TRANSISTORISED TV RECEIVERS

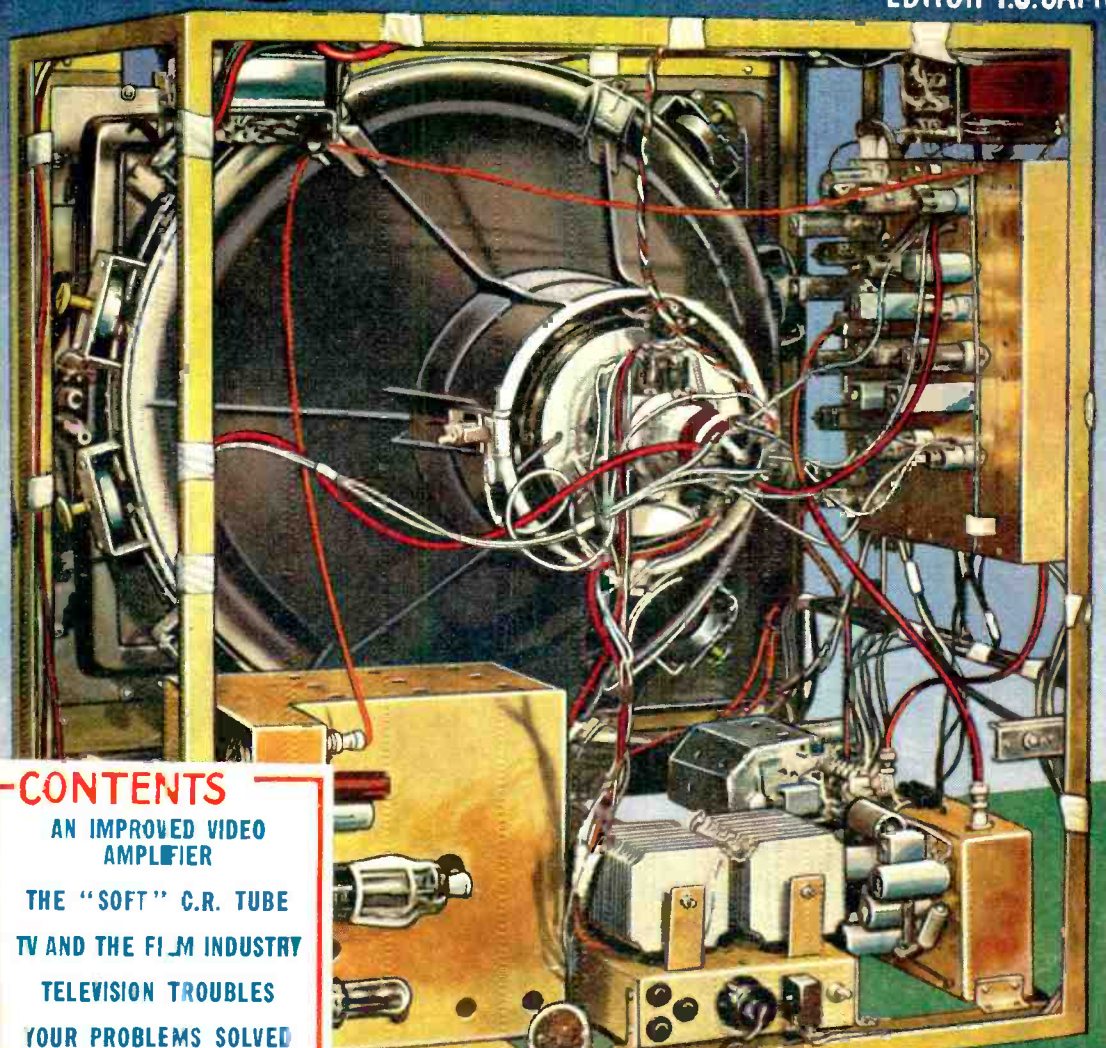
Practical Television

1'3

FEBRUARY 1959

AND TELEVISION TIMES

EDITOR: F.J. CAMM



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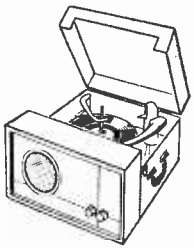

(R.P.3) 79/6

A delightful looking cabinet 14¾ x 17¾ x 8¾in. in 2-tone leatherette. Will take a B.S.R. Monarch 4-speed autochanger and 6½in. round speaker. Carr. & Ins., 4/6.

(R.P.4) 79/6

Stylish cabinet by famous manufacturer. Cloth covered in contrasting colours (red and grey). Grilled front controls panel. Size 15 x 19 x 8¾in. deep. Beautifully made—a cabinet of which you can really be proud. Takes 4-speed B.S.R. autochanger. 6½in. round or elliptical speaker. Room for any amplifier of your own choice. Carr. & Ins., 4/6.

(R.P.2) 69/6

A beautifully styled cabinet. Made by a famous manufacturer. In polka dot grey cloth with clipped lid and carrying handle. Size 16 x 14½ x 8½in. deep. Will take B.S.R. Monarch 4-speed autochanger and 4 x 7in. elliptical speaker and most of the modern portable amplifiers. Carr. & Ins., 4/6.

(R.P.5) 59/6

A well designed cabinet in brown leatherette. Strong clip fasteners, easy carrying handle. Takes B.S.R. Monarch autochanger and space for a 4 x 7 in. elliptical speaker. Can be made up into an ideal Record Player Size 16 x 14½ x 8½ in. deep. Carr. & Ins., 4/6.

(R.P.1) 49/6

A practical cabinet nicely designed, cloth covered two tone (brown and coffee). Size 15 x 17 x 8in. deep. Takes B.S.R. 4-speed autochanger and 6½in. round or elliptical speaker. Carr. & Ins.. 4/6.

Elegant cabinet, cloth covered in grey or red, with sunken control panel and speaker fret. Size 13 x 17 x 8in. deep. Takes B.S.R. Monarch 4-speed autochanger. 7 x 4in. elliptical speaker and most of the modern portable amplifiers. Carr. & Ins., 4/6.

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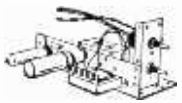

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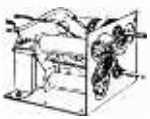

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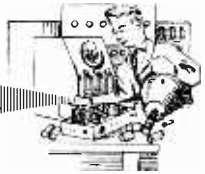

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The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Television." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for 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, Strand, 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.

TELEVIEWS

A SECOND BBC TV NETWORK?

THE chairman of the BBC, Sir Arthur fforde, referred in a recent speech to the future of TV. He says the picture is blurred by the conflicting interests of industry, the Press, the advertising world, and the entertainment and film industries, all of which are involved in commercial television. Although it may seem that the problem is a fight between the BBC and the I.T.A., for the possession of a third network, the problem goes much further than that. It is obvious that the addition of another commercial network could not raise the proportion of serious programmes within the peak listening hours to something higher than it is to-day. Also, a third network would have the effect of raising the proportion of "serious" to "light" programmes.

The solution, of course, rests with the Government, but the BBC considers that any further expansion of television, any change in an organisation which may be imposed, should have as the principal object the increase of the proportion of serious broadcasting matter above what is available to-day, between 7 p.m. and 10.30 p.m. Between those hours it is stated that only about one-fifth of the total TV programmes offered to the British public could be described as of any serious value.

CHEAPER TV TUBES?

THE TV tube monopoly now has a serious competitor so far as replacement tubes are concerned. A company has been formed to supply replacement tubes at approximately half the price charged by the large manufacturers and with twice the guarantee. A similar break into this Monopoly successfully occurred in the United States a few years ago, and as a result 60 per cent. of the total TV tube market is supplied by manufacturers outside the Monopoly. The replacement market in this country is over one million tubes a year. Whilst in principle there is nothing to stop anyone with the necessary experience and plant from making a C.R. tube, in fact, such an enterprising person would find that he could not purchase the electron gun because the manufacturers of tubes in this country have refused to put their guns on the open market. It would appear that the Government is aware of this as it appears to be fairly easy to obtain a licence to import the necessary guns. Complete guns are now being made by an independent manufacturer who offers to show anyone how to make a tube and supply the equipment.

INDEX TO VOL. 8

WILL readers please note that the index to Vol. 8 is now ready and available for 1s. 3d. by post from the publisher, address as on this page. Readers are reminded that loose-leaved binders for this journal are available for 10s. post free.—F. J. C.

Our next issue, dated March, will be published on February 20th

An Improved Video Amplifier

THIS ARTICLE EXPLAINS HOW TO USE IT

By D. R. Bowman

THIS article has been written in response to a great number of enquiries following the publication of an article called "An Improved Video Amplifier" in the October, 1958, issue of PRACTICAL TELEVISION.

First, the writer apologises for a mistake in the original article. The inter-valve coil L3 was specified as a PO2, whereas it ought to have been a PA2. However, for those who have already bought a PO2 this coil may be used with a larger sized iron dust core well inserted and held in place with wax, etc. This gives about the right inductance and no circuit alteration is needed.

Use as a Video Output Stage

The amplifier is well suited for use as a video output stage of a television receiver and the following points should be of assistance:

(a) The circuit may be used without alteration whether the signal is applied to the cathode or grid of the C.R.T. The most usual method is to apply the modulation to the cathode. This has the advantages of enabling direct coupling to be used with safety, and of preserving the D.C. component of the signal without modifications. It should be noted that with an H.T. supply of 240 volts, the D.C. potential at the 6CH6 anode is about 180 volts with no signal. It may not be convenient to apply such a high voltage to the C.R.T. cathode—about 90 volts is more manageable. Fig. 1 shows a way of achieving this reduction in voltage.

It should be realised that with the present amplifier there is no change of phase between the input (grid) and output (anode), whereas with the commonly-used single stage there is a phase change of 180 deg. There are, therefore, two possible courses of action if the experimenter wishes to build this amplifier into a set place of a single valve stage. The most straightforward is to change over the connections of the detector. A second method is to change from cathode to grid modulation of the C.R.T. If the former method is employed, it must be realised that leaky-grid or anode-bend detection cannot be modified in this way. (These detectors are employed little today, but may possibly be met.) With a diode, whether thermionic or crystal, the changeover of anode and cathode connections is a simple matter. If a change from cathode to grid modulation of the C.R.T. is contemplated, the experimenter's first task is to determine the original D.C. potentials of cathode and grid so that a suitable arrangement can be devised when the alteration is made in order to put the same D.C. potentials on the electrodes.

(b) Some enquiries have been made about D.C. restoration and one or two readers were puzzled because no provision was made for this in the published circuit diagram. The reason was that the provision of a D.C. restorer ought to be considered an extra. There are advantages to be had by its use, obviously, but the author prefers not to use it because his own receiver is then much less affected by "aircraft flutter." A "grey" interval between programmes is not really a disadvantage in his opinion and the variation of brightness between scenes presented is usually not great enough to cause annoyance. It is admitted that many require D.C. restoration and it can be had by wiring a germanium diode between the grid of the 6CH6 and chassis—which way round depends on the polarity of modulation required and if it is found that the diode anode goes to the grid it can be omitted because the 6CH6 will then do the clamping.

If a change from cathode modulation to grid modulation is decided upon and D.C. restoration is required, it must be remembered that the signal would have to be "clamped" to the C.R.T. grid. For this purpose no more is needed than a further crystal diode between the grid of the C.R.T. and the chassis. As an alternative, a cathode follower can be used with advantage. A suitable circuit for this is shown in Fig. 2. The type of valve used matters little, as long as its anode current is neither too small, nor too large. A 6J5 is admirable, but for those who like miniature valves, a 6C4 is very suitable. Sync may be taken from the point X if required, or, alternatively (with opposite polarity), from the grid of the C.R.T. Taking sync from point X will enable the original sync separator to be used without alteration—that is, if originally the C.R.T. cathode was modulated and sync was taken from this electrode. If point X is not used, it should be connected to the chassis through an 8 μF electrolytic condenser with a 0.01 μF mica condenser in parallel. R should be chosen to give the correct bias to the valve (for a 6J5, R has a value of 1,000 ohms). The cathode follower has the advantage of putting very little loading on the video amplifier and owing to the properties of the circuit, quite a large capacitive load—for example a long lead—can be attached to the cathode of the valve without appreciable losses. If this circuit is employed, the anode load resistor of the 6CH6 can be increased to at least 3 kΩ, giving increased gain if this is required. This should rarely be necessary, however. Another advantage of the cathode follower is that the sync separator can be fed without appreciably loading the amplifier.

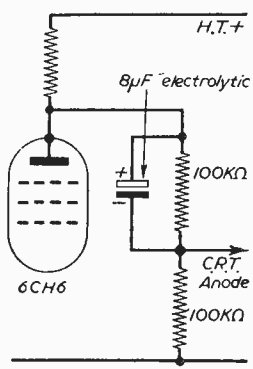

Fig. 1.—Reducing the D.C. voltage on the C.R.T. cathode.

(c) If a cathode follower is not used, sync

(*Continued on page* 333)

THE "SOFT" C.R. TUBE

HINTS ON USING A FAULTY TUBE, AND HOW TO ASCERTAIN WHETHER IT HAS GONE "SOFT"

By John Coles

THE word "soft" may appear rather curious to the uninitiated when used in relation to a picture tube which is a solid article. It does not mean that the tube loses its rigidness and in some strange way changes from an unyielding to a malleable form. It simply indicates that the degree of vacuum within its envelope is considerably less than it was when the tube was made, and that as a result the penetrating power of the electron beam is reduced.

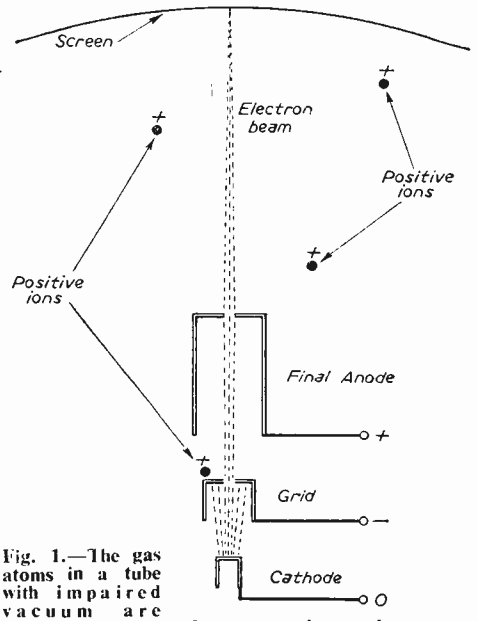

Fig. 1.—The gas atoms in a tube with impaired vacuum are bombarded by the fast-moving beam electrons and themselves lose electrons. This results in the creation of positive ions which drift towards the negatively charged grid, and detract from the tube efficiency.

It is unlikely that an envelope or neck air leak would be responsible, though this may be the case in the event of the tube being roughly treated and a diminutive crack developing in the glass, but here evidence is given by a milky effect appearing on the inside of the tube neck possibly accompanied by sparking across the electrodes when the tube is energised.

Usually the vacuum becomes progressively impaired by gas being generated within the tube itself, as the result either of old age or incorrect operation when young. Nevertheless, even when operating correctly, there are times when gas is emitted from the electrodes. This, which invariably occurs within the first few months of the tube being put into service, may or may not be sufficient to detract from the performance, but if it is, there is never any difficulty in obtaining a replacement under the terms of the guarantee, since the trouble can usually be traced to the inefficiency of the electrode de-gassing process during the tube's manufacture.

De-gassing is necessary in order to remove from the electrodes all traces of gas which might otherwise be liberated when the tube is put into service, but since the process is highly efficient nowadays, the trouble is far less common than it used to be, and now in the majority of cases of a tube going soft early in its life there is a suspicion of it having been incorrectly operated or used consistently with the ion trap magnet incorrectly adjusted.

Vacuum Essential

It will be remembered that the tube cathode is coated with an emissive material, such as strontium oxide or barium oxide, and that when the cathode is heated electrons are emitted from its surface. The electrons, being negatively charged particles, are accelerated to a high speed towards the final anode, which itself is charged highly positive by the EHT voltage. The electrons pass through an aperture in the grid electrode and finally emerge as a finely focused stream from a similar aperture in the final anode, and from here they are directed towards the fluorescent screen, as shown in Fig. 1. On impact with the screen, the kinetic energy which the electrons have acquired by reason of their mass and velocity is liberated in the form of illumination.

This pattern of events can happen successfully only if the space within the tube is relatively free from gas atoms. Obviously, since it is impossible to secure a perfect vacuum, several gas atoms will always be drifting around but are of little moment. However, if the vacuum is impaired some of the resulting greater number

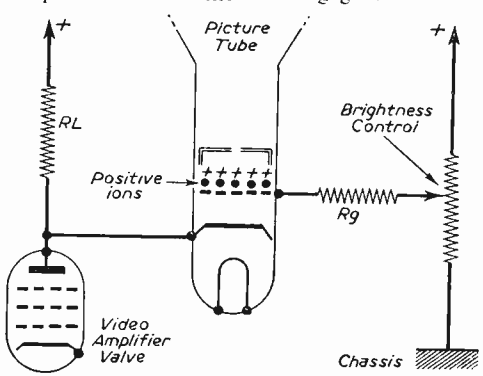

Fig. 2.—A diagram showing the biasing elements of a picture tube. In a "soft" tube the positive ions will be attracted to and collect on the grid as shown, and the positive charge on the grid will draw grid current through Rg, which will then act as a load resistor.

of gas atoms get in the way of the fast-moving electrons, and as a consequence the free electrons of these atoms are removed and contribute to the beam. The gas atoms which are so bombarded are thus deficient of a negative charge and so become what are known as positive ions.

Positive Ions

Positive ions detract from the normal operation of the tube in two essential ways: (1) they interfere with the beam electrons by deflecting

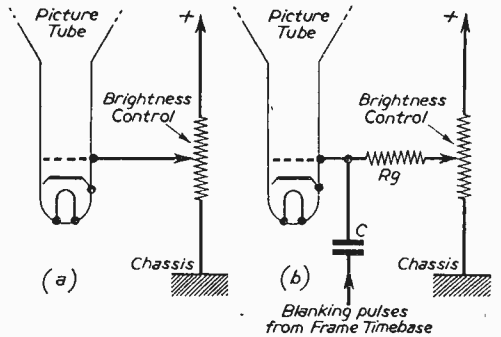

Fig. 3.—In most older receivers the brightness control is arranged as in circuit (a), but where frame-flyback suppression is featured, in more recent models, the circuit in (b) is often used.

them slightly off course and possibly reducing the velocity of some of them, and (2) they move at a slower speed than the electrons towards the negatively charged grid (see Fig. 1). The reason for them being relatively slow moving is because they are much larger than the electrons.

As a result, the picture may be affected in three ways: (a) it will almost certainly be found that the focus is very poor even though the focus control is working correctly and can be passed through a point where the focus is at optimum, although very poor; (b) the picture brightness will be below normal, and an attempt to increase the brightness will result in further defocusing and possibly in the picture going negative; (c) the picture may appear to be always too bright and of insufficient contrast owing to the brightness control not reducing the brightness sufficiently, even when it is turned right down.

Owing to the partial scattering of the electron beam as the electrons strike the drifting gas atoms in a soft tube, it can be understood why the picture brightness and focus are affected, though it may not be so readily realised why the control of brightness is affected.

In Fig. 2 is shown a circuit of the biasing elements of a picture tube. Assuming that there is no picture signal applied to the video amplifier valve, the tube cathode is held at a steady positive potential (relative to chassis) owing to the potential at the junction of RL and the valve anode. The tube grid is connected to the brightness potentiometer, and this can be raised from zero voltage to a positive voltage depending on the setting of the brightness control, again relative to chassis.

The brightness control circuit is so arranged that even when the grid is at maximum positive voltage (maximum setting of brightness control), the cathode is slightly more positive. This, then, means that the grid is always negative *with respect to the cathode* and that it increases negatively as the brightness control is retarded. This, of course, provides the normal control of brightness, and varying degrees of brightness corresponding to the picture signal result from the potential at the junction of RL and the video amplifier valve (i.e., tube cathode) falling below its zero-signal level in accordance with the picture modulation.

Resistor Rg, in the grid circuit, may or may not be present depending upon the circuit design. In most older models, the tube grid connects direct to the slider of the brightness control, as in Fig. 3(a), but in more recent models such a resistor is employed to facilitate the introduction of a frame-flyback suppression circuit—Fig. 3(b). This resistor is rather important when we are considering a soft tube.

Let us now return to the circuit in Fig. 2. If the tube happens to be soft, the grid, being negative with respect to cathode, will attract to it and collect quite a large number of positive ions, as shown in the diagram. These positive ions, as would be expected, endow the grid with a positive charge, and if there are sufficient number of them the resulting positive charge may outweigh the negative potential given to the grid by the external circuits.

When this happens, the grid itself will tend to attract some of the beam electrons, instead of controlling them in the ordinary way, and a current will flow from the cathode to the grid by way of the external circuits and Rg. Rg will, in fact, act as a load resistor to the conducting grid. Under this condition, of course, the operating range of the brightness control will be curtailed, and if the tube is very soft it may well be found impossible to extinguish the illumination completely, even by fully retarding the brightness control. This trouble is often encountered by the service technician and experimenter, and in most cases the cause is not fully understood.

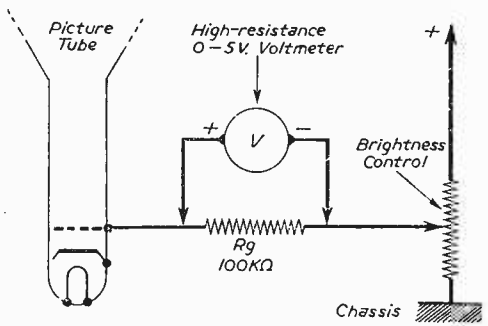

Fig. 4.—The set-up required for checking gas current.

On receivers not featuring a resistor Rg, the symptom may not be so prevalent, but the symptoms as mentioned earlier in the article will undoubtedly be present if the tube is soft. Unfortunately, causes other than a soft tube are likely to produce very similar or exactly the same symptoms as have already been considered, and

establishing conclusively that a soft tube is, in fact, responsible may appear rather difficult without performing a substitution check.

For example, impaired focus, lack of brightness and the picture turning negative when the brightness control is advanced may all be caused by the tube being low in emission, while uncontrollable brightness, as is well known, is often caused by poor insulation between the cathode and heater of the tube or by a defect in the brightness control circuit or video amplifier section of the set itself.

There are ways by which a soft tube can be proved without having to go through the process of installing a substitute tube. If the receiver does not use a grid resistor Rg, then a 100k component can be fitted temporarily and then a test made to find out whether the brightness control works normally under this condition. It should do since current should not normally flow through this component, and would flow only in the event of tube trouble. If the brightness control becomes partially inactive by this addition, then the tube grid is passing current.

If such a resistor is already fitted, however, and the brightness control is not operating properly, the resistor should be temporarily short-circuited. If this results in almost normal operation of the brightness control, then the tube is a first line suspect. In the case of a capacitor being connected between tube grid and the frame timebase, such as C in Fig. 3(b), the capacitor should be removed, since a leak in this would be likely to produce the same symptom.

It should also be noted that a leak between the first anode and grid of the tube puts the grid at a positive potential and prevents the brightness from being reduced to zero if a resistor Rg is incorporated. This trouble can be masked, however, usually at the expense of the frame-flyback suppression feature, by permanently short-circuiting Rg. This palliative can also be adopted, if necessary, to maintain in service a little longer a soft tube whose chief shortcoming appears to be uncontrollable brightness.

A Test for Gas Current

A test for a soft tube, often known as a gas current test, can be arranged by measuring the volts drop across Rg. Zero current will, of course, give a zero volts reading, but if current is flowing in the resistor, then a proportional voltage will be developed across it.

The set-up is given in Fig. 4. If necessary, Rg should be installed for the purpose of the test or changed so that its value is in the region of 100k. A high resistance voltmeter must be used to measure the volts drop (valve voltmeter preferably), the aerial should be removed from the set and the brightness control adjusted to a "normal" setting. It is also a good idea to disconnect any capacitor connected to the tube grid, so the circuit is left in skeleton form, as shown in the diagram.

If a sensitive meter is used, there will always be a small indication of voltage since a perfect vacuum is impossible, but if the reading is any more than a volt (it is usually greater than this if the tube is really soft), the tube vacuum is probably impaired.

AN IMPROVED VIDEO AMPLIFIER

(*Continued from page 330*)

can be taken from the amplifier from any of four points viz., either of the two anodes or either of the two cathodes. The anode and cathode of the 6AM6 give relatively small voltages. Neither is the voltage at the cathode of the 6CH6 very large. For preference, sync should be taken from the 6AM6 anode, and C4 (the trimming capacitor between anode and earth) omitted; the sync separator will have enough self-capacitance to render it unnecessary. If a larger sync voltage is needed, it may be taken from the anode of the 6CH6 and will usually be of the correct polarity as well. If this is done, it will be necessary to trim the core of the output inductance (L4) with the sync separator in circuit.

(d) A cathode follower circuit is not really

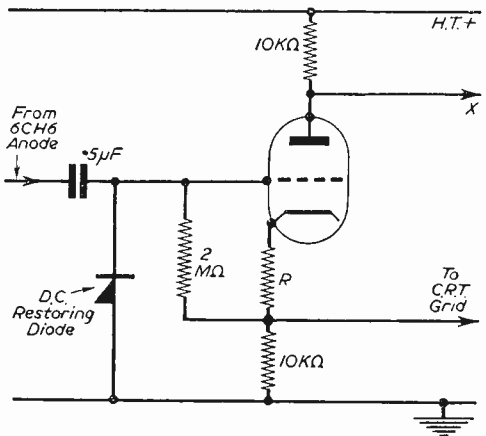

Fig. 2.—Cathode follower for use with grid modulation of C.R.T.

suitable for modulating the cathode of a C.R.T. It is almost impossible to overload a cathode follower on positive-going signals, but it will cut off rapidly for a few volts negative.

Use as a General Purpose Wide-band Amplifier

Another possible application of the amplifier is for the Y amplifier in a good quality oscilloscope. The best instruments use a "distributed" amplifier of low gain, or if higher gain is required, several of these in cascade. Many valves and much H.T. current are used in this arrangement. The result is a very expensive piece of apparatus which is capable of useful gain up to 30 Mc/s or even higher. The writer's home-constructed oscilloscope uses the two-stage amplifier which he has described, and it is found that any pulse wave-form arising in television techniques can be reproduced accurately on the tube face. For this application, the connection to one Y-plate is made direct to the 6CH6 anode, and L4 is re-trimmed as described on page 122 of the October issue. The tube used has a Y-plate capacitance of 18 pF and this restricts the available band-width to a little over 6 Mc/s. However, it does not appreciably increase the rise-time, and the "overshoot" cannot be seen on traces less than 1½in. in height.

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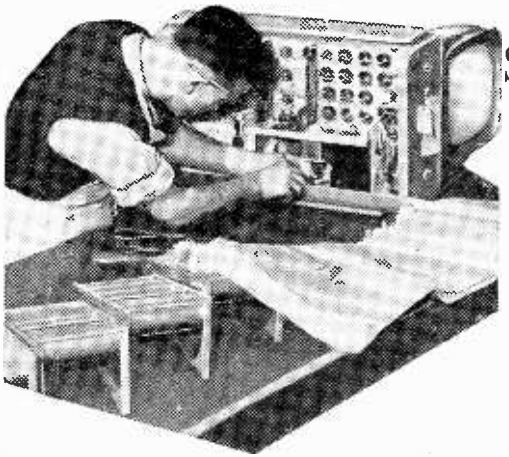

THE frame pulses appearing at the anode are integrated by C1, R1 and C2. These pulses can be applied direct to the frame generator or through the line pulse suppressor diode as shown. An alternative is also given, a crystal diode interlace filter. Both these methods remove any remaining line pulses, leaving a clean frame pulse for improved interlacing. The diode is biased in such a way that it will only conduct on frame pulses. The output is negative-going and is, therefore, suitable for feeding into a Miller transitron generator if required. The line pulses are differentiated by C3 and R2 before being fed to the appropriate generator (see Fig. 17)

Another way of taking off the frame pulses, this time from the screen grid, is shown in Fig. 18. The pulses are positive-going. The sync pulses developed across R1 are partially differentiated by C1 and R2. Owing to the longer duration of the frame sync pulses and the correct value of C1 and R2 a positive pip appears at the end of each frame pulse which is much greater than those which follow the line sync pulses. These pips are applied to the frame generator. The line sync pulses are developed across R3, the differentiating circuit being C2 and R4. A negative sync pip locks the generator. Fig. 19 is another type of sync separator which the reader might come across when servicing receivers. The picture signal is removed by the correct choice of biasing components, which also provide good separation of the line and frame pulses. The positive-going line pulses across R2 are fed to the differentiating network C1 and R1 and the frame pulses developed across R3 are applied to the integrating circuit R4 and C2.

The diode type of sync separator shown in Fig. 20 is not used to-day. V1A separates the line and frame pulses from the picture signal. The pulse amplitude is determined by R3 which applies a positive bias to the first diode anode. The sync pulses are amplified by the limiter valve V2. The frame pulses are integrated by R1 and C2. The line pulses are developed across R2 and differentiated by C3 and R4. The

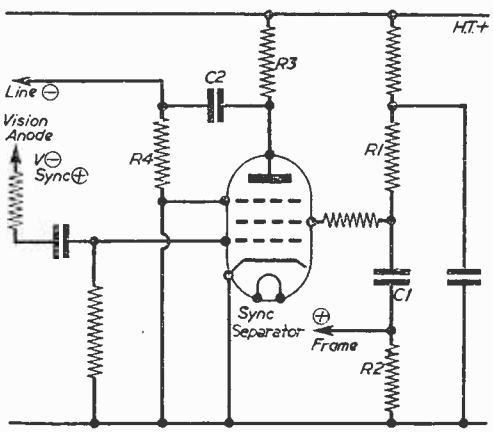

Fig. 18.—Taking off the frame pulses from the screen grid.

second half of the valve V1B is a D.C. restorer. Both the outputs from V2 are positive-going and are therefore suitable for feeding into line and frame thyratron generators.

Sufficient explanations and diagrams of differing types have now been given to enable the servicing of most types of sync separator to be carried out successfully.

Synchronising Separator Faults

If the picture is in two halves with a vertical black bar down the centre, and the line hold is "touchy," but the control is well within range of the locking frequency, first change the valve, then check the differentiating resistor and condenser components feeding into the line generator, and all the sync stage components. A high resistor is probably the cause. Sometimes the

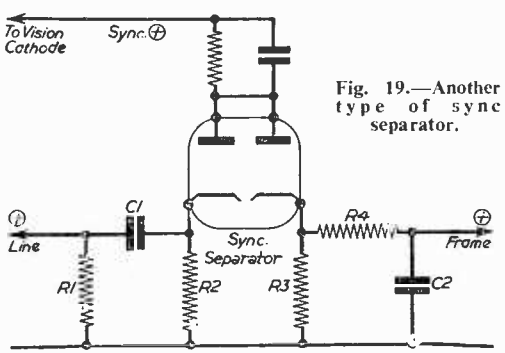

Fig. 19.—Another type of sync separator.

vertical black bar jumps in and out of the picture. If the picture is of normal strength and the frame lock is strong, a weak sync pulse to the line generator is the cause. If a line pulse clipper is incorporated in the circuit, this valve and its components should also be examined. The valve, or sometimes two valves, usually the triode sections of ECL80s, is situated between the sync separator and the line generator. A weakness in the clipper or sync stage will prevent the sync pulses from reaching the generator.

If there is a horizontal black bar across the screen which rises and falls, and rotation of the hold control fails to lock it, or if the frame locks weakly, with the locking frequency within the range of the control, change the sync separating valve first, then check the sync output network feeding the interlace filter, if this is fitted. Check the interlace crystal diode or valve and the input to the frame generator. The picture should be of good strength and line locking good. Examine all the sync stage components, especially the screen grid resistor, for an increase in value. Weak sync pulses to the frame generator are the cause of the trouble.

When there is no lock on either line or frame with a picture of good definition, the whole sync stage requires checking. If the picture nearly locks on line or frame when the hold controls are right at maximum or minimum, this is a fault in the generators (see line or frame faults). If on operating the line hold control the picture jumps bodily to the left with left fold over and on turning the hold control the opposite way the whole picture moves to the right with right fold over, examine the sync output network feeding the line generator or clipper, if this is fitted. The cause is that the sync pulse is too strong. This remark does not apply to sets having flywheel sync and A.G.C. A similar fault may occur, but the cause is different. If the picture is bent at the top, check the sync stage components generally and the video amplifier decoupling condensers.

If verticals have a stepped appearance or a horizontal displacement changing with the picture signal, examine the sync input coupling capacitor for leakage and check the grid resistor.

Pulling on whites, with definition still good, can only be cured by checking the sync components.

If there is a flickering, watered silk or similar effect, and alignment and picture definition are good, check the sync stage components and especially the interlace filter, if fitted.

Ragged verticals or tearing can be caused by a burst of interference, a strong sync pulse or a very weak one, but provided the picture is of normal standard and not weak, the fault is usually in the sync stage. Check the video amplifier anode to sync grid coupling condenser for leakage and also the grid resistor.

Check the coupling condenser from sync separator to line generator for leakage if verticals are intermittently displaced.

If the picture slips on camera changes, check the sync coupling condenser. This fault may also cause intermittent line hold.

If the picture tears into strips and pulls sideways and the line hold is weak, see the first sync fault described.

Flywheel Synchronisation

In poor signal areas where interference is prevalent, or when the sync pulse is weak, picture tearing will be more evident, owing to the timebase being prematurely triggered by the interference pulses, and where fading of the picture signal takes place the temporary absence of the sync pulse will destroy picture intelligibility. The incorporation of flywheel sync between the sync separator anode and the line generator output will help to maintain the running frequency of the timebase during periods of interference and fading.

In the anode circuit of V2B is a resonant circuit comprising L1 and C4. These are the flywheel components. If this resonant circuit is accurately tuned to the scanning frequency and an impulse is fed to the circuit, it will oscillate at this resonant frequency. This system can be likened to a mechanical flywheel which absorbs energy as the speed rises, and delivers energy as the speed falls. The flywheel circuit endeavours to maintain the frequency of the timebase constant until fading or other interference with the sync pulses is over, and the sync pulse returns to its usual strength and waveform.

The flywheel circuit will do everything it is intended to do, if the signal-to-noise ratio is high, but when the signal and the interference

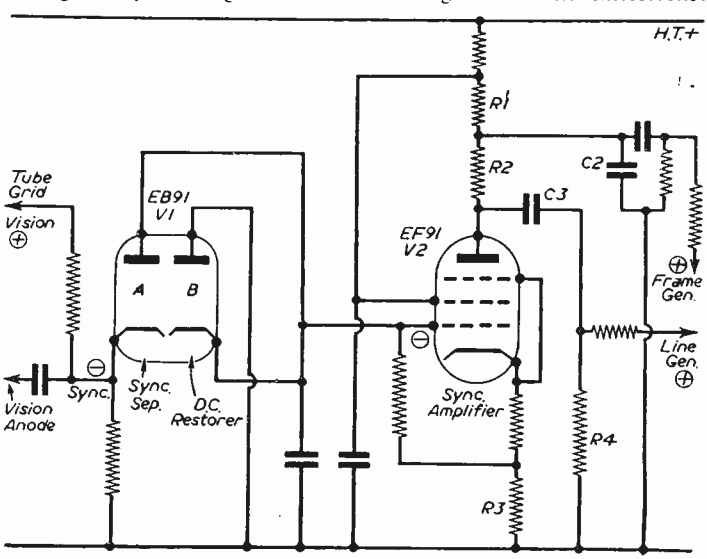

Fig. 20.—Diode type of sync separator.

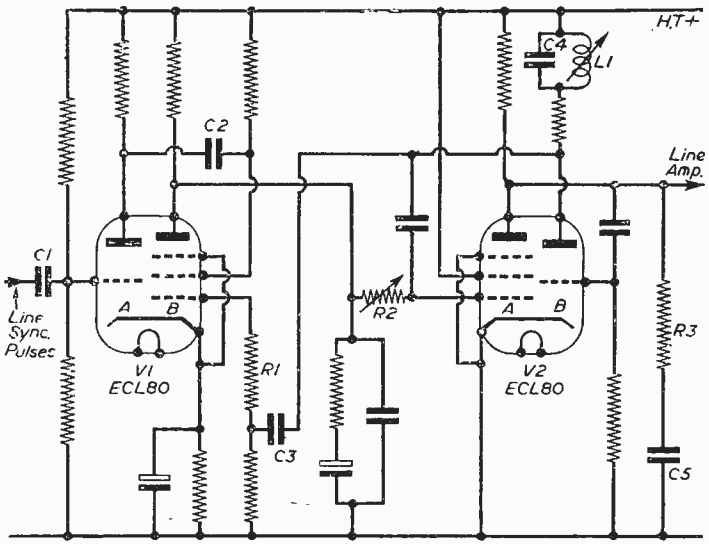

Fig. 21.—Flywheel synchronisation.

are nearly equal in strength, the interference pulse may fire the timebase prematurely. A phase control circuit will prevent this.

This valve will pass current only when the sync pulses and the line flyback pulses are applied to it at the same time. Therefore, if an interference pulse does not coincide in time with the flyback pulse, it will have no effect on the circuit. When a valve is used in this way, it is termed a coincidence detector.

Fig. 21. V1A and V1B and their components are used for phase control. V1B is the coincidence detector. V2A and B form a multivibrator oscillator for the line timebase. Line sync pulses are applied to C1 and then pass to a differentiating circuit and on to the triode grid, which is biased so that only the negative parts of the differentiated sync pulses are amplified by it, and voltage pulses having a leading edge corresponding to the leading edge of the sync pulses appear at the triode anode. These pulses are fed via C2 to the screen grid of V1B. The flyback pulses from the line timebase, appearing at the anode of V2B are fed back through C3 and R1 to the control grid of V1B. Both the flyback and sync pulses that are present at grids 1 and 2 are positive-going. The difference between the times of arrival of these two pulses at the valve varies the anode current of V1B and its anode voltage changes accordingly. These variations are passed via R2 to the grid of V2A and control the multivibrator's frequency of oscillation, thus maintaining synchronisation. Any random bursts of interference which do not coincide with the sync pulses will have no effect on the timebase, because it is only when the flyback pulse and the sync pulse coincide that the coincidence detector will pass current and thereby influence the timebase.

The line generator output is taken from the anode of V2A and the waveform is shaped by R3 and C5 before being fed to the line amplifier valve.

Noisy Volume Controls

ONE of the troubles which is becoming increasingly more frequent, as any servicing engineer knows, is the problem of noisy volume controls. This is all the more annoying since very often they are of the double variety, with the brightness or contrast control being fitted on the same spindle. Consequently, replacement of the control is somewhat expensive.

Recently, after having dealt with a veritable flood of sets showing this fault, I felt that it was time something was done to try to eliminate it; cheaply and efficiently. On studying the circuit diagrams of many sets of different makes, it became apparent that in almost every instance the volume control itself formed the grid leak of either the audio amplifier or the audio output valve—a bad practice in my opinion, since as the grid of the controlled valve is taken to the slider of the potentiometer, the value of this grid leak is not constant. Furthermore, grid current tends to flow through the track of the control and the movement of the slider over the track when this current is flowing causes the roughness and crackle which is amplified and passed to the speaker.

The solution was obvious—and so simple that I find it hard to understand why manufacturers do not alter their circuits in a similar manner, since they must have had many thousands of controls returned to them under guarantee, which on test, would appear to be working perfectly well. The method is simply to disconnect the slider of the control from the grid of the audio valve which is controlled, and insert a 0.1 μF condenser between the grid and the slider. This takes the current off the track of the control, and nearly always effects a complete cure (unless the control has been so badly pitted by grid current over a long period of time that it is really beyond hope—but it is surprising how seldom this is the case!).

All that remains is to connect a resistance of the same value as the volume control (usually 0.5 or 1 megohm) from the grid to earth.

Someone, of course, will be quick to point out that the introduction of the condenser will affect the response characteristics of the audio section—but in practice the difference is not readily detectable.

This is a lot cheaper than a new control, which would most likely suffer eventually in the same way.—(GM3KJA)

Replacing C.R. Tubes–2

FURTHER NOTES ON PICTURE TUBE PROBLEMS

By H. Peters

(*Continued from page 299 of the January issue*)

Ion-trap Magnets

THE ion-trap magnet can be treated similarly, although it does not follow that it will occupy the same place on the neck of the new tube. It should be handled very gently during tube changing and not banged, dropped, or allowed to come into contact with the focus magnet. The safest thing to do with it is to put it in a matchbox when you start your tube change and keep it in a safe place until it is due to be refitted.

Refitting can be trickier than the instructions suggest, for the aim is to slide it up and down the tube neck and rotate it until a raster appears. The ion trap is then adjusted in conjunction with the focus magnet to give the brightest possible in-focus raster regardless of picture position.

There are two main snags. The first is that it is by no means certain that the contrast and brightness controls are set correctly to produce a raster at all, and the easiest way to overcome this is to leave them set to give a picture of sorts on the old tube if its condition permits. The other is that it is quite easy to pass the correct setting the first time without the screen displaying a raster at all. This may be due to some phenomenon in the tube gun for which I can offer no explanation, or else (in my case) to clumsiness. When this happens a very dim secondary raster can often be seen when the ion trap is about 180 deg. from its correct setting, and slightly forward, and this can be used for "homing" on to the proper position.

If an ion trap has been inadvertently fitted in reverse there is no need to remove it, as it will merely take up a position 180 deg. round from where it used to be.

On some non-ion-trap tubes, such as the G.E.C. and Brimar early triodes, an ion-trap magnet is fitted to assist in picture positioning and the reduction of barrel and pincushion distortion.

Picture Positioning and Focusing

These two functions are both accomplished by the focusing assembly and are to some extent interdependent. The majority of receivers have permanent magnet focusing, where the field strength is varied by the insertion of a threaded sleeve or by varying the distance between two magnetic rings. Whenever possible the user's control for focus should be set midway and the focus magnet moved up and down the neck of the tube until focus is obtained. If locked in this position the user's control should defocus the picture when moved either way. As a tube ages the position of the magnet for correct focus changes slightly, usually towards the tube base, so that when a new tube is fitted it is common for the magnet to need to be fixed farther forward than previously.

Many modern receivers have a shuffle plate in front of the focus magnet operated by a lever or thumbscrew, whilst some have two rotatable magnetic discs by which the picture can be moved

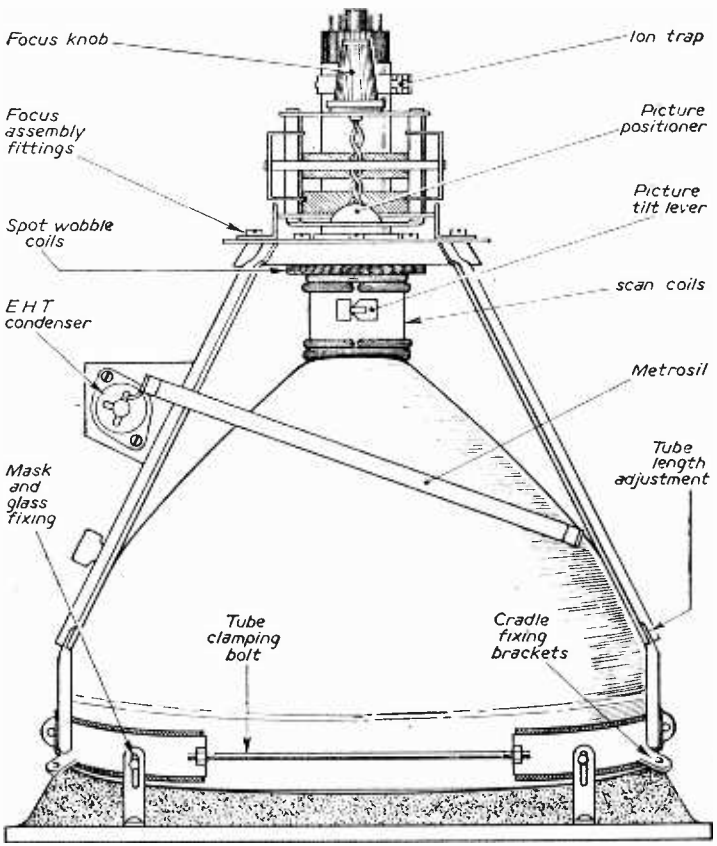

Fig. 4.—Details of the T231 tube cradle assembly.

in a variety of arcs until centred. These are also to be found on electrostatically focused tubes, where they are supported on the back of the deflector coils. A more recent positioning device used on electrostatic tubes is a form of overgrown ion-trap magnet in which the two angles of movement are produced (a) by rotating the magnet in its cup and (b) by rotating the whole assembly around the tube neck. On tubes with ion traps, extensive adjustment of focus or positioning will make it necessary to check that the ion-trap magnet is still set for maximum brightness.

Corner Shadows

These sometimes appear on a new tube and are mainly due to the deflector coils not being as far forward as they should be. Other causes of this trouble are incorrect setting of the focus assembly and the gun assembly of the tube being slightly to one side. This latter may be checked if physically convenient by removing the tube and fitting it upside down. This will either transfer the shadow to the opposite corner or in many cases remove it completely.

Cleaning

In many receivers the implosion guard and mask are fitted to the tube cradle, and to clean between the guard and the tube face involves as much work as changing the tube. There is normally a rubber or plastic dust seal around the joint between the tube and the mask and this is occasionally refitted after the tube has been put back in the cabinet.

For this reason it is essential to clean the tube thoroughly, its cradle, the chassis and the inside of the cabinet before reassembly. The ideal equipment for doing this job is a vacuum cleaner set to "blow" used in conjunction with a gentle dusting brush.

Tube Equivalents

Many older tubes are no longer available, and even more recent types are readily interchangeable although no direct equivalent is given. The table given last month lists some equivalents which readers ask about frequently, together with some not so obvious equivalents which have been successfully tried.

It should be pointed out that we intend to work through the most popular sets in this series, but if your own tube cannot wait we suggest you read the T231 section below. It is a good example of a complex tube change, touching on many points you are likely to meet on your own set.

EKCO T231

Covering also T217, TC220, TC268, TC248, TC220/1, TC268/1, T221, T231F, T283, TC208, TC209, T284, T293, in conjunction with paragraph "Variations."

Unboxing

Remove the cardboard cabinet back and the triangular plastic side panel, which comes away when the central bolt is undone. On late models remove the brass shield around the volume and channel change knobs by picking out the metal circlip with the fingernail. Early receivers have all-brown knobs, and on these sets the volume and channel change knobs are removed. These are the inner ones and pull off after the circlip has been picked out. The outer knobs will hang in the hole when the chassis is withdrawn.

Next discharge the EHT condenser, unplug the loudspeaker wiring (on consoles this is beneath the chassis shelf) and the inter-connecting plugs and sockets to the tube cradle.

These comprise:

1. C.R.T. base.
2. EHT lead (plugged into the top of the EHT condenser).
3. Spot wobble plug.
4. Deflector coil plug (located behind the mains dropping resistor).

Remove the two 4 B.A. bolts securing the rear chassis flange and slide the chassis out. Lay the cabinet face downwards on a soft cloth, unscrew the spot wobble switch bracket and remove the four long 2 B.A. bolts and washers which support the tube cradle at its front corners.

The tube cradle can now be lifted out by a series of awkward angular movements as follows: Stand over the cabinet facing its bottom, preferably at such a level that the whole cabinet is below waist height. Lift the tube assembly about an inch to clear the 2 B.A. bolt heads and move it a couple of inches towards the loudspeaker. Let it rest, change your grip, and tilt is upwards, so that the top of the safety glass rises clear of the top two 2 B.A. bolt heads and the tube base is pointing towards your chest. Slide the tube assembly upwards, tilting it more, until it is clear of the cabinet fixing bolts. Gently rest the safety glass down on the fixing bolts and change your grip.

Tilt the tube assembly sideways with the base pointing to your left and lift clear of the cabinet. Lay the tube cradle face downwards on a soft cloth and remove the cabinet for cleaning. Take care not to break the EHT metrosil with the wrist.

Next remove the four 4 B.A. bolts holding the safety glass and mask to the tube cradle and lift the cradle off the mask, putting it face downwards on a soft cloth. Mark and remove the ion-trap magnet and the focus assembly. This will reveal four brass 4 B.A. bolts which clamp the spot wobble coils to the tube, and these four bolts should be slackened off a couple of turns. Mark the scancoils to prevent accidental reversal, remove the four long 4 B.A. rods from round the tube face and lift the cradle off the tube. Note the order in which the washers surrounding the scancoils are fitted over the tube neck and then remove the scancoils. Thoroughly clean the chassis, inside of the cabinet, safety glass and tube cradle, change over tubes and reassemble tube cradle in the reverse order, not forgetting the plastic dust seal between the mask and the tube.

Refitting

Screw down the rose-shaped washers on the four bolts in the cabinet which support the corners of the cradle. Fit the cradle back into the cabinet by the same series of moves which enabled it to be removed. Ensure that the safety glass is snug and square in the front of

(*Continued on page* 349)

TELEVISION TROUBLES

Their Symptoms and How They May be Cured—6

By G. J. King

IN the Cossor 927 series the chassis is in two parts: the main chassis which contains the timebase and power circuits, and the sub-chassis, which slips into the base of the main chassis and contains the R.F., oscillator and I.F. circuits. In accord with the plan of this series of articles, the following will deal with picture symptoms owing to timebase faults, and most of the information given is applicable also to Cossor models 929, 930, 930T, 931, 932, 933 and 934.

The frame timebase circuit contains some rather high value resistors which appear prone to value alteration, and since the values are critical, curious fault symptoms associated with the frame scan are liable to occur which may not be easily diagnosed. The circuit of this section is given in Fig. 1.

Excessive Height

This symptom is the reverse of normal wear in the frame timebase, and when it occurs it is usually found impossible to reduce the frame scan to anywhere near normal by retarding the height control. Voltage readings rarely deviate from normal, and if a check is made of the valves these are invariably found to be up to standard.

The chief cause of the symptom is an increase in the value of R49, the 900 k resistor in the negative feedback circuit of the amplifier, connected between the anode of V1B and the frame linearity pre-set. This resistor is made up of a 1 megohm and a 10 megohm in parallel, and in the majority of cases it is the 1 megohm which is the culprit.

Other resistors which may be guilty of the symptom by increasing in value are R51 (made up of an 8.2 megohm and a 6.8 megohm in series), R54 and R66. Open-circuit or decrease in value of C54 may be responsible, but when this is the case the frame sync is often affected.

Intermittent Height

This symptom may be caused by intermittency in almost any component in the frame circuits, but after component tests fail to reveal the trouble, attention should be directed towards the H.T. supply to V2A. This is derived from the boost diode (17Z3) by way of a resistor/capacitor filter. If the filter components are in order, there is a good possibility that the trouble is caused by insulation breakdown in the picture tube between the first anode and cathode—the first anode also being energised from the boosted H.T. line.

C54, the 220 pF mica capacitor between V1B control grid and chassis, also has a habit of leaking intermittently—it has been known to go down to 2 kΩ. This, of course, results in frame collapse.

It frequently saves time when an intermittent frame fault is being investigated to disconnect C49 from the anode of V2A and connect it to the receiver heater line. This drives the frame amplifier with a 50 c/s mains signal and, even though the resulting scan is very much distorted, any intermittent alteration in scan amplitude will mean that the fault lies in stage V1B. If the scan holds steady with this signal, the multivibrator circuit, V1A and V2A, should be examined.

This method is also useful when it comes to tracing the cause of complete failure of frame

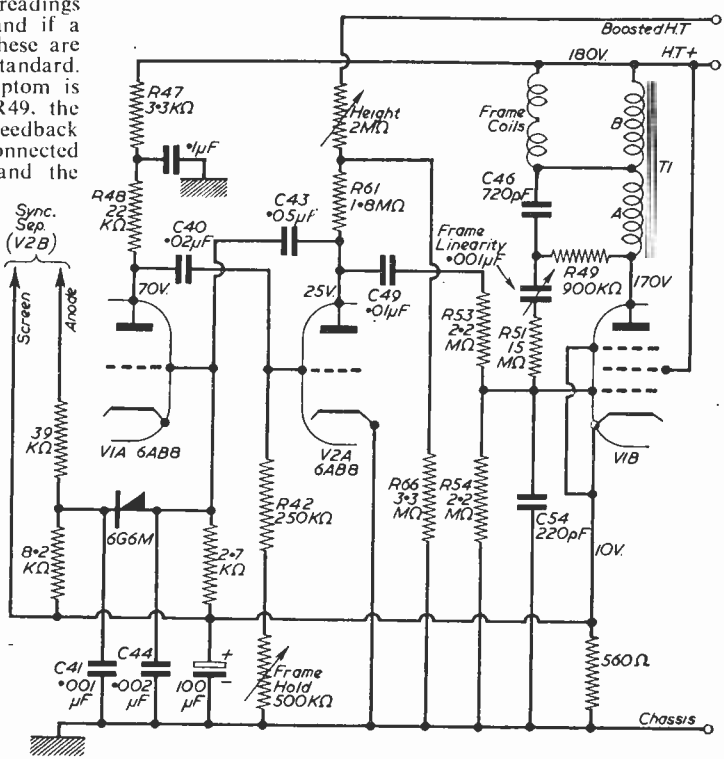

Fig. 1.—Circuit diagram of the frame timebase and interlace filter of the Cossor 927 series.

scan. It can quickly be established whether the oscillator or amplifier is defective.

Horizontal Line Only on Screen

This is the symptom of frame timebase failure, and when it has been established that the oscillator or amplifier is guilty, a few checks of voltage on the valve pins of the faulty section soon bring to light the defective part. If the voltage is higher than normal, it may mean that the valve is passing insufficient current owing to low emission. An emission test of the suspect or a check by substitution is then desirable.

In the Cossor circuit a break in section B of the frame output transformer T1 will not remove volts from the anode of V1B, as is usually the case, owing to the use of an auto-transformer. This may prove misleading, and if everything appears to be normal and yet a frame scan cannot be obtained this winding should be disconnected from the H.T. line and subjected to a resistance check. Section B should have a resistance of 13 ohms and section A a resistance of 1,000 ohms. The frame coils should have a total resistance of 47 ohms.

Insufficient Height

If the valves are up to standard, this symptom should lead immediately to a value check of R61, the 1.8 megohm resistor connected between the height control and the anode of V2A. This generally goes high, in which case its replacement effects a cure.

Impaired Frame Linearity

If a reduction in height is accompanied by cramping at the bottom of the picture, the multivibrator coupling capacitor, C43, should be checked by substitution, for it may have a small leak. If the cramping is at the top of the picture, R53 should be checked for value and replaced if necessary.

Foldover of the picture is sometimes caused by a fault in C40, and again, it is best to check this component by substitution.

Poor linearity is also caused by trouble in the negative feedback circuit of the frame amplifier. In particular R49, C46 and R51 should be examined. The frame linearity pre-set itself sometimes becomes intermittent in operation and rather critical to adjust properly.

Poor Frame Hold

In most cases this symptom is caused by a faulty 6G6M germanium diode in the frame filter circuit. If an improved lock is secured by shunting the diode temporarily with an 0.1 μF capacitor, the diode is faulty and should be replaced. The resistors associated with the diode circuit should also be checked if necessary. Other offenders in this respect are C41 and C44.

If the sync seems all right, but the correct locking point appears to be outside the range of the control, that is, if the frame hold control needs to be set at one end of its travel, R42 has most likely increased in value, and its replacement will restore balance. Other resistors which will affect the locking point by altering in value are R47 and R48.

Poor Line Hold

The circuit in Fig. 2 is the line oscillator which is in the form of a cathode-coupled multivibrator. The line speed is altered by the pre-set coupling capacitor, but on certain models a fixed 200 pF capacitor is used and the line speed is varied by a pot (250 k) connected in series with a 270 k resistor used in place of R60 in the control grid circuit of V3B.

Poor line hold is sometimes caused by a defective C50, the line sync coupling capacitor. In areas of weak signal its value has been increased to 25 pF to secure an improved lock. Alteration of R57 is another cause of the same trouble. If the picture tends suddenly to jump out of lock while working normally, V3 (6AB8) may be noisy. This can be checked by tapping the valve when

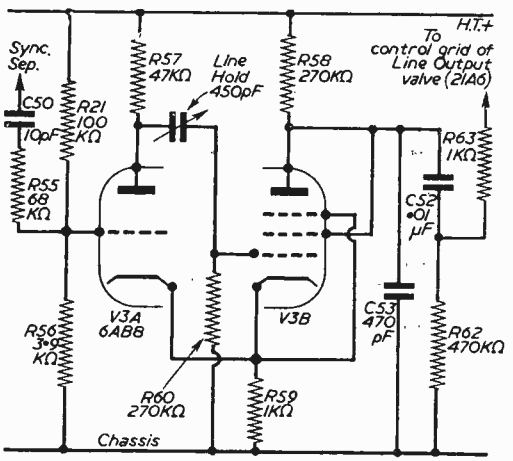

Fig. 2.—Circuit diagram of the line timebase generator.

the set is working. If this action upsets the lock the valve should be replaced.

It sometimes happens that poor electrical connection between the valve pins and the valve holder sockets gives the same symptom, but rocking the valve in its holder while the set is working reveals this trouble without difficulty. Cleaning the valve pins with fine emery cloth clears the trouble. Also a check should be made of the soldered connections on the valve holder tags.

Line Control at End of Range

This symptom is caused in most cases by value increase of R60, and in models which use a pot and series resistor by value increase of the series resistor. Alteration in the characteristics of V3 may also be responsible, and changing this valve with another of the same type in the receiver may save the purchase of a new valve. Another way of securing balance is by adjusting the value of R60 until the line locks within reasonable range of the control. If the locking point occurs with the line capacitor pre-set pretty well un-

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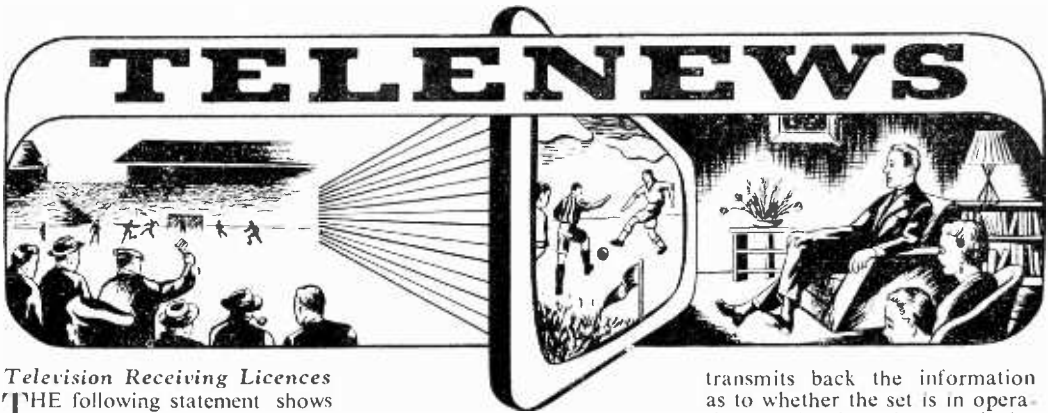


Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of November, 1958, in respect of receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London Postal...	1,635,979
Home Counties	1,108,070
Midland...	1,377,745
North Eastern...	1,407,740
North Western...	1,208,904
South Western...	700,552
Wales and Border Counties ...	509,970
Total England and Wales ...	7,948,960
Scotland	685,683
Northern Ireland	96,049
Grand Total	8,730,697

Improved Shadow Mask Tube

THE Radio Corporation of America have been devoting a considerable amount of attention towards improvements in the performance of shadow mask tubes, which at the moment seem to provide the best colour television pictures in the U.S.A. The newly developed glass bulb has increased filtering in the faceplate glass while the shadow mask itself has both a graded and tapered hole. This brings about an increased light output and a picture of better contrast in conjunction with an electron shield. A better polepiece assembly and improved gun are also contributary factors in providing this upgraded performance.

Television in Berlin Buses

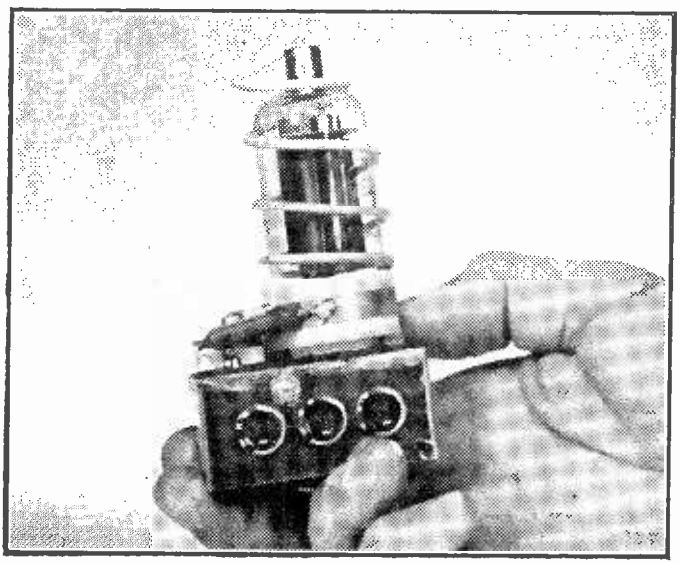
IT is reported in the "Frankfurter Rundschau" that a West Berlin transport firm is putting two new buses on the Berlin-Frankfurt route equipped with television. The receivers are British made Ekco portable models which operate from 12 volts. The first use of these receivers in West Berlin buses was reported last May and the idea is spreading.

Instantaneous Audience Ratings

IN the U.S.A. intensive effort is being directed towards the finalisation of an electronic system which will enable a speedy compilation of television audience ratings. In addition to New York, six other large cities have been installed with the necessary equipment. A cross-section of the various sets in the cities concerned have a transponder fitted. This receives a pulse over television lines every 1½ minutes and automatically transmits back the information as to whether the set is in operation and also the particular channel it is tuned to. The control office analyses all the results, prints these results on tape and activates a display board to enable visual observations to be made of the various channels.

Moon-scanning Camera

U.S. Navy scientists have designed and built an 8lb. scanning system to picture the moon. The unit was in the Pioneer Rocket launched on October 11th, 1958, in an attempt to reach the moon. Constructed at the Naval Ordnance Test Station, China Lake, California, the camera is designed to scan the moon from horizon to



A crystal-stabilising transmitter, weighing 2½oz., used in the TV type moon-scanning camera.

horizon, covering the whole surface as the rocket orbits the moon. The picture was to have been transmitted 240,000 miles to a special Air Force receiving station in the Hawaiian Islands. Power for the system is supplied by a battery pack weighing almost 5lb. with enough energy for three hours of continuous operation.

Teaching by Television

TELEVISION broadcasts to schools in this country have now found a useful niche in the education programme, so it is refreshing to find that Puerto Rico inaugurated early this year a station in San Juan which is devoted exclusively to educational programmes. The Government Department of Public Instruction on this island is responsible for the project. It is quite non-commercial and therefore does not compete with other stations on the island, and not only are the children catered for with broadcasts during the normal school hours but adults have a share during the evening transmissions which deal with subjects appropriate to grown-ups and high school students.

Radio and Television Course

THE Middlesex County Council recently announced their arrangements for the Spring/Summer 1959 Radio and Television Course which commenced on January 6th, Mondays and Wednesdays, 7.0-9.0 p.m. Fees will be per session of two terms: 20s. per session for one evening, 25s. for two evenings. Mr. Barnes is in charge during this session. There is still a little room. Enrolment should be made to Mr. E. N. Fennel, B.Sc.(Econ), F.R.G.S., L.C.P., Head of Institute, Wesley Institute, Wesley Road, Stonebridge, N.W.10.

TV for Italian Nuclear Power Station

A CONTRACT to supply television equipment to the first Italian nuclear power station at Latina has been awarded by the Nuclear Power Plant Company to Pye Ltd.

The Latina station is expected to start operating towards the end of 1961 and the television equipment will be similar to that being supplied to the A.E.A. establishment at Bradwell which is now under construction.

It is felt that the awarding of this contract to a British firm clearly demonstrates the lead which this country holds in the peaceful uses of atomic energy.

New E.M.I. Colour TV Camera

THE E.M.I. colour television camera channel Type 203, is the most versatile and compact colour camera ever developed. Utilising three vidicon tubes and a novel optical system, it has the advantage of being cheaper and much easier to operate than the more elaborate three image orthicon camera previously produced. The colour rendering is more accurate, and simplicity of operation makes the equipment specially attractive for industrial, medical and scientific uses.

Its large contrast range enables first-class outside broadcasting in colour and good picture quality even under poor lighting conditions. It is considerably lighter and more compact than anything previously produced either in this country, Europe or the United States. The camera has been designed to operate on 405, 525 and 625 line standards.

The general style of construction of the equipment follows the new E.M.I. practice, and takes the form of a series of standard cases which are fitted with handles for portability and fit into standard 19in. cubicles or consoles. The units are mounted on runners so as to give easy access to the internal assemblies. The efficiency of the camera's novel optical system is several times that of relay lens types. It has been designed so as to enable the maximum amount of light to fall on the photo-conductive surfaces of the vidicons.

Completion of the First I.T.A. Service

PLANS for the practical completion of its present television service by 1960 have now been provisionally approved by the Independent Television Authority. According to these plans, the last programme companies will be appointed this year and the last major service areas will be provided with programmes in 1960, four years before the end of the 10-year life of the Television Act of 1954.

The Authority has so far appointed 10 independent programme companies: Associated-Rediffusion; Associated Television; ABC; Granada; Scottish Television; T.W.W.; Southern Television; Tyne Tees Television; Anglia; and Ulster Television. Of these ten companies, seven are already supplying programmes. The last three begin programme transmissions this year: in the North East in January and in East Anglia and Northern Ireland towards the end of the year. More than 91 per cent. of the population will then have been brought within the Authority's service areas.

BBC Contract for New E.M.I. Camera

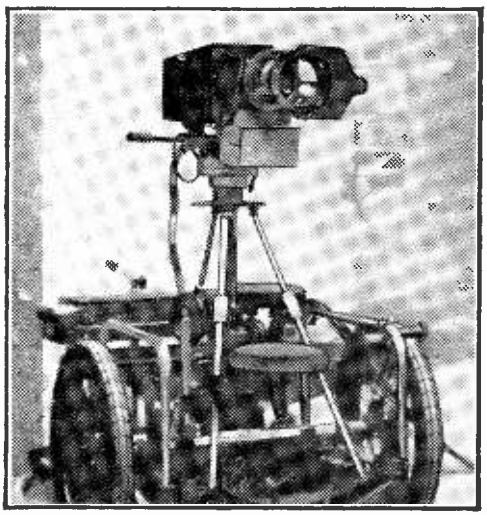
THE BBC has placed an order with E.M.I. Electronics Ltd. for nine vidicon camera channels Type 201, for use in various interview studios throughout this country. This is a new design television camera, using printed circuits and plug-in techniques to reduce weight and size to a minimum while at the same time retaining all the normal facilities. It is specially suitable for the export market, where broadcasting organisations frequently require a low-priced channel—the vidicon camera costs approximately half as much as those using other types of pick-up tubes.

The vidicon camera channel produces broadcast quality television signals on 405, 525 or 625 line standards, using E.M.I. vidicon tube Type 10667S, RCA vidicon Type 6326 or any equivalent tube. The camera is fitted with a four-station turret and has optional remote control of focus, turret and lens aperture.

The control unit may be up to 500ft. away from the camera.

Radio Show 1959

THE Radio Industry Council announces that the 26th National Radio and Television Exhibition will be held at Earls Court, London, from Wednesday, August 26 to Saturday, September 5, with a preview on Tuesday, August 25.



An experimental camera using an image dissector tube.

SIDELINES OF TELEVISION

TV's LESSER KNOWN DEVICES

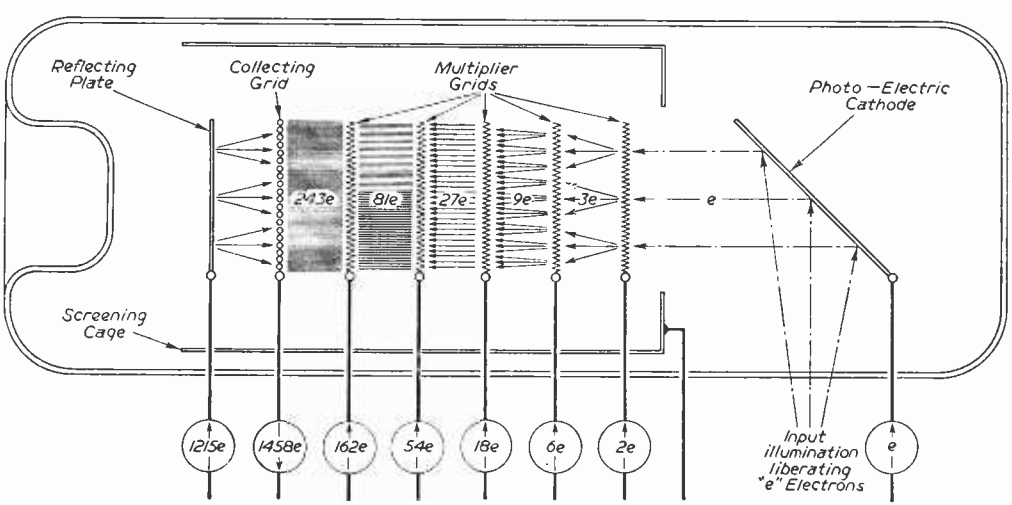
By H. J. Barton Chapple, B.Sc.

IT is amazing how cases arise in radio and television where development reveals that a full circle is turned in the investigation into devices designed for the improvement of the service. For this reason it is essential not to lose sight of some of the earlier schemes proposed, either for the transmission or the reception of television signals. In many cases, further advancement was halted because of the non-availability of certain materials but subsequent research may have provided alternatives. The original devices worked, but did not give the satisfactory results required for general use, in spite of the relatively lower standard of acceptance then existing.

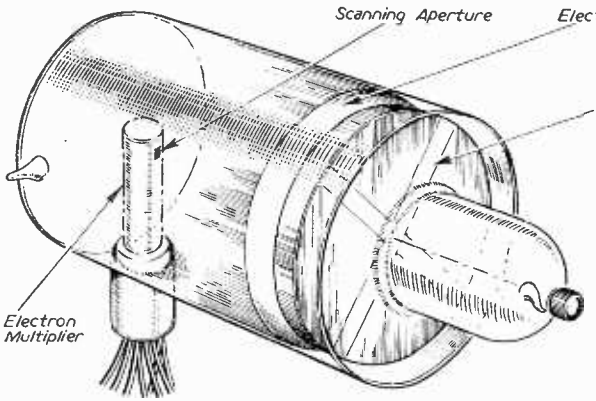
Brightness

It has been said many times that the low overall brightness of television pictures is a drawback and this becomes more marked if comparison is made with the home cinema where the Ft. Lambert brightness of the screen exceeds that of the cathode ray tube fluorescent screen. Any scheme to improve the light output of the conventional cathode ray tube receiving device should therefore find favour and, among those attempted, mention can be made of the secondary emission cathode ray tube. In essence the idea was to make the scanning beam of electrons function as a relay, for then the beam need not be of the same intensity as when screen luminescence is a direct function of the energy in the beam. This converter effect is brought about by making the main beam produce a secondary emission, so that the electrons released in this way, after acceleration, give increased light output as a result of their impact on the original fluorescent screen.

The device, as proposed originally, resembled a standard form of cathode ray tube with the usual gun and main electron beam focusing and scanning assemblies, but interposed in front of the tube's fluorescent screen was a secondary emission screen with an external electro-magnetic coil for focusing the secondary emission electrons. The screen was a very thin membrane, coated on the side facing the fluorescent screen with a substance capable of emitting secondary electrons when heated by the impact of the electrons in the main beam. The secondary electrons released are accelerated to the front screen by a positively charged semi-transparent metallic layer at the back of the phosphor layer of the main screen.



A pictorial representation of a grid cell multiplier.



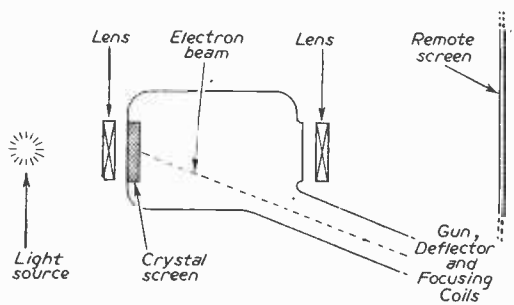
The image dissector tube.

Focussing is undertaken by the electro-magnetic lens and, depending on the accelerating potential, the impact of the secondary image on the tube front gives a brighter resulting image. The main difficulty seems to have been associated with the design of a suitable membrane capable of withstanding the tube's electron beam impact and the resulting rise in temperature brought about by this process.

Image Dissector Tube

Although the image dissector tube, designed originally by Farnsworth, did not provide such satisfactory results as the Iconoscope, it was a very ingenious device. Instead of a beam of electrons being made to scan a mosaic, on which was focused the scene or object to be televised, the complete electron image produced by the optical image was accelerated and focused at the remote end of the tube. Here the line and frame scan coils caused this image to pass bodily over a tiny hole in a plate electrode. Thus the image was split up into a continuous video signal, but since this signal is weak in intensity, amplification is provided by an electron multiplier.

This, in the extremely simple case, was composed of two plates energised by a radio frequency oscillator which caused the electrons to strike two secondary emission dynodes several times alternately. These impacts brought about a cumulative increase in signal strength because the secondary electrons so released joined with the main ones until collection was effected finally by the terminal collector. This scheme of overall gain was devised to compensate for the lack of the image storage effect of the Iconoscope.



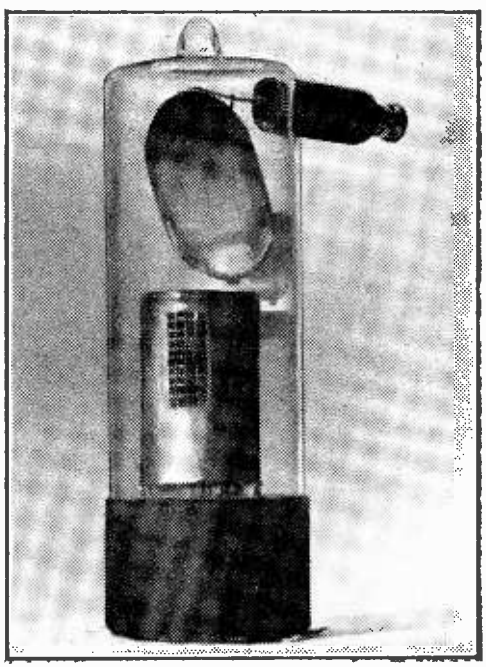
Basic details of a light relay C.R. tube.

Electron Multiplier Improvements

Improvements in the electron multiplier have taken place subsequently and varying designs have been used either in conjunction with the image dissector tube or separately accordingly to requirements. One of the most efficient of these has been applied for use in conjunction with a photo electric cathode and has a chain of secondary grid amplifying stages as illustrated. The electron current passing in sequence down the chain is amplified at each stage, the grid surfaces being treated to give a high secondary factor, but in the illustration this is shown as triple multiplication. There is a secondary reflecting plate at the end of the parallel mesh grid stages and being a hard surface this has a higher secondary emitting factor than the open mesh grids. With this type of multiplier very high gains can be effected.

If a television picture corresponding to the correct modulating signals can be built up on a

(*Continued on page 347*)



A photo electric cathode in conjunction with a multi-section grid multiplier.

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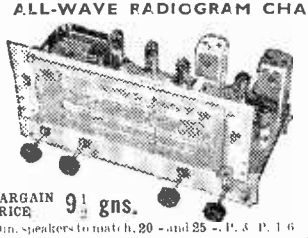

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8 - 450 v. T.C.C.	2 3	16 - 16 450 v. T.C.C.	5
8 - 8 450 v. B.E.C.	4 6	32 32 350 v. B.E.C.	4 6
8 - 16 450 v. T.C.C.	5 -	32 + 32 275 v. Hunts	4
16 450 v. B.E.C.	3 6	32 32 450 v. T.C.C.	6 6
16 500 v. Dub.	4	250 350 v. B.E.C.	8 6
16 16 150 v. T.C.C.	5 6	50 250 v. T.C.C.	6 6
32 350 v. B.E.C.	4	100 + 100 350 v. B.E.C.	11 6
32 500 v. Dub.	5	50 - 250 275 v. B.E.C.	12 6
50 + 50, 350 v. B.E.C.	6 6	100 + 200 275 v. B.E.C.	12 6

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5Z4	9 6	35L6	10 6	EF91	8 6
GAT6	8 6	EABC80	9 6	EL41	10 6
6K7	6 6	EB91	6 6	EL84	11 6
6K8	8 6	EBC41	10 6	EM85	11 6
6Q7	8 6	ECC83	9 6	EY51	12 6
6SN7	8 6	ECC84	12 6	EY86	14 6
6V6	7 6	ECF80	12 6	EZ40	8 6
6X4	7 6	ECF82	12 6	EZ80	8 6
6X5	7 6	ECH42	10 6	EZ81	8 6
7C5	9 -	ECH81	10 6	MC14	8 6
7Y4	8 6	ECL80	12 6	PC84	10 6
DAF96	9 -	ECL82	12 6	PCF80	10 6

PCF82	10 6	PL83	11 6	UF41	10 6
PCL83	12 9	PL84	14 6	UF89	8 6
PL81	14 6	PL802	10 -	UL41	10 6
PL82	10 -	PY80	9 6	UY41	8 6
PL83	11 6	PY81	9 6	UY85	8 6
PY82	8 6	PY83	10 6	VP2	8 6
PY83	10 6	U25	15 6	VP23	8 6
U26	8 6	UCH42	10 6	VP41	10 -
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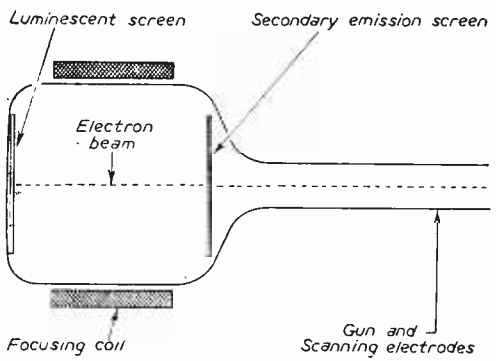
transparent media, an ordinary optical system of lenses and light source could be used to project the picture on to a remote screen. This would be a very attractive device and remove straight away the defect of relatively low illuminations on the fluorescent screen of a cathode ray tube. One device which made use of this principle took cognisance of the fact that alkali halide crystals when subjected to the bombardment of cathode rays darken in colour at the point where the beam is incident at that moment. Furthermore, as might be expected, the intensity of the electron beam, where it strikes the crystals, controls the depth of colour.

Varying Intensity

Unfortunately, where the electrons of the cathode ray beam strike the crystal lattice, the metal ions as atoms cause a cumulative effect in the path through the lattice, and this produces a blurring effect. The image loses its sharpness of outline and although the crystal layer thickness could be reduced to prevent the atoms spreading,



The secondary emission cathode ray tube.

when this is done the dark areas of the reconstituted picture become less opaque and the black section of the picture becomes grey.

Image Dissipation

Another factor which arises with this method, concerns the rate at which the screen image can be dissipated to allow further images to be built up as is required to conform to present television standards. For this to happen, the crystal screen has to be maintained at a high temperature and this militates against simplicity of construction. Other methods for influencing image dissipation have been tried and many patents exist which are associated with this ingenious device but its practical use on a full commercial scale has so far not materialised.

Conclusion

These short descriptions of a few of television's lesser known devices, however, serve to indicate that considerable ingenuity has been displayed by inventors and engineers and it would be a bold man who would predict that the ideas would not be revived in the light of more advanced present-day knowledge. Naturally, as and when such developments come along details will be published in this journal.

TELEVISION TROUBLES

(*Continued from page* 340)

screwed, vibrations from the loudspeaker may disturb line stability owing to the looseness of the capacitor plates.

The value of R21 should be checked in persistent cases, and if it is discovered that R21 is not employed in the model under examination, the fitting of such a resistor may assist in eliminating the trouble.

Insufficient Width

This may be caused by low H.T. voltage or by a fault in the line timebase. If the H.T. voltage is below normal (normal is 200 volts at rectifier cathodes), the 19Y3's should be checked for emission and the surge-limiting resistors checked for value (40 or 50 ohms).

If the voltage is normal or a little above normal, low emission of the line amplifier or booster diode (21A6 and 17Z3 respectively) should be suspected. These valves, and also the 6AB8 line oscillator, are best checked by substitution.

The 0.5 μF capacitor which is connected to the width control inductor gives the symptom if it leaks or loses value, so this is worth checking.

White Vertical Bars at Left of Picture

This symptom should lead to a check of R58, the anode load resistor of V3B. Some models use an 18 kΩ resistor, which should be replaced with a 270 kΩ if the symptom is present.

Vertical shaded bars may be caused by a spurious line timebase signal being picked up on the aerial feeder. The effect is usually present at maximum contrast, but can be eliminated by improving the aerial matching or by routing the aerial feeder clear of the line output stage side of the chassis. A check should also be made to ensure that the focus unit gantry is adequately braided to the receiver chassis.

Relaxation Oscillators—3

THIS ARTICLE DEALS WITH THE PUCKLE TIMEBASE

By R. Couvela

(*Continued from page 290 of the January issue*)

THE main disadvantage of the sawtooth generators so far described in this series is that the waveform is exponential, not linear. What this means is that each is produced by the charging of a capacitor through a resistor. Now, when the capacitor is uncharged, there is no voltage across it, so the full supply voltage

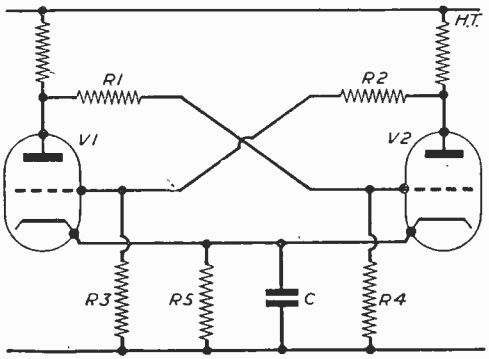


Fig. 1.—Stable multivibrator circuit.

is across the resistor. The charging current (Ic) may then be deduced from Ohm's Law, and will be given by $Ic = \frac{E_R}{R}$

As the capacitor charges, its voltage rises, so that across the resistor drops. Thus, in the expression above, E_R drops, so it is easily seen that a corresponding drop must take place in Ic: for this reason, the capacitor charges more slowly. The current drops steadily all the time, and the voltage of the capacitor never quite reaches that of the supply. For all practical purposes, however, this latter fact can be completely ignored as the differences between the voltages will not be detectable on any normal instrument.

From this, it can be seen that the waveform obtained from the generator cannot be a straight line, but will always be slightly curved. In order to counteract this effect, some designs of sawtooth generator use a pentode in place of the charging resistor.

The Puckle Timebase

If you look at the characteristic curve of any pentode, you will see that the anode current varies very little with the anode voltage for constant screen and control grid potentials, over a large range. A widely used generator using this principle is the Puckle timebase.

In order to help us to understand the operation of this timebase, we will first look back to the multivibrator to modify this circuit to obtain the Kipp relay, or bistable multivibrator. The circuit is shown in Fig. 1. At first sight it might be thought that the two valves, whose circuits are identical, would pass equal currents, but we should note the existence of R5. This resistor provides a bias circuit, making it possible to maintain one of the grids at a potential below that of the cathode without the use of any capacitor.

For instance, if V1 is conducting, its anode is held at a fairly low voltage, and the voltage on the grid of V2 will be given by the potential divider R1, R4. This voltage (Vg2) is given by $Vg2 = Va1 \left(\frac{R4}{R1 + R4}\right)$

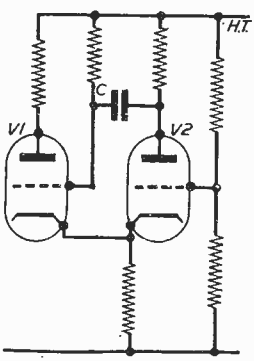
Thus, by a suitable choice of values for R1, R4 and R5, the grid of V2 may be at a much lower potential than the cathode of V2, and the valve will be cut off. There will therefore be no voltage drop across its anode resistor, so the grid of V1 may be at a relatively high potential, allowing the valve to pass current, which was our initial assumption. Thus, the circuit is in a stable condition, and will remain so no matter which valve is conducting.

Now, suppose that a positive pulse is applied to the grid of V2. V2 will conduct, causing its anode voltage to drop, which will cause the voltage of the grid of V1 to drop, which reduces the current in V1, raising Va1 and Vg2. Thus, we have started a landslide, which results in V2 conducting and V1 cut off, the other stable condition.

We see now that we have a bistable circuit. The circuit will remain in the condition in which it is set until the injection of an external voltage large enough to switch the circuit over. Note that the switch action described above may have been caused equally well by the receipt of a negative pulse on the grid of V1.

"Flip-flop" Circuit

Now we will pass to the so-called "flip-flop" circuit, which is a cross between the free-running multivibrator and the Kipp relay. The circuit is



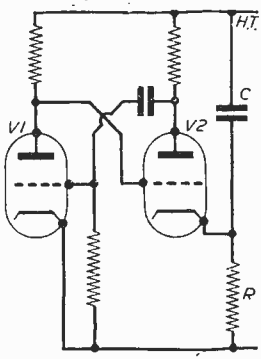


Fig. 2.—(Left) The "flip-flop" circuit.
Fig. 3.—(Right) Explanatory "flip-flop" timebase for Fig. 4.

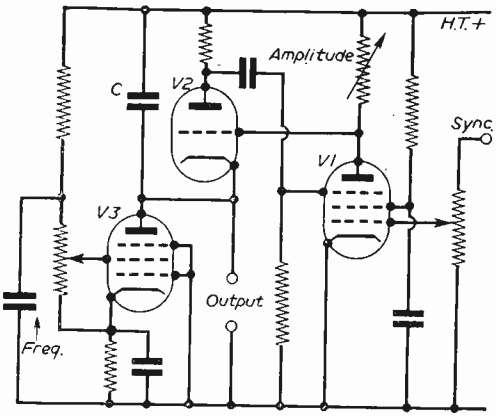


Fig. 4.—The Puckle timebase.

shown in Fig. 2. This circuit does not use the conventional multivibrator form, but rather the cathode-coupled form described in our last issue.

If we consider that V1 is conducting, the cathodes are held above the voltage on the grid of V2, thus V2 is cut off. Now, a negative pulse on the grid of V1 will cut off this valve, dropping the voltage on the cathodes. This causes V2 to conduct, which reduces Va2, reducing Vg1 and the action continues. Ultimately, V1 is cut off, and V2 conducts, holding Vg1 low, until C is charged.

When C has charged sufficiently to allow V1 to conduct again, the cathode potential rises slightly, thus reducing the current in V2, and another landslide occurs, at the end of which V1 is conducting, V2 being cut off. This will be seen to be a stable condition.

If we can couple this flip-flop circuit suitably to a charging capacitor, we can arrange that the charging of the capacitor can trigger the action of the flip-flop, and the conduction of V2 can discharge the capacitor.

It will be recalled that the operation of the flip-flop was triggered by the fall in voltage of the cathode of V2. In Fig. 3, the capacitor C is charged through the resistor R, thus the cathode of V2 starts at a high positive potential, and falls slowly. The grid of V2 is held at a fairly low level by the conduction of V1 causing a voltage drop across its anode load. When the voltage on the cathode of V2 drops to this value, V2 will conduct. This drops the anode voltage, which drops the grid voltage of V1, thus increasing the grid voltage of V2. The landslide following results in V2 conducting, discharging C, and the grid of V1 being held negative, pending the discharge of the coupling capacitor.

When this discharge is complete, V1 once more conducts slightly, thus reducing the grid voltage of V2, which again results in a landslide, at the end of which V1 is conducting, V2 is cut off, and C is once more charging through R.

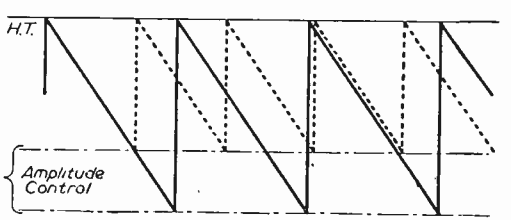


Fig. 6.—Effect of amplitude control on frequency.

Amplitude Control

As a refinement for the circuit, we might add an amplitude control, by variation of the anode load of V1. This alters the voltage on the grid of V2, thus controlling the voltage at which C starts to discharge. In addition, we could use a pentode for V1, which will provide a very good method of synchronisation. If we connect the circuit of Fig. 3, using the suppressor where grid is shown in V1, the action will be unaltered. Injection of a relatively small negative voltage on the control grid will result in the cut-off of V1, and thus the discharge of C.

These refinements are added in the circuit of Fig. 4, and also the constant current pentode circuit to which reference was made earlier.

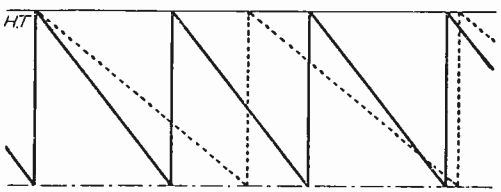


Fig. 5.—Effect of the frequency control.

An interesting point is the fine frequency control which is fitted to the pentode, V3. In a pentode, the screen grid potential plays an important part in deciding the anode current, so variation of this potential is used to vary the charging current of C, thus varying the sweep speed of the waveform (see Fig. 5). It should be noted that, as shown in Fig. 6, the amplitude control has a considerable effect on the sweep frequency.

(To be continued)

REPLACING C.R. TUBES—2

(Continued from page 338)

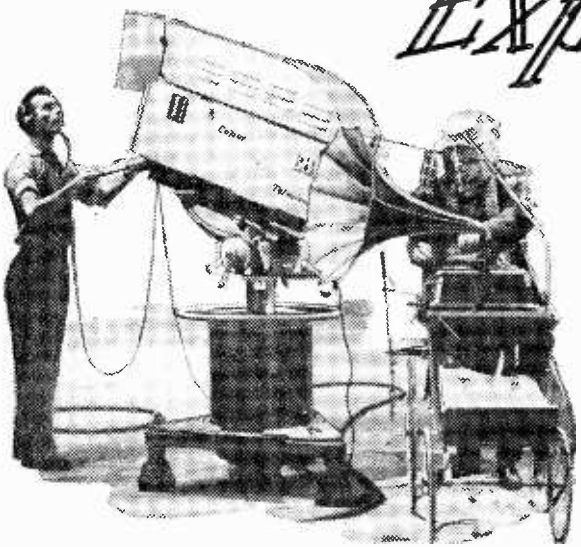
the cabinet and roll the four rose-shaped washers back until they meet the underside of the tube cradle bracket, then refit the washers and long nuts on top. Screw the spot wobble switch panel back, check that the tube cradle is firmly fitted in the cabinet and then turn the cabinet upright. Refit the chassis, reconnect the plugs and sockets, and replace the two chassis bolts into the rear flange. Switch on, apply a signal, and when the U25 warms up rotate the ion-trap magnet in conjunction with the brilliance control and focus magnet until the brightest possible in-focus picture is obtained. Re-centre the picture and straighten it using the shuffle plate and scan-coils.

If the shuffle plate does not bring the picture into the centre, the entire focus assembly can be moved, with the shuffle plate in mid-position to provide the final adjustment. When all is set up and tight, refit knobs, side panel and back.

(To be continued)

Experimenta

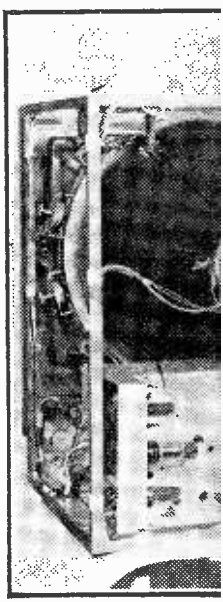
DETAILS OF SOME OF THE FEATURES OF THE PRESENT EXPE



RECENT articles in these pages on the colour TV programmes, coupled with the various colour transmissions carried out by the BBC have resulted in a great increase in the interest taken by readers in this aspect of the hobby. As a result we are receiving letters asking why we do not publish circuits or other data to enable readers to carry out experiments in conjunction with these transmissions. There would, however, be little use in our giving such data as there are one or two things which prevent the amateur from making full use of the transmissions.

First of all, it must be remembered that the main item in a modern colour television receiver is the picture tube. For the system which is at present being experimented with by the BBC use is made of the American R.C.A. shadow-mask tube. The principles of this have already been explained in these pages and it is important to remember that at present these are not being made in this country. Manufacturers who are taking part in the experimental transmissions and endeavouring to develop a modern colour receiver are importing these tubes from America under special arrangements, and it would appear that the ordinary man in the street is not able to obtain one of these tubes.

Without such a tube there is little object in wiring up a receiver as the results cannot be seen. There might be one way out of this difficulty, namely by feeding the three images separately to a standard tube (or to three tubes in an extreme case) but one would have no guidance in such a case other than degrees of shade, and in monochrome faults in the various colour circuits would not be visible.



View of the latest C
re

System Not Definite

Apart from this grave drawback, however, there is one other point which needs bearing in mind. It is not yet certain that the system which is being used (a modified form of the American N.T.S. system) will be the one which might eventually be adopted in this country. It is true that the modified system —a modification resulting from the use by us of the 405 line definition—has shown great promise, and those who have seen a colour programme will agree that the designers have done a wonderful job of adapting the system. At any time, however, some engineer may come along with a totally new idea which may prove more practicable, and would render the present apparatus obsolete. Readers must be warned, therefore, that colour is not "just round the corner" as some papers have led them to believe. Even assuming that the present scheme will eventually be adopted, there is still much ground to go over to produce a "mass production" colour receiver. To assist in assessing the work involved, some indication should perhaps be given of the complexity of the modern receiver as being used for experimental work.

Typical Receiver

On this page are seen two views of the latest model being used by the G.E.C. for experimental work, and although this has now been consider-

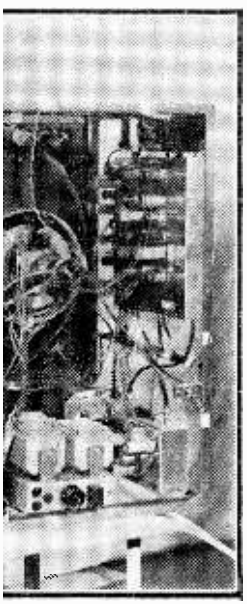
KEY TO THE RECEIVER SHOWN ON PAGE 351.

1—Deflector coils.
2—Convergence coil assembly.
3—Purity magnets.
4—Blue beam positioning magnet.
5—Equalising magnets.
6—Polythene sheath (covering 23 kV metal bodied tube, and graphite coated as EHT condenser).
7—Convergence chassis.
8—Line timebase and EHT unit.
9—Tuner unit.
10—I.F. deck.
11—Chrominance channel.
12—Reference oscillator.
13—Power pack.

Colour TV

THE MODERN COLOUR RECEIVER AS USED FOR EXPERIMENTAL TRANSMISSIONS

ably reduced in size from that which we saw a year or so ago, the illustrations give quite a good idea of the amount of apparatus which has to be crowded into the receiver. Starting with the tube, these are generally 21in. in diameter, and are of the all-metal circular type. As can be seen in the two views of the receiver, special magnets are positioned round the periphery of the tube to counter the earth's magnetic field at the point of reception. On the neck of the tube are the normal type deflector coils, and in addition, a convergence coil assembly, purity magnets, blue beam positioning magnet, and equalising magnets. This assembly alone shows the degree of complication which is to be met, in addition to the various sections of the circuitry employed.



.C. experimental colour iver.

The following notes are given in connection with this particular sample receiver by the G.E.C. and it is to be hoped that they will answer many of the questions which have been raised by readers who are keen to take an interest in this side of the hobby.

The new colour receiver, the fifth developed by the G.E.C., is believed to be the simplest yet made anywhere in Great Britain, and it is claimed that its colour reception standards are unsurpassed. Complying with the principle of "reversed compatibility," black-and-white reception is also excellent.

Size and Performance Problems

Although the research team do not claim that all colour problems have been solved, they have overcome many of the difficulties encountered in combining small size with good performance. The power pack was one of the main problems when size was considered. It was scaled down by introducing an A.C./D.C. technique and series operation of the valve heater chain.

Performance problems were mainly those of definition, registration and fringe signal conditions, consistent with long-term stability. Care had to be taken to ensure that definition was of high quality monochrome standards, and this meant that the colour de-coding circuits had also to be very carefully designed.

The shadow-mask R.C.A. tube presents certain difficulties in registration of the three colour images. Improvements have been made at Wembley by applying passive networks—with their inherent stability and simplicity—to the 405 line system.

Fringe Conditions

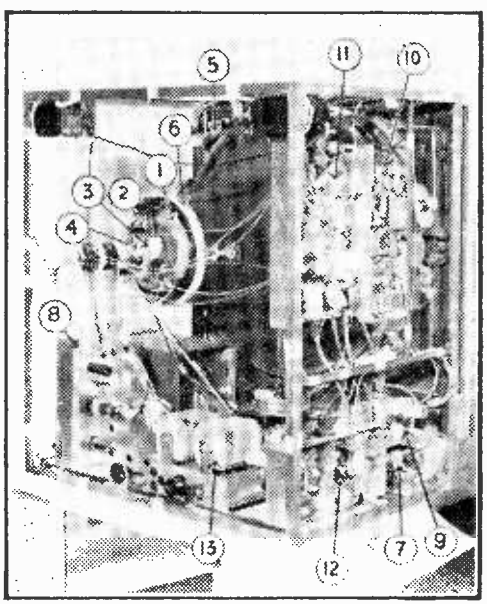
The G.E.C. team has now been able to ensure good colour reception even with a poor signal, by paying special attention to the synchronising of the sub-carrier oscillator. Using the G.E.C. Research Mobile Laboratory for testing in the Brighton fringe area, it was in fact found that colour reception was slightly more acceptable than the corresponding picture on a monochrome receiver.

Technical Details

The experimental colour receiver shown (Type TT4) is fitted, as has already been mentioned, with an R.C.A. 21in. shadow-mask tube, Type 21AXP22A. It has a complement of 35 valves and a total power consumption of 450 W. By using G.E.C. metal rectifiers and "series run" techniques it has been possible to accommodate the receiver in a cabinet measuring 21¾in. × 28¾in. × 31½in. Further developments are expected to enable a yet smaller cabinet to be used.

While most of the circuits used in the receiver conform to fairly conventional practice in colour work, some of the circuit details are novel and great care has been taken to ensure that the circuits used are operated under optimum conditions.

In designing the receiver, the aim has been to provide accurate convergence or registration of the three images on the tube; adequate bandwidth



Another view of the G.E.C. receiver. A key to the sections will be found on the opposite page.

and definition with correctly shaped frequency response characteristics in both luminance and chrominance channels, together with full D.C. maintenance: and stable and noise-free reference signal generation from the colour burst. In general, a good quality picture has been the goal rather than extreme economy in valves and circuits.

Small Power Pack

The receiver power pack incorporates direct rectification of the mains supply to provide one H.T. line of 250 v. at 200 mA. and a second H.T. line of 450 v. at 400 mA is obtained by a voltage doubling circuit. A stabilised negative line of −150 v. is also available for bias supplies. G.E.C. metal rectifiers are used. and the whole power pack unit measures only 5½in. × 7in. × 11in. Most of the valves in the receiver are series run, but two small transformers supply the higher current valve heaters and line timebase valves.

The tube EHT supply of 23 kV at 1 mA is obtained directly from the line flyback without voltage doubling. and a triode shunt regulator is used to stabilise the EHT and thereby minimise the effect of EHT changes on the convergence of the three electron beams.

Passive convergence circuits are fed from the line and frame timebases and supply the appropriate current waveforms to the dynamic convergence coils mounted round the neck of the tube. D.C. is also applied to these coils for static convergence adjustments and all the pre-set convergence controls are easily accessible at the front of the receiver. Line and frame raster shift is controlled by D.C. injection into the scanning coils.

Separate Crystal Detectors

On the signal side. a standard R.F. switchable tuner feeds a slightly modified production type I.F. deck. Sound rejection and sound I.F. take-off conform to usual monochrome practice. but in the vision circuits two separate crystal detectors (GEX54s) are used to provide isolation between the luminance and chrominance channels. This arrangement enables a high definition luminance signal to be maintained, and when this is fed to the ferrite loaded delay line (to provide time coincidence of luminance and chrominance) small reflections in the line are prevented from disturbing the smooth and symmetrical chrominance channel frequency response.

The luminance signal is amplified by two video stages in a "bootstrap" circuit and is ultimately fed in the correct drive ratios to the three cathodes of the tube. Master brightness is controlled by a bias arrangement in one of the video stages. and the D.C. component of the signal is maintained to within about 1 db.

"Clamping" Triodes

Two chrominance amplifiers with a 6 db bandwidth of ±500 kc/s supply two "clamping" triodes for high level demodulation along the red and green difference axes. R-Y and G-Y. After filtering. these difference signals are fed to the red and green grids of the tube. and also to a matrix amplifier which forms the B-Y signal for the blue grid of the tube. A reference frequency amplifier provides the two appropriately phased reference signals for the triode demodulators.

A front panel chrominance gain control is provided for adjustment of the colour saturation.

The continuous reference signal required for synchronous demodulation is obtained from an L.C. oscillator which is frequency and phase locked by a two-mode A.P.C. loop. or D.C. quadricorrelator, so that both fast pull-in and good noise performance are achieved.

One of the two detectors in the A.P.C. loop provides a D.C. voltage only when a burst signal is present and when the oscillator is phase locked. Since this is a synchronous detector it provides an accurate indication of the presence of a burst even under adverse signal to noise conditions, and is used as a colour "killer" control for switching off the chrominance channel automatically when a burst signal is absent. The output of this detector is also fed as an automatic chrominance control or A.C.C. signal to bias the chrominance amplifier from which the burst output is taken.

The colour burst is separated from the chrominance waveform and amplified before being applied to the A.P.C. detectors. The separation is carried out by a gating circuit which switches on the burst amplifier only during the burst period of about 4 μs. In order to be quite independent of line timebase synchronisation, the gating circuit operates from the back edge of the line sync pulses appearing in the sync separator output.

Advance of Australian TV

By G. W. OLIPHANT

THE year 1958 has been a boom period for Australian Television. At the end of 1956 3,612 receiving licences had been issued, this figure had increased to 166,576 by the end of 1957, and the figure of 415,245 for October, 1958, shows that the total will be near 500,000 when statistics are compiled for the end of the year.

This figure is the more remarkable when it is considered that, at the present, only Sydney and Melbourne have transmitters operating, and that the cost of a receiver is around £160 sterling. An Australian TV licence costs £4—and this does not cover radio, which is an additional £2 !

British manufacturers are well represented in the Australian field: Pye, H.M.V., Ekco and Ferguson (who sell under the trade name "Atlas") are in the market, competing with the American Admiral and Healing, and the giant Australian firm Amalgamated Wireless Australasia.

The Australian standard is 625 lines at 50 frames. Twenty-one inch is the popular size screen, and the recent advent of the 110 degree tube is rendering the former 90 degree tube obsolete. A.C./D.C. sets are *not* popular—Ekco are the only large firm marketing a set without a mains transformer.

1959 will give a further impetus to the industry, with the opening of transmitters in four State capitals, Brisbane, Adelaide, Hobart and Perth.

Transistors in TV Receivers

THE SECOND ARTICLE OF A SHORT SERIES DEALING WITH THE USE OF TRANSISTORS IN MODERN TELEVISION EQUIPMENT

(*Continued from page 282 of the January issue*)

The Video I.F. Amplifier

THE series resonant rejector circuit employed (C41, C42, L26, Fig. 7) lends itself to achieving a high Q, and it is connected in shunt with the tuning coil (L25) in the collector of the first stage.

The tuning frequencies and working Q's are based on a flat staggered sextuple design, the tuning frequencies being L24, 16.75 Mc/s; L28, 17.25 Mc/s; L25, 17.75 Mc/s; L30, 18.25 Mc/s; L27, 18.75 Mc/s; L29, 19.25 Mc/s. One-to-one bifilar wound transformers are used throughout as the tuning, coupling and phase changing elements.

The centre frequency gain is 72 dB with a maximum output approximately 1.5 volts from the detector. A redesign employing a higher value of detector load would give considerably more output. The detector load was kept low to give the maximum freedom to the designer of the video amplifier, but with the video amplifier about to be described the detector load could be increased three or four times.

The information given in this short series is taken, with permission, from a Paper read to the Television Society by B. R. Overton, B.Sc.(Eng.), A.M.I.E.E., and published in the Journal of that Society.

As the I.F. amplifier was designed as a separate unit by way of an introduction to a detailed study of the general wide band amplifying properties of the experimental transistors, no A.G.C. was attempted.

The number of stages used in the vision and sound I.F. amplifiers and the circuit techniques for the future will depend on the precise characteristics and spreads of production transistors. From this preliminary work it seems that quite practical television I.F. amplifiers employing transistors instead of valves are technically possible within the next few years.

Audio Stages

The audio section of the receiver has an output stage based on a single-ended push-pull 200 mW. stage designed for battery portable radio receivers. Advantage is taken of the higher H.T. line (12 v. rather than 9 v.) and the use of experimental transistors to increase the output to approximately 350 mW. The driver stage is transformer coupled to the output stage and preceded by a preamplifier.

Negative feedback is applied over the output and driver stages; full output is achieved with approximately 60 mV. input at 1,000 c/s. The frequency response at full output is flat to within 3 dB over the range of 80 c/s to 4.5 kc/s. The upper frequencies are deliberately attenuated by increasing feedback to achieve better balance. The current consumption of the whole audio amplifier, under quiescent conditions is approximately 8 mA, and for full output (speech and music) approximately 27 mA.

For convenience in handling as a separate unit the two 15 Ω speakers connected in series are fed capacitatively from the output stage. Direct coupling with a small blocking capacitor in the feedback loop has advantages both in performance and cost if the resulting split battery is acceptable.

Video Stage

The conventional H.F. transistor will conveniently provide a video output of about 8 volts peak-to-peak; the conventional television picture tube requires a video input of about 80 volts. This is the measure of the problem which faces the designer when he considers the video stage.

A good solution to this problem will be an important key to the introduction of transistors in television receivers. There are, of course, a variety of possible solutions to the problem. Obviously a solution which does not involve a higher H.T. potential than that required for the associated transistors circuits is much to be preferred.

Hence, a high slope picture tube is a very attractive possibility and this will be considered first.

High Slope Tubes

The behaviour of conventional cathode ray tube guns has been expressed by a number of workers, in empirical equations. The precise form of these equations is not unanimously agreed, but for our purposes the differences are not important.

Taking the transfer characteristic as

$$Ik = \frac{KVd^3}{Vco^{3/2}} \quad \ldots\ldots \quad (1)$$

Where Ik = cathode current μA
Vd = grid-cathode drive volts
Vco = cut-off potential volts
K = a constant

and equating the drive to the cut-off potential we have

$$Ip = KV\ co^{3/2} \text{ approximately} \quad \ldots \quad (2)$$

Where Ip = peak cathode current before commencement of grid current.

In practice the factor K can be changed by the designer very little (perhaps through the range 2.5 to 3.5) so if the cut-off is to be reduced without unacceptable reduction in beam current a very different gun is needed.

The first approach is to argue as follows:

Equation (2) refers to a conventional gun with one grid hole. Replace one hole by many holes to make up the current lost by the required reduction of cut-off. From what has gone before it is clear that a reduction of cut-off by a factor of 10 to 1 is desirable.

Thus according to equation (2) we require some 30 grid holes to make good the peak current.

Consider now the effect on spot size of putting 30 holes in the Wehnelt cylinder (grid). The focused spot in the centre of a television picture tube is a magnified image of the cross-over or focus which occurs between the grid and anode. The diameter of the cross-over is substantially smaller than that of the grid hole itself. Typical figures might be:

Grid hole diameter. 1 mm.:
cross-over diameter. 0.1 mm.

Thus if spot size is not to suffer and other things are to remain unchanged the 30 cross-overs must be placed effectively within the original cross-over diameter. Quite apart from the difficulty of achieving such a structure there are further consequences which must be considered. With such small holes the penetration of the anode field will be inadequate—in other words—the cut-off must now be increased.

Taking

$$Vco = \frac{Val\ d^{2\cdot5}}{K^1 (b \div f)^{1\cdot25}} \quad . \quad . \quad . \quad (3)$$

Where V al = first anode potential volts
d = diam. of grid hole
K^1 = constant
b = cathode to grid spacing
f = grid to anode spacing

We find that whereas we needed to reduce the grid hole by a factor of approximately 3 to achieve the small cut-off we are forced to reduce it by a further factor.

This in turn means that the electrode spacings (b) must be reduced and/or the anode field (V al/f) increased. Present picture tubes are designed with these features close to the limit for convenient production.

The one high slope tube which has been described has a grid-cathode spacing about one-third of normal without approaching the final requirements of definition. Thus, a real invention is required before a readily producible high slope gun is available for use with transistors operating off a 12 volt line. The need is well understood by cathode ray tube designers so we may hope that necessity will indeed be the mother of invention.

There is, however, the possibility of an intermediate high slope gun proving of use in a television receiver using transistors.

One method of achieving an improvement of slope is to increase the penetration factor ($D = 1/\mu$) of the gun, but this is only effective if cathode modulation is employed. The idea is best explained by a hypothetical example. Consider a gun with a cut-off of 100 volts and a first anode voltage of 50 volts. The peak current (corresponding to that for a gun with a 100 volt cut-off) will be given when the grid and cathode are at the same potential. If the grid-to-first-anode potential is maintained at 50 volts and the cathode is made positive the beam current will be reduced rapidly. In fact, if the penetration factor (D) is assumed to be constant with change in grid-cathode potential then cut-off will achieve for a cathode-to-grid potential difference (drive) of about 35 volts.

As can be seen from equation (3) the dimensions of the gun spacings come down rather rapidly as the first anode potential is reduced. Furthermore, equation (3) is far from complete for the range of first anode potential being discussed and and in practice the penetration factor has to be increased more than the equation suggests for a given improvement in effective slope.

It is doubtful if the "intermediate high slope gun" target can be achieved now by this technique without some loss of performance in comparison with the standard tube. As it has obvious advantages in conventional valve receivers we may expect it to undergo considerable development in the immediate future. Thus, it seems very likely that the intermediate high slope tube will be realised before the full high slope tube.

(Continued on page 357)

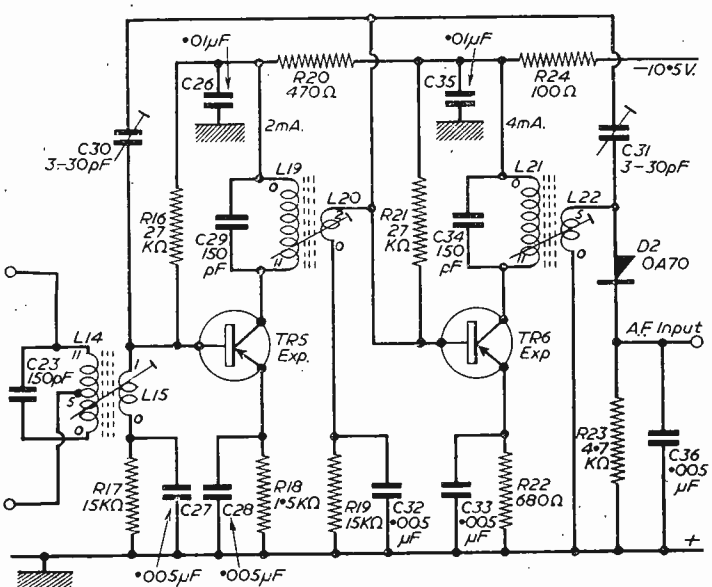


Fig. 6.—The sound I.F. amplifier.

High Collector Potential Transistors

A television video stage has been described which uses an experimental diffused base transistor to provide an output of some 100 volts p-p. This solution to the video problem is at first attractive on two counts: no new picture tube is required and a high level video signal is available for A.G.C. and synchronising purposes. On the other hand for an all transistor receiver an extra H.T. line is required and the high level signal may not really be required for other purposes.

At first sight the requirement of high frequency performance (short distances, low resistivity material) and high potentials (long distances, high resistivity material) are contradictory. However, considerable work has been done on this problem and techniques exist to get the best of both worlds. Nevertheless, the resulting structure is complicated and laborious to make. Hence, the high potential and high dissipation requirements of the 100 volt video transistor are such that it may be a long time before a suitable transistor can be produced in quantity with high productivity.

Perhaps, therefore, from the transistor point of view, the most likely technical solution in the future is an intermediate high collector potential transistor.

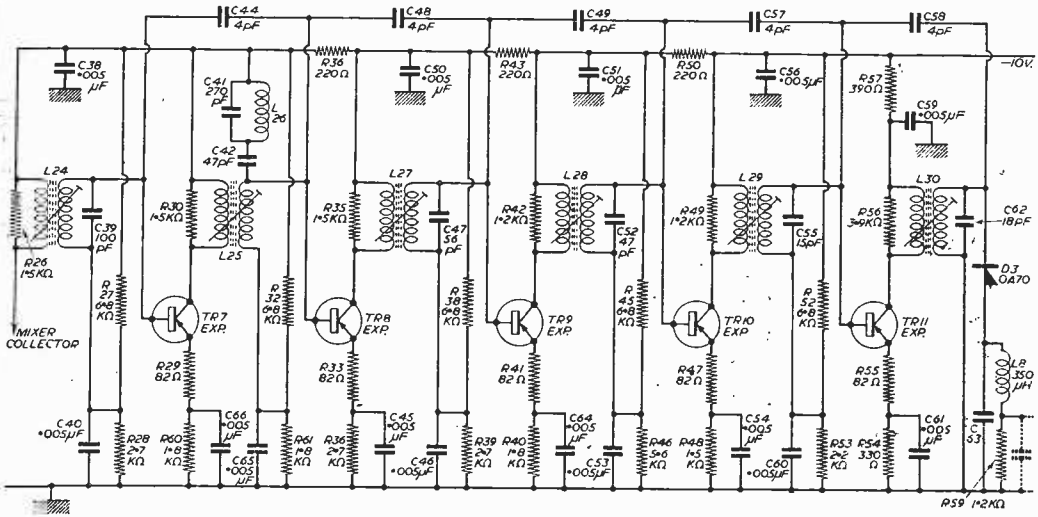


Fig. 7.—The vision I.F. amplifier.

Some of the other possibilities may be considered briefly.

Video Transformer

A video transformer seems at first to be a possible way of driving a normal picture tube from a low-voltage transistor stage. Even a cursory quantitative of the scheme shows it to be rather unattractive.

The transformer must have a flat response over the video range dropping by a 3 dB at perhaps 100 c/s and 2.5 Mc/s (frequency ratio of 25,000). The turns ratio must be about 8 to 1 and the output 80 volts. Video transformers with these characteristics can undoubtedly be made using supermumetal (low-frequency permeability approximately 50,000) tape 0.004in. thick as core material. The stray capacitance which these toroidally wound transformers introduce is considerable, limiting their use to low-impedance circuits.

Assuming a very modest effective capacitance loading of about 30 pF at the secondary then the secondary current swing must be in the order of 45 mA and the primary swing 360 mA. This could easily be regarded as a minimum yet the implied transistor requirements are formidable.

Power I.F. Stage

It requires even less consideration to confirm that, it is impracticable to drive the standard picture tube from the detector. Approximately 1A p-p at I.F. would be required from the output transistor and the radiation problems would be severe

Beanstalk Amplifier

The Beanstalk amplifier, due to L. E. Jansson, achieves a high output voltage by employing a series chain of transistors having voltage or dissipation limits which prevent this providing the output singly. Thus, this novel amplifier offered both an interesting study in itself and a simple solution to the video drive problem in the experimental receiver. As, in some respects, it makes small demands on the transistors it is not on economic grounds completely ridiculous for the future.

(To be continued)

Television and the Film Industry

WHY BOX OFFICE TAKINGS ARE DROPPING By W. Spalding

IN spite of the factor of the heavy tax burden which the film industry is expected to shoulder, the real reason for the box office slump is television pure and simple. The public will have its entertainment—high tax or low tax—and there is little doubt that, as television covers more and more of the country, the box office takings will continue to drop.

Television Tax

Television is also heavily taxed: there is the high rate of tax when the set is purchased and tax on subsequent replacements of the valves and the picture tube. The tax on a 17in. tube alone accounts for £6 9s. 6d., while the Chancellor receives something like seven shillings every time a valve is replaced—yet the viewing public is ever increasing, and now more rapidly than ever with the advent of the popular rental schemes.

Convenience

Visual entertainment is the life-blood of a remarkably large proportion of the population, and the actual medium by which it is presented matters very little. What does matter, however, is the convenience of obtaining it. It is far more convenient to flick a knob on the front of a box and be entertained in the comfort of one's home than to participate in the out-moded ritual of "going-to-the-pictures."

The logic of this reasoning is obviously influenced by the type of programme material available by way of television, but now that the cinema people themselves are televising short, snappy films and excellent plays of entertainment value comparable to cinema programmes, the local cinema show really has to be good to entice the enthusiastic viewer away from his television screen.

The cinema will always be assured the custom of the courting couple and those out for an evening's entertainment, but such patrons will hardly swell the takings sufficiently to cover the local expenses, let alone the high cost of film production. The 65,000,000 fewer cinema tickets sold in the first quarter of this year than in the first quarter of last year reveal forcibly that Mr. and Mrs. Britain are quite happy in being entertained by the medium of the television screen.

Take the Cinema to the People

If the people will not go to the cinema, then the only solution is to take the cinema to the people. In a very short time pretty well the whole of the country will be in the range of a television transmitter, which will mean that all those families desirous of being entertained will possess television screens. The medium for showing their films is thus becoming automatically available to the cinema industry.

While a channel not in use for local network stations of the BBC and ITV could be utilised for the transmission of current release films which would normally be screened at the cinema, there remains the problem of devising some simple method whereby the cinema people could charge viewers for the independent service they provide. Such ideas have been investigated in America, and several schemes have been evolved which, in essence, serve to scramble the signals corresponding to the film service so that on sets not arranged to receive them they produce just a jumble of lines.

Box Office in the Home

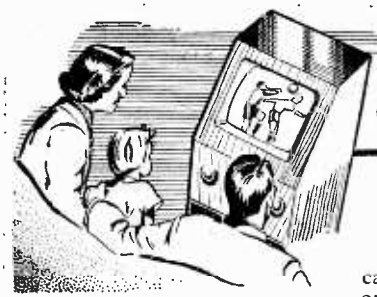
Installed by the cinema people, however, is a small coin box by the side of the television receiver, so that the insertion of a suitable coin sets in operation for a certain period of time a device which de-scrambles the signals and thus restores the picture intelligence. The de-scrambling code signal is sometimes fed to subscribers through a separate cable and sometimes through the telephone system, and in the latter case, instead of putting a coin in a box, the viewer requiring the film programme simply dials a certain telephone number, which debits his telephone account appropriately in favour of the cinema company automatically at the exchange.

"Piping" the Film Signals

There is another method of "piping" the film signals direct to subscribers through coaxial cable, in which case there is usually a monthly or quarterly charge for the service. This would appear to be the most desirable method since it avoids unnecessary congestion of the television channels which may be required for other services; it also ensures that the system is under the complete control of the cinema operators and allows for the transmission of interference-free signals for the provision of pictures of cinema standard. It also lends itself to the direct transmission of colour films with stereophonic sound accompaniment.

Visual Entertainment

Now that the recording and reproducing of pictures—as well as sound—on magnetic tape is actually taking place, it would appear that the whole mode of visual entertainment as we know it to-day will progressively undergo a complete change; cinemas will close, and every household with a television set will become a potential box office for the new cinema industry.



UNDERNEATH THE DIPOLE

A MONTHLY COMMENTARY

By Iconos

Movies and TV

THE principal technical society in the U.S.A. that concerns itself with television is the *Society of Motion Picture and Television Engineers*. This was established in 1916 in Hollywood by a number of film cameramen, including Charles. Rosher, who photographed all the big pictures of Mary Pickford, brightest film star of the silent days. The cameramen were soon joined by equipment engineers, photographic chemists, lens specialists —and in due course by sound recording engineers. The title of the organisation was then, more simply "Society of Motion Picture Engineers"— the "*and Television*" being added in 1950. At first, under its new and fuller title, television played a small part, as was appropriate for a new appendage to the academic body of the (then) mighty and prosperous feature film industry. The tail now seems to be wagging the dog, because nowadays the great majority of the papers published in its monthly technical journal concern themselves with television.

British Societies

OVER here, the equivalent technical body is the British Kinematograph Society, which has not changed its title but, nevertheless, possesses a most active Television Division, a section which, somehow, does not seem to clash with another somewhat similar organisation, the Television Society. Both societies are now very active; indeed, a large number of BBC and I.T.A. engineers are members of each of them. As a matter of fact, the societies do not cover quite the same ground. B.K.S. lectures and educational courses deal with every aspect of the studio side of television: camerawork, studio accessories operational methods and lighting. The Television Society lectures deal with transmitter, aerial and receiver design, new techniques and equipment. A recent well attended lecture dealt with the newest Cintel flying spot telecine equipment, when a paper was read by Ernest Traub, designer of its ingenious optical system.

The British Kinematograph Society has had lectures on *Inlay and Overlay*, the trick electronic techniques used on David Nixon's "magic" programmes, which was given by Mr. D. R. Campbell of the BBC, and *The Evolution of the Motion Picture Camera*, by Charles and W. P. Vinten, a paper which also devoted much attention to the new lightweight camera dollies for television in the studio and on exteriors.

The B.K.S. has organised a symposium on studio lighting for one of its lectures next month. Experts in both fields will talk about the organisation of lighting for films and for television. This should attract a large audience of television and film technicians who want to know all about the other man's job.

Satellites

THE BBC pioneered television for the world. Almost complete coverage of Great Britain and Northern Ireland has been obtained with eighteen transmitters having effective radiated powers of from .2 kw. to 200 kw., plus some recent smaller relay transmitters, known as "translators." The I.T.A. is following up with knowledge of the problems which have been surmounted by the BBC, plus some entirely new ones arising from the use of Band III. There has been some daring use of new types of directional aerials by Mr. P. A. T. Bevan, the I.T.A.'s Chief Engineer, and in almost every case the result has been highly satisfactory. I.T.A. are proposing to "tailor" the polar diagram of the newest transmitters to be installed in the remaining smaller areas, such as East Anglia, Kent, Devon, Cornwall, Solway, Berwick and North-east Scotland. There will in addition be a number of small-powered satellite transmitters, somewhat on the lines of the BBC's "translators," in parts of Western Scotland and the Isle of Man. I was surprised to hear that the Kent area was to be classified as a satellite. I would have thought that this prosperous corner of the Kingdom could support an independent programme company with a local studio.

How Small?

BBC and I.T.A. transmitter coverage are similar inasmuch as they are an arrangement of many transmitters of varying powers, to suit each particular area. When it comes to studio facilities, however, there is a big difference. The BBC has large and extensive TV studio facilities in various parts of London, principally in the Shepherd's Bush district, but fairly modest studio plants in the provinces. The major I.T.A. companies, on the other hand, have quite large provincial studio accommodation in Manchester, Birmingham, Glasgow and other big cities, which is superior in most respects to some of their London studios. Even the smaller I.T.A. programme companies at Southampton, Newcastle and Cardiff have extensive stage space and large staffs. Generally speaking, the numbers of staff employed per station is said to be much greater than that required by American TV stations of equal importance. It is not unusual for a small American TV station to put out over 20 per cent. of

local live production — the balance being film and networked programmes—with a staff of less than sixty. If the same methods were used here, then areas with even smaller populations than Solway, N.E. Scotland or Devon and Cornwall could support their own local I.T.A. television programme company.

A Classic Debunked

THERE are a number of plays of the slightly arty Irish type which have long been regarded as master-classics of the stage. One by one, they are being taken out, dusted and made into television plays by both BBC and I.T.A. Granada resuscitated J. M. Synge's *The Playboy Of The Western World*, which has long had the reputation of being a masterpiece of Irish whimsy. The highly melodramatic plot concerned the activities of a village half-wit who boasts that he has killed his father, thereby capturing the adulation of the villagers. What happened at the end of the story I cannot tell, because the dialect was so thick and heavy as to be practically unintelligible and I had to switch over to the BBC in self-defence! For the first twenty minutes or so, all the artistes, especially Joan O'Hara, who played Pegeen, might just as well have been speaking Chinese. One almost felt that the producer of the play might be saying "I dare viewers to understand any of this dialogue!" When will television producers realise the dangers of broken-English, dialect, regional accents, local slang, gabbled dialogue and poor diction.

The Elizabeth Plays

THE 400th anniversary of the accession of Elizabeth I to the throne has naturally led to a fair number of stage plays, films and television plays devoted to incidents in her reign. Both TV channels have done well with a number of productions which allowed their respective wardrobe, make-up and hairdressing departments plenty of scope. The BBC's *Till Time Shall End* was specially written for the occasion by Clemence Dane, and concerned the first three years of Elizabeth's reign, when her court was plagued with gossip, intrigue—and suitors for her hand. Gwen Watford played the part of Elizabeth with great dignity and power, and scored a great triumph, worthy of the winner of this year's Guild of TV Producers and Directors award. The award was for the "TV actress of the year." Other players who did well in this very fine BBC play were Tony Britton as Dudley, Fabia Drake as Kate Ashley and Alan Webb as Cecil. Michael Barry's direction was excellent.

Associated-Rediffusion's contribution had the rather horrific title *In The Shadow Of The Axe*, and was adapted from Andre Josset's play *Elizabeth*. It concerned itself mainly with the quarrels and reconciliations of Elizabeth and Essex, played by Catherine Lacey and Lawrence Payne respectively. Here was quite a different interpretation of the personality of Queen Elizabeth I, equally excellent and convincing. The production and technical values of this play were as good as any I have seen on commercial television, and the costumes and decor were faultless. I couldn't help thinking that, good as this play was, how superb it would have been in colour television! Costume and period plays come over very well in black and white, all the same, but must demand a very high standard of finish on scenery and properties. Perfectionism in any of these departments means money—lots of it. Fortunately, Associated-Rediffusion can afford it, with a gross revenue from advertising of over £250 each week. A-R certainly achieve quality and gloss with their more important dramatic shows. Pity they have to have so many "natural-breaks" for advertising! However, no advertising, no play!

TV to Aid Advertising

L.P.E. TELEVISION LTD., the television, cinema and radio advertising division of the L.P.E. organisation has commissioned the planning, engineering and installation of the most comprehensive system of closed-circuit television and telecine of its type in this country and possibly the world.

This project, which has been entrusted to Marconi's Wireless Telegraph Co. Ltd., will embody the most modern equipment, including a new camera of cylindrical construction which, although only 4in. in diameter and 11in. long, gives a picture of a much higher standard than is usually associated with miniature equipments of this type.

Two of the new Marconi BD871 cameras are to be used in the installation and each can have a dual function. Mounted on a tripod stand and fitted with a zoom lens either can be employed for viewing auditions, casting or rehearsals in the theatre. Mounted on a pedestal in the projection room either is available for telecine work. In this position they can be swivelled to "view" the film running through either of three projectors (two 35 mm. and one 16 mm.) or filmstrip in a slide projector.

Miniature Transmitters

IN telecine work the camera scans the film frame and converts the variations in light and shade into electrical (video) impulses. The video impulses, and also those derived from the sound track, are fed to radio-frequency modulators and amplifiers. These are crystal-controlled miniature transmitters. The modulators do not, however, feed their outputs into an aerial system as for broadcasting usage; instead, they are conveyed along cables to the 43 receiving points. In the same way the output from the auditioning camera is fed to another radio-frequency modulator and amplifier and similarly distributed. The receivers, therefore, have four radio-frequency signals fed to them, namely the BBC and I.T.A. signals and the signals emanating from the cameras. It is planned to use one camera permanently for telecine and the other for use in the viewing theatre or for telecine as required.

The 35 mm. projectors can run either "married" or "unmarried" prints and are modified to use magnetic stripe film. These projectors and the associated sound systems are being supplied by R.C.A. (Great Britain) Ltd. while the inter-office cabling is being carried out by Belling & Lee Ltd., both under sub-contract to Marconi's.

CORRESPONDENCE

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

FERGUSON MODEL 989

SIR,—Having benefited many times from information given in PRACTICAL TELEVISION may I, as an amateur, be permitted to give the results of an experiment carried out on an old Ferguson Model 989 which was passed to me because the tube was broken.

Using an isolating transformer, I fitted a 17in. Brimar C17FM—discarded because of low emission—in place of the broken 16in. Mullard MW 41-1, using a small length of aluminium angle for base with a strip of rubber and aluminium to secure the tube in position.

Apart from a negligible loss of focus I have obtained a very satisfactory picture. Hoping this will be of some use to other readers.—C. H. CROSSBY (Holloway, N.7).

COSSOR MODEL 937

SIR,—*Re* the answer to P. A. Vine (Coventry) in your December issue of PRACTICAL TELEVISION.

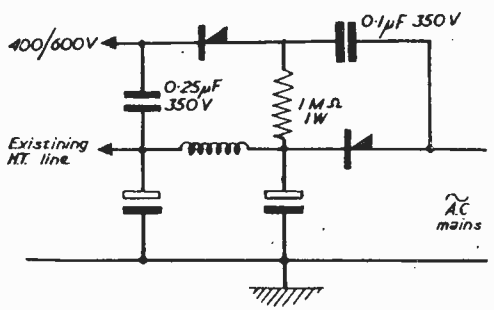
I had some fault on a Cossor Model 937 and it was due to sound instability caused by harmonic feedback from the detector circuits.

Cossor has a modification for this which consists of removing the second I.F. sound stage and then getting increased A.F. gain by using the first I.F. stage as a reflex audio amplifier.—HENRY BURNE (Irvine).

"PICTURE TUBE SUBSTITUTION"

SIR,—With reference to the article "Picture Tube Substitution," by G. Earl, published in the December, 1958, issue of PRACTICAL TELEVISION, the method of obtaining the first anode voltage, as shown in Fig. 4 of this article, will only obtain a voltage of approximately 300 v. with respect to chassis, which is insufficient when cathode modulation is employed.

A first anode voltage of the order of 250 v. with respect to cathode is required, therefore, at least 400 v. with respect to chassis will be necessary. This can be obtained by using a voltage additive arrangement, as shown in the diagram. The circuit was taken from the "Mullard Maintenance Manual."—L. F. MARSH, Mullard Ltd. (London, W.C.1).



Picture tube substitution. A voltage additive arrangement.

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.

SERVICE DATA

SIR,—Would you please allow me space in your excellent magazine to air my views on service data.

In recent issues, many readers have told of their experiences in trying to get service data from manufacturers, and have failed, with the result that they at once write to this magazine asking for the firms to be listed who refuse to supply. This in my estimation would be entirely wrong as if this journal did as proposed by some of its readers, it would "Kill the goose that lays the golden egg," in other words they could refuse to supply this magazine with the necessary data, and then where would we be?

I think if these readers who instigate these methods would have a little patience, this service data would be available to them in the near future through the channels of this magazine, or, as I have done, obtain the copies of "Radio & Television Servicing" when they become available.

I have found out that one can learn a lot by examining a television receiver, when not in use, without the aid of service data.—FRANK MALPASS (Hednesford).

SOBELL T121

SIR,—I would like to add a few remarks to your diagnosis, in November issue, of a Bradford reader's intermittent trouble with Sobell T121.

In this model, I.F.T.s T3 and T4 are covered with a sticky cellophane tape, which by chemical action produces multiple greenspot in the windings.

T3 is common to sound and vision, which explains dual nature of symptoms.

Replacements are *not* available, but they are simple to rewind by hand, and I would advise that both are dealt with to avoid future trouble.—W. E. H. (Windsor).

A READER'S HINT

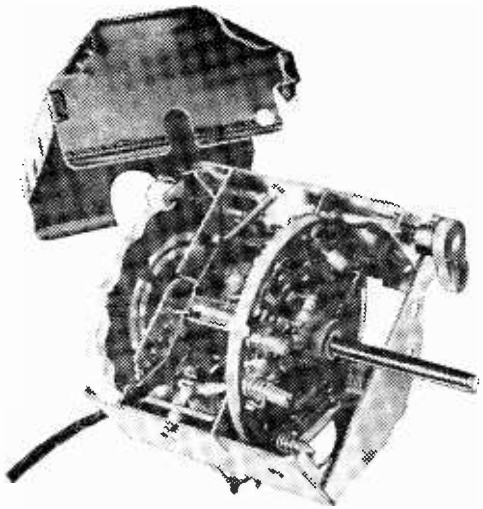
SIR,—I would like to pass on to readers of PRACTICAL TELEVISION a simple cure for Band I signals breaking through on Band III using a Teletron coil kit converter Mark I. After trying the usual wavetraps of various types I found, by winding three turns of 22 s.w.g. tinned copper wire on a ¼in. drill shank spaced the diameter of the wire, and soldered between the first valve control grid and chassis, it completely trapped Band I signals, and gave a 25 per cent. increase in Band III picture and sound.—C. E. DRAPER (St. Albans).

News From the Trade

Plastic Tuner Discs

NEW polystyrene tuner discs are incorporated in the tuner units manufactured by Radio and Allied Industries Ltd., Slough, for their television models TPS 173 and MP. 17. The discs or rotors are moulded in Styron 475 high-impact polystyrene which combines the essential properties of insulation, dimensional stability and lightness in weight.

One disc carries the oscillator and band-pass coils, and various condensers and resistors which provide a tuned circuit of the frequency required. The other disc carries the aerial coils. These



The new tuner unit.

coils terminate at various contact points at the back of the disc and both discs move in unison. The required frequency is determined by the disc position, the disc contact meeting two sets of switch contacts, one for the oscillator and R.F. band-pass sections and one for the aerial at a predetermined position in the unit. The unit is a semi-incremental inductance tuner capable of receiving any of the thirteen channels plus V.H.F./F.M.

English Electric 3in. Image Orthicons

FOR some years now the 3in. image orthicon manufactured by The English Electric Valve Company has enjoyed a reputation for producing television pictures of high photographic quality. This property of the tube is, in no small measure, due to the incorporation in the design of an electrode which corrects the decelerating field on the scanned side of the target. This electrode, in the form of a fine copper mesh, ensures that the decelerating field is strictly linear as distinct from the somewhat curved field in other versions of the tube. The mesh is, necessarily, of very high uniform transmission since the scanning beam passes through it twice, and any non-uniformities impress themselves on the beam and appear as spurious picture signals.

The function of this so called "field-mesh," which is located at a point of least beam interference, is to correct the approach of the scanning beam to the target by ensuring more accurate alignment of the electric and magnetic fields.

In this condition the mechanism of discharge has increased efficiency because the beam approach and deflection return path is constant over the whole scanned area. Furthermore, the displacement of the return beam from the forward path is reduced, so limiting the amount of geometrical distortion produced in the scanning section of the tube. In addition, the field mesh hides the inevitable faint blemishes on the first multiplier stage which otherwise would appear on picture.

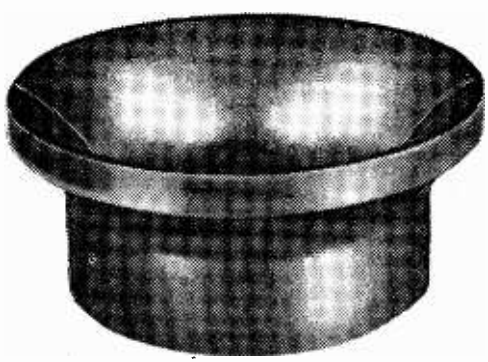
One further feature of the new series of tubes is the re-shaping of the main electrostatic focusing field in the scanning section, so that secondary electrons from the mesh are prevented from lowering the beam modulation and upsetting the sharpness of the return beam. The tubes have in consequence a lower D.C. output current, so ensuring better freedom from dynode saturation, and giving a signal current of greater purity and much better resolution.

At present two versions of the field-mesh image orthicon are available, the P-807 used for all normal monochrome work, and the P-809 which has found successful application in colour cameras. —English Electric Valve Co. Ltd., Chelmsford, England.

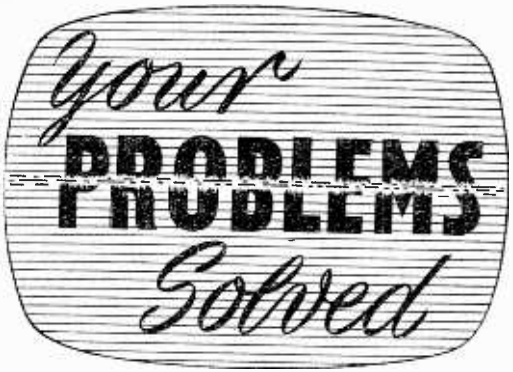
New Plessey Deflection Yokes

A NEW range of deflection yokes for 110 deg. cathode ray tubes has been manufactured by the Plessey Company Limited, Ilford, Essex. The range includes a fully flared Ferrite split ring with a cut-away portion which reduces weight, and consequently cost, without sacrificing performance.

In addition, a solid flared split ring and a yoke built up from four segments are available in Ferrite. A fully flared yoke is also available in Caslam material.



A flared ring core for use with 110 deg. C.R.T.



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

FERGUSON 992T

I have found the only way to make this set work is to insert three 150 Ω resistors in series, between H.T. line and H.T. end of C25 (0.25 μF). If these resistors are removed the PL81 anode gets red hot and the picture collapses. It seems to be working O.K. at the moment.

Can you inform me what is wrong? I have replaced R34, C25 and C62, also PL81, PY81, ECL80 and EY51.—A. James (S.W.6).

From your remarks we assume that the set only works with C25 short-circuited since, as you will see from your circuit, the H.T. side of the capacitor is, in any case, connected direct to the H.T. line.

If this is the case, then the trouble lies in V9 stage, for it is the conduction of this valve which supplies H.T. to the anode circuit, via the line output transformer, etc., of the PL81, and if this is lacking then the screen will glow red hot and the set will fail to work.

PHILIPS 383A/15

What is make and type of C.R. tube? For what transmitter and frequency is the set designed to receive? How could it be adapted to receive local station Truleigh Hill BBC, and/or Isle of Wight I.T.A.? Finally, can you tell me how the mains switch leads should be connected correctly and what type of switch? The leads to the switch are coloured, two red and two brown.—V. J. Connor (Shoreham).

The 383A receiver is a superhet with a 9.7 Mc/s sound and 13.2 Mc/s vision I.F. The tube used is a Mullard MW 22-7 or MW 22-14c which may be replaced by an MW 22-16. It is designed to receive Channel 1 (London) on 41.5 Mc/s sound and 45 Mc/s vision. It could be adapted to receive other channels by altering the coils associated with the EF50 R.F. amplifier and ECH35 valves. We cannot give precise details however. Both mains leads are broken by the double-pole on/off switch. Two leads come direct from the mains lead and two are wired to the transformer. The part No. of the switch is MK886.19.

H.M.V. 1816

This receiver has good reserve of contrast control, and sound, and when it's working all right a good picture, but the trouble is the line hold control is very critical of setting and the picture breaks up several times in the course of an evening, frame is perfectly steady.

I have replaced LN152 valve sync separator and line oscillator, the old one was low emission coupled with loss of width, but there is little if any improvement with the line locking.—P. R. Morgan (Bristol, 4).

The usual cause of poor line sync is an open-circuited 4 μF capacitor in the anode circuit of the video amplifier.

However, the more obvious components associated with pin 1 of the V10 LN152 (sync sig.—line osc.) should not escape attention.

COSSOR 927

My problem is a very dim picture. It has gradually deteriorated over 12 months or so. Until now it is necessary to have the mains voltage selector set for 210 volts A.C. (the supply here is 230 v.) in order to get a decent picture. The tube is rather old and I think possibly the emission has fallen off. But before I go to the expense of a new or rebuilt tube, I would like to be sure that the tube is at fault. Would you tell me, please, any other valve or component that would be most likely to cause a fault of this kind or a method of testing the tube's emission?

Another fault which occurs intermittently is a bright line across the screen horizontally. It may last for a minute or so, varying in its length of stay, then disappearing quickly; this may happen two or three times in an evening's viewing.

Yet another fault is a small bright spot the size of sixpence at the top of the screen, which is there constantly.—C. Lamb (Rotherham).

We would say that your tube is low emission, but that you may be able to extend its life by using a 6.3 volt boost transformer on its heater. The general symptoms of low emission are a patterning of the white parts of the picture on increasing either brightness or contrast, and a readiness for the picture to turn negative. Try the setting of the ion trap, which should be set for maximum light on the screen.

EKCO 161

I cannot open the picture to full width, at best it lacks about 1in. on either side and left-hand side (looking from the front) is slightly out of proportion to right-hand side. I thought it was low H.T. so I tried a new U801. I had to switch off quickly as it was flashing inside the valve. I put the old U801 back and the set went as before so I tried the new U801 again with same result of flashing. I think it is a condenser, but which?

I have fitted an A.S.V. converter self powered on top of cabinet for S.T.V. Channel 10 and I get a series of lines (like grain in wood) drifting across the screen. I have fitted an "Osmor"

pattern eliminator, the tunable type, but no difference.—A. Wright (Rutherglen).

We advise you to check that both of your 50 ohm surge limiters which feed the U801 are intact and also get the new valve changed under guarantee. Lack of width is usually due to a low 20P1 or 20L1 (if fitted), but even when new only just fills the screen. The only satisfactory way to combat patterning on I.T.A. is to use the type of tuner which takes the place of the receiver F.R. and I. F. stages.

MURPHY V114

This has given good service, but recently the 60 mA fuse kept blowing and on replacing same with a higher amperage one the U22 EHT rectifier began to disintegrate until the coating was completely stripped!

The condenser was suspected and replaced, this being a large aluminium capacitor, also the bakelite high voltage working one—the valve holder also on the transformer being replaced, another U22 valve having been fitted this has now repeated the above disintegrating! I can only suspect a possible s/c turns in the winding of the power transformer?

However, the fault may be an obscure one and I would be obliged if you could help me in this matter with suggestions of a possible checking through isolating components in turn.

On the last switching on before U22 failure the sound came on and the EHT gave the usual timebase lines on tube.—W. R. Prichard (Welwyn).

We are inclined to suspect the mains transformer as we have met this fault before and found it to be due to the same cause. Our own method was to check backwards from the tube by disconnecting the anode cap. then the bleeder chain. then the smoothing condenser and the valve was still flashing across. In our case the house fuses blew before the 60 mA fuse in the set.

PYE 14in. VT4

During the last two months I have had three PY81s in, the last one only lasting half an hour. The valves are lighting up O.K. but must develop an electrode short.

The set works perfectly when new valve is first put in. Could you possibly give me any idea as to the valve failures? D.C. H.T. O.K.—A. Dalton (Barnsley).

The next valve in the heater chain to the PY81 is the PL82 sound output valve. This is likely to develop a heater/cathode short intermittently. Another explanation is for an intermittent open-circuit to occur in the line-scanning coils circuit which leads to an increase in pulse voltage which strains the PY81 insulation.

H.M.V. 1842

Set was working O.K. then was switched off. On later switching on again set did not warm up. I took chassis out and found a resistor in halves. This component which is colourless and may be a thermistor is between pin 4 of the U153 at rear of the chassis and the voltage dropper. The height of the picture has gradually fallen off too and I would be grateful if you could tell me how to correct this other fault, too.—Wm. Carmichael (Glasgow).

The resistor referred to is a Thermistor. Various types are available and we would suggest a VA1015. Lack of light may indicate a failing PCL83 (LN309) frame timebase valve.

FERRANTI T1205S

I tried set out, sound perfect, but only a bright line across the screen. I changed the valves about, tried new ones, but just the same. Also when the set has been on for two minutes the line moves towards centre of tube leaving space of 1in. on either side.—G. Hadfield (Blackpool).

The horizontal white line denotes a fault in the frame timebase. The ECL80 just to the right of the tube on the main deck should be tested.

Then check the controls, height, vertical hold and form (inside near ECL80). Then suspect the frame oscillator and output transformer. Trace leads from ECL80 to these and check continuity of windings.

When the picture has been restored we would suggest you replace the metal rectifier which is in the centre of the chassis.

BUSH TV24

In the first place the picture will go very dim, and some times fade away, but on turning up brightness control the picture stays, but then gets too bright and has to be turned down again. It is the same on BBC and on ITV. I have plenty of contrast on ITV, but not quite so much on BBC, but still don't need to extend it to the full. The same thing results without converter. Regarding the converter, the channel switch is not working as it should do. The first turn clockwise should be ITV, the next turn should be the BBC, the BBC comes as it should do, the ITV doesn't come at the first turn, but if I go on to BBC and then turn back to ITV I get it with two or three tries.—H. Tattersall (Bacup).

The fading may be due to nothing more than a loose valve on the lower deck of the receiver or an improper contact between the valve pins and the base socket. There is a distinct chance, however, that the trouble could be more serious and the heater of the tube itself should be inspected to see if the glow reduces in intensity when the picture fades. A partial short in the heater may be responsible.

You should check the contacts of the band switch of the converter and remove the contrast control with a view to obtaining one from your local dealer. Probably 5 kΩ or similar value.

FERGUSON 988T

Having switched on and allowed the usual period time for warming up, the line timebase whistle is absent, sound is normal. On turning the horizontal hold to the left maximum (looking from the back) the EY51 lights up and the PL81

(*Continued on page* 373)

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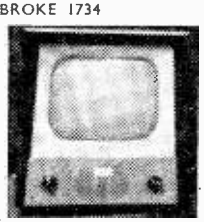

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line output valves anode glows red, reverse the procedure and the EY51 fades away and the PL81 has the usual blue glow inside the envelope and the valve returns to normal (anode overheating recedes). I might mention that on turning the horizontal hold to its fullest extent (left) and the EY51 light up the timebase whistle operates, but there is terrific oscillation in the speaker and the screen is one mass of horizontal lines which, of course, cannot be resolved into a picture.—R. Jones (Merton).

The PL81 itself should be checked. If a replacement doesn't improve matters, you should try the effect of connecting a 32 μF capacitor from H.T. to chassis as the smoothing capacitor could have lost efficiency.

BUSH TV24

I had a converter fitted about August, and we had ITV and BBC. Now I can only get ITV; when the aerial lead was fitted direct to the set, BBC could not be got, as all the valves light up. Could you inform me where the trouble is?—F. G. Charteris (Enfield).

You do not say what type of converter was fitted. We must therefore assume a Bush T184 tuner unit is referred to. In this case, check the two EF91 (or EF80) valves behind the tuner unit, the supplies to them (resistors, etc.), and the setting of the BBC tuner just to the right of BBC aerial input. The core of this adjustment may have become displaced. Check EF91 valves on left side and associated components before taking any other action.

H.M.V. 1829A

I have a fold at the top of my picture for about 1in. and I wonder if you would tell me which component or components to replace. I had just renewed EY51, ECC82, G781 and fitted new line output transformer and smoothing choke.—F. Carlington (Basford).

You should replace the LN152 (ECL80). If the fault remains, check the 3.3 MΩ resistor connected to pin 6 and the other components in the linearity network.

FERGUSON 992T

I have lost the picture on my set and have had my valves tested; seem O.K.

It collapsed from the sides inwards, which seemed like the width had failed. Please inform me as to other components to see to or my tube may have gone, and definite way to check.

Also if it is possible to change to 17in. tube as voltage, etc., seem the same except for internal focusing, but possible to use existing magnet. I only refer to electrical alterations.—G. Whitehead (S.W.19).

The PL81 is usually responsible for the described fault conditions but the ECL80 (SCH C onward only) line oscillator and PY81 efficiency diode may be suspected. We include these points, bearing in mind the fact that the valves have been tested. You should check the 4.7 kΩ screen dropping resistor of the PL81 (pin 8) and the components associated with the hold control. The line-output transformer may then be fairly suspected. A 17in. C.R.T. such as the Mullard MW43-64 may be used. Connect pin 7 to pin 11.

PILOT TV76

This now has a cathode heater short and is going soft, so I want to replace it. Is it possible to get a 17in. tube that could be used in this set without a lot of alterations other than to the cabinet? Also, for some time now the width has not been too good, i.e., about $\frac{1}{4}$in. each side short, otherwise using a "Sterling" converter I get very good results.—Eric Beard (Northampton).

The C14BM may be replaced by a C17BM or by an MW43-64 (Mullard) provided the first anode supply is taken to pin 10 and the focus assembly adjusted. This first anode supply should be derived from the 3.3 kΩ resistor and 8 μF capacitor which feeds the frame output transformer. Lack of width should direct your attention to the H.T. metal rectifier.

BUSH TV22

The picture has started to decrease in the width with a slight mistiness, but the mistiness is not persistent.

I know very little about TV, but would very much like to correct this fault myself. Could you please help?—G. R. Sumner (Wrexham).

On the right side of the main deck is a screened section. The rear part of this is detachable by removing the P.K. screw. Inside is a PZ30 valve, also a PL38 and an EY51 wired to the line output transformer. The PZ30 should be replaced.

ALBA T432

Could you please help me to locate the trouble in the above set? The line hold is very critical and needs constant resetting.

I have changed PL38 line output value also EF50, V7, V12 and V15, none of which seem to make the slightest improvement. The only way to hold the picture which tears and rolls sideways in either direction is to adjust for maximum height. This helps but is not always successful.—H. E. Mercer (Hove).

You should check the 16 μF capacitor C36B. This is most likely open circuited. Also check C30 and R23.

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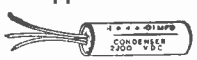

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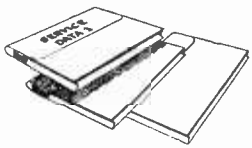

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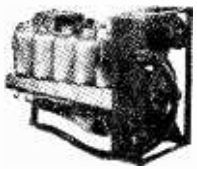
Complete Walkie-Talkie 25/-

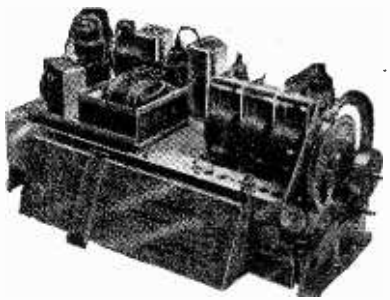


This is the 46 Walkie-Talkie. It has a range of approx. 5 miles—just right for search parties, fire brigades, etc. Operates from dry batteries. Complete with six valves and in metal case. Size approx. 12in. x 6in. x 3½in. Complete but less crystal, not tested nor guaranteed, **25/-**, plus 2/6 carriage.

R1155 for Spares

These are less valves but otherwise reasonably complete—ideal for spares—prices **£2** to **£4** depending on condition—carriage 7/6.

OFFERED FOR LESS THAN THE VALUE OF ITS COIL PACK



This set, a product of one of our famous manufacturers, has H.F. stage, covers 5 wavebands including short waves to 11 metres. Offered less valves (uses standard octal valves), power-pack, scale and drive, otherwise complete and unused. Price **£3 15/-**, plus 7/6 carriage, or 9 fortnightly payments of **10/-**.

Break-up Bargain

The unit 3515 less valves and I.F. strip. This contains components valued at least £10 as follows: 20—Paper tubular Condensers up to 1 mfd. 60—Carbon Resistors many high stability. 40—Silver Mica Condensers. 30—R.F. Chokes. 13—Octal Valve Holders. 1—Yaxley Switch. 1—A.F. Choke. 2—Miniature Variable Condensers. 1—Transformer. 2—Mansbridge Condensers. 1—Useful Chassis size 18in. x 11½in. x 7½in. with outer case.

Plus hundreds of miscellaneous items, nuts, bolts, washers, tag strips, I.F. sockets, etc. All for **6/6**, plus 5/- carriage up to 250 miles.

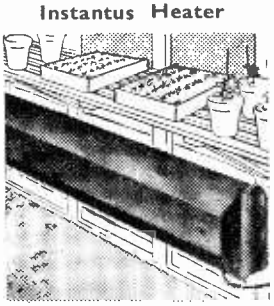
All-Mains Amplifier

Powerful three-valves mains amplifier ideal for dances, parties, etc. Complete less chassis, cabinet and speaker (available if required)—data **1/6** (free with parts). Price **19/6**, plus 2/6 post and insurance.

Unused and Boxed Valves

OZ4	9/-	6F5	9/6	7B5	12/6
1A4	9/-	6F6	7/6	7C7	12/6
1A6	9/-	6F7	12/6	7D3	9/6
1F7	12/6	6F8	9/6	7D5	9/6
1L18	8/6	6F32	10/6	7H7	8/-
1LA6	8/6	6G6	7/6	7K8	12/6
1LD5	3/6	6H6	2/6	7R7	10/-
1N56	3/6	6J5	5/6	7S7	10/-
1R5	7/6	6J7	6/-	12H6	8/6
1S5	7/6	6K6	7/-	12SH7	8/6
1T4	7/6	6K7	5/-	12SJ7	8/6
1T5	8/-	6L5	9/-	12SK7	8/6
2A5	12/6	6L6	9/-	25B5	12/6
2A6	12/6	6L7	10/7	26	10/-
2A7	12/6	6N7	8/6	27	10/-
2D13C	5/-	6R7	9/-	28D7	3/6
2X2	4/6	6S7	9/-	31	7/6
3A4	7/-	6SA7	8/-	32	7/6
3D6	5/-	6SG7	8/-	34	12/6
3Q4	7/6	6SH7	8/-	39/44	10/-
4D1	2/6	6SJ7	8/6	41	9/6
5U4	8/-	6SK7	6/-	42	8/-
5Z3	12/-	6SL7	8/-	43	10/-
5Z4	9/6	6SN7	7/6	57	10/-
6A6	12/6	6SQ7	9/-	58	10/-
6AC7	6/6	6SS7	9/-	71	9/6
6AG5	6/6	6T7	12/6	75	12/6
6A8	10/-	6TH8	12/-	77	8/-
6B4	5/-	6U5	8/6	83	12/6
6B7	10/6	6V6	8/6	84	8/6
6B8	4/-	6X5	7/6	805	30/-
6BQ6	12/6	6Y6	9/-	807	6/6
6C4	6/6	6Z5	15/-	913	90/-
6C6	6/6	7A2	12/6	954	3/6
6C8	5/-	7A7	9/6	1625	10/6
6D6	6/6				

Instantus Heater



Convector heater. Made from heavy gauge sheet steel (galvanised). For greenhouse, workshop, aviary, etc. 500 watt. **£1/12/6**; 1,000 watt, £2/10/-. 1,000 watt with wired but separate thermostat, **£3/17/6**. 2K watt free standing or wall mounting, **£3/19/6**; 2K watt with built-in thermostat, **£4/19/6**. Carriage and insurance 5/- per heater. ALL ARE GUARANTEED FOR 5 YEARS.

Speaker Bargain

12in. Hi-Fidelity loudspeaker. High flux. Permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new by famous maker. Price **32 6**, plus 3 6 post and insurance.

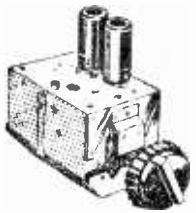
Variable Rheostat

Heavy duty slider resistor rated at 25 amps. Basic resistance is .4 ohms. Can be rewired to suit individual requirements. Ideal for dimmer circuit, etc. Price **8 3**, post 3 6.

Wrap your heater cable around the pipes in your loft to prevent a freeze-up. With full instructions. 16 yds., **9 6**.

Don't Stumble in the Dark

Install 2-way switches.
Our outfit comprises: 30 yds. Multicore cable, two 2-way switches, two wood blocks. Full instructions. **9 6** each, post and insurance 2 6.



LATEST TYPE Turret Tuner

Brand new stock, not surplus, with coils for Band I and III complete with valves. Model 1 I.F. output 33/38 Mc's. Series heaters Model 2 I.F. output 16/19 Mc's. Parallel heaters. With instructions and circuit diagram. **79 6**. With knobs, **3 6** extra, post and insurance 2 6.

Medresco Hearing Aid

As supplied by National Health, completely overhauled and in good working order with six months' guarantee. Only **£3 15 0**, plus 2 6 post and ins. Complete with earphone and *new* car plug but not batteries, these can be supplied as an extra for 5/- per set.
Superior model—new—higher gain—and self-contained batteries **£7 10.0**, or 10/- deposit and 15 fortnightly payments of **10/-**.

Yours for 10/- down and 17 fortnightly payments of 10/- or cash price

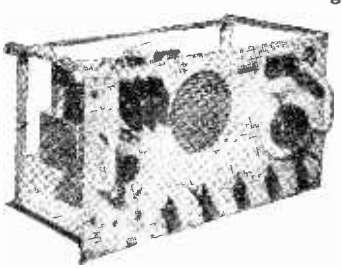
£8/10/0

The latest most up-to-date Record Player made by the famous B.S.R. Company. Using Hi-Fi Crystal Pick Up and fitted with every modern device. Definitely a record changer which will give years of trouble-free music. Not surplus but the current model. Price **£8/10 -** or Terms.

THIS MONTH'S SNIP

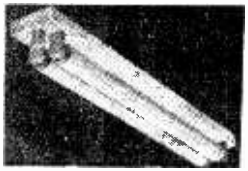
High output car battery charger, gives quick (car start charge) or trickle charge. Input standard A.C. mains, output 6 or 12 volt at 1-2½ or 4 amps. With meter and variable charge selector. Complete in hammer finish louvred case. Only 75/-, plus 4 6 carriage, or 10/- deposit and 8 fortnightly payments of 9 -. New and unused, guaranteed for 2 years.

Last Chance for this Fine Bargain



This is a super short wave receiver covering 5-50 metres (10-60 Mc/s). Uses 6 valves. Has R.F. stage, 2 I.F. stages B.F.O., etc. Muirhead instrument drive, two internal power packs, mains and battery vibrator pack. Complete with own P.M. speaker. Provision for phones and speaker muting. Complete in metal transit case; size approx. 24 x 18 x 12in.; weight 70lb. Suitable A.C. mains, 100-250 and 6 volt battery. In perfect condition, practically unused. Tested before despatch and guaranteed. Handbook free with each. Price **£6 19 6**, carriage and insurance 15 -. Or **10 -** deposit, plus 15 - carriage, and 15 fortnightly payments of **10 -**.

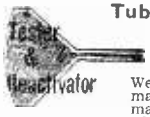
Fluorescent Lighting



Complete lighting fittings. Built-in ballast and starters—stove enamelled white and ready to work. Ideal kitchen, workshop—anywhere.
Twin 20 approximately 2ft. long complete with two 20W tubes. **49 6**.
Single 40 approximately 4ft. long complete with one 40W tube. **39 6**.
Inductor 80 approximately 5ft. long complete with one 80W tube. **59 6**. Carriage and insurance up to 150 miles 5,6, up to 250 miles 7 6.

21in. Miniature complete with 13 watt tube. Ideal for showcase or position where miniature fitting is required. Complete with latest 1in. diameter tube. **49 6** each.

Tube Tester and Re-Activaton

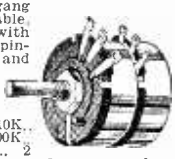


We can supply all the main components for making this unit which will not only test Cathode Ray Tubes but will also re-activate them, supplied complete with full instructions. Price **£3**, plus 2 6 post and ins.

For Your Lab.

Resistance substitution boxes are great time savers and you really cannot have too many of them, here then, is an opportunity to acquire these at a very low rate. Our R.S. kit available for only **8/6**, plus 1 6 postage, comprises a 50 W. precision variable resistor 0-100 K., six 2-3 watt fixed resistors, one 6-position switch, one pointer knob and one ordinary knob and instructions. This unit when made up will give an infinite variability over the range 100 ohm to 2 meg.

Morganite Potentiometers



Single and 2-gang types available, standard size with good length spindle, all new and boxed. Single types 1/- each, valves available: 5K., 10K., 25K., 50K., 100K., 250K., 1 meg., 2 meg. Gang type, 3 - each—valves available: 5K. + 5K., 100K. + 100K., ½ meg. + ½ meg., 2 meg. + 2 meg.

Yaxley Switches

4-pole,	2-way	1/6
12-pole,	2-way	1 6
6-pole,	3-way	2 -
3-pole,	3-way	1/6
9-pole,	3-way	2 -
2-pole,	4-way	2 -
4-pole,	4-way	2/9
4-pole,	5-way	2 6
2-pole,	5-way	2 6
1-pole,	12-way	2 6
2-pole,	12-way	4 6
6-position shorting switch		2'-

For convenience of callers all items advertised may be obtained by the following companies:

Electronics (Ruislip) Ltd.
42-46, Windmill Hill, Ruislip, Middx.
Phone : RUISLIP 5780.
Half day, Wednesday.

Electronics (Croydon) Ltd.
266, London Road, Croydon.
Phone : CRO 6558.
Half day, Wednesday.

Electronics (Finsbury Park) Ltd.
29, Stroud Green Rd., Finsbury Park, N.4.
Phone : ARChway 1049
Half day, Thursday.