Practical Television

1'6

AND TELEVISION TIMES

MAY
1961

How to use oscilloscopes

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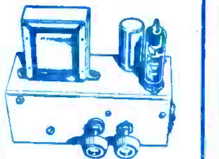

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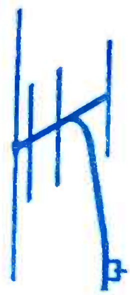

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RM-0 7/11	RM-5 19/6	14A163 38/-			

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Practical Television

AND TELEVISION TIMES

VOL. 11, No. 128, MAY, 1961

Editorial and Advertisement Offices:
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Contents

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

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

Television Aerials

WHEN television first began, one of the common criticisms levelled against it was the unattractive appearance of the aerials which were soon installed on many rooftops. However, it is only within recent years that this problem has been capable of solution—modern receivers are much more sensitive than early models and therefore require a less strong input signal. Modern transmitters are more powerful than their predecessors and their service areas extend for much greater distances. The result of these improvements in transmitter and receiver technique has been an increase in the use of indoor aerials which are not only more attractive but are also less expensive than outdoor types. However, it is not generally realised, especially by the layman, that the use of such aerials must be accompanied by a certain amount of care if picture quality is not to be marred. The main problem is to minimise the effect of reflections within the room; as the viewers move about, it may be found that the contrast of the received picture varies in sympathy. The solution is to position the aerial so that any disturbance is slight.

In certain circumstances, in flats for example, it may be obligatory to use an indoor aerial and the use of loft space will be precluded. Here, such aerials may give very poor results owing to the large amounts of screening metalwork which are likely to surround them. In flats, in particular, multiple reflections are liable to impair the definition of the picture—reflections from objects, and those caused by mismatches along the aerial cable, are both contributing factors. The effect is to cause a series of images on the screen of the receiver rather than a single, clearly defined picture. A very similar effect occurs when the bandwidth of the receiver is reduced from 3Mc/s to, say, 2Mc/s.

There is no easy solution to this problem and we think that in instances where the use of indoor aerials is enforced, then the provision of a multiple outlet amplified distribution system should also be compulsory.

The "best" Aerials

Our experts are often asked which is the "best" television aerial. This, and other correspondence, shows that it is not generally realised that the aerial to be employed depends on the conditions at the particular location. In general, the stronger the signal, the simpler the aerial. However, it may be found that while in one house an indoor aerial suffices, across the road a five-element array is required to secure an acceptable picture. The strength and direction of interfering signals must also be taken into account: it may be possible to use the directive properties of a complicated aerial array to minimise the effects of both man-made interference and reflections of the television signals.

Thus, selection of an aerial for a particular site is only possible by a combination of experience, and trial and error. However, we are always pleased to help readers in this and other television problems provided that their queries are accompanied by the Query Coupon from the current issue, and by a stamped, addressed, envelope for our reply.

Our next issue, dated June, 1961, will be published on May 21st.

Telenews

Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of February, 1961, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	Total
London Postal	697,246
Home Counties	657,662
Midland	477,279
North Eastern	524,914
North Western	450,971
South Western	393,952
Wales and Border Counties	233,133
Total England and Wales	3,435,157
Scotland	387,517
Northern Ireland	118,185
Grand Total	3,940,859

Printed Circuit Equipment

MAINLY as a result of the installation of the automatic, electronically controlled, equipment now installed in a new factory at Boreham Wood, Herts., Printed Circuits Limited are obtaining more and more export orders for all types of printed circuits.

During the month of January, orders were received from Western Germany, Hong Kong, New Zealand, Austria, Australia, Southern Rhodesia and Ireland.

The new equipment enables the firm to produce circuits of all types, rapidly, quality controlled at all stages of processing at a price which is now more than competitive with local production.

Packaged Television Station

AN acute shortage of trained teachers and lack of suitable educational equipment in many areas of the world can be overcome by a new "packaged" television station now being marketed by EMI Electronics Ltd.

Costing less than £10,000, including the studio building and a number of receivers, the EMI packaged TV Station provides a low-cost, uncomplicated television transmitter system which has been specially designed to meet the problems of education in television. The system has vast potentialities, not only in schools, but also in the field of adult instruction in such subjects as child welfare, public health and agriculture. In a region with flat terrain, good reception in schools should be obtained within 15 miles radius of the transmitter.

Plastics for TV Set Design

MATERIALS such as plaster and papier mâché have been used for many years in the construction of television and theatrical sets. Bakelite Limited have now announced the introduction of an important addition to the range of materials available to the set designer—phenolic foam—a cellular plastics material which is fire resistant and easy to prepare.

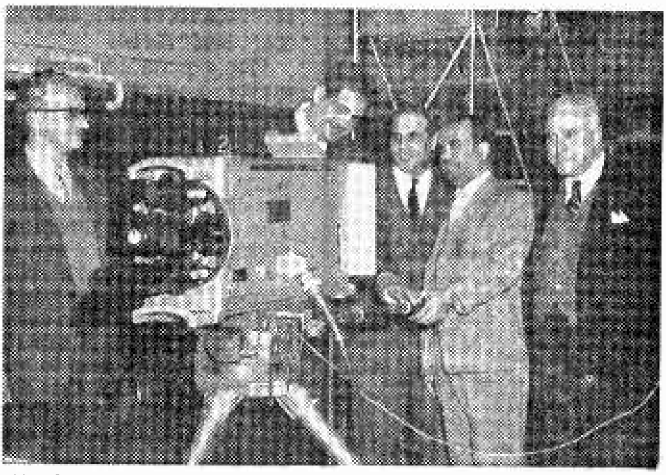
The foam making process is basically simple and comprises the mixing together in a container of carefully calculated amounts of phenolic resin and an accelerator. This results in a foaming action followed by rapid setting of the material.

In practical terms, a landscape set can be built to rough shape by constructing a light timber framework covered with hessian. The foam is mixed and then poured on to the supporting structure where it will harden within the half hour.

Usually the natural flow of the foam is sufficient for the effect required without any further forming or modelling. Where the sets to be constructed serve to add character to the production, however, the hardened foam can be shaped or finished with the greatest of ease without requiring special tools.

15 Colour TV Cameras for U.S.A.

EMI ELECTRONICS LTD. has been given orders totalling over a quarter of a million pounds for 15 colour television cameras, 250 monochrome cameras and other electronic equipment by its



Mr. Salah Amer and other members of his party inspect a Marconi Mark IV television camera at the company's TV Development laboratories.

American distributors, Fairbanks, Morse and Co., West Hartford, Connecticut.

EMI's colour TV camera utilises a novel optical system, several times more efficient than relay lens systems. It is compact and simple to operate, so is ideal for industrial use.

First colour and monochrome cameras under these contracts have already been dispatched to the United States and deliveries are continuing during the next six months.

The BBC Sphere at Olympia

THIS year the BBC celebrates the 25th anniversary of its Television Broadcasting, and, at the Daily Mail Ideal Home Exhibition, the story of its birth and development to the present day was historically traced and visually described.

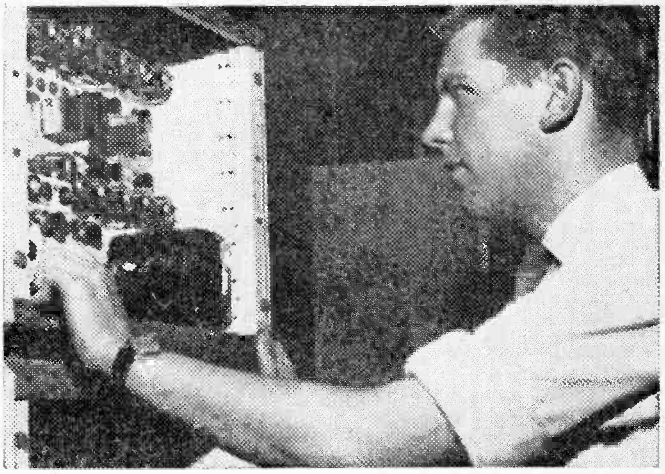
In a sphere which might be described as "an Aladdin's cave of electronic delights", 36ft in diameter and 12ft in height, a cascade of light and sound told the story.

Visitors passed through a dimly lit passageway into an even darker centre, and there saw light spots picking out a model of the Television Centre at White City—the largest television headquarters in Europe—and, appearing suddenly all round, were the flags of all the countries in the Eurovision link-up.

On the stand most of the activities of the BBC were illustrated, ranging from programmes in this country to those which from London now go out to Europe through the Eurovision network, originally sponsored and developed by the BBC, together with the French Television Service, and to North America through the BBC invention of Cablefilm.

Research Rockets

A SMALL exhibition of research rockets was held in the Science Museum recently. It was lent by the United States Navy Headquarters in London. Such rockets are fired to a height of nearly fifty miles and can be used to take samples of the atmosphere as they travel, and to transmit back to earth measurements of the temperature, pressure and radiation. When clear of the earth's atmosphere they can take photographs of the sun or of cloud formations over the earth.



The Pye special Effects equipment in Studio 2 Vision Control at Tyne Tees Television Centre.

The exhibition included five actual rockets of various sizes up to 14ft in length, and a nose-cone which has been recovered by parachute after firing to more than 100,000ft. The methods of firing and the results obtained from photographs were explained on screens.

Russian TV Exchange

NEGOTIATIONS between ATV and the Soviet TV authorities have recently been concluded for a series of "live" programmes from Moscow during the British Trade Fair (19th May to 4th June). Programmes from Britain will cover the Soviet State Fair in London in July.

The opening of the British Trade Fair will be covered by a Russian OB unit under the direction of an ATV producer. Other programmes include ballet from the Bolshoi Theatre and a documentary on life in Moscow. In July, a Russian producer will direct an ATV OB unit covering the Soviet State Fair in London.

New TV Tuner

THE American TV company, Zenith, has produced a new TV tuner which, they claim, can operate in the VHF or UHF bands without the need for conventional fine tuning controls to overcome frequency drift. It is built round a neutralised frame grid triode. A special gold-platinum-silver alloy is used on switching contacts with the object of eliminating corrosion and wear. Frequency stability is enhanced by the use of a glass-filled alkyd material for the channel strips. This is not only stronger than materials normally used, but resists moisture, a major cause of frequency drift. The tuner uses no printed circuitry and is individually wired and soldered by hand.

Egyptian Visitors

RECENTLY Mr. Salah Amer, deputy director of the United Arab Republic Broadcasting Corporation visited the Chelmsford works of Marconi's Wireless Telegraph Company Ltd. With other members of his party and Mr. D. Law, assistant chief of sales (studios), Broadcasting Division, he toured the company's TV Development laboratories.

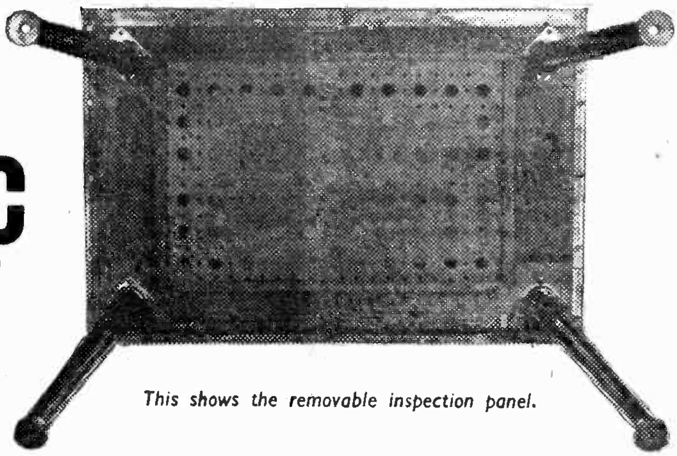
North East Electronic Engineering Exhibition

AMONG the exhibits of the Tyne Tees Television display-stand, at the first North East Electronic Engineering Exhibition, which was held in the City Baths Hall, Newcastle upon Tyne, from Tuesday, 28th February to Thursday, 2nd March, were two Marconi Mark IV 4½in. Image Orthicon Camera Channels, complete with all control equipment. These Cameras are normally used on Outside Broadcasts. Also shown was some of the Pye special effects equipment, as used in the Television Centre, Newcastle upon Tyne. An EMI TR90 sound tape recorder was demonstrated, and the public was able to record and listen to their own voices, with various special effects.

BUILDING A CABINET FOR THE OLYMPIC

(Continued from page 380 of the April issue.)

By R. Edwards



This shows the removable inspection panel.

FINALLY the front and side edges of the stool base (Fig. 9 last month) may be covered. The top and bottom panels may be beaded in, and the speaker slats positioned and fastened by pinning from the back. A piece of gold finished aluminium grille is fixed immediately behind the opening.

Back and Inspection Cover in the Base

Cut out the back to size from 1/8in. peg-board with a hole as shown (Fig. 8, last month). Drill and countersink around the edges for 3/8in. No. 6 screws for fastening to the fillets. Make the cover to the dimensions shown in Fig. 10 and glue and pin to the back over the aperture. The purpose of this projecting cover is to allow a greater air space around the dropper resistance on the chassis.

The holes in the back for aerial, mains lead, control knobs, etc., are best marked out and cut after the chassis has been positioned.

Fit the bottom inspection cover to slide into rebates (see Fig. 9). To give good ventilation it is advisable to enlarge every other hole in the peg-board to 1/2in. diameter.

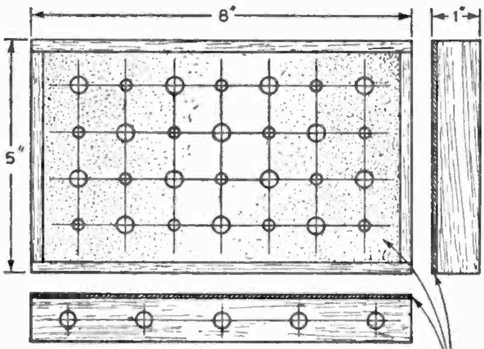


Fig. 10.—The dimensions of the ventilation panel on the back—see Fig. 8, last month.

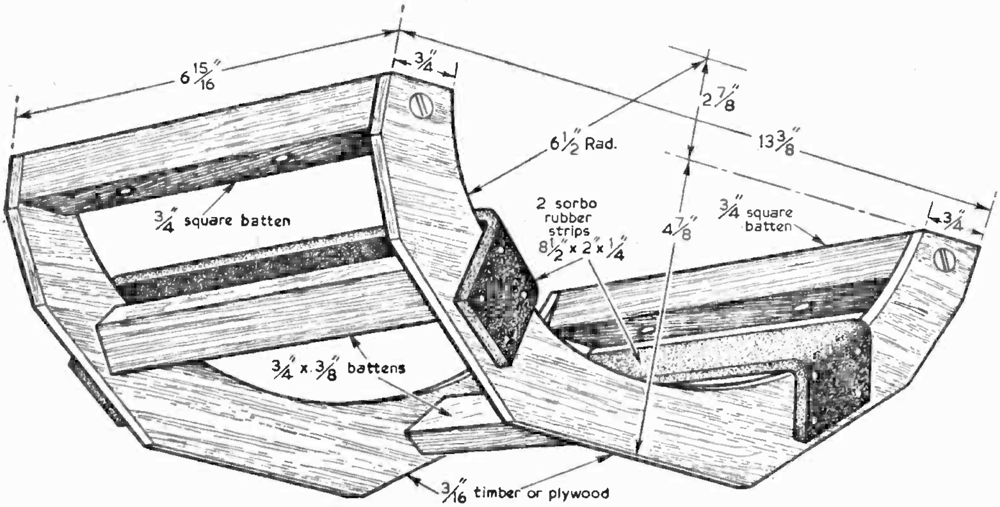


Fig. 11.—Constructional details of the tube cradle.

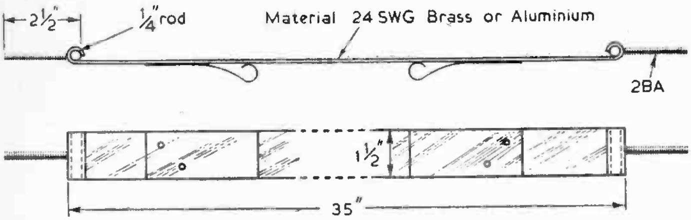
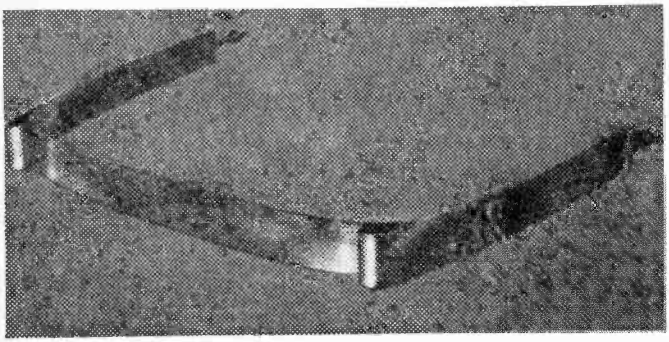


Fig. 12 (left).—Details of the metal tube clamp.

Mounting the Tube

Cut out a 2in. x ¼in. wide sponge rubber strip sufficient to encompass the periphery of the tube face, and sew the ends together to form a band. This should be a fairly tight fit around the tube. Place the aluminium strip in position.



Left:—The tube clamp.

When inserted into the frame, the tube face should project beyond the panel, leaving about ¼in. clearance from the "Perspex" front. Tighten the nuts on stems to clamp the tube and check that it is in centre of mask. Place the cradle in position and screw to edges of frame.

The inside of the cabinet should have two coats of French polish brushed in to seal the woodwork, and finally be painted a flat black. ■

Tube Supports and Clamp

A section of wood, as shown, is cut out and fastened to the bottom of the frame (see Figs. 6 and 7, last month) and this is scribed and cut out to the shape of tube. Holes to take 2B.A. screws are drilled through the ends. The metal strip (Fig. 12) with additional curved pieces riveted on is cut from 24s.w.g. aluminium. The ends are bent round ¼in. brass rods, which in turn are drilled to receive 2B.A. x 2½in. stems. These form, with a nut, the tensioning devices required to clamp the tube.

Blocks 2in. x 2in. x ½in. are glued to the top corners of the frame (Fig. 6, last month) and are for the strap projections to rest against.

The cradle, which is mounted behind the tube, is made up from $\frac{3}{16}$in. plywood sides with solid wood connecting pieces—Fig. 11. Two pieces of rubber strip are tacked across the top and bottom to bear against the tube as shown.

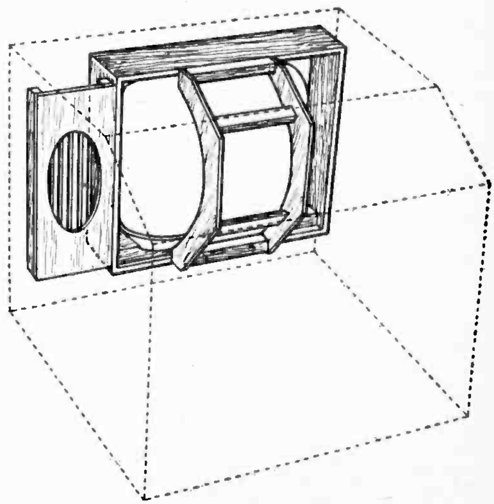


Fig. 13 (right).—The positions of the cradle and loud speaker baffle.

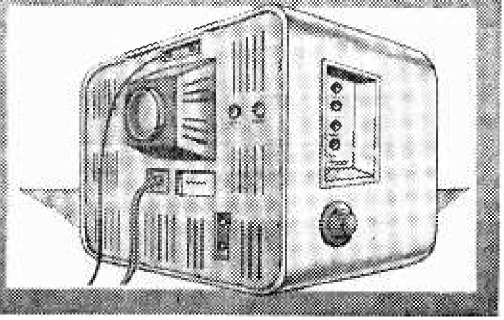
THE OTHER MAN'S FARM

Electronic equipment which will control mechanism to open and close gates automatically, was one of the items shown in the popular ABC Television programme "The Other Man's Farm," televised from the farm of Mr. N. D. O. Capper, Ullingswick, near Hereford, on Sunday, 26th March, 1961, at 2 p.m. It was seen in the Midlands, North, TWW, Tyne Tees, Scotland and Ulster, where a similar type of programme has already been featured.

Discussing this electronic device with Franklin Engelmann and Ernest Milner was Mr. J. T. Taylor, Agricultural Development Engineer, and Mr. J. A. Stokes, Manager, Industrial Electronics Engineering Department, both of Associated Electrical Industries Ltd. They also described other equipment which, although well known to many industries, may well be unfamiliar to farmers as aids to their everyday tasks.

Viewers saw electronic equipment which permits fluorescent lighting to be operated from normal tractor batteries, a vehicle which can be remotely controlled, and an automatic control for artificial lighting which can be used in poultry houses to simulate daylight in an endeavour to increase egg production.

Servicing Television Receivers



No. 67—THE DECCA DM45

By L. Lawry-Johns

(Continued from page 357 of the April issue.)

Line Hold Troubles (see Fig. 1, last month)

VALVE V9 (ECC82) is used as the line oscillator in a multivibrator circuit and in the event of loss of line hold this valve should be the first suspect. As a general rule, the circuit components do not give much trouble and if a replacement ECC82 does not give the desired result, attention should be turned to the flywheel phase discriminator valve V8 (ECL80) and its associated components, although the only items likely to give trouble apart from the valve are the 2μF capacitors C58 and C56.

The Frame Timebase (see Fig. 2, last month)

This consists of a multivibrator formed by the triodes of V6 (PCL84), the pentode of which is the video amplifier, and V7 (ECL80), the pentode of which is the sync separator, feeding an output pentode V16 (PL84). The first fault condition which is likely to occur is frame cramping whereby the bottom of the picture is cramped and the top elongated, probably leaving a gap at the bottom. This is normally due to a low emission PL84 and replacement of this valve will probably put this right—if it does not, check the cathode components R78 and C76.

The second most common fault is lack of height, leaving an equal gap at the top and bottom. This should direct attention to R70 (4·7M, yellow-mauve-green), which is connected to pin 1 of V7B. Replacement will usually clear the condition and restore normal height. Fluctuating height may be due to a faulty height control or a defective thermistor, TH2 (Varite Va 1008).

When V16 is replaced it is usually necessary to reset VR8 and VR9 to provide optimum linearity (equal spacing of the scanning lines).

No Frame Scan

When the raster fails to form beyond a thin white line across the centre of the screen check V16, V6 and V7 and check the anode voltage of V16 at pin 7. If there is no H.T. present the output transformer (T2) almost certainly has an OC winding and this normally means replacement.

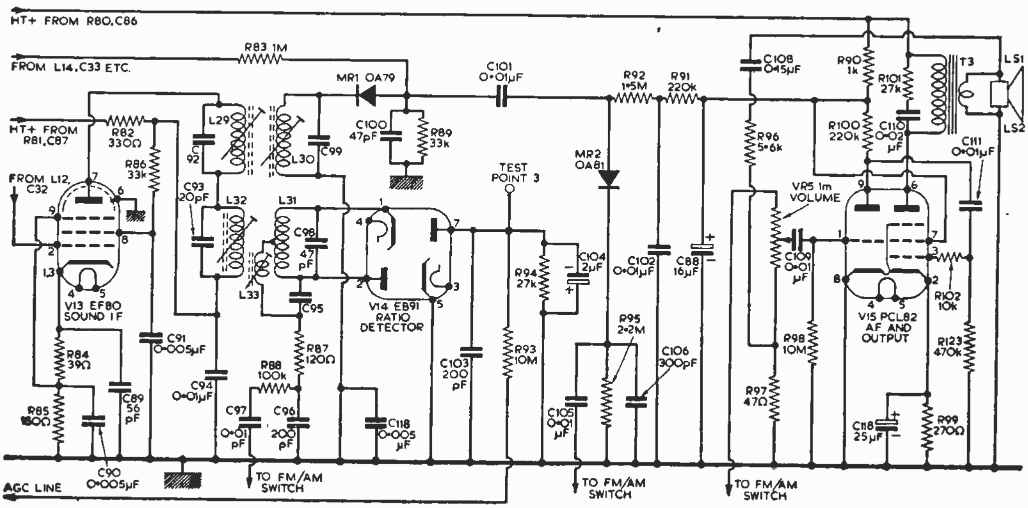


Fig. 5.—Circuits of the sound I.F., detector and output stages.

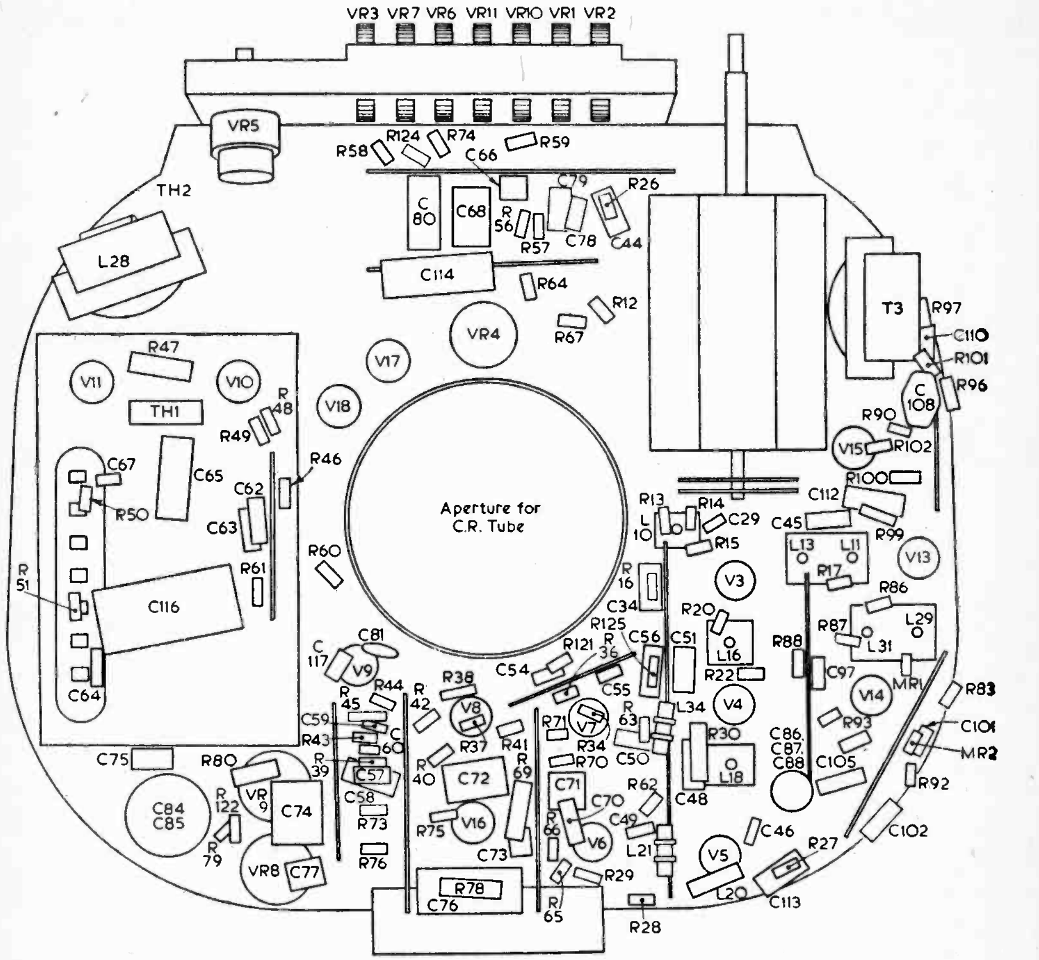


Fig. 6.—A simplified front view of the chassis.

If the H.T. is present and the valves are in order check VR7, TH2, C72 and R70.

Loss of Frame Hold

If the control VR6 is at one end of its travel and the picture is still revolving, check R64, although adjustment to VR4 may well stop the effect for a time. The purpose of VR4 is to enable optimum interlace to be obtained in conjunction with the hold control VR6. Interlace means the correct structure of the frame scan whereby all 405 lines are visible. If the picture is coarse and the line structure is made obvious by thick lines, the frame oscillator is not " firing " correctly and the interlace control should be adjusted until the lines appear finer and the picture detail at once improves. (See "use of controls"). If R64 is not at fault, and the picture continues to revolve, check V6 and V7, R71, R65 and R66 (R67 if necessary). C70, C71 and C73 are not often at fault.

Poor Sync

If the picture is a scramble in both directions, i.e., rolling freely and also pulling sideways, check V7 and V8. Although V8 is concerned with the line timebase the screen of V7 is strapped to its cathode and thus if V8 is faulty the frame sync will be impaired. In this connection C56 should not be overlooked and it is only the work of a moment to shunt a similar value capacitor across it for a quick test.

No Picture—Raster Normal—Sound Normal

If advancing the brilliance displays the line structure (raster) with no vision signal, the sound being normally received, check V4, V5 and V6. Check H.T. to pin 7 and pin 8 of V4. If absent, check the 330Ω feed resistors and the 0·005μF decoupling capacitors, C42 and C43. If these points are in order, check the video choke L20 which connects from pin 1 of V5 to pin 8 of V6. This coil may be o.c. at one end.

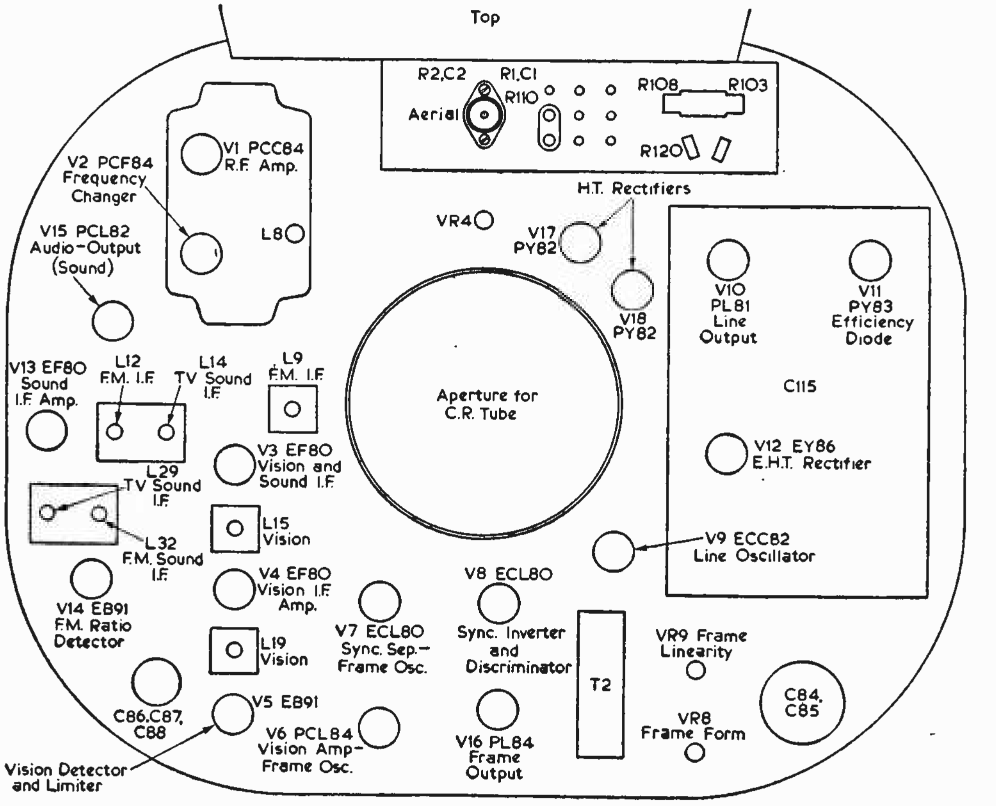


Fig. 7.—Rear view of the chassis.

Vision Normal—No Sound

Check V13, V14 (VHF—MR1 OA79—TV Sound) and V15, having ensured that the loudspeakers are connected.

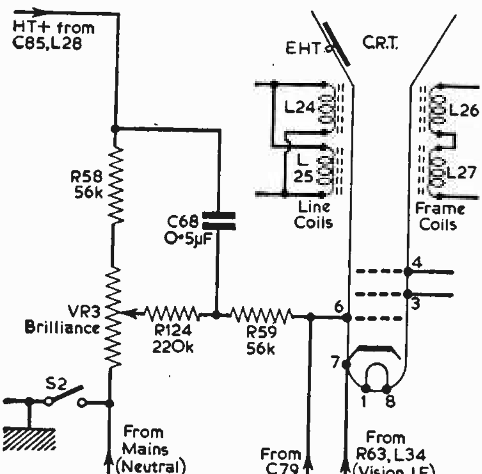


Fig. 8.—Scanning coils, brilliance control and tube connection details.

Distortion of Sound

If on **VHF only,** check aerial, V14 and F.M. coil alignment, C104, etc.

If on **TV sound only,** check R92 (1·5M), MR1 and MR2 (OA81).

VHF and **TV** sound **affected,** check V15 (PCL82), which often develops grid-cathode leakage, R100 (220k) which sometimes "goes high", and if the distortion is accompanied by loud rustling-crackling, etc., check the switch wafer and disconnect H.T. leads for test. "Tracking" across the paxolin sometimes occurs, resulting in varying H.T. being applied to the volume control.

Sound on Vision. R.F. Gain Set Correctly

This refers to ripples or bars across the screen which vary with the sound modulation. Normally it is due to mistuning, but if the fine tuner is at one end of its travel it should be set mid-way and the oscillator core coil adjusted.

There is a hole in the front of the tuner next to the fine tuner spindle which allows a suitable trimming tool to be inserted for this purpose. If the effect cannot be cleared by this means without loss of sound or picture definition, set the core for maximum sound (which should correspond to optimum resolution) and adjust the core of L15. This is between V3 and V4.

(To be continued)

There are many valve voltmeter circuits from which the amateur may select his design; this article will help you in

Choosing a Valve Voltmeter

to suit your requirements

By R. Brown

THE universal multirange meter is a very useful instrument, and few of us would like to find ourselves without one. Its frequency range is, however, very limited, usually to the low audio frequencies, and it is impossible to measure frequencies above this limit. To measure such voltages, and to make measurements in high impedance circuits, the valve voltmeter has to be used.

This is an instrument, using valves, which measures voltage over the same range as the multimeter; but which presents a very high input impedance to the circuit being tested, and covers a very wide frequency range. A great many of these instruments are commercially available, either in kit form or made-up, and articles describing their construction regularly appear.

The type of circuitry used in any particular instrument will depend largely upon the job it is intended to do.

Rectifier Plus Amplifier Instruments

The most common type of valve voltmeter is the one shown in Fig. 1. The audio or radio frequency voltage to be measured is fed into a diode detector. The output from this detector will be a direct voltage which will be proportional to the peak value of the signal being measured. This is shown in Fig. 2. On the positive half-cycles of the signal the diode conducts and charges the capacitor. On the negative half-cycles the capacitor discharges slowly through the load resistor. As a result of this alternative charge and discharge the voltage across the resistor will be slightly less than the peak value of the signal; but R is usually very large so that the discharge is very slow, and the voltage across R can be assumed to be equal to the peak value of the signal for practical purposes.

A D.C. meter cannot be connected directly across the anode load to read this voltage, since its low resistance would cause the capacitor to discharge rapidly during the negative half-cycles of the signal; ruining the accuracy of the instrument, and making its input impedance very low. So some form of electronic circuit must be included between the diode load and the meter. This circuit should provide a very high input impedance, since it is connected across the load resistance.

A high impedance input can be easily arranged using a triode valve, but since the voltage is direct the valve, or valves, must be directly coupled, and the meter readings tend to drift with changes in the mains voltage, valve ageing, etc. Some means of counteracting this must be found, and one such arrangement is shown in Fig. 3.

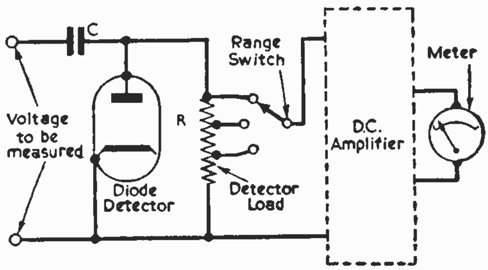
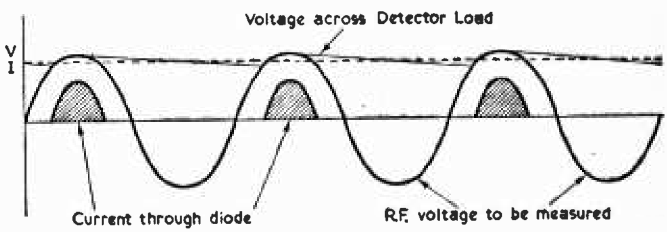


Fig. 1 (above).—The circuit of a rectifier-amplifier valve voltmeter.

Fig. 2 (below).—The voltages and currents in the detector circuit.



Two triode valves are used, of the same type, and connected in the same way. The meter is connected from the cathode of one valve to the cathode of the other valve, and the circuit values are chosen so that when there is zero input voltage the cathodes of the two valves are at the same potential; there is, therefore, no current through the meter, which indicates zero.

Any change in the mains voltage should now affect both valves equally, and, it is hoped, the valves will age at the same rate. This is probably

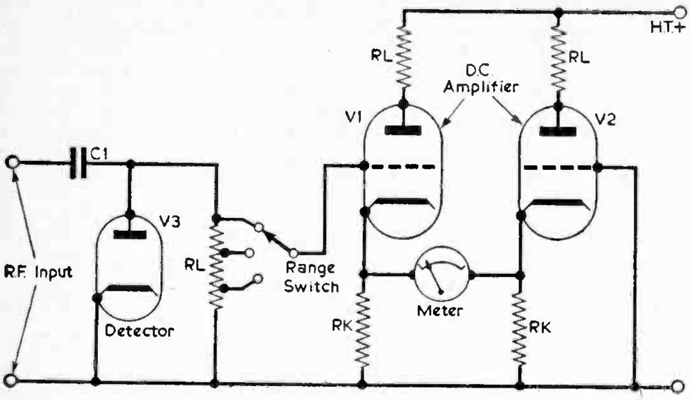


Fig. 3.—Another form of valve voltmeter.

the simplest form this type of voltmeter can take. It reduces drift by quite a lot; but other more complicated circuits are used, and these circuits reduce the drift to a correspondingly greater extent.

The drift is most noticeable on the most sensitive range of the instrument, and generally speaking the more complicated the circuit, and the more valves it uses, the less the drift, and the greater the sensitivity. With the circuit shown in Fig. 3, for example, the most sensitive range would probably have a full scale deflection of about two volts. With more complicated circuits, however, the full scale deflection could be as low as 300mV.

With most diodes the highest voltage that can be measured is 100V, although there are several diodes suitable for voltmeter use which can be used up to 300V.

The frequency range of the instrument depends largely upon the diode. Up to about 100Mc/s the frequency response is flat for almost all small receiving diodes. Above this frequency the inductance of the leads to the diode, and the transit time of the electrons from cathode to anode of the diode become important. The equivalent circuit of a diode at VHF is shown in Fig. 4 to be a series resonant circuit. The resonant frequency of the circuit, may be anywhere between 600 and 3,000Mc/s; but long before the resonant frequency itself is reached the inductance and the capacitance of the diode will have caused the voltmeter to give readings much higher than they should be. This is shown in Fig 5.

The relatively long transit time of the electrons at VHF will have opposite effect to this. The positive half-cycles of the signal will be over before all the electrons have reached the anode. The charge on the capacitor will thus be less than it should, and the voltmeter will read low. This is also shown in Fig. 5, and the combined effect of transit time error and resonance are also given.

A full scale deflection of 300mV on the most sensitive range is the best one can hope for with this type of voltmeter, and this sensitivity can only be achieved using the more complicated and expensive instruments. It is, however, possible to improve on this sensitivity, and with a reasonably cheap instrument. Instead of a diode detector, a leaky grid triode detector is used, the triode valve being in the probe.

With such an instrument the full scale deflection on the most sensitive range can be as low as 150mV. The maximum voltage that can be applied between grid and cathode of a triode valve suitable for this job is, however, limited to about two volts. This rather limits the applications of this type of instrument, and it is essentially a cheap method of measuring low radio frequency voltages, and is not a universal valve-voltmeter.

Amplifier-Rectifier Instruments

This is the second most used type of valve voltmeter. The voltage to be measured is first amplified in a wide band amplifier, and then rectified and fed to a moving-coil voltmeter.

The circuit of a simple instrument of this type is shown in Fig. 6. A cathode follower input is used, followed by a two-stage R.C. coupled amplifier. The output from the amplifier is fed

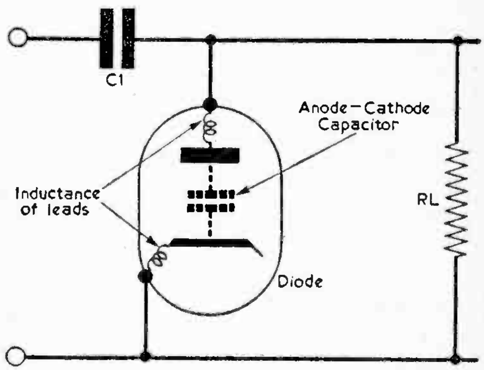


Fig. 4.—The effective circuit of a diode at VHF.

to a full wave rectifier which feeds the moving coil voltmeter.

Heavy negative feedback is applied over individual stages of the amplifier, and the output current from the amplifier flows through resistance R1, providing overall negative feedback. The effect of this feedback is to stabilise the gain of the amplifier so that it is largely independent of variations in mains voltage, component changes, and valve changes. It also helps to make the voltmeter scale more linear. This scale would otherwise be very crowded at low voltages because of the curvature of the rectifier characteristic.

The amplifier is usually fitted with high-frequency compensation circuits which, with the heavy negative feedback, ensures that its response is flat over a wide frequency range.

With a circuit similar to the one in Fig. 6, an instrument with a full scale deflection of between

10mV and 50mV on the most sensitive range can be produced. By including one or more further stages of amplification this sensitivity can be greatly increased, and instruments with a full scale deflection of as low as 1mV can be produced.

The frequency coverage is very much less than with rectifier-amplifier instruments, typical figures for the upper frequency limit being 1Mc/s to 5Mc/s, although instruments with upper frequency limits of as high as 10Mc/s or even 30Mc/s have been produced.

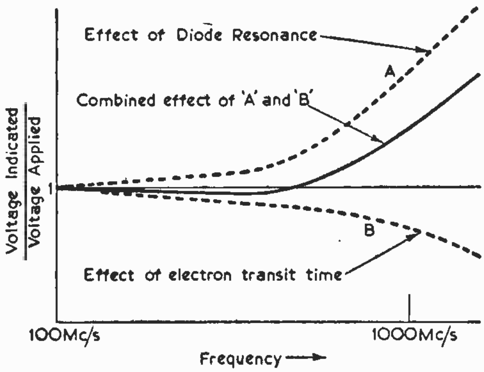


Fig. 5.—Before the resonant frequency is reached, the inductance and capacitance of the diode will have caused the voltmeter to give readings higher than normal.

Switching of voltage ranges is normally carried out in two ways. The load resistor, R2, of the cathode follower usually has a number of tapping points on it. The voltage developed across the whole of R2 is fed to the amplifier on the most sensitive range, on other ranges only a portion of this voltage is fed to the amplifier. The range covered by the instrument is further increased by including an attenuator between the input of the instrument, and the cathode follower. This attenuator can then be used to attenuate voltages which are too large to be applied directly to the input of the cathode follower. In this way complete coverage from say 1mV full scale deflection to as much as 300V full scale deflection can be achieved.

The amplifier-rectifier valve voltmeter has much more sensitivity than the rectifier-amplifier valve voltmeter, although it covers a much more restricted frequency range. The rectifier-amplifier valve-voltmeter is also of more general use since it is possible to measure direct voltage and ohms with it, while the amplifier-detector instrument is A.C. only.

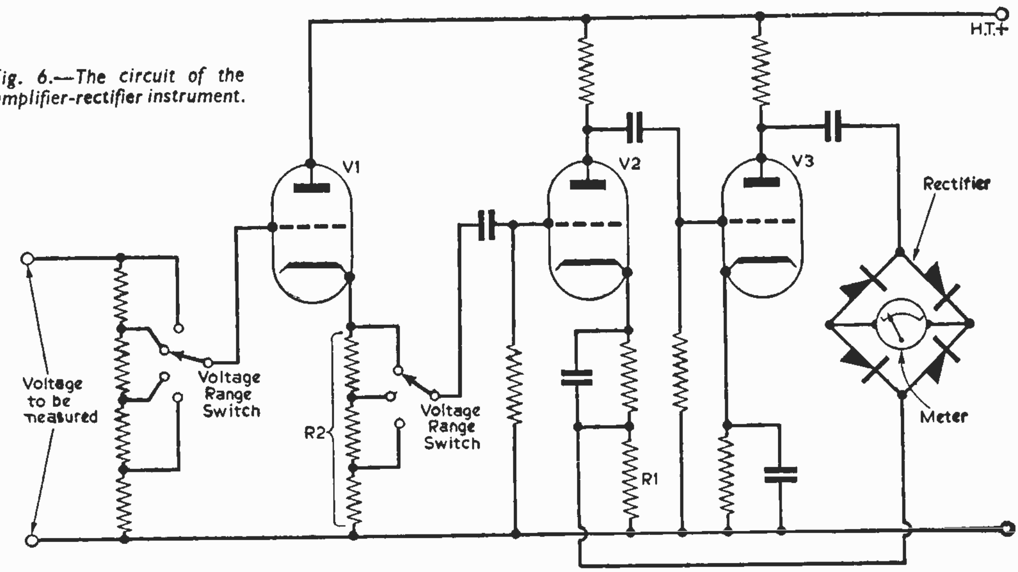
Interpreting Specifications

It is not always quite clear what an instrument manufacturer or instrument kit manufacturer means by the details set out in the published specification. Not that this is an attempt, as is sometimes rather ruefully said by people who have bought an instrument only to find that it doesn't do quite what they expected, to pull the wool over the customer's eyes. It is just that it is difficult to state the range and accuracy of a valve-voltmeter in a simple manner. The voltage range, for example, is usually quoted in two ways, the specification states that the instrument will measure voltage over the range of, say, 25mV to 300V with an accuracy of 3per cent of full scale deflection, ±10mV. The ranges of full scale deflection being 300mV, 1V, 3V, 10V, 30V, 100V and 300V.

Now just what sort of results is this instrument going to give? Well, the first point to note is that, in common with almost all valve-voltmeters, the accuracy is greatest at full scale deflection; it falls off fairly rapidly as the voltage being measured

(Continued on page 428)

Fig. 6.—The circuit of the amplifier-rectifier instrument.



Television Sound Faults

TRACING INSTABILITY AND DISTORTION

By L. E. Higgs

THE sound circuit of television receivers is often considered an "also ran" by some TV enthusiasts—and certain manufacturers—but a detailed examination of this necessary part of the set reveals it comprises at least one-fifth of the total circuitry and can produce some interesting fault symptoms peculiar to TV only.

Response

The good frequency response of TV sound, noticed since early days of TV, is due to the virtually unrestricted bandwidth of sound transmission compared with the restricted range of AM radio sound. The TV sound tuned circuits are adjusted to give a wider pass-band than strictly needed to reproduce the highest audible sound in order to accommodate local oscillator drift without sound loss and, strangely enough, to allow ignition pulses to reach the detector undistorted where they can operate a limiter more effectively. This does not mean that sound circuit trimmers cannot be peaked, because the coil coupling within the sound I.F. coils is often pre-set to give the required pass-band width.

The circuit of a typical TV sound section from the detector onwards is shown in Fig. 1, and most circuits will be found to correspond generally in most respects with this model.

Frame Tick

This trouble is recognised by a regular fast ticking or high pitched buzz in the background of the sound which does not change with the picture content, and is present when not tuned to a station and which varies when the vertical hold control is turned. Check the main H.T. smoothing capacitors for reduced capacity by bridging across with a spare 60μF, making sure the polarity is correct (Fig. 3). Hum and horizontal whistle from the speaker may also be present with this fault, and if the bridging clears it then the smoothing capacitor bank is deteriorating and should be replaced. Poor volume control input wiring screening can cause "frame tick" also, but, in this case, turning the volume control down either increases or decreases the sound. The best remedy is to probe gently and pull the wiring in the region of the volume control and high gain points of the circuit and try screening those most susceptible to hum. Use a

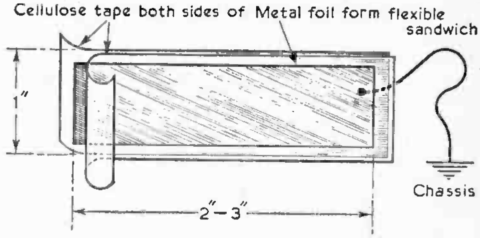


Fig. 2.—An insulated screen for reducing hum.

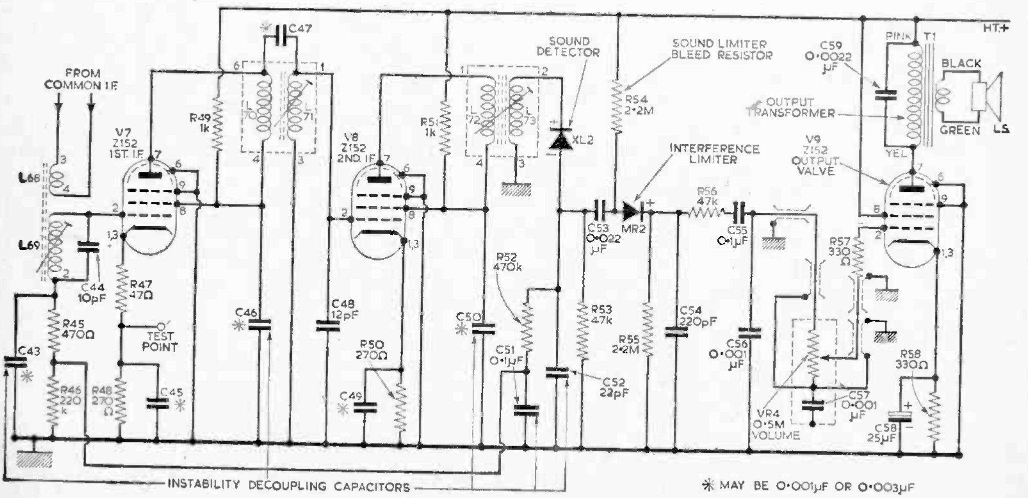


Fig. 1.—A typical sound section circuit.

strip of metal foil, well earthed, sandwiched between two layers of adhesive transparent tape (Fig. 2). If screening a component or wire silences the "tick", then the screen might be left in the chassis permanently or the offending wire replaced with a screened type. Poor bonding of screened wires also gives rise to this effect. Finally, this fault can also be caused by inter-electrode leaks in multiple valves where vertical oscillator and sound share the same vacuum space or cathode. Valve substitution is the quickest check here.

Horizontal Whistle

Like the vertical "tick", this trouble is due to part of the horizontal timebase voltage leaking back into the sound circuits, and the remedies to try are the same as above. Test for this by listening closely to the speaker while adjusting the line hold with the aerial disconnected, and the note should change and be heard through the speaker.

Hum

If present without the aerial plugged in, hum can be due to H.T. decoupling—test by bridging as explained under "frame tick".

Heater to cathode leaks can cause a larger proportion of hum faults in TV than in radio because there are so many more valves that can be involved. As many receivers put A.F. stages in multiple valves (double triodes, triode pentodes and double diode pentodes) with other sections performing "noisy" functions unconnected with sound, the results of leakage between sections (Fig. 4) can cause strong hum, possibly aggravated when the valve is tapped —again substitution is the quickest test as valve testers do not always show up intermittent defects. Do not confuse the prominent frame buzz that is emitted from the scan coils direct, and not from the speaker, with hum, and take care to differentiate between the sound of 25c/s of coils mains hum from the rattling buzz of *vision-on-sound*.

Vision-on-Sound

This is a harsh buzz that breaks through the sound only when a channel is being received—it cannot occur with the aerial disconnected. On a normally operating TV, tuning the fine tuner on the channel selector until the sound fades out, without losing or wobbling the picture, gives a buzz that rises over the sound; this is the video signal and will vary with the picture content—quiet with a grey or blank background and loud with large black and white areas. This is a good exercise to enable one to recognise this fault—on a normal set off-tune. Obviously if this trouble crops up, retuning the local oscillator is the first check. Remember, that if the fine tuner on one channel does not quite reduce this buzz—but the other channel is normal, there is a good chance that the coarse tuning slug in the turret is off-set and requires a slight adjustment on that channel only.

Another cause of *vision-on-sound* is overloading of the R.F. stage by too much sensitivity or too strong a signal from the aerial. Fitting attenuators in the aerial lead will cut out this type of sound buzz.

Leakage across common sound and vision valve sections—such as vision limiters in the same envelope as A.F. amplifiers—can cause *vision-on-sound*, and valve substitution is required for a quick test. Tuning misadjustment of the I.F. and R.F. tuned circuits as a result of tampering with the slugs or trimmers is difficult to clear without a complete re-alignment exactly following the maker's procedure.

Intermittency

Crackles and fading in the sound, if accompanied by disturbances on the screen, are caused in the common sound and vision stages of the receiver—including the aerial and feeder. However, noise, with no picture disturbance, generally arises subsequent to the sound take-off point in the common circuitry. Valve pin contacts, defective components, faulty valves and the volume control constitute the main sources of crackles. Gentle probing and tapping of suspect parts is the best

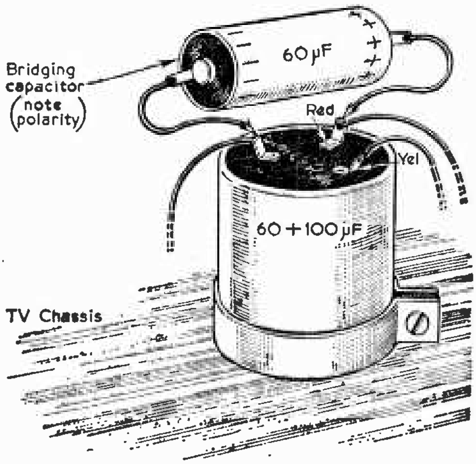


Fig. 3 (above).—The method of bridging a main smoothing capacitor.

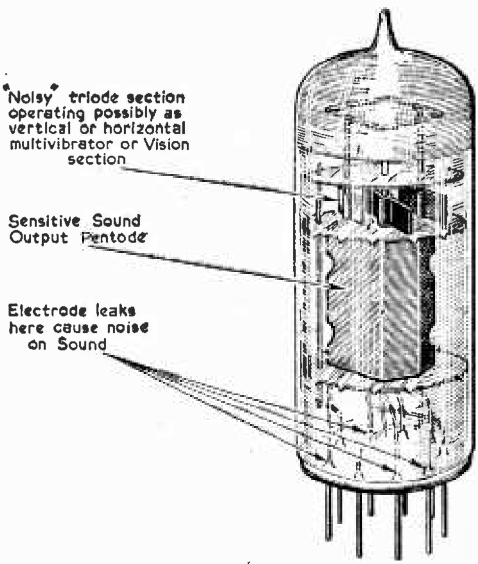


Fig. 4 (above).—The cause of inter-electrode noise.

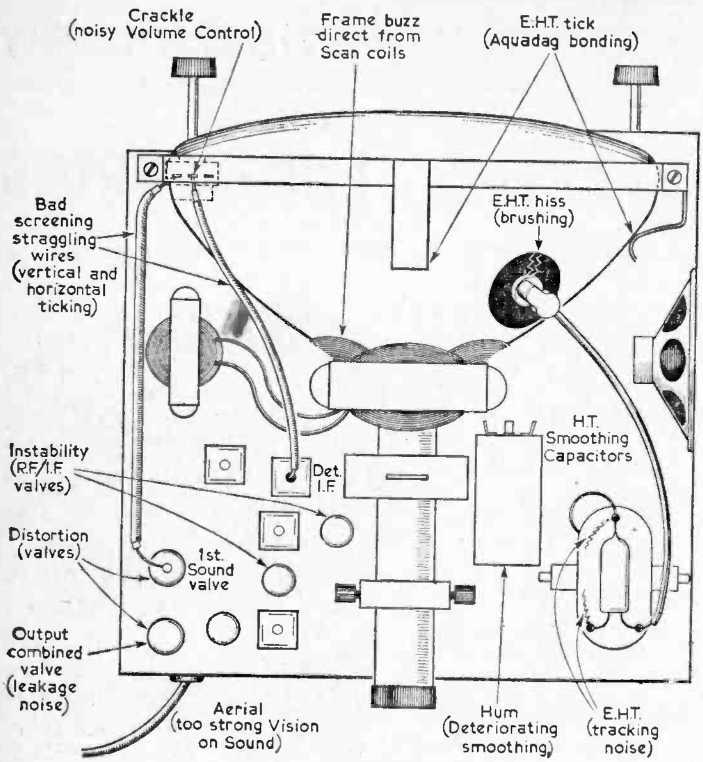


Fig. 5.—Possible points on the chassis where noises may originate.

approach to locate intermittent noise. It is advisable with intermittents to notice whether they are affected by a warming up delay and not to try looking for the trouble until the conditions exist.

Interference Limiter

This part of the circuit is peculiar to TV circuits and generally takes the form of a diode in series with the audio output from the detector (Fig. 1). With audible frequencies, the diode acts as a low resistance and passes the speech or music on to the amplifier stages. But, by a long time constant coupling arrangement, steep fronted high frequencies, e.g. motor vehicle interference pulses, bias off the diode momentarily switching off the sound circuit for the fraction of time that the impulse exists.

The efficiency of these arrangements varies considerably. The transient-triggered circuit is pre-set by the maker's choice of circuit components to "switch off" when a frequency just above audio range is received. Now, as these parts deteriorate, the upper trigger limit is reduced to *within* the audio range with an initial effect of exaggerated sibilant sounds—hisses and ssh's following "ess" sounds. This is nearly always due to a high value H.T. bleed resistor (Fig. 1) of around 2-3M going high in value (possibly 5-20M). The rise in value lowers the circuit time constant, causing audio clipping. When the resistor goes really high the sound output is weakened and distorted.

The diode in these circuits can be of the metal (germanium) or thermionic valve types.

Distortion

Generally, distortion only takes place after the sound detector, as overloading in tuned circuits is unaccompanied by wave distortion due to the integrating effect of the resonant anode circuit. But, after the detector, everything can be suspect. The detector itself, the interference limiter (above), the usual two valve stages and their feeds, or even the loudspeaker itself. The best test for distortion is to "listen in" at the output valve grid, the live upper volume control tag and the detector in turn to isolate where the distortion stops—with phones (isolating capacitors in each lead: 350V A.C.), and trace forward from there.

EHT Tick

Spasmodic ticking that is sometimes missing, seldom rhythmical that occurs with the aerial disconnected and varies with picture brilliance, usually comes from the EHT D.C. circuit. Switch off all the room lights for this trouble and often, around poor bonding on the tube coating, a spark may be seen to flash with each tick. The EHT rectifier, too, may be defective and twinkle within when ticking takes place (Fig. 5).

EHT Hiss

A rushing noise in the sound, accompanied by random spots all over the screen or vertical ragged bars down the raster, is sometimes encountered on damp days for a little while after switching on. This is the effect of EHT tracking or brushing, over damp or dirty insulation in the line EHT high voltage points.

Cleaning insulating surfaces and adding a smear of silicone grease clears up this trouble if the materials are not pitted and carbonised (Fig. 5).

Instability

This effect is a roaring sound, distortion or a faint plop with permanent or occasional loss of sound. The alteration of the sensitivity, contrast, and fine tuning control may affect the condition, and there will be patterning on the screen to accompany it. If the internal trimmers have not been tampered with at any time, then this most difficult fault can be cleared by eventually tracing back to a faulty sound or vision valve which is oscillating—often owing to a screen, cathode, or H.T. decoupling capacitor deteriorating to a low value. Bridging all suspect capacitors with a 1000pF capacitor with short leads is the quickest check (Fig. 1). ■

Flywheel Synchronisation

Part 2

COMMERCIAL CIRCUIT I

By R. Talks

IN this circuit g1 and g2 of the pentode section of V2 are the oscillator electrodes. The coils S1 and S2 consists of 675 and 2265 turns of 42s.w.g. S.S.C. wire wave-wound on a 6mm diameter former. A long ferroxcube core of 3mm diameter is a coarse frequency control. The line hold control consists of a fine control in the form of a hinged metal flap. This acts as a shorted turn with variable coupling to the coil, the long core passing through it. The oscillator, of course, works in Class C, and its anode current pulses provide the drive waveform for the line output valve V3. The rising edge is shaped by R12 and C11 to bring the pentode back sipation exceeding the valve limit; it has to be bypassed at oscillator frequency by C13.

The triode of V2 is the reactance valve. The anode resistance (ra) would normally give heavy damping of the oscillator tuned circuit. This is prevented by feeding the grid with a signal in antiphase to that at the anode and $1/\mu$ of its amplitude. In addition, of course, we need a quadrature component at the grid to produce the variable reactance. In this circuit we require an increasingly positive discriminator output to increase the oscillator frequency. This is economically arranged by feeding the reactance valve grid via C9 from the opposite end of the tuned circuit from the anode. The grid circuit is effectively a capacity shunted by a resistance. This provides both the antiphase (to the anode) component and the correct quadrature component.

In the discriminator, T1, is the phase splitting transformer fed with sync pulses via V1, the function of which will be discussed later. The

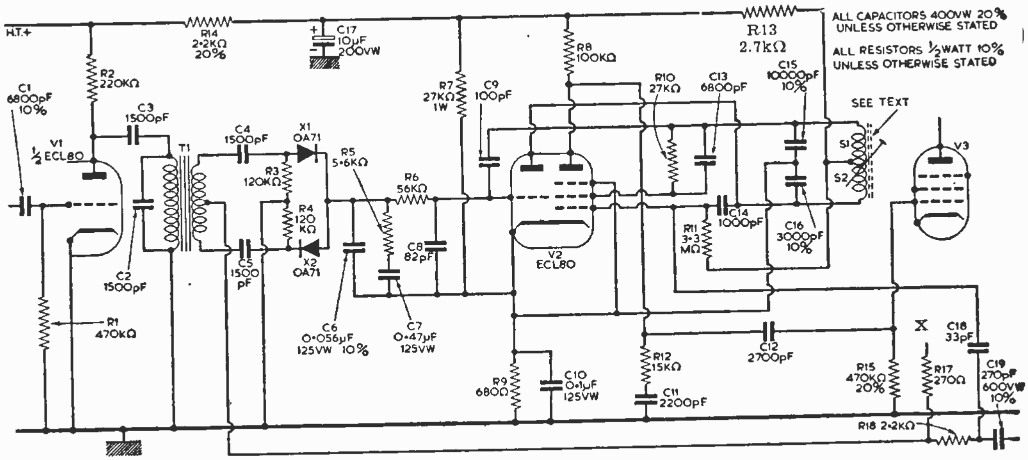


Fig. 8.—A commercial flywheel sync circuit. (Point 'X' is connected to the cathode of V3, from which point R16—10Ω—is wired to earth).

into conduction gradually. It is necessary to keep V3 cut off for a sufficiently long period; the flyback must not be damped, and, in any case, we do not require V3 to conduct in the early part of the scan. The grid leak, R11, is therefore returned to a positive point to give appreciable discharge of C14 during the non-grid conduction period. This ensures a long grid conduction period and so produces a long negative pulse at the grid of V3. The leading edge of this pulse must be steep. Its rate of fall is increased by adding C18. A positive pulse, derived from the line output transformer, is fed via C18 to the oscillator grid. As soon as this grid passes cut-off, causing flyback to start, the fed-back positive pulse rapidly drives the grid into grid current, so steepening the rate of rise of anode current. Resistor R10 merely prevents the g2 dis-

timebase waveform is obtained from the line transformer, where the flyback pulse is a half cycle of a sine wave. This is differentiated via C19 and produces at the secondary tap of T1 a waveform vaguely reminiscent of the ideal previously discussed (see Fig. 9). The diode circuit is "telescoped" somewhat compared with Fig. 5 last month, which served mainly to indicate the principle. The diode outputs are added directly in C6. This is the filter and its size largely determines the pull-in range.

Damping Circuit

We now come to R5 and C7—the damping circuit. Here it must be confessed that the earlier description of the mechanism of pull-in, whilst being correct in essence, was oversimplified. Without the damping circuit, the oscillator frequency "hunts" about the sync pulse frequency. After any disturbance, this leads to "wavy" verticals in the picture. The mechanism is as follows.

Firstly, we recall the three points enumerated at the start of the "pull-in behaviour" section and return to Fig. 7 (last month). When the sync-pulse phase reaches P, where, in steady conditions, the discriminator output would just lock the oscillator, the control voltage is lagging behind the discriminator output owing to the action of the filter. Consequently, the oscillator frequency has not been lowered to that of the sync pulses which pass, therefore, beyond P. Eventually the control voltage rises enough to bring the oscillator down to sync frequency, but now the discriminator output is higher than it was at P—the sync pulses are somewhere between P and N. This higher output raises

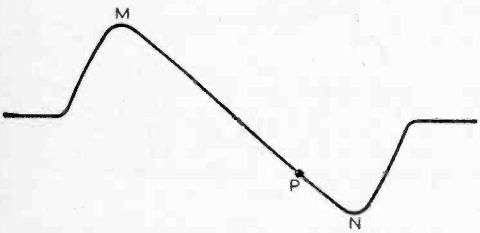


Fig. 9.—Waveform at the secondary tap of T1.

the control voltage still further, the oscillator frequency falls still further and the pulses start to move back towards P. At some point, the discriminator output falls below the control voltage and the above process repeats with the directions of change reversed. In theory, this hunting could carry on indefinitely, but in practice various things would damp it out. However, without R5 and C7, the damping is not sufficiently heavy and there is a train of "wiggles" after any sync disturbance.

It is easier to explain the action of the damping circuit in Fig. 8 by considering what happens after a sync disturbance. This, in any case, is the important problem in practice. Suppose the timebase to be running synchronised at some point, such as P of Fig. 9. Then C6 and C7 are both charged to the same voltage—the equilibrium voltage. Now suppose the sync pulses disappear for a time. Capacitor C6 starts to discharge via the diodes as soon as C4 and C5 have discharged enough to allow this. C7 falls in voltage much more slowly than C6 because the current flowing from it equals the difference of voltage on it and C6 divided by R5. That is to say, its rate of discharge is only small until C6 has discharged appreciably. Furthermore, the time constant of C7 and R5 is relatively long, giving a slow rate of fall of voltage on C7. So when sync pulses reappear, C7 is still pretty much at equilibrium voltage, but C6 has discharged and so the oscillator frequency has risen. The sync pulses are now somewhere between P and N, say. Now, we are back to the situation described in the preceding paragraph, but with this difference: C6 is recharged via the diodes and also from C7. Therefore, its voltage rises more rapidly than it would by charging via the diodes alone. If we can make C6 rise in voltage exactly in step with the phase of the sync pulses, then we have achieved the ideal case and there is no overshooting of P, and therefore no hunting. That there is a suitable compromise in practice can be seen by looking at the two extremes of the damping circuit time constant. Assume C7 is very large and can be taken as a battery over the period considered. Now if R5 is very large, it is effectively an open circuit, and we have no damping circuit at all! If R5 is very small, then C6 is restored to equilibrium voltage almost instantaneously. In this case it takes a very long time for the phase to become correct again. Somewhere in between is a compromise. Playing about with the components in the damping circuit is a very easy way of achieving another half-hour of tax-free entertainment.

Frame Sync Effects

We come next to V1. All flywheel circuits find the frame sync period a rather indigestible morsel. Generally speaking, it alters the discriminator output and so changes the oscillator frequency. This

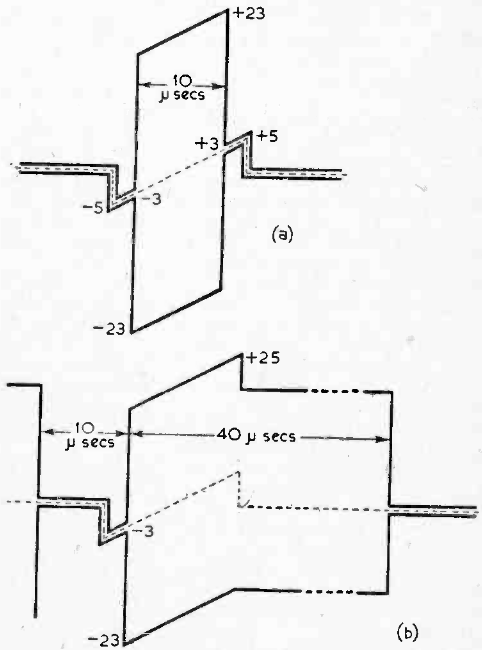


Fig. 10.—Waveforms with sync pulses of 20V amplitude—(a) with symmetrically situated line sync pulses; (b) during a frame sync pulse.

recovers once the frame sync period is over, but normally a residual effect is left which gives curved verticals at the top of the raster. The discriminator output is usually sensitive to pulse length, but the effect would happen even with our ideal rectifiers. Fig. 10 shows the waveforms with sync pulses of 20V amplitude, a timebase waveform running from (−5)V to (+5)V, and the relative durations more correctly shown than previously—10μsec sync pulse and 15μsec flyback time.

Suppose the line sync pulses to be symmetrically situated as in Fig. 10(a). The peak voltages are equal, and so the resultant output from the discriminator is zero. Fig. 10(b) shows the state of affairs during a frame sync pulse. The negative peak is not altered, but the positive peak has risen by 2V. It is the function of V1 to prevent this from happening. The grid of V1 is fed from the usual sync separator but, at its anode, the frame sync pulses are missing. The sync separator output has the form shown in Fig. 11. When the separator is brought into conduction, the valve current rapidly discharges the stray capacities, and there is a sharp fall of voltage at its anode. When the valve again cuts off, however, the capacities have to recharge via the anode load, which is a high resistance. So, the rising edges at the anode are a normal capacitor charging waveform with a time constant somewhat longer than 10μsec. A is a normal line pulse, B and C are twice line pulses. Their tips only rise to the level shown dotted. If this level is below the cut-off of V1, then they produce no output at the anode. Thus, in the frame sync period, the discriminator receives a long pulse (4 lines duration) which gives equal positive and negative peak voltages, and tends to produce zero discriminator output. This is no change if the original setting was as in Fig. 10(a). This "central" adjustment is important for several reasons. Firstly, it is the centre of the pull-in range and so allows most oscillator frequency drift (owing to mains variations, etc.) before readjustment is necessary. Secondly, loss of sync pulses will produce no change of output, and therefore no change of oscillator frequency. Thus, the picture will not have moved sideways in the raster when sync pulses reappear and there is least disturbance of the picture. Thirdly, spurious sync pulses outside the MN region give zero output because they are applied equally to both discriminator outputs. Thus, they give no change of frequency. Some flywheel receivers have made special provision for achieving this best adjustment.

Commonly, the line hold control knob has to be pushed in before it engages its electrical control. The pushing in also operates a switch which removes sync from the discriminator, thus ensuring zero output. The control is adjusted until the oscillator is as near sync frequency as possible, which is easily seen from the picture. Releasing the control reapplies the sync pulses. Despite these precautions, there is almost invariably a small residual curvature remaining at the top of the picture. The effect of the frame sync period is easily observed by turning the frame hold control until sync just breaks above 50c/s. As the picture drifts down, the frame blanking period can be studied (it can often be held steady near the middle of the tube face). The end of each line has a falling edge from black to sync level whether it be a line or a twice line pulse. If the brightness is turned up this edge can be seen, and its deviations from the straight (and narrow path of propriety) observed.

Function of C2

Picture centring with a flywheel always presents a practical problem. As shown in all previous

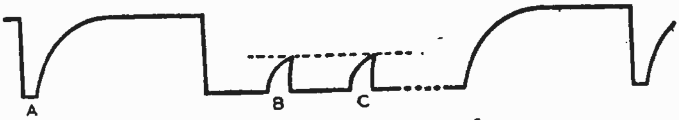


Fig. 11.—Sync separator output waveform.

diagrams, the flyback starts before the sync pulse at all settings within the pull-in range (in fact, within the hold range). This means that the right-hand side of the picture is folded over, except perhaps at one extreme of pull-in, where conceivably only the front porch is folded over. Capacitor C2 Fig. 8 corrects this. It delays the rise of the sync pulse at the discriminator. In fact, the pulses shown in the diagrams should be "sloped off" appreciably, and their peaks occur later than the leading edge of the transmitted pulse.

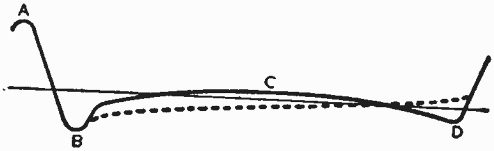


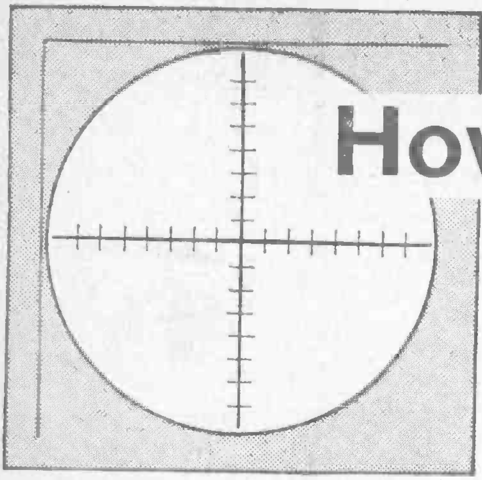
Fig. 12.—The addition of R17 prevents a spurious lock position—initially, CD has the same direction of slope as AB and lock is possible; adding R17 alters the slope of the curve as shown and this curve has the wrong slope for locking everywhere except between A and B.

One final component calls for some comment—R17. This is added simply to prevent a spurious lock position. The actual timebase waveform at the discriminator does not have zero slope during the forward stroke (see Fig. 12). In fact, the portion CD has the same direction of slope as AB. Consequently, locking with the sync pulses or CD, though weak, is possible. The waveform across R16 (which is wired from V3 cathode to earth) has no falling portion during scan, so it is added via R17, and so produces the dotted waveform of Fig. 12. This has the wrong slope for locking everywhere except between A and B.

Precautions must always be taken to prevent hum voltages, etc., reaching the reactance valve. Naturally, it cannot distinguish between "proper" control voltages and any hum picked up incidentally. Leads and components should not be placed near high voltage mains leads. An extra stage of smoothing is provided for the H.T. supply to the flywheel: R14 and C17.

Finally, it is of interest to see how far this timebase meets our requirements set out at the end of the section on Interference. Noise cancels out, largely because the sync pulse affects both discriminator outputs equally. Any slight lack of balance is not serious, though, because the flywheel filter reduces the effect of random variations. Provided that we are set to the zero output position, then change of shape of the sync pulses should have little effect, again owing to the balanced nature of the discriminator. Loss of sync pulses also has minimum effect since this condition too gives zero output. Interference and spurious pulses can have little effect as long as they fall outside the region AB of Fig. 12.

(To be continued)



How to use Os

By D. R. Bowman

ANYONE who takes up the study of electronics, whether for pleasure or to earn a living, sooner or later says to himself, "I wish I could see what is going on". This article is written to cater for those who have arrived at that point; they will be those who have perhaps built up a few circuits and have a working knowledge of practical circuitry.

In a very wide variety of circumstances, it is possible to "see what is going on"—providing one knows what to look for. The idea is not to persuade the constructor to buy an oscilloscope, but if it happens that any reader who possesses no such instrument decides afterwards that it is a "must", so much the better. For the real beginner—the man who "hardly knows a red volt from a black one"—the best advice is perhaps to keep copies of *Practical Television* carefully—the time will come!

Use with D.C. and A.C. Circuits

Where direct current is concerned the oscilloscope is not unrivalled for making measurements, since other more portable and less expensive instruments do the job well. However, A.C. is the heart and soul of electronics, and as soon as voltages and currents begin to vary regularly with time it may at any moment become important to know just how, how much and how fast they are varying, and where they start from. The 'scope now comes into its own.

The astute reader will have spotted in the last paragraph the statement, in paraphrase, that alternating voltages and currents possess the properties of wave-form, amplitude, frequency and phase. This is perhaps a debatable statement, but it is near enough for practical purposes in most cases. All these quantities can be presented in visual form, and at least rough measurements made. It is fair to say that for precision work, measurements nearly always have to be made by means other than the oscilloscope. However, this is normally a requirement of the research or development engineer. The man servicing his own television receiver, setting up an F.M. receiver or checking the fidelity of an audio amplifier rarely needs to undertake precise measurements; 5per cent is usually near enough, and often a "general idea" is quite useful.

The Display as a Graph

The most instructive summary of a physical process in which cause and effect are related is the graph. The oscilloscope exists to draw graphs, rapidly and consecutively, which show the behaviour of currents and voltages. It is possible for the oscilloscope to show also the behaviour of fields—a good example is the television receiver where a linear scan indicates immediately that the magnetic field causing the scan is varying linearly with time.

Fig. 1(a) shows a typical graph. It represents the behaviour of the current in the circuit in Fig. 1(b). The reader will be familiar with the experiment, which consists essentially of putting the switch over to the right at a given moment and measuring the current flowing into the capacitor C at various later intervals of time. It is a simple enough matter to arrange circuit values so that the current can be measured with a milliammeter or microammeter at intervals of, say, 5secs, and to plot the results: 100μF with R1, 100k and a microammeter with a 9V battery. If R2 is 1k a slow drop in current over a minute or more is obtained with a much more rapid effect when the switch is reversed to discharge the capacitor.

The point about this armchair experiment is that time is related to current, and a recognisable waveform of definite shape, amplitude and phase is produced. This gives a suitable introduction to the importance of time in electrical measurements. Not only time as the horizontal axis of the graph—the intended part of the experiment—but also the time taken to plot just one change at all accurately. To obtain a plot of the quantities just described takes at least three minutes. The oscilloscope can do no better in this particular case, but when circuit parameters include pF rather than hundreds of microfarads, and resistances of a few hundred ohms only it is vastly superior to the meter and the seconds-hand of a watch. In the experiment just outlined, t1—t0 is at least 3 minutes; when it is 3μsec, the watch is not much use, and neither is the meter.

The oscilloscope is, therefore, predominantly a means of representing time—and very small intervals of time perhaps—along a horizontal axis, and the instantaneous value of a current or voltage along the vertical axis. The fact that it shows the result in a visual form is a handy by-product, but intrinsically the visual presentation is only a bonus—nevertheless a most useful one.

The Importance of the Massless Electron Beam

It was remarked a moment ago that where time intervals are small, watch and meter are not very

cilloscopes

useful. It may be instructive to enquire why. Suppose the pointer of the meter and its attached moving coil were completely massless and offered no area to the surrounding air to cause damping of its movement, it might be supposed that the pointer would follow the voltage or current exactly. Then by repeating the experiment at regular intervals, hundreds of times a second, nothing could be seen but a blur where the meter pointer oscillated. However, by arranging a stroboscope to flash a little faster than the experiment was repeated, and illuminating the pointer with this device, a slow-motion picture of the experiment would be obtained. Note here, please, that the speed of movement is no real difficulty; what is the difficulty is in approximating to a massless meter movement.

In the original oscilloscopes, the mass of the movement was reduced by making it very small and light and using a beam of light as a weightless pointer. Extraordinarily good results have been achieved with these instruments, which still find a limited application. However, the mass still existed, and consequently speed of movement and ability to "follow" the waveform were such that the device could only cope with waves of low frequency. In the cathode ray tube there can be formed a pointer and "movement" of ridiculously small mass in the shape of a narrow beam of electrons. If the relatively high mass of the meter movement is "sluggish", the electron beam can be said to have a high "agility". One is tempted to write an equation at this point, but the temptation will be resisted. There will be plenty of equations for the experimenter later on when he starts to work with his instrument.

The Electrostatic Tube

The cathode ray tube has been often enough described, in these pages and elsewhere, and it is not proposed to detail the construction and mode of operation here. Our discussion will deal, however, with the oscilloscope tube only, and except for specialised apparatus the only type used is the electrostatically focused and deflected tube.

This type of tube contains the usual electron gun, modulating tube or "grid", and anode together with an electron lens system. All these electrodes, provided with the correct potentials, contribute to the formation on the fluorescent screen of the tube of a small bright spot—the visible end of the massless pointer. In addition, means are provided for deflecting the pointer and so moving the spot. A further consideration of Fig. 1 will show that the horizontal deflection of the spot in that case would be proportional to time. This is very general in oscilloscopes. The horizontal axis of a graph is generically termed the "x-axis"; consequently there is required a means of X-deflection of the spot regularly with time. The axis of the graph at right angles to this is known in general terms as the "y-axis"; consequently the waveform to be investigated will require Y-deflection of the spot, proportional to the instantaneous measure of the quantity concerned—usually voltage or current.

Non-Temporal Quantities

So far if has been assumed that the x-axis will always be a measure of time, and it is true that very many of the measurements made with an oscilloscope do actually require a horizontal time scale. However, quite a number of useful comparisons can be made in which the horizontal axis of the graph is not temporal but concerned with some other quantity. An example is the use of the instrument to plot valve characteristic curves, either Ia-Vg or Ia-Va. Nevertheless, it is usually conventional to express any such x-quantity as if it were proportional to time, and to use the oscilloscope accordingly, for reasons of practical convenience.

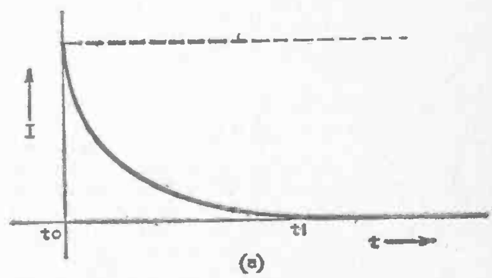


Fig. 1a.—A graph which represents the behaviour of the current in the circuit of Fig. 1b.

Deflecting Plates X and Y

To accomplish the deflection of the electron beam, small metal places are inserted into the envelope of the cathode ray tube—in the neck as a rule. They must not be placed too near the electron lens assembly, or the electric fields which focus the spot will be distorted. Nor must they be placed too near the tube face—or the electron beam's deflection will be too small to be useful. The plates are arranged in pairs as shown (Fig. 2). The Y-plates are usually placed nearer the electron gun so that improved deflection sensitivity can be obtained. The X-plates need not as a rule have such good sensitivity, and are put nearer the tube face. Sometimes, however, this arrangement is reversed, for special purposes.

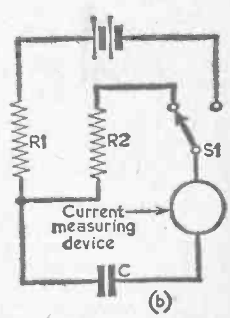
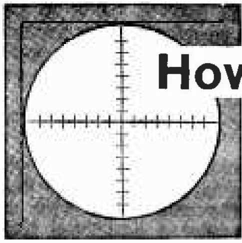


Fig. 1b (right).—An experimental circuit for obtaining the curve of Fig. 1a; the experiment consists essentially of putting the switch over to the right at a given moment and measuring the current at various later intervals of time.

The operation is simple to visualise. The



How to use Oscilloscopes

beam of electrons, passing between a pair of plates, is affected—either attracted or repelled—by the field instantaneously existing between the plates. The beam is deflected, and continues in its new direction until affected by some other electric or magnetic field or until it strikes the fluorescent screen. If the plates are connected to sources of steady potential, a constant deflection will be obtained.

If the potential is doubled, twice the deflection should be obtained, and so on proportionately. This proportionality can be secured, by the correct shaping and spacing of the plates, to a high degree of accuracy. The angle of deflection is then a linear function of the potential difference between opposite deflecting plates.

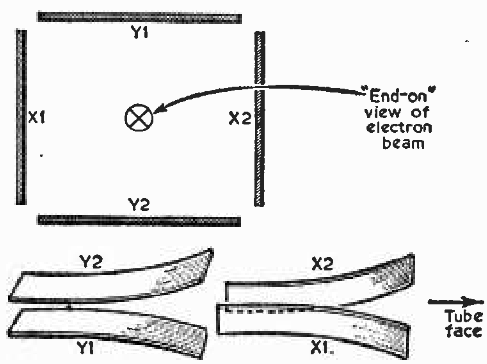


Fig. 2.—Arrangement of the deflecting plates.

Sensitivity of the Tube

These considerations apply to both pairs of deflecting plates, and it will thus be seen that both X- and Y-deflections can be obtained, simultaneously, of the electron beam. The deflection of the beam, owing to a pair of plates, is given by the equation

$$\text{Deflection} = \frac{Vd}{Va} \times \frac{a}{b} \times l$$

where Vd = potential between deflecting plates
Va = anode voltage
a = length of deflecting plate in the direction of the beam
b = distance between deflecting plates
l = distance from centre of deflecting plates to fluorescent screen.

This formula applies only to electrostatically deflected electron beams. Where magnetic deflection is used, a different formula applies.

The equation may be obtained simply on theoretical grounds and can be shown to apply closely to practical cases. Two important inferences can be made from this equation. First, that the lower the anode voltage, the greater the deflection sensitivity; and, second, that the deflection is proportional to the deflecting voltage.

Linearity Requirements

It is worthwhile to consider again, at this point, the simple experiment discussed previously.

In order to show the graph of the experiment on the oscilloscope tube face, a number of requirements exist, as follows:—

(a) the movement of the spot along the horizontal (x) axis must be a linear function of time.

(b) the movement of the spot in the Y-direction must be a linear function of the current flowing.

(c) the experiment—the charging of the capacitor and noting current at equal intervals of time—has to be conducted as frequently as may be necessary so that by "persistence of vision", the moving spot on the tube face may appear to trace out the appropriate curves.

The last consideration involves the discharge of the capacitor, the return of the spot to the beginning of the graph, and the reconnection of the capacitor to the charging circuit. The mechanical and electrical arrangements would be simple enough to devise in practice. If, as in the particular example quoted, the trace is too slow to appear as a line on the tube face, a photographic exposure—or the use of a tube with long-afterglow or "long persistence" qualities—could be arranged.

The requirement that spot movement in the X-direction must be linear with time necessitates the design of circuits which will set up a potential difference between the X-deflecting plates which increases linearly with time. Such circuits are known generally as linear timebase generators. Since the potential can hardly go on increasing indefinitely with time, a halt is called at some convenient point. At this point the spot is returned, as rapidly as practicable, to the beginning of the trace ready for the "sweep" to start again. This is known as the "flyback".

The requirement that deflection in the Y-direction must be a linear function of the quantity being measured, means that unless the latter is a sufficiently high voltage to be applied direct to the Y-plates, a Y-amplifier of linear characteristics is needed, together perhaps with other linear circuit elements such as resistors. "Linearity" is another name for absence of distortion, and it might be thought that normal good amplifier design would be sufficient to ensure good results. This is actually a mistake; very great care indeed has to be taken in designing suitable circuits, as will be seen later.

(To be continued)

NEXT MONTH

Building a simple check 'scope for TV

SPECIAL TV TOOLS

HINTS AND AIDS FOR SERVICING

By H. Bedford

OVER the years, a special collection of tools that have proved their worth by easing difficulties and speeding the job has appeared in the boxes and bags of TV enthusiasts and full-time engineers.

Most of these aids are simple and inexpensive, such as the insulated dental mirror used to detect concealed burn spots on the inaccessible side of wirewound resistors, read labels on valves too hot to withdraw, and turned away from the user, and to check for dry joints under tags. Mirrors can be obtained for a couple of shillings or so from tool shops, but you will have to insulate the metal stem and backing before using them on a live chassis.

Mirrors are usually accompanied by the light from a torch, but so often it is not practical to shine a light from behind or under the subject to be illuminated. An idea that overcomes this problem is to connect the base of a broken flash-light bulb to an MES bulb holder via a length of coaxial cable, the inner core connecting the centre contacts and the outer braid the threaded body. The connections are soldered and bound with tape (Fig. 1). This accessory takes up no room in the tool box and can be screwed into a flashlamp when an awkward job is encountered.

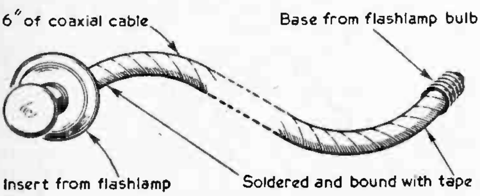


Fig. 1.—Flexible inspection lamps made from odd lengths of coaxial cable.

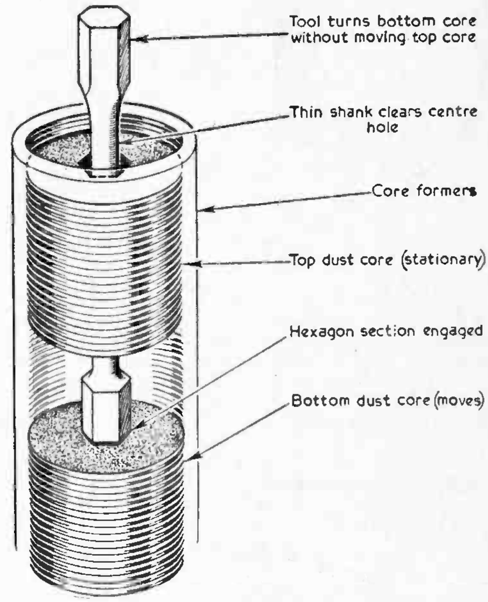


Fig. 2.—This tool enables the bottom core of an I.F. transformer to be turned, without moving the top core.

Soldering methods have changed greatly during recent years, and the 65W irons common years ago are almost displaced by miniature types of less than 25W consumption and the quick-heat type powered by a transformer. Printed circuits have accelerated this change, and the transformer type of iron enables the tedious job of melting six connections at once to be carried out easily (Fig. 3) when replacing I.F. transformers on printed circuits.

Trimming tools are fast becoming specialised items with the many types of adjustment encountered on various receivers issued over the years. Many of these tools can be most easily made up from a collection of knitting needles filed to shape. Certain types of earthed studding adjusters are not affected by metallic contact and flattened brass tube can be used. The hexagonal hole found in later slug cores is ingenious because it permits the lower core in a tuned inductance to be adjusted *through* the upper core by a special plastic tool with a turned-down shank section (Fig. 2). This circular section does not disturb the upper core while the lower is adjusted, and when lifted out of engagement with the lower core, the upper core can be manipulated.

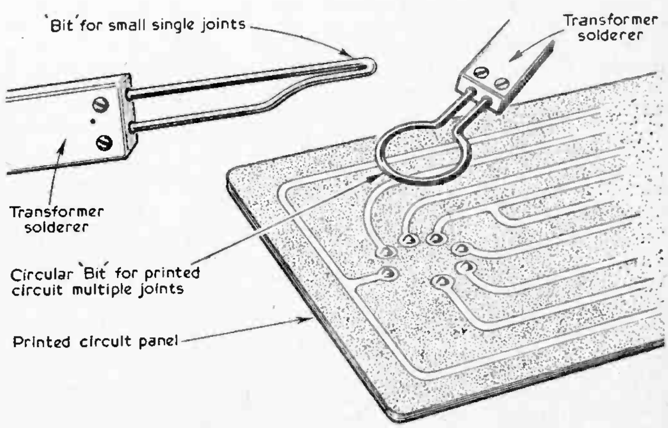


Fig. 3.—Transformer soldering irons with special "bits".

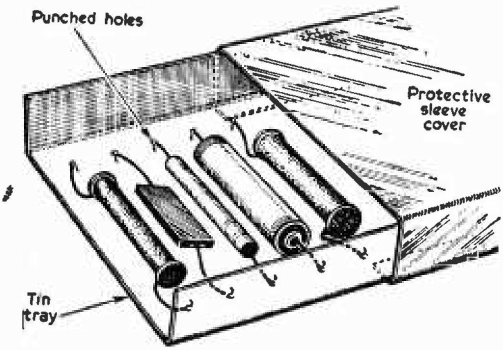


Fig. 4.—A convenient method of storing wire-ended components.

Printed circuits also demand a needle-sharp probe on the multimeter for contacting through the layer of varnish with which many circuits are coated.

A watchmaker's lens for checking suspect joints on printed circuitry and inspecting the small components found in modern TV sets is becoming virtually a necessity.

The high magnetic fields surrounding loudspeaker speech coils and focus assemblies make work with ordinary steel tools difficult, if not impossible. A pair of slender, plated, non-magnetic tweezers simplify the work considerably when removing particles from the speaker gap or soldering moving coil connections. Some of the older focus and picture centring assemblies were sensitive to steel tools used when adjusting the raster position. The picture shifts over to one side when the screwdriver is brought near the adjustment, and after adjustments are made removal of the tool again displaces the raster. All that is required to overcome this disadvantage is a piece of brass rod filed to a screwdriver blade and set in a wooden handle. This tool has no shifting effect on the magnetic field at all as it is non-magnetic.

Generally magnetic effects cause difficulties, yet it is often an advantage to carry a small magnet in the tool kit; for example, when a screw has to be fitted in a narrow aperture that only the screwdriver can reach. By holding the magnet in contact with the screwdriver shank the tip of the tool becomes magnetised and the screw will remain on the blade while it is gently carried to its inaccessible spot. If the screw is dropped at all then fishing with a magnet or magnetised tool quickly finds it. Small powerful magnets can be obtained from scrap focus assemblies.

Volume and brightness controls are nearly all fixed with a standard locking nut, ¼in. Whitworth. By keeping a box spanner with a thin wall in the kit it is sometimes possible to remove and refit these controls through the bottom of the cabinet after slackening the control nut first through the front panel hole.

Certain of the more usual tools can be conveniently kept in wallets, saving room and weight in the tool-kit. These tools need not be particularly expensive. However, items such as long-nosed pliers and side cutters should be the best quality obtainable.

The loose jumble of resistors and capacitors that accumulate in the bottom of a tool-kit is bad for the parts themselves, and time is wasted in looking for the value that has been half erased. A tidy way of stocking these parts is to mount them in a thin "match box" type of container that can be bent up from thin sheet metal with small pierced holes to hold the wire ends as shown in Fig. 4.

International Award for "Outstanding Contributions to the Advancement of Television"

The Committee of Honour of the world's first International Festival of Television Arts and Sciences announces that 71-year-old Sir Noel Ashbridge will be one of six internationally famous scientists to receive a Citation "for outstanding contributions to the advancement of television and broadcasting".

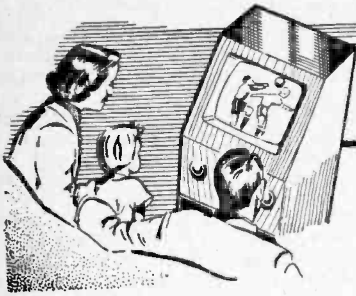
Others to be honoured are: General David Sarnoff (U.S.A.), Professor J. Boutry (France), Professor P. V. Shmakov (U.S.S.R.), Doctor Kenjiro Takayanagi (Japan), and Mr. Eric Esping (Sweden).

It was stated from Montreux, where the Festival will be held from 15th to 27th May, that a Presentation Ceremony will take place at Montreux Palace Hotel on the afternoon of Saturday, 20th May.

A welcome will be given to those receiving Citations by a member of the Festival Committee of Honour, after which there will be a keynote address.

Actual presentation will then be made by the Festival Committee of Honour to which recipients, or their representatives, will no doubt wish to reply.

The Citation will take the form of a Scroll, which will mention the outstanding contributions made by the recipient in the advancement of television and broadcasting.



UNDERNEATH THE DIPOLE

TELEVISION PICK-UPS AND REFLECTIONS

By Iconos

THE closing of the Walton-on-Thames studios is a blow to British television as well as to British films. It was here that the phenomenally successful Robin Hood series was made, still being shown and reshown at television stations all over the world. Advertising filmlets, "The Buccaneers", "Sir Lancelot", TV serials, and, of course, a large number of important British feature films were made here.

The Walton Stages

Walton studios had five stages, three of them very large and capable of coping with the largest type of film production in Cinemascope and colour. There has been a film studio on its site since 1898, when Cecil M. Hepworth started making films in the back garden of a villa in Hurst Grove, Walton, including the historic four-minute drama, "Rescued by Rover", which has been seen on television many times. Hepworth was a fine photographer and technician besides a practical film producer (as film directors were called at that time). He was the inventor of the original machine for automatically developing and printing cinematograph films, which replaced the clumsy method of winding the films on frames and dipping them in deep developing and fixing tanks. Hepworth's machine was the forerunner of the modern Lawley automatic film processor, used in all the BBC and most of the ITA television centres for developing 35mm and 16mm news and documentary film. Hepworth built two of the first all-glass "daylight" film studios at Walton, which operated continuously making silent film features for many years until talking films arrived, when the plant was expanded with an additional soundproofed stage and a large exterior "lot". Television requirements plus its normal cinema film output strained its capacity, and more stages, workshops and an elaborate sound dubbing theatre were added.

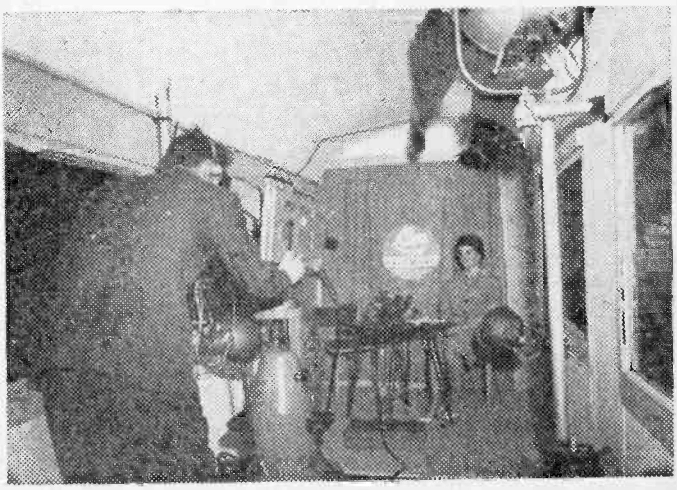
This theatre was acoustically treated to make it suitable for recording large symphony orchestras; it also included a closed-circuit system for telecine and television. Now, it seems, the whole historic site is likely to fall into the hands of a land development company who will erect flats, offices and, I suppose, the inevitable supermarkets. This seems to be the fate of many theatres, film studios and music halls in these days of increasing site values and diminishing box office takings. Henry Irving, Dan Leno and Cecil Hepworth wouldn't have liked it at all.

On the other hand, I feel pretty certain that all of them would have studied and embraced the newer medium of television with enthusiasm as another field of show-business.

Early days at Ealing and Lime Grove

Hepworth's rival in the film pioneering days was Will Barker, who built a three-stage film studio at Ealing Green in about 1906, where dozens of short melodramas and comedy films were turned out at the rate of one every two days! I am told that chases by comic looking policemen in the Keystone tradition were a familiar sight to the residents of Ealing in those days. Later, rebuilt and modernised, it turned out many world-famous films under the direction of Sir Michael Balcon until it was taken over by the BBC for its very comprehensive documentary film services on 35 and 16mm film.

Gaumont's original British film studio was at Lime Grove,



The exhibition train which toured the West Country to publicise Westward Television's new commercial service, which begins transmission on April 29th, contained this fully operational TV studio equipped by Marconi's.

Shepherd's Bush, and was copied from Hepworth's all-glass "daylight" studio at Walton, which was on the first floor with workshops underneath. This studio also expanded to four soundproofed stages when talkies arrived, but one of them retained the shape, size and exact location of the pioneer Gaumont studio stage. When taken over by the BBC, this original stage was one of the first to be brought into use for television and continues to give excellent service.

At any rate, it seems that Ealing and Lime Grove will carry on in the true tradition of show business. The show must go on!

In case any reader wonders what an all-glass daylight studio is, I must explain that in the early days of silent films, most cinema studios relied upon daylight as an illuminant, sometimes adding a few supplementary arc lights or low-pressure mercury vapour lamps for effects. Other lighting control was with blinds or scrim diffusers supported on wires beneath the glass roof. The results were then much better photographically when compared with films shot entirely with artificial light.

But there were difficulties on days when the light varied with the sunshine and clouds. The advent of talking films and the need for soundproofing spelt the end of these elaborate greenhouses. Some of the original studios were bricked-up, roofed and soundproofed and are in use to this day. Apart from the original Lime Grove stage already mentioned, one of the smaller stages at the National Studios, Elstree (now modernised by ATV) was a pioneer silent film studio that is still "in business". This stage had its height raised by seven feet by digging down that amount and fitting a new floor.

History of Television

THERE are several different ways of presenting history on television, varying from the elaborately edited film of the actual events to the simple straight-forward lecture, in which the speaker uses few notes and fewer diagrams. With a really competent and sincere speaker who is completely at home with both his subject and with the television camera, the informal off-the-cuff "fireside" chat is probably just as effective as the edited film. But there are not many television lecturers of the standard of General Sir Brian Horrocks and Alan Taylor, who are able to retain the interest of viewers by sheer personality apart from their thorough grasp of every historic subject they discuss.

Documentary television films of actual events in the last war are the product of much patient research and the collection of film excerpts from many sources, followed by skilled editing and the addition of commentaries and background music. Good though these are, one is acutely conscious of the professional polish applied in the editing process and the opportunity it might give for manipulation or falsification. On television, the war film montages with rapidly succeeding shots of shell bursts, guns firing and bombs dropping, etc., all accompanied by heavy dramatic music, all tend to lose their impact upon the viewer when seen, in the same form but in different context, for the umpteenth time. This type of television history presentation is naturally confined to the last sixty-three years, for it was not until 1898 that an important historic event was recorded on motion picture film—Persimmon winning the Derby. Before this time, history was visually recorded by the artist-reporter or, from about 1850, by the earliest of still photographers.

"Meet Mr. Lincoln"

A fine example of the use of visual stills was seen in "Meet Mr. Lincoln" an American TV documentary by the N.B.C., presented on BBC television. Very early photographs taken during the American civil war together with reproductions of artists drawings and contemporary Press cuttings were brilliantly edited to form a coherent visual story, with long shots, close-ups, panning and tracking shots. Intelligent use of camera movement on the title bench when photographing these drawings seemed almost to give the illusion of moving pictures. The narration and background music told the story and set the mood with great effect—leading up to the assassination of President Lincoln at a theatrical performance, a sequence which came over with an impact which conveyed the full tragedy of the event. I thought that "Meet Mr. Lincoln" was one of the best television documentaries we have had from the U.S.A.

Regional Competition

THE BBC's television studios and facilities in the various provincial areas cannot be said to be on a grand scale, when compared with their ITA rivals—excepting in the London area, where the BBC's studios at Wood Lane, Lime Grove, Shepherd's Bush TV Theatre, Riverside Studios, Ealing Studios and the Alexandra Palace must amount to a staggering figure in capital investment, not to mention the huge running cost and hundreds of staff required. In the provinces, BBC facilities are good, but on the whole, comparatively modest.

In Scotland, the expanding studio stage space and facilities of Scottish Television may indirectly have had something to do with the BBC's recent decision to double the capacity of their television building in St. Margaret's Drive, Glasgow, at a cost of about £800,000. The same trend is reflected in other places where competition is expected. Even in Plymouth, the BBC TV facilities have been greatly expanded to compete with Westward's opening at the end of April. The competition in this area intensifies in those parts of Somerset and North Devon where there is an overlap between TWW and Westward—where viewers will have a choice of three programmes. The new ITA transmitter at Stockland Hill has received excellent reception report from Weston-super-Mare and from parts of Bristol. A three-way choice of TV programmes is quite a possibility these days, with more than one line connection between various parts of the country. As far as I can make out, there is nothing to prevent Westward taking items from ATV and ABC—TV at the same time as TWW is taking, say, Granada and A.R.—all on the same evening.

Letters to the Editor

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

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

CORONA DISCHARGE

SIR,—For some time I have experienced intermittent corona discharge in my home-made receiver, and this appeared to vary in such a way that I could not put it down to any one factor. Recently I decided to try and find a solution and noted that this discharge, which was accompanied not only by sound in the speaker, but also by spots on the screen, seemed to vary with the picture content. It finally transpired that a dark picture, which obviously did not fully load the EHT circuit, caused corona, and this disappeared when a very bright screen was displayed. I thought, therefore, that a load across the EHT might work, but such a load would have to be removed on bright images or larger current drain. I thought of a thermistor in the EHT lead, or one across the EHT supply, but could not find a value which would work, and finally I made a considerable improvement in a very simple manner. I was utilising the screening of the tube as the EHT condenser, via a spring contact, and in the course of testing the efficiency of this I used a separate condenser I had available. It was marked 0.001μF and it appeared to give better results than the tube coating. This I found on looking at a circuit was rated at 0.0005μF so I concluded, rightly as it turned out, that a much larger condenser was required. Finally I used two 0.001μF condensers in parallel and the corona does not now occur. Perhaps one of your experts will say whether or not this large capacity will do any harm to the rectifier.—G. BENSON (Watford).

STELLA ST6417

SIR,—Mr. Sirl (Salisbury) complains that the line hold needs to be continually readjusted (Your Problems Solved, February 1961). Changing the 220k to 100k sometimes helps with stronger lock. The most effective cure is to replace the line blocking oscillator transformer, as a slight leak between windings or short-circuited turns will make the line hold very critical indeed. This was the fault on one particular set I had to repair. The changing of the 220k to 100k gave a much better lock, but when switching on from cold, the line hold needed to be adjusted and it slipped out of lock again after about ½ to 1 hour.—S. WHITTEN (Buckingham).

VALVE FAULTS

SIR,—Some time ago I saw in your pages a criticism from a reader who had experienced difficulties caused by valves not being standard. I recently had a strange experience which might be of interest to others who come across an apparently incurable fault. I have a set in which there are no less than three ECC82's, and one of these is used in the frame timebase. Recently the hold was getting very weak and eventually I had to do something about it. I realised that substitution of the valve would be the first thing to do, so I removed one of the other valves and changed it over with the frame valve. The trouble was not removed, but hold was a little firmer, and the original valve did not seem to affect the other part of the circuit to which it was transferred. I did the same thing with the other ECC82, and again there was not a complete cure. I thought it very unlikely that three valves would all be faulty, but thought it worth while having them tested. When put on a tester a the local shop all three showed the need for replacement. I did purchase a new one, which when inserted in the frame section returned the set to its original condition, but the other parts of the circuit work perfectly with any of the three valves. It would appear that after just over four years' working all three have fallen to the same level, but the frame timebase is the only part of the complete circuit where the characteristics of the valve are critical.—F. H. ROBERTSON (York).

ADVERTISING AWARDS

SIR,—The ITA have recently announced that they will no longer televise any advertisements which compare one product with another. This would appear to be a result of the severe criticism that all television advertising has received during the last few months. There is, therefore, a need for something that would encourage advertisers to produce advertisements that are in every way enjoyable for the viewing public. Why not, then, have a "Television Advertisers Awards" scheme, where, each year, Oscars are given to the companies whose advertisements are, in the opinion of either, a committee or the public, most appealing (not, of course, meaning free gift offers and the like). Awards could be given for such qualities as, the most interesting, the most amusing, or the advertisement with the most pleasant musical arrangement. If enough publicity were given to such a scheme, advertisers would surely make an effort to raise the standards of their advertisements.—R. BROOKS (Staines).

DECCA DM45

SIR,—R. Houston, Your Problems Solved (January issue), complains of lack of height at bottom of the picture on his Decca DM45. If after replacing V16, —PL84 vertical output, V7—ECL80 sync separator and half-frame multivibrator, V6—PCL84 vision amplifier and half-frame multivibrator, a cure is not effected, I would suggest a check is made on the following two capacitors, C76 (500μF cathode capacitor of V16) and C77 (0·03μF) feedback capacitor in linearity circuit, from anode of V16—PL84). If C77 develops a leak or short circuit it causes cramp at the bottom, or even complete foldover at the bottom. C77 has been faulty in two of these sets I have serviced; C76 was faulty in another set.—S. WHITTON (Buckingham).

LINE CONTROVERSY

SIR,—I feel that any suggestions that, in this country we should change our television system to one using 625 lines, are quite useless. My reasons for this are, firstly that on any size screen, smaller than a 21in. model, the difference would not be easily noticeable by the average viewer; and secondly that, if two receivers each having a different number of lines, were viewed side-by-side the superior quality of the 625 line set would be obvious, but viewed apart, I am sure that the improved picture would not be appreciated.—G. REENSLEVE (Walthamstow).

TV MASTS

SIR,—I have only recently become interested in television construction and servicing, and must confess that, as yet, I know very little about this subject. There is one thing that worries me in particular, and that is how to tell the difference between a television transmitting aerial and the many other masts that litter our countryside. I do not even know if there is any structural difference that may be easily recognised and is common to TV masts, but if any reader knows one, I would be obliged if he would write in.—M. A. STUART (Coulsdon).

CHOOSING A VALVE VOLTMETER

(Continued from page 411)

decreases, and generally speaking the lower part of the scale is very inaccurate. Taking the three-volt range as an example, the accuracy with which 3V can be measured is 3per cent of 3V, ±10mV, which is ±100mV, about 3½per cent. When measuring 2V on this range the accuracy is again ±100mV but this now corresponds to 5per cent, and at 1V the accuracy has deteriorated to 10per cent. The voltmeter ranges are, however, usually chosen so that the lower part of any range is covered by the next lowest range. To measure 1V or lower in the example given, one would switch over to the 1V range.

This cannot be done, however, on the lowest range, 300mV in this example, and one can only make rough measurements on the lower part of the range. At 100mV, for example, the accuracy is ±3per cent of 300mV ±10mV, which is ±19mV or 19per cent, and this error increases rapidly at lower voltages on this range.

Details of the frequency response are also included in the specification, and must be taken into consideration when estimating the accuracy of the instrument. The frequency response curve is usually flat over a wide portion of the frequency coverage, and the figures for measurement accuracy already discussed apply here.

At the low frequency end, however, the response of both types of valve-voltmeter start to fall off, while at the high-frequency end the response of rectifier-amplifier instruments becomes high (Fig. 5) and the response of amplifier-rectifier instruments falls off. Over these upper and lower portions of the frequency coverage the error due to the change in frequency response, which is usually quoted in decibels relative to the response at mid-frequency, must be added to the other errors quoted to obtain the total possible error in the voltmeter reading.

BRITAIN'S FIRST SCHOOL-TO-SCHOOL TELEVISION LESSONS

An unusual experiment in the use of closed-circuit television as an aid to teaching is being tested by High Definition Television Ltd., a company of the Pye Group, in co-operation with the Middlesex Education Committee, the Hayes and Harlington Divisional Executive and the School Governors.

Two schools two miles apart—Hayes Grammar School and Barnhill Secondary Modern School—have been linked by microwave equipment so that science lessons from the Grammar School can be televised direct to the Secondary Modern School. This is the first time that such an experiment has been made part of the regular curriculum in a British school, and it will be seen that this is a *school-to-school* television operation as distinct from the national schools television service offered by both BBC and ITV. This experiment will last for a complete term and is registered with the National Foundation for Educational Research.

In Hayes Grammar School a Science Master teaches his own class, using various apparatus to illustrate the lesson. He faces not only his pupils but two small Pye industrial television cameras. One of these is situated directly opposite the teacher and covers his desk and the blackboard. The second camera, on the teacher's extreme right, is used for enlarging small objects and to give close-up views during scientific experiments.

The teacher wears a microphone hung around his neck and is able to select cameras and sound circuits by means of a specially designed switcher unit placed on his desk. A monitor screen shows him the picture being transmitted to the other school.

At Barnhill Secondary Modern School a large High Definition Television schools receiver with a 27in. screen faces the class.

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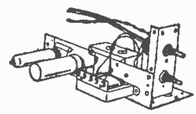

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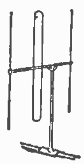

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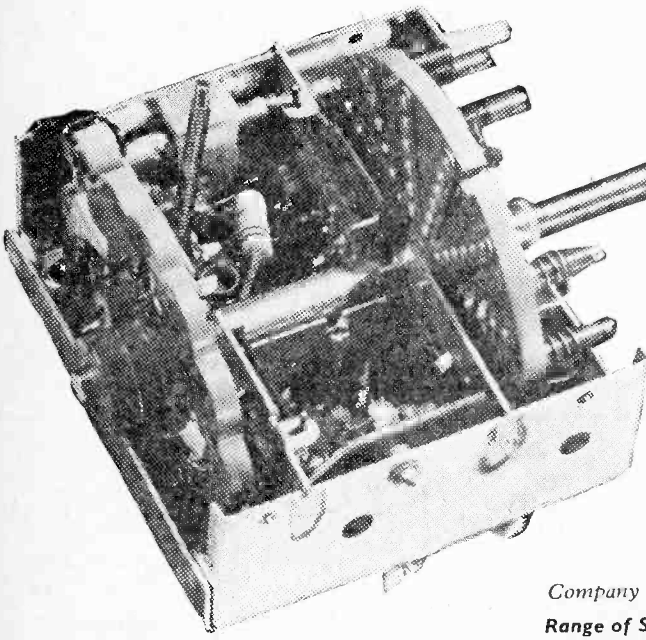
Trade News

NEW PROSPECTS AND DEVELOPMENTS

Silicone Compound

A SILICONE compound named MS4 is manufactured by Midland Silicones Ltd., and is non-melting and retains a grease-like consistency from (−50)°C to 200°C, and has excellent dielectric



MS4 is widely used for lubricating switch contacts and moving parts such as are employed in this multi-channel tuner. It is also used to prevent arcing and corrosion around the anode terminals of cathode ray tube EHT connections.

characteristics, is highly water-repellent and resists oxidation. Some of its uses are, a dielectrical potting material for transistors and other electronic equipment; a lubricant on electrical contacts, meter bearings and other mechanisms; a seal for electric heating elements, aerial connectors, plugs and sockets against the ingress of moisture; and to prevent corrosion on battery terminals, leads, spark plugs and almost any equipment liable to rust or corrode.

MS4 is in common use today by the world's major airlines, by Post Office authorities in Britain and abroad, and the fighting services, by leading motor companies in several countries, by all the principal electrical and electronic manufacturers and by many other companies in every industry.

MS4 is produced by *Midland Silicones Ltd., 68 Knightsbridge, London, S.W.1.*

Closed-circuit Television Camera

THE "NEVEYE" closed-circuit television camera has been designed and developed by the Nottingham Electronic Valve Company Ltd.

This camera uses modern circuit design, transistors and semi-conductors. It has been designed to work into any standard domestic television receiver from ordinary mains supply and is so simple that it can be operated by the least technically minded.

The output from the camera is a composite modulated radio frequency signal, and is tunable to any channel in Band I. Synchronising impluses and blanketing impulses are derived within the camera and are mixed with the vision signal to form a composite waveform which will lock any standard receiver working on the British 405 line system, or alternatively on the Continental 625 line system. The radio frequency output is approximately 10,000μV into 75Ω for peak white modulation.

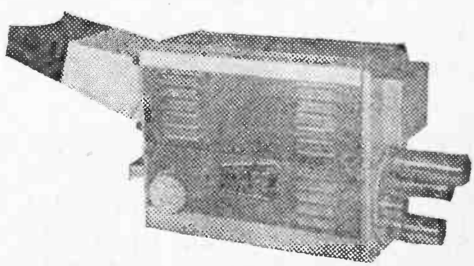
The camera tube is of the photo-conductive type and can be supplied with infra red or ultra violet sensitive targets at extra cost.

The camera is made by the *Nottingham Electronic Valve Company Ltd., East Bridgford, Nottingham.*

Range of Specialised Television Equipment

A WIDE range of closed-circuit television equipment is now being marketed by Rank Precision Industries Ltd., whose TV consultancy service has been expanded to meet the growing demand of industry, education and medicine.

Flexibility and simplicity in their design of individual installations are now increased by the

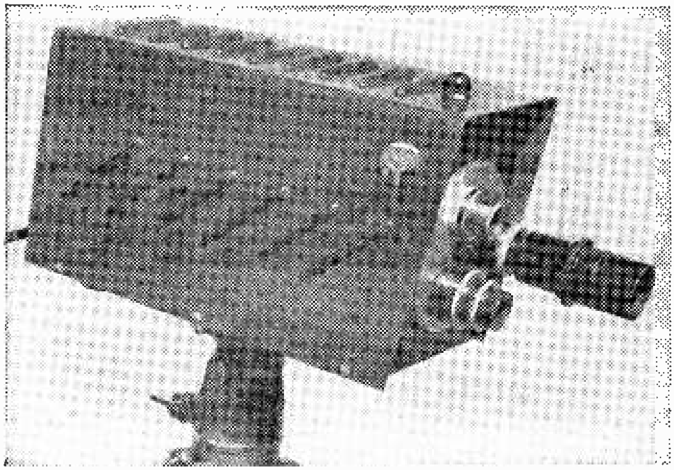


A high resolution studio broadcast TV camera, manufactured by Dage of America and distributed by Rank Precision Industries Limited. This camera has an electronic viewfinder.

availability of ten different types of television cameras ranging from a miniature nuclear camera to a high resolution industrial image-orthicon model.

From January 1961, the company has had exclusive selling rights in the United Kingdom and many overseas territories for the Dage range manufactured by Thompson Ramo Wooldridge.

The model 320B/V, for example, is a studio broadcast Vidicon camera with 700 line horizontal, resolution. The 4-lens turret or zoom lens are rear controlled. The 5in. electronic viewfinder is removable, enabling it to be used as a film camera, when fitted with dust cover-blower assembly. It has built-in indicator lights and intercom facilities and is fitted with an overscan protection switch. The 320B/V is manufactured by *Thompson Ramo Wooldridge, Michigan City, Indiana, U.S.A.*

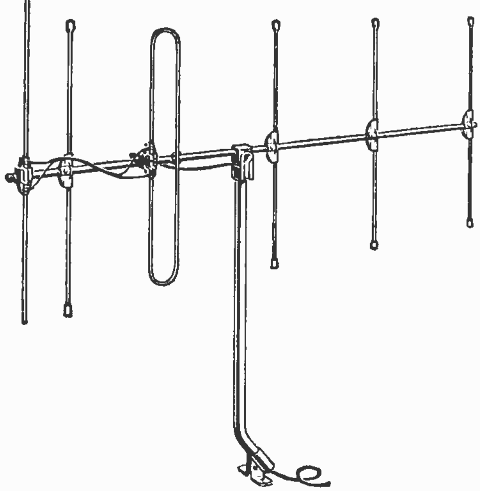


A view of the "Neveye" closed-circuit TV camera fitted with a lens turret for wide angle and telephoto shots.

New Aerial and Attenuators

THE following new products are now available from all Antiference Distributors.

The HL514 loft aerial is available in all vertical Band I/III channel combinations, has a double-driven array incorporating a telescopic single dipole for Band I and five Band III elements. The aerial is complete with angled arm and bracket and is supplied fully assembled with automatic "click-mec" elements in individual envelopes. The price (from 1st April) is 42s. 0d.



The new Antiference TV aerial—type HL514

The Balancer, BA/1 is a "frequency conscious attenuator" and is designed for easy insertion into TV aerial downleads to provide variable attenuation of Band I signals without affecting Band III, or of Band III signals without affecting Band I; so enabling a balanced signal to be easily obtained in areas where non-cositing of transmitters, different power or reception conditions result in an unequal signal being received. The unit is housed in a streamlined cream plastic cover. The price of the BA/1 is 16s. 0d., complete with lead and plug. Both the BA/1 and the HL514 are made by *Antiference Ltd., Bicester Road, Aylesbury, Bucks.*

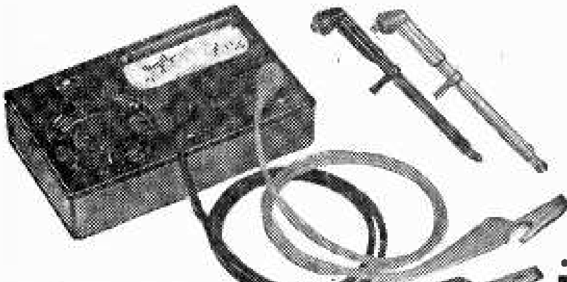
Colour Television at "Daily Mirror" Opening

When, on Tuesday, 7th March, Mr. Cecil Harmsworth King, chairman of the "Daily Mirror" Group, carried out the official opening of the impressive new headquarters of the "Daily Mirror" and "Sunday Pictorial" in Holborn, the proceedings were televised in full colour to overflow audiences in the building.

The operation was carried out by the Marconi Company using two colour cameras and 35mm colour telecine equipment. An 8ft x 6ft screen was installed in the staff canteen, and a further twenty 21in. monitors in various parts of the building.

The opening ceremony, which took place in the foyer, was followed by a colour telecine programme which included a film showing the building itself under construction. The programme was recorded on Videotape for subsequent performances in black-and-white.

More for less...



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0— 25 V.	0— 250 V.
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0—1000 V.	

Resistance	D.C. Current
0—20,000Ω	0— 100μA
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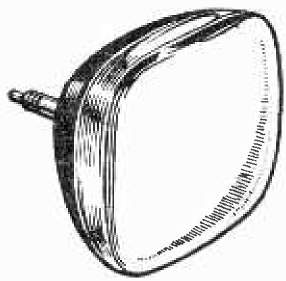

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Your PROBLEMS Solved

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. 439 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

FERGUSON 306T

I would like to install a new tube but I am not sure of how to remove the old one. Also, I think the tuner is faulty for when it is operated thin black lines run across the screen accompanied by crackling noises. This stops a few seconds after tuning.—J. Harkness (Greenock).

The tube is removed as follows: remove the focus dome, the tube base connector and ion trap magnet. Slacken off the deflector coil adjusting screws and after discharging the final anode of the tube to chassis, remove the EHT connector. Unhook the tube earthing spring and withdraw the tensioning screws on the retaining strap. The strap may then be removed and the tube carefully drawn away from the deflector coil assembly.

When replacing the tube, ensure that the deflector coils are as far as possible forward and that the screen end of the tube is correctly positioned in its cradle. The tension spring which contacts the external conductive coating on the tube must be stretched between the hook on the top support and the tag.

Dust or grease on the contact pips of the turret coils may be responsible for the tuner fault. These contacts should be very carefully cleaned and polished with a soft cloth.

VIDOR CN 4221

Having replaced the line output transformer, on switching on, the sound comes up, as does the line timebase whistle. They then immediately cut out and at the same time the two H.T. rectifiers (PY82) glow very bright and the two fuses blow. No other components have been touched other than the PL81, PY81, ECL80 and EY51 which I have replaced with no avail.—R. Robinson (Maidstone).

Although we cannot say that this is the cause in your case, we have often found that a lead passing through the chassis near the PL81-PY81 valve bases breaks down and shorts to the chassis. You should check this point.

McMICHAEL CR52

The trouble is seemingly situated between the 32μF electrolytic condenser and the 120μF electrolytic. Connecting the positive sides of these condensers is a 1,000Ω, $\pm$ 20per cent tolerance resistor which becomes red hot when the receiver is in use. The picture disappears but the tube functions correctly. Also the sound has vanished. I tested both condensers and found a short in the 120μF, but the 32μF was in order. I also tested valves GZ32 and PL38 and these proved to be in working order. When I disconnect the 1,000Ω resistor there is a raster which can be reduced with the brilliance control. Upon connecting a new 120μF condenser the same symptoms occurred. I really think the fault lies somewhere on the EHT side as this 1,000Ω resistor only gets hot when the picture is coming on, or as the EY51 lights up along with the EHT whistle associated with the picture.—J. Greenshields (Glasgow E.3).

There are two 1k 6W resistors from the 120μF capacitor. One feeds H.T. to the vision strip, the other to the sound. We are inclined to suspect the latter. If no other components are damaged check the 0·003μF capacitor which decouples the H.T. line at the sound I.F. stage. This is a small capacitor and you will have to trace the H.T. line along from the resistor to locate and disconnect it.

PETO SCOTT 1712T

This set has recently been converted to receive ITA using a Brayhead tuner as prescribed. The BBC programmes are good but the ITA at times is covered with a herring-bone pattern (horizontal). I have tried to adjust the oscillator coil but this fails to cure it. Would wiring directly into the chassis and cutting out the adaptor coil be a better solution?—M. Williams (Retford).

Since the pattern interference is not present all the time it may well be a form of external interference picked up by the aerials. If this is the case, it may be alleviated by carefully orientating the Band III aerial for maximum signal pick-up consistent with minimum patterning.

PAM 754

I replaced the H.T. rectifier on the above set and the set worked fine for some time, but now on switching on, the top of the picture is cramped about a quarter of the way down. On warming up this gradually recedes to about 1in. down each side. Also on increasing the brilliance with the fine tuner on the right-hand side I lose volume, is this in order?—W. Couper (Port Glasgow).

Your symptoms are still those of low H.T. and you may easily have another faulty rectifier. Other items to check are the PL81 line output valve, and the CRT which may have a first anode leak reducing the boosted H.T. line.

PYE VT7

The CRT on my set has lost a great deal of emission. The set is being run on a 250V D.C. supply. Is there any way the tube can be boosted? As I live in a fringe area, will a preamplifier fitted to a standard set make it equivalent to a fringe model? Is there available commercially some form

of booster to fit at the aerial end when the aerial is fitted 100 to 150yd away from the house?—J. Jones (Llandyssul).

You may boost your tube a little by connecting a 5,000Ω 10W resistor between the voltage selector terminal 5 and the " hot " side of the CRT heater—usually pin 1. We cannot advise you about a head amplifier.

You may like to try fitting a 30L15 frame grid valve in place of your PCC84 R.F. amplifier, and retuning the tuner; or alternatively writing to the manufacturers who have designed a higher gain replacement tuner for this model.

EKCO T141B

I would like advice on the following faults of this receiver. The picture is displaced to the left, leaving ½in. space on the right, which cannot be filled by the line hold or width control. The picture is also smudgy to the right of the outlines; is this called " flaring"? Also when contrast or brilliance is advanced the raster becomes defocused and even if carefully set to prevent defocusing a few lines on top of the picture begin to tear to the left. If, as I suspect, the tube is failing, is it possible to boost it with any success? If so I would appreciate advice on how to go about it. The tube is a Mazda CRM 121B, which I think is the original.—J. Gibson (Wirral).

Gaps on the right normally denote a low emission 6P28 line output valve. Your other symptoms all point to a faulty tube which may be low emission and heater-cathode. Try fitting a low capacity 2V CRT transformer. Connect the secondary to pins 1 and 8, having removed and isolated each previous connection and connect the mains side of the transformer between the chassis and the copper strip behind the voltage selector.

SOBELL T224

When the set is switched on for about an hour both the picture and sound fluctuate. After that it seems to settle down to an almost normal picture. —W. Eaton (Shipbourne).

It would appear that there is a poor contact at one of the V1, 2 or 3 valvebases. If the receiver has not been converted, check the seating of the rear left side ECL80 and centre EF80 and the base connections. If the receiver has a turret tuner check the seating and base contacts of the tuner valve and clean the turret studs etc.

BUSH TV24

I have replaced an isolation and booster transformer to feed the CRT owing to the deterioration of the picture. On a 25per cent boost the picture is better but still not really good. On placing it on a 50per cent boost it gives a good quality picture but after a few minutes the picture darkens and is hardly visible. When the set is switched off and on again after a few seconds, it does the same thing again. I would like to point out that on the 25per cent boost the picture remains the same all the time, but as already stated, it is not of really good quality.—A. Glover (Leicester).

Excessive application of boost (50per cent) will result in a complete loss of emission. If you wish to retain the tube (which should really be replaced since it has given good service) you will have to run it on the original 6·3V or on low boost (25per cent).

K.B. LVT30

The set gives constant trouble after an hour of running on both BBC and ITA. The set develops heavy horizontal lines varying in number from four or five and sometimes they cover the whole screen. I have replaced the 6AL5, 12AX7, 12AU7, 6BW6, 6DC6G valves, the common I.F. 8D3, and also 2 and 3 vision 8D3's. The tube is only six months old and has been tested for leakages. All the voltages given on the service sheet have been tested and found to correspond with those of my set.—J. Kenny (Chester-le-Street).

Whilst the lines may denote a poor contact in the frame timebase control (check effect of operating height etc), a faulty H.T. feed resistor could cause a similar effect in the vision I.F. strip.

Remove the 6AM6 valves in turn, V3, V4, V6, to try to locate the defective stage. Probing the valve-base components could well show up the faulty one immediately.

ENGLISH ELECTRIC 1550

The picture only fills about three-quarters of the screen, but when I move the focus control the picture fills the screen, but it loses its brightness and goes out of focus. What components should I check or change. When I touch the TV and F.M. switch on the front of the set I lose the picture but the screen remains illuminated.—T. Morgan (Weybridge).

You should replace the large metal rectifier situated on the lower power pack. The type number of this is H45-21-1BFL. You should clean and if necessary adjust the TV/F.M. switch contacts.

FERRANTI 24K6

The picture collapsed to a vertical band about one-third of the width and then broke up and finally disappeared. The sound is still present.—H. Wroe (Oldham).

The symptoms denote a collapse of the line timebase operation. Check the line oscillator output PL81 valve, which is the most likely cause of failure and then check the PY81, R105 (1·8k) R106 (500Ω) and R107 (300Ω).

G.E.C. B.T. 1252

Can I replace the G.E.C. 7203A CRT with the Mullard MW 36-24, and what circuit modifications and ion trap magnet will be required? Can the same modification be carried out on model B.T. 5643? If so which Mullard tube can be used, this being a G.E.C. 6901A 16in. CRT?—B. Thomas (Chorley).

When using the MW36-24, a new CRT base is required and provision made for the anode volts. This can be obtained from one side of the height control. The ion trap magnet is an IT9.

With reference to the B.T. 5643, it would be possible to use a Mullard MW41-1. This tube has metal cone envelope and again provision must be made for the first anode volts. The previous answer applies here.

K.B. MV60

The picture suddenly collapsed and left a ½in. horizontal line. The picture seems to be there and the sound is working correctly. I also have a Bush TV32, which gives a good picture, but the bottom is compressed and leaves a gap at the bottom of the screen.—C. Simpson (Hounslow).

Check the frame timebase valves on the MV60 model, 12AU7 and 6BW6. If these are in order (under tube) check continuity of frame oscillator and output transformers, height control etc. On the TV32, check the right side ECL80 valve and 8μF electrolytic which decouples pin 8.

DECCA DMC17

When the above set was switched on, the picture was normal for a few minutes then broke down into wide zig-zag lines, then disappeared altogether. I discovered that the video amplifying valve (EF80) was glowing bright blue, so I substituted a spare valve, but still without results. The sound is still there.—A. Ward (London, S.E.19).

First ensure that the line timebase whistle is normal and that EHT is present at the CRT anode, EY51 etc. Then check the video amplifier circuit; anode load 6·8k pin 7, grid 3·9k-2·2k pin 2 and cathode 15Ω-200Ω, pins 1 and 3.

PHILCO T1412

There are three dark lines on the left of the picture and it is slightly darker on the right side, also it is critical on the vertical hold.—F. Hood (Seaham).

There are two 0·001μF capacitors associated with the scanning coils and one associated with pin 2 of the tube base to chassis. Replace the latter 0·001μF first, and if the symptoms persist, check the other two. Regarding the poor frame hold, check the ECL80 immediately to the front of the PY82 valve on the left of the tube and the resistors associated with pin 8 of this valve base.

SOBELL TS14

The picture on this set has been fading over the past few weeks and now with the brilliance control fully advanced and no signal the raster is not visible. The tube appears to be in order as interference spots show up quite white. The EHT also appears to be correct as the picture has not altered in size.—D. Pettitt (Cumberland).

The ion trap magnet on the rear of the tube neck must be aligned for maximum brilliance. Also check the tube base contacts, the resistors associated with the brilliance network to pin 2 and the video amplifier resistors. These are 47k to pins 1, 3 and 9 (from H.T. pin 8) and 470Ω from pins 1, 3 and 9 to chassis.

GEC BT6542

This is a 16in. model with I.F.'s of 38M to which I have added a tuner unit, type BT204. I have secured a good picture from Holme Moss —Band I and from Winter Hill—Band III, but the sound output is low. Unconverted, the set gives excellent sound and picture. There are no obvious valve faults. The set also has a loud line whistle. Is it possible to reduce the noise without interfering with the line output transformer?— N. Logan (Royton).

Adjust the Band III oscillator tuner for loudest sound with the fine tuner midway. Readjust the aerial and R.R. slugs for optimum picture and then readjust the oscillator for minimum sound-on-vision. Curing the noise is difficult on this model. Try packing round the line output transformer with sorbo rubber.

DEFIANT

This set has developed a peculiar fault. On BBC there is a bright picture with plenty of contrast, but it is very prone to any kind of interference, which seems to be present all the time, and the sound level is well down. On ITV, however, the sound is fine but the picture is weak owing to a poor aerial. After a while the line timebase begins to slip and continues to do so every few minutes. This does not happen on BBC. I have changed over two ECL80 valves on the chassis and replaced both valves in the tuner with working valves. This restored the ITV picture but the other faults remain.—S. Dinnair (Crawley).

As you omitted to mention the model number of the set we are somewhat handicapped in our reply. However, it would appear that the alignment of the BBC coils is inaccurate. This may have been done deliberately in order to reduce the BBC signal which may have been excessive. If the model is one of the 1456 series you should release the rear right side thumb-screw and rotate the BBC tuning cam for maximum sound. If the input is excessive, use an aerial attenuator to the BBC socket. We will advise you further if necessary, but if, as you say, the ITV signal is weak, an effort should be made to improve the aerial.

VIDOR C.N. 4218

There is no EHT on this set. I have changed all valves in the circuit and checked windings. The recovery diode valve has a cathode voltage of only 175.—J. Hackworth (Oxon).

We presume the valve check included the frame output-part line oscillator, ECL80, the PL81 and PY81. You should now check the 1·5k 5W resistor to pin 8 of the PY81, also the 1·2M to pin 1 of the ECL80. Then check in turn the 0·25μF boost capacitor (shorted), the 100pF across the line output transformer windings, before suspecting the line output transformer. Make a check on the hold control etc. If the PL81 overheats check the 0·01μF capacitor from pin 1 of the ECF80.

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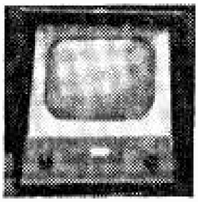

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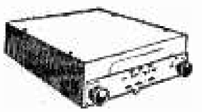

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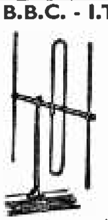

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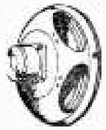

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6AM6	5/-	6X5	6/6	EF39	5/6	PY80	7/6
6B8	5/-	12AT7	8/-	EF41	9/6	PY81	9/6
6BE6	7/6	12AU7	8/-	EF50	5/6	PY82	7/6
6BH6	9/6	12AX7	8/-	EF80	8/-	SP61	3/6
6BW6	9/6	12BE6	8/6	EF91	5/-	UBC41	9/6
6D6	6/-	12K7	6/6	EF92	5/6	ECH42	9/6
6F6G	7/6	12Q7	6/6	EL32	5/6	UF41	9/6
6H6	3/6	35L6	9/6	EL84	8/6	UL41	9/6
6J5	5/6	35Z4	7/6	EM81	9/6	UY41	8/6
6J6	5/6	80	9/6	EZ40	7/6	U22	8/6
6J7G	6/6	807	5/6	EZ80	7/6	VR105	9/6
6K6GT	6/6	954	1/6	E1148	1/6	VR150	9/6
6K7G	5/6	EA50	1/6				

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ALUMINIUM PANELS. 18 s.w.g. 12in. x 12in., 4/6; 14 x 9in., 4/-; 12 x 8in., 3/-; 10 x 7in., 2/3.

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16/450v.	3/-	8+16/45v.	3/9	32+34/450v.	6/-
16/500v.	4/-	8+16/500v.	5/6	32+32+32/350v.	7/.
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