple sinusoidal waveform but a series of narrow pulses occurring between relatively longer intervals. Another question arising with multi-standard sets is, "What will happen when the number of lines is changed from 405 to 625?" We will need to check that the heater power does not go outside the limits set by the valve manufacturers or the rectifier could have a very short life indeed.

The receiver designer in a factory would use a sensitive (and expensive) hot-wire ammeter to measure the power developed in an equivalent load resistance to that of the rectifier filament or heater. We must adopt a simpler technique. Fortunately we can make use of the fact that for a fixed anode-cathode voltage the anode current flowing is very dependent upon the heater power. If we disconnect the anode of the rectifier from the e.h.t. overwind and connect it instead to a low voltage supply (say 50 volts) in series with a resistance and a milliameter, as shown in Fig. 1, then, upon switching on the line scanning circuit a certain reading will be obtained on the meter. This reading can be noted and its value for maximum and minimum scan and (where applicable) 405 and 625 line working observed.

Next a d.c. supply from a battery is used for the heater supply, still retaining the battery h.t. supply and variable resistor (see Fig. 2). As we vary the heater supply voltage by means of R1 then the anode current flowing is seen to vary. It is only necessary to adjust this current in turn to each of the values noted previously for the heater power, ie, product of Ih, and Vh to be determined, for each of the limit conditions set up earlier. The power provided at the rectifier filament will be exactly the same for the pulse-driven and battery-driven conditions, provided the anode current is kept constant. This is due to the fact that the energy supplied is the product of the voltage and current averaged over a long period of time, as can be seen roughly by eye, since the brightness of the filament is the same in both cases.

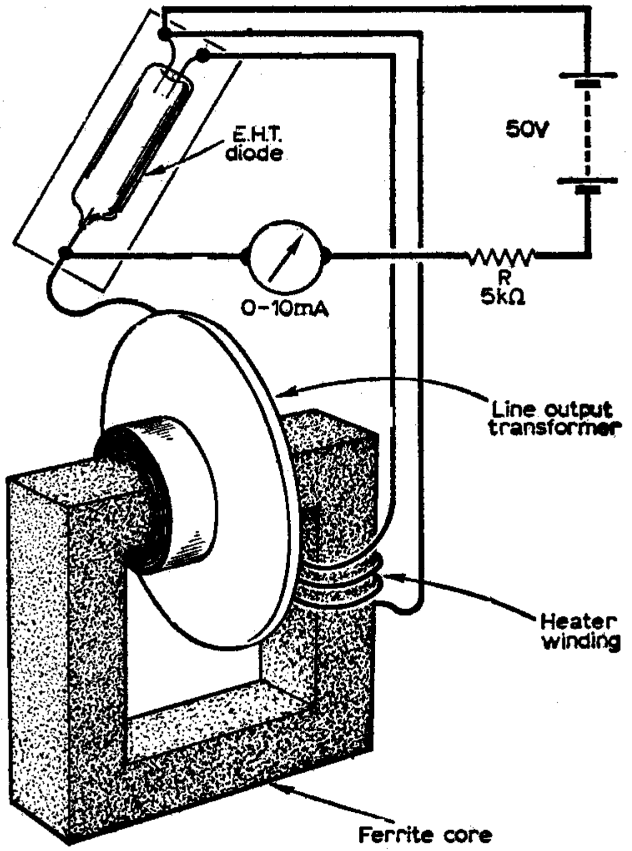


Fig. 1—E.H.T. diode measurement under operation conditions.

Operation of the Line Output Valve

The power output valve used to drive the line scanning coils via the output transformer dissipates a sizeable fraction of the total power supplied to the television receiver. The question is, "How much power?"; for overdissipation outside the maker's maximum ratings would lead to frequent valve replacement.

Unfortunately the pulse nature of the anode current and voltage waveforms prevents us from placing d.c. meters in these circuits and calculate their product, Ia, Va. A.c. meters are out of the question since these are designed and calibrated for sinusoidal waveforms of much lower frequency. We could, of course, use an oscilloscope and measure the products point by point over the entire waveform. The square root of the sum of these products would have to be taken and the whole turn out to be a very laborious and not very accurate method. Once again the manufacturers methods are of little value to the experimenter.

The "professional" method is to use a small hooded thermopile, which receives a fraction of the heat radiated from the valve under running conditions and produces a current proportional to the power dissipation within the valve. The valve is then operated under d.c. conditions with its anode taken directly to an adjustable h.t. supply and its value varied until exactly the same thermopile reading obtained as in the operational case. The power dissipation may then be derived from the product of the anode current and supply potential.

The Thermocouple

A somewhat similar method could be employed, but using a much simpler arrangement in place of the thermopile. This is the thermocouple shown in Fig. 3. It consists of two lengths of copper wire between which is connected a length of Constantin or Eureka wire. If one junction of the copper/constantin wires is kept at a constant temperature, away from the source of heat, then the application

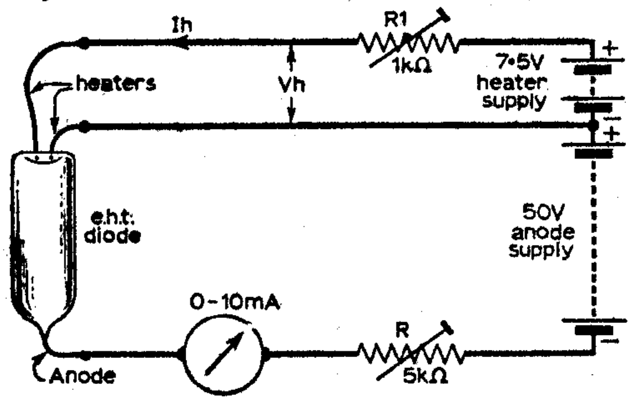
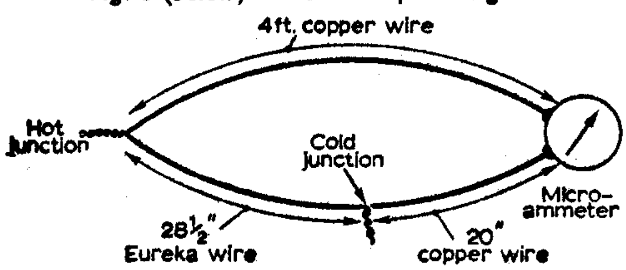


Fig. 2 (above)—E.H.T. diode static measurements.
Fig. 3 (below)—Thermocouple design.



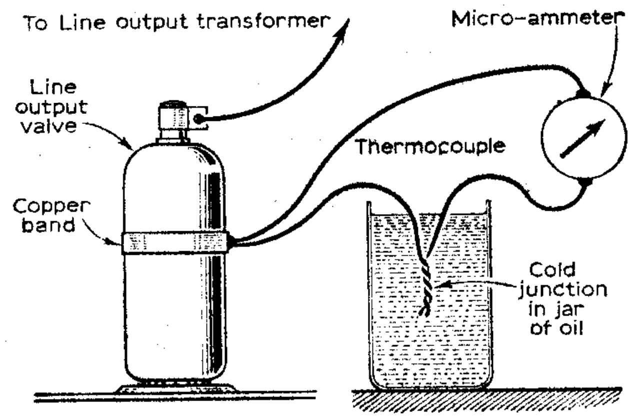
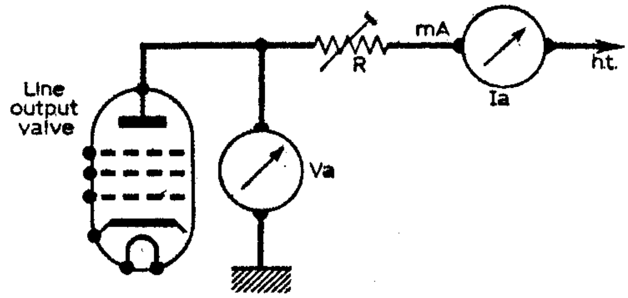


Fig. 4a (above)—Operational measurement and (b) below, static measurement of line output valve.



of heat to the other junction will cause a small current to flow which will be proportional to the rise in temperature of this second junction with respect to the first.

This current will be quite small, in fact only 0·66μA per degree rise Centigrade with the values given in Fig. 3. Many experimentrs may already possess a suitable microammeter for this purpose. It is possible to make use of a transistor current amplifier in order that a less sensitive meter be employed. I hope to describe in a later article, a suitable amplifier which will enable a more robust milliammeter to be used for this purpose. To use the thermocouple in the measurement of anode dissipation, the following technique can be applied: The "hot" junction of the thermocouple is soldered to a copper strip or several turns of bare copper wire wrapped around the valve envelope, as shown in Fig. 4a. The cold junction can be placed in a small jar or test-tube filled with oil, and the free ends of the thermocouple connected to the microammeter or transistor amplifier.

The valve is then operated under normal line scanning service and after about 10 minutes of operation the reading of the microammeter should have stabilised and this can be noted. It is also necessary to measure the screened grid dissipation, since this must be maintained constant for our test measurement. This presents no difficulty since pulse waveforms are not involved and d.c. meters can be used.

At the end of this period the set is switched off and the valve anode lead transferred via a variable resistor, R, and a milliammeter directly to the h.t. supply, as shown in Fig. 4b. At the same time a voltmeter is connected between anode and chassis terminals. Power supply to the line output valve is again applied and the anode potential adjusted by variation of resistor R, until the same reading of the thermocouple microammeter is obtained.

Once again a lag of 10 minutes must be allowed until the valve reaches operating temperature. It is also necessary to check that the screen dissipation is unchanged and it may be necessary to modify the screen feed resistor to bring this back to the original running condition noted previously. Having achieved the required conditions of screen dissipation and thermocouple meter reading the values of Ia and Va can be read off and their product will give a value of anode dissipation reached under normal running conditions.

This measurement is rather a " sluggish " one to make since an adjustment to R will be followed by a change in microammeter reading only after a few tenths of seconds and some patience will be required to arrive at the correct value. Once obtained however and assuming this to be below the maximum allowed by the maker for the valve, one will have the satisfaction of knowing that its life will not, at any rate, be prematurely shortened by over-dissipation! Also, as we shall see later, the thermocouple has other uses in television receiver measurement.

Linearity measurement

Having checked the operating conditions of the line output valve it may be required to check a performance characteristic, namely that of picture linearity. The BBC or ITV test cards are, of course, invaluable here, and if a pattern generator is available this too will give a useful indication of circuit performance. However, as experimenters, we will probably want to measure this performance characteristic accurately and in such a way that it may be compared with other circuits we have constructed. To do this some form of ruler is required and a method of avoiding parallax error, which is due to the thickness of the glass screen and implosion guard.

A simple form of linearity measuring device is shown in Fig. 5. To avoid the parallax error the instrument is constructed rather like a travelling microscope and consists of two parts; a graduated scale about 50cms long, and a metal sleeve carrying an eyepiece, which is free to travel along the scale. The eyepiece is a tube about 3 inches long, containing a piece of perspex at either end upon which are engraved crossed lines. In use the measurements are made at the point of alignment of the centre of the crossed lines so that the viewer is always looking exactly at right angles to the screen. In order that the device may be brought quickly into use and to dispense with cumbersome mounting arrangements, two rubber " suckers " are fitted about 9 inches apart on the back of the graduated scale. The instrument may then be " stuck " on the face of the tube or implosion guard and enable measurements to be taken quickly and accurately.

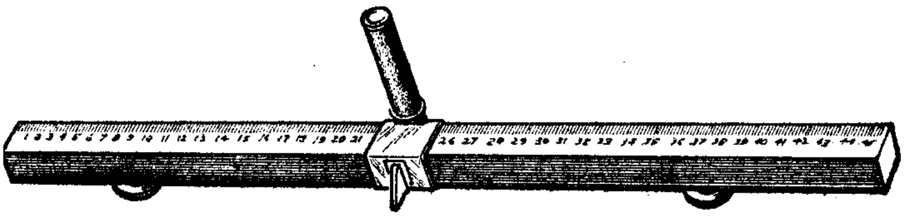


Fig. 5: A simple linearity measuring instrument. The scale may be made by marking out a long piece of white card with Indian ink and attaching it to the instrument with a strip of Sellotape.

If we want to express the measurements as a single figure for comparison purposes we can make use of the formulae:—

$$\text{Non-linearity} = \frac{200\,(a - b)}{a + b}\ \%$$

where " a " is the width of the widest bar or test-card square we have measured and " b " is the width of the narrowest bar measured.

Alternatively we can plot the non-linearity as a graph showing the percentage of departure from the width of the bar in the screen centre. Next month I will discuss other receiver measurements which can be made with simple equipment, including r.f. alignment and further temperature measurements.

(TO BE CONTINUED)

DX-TV

A MONTHLY FEATURE FOR DX ENTHUSIASTS

by Charles Rafarel

I AM delighted to say that the " depression " that has spread over us in the last two months has lifted and DX-TV is really " back in business " again.

Conditions have improved enormously, and this has applied to Sporadic E as well as to Tropospheric propagation, so I will deal with conditions in that order. Firstly Sporadic E:—

We have been waiting patiently for a late opening, and we know from previous years that this is possible in October or even later. This year has produced one all right; dates and results below, as received here in Bournemouth.

30/9/65: R1 USSR, R2 Bratislava, R2 USSR, E2a Jauerling Austria, E4 Patscherkopfl Austria (a rare one), E2 Grünten W. Germany, IA RAI Italy, IBRAI Italy.

4/10/65: E2 and E4 TVE Spain.
5/10/65: R1 USSR.
6/10/65: E2 and E4 TVE Spain.

This is not a brilliant opening, but it does at least show that Sporadic E is not yet over for this season! The really good news is the early and excellent advent of the awaited Tropospheric opening. This came up so suddenly that it caught me " on the hop "; I was away on the Continent for the best part of this opening, and only saw the very end of it. For this reason, I am mainly going to quote the results of two DX readers—**R. Bunney** of Romsey, and **J. Snelling** of Southampton.

When you read what was achieved by them in September/October I am sure you will agree that the results were most praiseworthy, and that we must once again take a look at the original idea that the " ceiling " for Tropospheric reception was a maximum of about 500 miles. The period covered 19-24/9/65 and the reception by R. Bunney is as follows:—

Band I: E4TVE Bilbao-Sollube Spain, received over a period of four days as a typical steady Tropospheric Signal Distance—540 miles.

Band III: E5, Inselberg, East Germany. E6, Koblenz, West Germany. E7, Heidelberg, West Germany. E8, Feldberg, West Germany. E9, Langenberg, West Germany. (I too had this on 9/10/65.)

U.H.F.: Ch.21, ORTF, France (? Brest). Ch.22, Wupperthal, West Germany. Ch.24, Aachen, West Germany. Ch.25, Dortmund, West Germany. Ch.26, Bonn, West Germany. Ch.27, Heidelberg, West Germany. Ch.28, Boppard, West Germany. Ch.28, ORTF, France, Clermont Ferrand. Ch.29, ORTF, France, Nantes. Ch.32, Saarbrücken, West Germany. Ch.33. ORTF, France, Rouen-de-Couronne. Ch.34, ORTF, France, Metz Luttanges. Ch.43, ORTF, France, Le Havre. Ch.51, BBC, Wenvoe.

On 4/10/65 (good opening to the north as well):—Band III: B8, Burnhope. B10, Black Hill. B12, Winter Hill. B13, Ceikirk. F7, ORTF, France, Le Havre (low power relay). F4, ORTF, France, Nantes. E6, Brocken, East Germany. E9, NRK, Bergen, Norway, just over 700 miles!!! F11, ORTF, France, Amiens-Bouvigney.

U.H.F.: Ch.24, ORTF, France, Troyes-les-Riceys.

J. Snelling during the same period had a number of the above, and also the following:—

R10 Pzlen (Pilsen) Czechoslovakia, 625 miles Band III. Ch.31 Dresden, East Germany, 670 miles u.h.f.

Those against which I have noted the mileage are of course exceptional particularly the E4 TVE Sollube DX tropospheric in Band I, pretty rare at this distance, and of course Bergen and Pzlen put our ceiling very much over 500 miles. Finally the u.h.f. Dresden DDR indicates as I have suggested before that u.h.f. is well capable of considerable distances for DX reception.

While all this was going on, yours truly and his wife were basking in the sun on the observation platform of the TV mast at the Heidelberg transmitter, and feeling well pleased with life, he dropped a Post Card showing the mast to our Editor, and casually remarked that being such a lovely day he hoped that the signals were reaching England! Many true words are spoken in jest, for that was both the day and the hour that in fact Heidelberg E7, Ch.27 were roaring into Southern England, and we were at the opposite end of the link on this occasion!!!

These early openings, I hope, augur well for the coming tropospheric season, and by all laws of average we should be getting better conditions, and we look forward to hearing more of your DX successes, particularly in Band III, and u.h.f. and I hope too that you have profited from the recent openings.

NEWS

NRK Norway: Just for the record the following stations are now operating and have been received here:—

E2 Gulen 8kW. Location 05·09·30E and 61·02·01N.

E3 Gamelsveten 30kW. Location 06·19·06E and 62·34·32N.

E4 Bremanger 30kW. Location 04·59·39E and 61·52·29N.

With reference to my earlier comments re ORTF Strasbourg F5, I confirm the poor height and location of the mast which I have seen for myself during my recent visit to the town, it is only some 300ft. high, and is situated near the town centre, so the suggested resiting that I mentioned earlier should eventually help us.

READERS' REPORTS

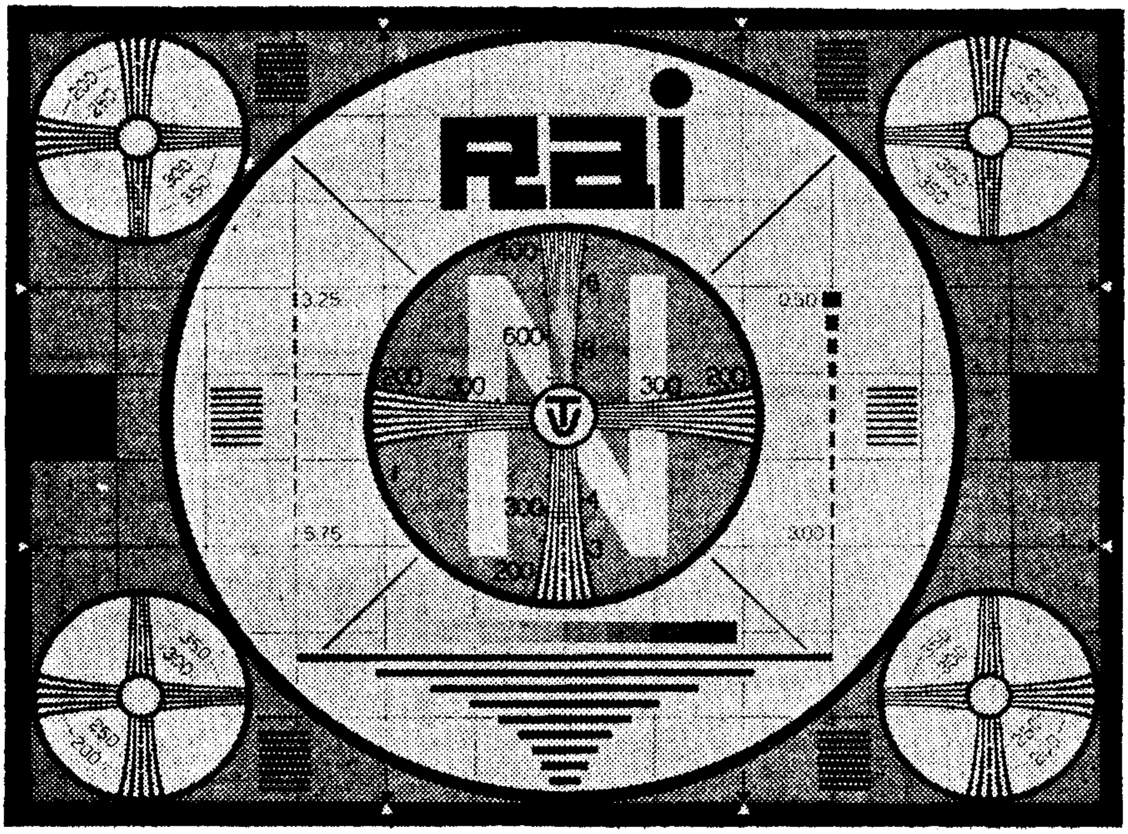
Edward Baker, of Whitley Bay, has turned in a very good log covering 14 countries including the following:—

E3 Kreuzberg, West Germany.
E5 Aalberg, Denmark.
E6 Oere, Norway.
E4 Stockholm, Sweden.
IB RAI, Italy, Mte Penice?
E2 Ruiselede, Belgium.
E3 Tervola, Finland.
E3 Coimbra, Portugal.
E3 TVE, Zaragossa? Spain.
F2 ORTF, France, Caen?
E4 Lopik, Holland.
E4 La Dôle, Switzerland
and U.H.F. Ch.26 Lingen, West Germany.

C. F. Wilson, of Potters Bar, reports reception of my " mystery " white cross test card on R1, so I was not seeing things after all! We still do not know where it came from. He has also had France F2 Caen, RAI Italy on IATVE on E2, E3, and E4, and Portugal Coimbra on E3, so once again our best wishes for future success!

J Kelleher, of Macroom, Eire, has sent us photos covering USSR, Czechoslovakia, West Germany, Spain, Poland/Hungary, and reports of reception of Sweden, Switzerland, and France, so the DX has been good in Eire recently.

DATA PANEL-4 RAI ITALY



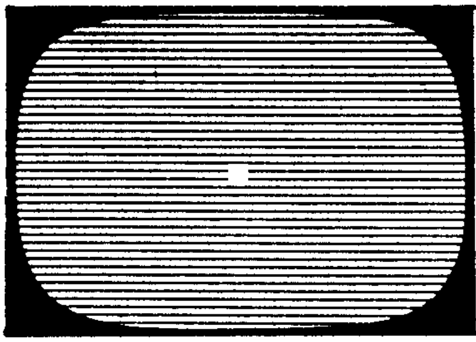
Test Card—as photo. Test card for second proprogramme (UHF) is identical except that the centre 'N' is replaced by a 'Z'.

Channels. RAI on Ch IA, and IB are often well received over here and occasionally reception is possible on Ch IC in Band II as well.

Do not forget to try and read the small number in the centre of the top right-hand corner circle of the test card, which indicates the exact station. To recapitulate on these numbers:

3=Mte Penice Ch IB. 11=Mte Faito Ch IB. 14=Mte Caccia Ch IA. 23=Mte Cammarata (Sicily) Ch IA. 31=Mte Nerone Ch IA.

Transmissions. Times of test card in the summer season are "working days" from 10.00-12.00, and 15.00-18.00, and 15 minutes before each group of programmes, programmes normally start at 18.30. Winter Test Card schedules are 15.15-18.00 only, there are schools broadcasts normally in the mornings and afternoons, evening programme starts as above usually at 18.30.



Servicing TELEVISION Receivers

by L. Lawry-Johns

No. 120: The Decca DM3/C serial No. 50,001 onward

THESE are completely different receivers from the earlier DM3-DM4 etc., series dealt with in the December 1958-January 1959 issues.

We are presenting this article because many readers have applied to advertisers for a service sheet and have only been able to get information relating to the early version, which is of little use to them.

Brief Description

A 17″ 90° deflection angle MW43-80 tube is used with a closed loop sleeve on the tube neck serving as a line linearity control. Flywheel line sync is employed, which helps to stabilise the picture horizontally in areas of weak signal and areas plagued by multi path signals—reflecting surfaces—factory chimney stacks, hills and other sources of " ghosts ". As is well known, reflected signals can completely ruin reception, causing the picture to break up into horizontal bands according to the white signal content. Flywheel line sync helps to overcome this distressing condition, although the ghost images remain, of course, these only being removed by careful siting of a multi-element aerial.

Where it is not practical to use a multi-element aerial, a single dipole can sometimes be arranged horizontally (where it would normally be vertical) and rotated to present a non-receptive end tip to the reflecting source.

However, to return to the receiver in question!

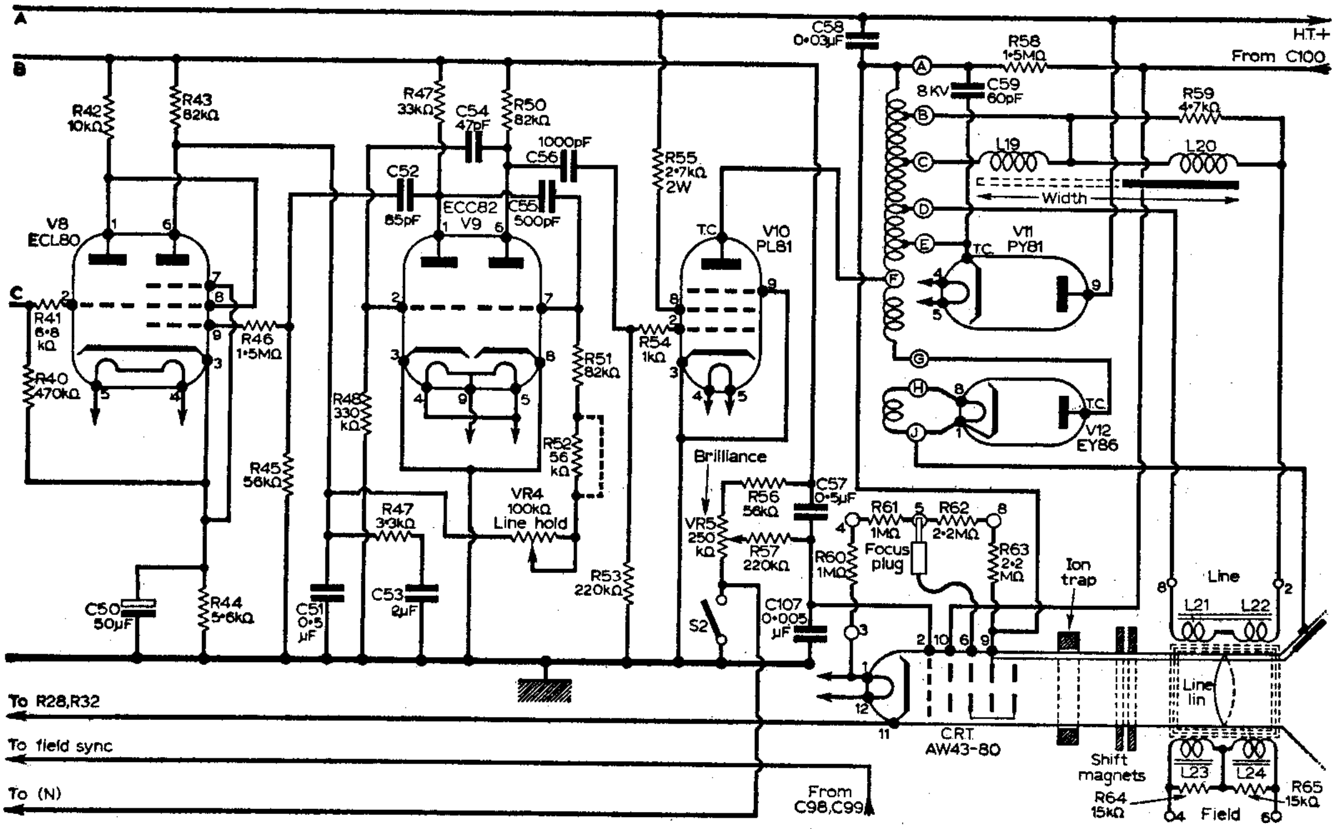


Fig. 1—Line timebase and c.r.t. circuitry.

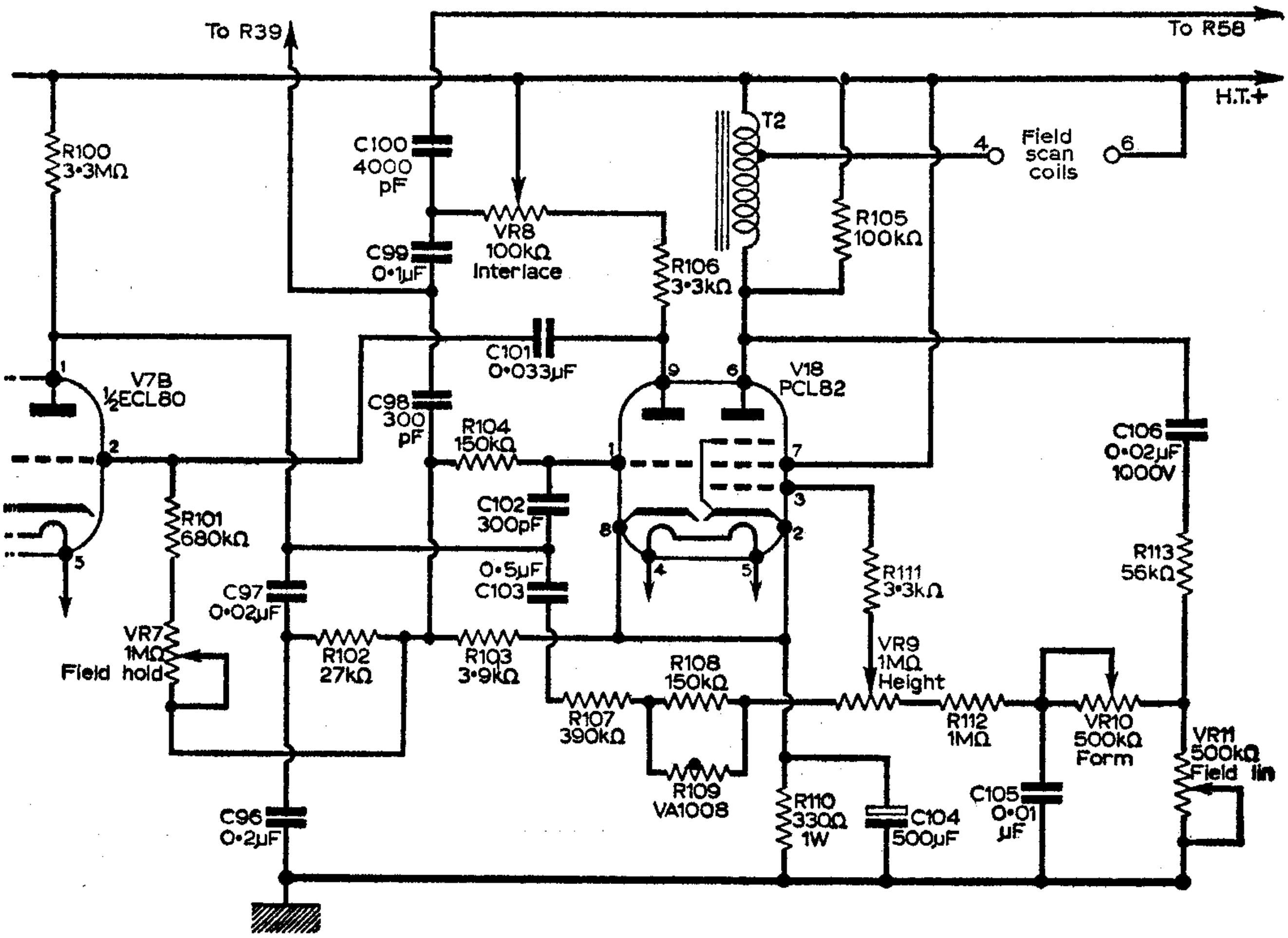


Fig. 2—Field timebase and associated circuitry.

Two PCL82 valves are used, one as the audio-output valve, the other as part frame (field) oscillator-output. The line oscillator is an ECC82, used as a multivibrator whilst two ECL80 valves function respectively as flywheel line sync discriminator and sync separator—part frame oscillator. The other two valves on the right side of the chassis are the two h.t. rectifiers (PY82).

The centre compartment houses the PL81 line output valve, the PY81 efficiency diode and the EY86 e.h.t. rectifier on the side of the line output transformer frame. On the other side of the chassis is a common i.f. amplifier, followed by a vision i.f. and a sound i.f. amplifier, all three being EF80's. There are two EB91's, one of the sound detector and limiter, the other performing the same function in the vision strip. This latter is followed by a PCF80 video amplifier-cathode follower. The tuner unit, which has the coil biscuits arranged for convenience of switching, i.e. 9 being next to 1, 10 being next to 2 etc., has a PCF80 at the front, PCC84 to the rear.

There are no small metal rectifiers or crystal diodes in the circuit. Of the fuses, of which there are two, one is a 1A in series with the mains live lead, the other is in the h.t. circuit (500mA). A thermistor (marked R76) is included in the heater chain between the PY81 and PCL82 heaters, and is a VA1015.

Common Faults

The faults to he expected are of a different nature to those usually encountered in the earlier version, which in the writer's opinion was one of the most reliable and most predictable of receivers, in addition to its ease of service qualities. This modified model with its refined timebases ran into a little trouble because of them, and the more flimsy front controls.

The rather troublesome PCL83 used in the earlier audio-output stage has been replaced by the more reliable PCL82 but even this, despite its enhanced power qualities, has not proved as reliable as the original versions, which used an ECL80.

The Line Timebase

Loss of line hold is frequently encountered, but this is usually put right with a replacement ECC82 line oscillator. Loss of sync is often caused by the 50μF 50V electrolytic, which decouples the cathode of the flywheel sync ECL80 and the sync separator screen grid (pin 8) becoming o.c.

Failing width often denotes a low emission PL81, whilst no picture at all is most often due to complete failure of this valve, the line whistle being almost completely absent in this case. When the line whistle is audible, check the EY86 e.h.t. rectifier. The screen feed resistor, 2·7kΩ, does not give as much trouble as the 4·4kΩ used in the

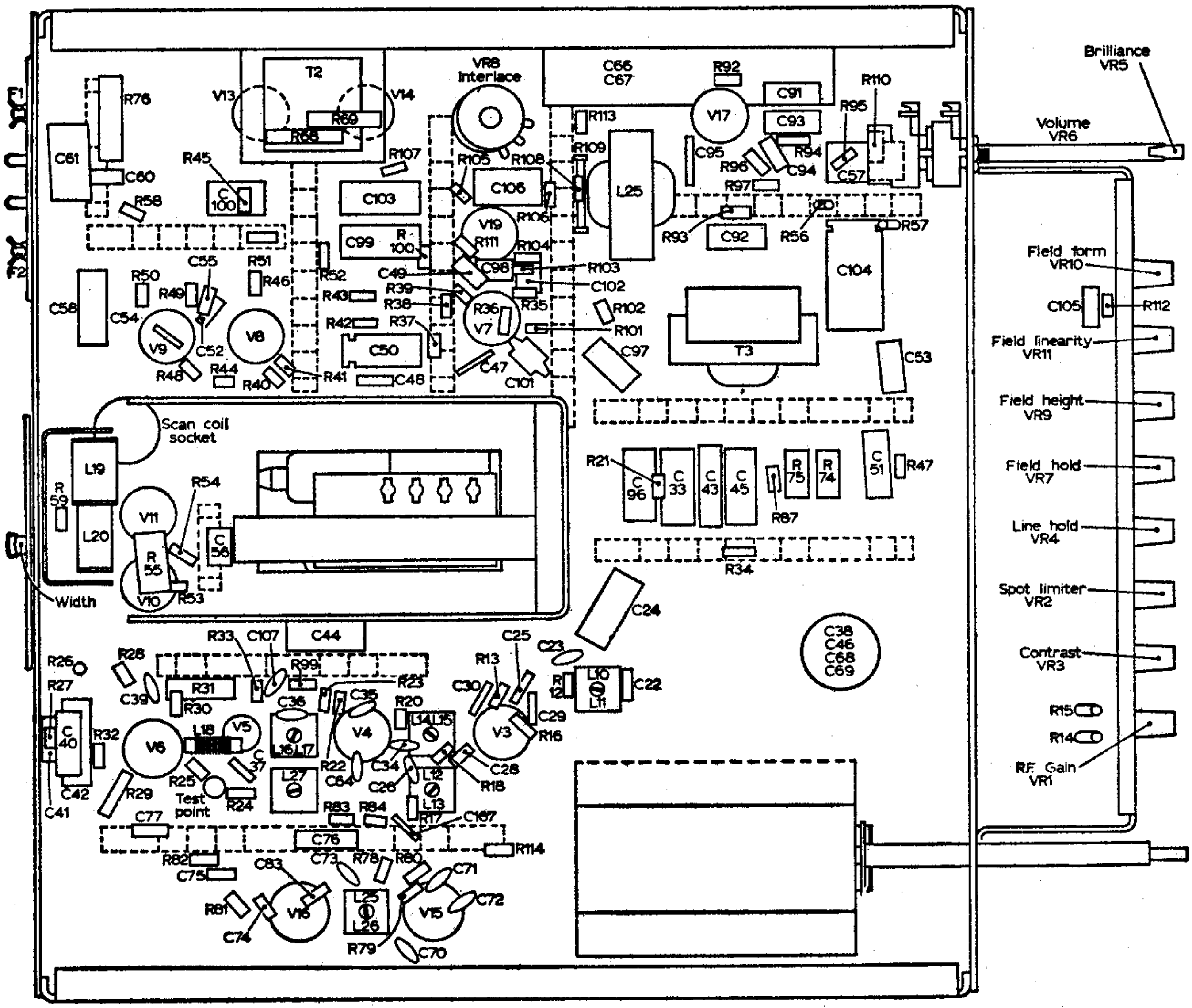


Fig. 3—Chassis layout showing location of components.

original models. However, it should be checked when a low emission PL81 is suspected.

The Field (Frame) Timebase

Faults to be expected here are those due to shorted or leaky capacitors, low emission valves, and one resistor in particular " going high ". The resistor referred to is R100 3·3MΩ to pin 1 of V7 ECL80. It takes a long time to change drastically, but the change is marked by a corresponding loss of height. Bottom compression directs attention to V18 PCL82 and also to its 500μF cathode electrolytic (pin 2) across R110.

Severe disturbance in the form of erratic bunching of lines and the intermittent variation of height and vertical form or linearity should direct attention to the front control panel where the tracks can be cleaned and lubricated after the judicious use of a screwdriver, box spanner and a pair of long-nosed pliers.

Total collapse of the frame scan with arcing in the interlace control often results from C101 0·033μF shorting. This capacitor does seem to be troublesome and is wired from pin 9 of the PCL82 to pin 2 of the ECL80. Loss of hold can be due to leakage through this capacitor and to a change of value of R101 680kΩ.

Bottom compression not due to previously outlined causes may be due to a faulty 0·01μF capacitor C105. C106 0·02μF 1kV does not give much trouble, but should not be overlooked.

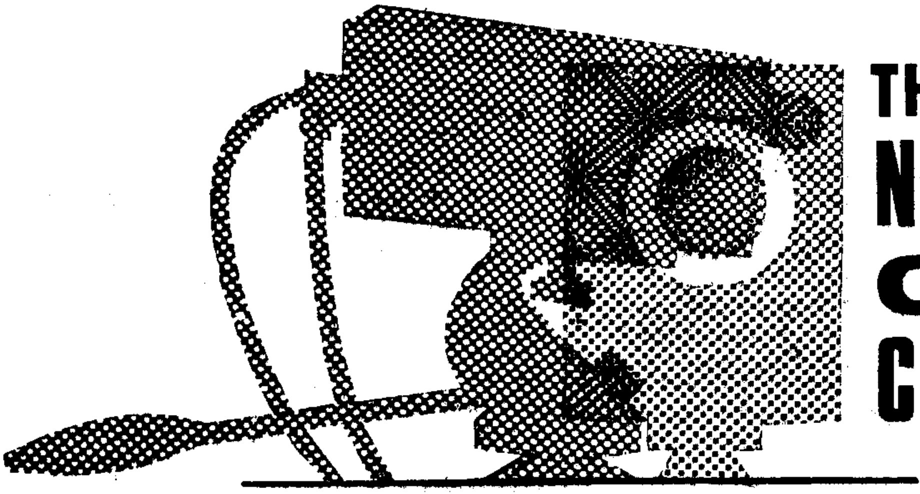
Brilliance Working in Reverse

If the raster is fully illuminated when at minimum, but fades out as it is advanced, the chances are that this, or has been, accompanied by signs of overheating. Attention should be directed to the video amplifier stage h.t. supply, where C38 16μF or C39 0·003μF may be shorted thereby burning out R30 (1kΩ). Uncontrollable brilliance—the control having no effect at all, has on more than one occasion been due to C57 0·5μF becoming shorted.

Hum Bars

When the picture is divided into black and white horizontal bars, say top dark bottom bright, check the EB91 V5, which sometimes develops a heater-cathode short. If the EB91 is not at fault, check the PCF80 video amplifier.

TO BE CONTINUED



THE NEV-ICON CCTV CAMERA

By M. L. Michaelis - Part 1

IN recent months the advertisement columns of this journal have offered a complete CCTV camera unit, the "NEV-ICON" distributed by Messrs. Horntons Electronics, Birmingham, at the lowest price yet found for such equipment. Numerous readers will doubtless have purchased one of these units and will have gathered their own experience therewith. Nevertheless, we are sure that those readers will still find much of interest in this article and that CCTV enthusiasts at large will profit from the discussion. This unit is a complete vidicon-camera with a modulated r.f. output suitable for direct connection to the aerial socket of a standard unmodified television receiver, yet it is so small and light that it can be stood on the opened palm of the hand. The circuit is fully transistorised apart from the vidicon tube itself and two miniature neon stabiliser tubes for the vidicon h.t. supplies.

Power Supplies and Stabilisation

The NEV-ICON uses a current stabiliser transistor for the vidicon focus coil current, a pair of subminiature neon stabilisers for the vidicon h.t. supplies and a power zener diode to stabilise the -10V common collector supply for the transistorised signal and timebase circuits. This high degree of overall stabilisation in the power supplies obviates virtually all long-term drift, so that a picture once set up remains unchanged over very long periods of operation, even in the face of mains voltage fluctuations. This is an outstanding feature of the design.

The equipment consists of two units, the camera section measuring about 3 x 4 x 8 inches and the small mains power unit measuring about 3 x 4 x 2½ inches. The power unit contains the mains transformer and the -10V collector supply rectifiers together with associated smoothing components and the stabiliser zener diode, i.e. the components shown within the dotted line on Fig. 1 which depicts the entire power supply circuits. All other sections of the power supply circuit are within the camera unit, chiefly on the rear vertical printed circuit board which carries the vidicon supply circuits.

The camera unit assembly can be removed from its tunnel-shaped casing after unscrewing the tripod ring at the base. It consists of a stout paxolin baseplate carrying no circuitry but merely used to fix the front and rear vertical panels along their bottom edges. The front vertical panel carries the focus and deflection coil assembly for the vidicon. This coil assembly is completely sealed and screened, so that the camera may be operated in the opened condition for carrying out adjustments, without stray light thereby entering the vidicon.

The Lens Mounting

The lens mounting plate with thread matching the exchangeable TV lens is mounted on the front side of the front vertical panel and can be removed separately to expose the vidicon target and allow the vidicon tube to be inserted or removed through the large opening in the front panel and coil assembly. No target mask is used and the target connection is established by a spring-plate situated on the left side. The vidicon tube can be slid back and forth axially to bring the target into the focal plane of the lens and when the correct position has been found the tube is clamped there by tightening the pinch clip on the rear extension of the coil former near the tube base. The necessary adjustment is best made with the opened camera running, whereby an object at known distance should be televised, with the lens focus ring set to this known distance. The vidicon tube is then slid forwards or backwards in an axial direction until the picture on the receiver reaches optimum focus, adjusting the small white electrical focus knob at the top of the rear panel where necessary.

Rotation of the vidicon about its axis theoretically produces no effect in this design, since the coil assembly is fixed and thus determines a fixed raster orientation. However, if the raster is found to be displaced so that one or two edges lie too close to the target rim, try rotating the tube about its axis. Such raster displacement can also arise if the coupling electrolytics to the deflection coils leak, so in case of trouble this point needs checking too. The advertised f/1·9 TV lens shades-off slight areas very near the vidicon target rim when higher stop-numbers are set (bright lighting), but not at small stop-numbers used for weaker indoor lighting. This is another reason why the raster should be reasonably well centred on the target face, when the lens gives excellent images at all settings of its stop.

Circuit Boards

The front vertical panel is packed by a stout piece of paxolin carrying two printed circuit board sockets. The rear vertical panel is metallic and carries the coaxial r.f. output socket, the multi-connector for the power supply cable, the electrical focus knob and some holes for screwdriver insertion to adjust the line hold control and some other normally sealed presets. These controls are situated on the vertical printed circuit board at the rear, which chiefly accommodates the vidicon tube supplies and is fitted with two further sockets for printed circuit boards directly opposite to those on the front vertical panel. The remainder of the camera circuitry is accommodated on two horizontal printed circuit boards which plug-in at both ends into the respective longitudinal sockets on the front and rear vertical panels.

The two horizontal printed circuit boards thus lie in two storeys below and parallel to the vidicon tube and its coil assembly. The upper printed circuit board accommodates the three-transistor video amplifier (Tr1 to Tr3 in Fig. 2), the r.f. oscillator and modulator diode (Tr4 and D1 in Fig. 2) as well as the tuner assembly with a long paxolin tube into which a non-metallic trimming tool can be inserted through a small hole in the front panel to the left of the lens, for adjusting the r.f. carrier frequency (trimmer). Contrary to the instructions supplied by the distributors, it was found to be more advisable to trim this tuning adjustment on the camera rather than to alter the fine tuning on the TV receiver for final optimum picture focus, so that the receiver does not need continual readjustment when switching between CCTV operation and a broadcast programme.

It will be found that a picture can be locked at two fairly widely separated settings of the camera tuning, because of the double-sideband camera output but single-sideband receiver response. It is usually found that line and field hold on the receiver is much more rigid in the one of these settings than in the other. Once the correct setting has been found, both line and frame lock were found to be extremely good, another pleasing feature of this equipment leading to exceptionally rigid pictures with a good receiver. The makers advise that some TV receivers employing flywheel line sync are not suitable. Tests were made with a receiver using a sinewave line oscillator corrected with a reactance valve circuit driven from a phase and frequency discriminator comparing the sync pulses and the line flyback pulses from the line output transformer. This is the most modern type of line sync circuit in television receivers and it gives truly rigid lock on the signal from the CCTV camera here under discussion.

The lower printed circuit board accommodates the four-transistor timebase circuits (Tr6 to Tr9 Fig. 3) and the blanking and sync circuits involving the transistor Tr5 in Fig. 3. There are no large oscillator or output transformers, so that the circuit is accommodated in a surprisingly small space—at the price of a slight loss in linearity which is, however, quite tolerable.

The division of circuitry into the sections as

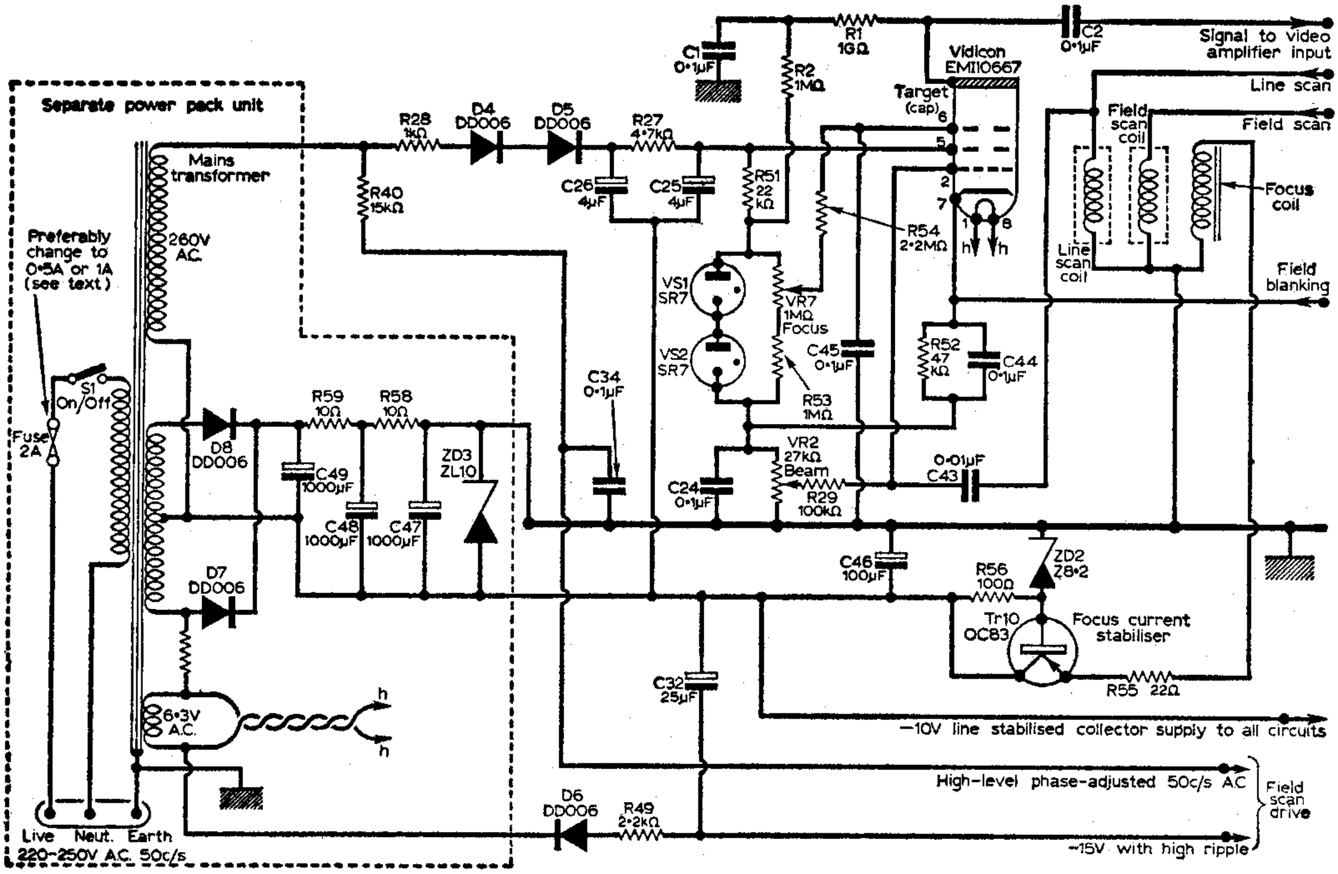


Fig. 1—Power supplies and vidicon circuit.

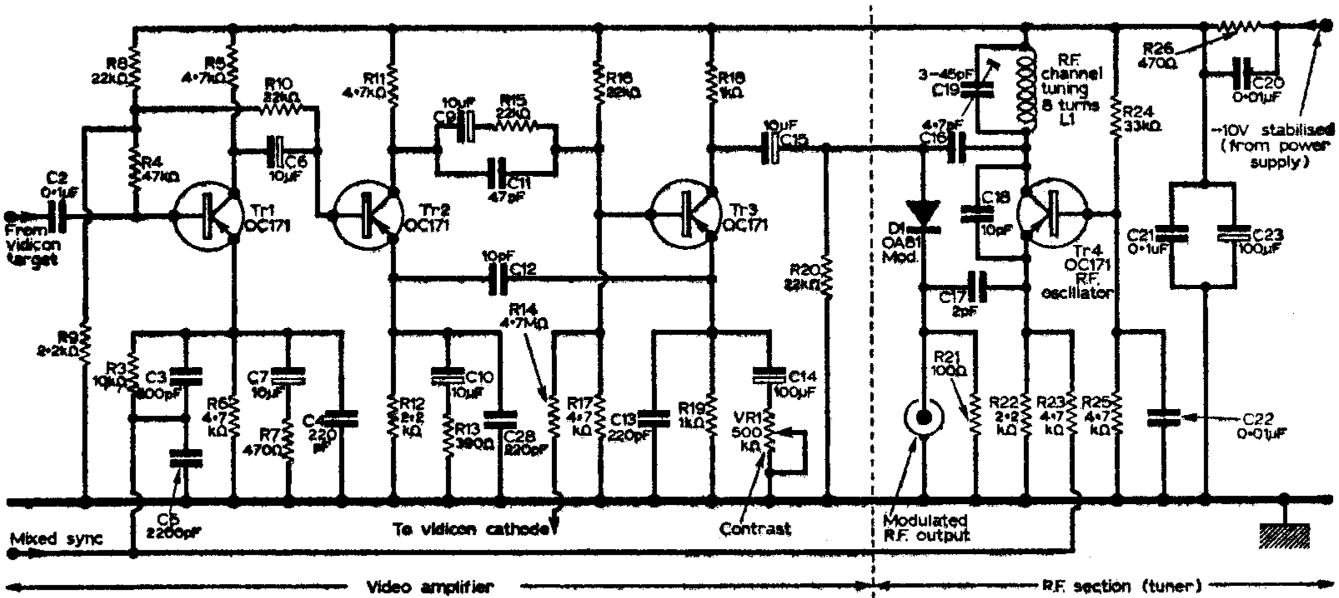


Fig. 2—Video R.F. circuits.

here published in Figs. 1, 2 and 3 respectively corresponds very nearly to the division among the actual circuit boards, although some slight transfers have been undertaken on paper in the interests of optimum clarity on the published circuit diagrams. The portion of Fig. 1 within the dotted line *exactly* depicts the separate power supply unit, whilst the remainder of Fig. 1 roughly corresponds to the contents of the rear vertical printed circuit board and vidicon assembly. Fig. 2 closely corresponds to the contents of the lower horizontal printed circuit board and Fig. 3 to the upper horizontal board.

The distributors supply a three-page instruction leaflet for setting-up and operation, the essential contents of which are distributed and commented at various points in this article. They also supply a full blueprint circuit depicting the *exact* distribution of components among the various sections and boards and all relevant interconnections. These documents, together with the information here published, will be found to represent a very comprehensive collection of information on this equipment, so that even relative beginners should find little difficulty in finding their way around the circuits.

Dismantling the Camera Unit

The camera assembly can be slid out to the rear after the tripod mounting ring on the base of the outer casing has been unscrewed. The lens and lens plate should then be removed by unscrewing the large turret screw directly below the lens. Thereafter, it is advisable to pull-off the vidicon tube base (on flying leads), slacken the tube clamp near the base and remove the vidicon through the front-end hole in the coil assembly normally covered by the lens plate. It should be laid aside in a protective box to prevent accidental damage to it whilst working on the camera circuit boards. The rear vertical circuit board and panel can be pulled back to the rear sufficiently to disengage the two horizontal printed circuit boards from their front and rear socket strips after the two bolts along the bottom edge of the rear metal panel and the bushing bolt along its top edge have been removed. The lower (timebase) circuit board is thereupon immediately free, whereas the r.f. output cable still needs to be unsoldered from the upper (signal) board to free it completely too.

The rear vertical circuit board can then be freed completely by unplugging the individual leads on it going to the vidicon coil assembly, but it is first necessary to note carefully the colours and relative positions of these three connections before breaking them. The camera is therewith completely dismantled into its separate circuit bricks, giving full access to all components.

The camera should be reassembled in the reverse order after completing intended circuit modifications, overhaul or repairs.

Servicing

The distributors state that the cameras are new but untested, and may therefore require slight attention such as clearing dry joints, etc., before satisfactory performance is achieved.

The sample equipment purchased by the author showed no defects of any kind within the camera unit, but confused connections to the mains transformer primary in the power pack. The "common" and "240V" taps had been inadvertently exchanged relative to their labelling. Thus upon connecting to the tappings labelled according to the local mains voltage of 220V at the author's premises, the full mains voltage was applied between the 220V and 240V taps, causing immediate burn-out of the mains transformer primary before the fuse could blow. The 2A fuse fitted is considered to be too heavy, and it is advisable to replace it by a 500mA or 1A fast-action fuse in the mains primary circuit.

After the necessary repairs had been undertaken in the power pack, the equipment immediately worked correctly on the simplified BBC 405-line system for which it is built as it comes from the makers. There were no dry joints or other faults discernible.

The equipment had to cover a long journey from the supplier to the author and some carriers

—certainly the final one delivering the parcel at the door—handled it upside down although it was clearly labelled " this side up ". Thus the vidicon travelled some considerable time with the target pointing face downwards, which the makers stipulate as being forbidden, since otherwise any loose particles within the tube could scratch the target. However, the subsequent tests failed to reveal the slightest damage on the target, which was in fact particularly good and free of blemishes in the particular specimen involved. Thus maybe this question of vidicon orientation is not all that critical after all, at least not for amateur purposes, although of course one should not wantonly disregard the manufacturers' instructions. In this connection it is also worth mentioning here that the author has at various times been compelled to operate another different vidicon camera in his possession with the target pointing vertically downwards, and no damage has ever been encountered thereby so far. This should not be taken as a recommendation to operate equipment in this manner, but rather as an indication that damage is certainly not inevitable if such operation is unavoidable or accidental.

Far more serious are the effects of pointing the camera directly at the sun or at any other light source of equivalent intensity (including reflections of the sun in glass or water) when a lens is attached. This must be avoided under all circumstances.

Conversion to Simplified CCIR 625-line System

The equipment was subsequently converted to CCIR 625-line operation, this being the standard on which the equipment was required for its ultimate application. The suppliers were not able to furnish any direct instructions for such conversion, but assured the author prior to purchase that they had received general reports of its feasibility. Experiments on the part of the author showed that the necessary changes were indeed simple, and since in some respects the printed circuit boards appeared to be " prepared " to a greater extent than coincidence would suggest (initially blank holes just at the required points) it is possible that this camera might have been originally intended for optional or dual standard by the makers.

To change from 405-positive to 625-negative, the changes involved are merely the reversal of the modulator diode, interruption of one printed conductor, change of value of two capacitors and the addition of a preset variable resistor, apart from readjustment of existing preset controls.

The Circuit—General Features

The circuit of this camera equipment is impressive in its extreme simplicity whilst fully and adequately incorporating all the essential features for practical usability. Where even higher standards of performance are desired, sockets for connecting external ancillary units may readily be added, so that the camera is capable of forming the nucleus of high-quality equipment.

The timebase circuits employ no costly and large transformers. The linearity, especially in the field scan circuit, is slightly poorer than with larger transformer-matched circuits, but this is here considered to be a most worth-while sacrifice

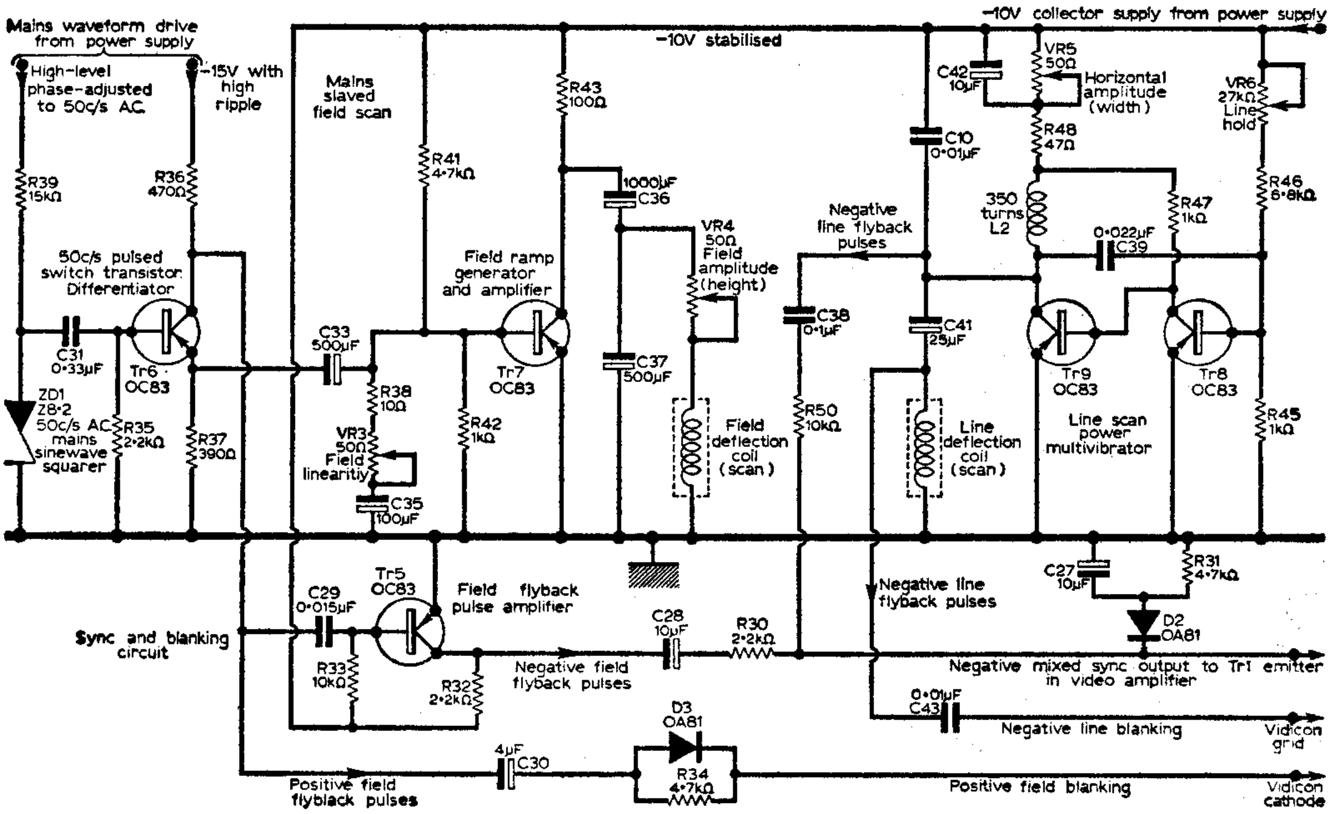


Fig. 3—Timebase circuit.

in the interests of low cost, simplicity and small size. The timebase performance is very reasonable and the author does not consider that there is any serious drawback in this part of the equipment.

The tuner and modulator circuit (Tr4 and D1 in Fig. 3) is excellent in every way. The performance of this surprisingly simple arrangement is quite beyond reproach on both positive (BBC 405-lines) and negative (CCIR 625-lines) modulation, provided proper attention is given to the details discussed below. The video amplifier is in the author's opinion the weakest part of the equipment. The bandwidth was rather constricted in the sample to hand, although certainly quite usable results were obtained. However, the picture definition was decidedly short of that achievable with other equipment in the author's possession, although the latter is admittedly considerably more complicated and expensive.

Apart from some restriction of bandwidth, the gain also appeared to be barely adequate in the video amplifier. It was difficult, although certainly possible, to obtain a really good contrast, i.e. deep modulation of the carrier. However, there are other factors apart from video gain which here play a role. The modulation depth of the sync pulses must not be excessive, otherwise the vision swing is thereby restricted, and the raster amplitude on the vidicon target must not be adjusted to cover too small an area, otherwise the charge pickup and thus input to the video amplifier is obviously low. Given proper attention to these points, very reasonable contrast and definition was achieved on both 405 and 625-line systems, but the equipment gave the impression of " running flat-out without any circuit reserves of gain or adjustment latitude". It is possible that these factors can vary widely from one equipment to another and some judicious selection of transistors with optimum characteristics within their type group would very likely exert a considerable influence on the performance.

The Video Amplifier Circuit

The video amplifier consists of a three-stage RC-coupled transistorised circuit with high-frequency boost in the emitter circuits (reduction of negative feedback at the higher frequencies) and through positive feedback via C12 as well as preferential coupling via C11. This compensates to a reasonable extent the high-frequency attenuation given by the stray capacitance of the vidicon target circuit in conjunction with the low-frequency impedance of the input circuit at Tr1 base.

Target Load Resistor Value

A very interesting and unusual feature of the input circuit is the enormous value of the target load resistor R1 which is 1 Gigohm (1000 Megohms). This is returned to a high stabilised h.t. voltage much greater than the normal positive target voltage under any actual operating conditions. The target voltage therewith adjusts itself automatically to a correct value, according to the mean intensity of illumination of the target.

The normal peak white current at the target is 0·25 microamps for the EMI 10667 vidicon used in this equipment, which produces a voltage drop of 250V across the 1 Gigohm load resistor and automatically leads to a reduction of the input-end h.t. voltage to a small value between 10V and 100V at the target, as required. If the target illumination is very low, then a higher target voltage is required and this is here established automatically in that the target current reduces very slightly such that the voltage drop across R1 falls and the target voltage rises. The converse takes place when the target is brightly illuminated, giving an automatic reduction of the target voltage to the then required much smaller value around 10V. The target voltage adjustment is therewith fully automatic over a wide range of illumination values, making any manual or preset control quite unnecessary on the one hand and giving a latitude of one or two stop-numbers either way for the lens aperture setting on the other hand. This arrangement works extremely well and smoothly.

In the author's opinion it represents an ingenious circuit " trick " well worth incorporating into other vidicon equipment. A further great advantage of the circuit is that it definitely prevents excessive target current, since R1 will not allow more than about 0·3 microamps maximum to pass and the limiting rating of the vidicon target before damage is likely is some 0·8 microamps. This safety measure to some extent reduces the chances of damage when pointing the camera accidentally at bright artificial light sources (naked incandescent lamps), so that the precautions advised in this respect in the makers' instructions are probably overcautious even though they should not be wantonly disregarded.

Signal and Sync Combination

The mixed sync signal established on the timebase circuit board is injected strongly at the emitter of the first video amplifier transistor Tr1 and *very* strongly again at the emitter of the r.f. oscillator for additional direct sync modulation at the oscillator. Considered on a pure basis of sync to vision ratio in the resulting effective modulation waveform, this represents a sync amplitude several times as great as the vision amplitude, in apparent contradiction to the standard. This is necessary only on 405-line positive modulation to establish a correct *modulation envelope*, which is all that matters as far as the final output is concerned.

Modulation

The modulator diode D1 functions as r.f. gate in controlling the transfer of the r.f. waveform from the collector of the oscillator Tr4 to the modulated r.f. output socket. Simultaneously, neglecting R21, the modulator diode D1 acts as negative d.c. restorer for the video waveform from Tr3 in conjunction with the time constant of C15 and R20. The efficiency of this d.c. restoration essential for the modulating action is improved by shunting a v.h.f. choke across R21 (some 10 to 60 turns of thin enamelled copper wire wound directly on the resistor) to remove its impedance at video frequencies.

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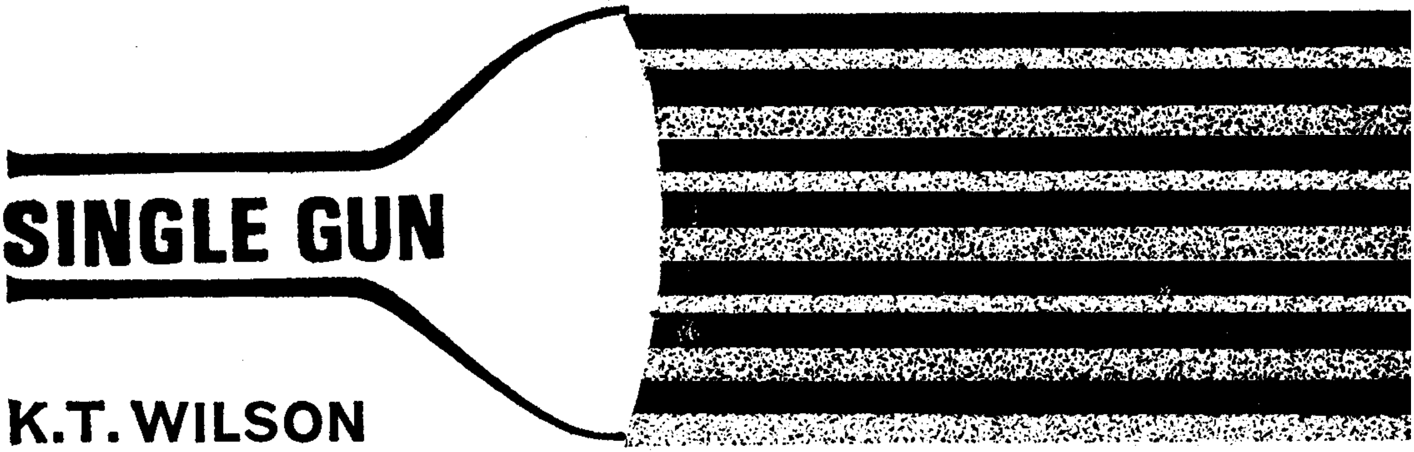


SINGLE GUN

K.T. WILSON

WHEN colour television started for the second time in the U.S.A., after the brief and unhappy use of a non-compatible field-sequential system, the choice before the licensing committee of the Federal Communications Commission was fairly simple—the NTSC system and the R.C.A. Shadow-mask tube or nothing at all. Now, however, as Europe is on the brink of setting up colour television transmissions, there is a choice both of operating systems and of possible tubes.

The NTSC system, thoroughly developed and already in use in three countries (U.S.A., Japan and Cuba) is challenged by the much newer, untried, but rapidly developing SECAM system, and to a lesser extent by the PAL system which is itself a refinement of the NTSC system.

All three systems can, of course, be used along with the shadow-mask Three-gun tube, but there are many who feel that the price and complexity of this tube may well retard the growth of colour television in Europe. American experience with colour television tends to substantiate this view.

The construction of successful single-gun colour tubes has been the aim of dozens of laboratories all over the world. The difficulty lies in designing a tube whose manufacturing tolerances will be such that it can be mass produced, preferably using the same machinery and jigs as are presently used for making black-and-white tubes, and yet whose operating principles are such that the extra circuitry needed to operate it does not swallow up the economic advantage of the tube, nor make the set impossibly difficult to use. Let us first examine the leading types of single-gun tubes, and then the circuitry methods involved.

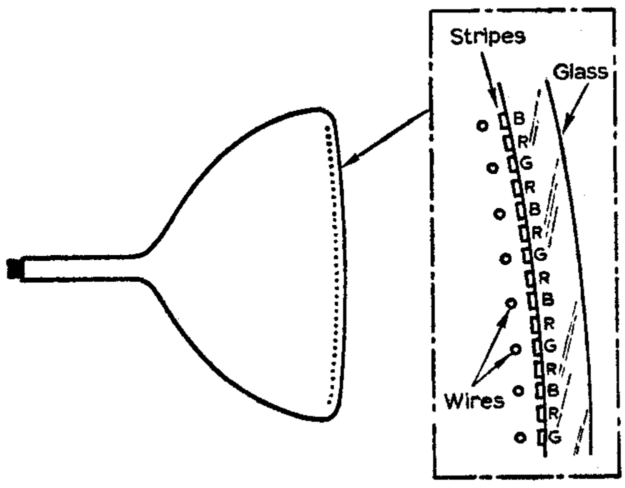


Fig. 1—The Chromatron tube.

Types of Tube

There are two types of single-gun colour tube. Both use stripes of phosphors in colour sequence. The stripes are generally vertical, and are laid in the sequence Red-Green-Blue-Red-Green-Blue across the tube face. The techniques used for laying these stripes are similar to those used for depositing the phosphor dots on the Shadow-mask tube. The sequence shown above is known as the Continuous Colour Sequence (CCS); the sequence Red-Green-Blue-Green-Red-Blue may also be used with double Red and Blue stripes, this is known as Reverse Colour Sequence (RCS).

Where the two types of tube differ fundamentally is in the methods used to ensure that the correct amount of beam current hits each stripe at the right time to produce the effect of a correctly coloured picture. One type of tube uses a deflecting signal to shift the beam to the correct stripe; this deflecting signal must be derived from the colour information in the received signal. The other type of tube makes no attempt to influence the beam as it scans, but continuously detects the position of the beam and uses the output of this detecting circuit to modify the signals presented at the grid and cathode of the tube.

The Chromatron

The outstanding tube of the first type is the Chromatron. This tube has appeared in both single and triple-gun versions, but only the single-gun version will be discussed here. The phosphor stripes, in reverse colour sequence, are deposited on the face of the tube (in early Chromatrons, the phosphor stripes were deposited on a flat glass plate within the c.r.t. bulb) and an array of vertical wires is mounted on a cylindrical carrier close to the face-plate and accurately registered with the phosphor stripes so that each blue and each green stripe has a wire in front of it. One demonstrated version of the tube had 1,000 wires with 500 Blue, 500 Green and 1,000 Red stripes.

The screen operated at 25kV and the d.c. poten-

COLOUR TV TUBES

tial on the wires was 7kV, giving a very much brighter picture than the Shadow-mask tubes.

The excess number of red stripes compensated for the low efficiency of the red phosphors in use at the time. More efficient red phosphors are now available.

This tube operates by switching the beam during line scan so as to spend more or less than the normal scan time on any given stripe according to the colour signal received. In theory, this switching should be done by square waves; but the high switching voltages (1kV in some versions of the Chromatron) and the high capacity of the wires to the face plate (that is, the aluminised layer on the phosphors) prohibits this. Sinusoidal switching is therefore used, errors are minimised by having a black stripe between each two colour stripes, and to simplify it all further, the switching is carried out at NTSC subcarrier frequency. The beam therefore moves as if it were deflected by a saw-tooth waveform on which had been superimposed a high-frequency sine wave, and the signal to the gun of the tube is coded so that scan and colour signal keeps in step.

The question of coding the gun signals will be treated in more detail later, what must be borne in mind is that colour television systems transmit at least two colour signals simultaneously; the NTSC system, three, but the single-gun tube can cope with only one colour at a time. The colour signals must therefore be treated so that they appear in sequence, and this sequence must keep step with the scanning of the phosphor stripes.

The development of the Chromatron tube has been accompanied by developments in the coding and switching circuitry, though the colour switching still requires a considerable amount of power, 30W being a typical figure. The Chromatron may achieve the distinction of being the first single-gun colour tube in a production TV set, as the Sony Co. of Japan have announced their intention of producing an 11in. set using such a tube.

The Banana tube, developed by Mullards, is basically of the scan-switching type, but the tube itself is a long cylinder with a gun at one end and the "screen" a band of colour stripes running down the cylinder. The beam passes down the tube and bends over to meet the stripes at a point determined by the scan and the colour deflecting electrodes. Frame scanning is carried out mechanically, the tube fitting inside a rotating drum which carries a set of lenses. Because of the mechanical scan, it is very doubtful if the Banana tube will ever be used commercially.

The Apple Tube

The second type of tube has also been brought to a point where commercial use is possible. This type, the beam indexing tube, is typified by the Apple tube, developed by Philco in the U.S.A. and by the Thorn-Sylvania Laboratories over here. The tube recently announced by the Rank Organisation for the "Telycolour" system (of which few details have been released) is thought also to be of this type. The steps in the evolution of this tube are interesting, and indicate the difficulties which have faced designers.

Early versions of the tube used one stripe of secondary emitting material for each three colour stripes, the latter being in CCS order. Each time the beam passed over the stripe of secondary emitting material (typically Magnesium Oxide), a beam of low velocity secondary electrons was emitted and collected at a subsidiary electrode.

The pulses available at this electrode were then used to control the coding of information at the grid of the tube. This seemingly simple scheme was fraught with difficulty. Firstly, the velocity of the secondary electrons was so low that there was an appreciable time lag in collecting electrons from the centre of the screen as compared to the edges. This caused a shift in hue at the centre or the edges. More seriously, the pulses available at the collector electrode could not be directly used to modulate the colour information at the grid, as this formed an unstable feedback loop.

The next approach was to use a double beam gun with one beam modulated by the colour information and the other by a pilot carrier at about 42Mc/s. The two beams were scanned together, and the scanning of the pilot beam over the index stripes produced an output at the collector electrode of 42Mc/s modulated by the stripe frequency, that is $\frac{n}{1}$, where n is the number of stripes scanned, and 1 is the time for one line scan. This frequency was of the order of 6-7Mc/s. The difference in transit time of the secondaries was compensated for to

continued over

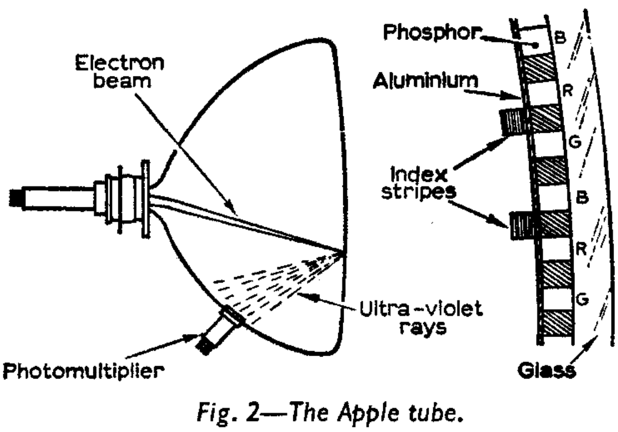


Fig. 2—The Apple tube.

some extent by shifting the index stripes gradually away from their following colour triplets towards the centre of the screen.

Difficulties with this tube included cross-talk between the two beams, interference in the index amplifier, the screen acting as an aerial to pick up any signals at 42Mc/s, and limited contrast due to the fact that the pilot beam also excited the phosphors causing an illuminated background.

The latest version of this type of tube has brilliantly overcome many of these difficulties. The indexing stripes are of a phosphor material which produces Ultra-violet (UV) light on excitation. For such light the transit times are negligible. The UV is picked up by a photomultiplier tube placed outside the tube. Since the indexing information is in the form of light and cannot interfere with or be modulated by the electron beam there is no need to use a pilot r.f. carrier.

A single beam electron gun is used and the indexing stripes are placed closer together, one after each two colour stripes. This method of striping, called the "related frequency" method, avoids instability by making the index stripe frequency generated by the scanning beam as it passes over the index stripes $\frac{3}{2}$ times the colour triplet frequency; that is the frequency at which the colour information must be coded at the input of the tube. Coding and index signals are then kept in phase lock by circuitry similar to that of flywheel sync arrangements. Special arrangements have to be made at the beginning of each line scan as there is a 50-50 chance of the phase control loop locking on to the wrong stripe; this is obviated by having a series of "run-in" index stripes at the edge of the screen. Colour information is blanked out while the beam crosses these stripes.

Since the beam which excites the colour stripes also excites the index stripes the tube must never cut off or the indexing will be lost. This limits the contrast range of the tube but not the colour saturation. One further refinement was to use an elliptical spot shape to "fill in" the gaps between line scans and increase the brightness by making the spot cover more of the phosphor stripe, since the major axis of the ellipse was in the direction of the phosphor stripe.

The Apple tube is the type which has received most development attention in Europe, notably from the laboratories of Philips at Eindhoven and the Thorn-Sylvania laboratories in this country and will almost certainly be the type of tube used if single-gun tube sets are offered for sale in the near future.

Signal Coding for Single-Gun Tubes

The signal to the gun of a single-gun tube must consist of two parts: a white or luminance signal which must be a mixture of equal parts of the three colours transmitted and also a colour or chroma-signal which must consist of the three colour signals in sequence. If we consider these chroma signals as being delivered to the gun by a one-pole, three-way switch the switch "ways" would be 120° apart assuming that the phosphor stripes were of equal widths and of equal efficiencies. This is equivalent to a mixture of three signals 120° apart in phase, so the complete signal to the gun of the tube can be written as:

$$E=A(R+B+G)+C(R.Cos.nt+B.Cos.[nt-\frac{2}{3}\pi]+G.Cos.[nt-\frac{4}{3}\pi])$$

where the first bracket represents the luminance signal and the second bracket represents the chroma signal. "n" is the "writing frequency", the number of stripes divided by the line scan time and the pi portions represent successive intervals of 120°.

Now to obtain such a signal we could go through all the processes of detection for the colour system of our choice, ending up with the three colour signals. Our luminance signal would then be obtained in the familiar way by adding the three together, in a resistive matrix for example, and the chroma signal would be obtained by modulating a carrier at writing frequency with the three colour signals 120° apart in phase. Such a system is fairly straightforward but very cumbersome. It would add both to the processing of the signal and to the expense of the set. A far more interesting possibility is of using the received signal, suitably modified but not demodulated, to apply to the tube.

At this point we must consider the two types of system (since PAL is only a variant of NTSC) separately. As the war between the two systems has hotted up recently and many questionable accusations have been made about the capabilities of each the author must take up a neutral stance. Contrary to what has been frequently stated either type of signal can be converted to a signal suitable for a single-gun tube working with the stripes in continuous colour sequence (this will be referred to as the CCS signal), nor is it true that the conversion of SECAM to CCS is more difficult; many may think it easier. To follow chronological order of development we shall consider the NTSC conversion first.

NTSC System

The NTSC signal consists of a luminance signal plus a carrier modulated by two colour difference signals. The modulation is in phase and amplitude. The chroma signal can be represented by red, blue and green signals spaced at phase angles of 116°, 106° and 138°. This suggests that the direct conversion need involve only changes of phase and carrier frequency. It is more convenient to use the two colour difference signals R-Y and B-Y of the NTSC signal and when this is done the conversion boils down to three steps: (1) The sub-carrier frequency of the NTSC signal has to be replaced by the writing frequency of the CCS tube. (2) The NTSC luminance signal, which is $X=0{\cdot}59G+0{\cdot}30R+0{\cdot}11B$, must be converted to the CCS luminance signal, which is $Y=0{\cdot}33G+0{\cdot}33R+0{\cdot}33B$. (3) The chroma signals have to be changed in phase and amplitude on their new sub-carrier. The NTSC chroma signals are $0{\cdot}88(R-X)Cos.mt+0{\cdot}49(B-X)Sin.mt$ where m is sub-carrier frequency.

The CCS signals converted to colour difference form so that they may be written in the same way are:—

$0{\cdot}89(R\text{-}Y)\cos[nt-19°]+0{\cdot}74(B\text{-}Y)\sin[nt-21°]$.

The methods of performing these transformations are as follows: Step (1) is a frequency changing operation. Step (2) can be accomplished by adding the luminance component of the NTSC signal X to the signal Y-X, obtained by demodulating the NTSC signal at a gain of 0·58 and a phase angle of 19°. Step (3) is performed by applying the sub-carrier signal to an amplifier whose gain is controlled by the phase of the input signal. Such amplifiers are known as "elliptical-gain amplifiers" and work by mixing the signal with another carrier at the second harmonic of the sub-carrier and at the correct phase. Since the sub-carrier and its harmonics are readily available in any colour set this transformation, though rather formidable on paper, amounts to little more than another "frequency-changer" type of stage.

A very important point relating to the third step is that the NTSC signal could be modified to eliminate the need for this stage. If the NTSC sub-carrier were modulated as indicated for the CCS chroma signal, only steps (1) and (2) would be needed. Step (2) cannot be eliminated by an alteration of the NTSC signal as such an alteration would make the signal non-compatible and Step (1) is necessary since the NTSC sub-carrier is chosen for minimum visibility on a black-and-white set, whereas the writing frequency of the CCS tube depends on its internal construction. Chromatron tubes may, however, use the NTSC sub-carrier frequency directly, but the signal processing for these RCS tubes is more difficult and will not be discussed here.

The SECAM System

The SECAM conversion is, as might be expected, quite different, although the steps are the same. The unique feature of the SECAM signal is that the colour difference signals are transmitted sequentially on alternate lines and appear simultaneously at the tube by combining transmitted signals with those delayed by exactly one line period. The colour difference signals are frequency modulated on to the sub-carrier and the first priority of a SECAM to CCS converter is to change the sub-carrier modulation to a.m.

An elegant method of performing this operation has recently been devised. The frequency-modulated sub-carrier is fed into a mixer the other signal to which is the same sub-carrier delayed by a time equal to half a cycle of sub-carrier centre frequency. For an unmodulated sub-carrier this means adding the sub-carrier to the inverse of itself, giving no output for an unmodulated sub-carrier but giving an output whose amplitude is proportional to frequency deviation for a modulated sub-carrier.

By using a further two mixing operations the f.m. input can be completely transformed to an amplitude modulated signal with a suppressed sub-carrier at the writing frequency of the CCS tube. This triple mixing operation is the key process of the SECAM to CCS change and the rest of the signal processing follows along the normal SECAM lines, that is, de-emphasis filtering, the line delay and signal matrixing and switching. The luminance signal for the CCS tube is obtained by synchronous detection of the chroma signal from the switch referred to above. The whole decoder is no more complicated than the SECAM colour channel for a three-gun tube.

Telycolour

The recently announced Telycolour system, although using what is certainly a single-gun tube, works on an entirely different principle. The tube itself is no different to the normal c.r.t. except that it is built to closer tolerances to improve scan linearity. Attached to the front of the tube is a filter screen consisting of a very large number of translucent coloured dots the same size as the spot on the screen of the tube. As the tube is scanned along a line the dots, which are arranged in colour sequence, are illuminated.

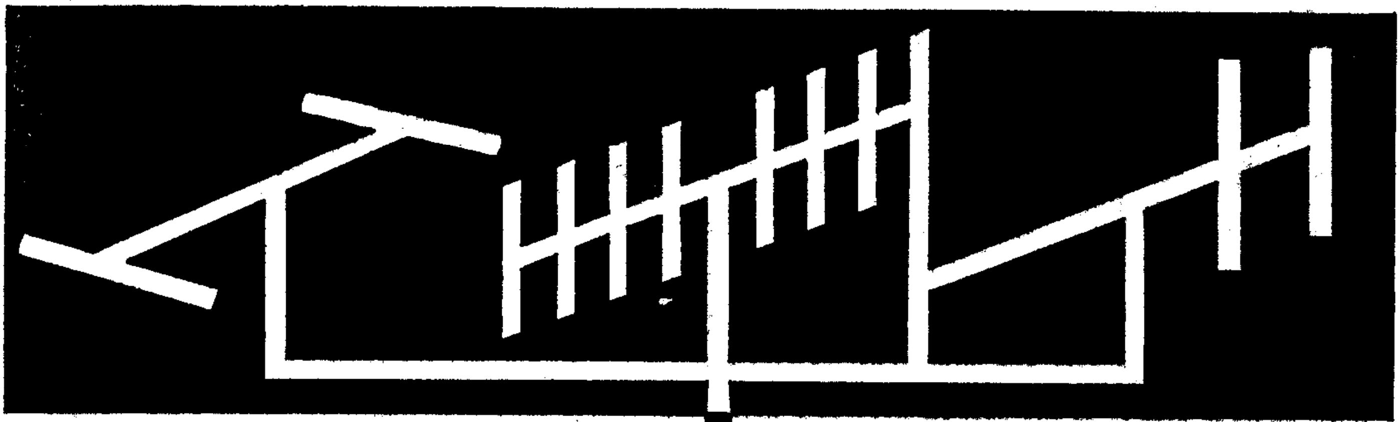
Under normal conditions the picture will be white as before, although of much lower brilliance, but if the beam can be modulated by a signal of the correct colour as it passes over any given dot then a colour picture will be seen. The difficulty of the scheme is ensuring, in the absence of any feedback scheme, that the beam is passing over the correct dot at the time of, for example, the red signal.

The tolerances required on tube geometry and scan linearity to make this scheme succeed make it very unlikely that really acceptable pictures would be obtained but the fact that Rank-Cintel are making tubes for Telycolour makes one hesitate to write it off as a feasible proposition.

Single-Gun Advantage

Colour television is at best rather more complicated than black and white. The use of a single-gun tube, while simplifying to some extent the task of the tubemaker and reducing the price of the most costly single item in the set, complicates to some degree the circuitry required.

Anyone who has taken the large step from black-and-white circuits to colour, however, will find the transition to CCS circuits rather easier. CCS sets will in fact use fewer valves than did the original NTSC sets. Economically the overall advantages of the single-gun tube are very great. It can, for example, be as readily regunned as any black-and-white tube, it is undisturbed by magnetic field variations (eliminating the degaussing operations for the set-up of the shadow-mask tube and hence lowering installation costs) and, apart from the deposition of the phosphor, it requires no close-tolerance operations which would not be performed on a black-and-white tube. The reason for its late appearance on the scene is not due to any commercial conspiracy but to the enormous amount of development work which has had to be done to make the single-gun tube and its associated circuitry a commercial proposition. Let us hope that this work has not been wasted and that the single-gun tube will bring "inexpensive" colour TV to Europe. ◘



EXPERIMENTAL VHF

PART TWO

IN the October issue, the amplifier, its design and performance were fully described. While the basic design was for battery operation, a PP4 lasting many weeks at a load of 5mA provided one does not forget to switch off each time after use, some constructors will almost certainly wish to operate the amplifier from the mains power supply.

Mains Power Unit

This is neither a difficult nor costly problem since only a small, very low power supply unit is needed. A circuit of a unit of this kind is shown in Fig. 8. This can be built into any small box, even a partnering 2oz. tobacco tin, quite easily. The biggest component is the mains transformer. This must have separate primary and secondary windings, and the primary winding must be suitable for the local mains supply voltage. The secondary winding produces a low a.c. voltage.

The amplifier will operate quite well over a range from 6 to 12V, but too low a voltage will limit the signal output level for a given ratio of cross modulation (see Fig. 1). A transformer with a secondary output of between 6 and 9V is suitable, for the d.c. output voltage will be a little above the a.c. voltage across the secondary winding. This is because of the very small current taken by the amplifier which allows the reservoir (C1) and smoothing (C2) capacitors to charge to almost peak value of the a.c. across the secondary.

The volts drop across the filter resistor R1 reduces the output voltage a little, depending upon the value chosen for the resistor, but even so the net output voltage is generally a little above the applied a.c. voltage. R1 can be chosen to have a value to provide an on-load (with the amplifier connected) output of 9V or not less than 6V, as determined by the a.c. voltage across the transformer secondary. In the prototype the author uses a transformer giving about 8V a.c. and a 1kΩ filter resistor. With the electrolytic values as shown this gives incredibly good smoothing, as would be expected. A small heater transformer can generally be over-run a little on the primary to give 7 or 8V across the secondary. Alternatively, one of the miniature transistor-equipment mains transformers can be employed. These are available with almost any required secondary voltage.

A small germanium diode is suitable for the main rectifier, shown as D1 in the circuit. The author has used a Mullard OA81 diode in this position quite successfully. This is capable of giving an average forward current of 17mA at 75V at a temperature as high as 75°C.

The primary is best connected to the mains supply through a pair of fuses, F1 and F2, valued at about 250mA, and an on/off switch (d.p.s.t.), S1.

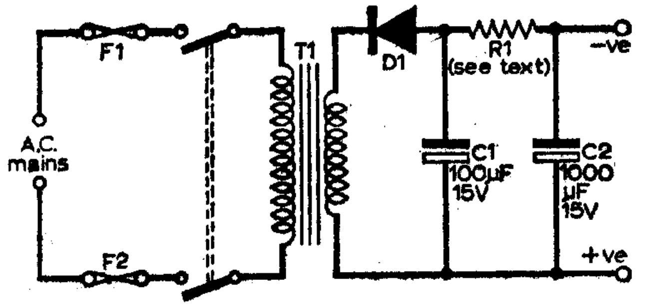


Fig. 8—Circuit diagram of mains power unit suitable for the amplifier.

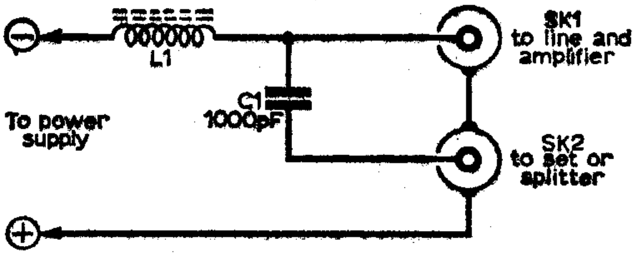


Fig. 9—Here is given a circuit of a power filter which can be incorporated in the power unit for line-powering the amplifier over the coaxial cable.

A medium-gain wide-band set-side amplifier covering Bands I, II and III

AMPLIFIER

BY G. J. KING

If this sort of mains power supply is to be used with the amplifier there is no need for the amplifier switch proper. This can be deleted and the amplifier switched by the mains toggle, S1. A short length of well insulated twin conductor should be used to couple the power pack to the amplifier, the cable being protected from the tin cases by rubber grommets.

It is possible to build the power supply unit actually in the tin box of the amplifier if required, but this calls for one of the miniature mains transformers, mentioned above.

Line Powering

There are applications which demand the amplifier to be employed at a distance from the receiver and probably out of easy reach of a mains supply. In these cases it is best to power the amplifier over the coaxial cable carrying the signal. This is possible by the use of a mains filter at the power

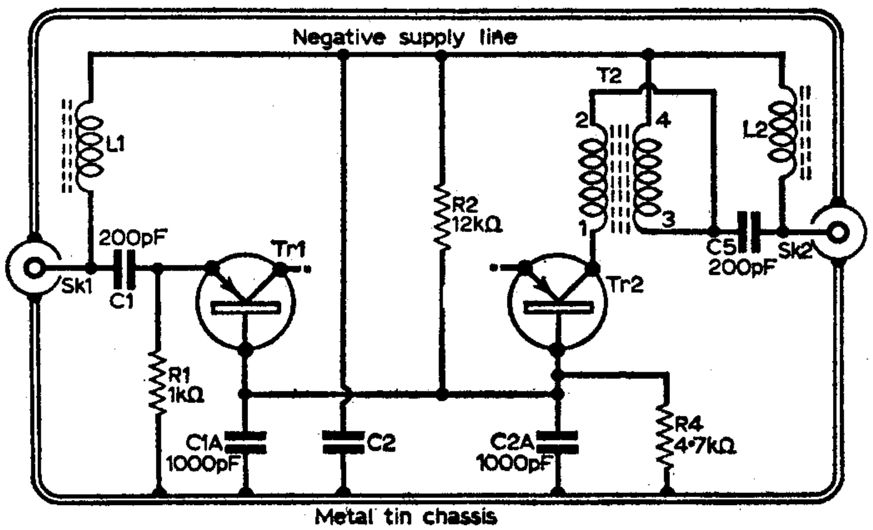


Fig. 11—This circuit diagram shows how the amplifier must be rearranged for line-powering. C1A and C2A are extra components.

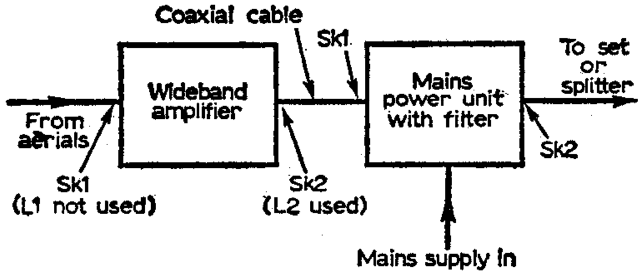


Fig. 10—When line-powering, the amplifier is generally best arranged to be next to the aerials.

unit and by slight rearrangements at the amplifier.

A simple mains filter is shown in Fig. 9. This can be built into the case of the mains power unit. All it consists of is a filter choke L1 to pass the negative d.c. supply to the "line and amplifier" socket and a capacitor C1 to pass the signal from the above-mentioned socket to a socket which accommodates the coaxial lead to the set or splitter if the

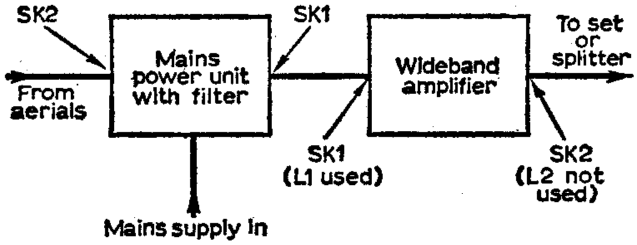


Fig. 12—It is possible to arrange the line-powered circuit so that the amplifier is next to the set or splitter as shown.

amplifier is used to supply a number of receivers from a common aerial (see later).

The method of connection is shown in Fig. 10. Here it will be seen that the d.c. supply from the mains power unit is fed via the filter from Sk1 (Fig. 9) to Sk2 of the amplifier. If we look at the circuit in Fig. 3 of October's article we shall see that as the amplifier stands the d.c. would not get into the amplifier. Without the transient protection choke L2, the d.c. would be isolated by C5. With the choke L2 in circuit, then this would short-circuit the d.c. supply. On no account, therefore, must line power be injected into the basi battery-powered amplifier.

Amplifier Modification

To accept the line power, th amplifier must be altered a little How this is done is revealed in Fig. 11. Here it will be seen the bases of the transistors are lifted from this chassis. Instead they are connected via extra capacitors, C1A and C2A, to the metal box. These capacitors should be mounted as close as possible to the base lead-outs and "earthed" to the metal sides of the sub-assembly. Ceramic capacitors should be used.

The two bases are connected together and they are biased by R2 and R4 as in the original model, but R4 is now connected to "chassis" and R2 to the *negative* line. This calls for a slight re-arrangement of the wiring on the tag strips. C3 in the original model is no longer required, neither is switch S1.

This time chokes L1 and L2 are essential, but instead of being connected to the metal chassis they are connected from the centre of the coaxial sockets to the negative supply line. Looking again at Fig. 9 it will be seen that the positive of the supply connects to the outer conductor (braid) of the coaxial cable feed to the amplifier. The choke L1 in this circuit connects the negative of the supply to the inner conductor. Power at the correct polarity is thus injected into the amplifier via the coaxial cable, socket Sk2 and L2.

The chokes represent an almost open-circuit to v.h.f. signals while passing the d.c. supply without appreciable resistance. The d.c. is blocked by C1 in Fig. 9 and by C5 in Fig. 11. These capacitors, however, pass the v.h.f. signals without undue loss. The chokes employed by the author are ordinary 1A television suppression chokes designed for the suppression of electrical equipment against television interference. Suitable chokes are manufactured by Belling and Lee Limited.

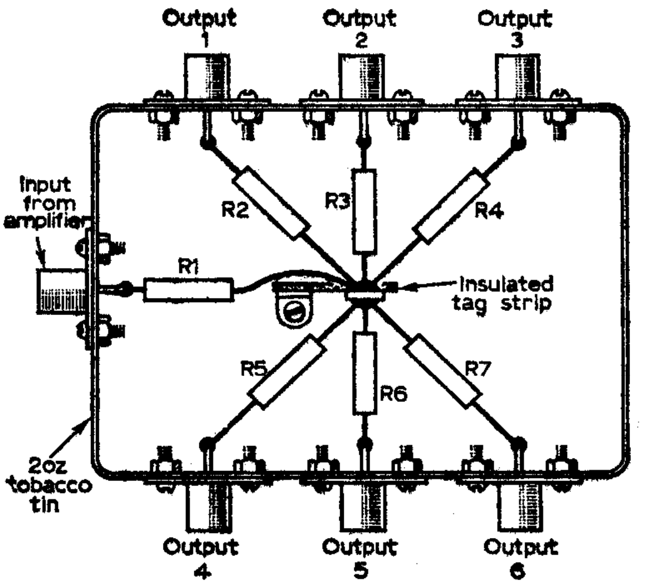


Fig. 14—Construction details of a six-way star network.

Extra Amplifiers

Choke L1 in the input circuit allows the power supply to be fed in this, and if required, giving the arrangement shown in Fig. 12. Moreover, two (or more if the power supply unit can handle the extra current without too great a voltage drop) amplifiers can be powered from one line since the inner of the input socket is connected to the inner of the output socket, via the negative supply line and the two chokes. This permits the arrangement shown in Fig. 13, the two amplifiers being cascaded signal-wise.

When an amplifier is line-powered it must be remembered that by the use of two filter chokes, one at the input and one at the output, the power supply is present at both ends of the amplifier. This can result in a short-circuit across the power supply under certain conditions. For instance, some aerials and diplexers or triplexers have d.c. continuity between the two conductors of the coaxial cable. Thus, with the two chokes connected in an arrangement as at Fig. 10 a short could occur on the power circuit. This is avoided by connecting the choke corresponding to the end of the amplifier that the power is to be injected and deleting the other one. In Fig. 10, therefore, only choke L2 would be used, while in Fig. 12 only choke L1 would be used. In Fig. 13, of course, both chokes would be connected.

An extended coaxial circuit with one, two or more amplifiers may be necessary to feed a multiplicity of v.h.f. signals over a distance of 200/300 yards or more from a hill-sited aerial, for instance, to receivers in a valley. Without any amplification the aerial signals would soon be weakened by the attenuation of the coaxial feeder cable. The attenuation is greater the higher the frequency of the signals. Thus, signals in Bands III and II are attenuated more over a given length of cable than signals in Band I.

If an amplifier is used at the receiver end of a long run of aerial feeder cable the picture "noise" (i.e., grain and snow effects) will be greater than necessary due to the weakened signal being applied to the input of the amplifier. The strongest possible signal should always be fed to any amplifier to secure the best signal/noise ratio.

The use of an amplifier close to the aerial, where the signals are most powerful, is often made difficult if not impossible, by the lack of mains supply in proximity to an isolated aerial site. The line-powering of amplifiers resolves these difficulties, of course.

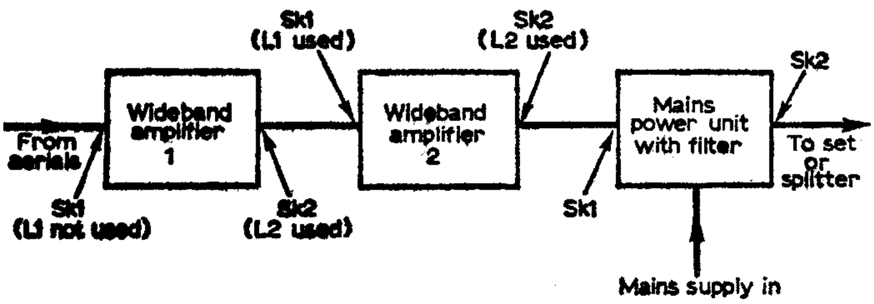


Fig. 13—Two (or more) amplifiers can be line-powered from a single power supply unit as shown in this diagram.

Signal Splitting

To operate a number of receivers from a common cable carrying a multiplicity of signals, some means is necessary for splitting the common feed into the required number at set feeds. It is not possible simply to parallel a number of set feeders to a common cable as this would introduce mismatch effects and cause a great deal of trouble. Some means of matching each set feed is essential whilst maintaining the correct matching on the common feeder.

A simple way of getting a number of matched outlets is by means of a " star " network. A six-outlet star network is shown in Fig. 14. This simply consists of six coaxial sockets and six resistors for the outputs plus one coaxial socket and one resistor for the input. The device can be built easily into a 2oz. tobacco tin to match the amplifier and power unit. In the centre of the tin is a tag-strip carrying one insulated tag terminating all the resistors.

Since the impedances of the input and output coaxial cables are equal, all the resistors must have like values. The value depends upon the number of outlets and can be found from the simple expression $R=Zo(n-1)/(n+1)$, where Zo is the characteristic impedance of the cables (usually about 70Ω) and n the number of outlets. For six outlets R works out to be just a little under 36Ω. The nearest preferred value would probably be used in practice. This is 33Ω. Insulated resistors are most suitable for the application, and they should be non-inductive carbon type.

The insertion loss of such a device is equal to the number of outlets, Thus, the loss given by the six-outlet star will be six times. This means that if a signal of, say, 300μV is fed to it, only 50μV of signal will be present at each correctly matched output. Here, then, is revealed the reason why signal amplification is essential when it is required to feed a number of sets from a single aerial system.

Let us suppose that an aerial signal of 1,000μV is present on all required channels. Using one wide-band amplifier would lift the strength of each signal to 4,000μV. If the amplifier output is then applied to a six-way splitter, each outlet will deliver a signal of about 660μV on all channels which is adequate for most sets. □

IS YOUR TV REALLY SAFE?

—continued from page 106

in the surface of the glass will cause a localised redistribution of stress which may make the tube more likely to implode. Finally, wear safety glasses if you can get hold of a pair—just in case.

Cabinet Stability

When a push through c.r.t. presentation is used, in conjunction with a bull's eye guard and possibly a slimline cabinet, the whole assembly may be front heavy. Only a small pull is then needed to make the whole thing fall over. If the receiver is a table model the problem can easily be overcome by using feet that project forwards, as illustrated in Fig 18a. If the stand is used instead, the front legs will have to be splayed forwards as in Fig. 18b.

X Radiation

As everyone knows, X radiation in excessive doses can have a harmful effect on health and genetic influences. It is also a fact that high voltage thermonic rectifiers, such as e.h.t. diodes, emit X-rays. When e.h.t.'s in common use reached the neighbourhood of 16kV it was at first thought that any further increase would lead to a risk of excessive radiation, and that this would be difficult to guard against—particularly for servicing operations involving close proximity. Fortunately recent advances in valve technology have enabled this problem to be overcome, and c.r.t.'s are now being released by the makers for use at higher values of e.h.t. It is fair to say that no danger exists for either viewers or engineers.

A Summing Up

In this article an attempt has been made to remind readers of the hazards, some minor but others very important, which can exist in a perfectly ordinary television receiver. In some cases it has been possible to suggest remedies or ways of alleviating the problem. Unfortunately space does not allow us to discuss all the issues that can arise. Some, perhaps, that have been mentioned have not received all the attention they deserve.

The important thing is to be conscious of the general problem of safety, to bear in mind the principles involved, and to cast a wary and suspicious eye over any circuitry and construction that we happen to be working on. Safety problems can be fun to solve, and the whole technique and design approach becomes not an added chore, but a challenge to the enthusiast. Even if you are not currently engaged on building anything, why not take a close look at any receiver you happen to have in the house. See if you can spot all the safety features that have been built in to it, and any that are missing. The amount of care taken over matters of safety is often a good guide to the quality of the receiver as a whole. □

PRACTICAL WIRELESS AND PRACTICAL TELEVISION FILM SHOW

The Film Show, which is held annually, and to which readers of P.W. and P.TV. are invited, is to be held as before, at Caxton Hall, Caxton Street, Westminster, London, S.W.1. The date of the Show, which is arranged in collaboration with Mullard Limited, is Friday, 4th February, 1966, at 7.30 p.m. sharp. The films to be shown are "Electromagnetic Waves, Part II" and "Thin Film Microcircuits" and the illustrated talk will be on "Transistor Topics". Refreshments will be provided. The talk will be given by Mr. I. Nicholson of Mullard Limited, and in the chair will be Mr. W. N. Stevens, Editor of "Practical Wireless" and "Practical Television". Applications for free tickets should be made to

FILM SHOW

"Practical Wireless", Tower House, Southampton Street, W.C.2. and *not* to Caxton Hall.

A stamped addressed envelope must be enclosed.

SHORT CIRCUITS IN HEATER CHAINS

A BRIEF DISCOURSE ON A COMMONLY MET FAULT

by F. A. Grindthorpe

THE normal circuit consists of a source where a difference of potential exists and a conducting path across these points. If the conducting path consists of material which resists the flow of current very little load is imposed upon the source and, according to actual resistance value and the available pressure or difference of potential, the exact current can be calculated as our theory tells us by applying Ohm's Law.

The Short-Circuit

With the current known all parts of the circuit can be designed to comfortably carry or pass this and insulated according to the existing difference of potential. The current flows through the intended circuit because this is the only one available provided the designed conditions remain constant. The conditions will change if the resistance of the circuit or the pressure at the source changes or if another path or circuit is offered. If an alternative path of low resistance is put across the original the current will take this path, thus presenting a further and perhaps much heavier load across the source.

It is to provide for such a change in conditions that a "weak link" is included in most circuits which is designed to heat up with a passage of excess current and cause the circuit to break before any serious damage is caused by overheating elsewhere. A fuse or contact breaker does this. Therefore the failure of a fuse will normally indicate that the current has been offered an alternative path. On most domestic appliances the load presented is clearly marked and the supply is fused accordingly. If only this appliance is in use and the fuse fails suddenly no great effort is normally required to find the source of the alternative path or short-circuit which has caused the excess current, normally a breakdown of insulation.

We are not really concerned with this sort of direct short. It is the indirect or partial short which demands more investigation and logical thinking. Now consider a chain of fairy lights which are a number of resistors wired in series. Let us assume that halfway along the chain there is a breakdown of insulation between the supply lead to a lampholder and the return lead as in Fig. 1. The supply now flows through the lamp up to the point of breakdown, where a low resistance alternative path back to the source is now presented. The only supply available for the remainder of the lamps is the difference of potential across the point X which, if it is a direct connection, is very small indeed. Thus the lamps to the right do not light up, whilst those to the left light much more brilliantly. The resistance of the circuit has been approximately halved and, as the supply source remains the same, the current flowing is doubled, still not enough to blow a supply fuse but enough to cause the next "weakest link" to fail, which would most likely be one of the lamps. When this happens the circuit has two faults, an open-circuit, which stops the passage of current completely, and a short-circuit, which will not show up until the faulty bulb is replaced.

The Heater Chain

Now consider what happens when a similar fault occurs in the heater chain of a TV receiver.

This is a very common fault, some valves lighting brighter than normal, others not lighting at all or perhaps lighting dimly if there is resistance at the point of breakdown. Reference to Fig. 2 will show that V6 has a cathode connected directly to chassis as in the case of some sync separator or oscillator circuits, whilst V5 has its cathode returned to chassis through a 100Ω resistor as in some i.f. circuits.

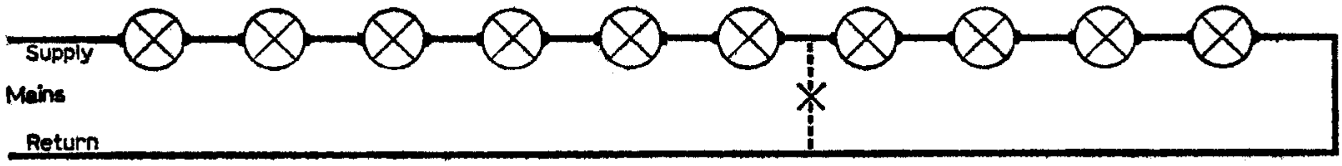
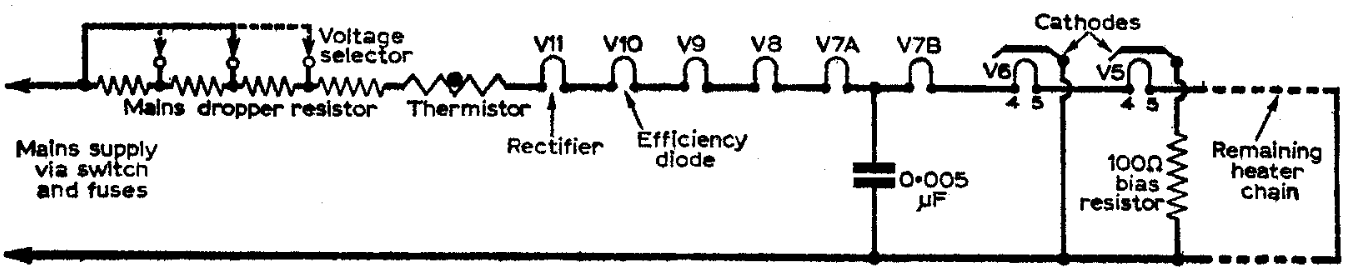


Fig. 1 (above)—Fairy light series chain. Fig. 2 (below)—TV heater chain.



If V6 develops a heater-cathode short the heater current is diverted to chassis, which is the return to the mains, and the valves to the right receive no heater current. The preceding valves light brighter and more current is passed through this "shorter" circuit. The increase in current will probably not be sufficient to cause another valve or the fuse to fail but in some cases a valve further up the chain, which may already have had weak heater-cathode insulation, does not like the added strain and breaks down, in which case the current will rise further, other heaters may fail, the dropper may become red hot and the fuse fail—all within a second or two.

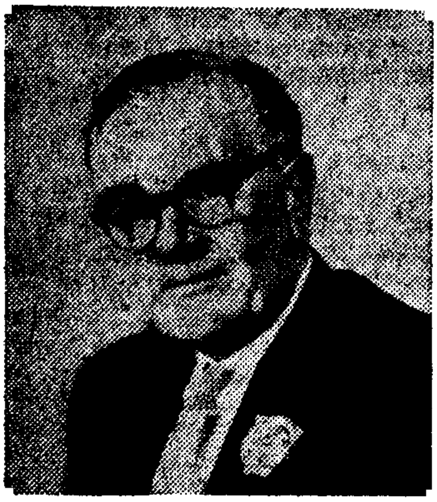
Should V5 develop a heater-cathode short the 100Ω resistor provides a parallel path, the remaining valves receive less heater current, the balance going through the resistor, which will almost certainly heat up according to the current passed. If this is in the sound circuit a hum may be heard if the other sound valves are still receiving sufficient current. If the heat is sufficient the resistor may change value (being of the carbon type), perhaps becoming a virtual short-circuit, the conditions then approximating to those which obtained for a defective V6. The resistor could burn out altogether, whereupon the heater circuit returns to normal with the fault condition becoming those which would obtain if V5 lost emission. Before this, however, the smell and smoke of the overheated resistor would have called attention to it.

More Obscure Shorts

Despite the "chain reaction" which the above shorts can cause, reference to the maker's information and noting which valves light and which do not will rapidly narrow the search down to one or two possible culprits and no real difficulty should be experienced. However, it is often the case that decoupling capacitors are included in the heater circuit and these are often overlooked as a possible source of trouble. Quite often these fail when the circuit is broken at some point, say V6 heater becoming open-circuit, causing the full mains voltage to be applied at all parts up to this o.c. This sudden rise in working conditions causes the capacitor to break down, whereupon the full current flows through the four valves, causing these to light up brilliantly prior (probably) to one failing.

A very common example of a misleading short is when all the valves heat up normally until the line timebase warms up and the whistle starts. The whistle suddenly stops and either the fuse fails, the dropper becomes red hot or, if a valve rectifier is used such as a PY32 or PY33, this lights very brightly indeed before it or the cause of the trouble blows itself out, the cause being a heater-cathode short in the efficiency diode (PY81, for example), when the voltage rises well above the mains or h.t. voltage as it does when the line timebase starts to function. This is what has happened when the fault presented to the repairer is an o.c. heater chain (no heaters glowing) and tests show that the efficiency diode has an o.c. heater. Replacement of the valve restores normal conditions in most cases. ☐

UNDERNEATH THE DIPOLE



THERE is an old saying in show business: "The *flag* and *mother* saved many a bad show". When in doubt playwrights used to introduce something concerning both of these ingredients to ensure full houses in the theatres. "Atmosphere" was helped by oxygen-cum-coal gas limelights with light salmon filters for love scenes, amber for drama, lavender for moonlight and green for tragedy.

Equitation—in Black and White

Battles were won by Caesar, Marlborough, Napoleon and Wellington by the strategic use of colourful cavalry. In mechanised form they were won by Montgomery. In films the first battle for colour was won by Technicolor with the assistance of scenes dominated by horses in Westerns and dogs by Disney.

After lengthy demonstration sessions of the various colour television systems seen lately I am convinced that the fundamental elixirs for success in colour TV should follow the same rules. Take, for instance, the BBC's programme of *The Horse of the Year* transmitted from Wembley. Here was, as usual, a show full of tension, gripping the viewers by the performance of riders and horses. For me a magnificent equestrian display superbly presented by Bill Duncalf and David Kinneard left me thinking about what we were all missing by seeing it in black and white.

Equitation—in Colour

As I gazed at the well-groomed horse and immaculate riders on television I recalled some of the magnificent colour results I had seen on all of the TV systems, particularly the latest version of SECAM. In this case the picture had travelled 338 miles by five microwave hops, public broadcasting, coaxial cables and telephone lines from Paris to London.

Those BBC-1 horses of the year had suddenly become to me drab, anaemic shadows. Where were the glorious scarlets of the hunting pink jackets of the men, the bottle green wear of dashing Irish riders or the svelt navy blue or black habits of the ladies? Where were the verdant greens of the foliage around the jumps or on the hats of the ladies, the dark reddish tan of the floor covering? They weren't on British television as they already are in colour television sets in seven million homes in the USA and—shortly—will be on TV in France, Germany, Holland, Belgium and Italy. *No, sir!* We can't afford it. It is already costing too much to throw money down the drain in flooding the country with a multitude of high, medium and low power stations to increase the coverage of u.h.f. transmission on BBC-2 and—maybe—ITV-2.

What a Pity!

When will the PMG progress in an age which demands coloured Sunday supplements in newspapers, coloured motor-cars, coloured holiday snaps and coloured home movies? Even the "flag and mother" deserve a little colour don't you think? That's what the greatest showman of all time—Barnum—thought. It is a thought frequently in the mind of Mr. Sidney Bernstein, head of Granada. The black-and-white picture of Mr. Phineas T. Barnum is on the wall of every executive office of Mr. Bernstein's television centre in Manchester—a reminder that they are all in show business.

SECAM, PAL and QUAM

These names sound like a trick cycling act in a music-hall who perform miracles of equilibrism on a high wire. Metaphorically speaking that is what they have succeeded in doing. Years after the American NTSC system had been launched colour television is now being received in no less than seven million homes in USA.

Years later the French evolved a slightly more sophisticated version, SECAM, followed by the German development of PAL, the latter of which has been incorporated with a combined NTSC-PAL version called QUAM.

SECAM avoided cross-talk and phase distortions between simultaneously transmitted colour signals with a delaying device which transmits each colour separately, the correct sequence of which is restored in the receiver by a memory system. The German PAL has the same objective as SECAM (i.e. reduction of cross-talk and distortions) but by applying a push-pull kind of isolation of each colour by reversing the phase of each individual line.

Both systems claim advantages over the more straightforward NTSC, in which (when transmitted under unfavourable line or other conditions) peculiar distortions occur which sometimes result in disconcerting effects such as the removal of a girl's lips to the middle of her cheek. At this moment, however, it seems to me that there is little difference in the results of all these colour systems *when transmitted and received under the* *best possible conditions.* But the recent PAL and SECAM improvements indicate that reasonable colour can be maintained under difficult conditions.

405-Line Colour

The next step will be to look at a demonstration of SECAM on 405 (instead of 625) lines and compare results with those obtained with NTSC and PAL—or even QUAM (which has the flavour of a professional legpull). Whatever happens the major originating medium of staged colour TV subjects is likely to be filmed—not live or taped productions.

My assessment of the electronic techniques of colour television is necessarily that of a layman, since this is a highly specialised development in which very advanced TV engineers have their own differing theories. Some of them refer to NTSC as "*Never twice the same colour*", others say that SECAM is really "*Something essentially contrary to the American method*", while PAL supporters claim it means "*Peace at Last*". As for QUAM this has been puckishly referred to as a "*Quite unexpected American manoeuvre*". Which will be selected for use in the UK? The decision will be a political, not a technical, one.

Complications of Colour and Sound

The introduction of colour in television studios (and the film studios which make colour films for television) is likely to introduce complications. For live television more lamps (and larger ones) will have to be used and major changes may be required to the amazing Strand remote controlled lighting system. The elaborate keyboards and stop keys, controlling circuits and dimming devices, will make even greater demands upon the computer system which memorises the lighting as rehearsed. A dozen or more light changes can be pre-set, including changes of colour.

Colour motion picture film for television will also need a memory system for the exact reproduction of any selected lighting arrangement which has been slowly and carefully built up during rehearsals. The lighting problems of colour on film intended for colour television are not limited to 57 varieties, like Heinz's products, but the traditional 67 different hues in the filters on the lamps as listed for years in Strand Electric's catalogue—from "light salmon" and "chrome yellow" to "slate blue". All of these hues will not be required for horse shows—but certainly will be in demand for the Royal Ballet, the Bolshoi or *Sunday Night at the London Palladium.*

Hey Presto!

"Hey presto!" are the magic words that were used on the stage by illusionists and conjurors to restore the two halves of a sawn-up woman. Clever and amusing patter, diversionary actions, decoy lighting and optical devices all played their part in creating the illusion of the famous presentation by P. T. Selbit "Sawing a Woman in Half!" Interest and tension was retained not merely by the rapidity of the trick but by clever variations of the speed of the magician's actions and movements. The most important factor was accuracy in timing not only by Mr. Selbit himself but by the split-second co-operation of his assistants.

Legerdemain

The quickness of the hands deceived the eyes of the audiences in the great music-hall days of David Devant, Chung Ling Soo, Harry Houdini, Carl Hertz and the Great Lafayette. But in this modern age of electronics the technicians of television and films achieve fantastic effects at the pressing of buttons, by vision mixing and by the zooming of lenses.

Trigger-happy Directors

At this point some television directors become trigger happy on the control consoles initiating zooms, cuts and mixes in attempts to mesmerise the viewers with their technological virtuosity—gimmicks galore—and keep your seats for eyestrain! They forget that one of the fundamentals of the art of telling a story in show business is the concealment of the mechanics of presentation.

The stage, proscenium and "tabs" of a normal theatre were devised to hide the scenery, the lights and the people waiting in the wings. True, a modern approach in the theatre world has in many cases abandoned the magic of illusion with theatre-in-the-round revealing the faces of the audience on the other side of the stage and the unveiling of the secret mechanics of the theatre.

Giving the Game Away

Now we can tell all! This technique was initiated on television in some programmes months ago such as TW3 when cameras, lights, microphone booms and autocues were purposely pushed into the picture. These gimmicks have their places but become a bore by repetition.

Even the sudden jerk at the start of a camera track can irritate but it can be hidden by diverting the attention of the viewer to some other quick movement by an actor such as lighting a cigarette or rising from a chair simultaneously with the start of a camera movement. Television directors ought to follow the old show business rules — divert attention to other movements which are natural actions in the scene.

Gimmicks galore will no doubt appear when colour is used by BBC-1 on their avant-avant-avant-garde show BBC-3. "The flag and mother" will be twopence coloured instead of penny plain. Hoarse opera breathed into neck microphones will indeed be horse opera with green cows on red fields and no shooting until the cameramen see the whites of the actors' eyes. BBC-3 will no doubt join in the colour race, bumping and boring the course as an "also ran".

Iconos

FIRST TIME TESTS

By H. W. Hellyer

PART 4: NO PICTURE

IN the previous three articles we have been concerned with the basic structure of the television raster—if you like, the light on the screen. Having got to the stage where we have a good raster, controllable by the brightness control and filling the screen adequately, we are now concerned with the signal which is being used to modulate that raster and produce a picture. One point has already been made—if the brilliance control varies the raster from complete blackout to full brightness there is a fair chance that the d.c. conditions of the video stage are in order.

A fair chance—it is not possible to be more definite than this because the great variety of video circuits and interference limiters, not to mention automatic gain control networks, makes for widely differing conditions. And it must be stated at the outset that remarks apply to 405-line receivers unless otherwise specified. Video conditions are quite different for dual-standard receivers.

If the rotation of the brilliance control does not have the required effect, attention should be given to the coupling between the video amplifier and the cathode ray tube. A glance at Fig. 10 will show why. This is the circuit of a basic video stage with the vision detector, the brightness network and a few of the other things we shall discuss also depicted. It can be seen that the video anode is d.c. coupled to the c.r.t. cathode so that a standing d.c. voltage may be expected at this point, and the grid of the c.r.t. has a varying voltage applied to it from the brightness control potentiometer.

A common symptom is that of uncontrollable brightness ("common" in that it can happen to many different makes of receiver, not that it is likely to happen often to any one particular set, let me hasten to say!). This simply indicates that the biasing conditions of the tube are upset. A typical tube used in the circuit of Fig. 10 would require from 30 to 75V negative at its grid with respect to cathode for cut-off. So a rise in the voltage applied to its cathode because of faulty video conditions

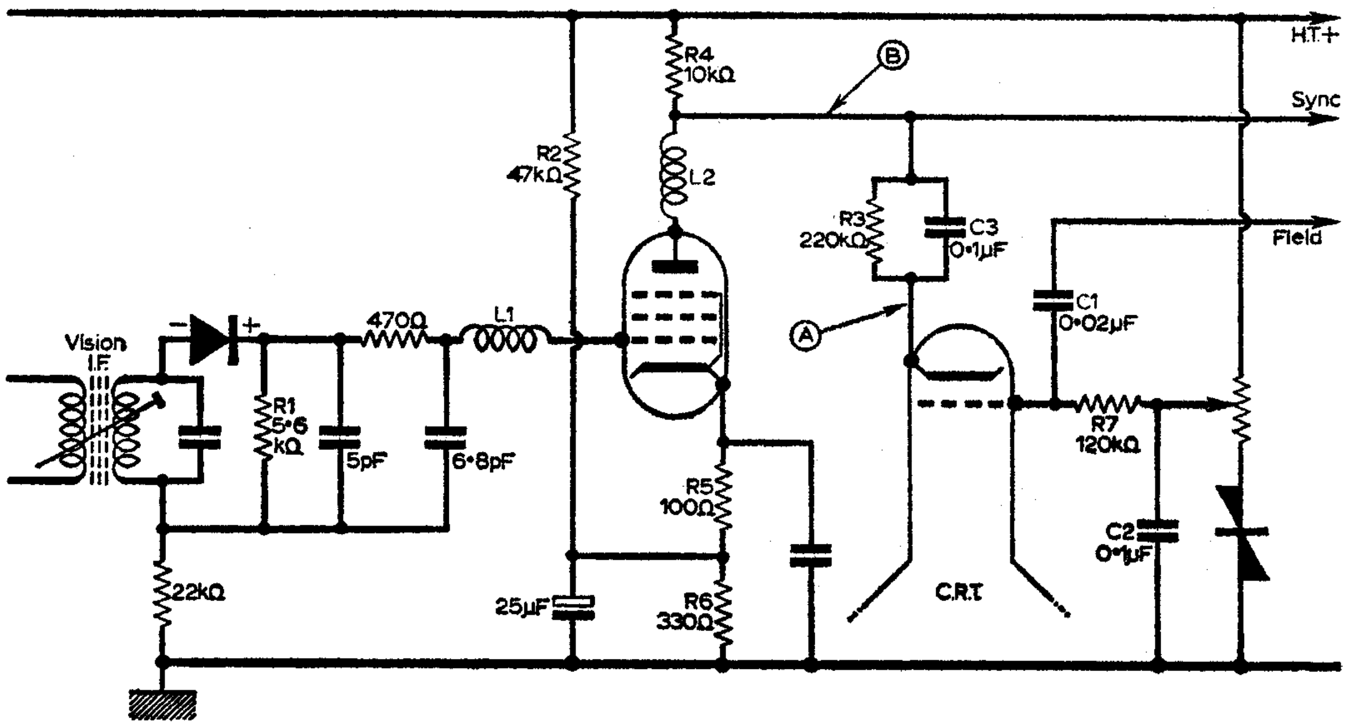


Fig. 10—Basic video and detector stages of a 405-line receiver. See text for reference to numbered components.

would be expected to blank out the raster or dim it considerably, while a fall in this voltage would produce the symptoms of uncontrollable brightness.

This becomes even more obvious in receivers using a brilliance potentiometer network for grid control of the tube as in Fig. 11. Should R2 go open-circuit or, as is more usual, the variable resistor itself develop a fault at the "earthy" end, almost full h.t. potential would be applied to the tube grid at all settings of the control. An over-hasty check of electrode voltages can cause one to overlook this. One must also check for the actual voltage difference between cathode and grid—not from chassis to either electrode—and note its variation when the control is rotated.

If no meter is available it may be possible to eliminate several possible causes by the tests outlined in Parts 1 and 2 of this series. Our aim in this article is to establish whether the video stage conditions are the cause of the blank or over-bright screen.

Referring again to Fig. 10 what are the most likely causes for cathode voltage variation at the tube connection? Taking the case of the blank screen or extremely dim raster that can be brought to maximum brightness when we temporarily short-circuit grid and cathode pins of the tube, imposing zero bias. With that short-circuit removed and the knowledge that the grid is receiving its correct h.t. when the brilliance control is at maximum we are faced with the conclusion that the cathode voltage is too high at point A.

Various Tube Symptoms

It should be stressed that there are various tube symptoms that will cause faults such as this—a lack of first anode voltage, for example. But we have touched upon these matters in Part 2 and need not repeat them.

As the tube is only likely to take from 100 to 350μA the possibility of components between the cathode and the video output going "high" need hardly be considered except for one very important point. The coils L1 and L2 of Fig. 10 are radio frequency chokes. L2, used for high-frequency correction (the bandwidth of the video amplifier having to be retained from practically d.c. up to 3Mc/s), is very often made from a number of turns of fine wire wound on a carbon resistor. Fig. 12 shows the construction of an r.f. choke and illustrates the ease with which open-circuits can occur. The joints of the fine wire with the resistor lead are especially vulnerable.

If L2 should go open-circuit the voltage at point B (Fig. 10) then raises to the h.t. value and the tube is biased beyond cut-off. But an alternative fault that would reduce or cut off the anode current of the video amplifier will have a similar effect. Thus the symptom of "no raster" or very dim raster should not cause one to overlook the simple cause of a low-emission video amplifier.

However, in these circumstances it is likely that some semblance of modulation will be present to give a clue; thus far we are considering conditions of no modulation and incorrect brilliance, so let us not jump too many hedges at once.

A fault that can be confusing if tests of varying

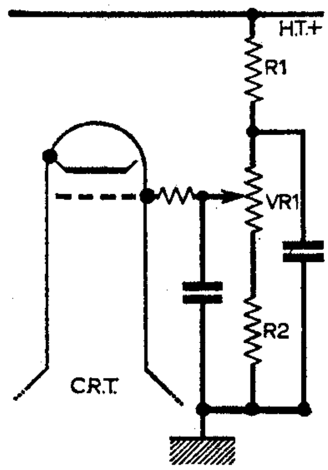


Fig. 11—Alternative brilliance control potentiometer. Note absence of voltage dependent resistor, used as in Fig. 1, to compensate for changes due to varying h.t.

grid voltages are made at the control rather than at the grid itself is a short-circuit of the bypass capacitor C2, which will drag the grid voltage to chassis potential and thus beyond cut-off. Similarly an open-circuit in the cathode of the video amplifier, by no means uncommon, will produce the same effect as an open-circuited anode choke and cut the beam off. As we have seen, these faults can be pin-pointed fairly quickly by first eliminating the tube fault condition.

The opposite state of affairs, uncontrollable brilliance, can be caused by a tube fault such as a heater cathode short-circuit or inter-electrode leakage. If the cathode connection is removed and residual brightness remains, even with the brilliance control set at minimum, it is pretty certain that this is the trouble. As the heaters are virtually at chassis potential this again means that the tube is grossly over-biased. The remedy, apart from the obvious one of replacing the tube, may be to power the heaters from a good isolating transformer so that there is no chassis connection. Too often this is only a partial remedy as the leakage also causes deterioration of the video signal and a smeary, blurred picture. But it is certainly worth a try; a transformer is a good deal cheaper than even the most inexpensive "bargain" tube.

Before jumping to the conclusion that the symptom of uncontrollable brilliance must mean the tube is a dud there are one or two other possible causes that should be investigated. Consider, for example, that innocent looking

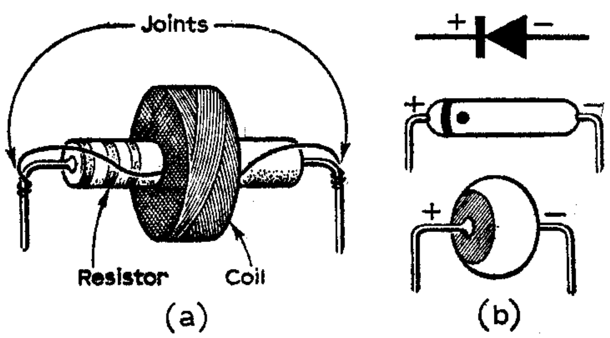


Fig. 12—Peaking coil (a) is wound with fine wire on a carbon resistor. Attention should be paid to the joints, as shown. The symbol for a semiconductor diode and the physical appearance of two such units is given at (b). Polarity must always be observed when refitting these components.

capacitor C1. Its purpose is to suppress the field flyback lines by applying a pulse to the grid to ensure beam cut-off during the field flyback period. It is very often connected to a point in the field circuit which also carries h.t. Then, if C1 goes short-circuit, h.t. is applied to the grid regardless of the brilliance setting. In its "part faulty" condition C1 can cause some queer symptoms and the best way of making sure is simply to disconnect it and put up with the flyback lines while the rest of the tests are carried out.

Working in conjunction with C1 is the resistor R7, acting as a load for the frame pulses. If there is a voltage across this resistor and the two capacitors are in order it may be that the tube has developed a fault. The effect is to reduce the range of the brightness control and again is easily proved by short-circuiting the suspected component, as before ignoring the flyback lines while making the test.

A Quick Test

Assuming that the tube is in order and its bias circuits correct a quick test for video conditions can be made by feeding in a "false" video signal. An audio signal coupled from the volume control via a 0·1μF capacitor rated at above 600V working can be tapped on the grid pin of the video amplifier. If this valve is doing its job properly the resulting modulation should give bars of dark and light variation across the screen, changing with the video content. The capacitor can be tapped back along the input chain to the video amplifier and applied to the detector to check for losses in this circuit, often quite complicated and a possible source of modulation loss.

The difference in signal displayed at each side

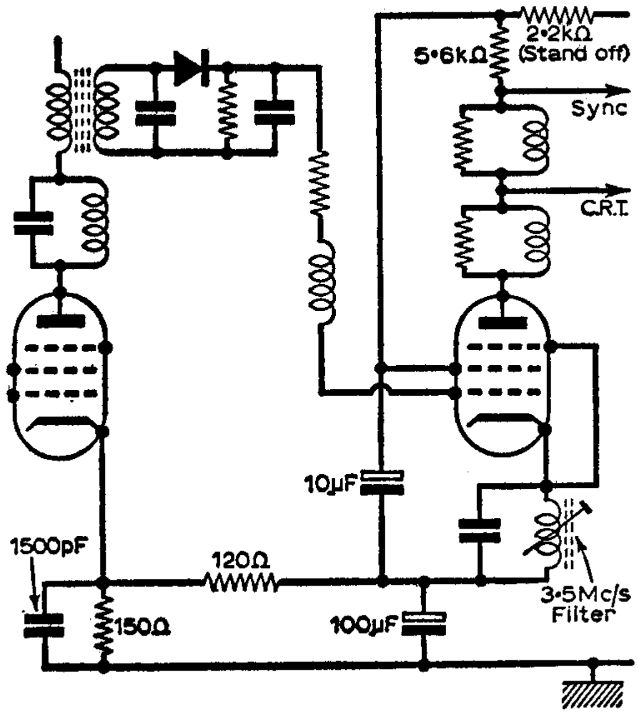


Fig. 13—Circuit of unusual video output stage, showing method of decoupling cathode circuits for maximum low-frequency compensation and optimum d.c. conditions. Video amplifier and final i.f. amplifier share a common bias resistor. Stand-off resistor in h.t. circuit is safety device.

of the diode may not always be significant as the display depends on the nature of the modulation and the settings of the field control for any resolution of the bars. It is possible to obtain a steady bar by tapping the test capacitor from a point on the heater line to the video stage, thus providing a 50c/s signal to which the field can be locked. This gives a hum bar but is not always a reliable test owing to the signal strength and the effect of coupling, which we shall consider later.

Several times in the preceding paragraphs a reference has been made to the "d.c. conditions" of the video amplifier. Without entering too deeply into the "black level" controversy and the vexed problem of d.c. restoration we can say that the usual circuitry entails a d.c. path from the vision detector to the cathode ray tube. Usual, that is, in the sets we are considering, i.e. more than two years old and 405-line only. So we can say that any signal appearing across the video detector load (R1 in Fig. 10) will be passed to the cathode of the tube as a varying d.c. signal amplified by the video output valve. This point is quite important, for it is the d.c. content of the signal that determines the black level of the picture. If, for example, we inserted a capacitor in this "path" we are considering the result would be to reduce the video signal to a pasty ghost of its normal contrasted range and probably to upset the synchronisation as well. (To some extent, when a pentode sync separator is used, the grid-cathode action as rectifier provides a measure of d.c. restoration, but camera changes, etc., would tend to trip the sync more easily.)

These conditions are precisely what happens when L1 goes open-circuited or, as seems all too likely with some models, develops a high resistance joint. The same symptoms are to be observed when the diode detector back resistance reduces. The test for the first fault is obvious but the test for the second is substitution alone. Testing these diodes (typical diodes are GEX34, OA70, GD13, MR1) is quite ineffectual. Even the best ohmmeter can only give an idea of their quality and the back resistance, which may read a megohm or more on a 20,000Ω/V meter, can reduce to a hundredth of this value when the component gets hot or has a few volts applied. (Fig. 12b).

Breakdown—Overload

This brings us to another point. A prevalent cause of breakdown of a detector diode is a temporary overload. The common origin is the video amplifier valve itself. Many a diode has been ruined by having been fitted as a replacement and subjected to heavy overload as a result of inter-electrode short-circuits in the video amplifier.

Another cause of detector breakdown is rather more remote and difficult to prove. This is the problem of i.f. instability. If after replacing a diode the video amplifier appears to get too hot, the anode or screen beginning to glow, suspect this condition, which is easily caused by an open-circuited bypass capacitor. In many sets small disc ceramic capacitors are used as screen decouplers. These are not highly rated components and it can often give an old set quite a new lease of life to replace the decouplers with modern components. The symptoms on the screen may vary from a bright " hash " with hints of modulation to a flat, pasty picture with dark flashes, depending on the bias conditions and, particularly, on the state of the resistors in the video amplifier circuit.

Prime Causes of Video Faults

Up to now no mention has been made of these components, although they are in fact prime causes of video faults. In the circuit of Fig. 10 it can be seen that a measure of regulation is supplied by the potentiometer formed from R2, R5 and R6. The screen grid voltage and the cathode bias of this stage both matter vitally for good results. If the screen grid resistor shows signs of of having overheated—change it. You may possibly be wasting 1s. 4½d. but, on the other hand, this action could save the cost of a video amplifier, a detector diode, several hours of work which may entail rewiring a burned printed circuit board and the wrath of a pictureless family! The author has had the distasteful task of " rebuilding " several video stages which have completely burned out through the bias components having been neglected when, on a previous repair, the valve was changed.

Normally the video amplifier is biased to near cut-off until a signal arrives. The rectified signal across R1 rises with the white content of the signal, the rising positive voltage on the video amplifier grid causes a corresponding current increase through the anode load and a voltage drop at the cathode of the tube, allowing the tube bias to rise from cut-off. So we can say there are two important d.c. voltages to consider; first the black level voltage and second the rapidly varying picture information.

Wide Bandwidth

This rapid variation means that the stage must have a wide bandwidth. For 405-line signals the nominal is 3Mc/s, although the vast majority of commercial receivers do not approach this ideal. Lack of bandwidth affects the high-frequency resolution of the picture (the fine gratings of the test card are an example) and gives a flat picture lacking in detail. Factors that affect this are the load of the valve (in conjunction with its mutual conductance, so do not neglect the possibility of the valve itself being at fault), the detector load resistor and the various shunt capacitances.

Video valves are usually chosen for their high mutual conductance so that a low value of load can be used. This is because the stray capacitances, which are unavoidable, would be aggravated by the use of a high load.

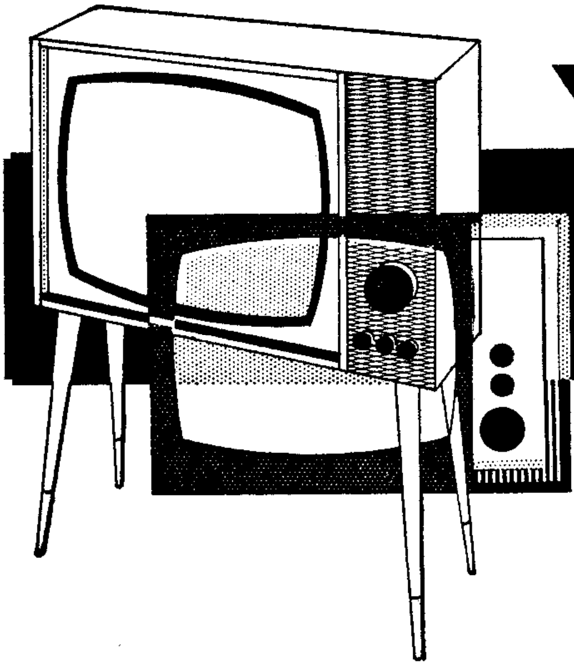
The series network in the feed to the tube cathode is also part of this arrangement. Commonly called an " anti-flutter " network because the time-constant of the components is such as to iron out rapid variations in brightness level that result from changes of signal level as would be caused by aircraft flutter, this is really a low-frequency attenuator. A fault here could give a heavily contrasted picture with black-after-white smearing.

Similarly the cathode circuit has compensation for the frequency losses, bypassing the cathode resistors and sometimes adding loading coils for peaking at trap frequencies (see Fig. 13). A heavily contrasted but poorly detailed picture can result from a short-circuit and a low-gain picture from an open-circuit of the cathode bypass. But much depends on the actual circuitry and, as stated at the outset, there are so many different versions that only general guidance to first-time testing can be given.

The preceding notes have stipulated only the use of a meter and the odd component that the enthusiast should be able to find in his spares box. It will be apparent that time is saved by visual inspection of the video signal at and beyond the detector. For this purpose an oscilloscope and, as an input, a pattern generator are invaluable. Any enthusiast who anticipates a number of tests on receivers for which service data may be quite unobtainable would do well to consider the worthwhile task of building one of the several designs for these instruments that have appeared in these pages.

However, I exceed my brief: first-time tests are for emergencies only and time is only one of the factors that weigh us down, so let us take a look next month at the interference limiters and a.g.c. circuits of the television receiver and consider how we may make a few tests without a ready-made laboratory to support us.

(TO BE CONTINUED)



Your Problems Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 140 must be attached to all Queries, and a stamped and addressed envelope must be enclosed.

MARCONIPHONE VT16A

There is no horizontal hold and very little vertical hold. Sound is perfect. The picture, when possible to get upright, runs across the screen at a fast rate, and sometimes slows down to almost a halt before going the other way. All valves are OK. PL81, PY81, PCC82, PCL82 have been replaced. The wired cap covering to PL81 was burnt. This has been replaced. The combined vertical and horizontal holds are not at the end of their travel. The interference limiter seems to have no effect at all.—H. Hale (Croydon).

It is possible that the trouble here lies in the video amplifier section, particularly if the picture is also a bit watery. Check this valve and the components in its cathode circuit. If the trouble persists, however, attention should be paid to the sync separator stage and associated components, particularly those on the control grid.

MURPHY V410

My set has suddenly lost line hold, the picture is split about ⅓ from bottom by black band, which shows upper part of test card, but the ⅔ above black band is distorted and drawn excessively to the left. The horizontal hold control is fully on, and if retarded loses the picture completely and leaves only a wicker-work appearance on the screen, which is rolling.—G. Kaine (Stoke-on-Trent, Staffordshire).

Check that your main smoothing is efficient, and try substituting the 6/30L2 line oscillator valve between the 30P4 and the U191. Check also the 150 pF capacitor wired across its pins, and the two WX6 discriminator diodes lower down on the i.f. strip.

PHILIPS 1458U

Suddenly the picture went off altogether the sound is OK I had the two tuner valves, PL81, PY81, and rectifier tested and they are OK. The line whistle is present and EY51 lights up. The small transformer beside PL81 looks as if it is burnt out.—C. Horce (North Shields).

If there is no raster (screen illumination) even when the brightness control is turned right up the trouble is caused either by a tube fault or something wrong with the tube biasing, assuming that an h.t. voltage is in fact present. If the tube heater is out, or very dim, it may possess an internal short-circuit. Otherwise, check the brightness control circuit and the video amplifier and feed from the anode of this valve to the cathode of the picture tube.

If there is screen illumination, the trouble could lie somewhere in the vision i.f. stages, including the vision detector and video amplifier.

CHALLENGE C501

On this set I have an e h t. failure. I have checked and tested the PY800 and PL36 and renewed the e.h.t. rectifier valve DY86. The L.O.T. has proved satisfactory after testing and the associated whistle can be heard. Also there is good voltage at the top cap of the DY86 but nothing at the connection to the tube. I have also checked the valve base connections to the DY86.

Sound on all channels is perfectly normal.—E. Willmott (London, N.10).

Provided the L.O.T. has continuity of its e.h.t. overwind and primary windings a d.c. voltage will exist on the anode of the e.h.t. rectifier. Pulse voltage is required here. If this is, in fact, present, suspect a short somewhere on the e.h.t. feed to the tube or in the tube itself.

DEFIANT 9A52

When it is first switched on the frame starts to roll. Then it stops when the vertical hold is adjusted, and stays locked for about two hours. Then it starts to roll again, and the control has to be adjusted again. This occurs about four times each night. I have replaced frame output

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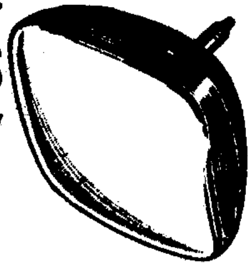

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MW36/24	AW36-21	CRM122	CME1902	C14GM	C19/16A	4/15G	172K
MW31/74		CRM124	CME1903	C14HM	C19/10AD	5/2	173K
MW31/16		CRM141	CME1906	C14JM	C19AH	5/2T	212K
MW43/80		CRM142	CME2101	C14LM	C19AK	5/3	6901A
MW36/44		CRM143	CME2104	C14PM	C21/1A	5/3T	7102A
MW53/80		CRM144	CME2301	C171A	C21/7A	14KP4	7201A
MW53/20		CRM152B	CME2302	C174A	C21AA	17ARP4	7203A
MW43/43		CRM153	CME2303	C175A	C21HM	17ASP4	7204A
MW41/1		CRM171	CME2306	C177A	C21KM	17AYP4	7205A
AW59-91		CRM172		C17AA	C21NM	21CJP4	7401A
AW59-90		CRM173		C17AF	C21SM	SE14/70	7405A
AW53-89		CRM211		C17BM	C21TM	SE17/70	7406A
AW53-88		CRM212		C17FM	C23-7A		7501A
AW53-80		CME141		C17GM	C23-TA		7502A
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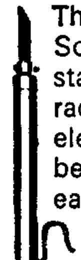

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valve PCL85 and frame oscillator ECH84 with no better results.—F. Brown (Chopwell).

If the lock is fairly good when the frame hold control is correctly set, the drift—if not the valve trouble—could be caused by alteration in value of a resistor or capacitor as the set's temperature rises. Check in particular those components associated with the frame hold control circuits.

ALBA 301

I cannot receive ITV signals but the BBC is perfect. The set is fitted with a Cyldon P/16/H band 3 converter.

I have fitted new PCF80 and PCC84 and tried the coils in another set of the same type but everything seems to be in order. —A. Armstrong (Wimborne, Dorset).

Check that the ITV aerial feed to the set (via the diplexer, possibly) is in order, for the aerial may be delivering BBC signals but not ITV signals. If the aerial system appears to be in order, failure of the tuner's local oscillator on the higher frequency band 3 channels only could be responsible. There may be a faulty capacitor in the PCF80 triode (oscillator) circuit that works all right on band 1 but fails on band 3.

GEC BT125

Sometimes when switching on nothing happens, and at times during viewing the picture and sound disappears for a moment as though quickly switched off and on. The black wire from the contrast and volume controls is broken off at the other end.—R. Kirkwood (Glasgow).

When the set refuses to operate, check the continuity of the dropper sections at the top centre of the chassis. Check associated components and supply if necessary. The common lead of the contrast and volume controls goes direct to chassis.

PHILIPS 17584

The MW43-64 is failing, and as I have a new AW43-80 tube I was wondering if I could fit this as replacement. Also, how can I get rid of the pulse bars at the top of the picture?—D. MacKingie (Maidenhead).

The MW43-64 tube has a deflection angle of 70°. It is also magnetically focused. The correct replacement is an MW43-69. The AW43-80 has a deflection angle of 90° and is electrostatically focused. It cannot be used in place of the MW43-64 satisfactorily. To " push up " the pulse and bar it is necessary to speed up the retrace period. This can be done by altering the value of the components to pin 1 of the left-hand ECL80 (of the pair as viewed from the rear). The capacitor, now 33,000pF can be reduced to 0·02μF.

MARCONI VT68DA

A wire about 10½in. long has become disconnected, the sound and brilliance are perfect but I cannot get the picture.—A. Holland (Stockport).

We regret that from your description it is impossible to identify the wire or circuit which is disconnected. Indeed, the wire may have to be orientated in this way. You will have to let us have much more information before we can possibly help you. Check the circuits to which one end of the wire is connected and send us a sketch of this, showing the actual position of the wire at its connected end.

DEFIANT T172

The set works satisfactorily for up to one hour after switching on, then the line hold lock fails. I have changed V8 (sync separator) but it does not help.—W. J. Graham (Gosforth, Newcastle 3).

It is possible that the line timebase oscillator valve characteristics drift when hot. This valve is best checked by substitution. If the trouble persists and the line hold control has progressively to be turned to keep the picture locked, ending finally at the end of its travel, a check should be made of the resistors in the line hold control circuit, as one (or more) of these may alter in value with temperature rise.

SOBELL 196DS

I can obtain the u.h.f. tuner; what would be the work entailed in fitting and connecting same to receive BBC-2?—F. Berry (Failsworth, Manchester).

This set requires the addition of a u.h.f. tuner and preferably a flywheel sync unit for the reception of BBC-2. The tuner is relatively easy to instal, details being supplied with the component. The flywheel sync unit consists of a printed panel which plugs into the timebase printed circuit panel. Again, details for fitting are supplied with the unit.

AERIALS FOR ITV

For the past two years we have had difficulty in getting a reasonable picture from ITV because of picture break-up. We have had three different aerial " experts " who recommend a parabolic aerial.—J. W. Sharples (Plympton, Devon).

We cannot be sure whether any special type of aerial would solve your problem. It seems as though you may be in a heavily screened location. If you are getting some sort of ITV picture, improvement may be possible with the use of a transistor v.h.f. amplifier for connecting between the set and the aerial. If the break-up is caused by reflected signals, the added gain of the amplifier would enable you to orientate the aerial for the best discrimination against the pick-up of reflected signals.

FERGUSON 315T

The picture quality has gradually worsened till you can hardly see the picture at all. I have replaced V7 (PL36) V8 (PY81) and V9 (EY86) but to no effect. All heaters in the valves are working. Sound OK but just the faint outline of a picture. Aerial connections have also been checked.—B. Simcock (Prescot, Lancs.).

Your remarks strongly suggest the tube is failing. Check the setting of the ion trap magnet on the tube neck (adjust for maximum brilliance) and the voltage across the tube heater pins 1 and 12 which should be 6·3V approximately.

DECCA TU RG 666

The trouble is that once the set has warmed up the picture seems to roll very slightly in an S type movement starting from the bottom and working slowly to the top.—A. R. Bayliss (Southampton).

This trouble is almost certainly caused by the presence of 50c/s hum in the field timebase or vision circuits. The cause is usually low value or failure of one or more of the electrolytic reservoir and/or smoothing capacitors.

ULTRA BERMUDA 6628

A continual burr or buzz comes through the speaker, the set is otherwise all right on sound and vision.—D. Glendinning (East Kilbride).

You have not supplied sufficient information to allow us to make an accurate diagnosis. However, if if the buzz remains with the volume control turned right down it could be caused by failing electrolytic smoothing capacitators in the power supply or trouble in the audio valves. If it fades as the control is turned down, then it could be caused by overloading in the early signal stages, causing cross-modulation, or by misalignment of the i.f. channels. In this latter case, though, the buzz may change in character as the picture content changes.

ULTRA V17-70

The sound is all right but there is no picture, just a white line about ½in. wide going across the middle of the screen. I have renewed the valves 30PL13, 30FL1 and 30P4, but this has made no difference.—G. Jones (Aberdeen, Scotland).

This is the symptom of field timebase failure. Almost any component failing in this section of the circuit would produce just a horizontal line across the screen. If the valves are all right, check the smaller components in the field circuits and also the associated transformers. The trouble could well be caused by open-circuit of the primary winding of the field output transformer.

TEST CASE -37

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.

? *On one of the latest Pye models, the symptom was that of intermittent flashes across the picture. After checking the line output valve, associated components, including the line output transformer, the trouble was located to poor insulation in the line scanning coils, the insulation appearing to collapse after the set had been running for about thirty minutes or so. Flashover in the coils was not visible but coil replacement completely solved this symptom.*

However, the replacement coils gave a picture of somewhat reduced width with an apparent reduction in e.h.t. voltage, revealed by the picture lacking full brightness accompanied by the symptoms of poor e.h.t. regulation. For instance, the screen brightness collapsing altogether with increase in setting of the brightness control.

Assuming that the replacement scanning coils were faulty the resistance of the windings was checked and was found to agree very closely with the values given in the service manual.

The set was switched on again and various tests were made in the line timebase section, but the fault persisted. Then it was found that the scanning coils were overheating.

What could have been the cause of this trouble and what else should the experimenter have done to locate this fault? See next month's "Practical Television" for the solution to this problem and for a further item in the Test Case series.

SOLUTION TO TEST CASE 36
(Page 93 last month)

White lines at the top of a picture on a set in which a thyratron field oscillator valve is featured should immediately lead to a substitution check of the valve itself.

After years of use, the internal resistance of a thyratron may fail to fall to the desirable very low value during its conduction period. This means that the field flyback is prolonged, hence the display of the horizontal white lines and the test pulses at the top of the picture.

A further symptom which may also be present is vertical judder. However, this may not occur immediately after initial warm-up period, since the thyratron may tend to work fairly consistently until it reaches a certain temperature.

QUERIES COUPON

This coupon is available until DECEMBER 23rd, 1965, and must accompany all Queries sent in accordance with the notice on page 136.

PRACTICAL TELEVISION, DECEMBER, 1965

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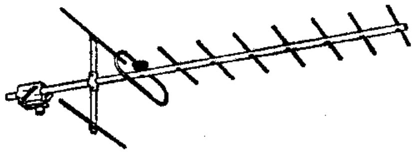

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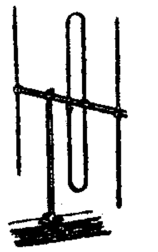

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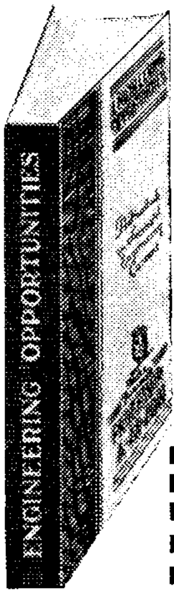

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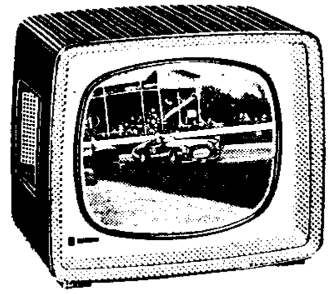

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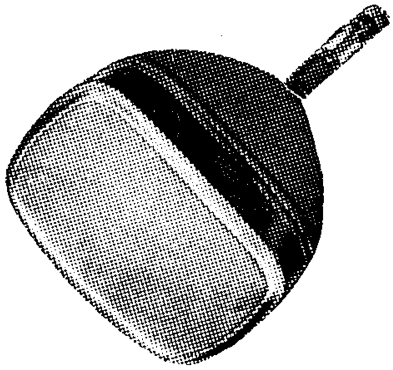

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