Griffin

THE D.C. RESTORER

PRACTICAL TELEVISION

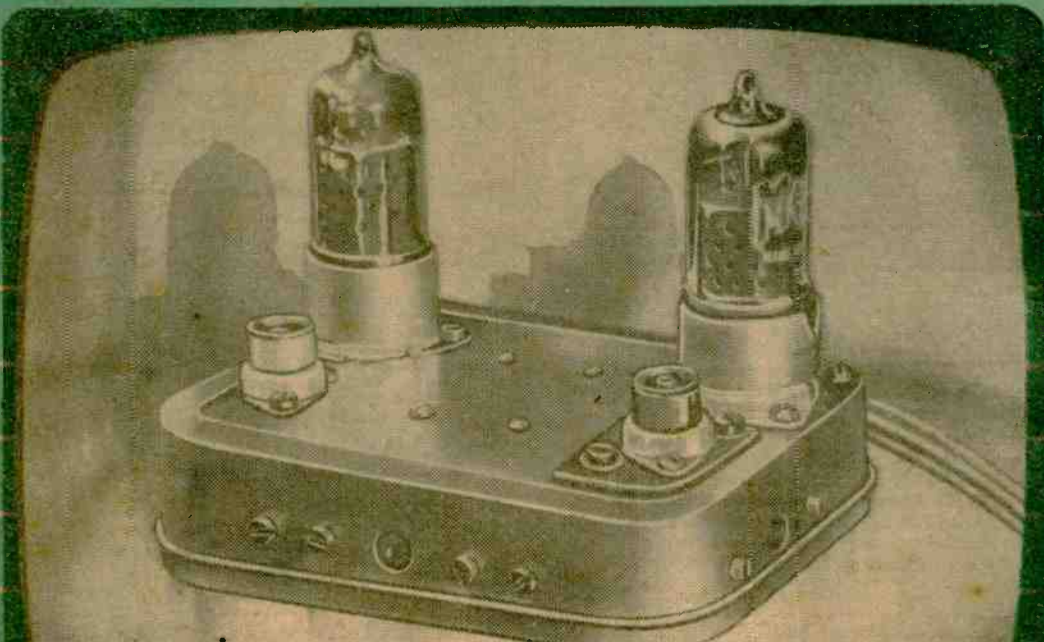
EDITOR F. J. CAMM

1/-

& "TELEVISION TIMES"

Vol. 1 No. 9 FEBRUARY 1951

A NEWNES PUBLICATION



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IN THIS ISSUE

CONDENSERS

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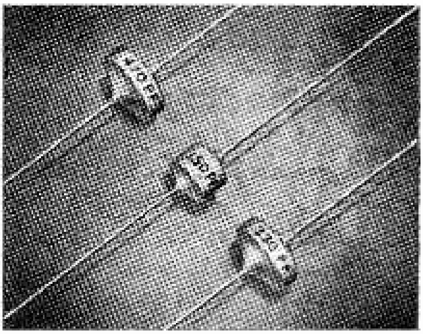


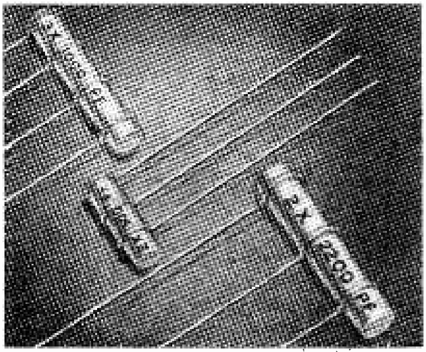
Hi-K 'PEARL' CERAMICS

Capacity pF.*	Wkg. Voltage		Dimensions		Type No.
	D.C.	A.C.	Length	Dia.	
1·0	500	250	3·5 mm. to 7 mm.	5 mm. to 7 mm.	SPG 1
10·0	500	250			SPG 1
33·0	500	250			SPG 1
150	500	250			SPG 1
330	500	250			SPG 1
470	500	250			SPG 1

Hi-K MULTIPLE TUBULAR CERAMICS

Capacity pF.*	Wkg. Voltage		Dimensions		Type No.
	D.C.	A.C.	Length	Dia.	
2 × 500	500	250	10 mm.	4·5 mm.	2CTH 310/W
2 × 1000	500	250	10 mm.	4·5 mm.	2CTH 310/W
2 × 1500	500	250	15 mm.	4·5 mm.	2CTH 315/W
2 × 2200	500	250	22 mm.	6 mm.	2CTH 422/W
3 × 500	500	250	15 mm.	4·5 mm.	3CTH 315/W
3 × 1000	500	250	15 mm.	4·5 mm.	3CTH 315/W
3 × 2200	500	250	22 mm.	6 mm.	3CTH 422/W

* Guaranteed not less than stated values at 25°C.



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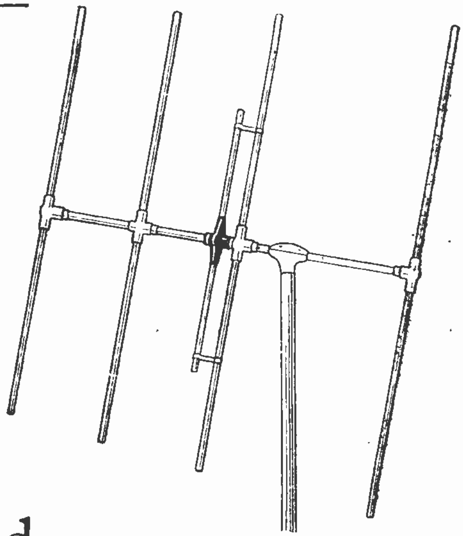

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& "TELEVISION TIMES"

Editor: F. J. CAMM

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Televiews

1951—Greatest Television Year

THE year 1951 will be the greatest in the history of television. Within the next few months we shall see the spread of television to the Northern areas, where already aerials are being erected in preparation for it. Before 1951 is out there will be new stations in Yorkshire and in Scotland, thus bringing the benefits of television to another 14½ millions.

It has been announced that as the television service spreads the regions will replace the London transmission with programmes which are more local in nature. There will also be more local outside broadcasts.

Our readers will perceive that those living within the fringe areas and whose sets are capable of adjustment will thus have the choice of an alternative programme, whilst for others who are tied to the programmes radiated by their nearest transmitter there will merely be a variation on the London items to suit local needs.

No doubt, as a result of the experience of 1950, there will be drastic changes in the programme material. It is generally agreed that these are not up to the standard of the technical efficiency behind them. The material is poor, whilst the transmissions themselves are good. Critics, however, often overlook the important fact that the B.B.C. itself is well aware of these deficiencies, and it is due to circumstances often outside their control that they are not able to do better.

The attitude of the sports promoters, for example, towards the televising of outside sporting events, as well as the attitude of certain of the musicians' unions and other societies, has prevented the radiation of programmes which the B.B.C. have in mind. Difficulties in this direction are more intense than the public and the critics generally realise. At the same time the producers themselves are learning a great deal from the present programmes, which in these early days can only be regarded as experimental. It would not have been thought a year ago, for example, that a simple "set" of a table with four men sitting round it would have topped the bill, but the "In the News" feature is the most successful television programme up to the present. It would appear also that documentaries are high up in the list, according to the official estimate of viewer appreciation. Yet, not so many months ago, some of the B.B.C. officials told us that light entertainment should be the chine of television entertainment.

It seems reasonable to assume that within five years television will cover the country, and it is interesting to conjecture as to the effect of this on the sound programmes.

When the first issue of this journal went to press there were 285,000 owners of television receivers. In the short space of nine months, that number has increased to 600,000, and each week sees a steady rise. The demand for this journal rises with the number of viewers, and although we print the maximum number of copies it is still not possible to satisfy the demand entirely.

TV IN U.S.A.

SINCE the war over 5,000,000 TV receivers have been sold in the United States. More than 100 States are radiating programmes to serve these receivers, and these are distributed over the 12 V.H.F. channels assigned for commercial broadcasts. Stations which are widely separated geographically can operate quite satisfactorily on the same channel because of the inherently short transmission range of the high frequencies used for television. But because even the best receivers have trouble in differentiating between the two stations on immediately adjacent channels, the maximum number of practical stations which can be received well in any given area is seven. This limit has already been reached in New York and Los Angeles.—F. J. C.

OUR CHANGE IN PRICE

Readers will have noticed that, commencing with this issue, the price of this magazine has been increased to 1s. We greatly regret that the costs of production which have continued to rise for a long time past have compelled us reluctantly to make this increase, which has been delayed as long as possible. Paper alone today is costing four times its pre-war price.

If we are to maintain the high technical standard we have set and give our readers and the trade the service to which they are entitled, no other course is open to us. The price increase will enable us to retain our high standard, and to continue to provide for our readers material written by all the leading authorities in this fascinating field.

The D.C. Restorer

An Important Feature of Proper Picture and Sync Working

By BERNARD BARNARD

IT is probably because the D.C. Restorer stage in a television receiver usually consists of a simple diode that it seldom receives the careful attention that experimenters lavish on the more complicated parts of their equipment.

The stage has, however, two important functions to perform, and if it is ineffective in either of them results will be extremely poor.

These two functions are as follow:

(1) To ensure that the brightness of the scene as viewed on the C.R. tube bears a proportionate relationship to the brightness of the original scene.

(2) To enable the sync separator to function as near perfectly as possible.

It may be useful to examine in some detail these two functions because an accurate understanding of them will lead to a better realisation of what the Restorer diode has to do, and thus to the ability to diagnose faults that arise when the stage is not working correctly.

In general, a D.C. Restorer is required whenever a coupling condenser is used in the video circuits that follow the detector, and this rule must be observed right up to the modulated electrode of the C.R. tube. There are other ways, apart from the use of coupling condensers, in which the D.C. component can be lost or attenuated and these will be dealt with later.

First of all, let us be quite clear what is meant by the term "D.C. component." Fig. 1 has been drawn to give a simple illustration of an alternating signal voltage accompanied by a D.C. component.

The triode valve in Fig. 1a is drawing steady anode current through its load resistance of 5,000 ohms; if this steady current is 5 milliamps there will be a steady voltage developed across the resistance of 25 volts. When the alternating signal voltage is applied between grid and cathode, it will cause a rise and fall of anode current above and below the 5 milliamps and thus the resulting voltage across the resistance will rise and fall about the steady value of 25 volts. The 25 volts is, of course, the "D.C. component" in this case and is constant irrespective of the amplitude of the A.C. signal.

Video Signal

The action is slightly more complicated when a vision signal is applied to the valve for this already contains a D.C. component of its own (see Fig. 2). If this is applied between grid and cathode in a positive sense—as it often is—it will increase the 25 volts that is already there. A brightly-lighted picture having a large D.C. component of its own will increase the 25 volts to, say, 30 volts, and this will be maintained until the mean lighting at the transmitting end changes. A dimly-lit scene at the studio will produce a much smaller D.C. component in the signal and will, in turn, cause a correspondingly small increase of D.C. in the anode circuit, in this case to, say, 26 volts only. All this goes on irrespective of the H.F. fluctuations, or A.C. component, which produces the picture detail.

In ordinary sound radio this D.C. has no importance, but it must be clear that it makes a very big difference to the visible effect on the C.R. tube. If applied to the grid of the tube, it will be in a positive direction and will reduce the negative bias already applied there by the brilliance control and will, therefore, cause the tube to glow steadily. The television signal, therefore (which is produced by the *alternating* component), will reproduce the picture about this steady brightness. If all is well this steady brightness will be similar to the general level of studio lighting and the whole effect will be an accurate representation of the original scene.

If the D.C. component is not applied to the tube grid, however, the picture will still be reproduced but, this time, it will be about a steady brilliance that is determined by the setting of the brilliance control and not by the television transmission. This is not at all satisfactory, for if the brightness is set to give a good picture on a full daylight scene and the transmission later changes to a dull interior, the reproduction will be very poor indeed. This is illustrated in Fig. 2, which shows the A.C. component of two identical line scans, the first with a large and the second with a small D.C. component. Obviously both will produce the same pattern on the screen, but the first will be about a far higher average brilliance.

Reverting to Fig. 1, if the valve is coupled to another stage or to the grid of the C.R. tube and a coupling condenser is used, it is obvious that the D.C. component will not be passed by the condenser and only the A.C. can function in reproducing the picture. The pattern of the picture will thus be reproduced, but not at the correct brightness.

The coupling condenser, however, introduces more trouble than this. The input signal voltage is D.C., fluctuating at high frequency and when this is applied to a condenser the output is not precisely the same as the input.

Consider Fig. 3, which shows the "before and after" of the fluctuating D.C. applied to the coupling condenser. It shows that it emerges from the condenser as a truly alternating current—that is, one that changes in

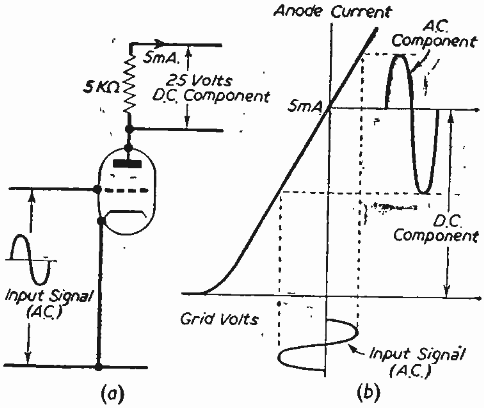


Fig. 1.—Simple triode circuit illustrating the D.C. component.

magnitude and *direction* and that it arranges itself around the zero line in such a way that the areas enclosed by the waveform above and below are equal.

From this it follows that the actual position of the waveform (which includes, of course, both modulation and sync pulses) relative to the zero line depends upon the degree of modulation and, therefore, as the nature of the picture changes during transmission, so will the position of the waveform change.

Sync Separation

The most serious effect of this wandering about on the part of the signal is that the sync separator cannot function. All types of separator work on the basic principle that it starts or stops conducting at a voltage corresponding to the junction point of picture modulation and sync pulse, and if this junction point is continually shifting then the separator cannot work.

The D.C. Restorer diode has, then, to overcome this trouble and so arrange matters that all sync pulses start at the same voltage level when they are fed to the separator.

Fig. 4 is included for the sake of completion and shows a familiar way of connecting the diode. It is connected with its cathode to the grid of the sync separator so that it conducts only on the negative-going sync pulses—negative cathode being the same, of course, as positive anode. When the diode conducts the direction of electron flow is from anode to cathode, making the separator grid positive with respect to its cathode. In other words, the restorer produces a positive bias on the grid of the separator, and the amount of this bias depends on how far negative the sync pulses go. Thus as the waveform tends to wander about, due to the condenser action explained above, the diode generates a voltage

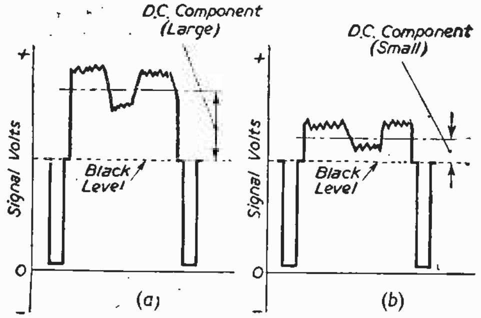


Fig. 2.—Video signal, D.C. component, and sync pulses.

in the opposite direction which pushes it back and, in effect, keeps it steady. So that all sync pulses start from approximately the same voltage and the separator is able to work.

It is, perhaps, as well to mention at this point that it is possible to effect D.C. restoration for the above purpose by dispensing with the diode and allowing the sync separator valve to run into grid current; the grid and cathode themselves function as a diode under these circumstances but when this system is used, the signal phase must be reversed so that the pulses are positive going.

The condenser and resistance shown in Fig. 4 are, of course, essential to the action of the diode; their values are not critical and are usually of the order of .1 μF and 1 megohm respectively. It is possible, however, to improve picture quality under some conditions by experimenting with these values in circuits which employ D.C. restoration to the C.R. tube. If the time constant of condenser and resistance is too short, for instance, the positive voltage developed by the diode will not be maintained for the duration of a full line scan and there may be a dark shading off of the picture on the right-hand side. In such cases it is usually advisable to keep the condenser value at about .1 μF and increase the resistance so that it discharges at a slower rate.

Two Possible Causes

Reference was made earlier to other ways in which the D.C. component can be lost or attenuated. Such

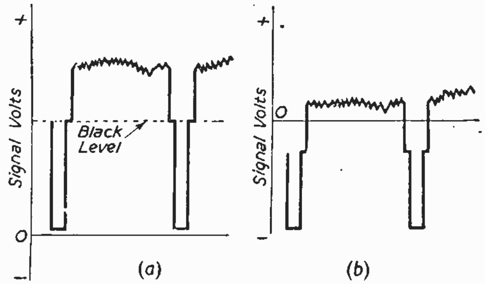


Fig. 3.—Effect on the D.C. component of the coupling condenser (a) without condenser, and (b) with condenser

difficulties can crop up in the video stage and two possible causes of this sort of trouble are as follows.

If the cathode bias resistor is by-passed by a condenser, it must be a *small* one (of the order of 300 pF) which is,

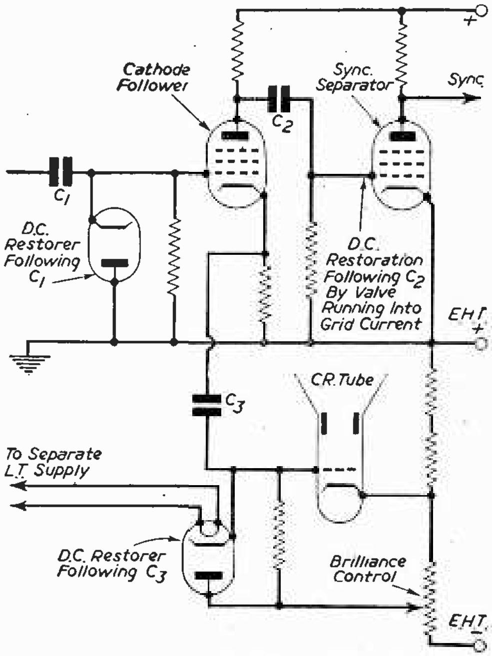


Fig. 5.—Circuit of a cathode follower video stage feeding the tube from the cathode and the sync separator from the anode.

of course, contrary to normal audio practice. The function of this condenser is to accentuate the H.F. response of the stage by reducing the amount of negative feedback at these frequencies : if a large condenser—say 16 μF or more—is used it will have a very appreciable reactance at the very low video frequencies (and D.C.) so that only these frequencies will be subject to negative feedback and they will consequently be amplified much less.

Much the same argument can be applied to the use of a decoupling condenser for the screen grid of the video amplifying stage. This condenser will not by-pass the very low frequencies and, as a consequence, the valve will not amplify them to the same extent as the middle and upper frequencies of the video range.

These two last-mentioned points are not likely to reduce the D.C. component sufficiently to upset the working of the sync separator, but experiment on the lines indicated very often results in worthwhile improvement in picture quality.

Fig. 5 shows the very popular circuit of a cathode follower feeding sync separator from its anode circuit and the C.R. tube grid from its cathode. Both feeds include coupling condensers and, therefore, D.C. restoration is necessary in both places. The circuit shows a

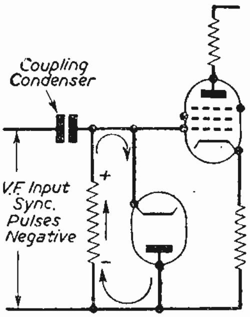


Fig. 4.—The arrows show direction of current flow when the diode conducts.

diode in each position, but it is quite possible to use a Westector type WX 6 in front of the tube grid and this dispenses with the necessity of a separate heater winding for the diode.

Camera Tubes

Some Interesting Details of Modern Transmitting Equipment

By R. E. B. HICKMAN

DURING the past fifteen or more years a considerable amount of research work has been devoted to the improvement of television camera tubes. An intensive development programme has aimed at increasing the sensitivity of camera tubes, improving resolving power, improving stability and decreasing the size of the optical system of the tubes.

The Iconoscope

The first commercially practicable camera tube was the Iconoscope, which was patented by Dr. Zworykin in 1923. This tube, shown diagrammatically in Fig. 1, is still used in modern television studios in the transmission of motion picture films and has been extensively used in studio work. It needs complicated correction circuits and strict attention to subject lighting, but in skilled hands it is capable of producing high quality pictures. The resolving power of the Iconoscope is satisfactory and it has the great advantage of being completely stable at all light levels. However, in order to obtain satisfactory pictures from such a tube, a high level of incident light, some 1,000 to 1,200 foot candles, is needed on the subject.

The Iconoscope does not easily cope with subjects containing great contrasts of lighting. For instance, with outdoor scenes showing bright sunlight and deep shadow at the same time, the brightly-lit portions of the scene tend to reproduce over-brightly in the transmitted picture and the shadows too dimly, giving a " soot and whitewash " effect. Improved versions of the tube with smaller dimensions, increased depth of focus and great sensitivity have been developed, but the inherently low sensitivity eventually led to the Iconoscope being superseded by the Orthicon tube.

The Orthicon

In design and operation the Orthicon, introduced in 1939, was a tremendous departure from Iconoscope tradition. The smaller size of the mosaic in the Orthicon provides a greater depth of focus and the required incident illumination of the subject to produce a satisfactory transmitted picture is only 100 to 200 foot candles.

Although the Orthicon has considerably greater sensitivity than the Iconoscope, it has many disadvantages. The Iconoscope is extremely stable, but the Orthicon tends to become unstable in regions of bright illumination and its resolving power is less than that of the Iconoscope in moving scenes. There is also a lack of detail in the lower level portions of the transmitted picture. Thus it will be apparent that although the Orthicon can transmit many pictures which the Iconoscope cannot, its usefulness is severely limited.

Image Orthicon

The most important development in camera tubes of the past few years has been the now widely used Image Orthicon tube. This tube is used at the present time in all types of cameras. Special types have been produced particularly suitable for poorly lit outside pickups, for indoor studio use or for general purpose use.

The Image Orthicon shown diagrammatically in Fig. 2 combines the features of several of its predecessors. It includes in one envelope, of maximum diameter about 3in. and 15½in. overall length, an image section, a target or mosaic assembly, a low voltage scanning section and a 5-stage signal multiplier.

Image Section

The image section contains a semi-transparent photocathode on the inside of the face plate, a grid to provide an electrostatic accelerating field, and a target which consists of a thin glass disc with a fine mesh screen very closely spaced to it on the photocathode side. Focusing is accomplished by means of a magnetic field produced by an external coil, and by varying the photocathode voltage.

Light from the scene being televised is picked up by an optical lens system and focused on the photocathode, which emits electrons from each illuminated area in proportion to the intensity of the light striking the area. The streams of electrons are focused on the target by the magnetic and accelerating fields.

On striking the target, the electrons cause secondary electrons to be emitted by the glass. The secondaries thus emitted are collected by the adjacent mesh screen, which is held at a definite potential of about one volt. Therefore, the potential of the glass disc is limited for all values of light and stable operation is achieved. Emission of the secondaries leaves on the photocathode side of the glass a pattern of positive charges which corresponds with the pattern of light from the scene being televised. The charges set up a corresponding potential pattern on the opposite or scanned side of the glass.

Scanning Section

The opposite side of the glass is scanned by a low-velocity electron beam produced by the electron gun in the scanning section. This gun contains a thermionic cathode, a control grid (grid No. 1) and an accelerating grid (grid No. 2). The beam is focused at the target by

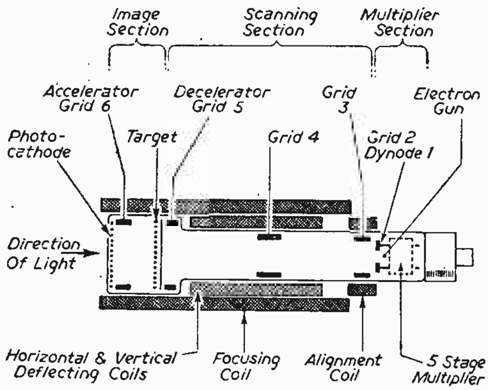


Fig. 2.—Schematic arrangement of the Image Orthicon.

the magnetic field of an external focusing coil and the electrostatic field of grid No. 4.

Grid No. 5 serves to adjust the shape of the decelerating field between grid No. 4 and the target in order to obtain uniform landing of electrons over the entire target area. The electrons stop their forward motion at the surface of the glass and are turned back and focused into a five-stage signal multiplier, except when they approach the positively charged portions of the pattern on the glass. When this condition occurs, they are deposited from the scanning beam in quantities sufficient to neutralise the potential pattern on the glass. Such deposition leaves the glass with a negative charge on the scanned side and a positive charge on the photocathode side. These charges will neutralise each other by conductivity through the glass in less than the time of one frame.

Alignment of the beam from the gun is accomplished by a transverse magnetic field produced by an external coil located at the gun end of the focusing coil.

Deflection of the beam is accomplished by transverse magnetic fields produced by external deflecting coils.

The electrons turned back at the target form the return beam which has been amplitude modulated by absorption of electrons at the target in accord with the charge pattern whose more positive areas correspond to the highlights of the televised scene.

Multiplier Section

The return beam is directed to the first dynode of a five-stage electrostatically focused multiplier. This utilises the phenomenon of secondary emission to amplify signals composed of electron beams. The electrons

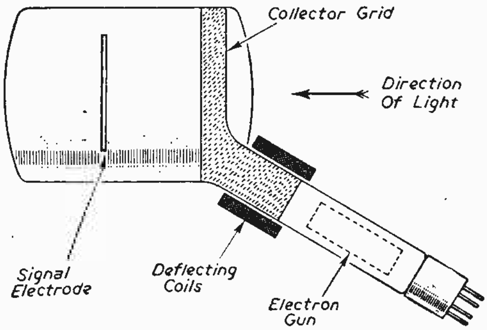


Fig. 1.—Schematic arrangement of the Iconoscope.

in the beam impinging on the first dynode surface produce many other electrons, the number depending on the energy of the impinging electrons. These secondary electrons are then directed to the second dynode and knock out more new electrons. Grid No. 3 facilitates a more complete collection by dynode No. 2 of the secondaries from dynode No. 1. The multiplying process is repeated in each successive stage, with an ever-increasing stream of electrons until those emitted from dynode No. 5 are collected by the anode and constitute the current utilised in the output circuit.

The multiplier section amplifies the modulated beam about 500 times. The multiplication so obtained increases the signal-to-noise ratio of the tube and also permits the use of an amplifier with fewer stages. The gain of the multiplier is sufficiently high so that the limiting noise in the use of the tube is the random noise of the electron beam multiplied by the multiplier stages. This noise is larger than the input noise of the video amplifier.

Advantages of Image Orthicon

As this brief summary shows, the Image Orthicon has all the advantages of the Orthicon, together with the added advantages of greater sensitivity due to the image section and of greater stability due to the mesh screen near the target. Its sensitivity is about 100 times that of the Iconoscope and it is stable over a light range of several hundred to one. These features make it extremely versatile and extremely useful for outdoor scenes. Without any change in adjustment the Image Orthicon can handle first say, a brightly lit scene and then immediately be used for a scene in deep shadow. It is also much superior to the Orthicon in reproducing scenes containing great contrasts of illumination.

Disadvantages of the earlier Image Orthicon included a loss of signal-to-noise ratio and resolution compared with earlier tubes. In addition, the half-tone response differed from that of the Orthicon, giving an unfaithful grey scale colour rendition.

Development of the Image Orthicon

The first commercially available Image Orthicon was the type 2P23 introduced in 1946. In spite of the drawbacks mentioned above, its great accommodation of wide ranges of illumination led to wide use in outdoor pick-ups. The photosurface of the 2P23 is highly sensitive to infra-red excitation and different specimens show a wide range of spectral responses, so that it is difficult to obtain two matched 2P23 tubes. Two cameras, using this tube, may transmit pictures of the same scene, one showing, say, grass as a medium grey, while the other shows it as practically white. For studio use this unfaithful colour rendition presented difficulties, so that in 1947 a new tube, type 5655, was brought out to meet this need.

The photosurface of type 5655 tubes has little or no response to infra-red radiation, so that colour rendition is much improved. The signal-to-noise ratio is better than that of type 2P23. The new photosurface, however, has a lower sensitivity particularly to incandescent light. Studio lighting levels of some 300 foot candles are required to produce the same depth of focus as is provided by 100 foot candles with 2P23 cameras.

The better colour rendering of the 5655 tube was such an advantage in the studio that in 1948 type 5769 was introduced. This tube has the same target structure as the 2P23 and the same photosurface as the 5655 and has been used to great advantage in studio work. A major shortcoming of the type 5655 and 5769 is that their maximum spectral response is in the blue end of the spectrum, necessitating a considerable amount of care with lighting and make-up, since flesh tones tend to televise too dark.

Experience with these three Image Orthicons has emphasised the need for a high sensitivity tube with a spectral response matching that of the human eye. The latest development is the Image Orthicon RCA 5820. This tube has the target structure of the 2P23 and 5769 with a new photosurface. Because the spectral response of the 5820 is so nearly the same as that of the eye, the problem of making scenery and arranging make-up is much simplified. In general, if lighting and make-up is satisfactory to the eye, a camera using a type 5820 tube will reproduce the scene with good colour rendering. Another important aspect is that the variation in spectral response between individual tubes is much less than with any of the earlier tubes and in practice, under normal use, the variation in the final picture is not noticeable to the observer. When the 5820 is used for outdoor pick-up, illuminations of several thousands of foot candles may be encountered and neutral filters with a transmission of 5 per cent. may be required.

Conclusion

The present trend towards increasing screen brightness of television pictures has made the observer increasingly conscious of noise and other imperfections in the transmitted picture. At the same time, there is a demand for high quality pictures with still lower studio illumination. The result is that increasing demands are made on the performance of the camera tube from the standpoint of sensitivity and particularly of signal-to-noise ratio.

The fluctuation noise associated with the photo-emission in camera tubes sets the upper limit of signal-to-noise ratio attainable. The aim of the designer is to produce a tube in which the generation of the video-signal incurs neither loss of signal nor addition of unwanted spurious signal and in which the signal-to-noise ratio at all light levels is limited only by the inherent shot noise in the primary photocurrent.

Latest developments are directed towards a method of signal generation using the scattered electrons produced when the low velocity beam described above impinges upon the target. Camera tubes working on this principle can be produced with a very high order of signal-to-noise ratio.

CLUB Reports

BRISTOL AND BATH TELEVISION CLUB
Hon. Sec.: J. Archer, 100, Beauley Road, Southville, Bristol, 3.

NEW members have been joining steadily, and the club now has the use of a workshop.

In the New Year it is planned to have lectures and workshop evenings, alternate meetings. The last club meeting was held on Tuesday, November 28th, 1950; thereafter the club will meet at fortnightly intervals. New members welcome at club headquarters.

Please note, the hon-secretary's name and address is as above, and not as published in our last issue.

THE SOUTHWICK & DISTRICT RADIO & TELEVISION CLUB
Hon. Sec.: F. Basilio, 111, Vale Road, Portslade, Sussex.

THE above club is now being reorganised and meetings are being held at the "King's Head," Fishersgate, Sussex, every Tuesday. Old and new members are very welcome on these evenings.

A slow morse course is now running and it is hoped to have a TX at the headquarters very shortly.

THE BRITISH TELEVISION VIEWERS' SOCIETY
Hon. Sec.: Leslie G. Pace, 140, Fairlands Avenue, Thornton Heath, Surrey.

MR. Ronald Waldman, the acting-head of Television Light Entertainment, addressed a crowded gathering of members and friends at the British Television Viewers' Society's monthly meeting in November, 1950, at Kennard's Restaurant, Croydon.

The speaker mentioned the great difficulty experienced in finding the suitable type of artiste for light programmes and also spoke of the hazards encountered in preparing this kind of entertainment, viz., the special musical arrangements and orchestrations needed, contracts, and possible bans by other organisations. After briefly outlining some of his plans for future programmes Mr. Waldman concluded his engrossing talk by describing at some length American methods of preparing television programmes and their presentation as compared with British methods.

The television actor and producer, Mr. Graeme Muir, addressed members on Monday, December 4th, 1950.

Mr. Muir is now the producer of "Kaleidoscope" in succession to Mr. Ronald Waldman, and he explained how his past acting experience had materially assisted him in his production of this popular feature. He described in detail the preparation of the several items which go to make up the fortnightly presentation of "Kaleidoscope," and also gave members some interesting facts concerning the workings of the producer's control room at Alexandra Palace.

Many questions were put to the speaker: these included the filming of plays, use of the Lime Grove studios, actors' reactions before the cameras and so on, and the meeting closed with a vote of thanks to Mr. Muir for a very interesting talk.

D.C. Receivers–I

The Problems of Operating Television Receivers from D.C. Mains

By W. J. DELANEY (G2FMY)

A LARGE number of queries come to hand weekly asking for details of a television receiver design suitable for operation with D.C. mains supplies, and so far there has been no home-construction information for this particular type of receiver. The main reason is, of course, that there are now only a comparatively small number of viewers who are on such supplies, and the intention is that sooner or later this type of mains supply will be converted to A.C. However, for those who wish to experiment with television equipment the following details are offered.

In certain respects there is no difference between ordinary radio and a television receiver so far as D.C. supplies are concerned. The principal difficulty arises in the satisfactory operation of the time bases with voltages of 200 or just under. So far as supplies of 230 volts or more are concerned there are practically no difficulties. However, to take the circuit through its various phases we will deal with the problem right from the beginning.

Heaters

In a normal television receiver our supplies have to consist of a low-voltage at high amperage for the various heaters; a high-voltage at comparatively low amperage for the various anodes, and an extra-high-tension supply for the picture tube. The latter is available at the moment in two distinct types—triodes and tetrodes. In the case of the former the supplies already mentioned are covered, but with a tetrode an additional voltage between 160 and 400 is required for the first anode, and this can introduce certain difficulties as will be explained later. Dealing first with the heaters, most valves suitable for modern television equipment—either standard or midget—are of the 6.3 volt type.

The normal practice on D.C. supplies, as it is not possible to use a mains transformer to step down the voltage, is to wire the heaters in series, including in the chain a resistor to bring up the total voltage to that of the mains supply. Obviously in this method of connection the current through the complete chain must be constant and therefore valves with a similar current rating must be chosen, or arrangements made to equalise the current as will be explained later.

In a simple radio receiver there will be a maximum of, say, four valves, and it is desirable therefore to push up the heater voltage to as high a value as possible to avoid having to waste excessive voltage.

The modern television receiver will consist of 14 or more valves plus the tube, and this gives quite a reasonable voltage, leaving only a medium value of resistor to include—or at least bringing the total to round about the same as that of an ordinary radio. Similar principles have to be taken in the order and method of wiring the heaters—considering each heater as a small smoothing device and therefore leaving until the end of the chain those valves which might be affected by the unsmoothed A.C. supply (in the case of a "universal" receiver), or a rough D.C. supply.

Protective Resistor

It might be pointed out here that it is desirable to construct a receiver for D.C. supplies on "universal" lines—that is, include a rectifier so that at any future date it may be used with an A.C. supply without alteration. So far, then, we have seen that the heaters should be wired in series instead of in parallel as in the case of an A.C. receiver. The stages most susceptible to hum are, in their order of priority, the picture tube, the demodulators, interference suppressors (if any) and the early stages of the picture receiver. The H.F. by-pass condensers found at the heater circuits of an A.C. receiver are still required and should be joined at the valveholder between the mains side of the heater and chassis. These condensers are, of course, only used in the vision and sound receivers. Some commercial receivers employ, in addition to the condensers mentioned, a small choke—generally included between the "last" valve and the picture tube heater, and this may consist of 100 turns or so on a short length of 1in. diameter paxolin tubing—but if used it must be of wire suitable for a current of 300 mA. (.3 amps.) and must be so placed that it is adequately cooled and not near any electrolytic condensers. Personally, we have not found it necessary, and no hum from poor heater smoothing has been found with a simple series heater chain.

The series resistor used to bring up the voltage is the critical component in the D.C. receiver. If the heaters are just connected in series and joined across the mains, with a normal resistor to bring up the total, when switched on the maximum voltage will exist and it should be remembered that the resistance of the heater is much lower when cold and thus there would be a really serious risk of burning out at least one of the valves. Therefore, in addition to the standard type of resistor a specially-produced component should also be employed for safety. This is a type of resistance of which the value varies with temperature. When cold it has a high resistance, and this falls to a very low value when it is fully warmed up. In the majority of cases its value may be ignored

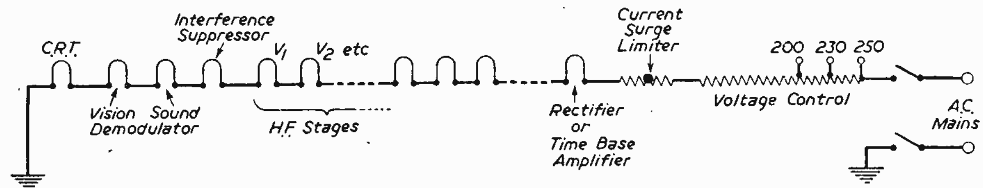


Fig. 1.—The arrangement of the heater circuits in a D.C. operated television receiver.

in the complete heater chain as it is so low, but it does prevent the initial surge which is most likely to occur when the receiver is first switched on, and which is due to the fact that the current will be of a high value due to the cold heaters. Some idea of its effect may be gained from the following data of a standard commercial component. Rated for a .3 amp. chain, the cold resistance is 3,000 ohms, and when passing .3 amp. it measures only 44 ohms.

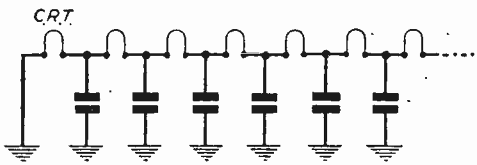


Fig. 2.—Decoupling condensers should be included in all H.F. circuits as shown here.

Where valves with different *current* rating are employed they must be joined in parallel or resistors connected across them as it must be remembered that through the chain a constant current must flow, and thus it does not matter whether one uses all 6.3 volt .3 amp. valves or one 12 volt .3 amp. with the rest of the 6 volt type, provided that the current is constant. If, for instance, a valve with a 6 volt .15 amp. heater were to be included, it would be necessary to add a resistor in parallel with that heater, the resistor having the same value as the heater (6 volts at .15 amp.=40 ohms). It might be possible to group certain valves to maintain the constant current rating, but all such problems are solved in the simplest way by using all valves and tube with a similar current rating. The series resistor to make up the total voltage may be tapped or made up from two or more low values in series so that if the receiver is taken to alternative supplies it may be adjusted.

Next comes the problem of the E.H.T., and this will be dealt with in the next issue.

(To be continued)

Studio G, Lime Grove

THE second studio at Lime Grove to be converted by the B.B.C. for television productions—Studio G—was used for a broadcast for the first time on 23rd December—the opening programme being "Gala Variety."

With a floor area of over five and a half thousand square feet, Studio G is the second largest of the Lime Grove Studios, and will be used mainly for light entertainment programmes. It has been equipped with four Pye Photicon cameras, one of the types that are used on outside broadcasts. Adjoining the studio, and separated from it by a glass panel, an apparatus room has been built in which the electronic equipment for the cameras is installed. Altogether the apparatus room contains equipment for six cameras—four in the studio, one for televising films, and one spare. Above the apparatus room is the control room, with a window overlooking the studio. This contains the monitor screens which display the picture being transmitted and a preview of the pictures from two of the other cameras in the studio. It also contains the vision mixing equipment, with which the change-overs are made from one camera to another during a production. A novel feature of the control room is that the sound mixing equipment for controlling the outputs of the various microphones in the studio is isolated from the rest of the area by a glass partition, which can be raised and lowered by remote control. When it is raised the sound engineer can listen at whatever volume he prefers without disturbing the rest of the production team.

Cables

British Insulated Callender's Cables, Ltd. supplied 750 yards of television camera cable. This cable is used for the permanent wiring from the apparatus and control rooms to eight socket outlets conveniently disposed around the studio. It is also being used for the plug-in trailing cables from these sockets to the Pye television cameras. The wall-mounted sockets have been specially designed by B.I.C.C. for this installation and, like the camera cable couplers, are integrally moulded in polythene to the cable end to form a sealed termination with all the circuits correctly disposed and screened.

Flexibility

A camera can be connected instantly via a short length of trailing camera cable to any of the wall-mounted sockets. Flexibility in the use of cameras throughout the studio is therefore greatly facilitated, maximum manœuvrability being obtained without having cumbersome long lengths of trailing cable. This facility is particularly advantageous in a studio the size of Studio G.

Air-Conditioning

The studio is air-conditioned ; the ventilation system is of a new type, the use of which at Lime Grove will give valuable experience for later installations at the White City studios. Tests have shown that the refrigeration unit—supplied by Carrier Engineering Co., Ltd., and the first of its kind to be installed in this country—will hold the studio temperature at a comfortable level, even in summer, with the full 300 kilowatts of lighting on.

Midget Television-radio Receiver

Details of the Interesting Miniature Combined Broadcast and Television Receiver Built by 17-year-old L. G. WHITE

CONSIDERABLE interest was recently aroused by the report in the press that an amateur-built midget television receiver had been exhibited at a local radio club exhibition. Photographs showed it to be small enough to be carried on one hand, and we thought that details of this novel receiver would interest our readers, and we accordingly asked the designer to let us have such information as would enable anyone interested to duplicate the work.

In the original model the vision receiver is built on a sub-chassis 1⅜ in. by 6¾in. Four R.F. stages are used, with Mullard EF91 midget B7G valves (ex-Government CV138 or 6AK5 would also be suitable), followed by a double diode, EB91, which serves as demodulator and also D.C. restorer. For the video stage another EF91 is used.

Circuit

Transformer couplings are used in the R.F. stages to help maintain stability and save components. The only midget parts used are the ⅛-watt resistors. The coils are standard, removed from a scrap Pye 45 Mc/s strip, as also were the 1,000pF condensers.

The output from the vision receiver is fed into a cathode follower (which is mounted on the main chassis), to the grid of the C.R.T., and to the sync separator. The sync separator operates as a straightforward anode bend stage, using an EF92, and by careful design of the output system it can be made to work very well. The sync pulses are fed through the differentiating and integrating circuits, which are part of the anode load of the sync separator, and the grid leaks of the time-base oscillators.

Time-bases

The time-bases are cathode-coupled multi-vibrators, using ECC91 (6J6) double triodes. This arrangement employs two valves instead of one, but the two are the same size as a single valve, so that one saves room by this, and the fact that there are no transformers or other big components to use.

From the time-bases the sawtooth is fed to a 6SN7GT double triode. The first half is an amplifier with negative feedback in the cathode circuit to give the correct gain. The second is an amplifier with 100 per cent. negative feedback, thus giving the paraphase voltage required.

Sound

The TV sound receiver is built on a sub-chassis, size 3in. by 1⅜ in., and consists of 2 R.F. stages similar to the vision receiver, followed by a diode demodulator and an audio stage (6AT6). The output stage is mounted beside the loudspeaker, which is a 2in. type.

The broadcast receiver is a reacting detector with pre-set tuning. This is fed, when required, to the grid of the 6AT6 via the radio-TV switch.

LIST OF COMPONENTS

C1, 2, 5, 6, 8, 9, 13, 14, 15, 18, 20, 26—·001µF 350v. moulded mica.
C29—.0005µF 350v. moulded mica.
C11, 12, 37—.0001µF 350v. moulded mica.
C30, 31, 34, 39, 27, 38, 41, 45—.1µF Metalmite, T.C.C.
C33, 35—·05µF Metalmite, T.C.C.
C23, 10, 17, 19, 42, 46—.01µF Metalmite, T.C.C.
C16, 22—10µF 15v. metal pack, T.C.C.
C7, 40—.005µF 350v. Ceramic.
C3, 28, 49—10pF 350v. Ceramic.
C4, 32—50pF 350v. Ceramic.
C36—200pF 350v. Ceramic.
C25 {20+20µF 250v. Plessey. / 16µF 450v. Plessey.}
C24—.08µF 2.5kv.
C21—8µF 500v.
C43, 47—.01µF 1,000v. T.C.C.
C17—.1µF 1,000v. T.C.C.
R1—47Ω ⅛ watt.
R3, 2, 23, 25, 35, 42, 50, 56, 64—1kΩ ⅛ watt.
R4, 12—2MΩ ⅛ watt.
R5, 13, 49, 66, 68—10kΩ ⅛ watt.
R6, 34—3.3kΩ ⅛ watt.
R7, 24, 25, 36, 39, 43, 52, 60—1MΩ ⅛ watt.
R8, 9, 15, 16, 21, 27, 28, 33—220Ω ⅛ watt.
R14, 19, 26—5.6kΩ ⅛ watt.
R17—50kΩ ⅛ watt.
R20—150kΩ ⅛ watt.
R40, 51—470kΩ ⅛ watt.
R41, 45, 48—100kΩ ⅛ watt.
R44—2.2MΩ ⅛ watt.
R46, 47—470kΩ ⅛ watt.
R53, 54, 61, 62—56kΩ ⅛ watt.
R58—1.5kΩ ⅛ watt.
R59—2kΩ ⅛ watt.
R31, 67—100kΩ ¼ watt.
R32—4·7kΩ ¼ watt.
R37, 38—10kΩ ¼ watt.
R10—6.8kΩ ½ watt.
R11, 18, 22—1kΩ ½ watt.
R29—150kΩ ½ watt.
R30—1MΩ ½ watt.
R55, 57, 63, 65—22kΩ ½ watt.
(All the above are 20 per cent. tolerance.)
TC1, 2, 3—3-30pF Philips Trimmer.
VR1, 2, 3—100kΩ.
VR4, 5—1MΩ.
SW1—2-pole, 2-way.
SW2—3-pole, 3-way.
CK1—100 turns 36 s.w.g. on ⅛ watt 1MΩ resistor.
CK2—5H 100 mA.
T1—Auto, tapped: 0, 230, 300, 900v.; 4v. and 6.3 amps.
T2—L.S., midget type.
M1, 2—Type H100 Westinghouse rectifier.
M3—230v. 60mA. (ex-Service).

Power Supply

The power supply is a little unusual inasmuch as an auto transformer is used. This was employed in order to keep the size of the transformer as small as possible without it getting too hot. Tappings are made at 220, 310 and 900 volts. The 310-volt output goes to an ex-Government 230v.60mA. metal rectifier into an 8μF condenser. Smoothing is effected by a 5H 100 mA. choke, and 40μF+4μF and a 16μF condenser. This common supply is used for the whole receiver. The 900 volt winding supplies two H100 rectifiers in series. A .08μF condenser, 100 KΩ resistor and a .1μF condenser are used for smoothing this supply.

Separate Heater Supply

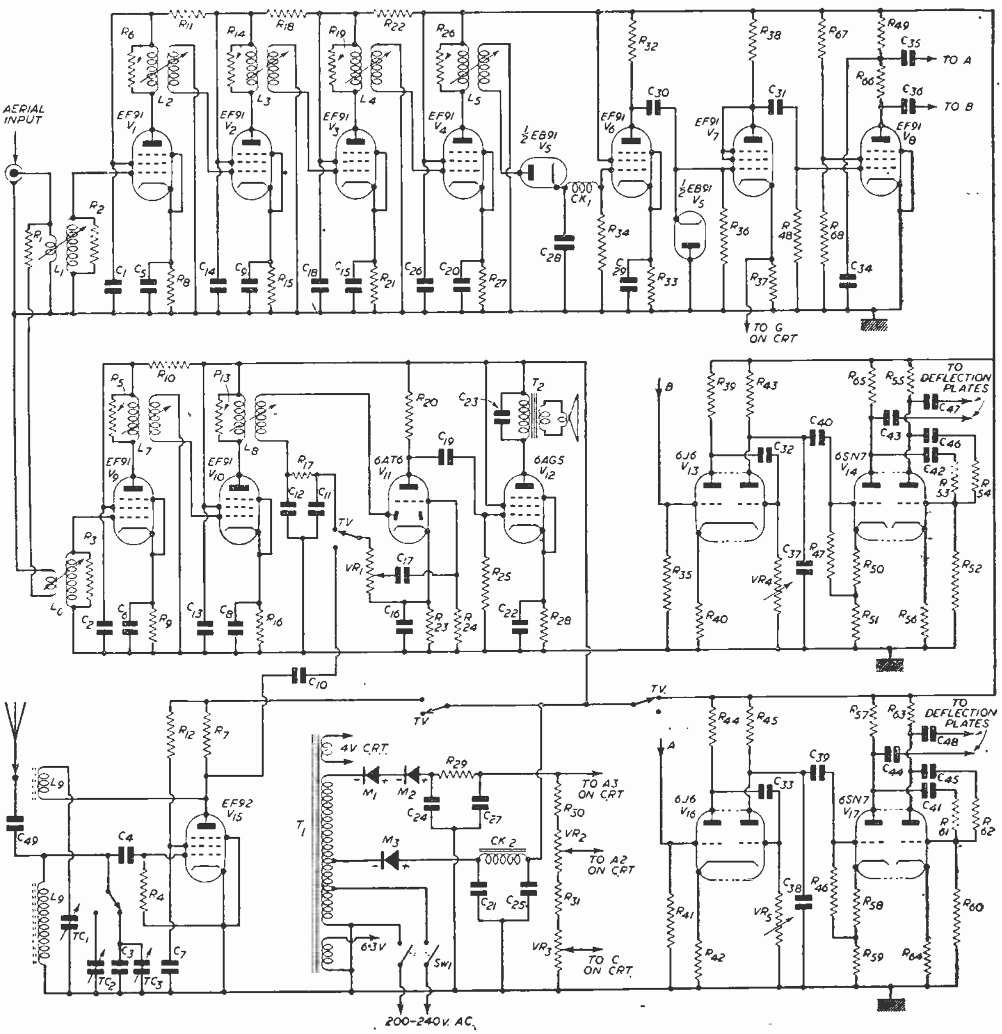
The valve heaters are fed from a common 6.3-volt 6-amp. winding on the transformer, and the tube heater from a 4-volt high insulation winding.

The tube is a VCR139A, which, if carefully selected (there are some which are not very good for TV), will be found to give a very good picture approximately 1¼in. wide.

Bandwidth

On the original receiver one can see the 1.5 Mc/s bars on the B.B.C. test card. This may not seem very good at first, but when one considers the size compared with a standard receiver one can see it is all that is required.

Comfortable viewing is possible in normal room lighting provided that direct light does not fall on the tube.



Circuit of the Completed Midget Television-radio Receiver built by the Author and illustrated on page 399. A full list of the components used in the original model will be found on page 395.

More About Voltage Doublers

By T. W. DRESSER

SINCE the publication in the second issue of PRACTICAL TELEVISION of the writer's article entitled "E.H.T. for the VCR97," he has been asked on a number of occasions exactly how the circuit functions, and has gone to some trouble to give a precise explanation. In view of the need for such an explanation it would seem that some readers, while familiar with practical voltage-doubling circuits, are not at all conversant with the theory underlying the operation of doublers and multipliers generally, nor with their limitations. That there is a limit to their usefulness is beyond question, and as this limitation arises essentially from the nature of the circuit, playing with doublers without a thorough knowledge of their basic theory almost comes under the heading, "Where angels fear to tread"!

All voltage doublers and their high-class brethren—treblers and quadruplers, too, for that matter—derive primarily from the standard half-wave rectification arrangement shown in Fig. 1. This series circuit is almost universal in D.C./A.C. receivers, and few readers will not have encountered it at some time or other. There is, however, a variant of this circuit which is not so well known and which is given in Fig. 2. For the very obvious reason that the output is taken off in parallel with the valve and not in series as in Fig. 1, this is known as a shunt or parallel circuit.

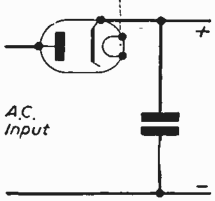


Fig. 1.—A standard half-wave rectifier circuit.

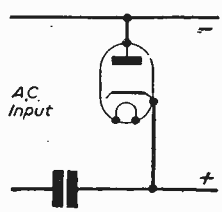


Fig. 2.—A variant used on some A.C./D.C. receivers.

The mode of operation is substantially the same in both arrangements. In the series circuit, under no load conditions, the valve conducts on positive half-cycles and the condenser charges to the peak value of the input voltage—that is, 1.414 times the R.M.S. value. With a load applied to the circuit, the condenser partially discharges while the valve is not conducting, and due to this fact and the ripple in the output the voltage fluctuates to some extent. With the parallel circuit, the cycle of events is pretty much the same as far as the condenser is concerned, but in this case the output voltage is that of the condenser in series with that of the A.C. supply, and under no load conditions the output voltage varies between zero and twice the peak voltage, e.g., peak condenser voltage plus peak A.C. voltage. The ripple voltage in the output is therefore equal to the mean steady voltage which is the peak value of the input, and for this reason the circuit is never used in half-wave rectification systems. The high output voltage obtainable from this circuit can, however, be put to good use in doubling arrangements and, in fact, is so used in the unit designed for the article "E.H.T. for the VCR97." The circuit is given again in Fig. 3, and it will be seen to consist of a series circuit and a parallel circuit. The operation is as follows: On the negative half-cycles V1 conducts and the condenser C charges up to the polarity indicated while V2 remains non-conducting. On the positive half-cycles, V2 conducts and V1 becomes non-conductive, but the input voltage to V2 is not that of the A.C. supply alone. It is, in fact, this voltage plus the voltage across C, and the sum of the two voltages applied through V2 charges up C1 to twice the peak value of the input. This is the output voltage. In the case of the unit mentioned, a transformer was wound to give an R.M.S. value of 975 volts into the doubler circuit. Now, 975 x 1.414 = 1378.65 and twice 1378 = 2756, which is the output voltage in theory when the circuit is not loaded. On load, at the small current drawn by a VCR97, the measured voltage across C1 is 2,300 with this input, and the no-load figure can be taken as reasonably accurate, therefore.

Quadruplers

Voltage quadruplers are merely two doublers of the kind shown in Fig. 3, but for clarity a quadrupler circuit is shown in Fig. 4. The only way in which it differs from those of Fig. 3 is in the voltage rating of the condensers C3 and C4, which will have to be at least twice that of the condensers employed in Fig. 3. It should be

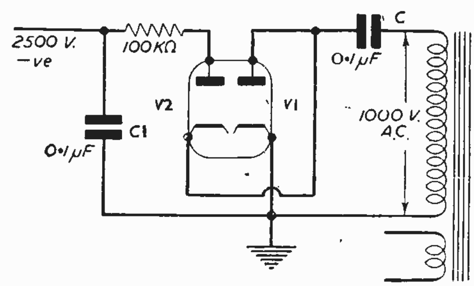


Fig. 3.—A simple doubler circuit.

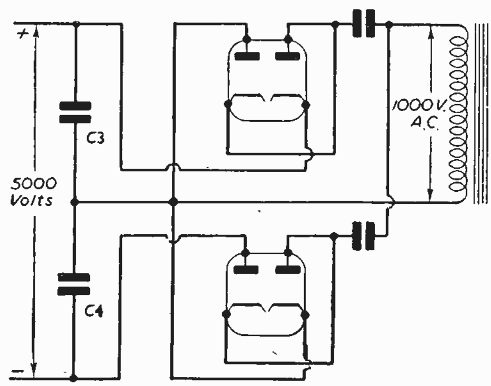


Fig. 4.—A quadrupler circuit—two doublers of the type shown in Fig. 3.

pointed out that the heater windings on the transformer should be insulated to withstand the high circuit voltages, and in fact it might be good policy to dispense with valves and heater windings and use metal rectifiers.

It has been stated that the purposes for which doublers can be used are limited. This is essentially due to the fact that the regulation of such circuits is poor unless very large condensers are used, and the use of such condensers brings in its train another cause of trouble in that they have a decidedly adverse effect upon the rectifiers due to the high peak currents which will flow. Generally speaking, it can be said that doubling circuits are very useful where high voltages at low current are required, as in television receivers, but that is the extent of their usefulness. For TV work, there is no doubt, they are highly suitable as well as being more reliable and less susceptible to breakdown than 50-cycle high-voltage transformers, and it is hoped to prepare details of a 5,000-volt unit for magnetic tubes when experiments now in progress are concluded.

Incidentally, this circuit will provide 2,000 volts—ample to operate a VCR97—from a standard 350-volt winding at a cost of two 6H6 valves and a filament transformer, if used as in Fig. 5. It has to be remembered that the filaments of the second 6H6 are at high potential, and a filament transformer insulated to withstand 2,000 volts is necessary. Such a transformer can be made at home, however, without much difficulty. A standard output has a primary wound to 250 volts, and this can become the primary of the proposed filament transformer. Connect the primary to the mains and check the voltage on the secondary with an A.C. or moving-iron meter, whichever is available. Having ascertained this figure, disconnect the transformer from the mains and remove the secondary, counting the turns as you do so. Divide the turns by the output voltage and you have the turns per volt. Now wind over the primary six layers of oiled cotton or silk (Empire cloth) and then put on a new secondary of turns per volt by 6.5; 36 S.W.G. enamelled wire will be quite suitable, as the current is only 0.3 amperes. Finally, finish off with a layer of Empire tape and your filament transformer is complete, giving an off-load voltage of 6.5 and on-load 6.3, and adequately insulated.

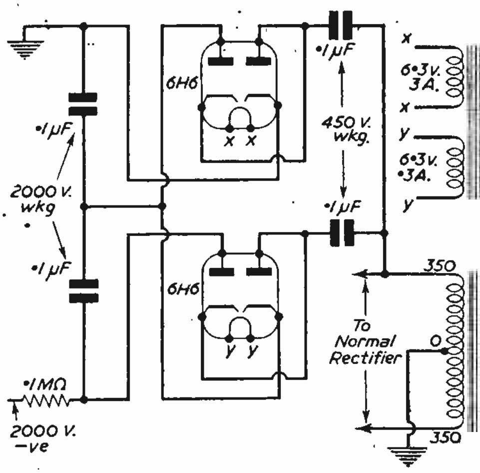


Fig. 5.—A high voltage quadrupler circuit.

In conclusion and in order to pacify the pedants, the writer would point out that although the expresssion "half-cycle" has been used in this article, it has been used solely in the interest of simplicity. The actual conducting period of the valves is, of course, a proportion of the half-cycle, dependent upon the load current and the condenser capacity.

Sports Magazine

A NEW series of Television Sports Magazine, now taking seasonal leave of the screen, will start on January 24th. Among some of the ideas that the editor and producer, Berkeley Smith, has for the new series is a contest between the world darts champion, Jim Pike, and one of the leading women archers in this country. He is also on the look-out for a suitable gymnasium or drill hall which would allow mountaineering experts to demonstrate, as far as is possible indoors, some of their techniques.

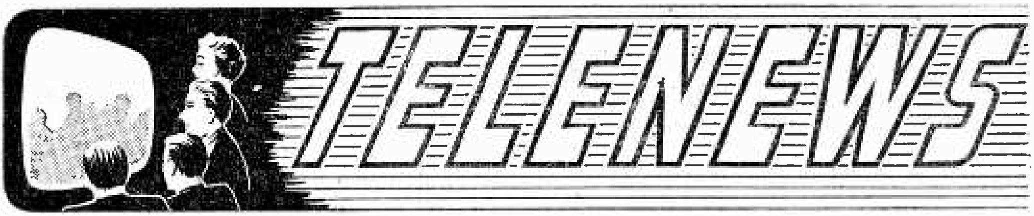
The records show that in the first ten programmes 25 different sports have been featured, from the more universally popular Association football (presented three times), to the smaller, more specialised sports such as kayak canoeing and padder-tennis.

With such varied sports, one of the main problems has been the special equipment that has had to be brought into the often-restricted areas of gymnasiums, swimming baths and drill halls. In the first programme in the series, from the Y.M.C.A., Tottenham Court Road, when Channel-swimming was featured, the difficulty was to get a boat large enough to hold an oarsman and the trainer through the narrow corridors leading to the swimming bath, so that the subject of feeding from the boat could be illustrated. Finally, a boat of the right dimensions was found and, after considerable manœuvring, was edged into the bath with inches to spare.

At Grove Park Drill Hall, for instance, 30 bales of tan had to be laid down before it was safe to bring in the highly valuable show jumpers, Tankard and Craven A. In view of the large amount of lighting in the hall, it was felt advisable to put some modified lighting in the gun park, used as a stable for the horses, so that they should become acclimatised gradually to the strong lighting in the hall.

At Dulwich College, the horizontal bar used by the German and British Olympic gymnasts was almost "taking off" owing to the extraordinarily vigorous and complicated movements being performed by these experts. After much experiment, it was found that the only safe way of securing the bars to the ground was to have six boys from the College sitting around on the struts.

Among star names which have already been introduced in the series, viewers may remember particularly the "Sportsman of the Year"—Reg Harris, Denis Compton, the famous Tottenham Hotspur wing combination, Medley and Baily, and the skating champions, Hans Gerschwiler and Jeannette Altwegg.



Broadcast Receiving Licences

12,334,150 broadcast receiving licences, including 549,200 television licences, were current in Great Britain and Northern Ireland at the end of November, 1950.

Some viewers seem to be under a misapprehension that when they install television they need an additional £1 licence. This is not so. The £1 licence is for sound only; the £2 licence is for sound and television. Viewers should take out a £2 licence as soon as their sets are installed; a rebate of 1s. 8d. per month may be claimed on the unexpired portions of their £1 licences.

German Television

NORTH-WEST German radio recently inaugurated the first television service in post-war Germany. Films were used for the transmission.

Re-diffusion

THE first licence for re-diffused television programmes has recently been issued by the P.M.G. to Link, Sound and Vision Services, Ltd., of Gloucester. The first house should be connected up by May 1st. The Sutton Coldfield transmissions are to be used, and the charge will be 7s. 6d. a week.

A Television Experiment

EXPERIMENTS are being carried out by Glyn Mills and Co., and Pye, Ltd., in connection with the confidential transmission by television of banking records.

Still in its early stages, the experiment necessitates the erection of an aerial mast on the roof of Holts Branch of Glyn Mills Bank in Whitehall.

After completion of the mast, some weeks will elapse before the transmission stage is reached, since considerable research and experiment has yet to be carried out.

Lord Nuffield on TV Suppression

"I HOPE that such a fitment will eventually become standardised throughout the motor industry," writes Lord Nuffield to the Radio Industry Council, on the subject of suppressors to prevent interference with television.

The Council, which for the last three years has been responsible for a campaign for the voluntary suppression of interference, had written thanking Lord Nuffield for his group's recent decision to fit suppressors to all new cars and commercial vehicles.

Colour

THERE will probably be no colour television in Britain for 10 years, and it will certainly not come in less than five years, Nottingham branch of the Association of Supervising Electrical Engineers was told recently by Mr. H. A. Fairhurst, who is in charge of television research for a well-known radio firm.

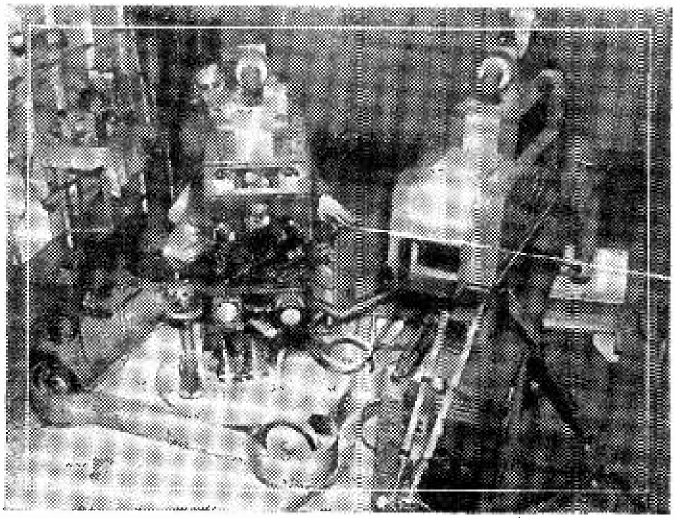
Prize-winning Visit

WINNER of the competition sponsored by Ekco for an essay on maintaining radio sales when television reaches Scotland, Mr. Alexander Petrie came south for a two-day visit to Southend and London, which was the prize in the competition. A full two days included a tour of the firm's factories, a visit to the Alexandra Palace television studio, and an evening "seeing the sights" in London before returning.

Mr. L. White with his miniature television and radio receiver, a description of which appears on page 395 of this issue.

Welsh Site

OBJECTIONS to the originally proposed site for the Welsh TV station have resulted in negotiations being opened for a new site at St. Lythan's Downs, near Wenvoe, Glam, according to the P.M.G.'s statement in the House.



R.C.A. colour television cameras in the studio of WNBW, Washington, D.C. The cover of the left camera has been removed to show the dichroic mirrors and reflectors which split the light beam from the televised scene into the three primary colours, green, blue and red.

Steel Tubes

THE practice of using metal for the main portion of picture tubes is growing in America. The latest reported development is the production of a new stainless steel having a heat expansion rate almost the same as that of glass. As a result, the metal tube can be made to take full advantage of the properties of stainless steel, and the risk of the glass cracking as the tube heats up is avoided.

Scrambled TV

A SECRET television system, designed to enable only subscribers to participate, was recently tried out in U.S.A. The signal is scrambled and there is a special decoder in the form of a plastic card, identical to within 1/10,000th of an inch to that used at the transmitter. Unless this card is fitted to the receiver, the picture is unintelligible. The test broadcasts are being made by station WOR-TV.

Memory Tube

ANOTHER new idea reported from America is a picture tube designed so that the picture is fed to it at the rate of two frames every 1/60th of a second (standard American A.C. mains frequency), and these impulses are "stored" until the picture is complete and it then projects the completed picture once each 1/60th second. It is claimed that this arrangement eliminates flicker, as there are no scanning lines and brilliancy is 5,000 times as great as present tubes.

Micro wave Links

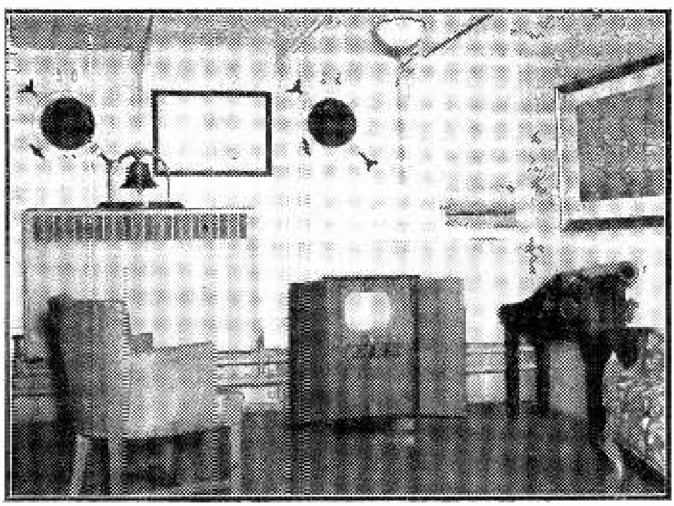
THE B.B.C. have ordered from the Marconi Co. six sets of microwave television links designed to operate within the band 6,500 to 7,500 Mc/s utilising wide-band frequency modulation. A special feature of the equipment is the intercommunication facilities which are provided by means of which a standard headset may be plugged in for telephonic communication by line or separate radio with other units, the studio, or the transmitter.

Last View of 1950

THE passing of the Old Year was seen on the television screens in the form of a close-up of Big Ben showing the hour of midnight, and as the chimes were faded out the cameras transported viewers to the belfry of St. Margaret's, Westminster, where the bellringers were seen ringing in the New Year. Three Marconi cameras were used in this transmission.

Television in Japan

THERE is no regular television service in Japan at present but negotiations are well under way for its introduction. The subject is not neglected, however, as there is now a weekly transmission for testing purposes. Some time ago the Japanese Broadcasting Corporation showed television to the general public, street scenes being transmitted to receivers set up in the Mitsukoshi Departmental Store in Tokyo.



An Ekcovision 12in. receiver installed on board H.Q.S. "Wellington," moored in the Thames.

Long-range R.F. Unit

Using a Modified Type 24 R.F. Unit and R1355 I.F. Strip

By E. N. BRADLEY

EXPERIMENTS extending over a period of two or three years were brought to a successful conclusion when the Sutton Coldfield sound and vision transmissions were received at the writer's location a mile or so from Land's End—the most westerly reception point so far. Repeated and unsuccessful tests on the Alexandra Palace signals had indicated that a highly sensitive superhet would be essential, and an R1355 I.F. unit was accordingly chosen as the basis of the receiver, the major part of the new design work being concentrated in the R.F. unit which was to function both as a high-gain R.F. amplifier and frequency changer-local oscillator. It is only incidental that the completed receiver has proved that results at this extreme point of the West Country are worthless for entertainment purposes—when conditions are satisfactory the final output from the R1355 cathode follower is equivalent to a local signal.

The receiver has been tested on two very different types of aerial—an inverted V with long legs and a central height of 60ft., and a T-match dipole with reflector at a height of 20ft. Local conditions, chiefly the ever-present possibility of strong gales, prevent the erection of a high dipole, but nevertheless, results on the two aerials were practically equivalent, apparently showing that there is little to be gained by increasing the height of the dipole. Added directors and reflectors too, it would seem, would be of little benefit, for the signal is always subject to extremely strong fading, and even the carrier is lost in the troughs.

Nevertheless the receiver is being retained and good results are expected from the future Cardiff transmitter.

The high-gain R.F. unit is shown in Fig. 1 and consists of 4 R.F. stages before the mixer. The main point of interest is that the complete circuit is built up in the case of a Type 24 R.F. unit, Mod. 27—an unmodified Type 24 unit could also be employed—so that all supplies are taken from the power supply built into the R1355, a separate pre-amplifier power supply thus being obviated. A further point of some interest is that practically all the valve circuitry and components are retained in the R.F. unit with the minimum of conversion, whilst the Type 24 unit is one of the cheapest to buy.

To prepare the unit for conversion, strip away completely the existing switchgear, coils and trimmers found in the screening compartments on the left side of the chassis, looking from the front. Remove the tube carrying the coaxial lead in the oscillator circuit tuning compartment, and place this aside for re-use in the mixer circuit. Take the ceramic feedthrough bushing from the oscillator compartment and, after the necessary drilling is completed, remount it in the mixer compartment (the middle compartment) so that it feeds through the central dividing wall.

Below the chassis only three connections need removing—clear away the lead from the R.F. valve (the front SP61) which passes through into the mixer tuning compartment, and remove the screen bypass capacitor from the oscillator valveholder, the small moulded capacitor supported between tags Nos. 4 and 6. Finally, clear away the lead which connected the oscillator cathode to the oscillator tuned circuit, and connect the "cold end" of the oscillator bias network direct to the nearest earthed point.

On the top deck of the chassis there are now three cleared screened compartments which provide ideal mounting positions for a further three R.F. stages, the original R.F. stage of the unit thus becoming R.F. stage No. 4. The valves employed for the new R.F. stages are 6AC7's, excellent in every way for television work. These valves have a slope of 9 mA/V, require 0.45 amp. heater current against the 0.6 amp. of the SP61, and have a particularly sensible basing arrangement which permits of the shortest possible grid and coupling leads. Besides all this the valves are of the small metal type, thus being well screened and taking up little head-room, so that the new stages may be mounted on small sub-chassis above the main chassis. This removes any need to disturb the existing under-

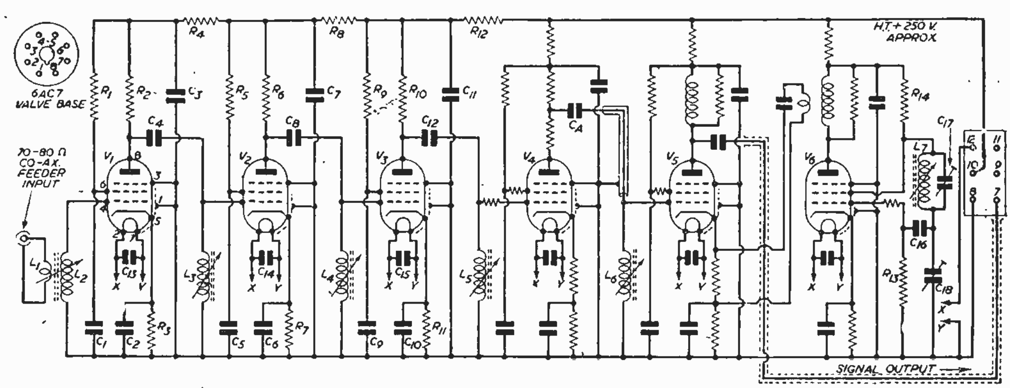


Fig. 1.—The circuit. Component values refer only to the new circuits. L1 should be earthed.

chassis circuits, the need for drilling new valve holes through steel, for aluminium sub-chassis can be used, and adds further to the screening.

Sub-chassis

The three sub-chassis are shown in Fig. 2—it will be seen that they take the form of right-angled shelves, the valve and coil being mounted on the shelf itself with the back drilled with holes to coincide with holes already found in the central wall of the chassis compartments. The dividing walls between compartments 1 and 2, and 2 and 3, should be temporarily removed (they form a single U-shaped section) and drilled with feedthrough holes as shown in Fig. 3. These holes permit the heater and H.T. leads, and the coupling leads, to be passed from stage to stage by the shortest routes. The holes may be bushed with small rubber grommets.

Note that the sub-chassis or shelves for stages 1 and 2 are each filed away at one part of the angle, and note, further, that the new stage 1 is at the rear of the chassis. The coil is therefore connected with the aerial input socket by a length of 70 or 80 ohms coaxial feeder which runs through the slots left in the compartment by the removal of the switchgear. This feeder is pushed back against the central wall, so that in a side view it is behind the valves.

The filed-out section of sub-chassis 1 thus permits the passage of the aerial lead down to the coil, whilst the cut-out in sub-chassis 2 accommodates the metal tube coaxial lead removed from the oscillator section. This tube can be bolted in place by the lugs attached as the shelf is secured (a little "juggling" is required to slide both the sub-chassis and tube into position) and the base of the tube should rest on the rubber grommet in the chassis top deck giving access to the coupling capacitor of the original R.F. stage, now the fourth R.F. stage. If the tube was cut away with its end wires in place, sufficient wire will protrude down through the chassis to make a connection via the soldering tag to the coupler Ca, and the top of the coaxial lead is taken to the ceramic feedthrough bushing which gives on to the mixer grid (the central SP61).

Wiring

Each stage is wired individually on its sub-chassis before this is mounted on to the chassis, so that it is easily possible to attain very short wiring and the desirable placing of components. As with any television circuit all earthed leads within each stage must be taken to a single earthing point, provided in each case by mounting a soldering tag under the valveholder bolt nearest the Nos. 1 and 8 tags. The screen, heater, cathode and anode-screen decoupling capacitors must be mounted directly across the valveholder tags ; an unnecessary inch of wire in these circuits might cause feedback which would be difficult to trace and rectify. The anode and screen resistors should meet and join with their common decoupler immediately below the valveholder, all spare wire ends being cut away. All three stages can be wired up before assembly, for there remains only the coupling capacitors and the H.T. and L.T. leads to be connected up.

The coils, mounted close to the Nos. 4 and 5 tags of the valveholder, are wound on formers of the type shown in Fig. 4 ; these are widely obtainable, and probably the constructor already has spare formers of this type taken from ex-Service gear. The formers should have brass slugs fitted. The wire gauge employed is by no means critical ; 28 S.W.G. enamelled wire was employed in the original, but a few sizes above or below this figure will serve equally well as in any case some slight trimming will probably be necessary. The trimming will consist of no more than closing up or opening out the turns of the coils by a slight amount—in the first instance the coils should be wound with turns spaced by their own diameter. When the unit is tuning satisfactorily the coil turns may be set by running melted paraffin wax over the formers.

When the three sub-assemblies are completed they may be mounted in place and the coupling capacitors, C4, C8 and C12, connected up. The body of the capacitor should be in the compartment of the following stage, with one lead passing through the drilled hole in the inter-compartment wall to the anode of the previous valve, and the other lead taken directly to the grid tag on the neighbouring valveholder. The live heater lead and the H.T. wiring both pass through the second drilled hole ; in the case of the H.T. wiring the free wire ends of the decouplers R4, R8 and R12 will probably be found sufficiently long.

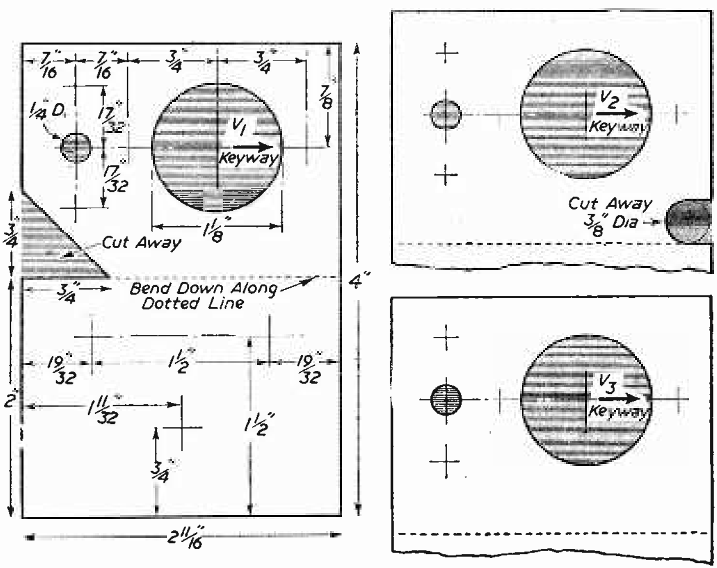


Fig. 2.—The sub-chassis, underside view. All dimensions are identical except for cut-away portions.

Power Supply

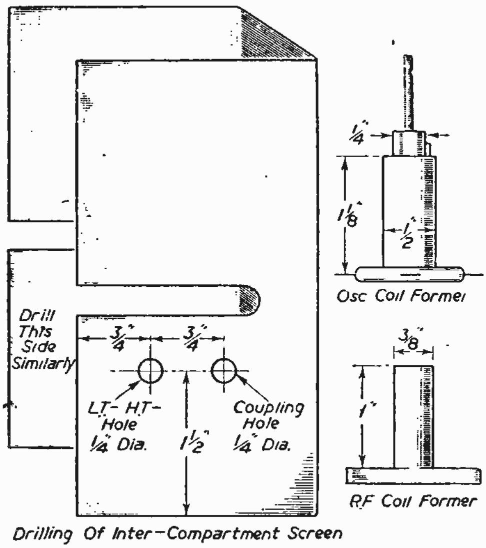
H.T. and heater power is supplied to the new R.F. stages by leads passing up through the holes in the chassis top deck left by pressed-out soldering tags. The heater lead is taken straight from plug No. 12 on the Jones plug at the rear of the chassis up to the heater of V1, the 6AC7 in the rear compartment, but the H.T. lead is taken from the

(*Continued on page 405*).

(Continued from page 402)

tag board in the front under-chassis compartment and therefore to V3. The decoupling resistors of the three new stages are thus effectively in cascade.

So far no mention has been made of the coupling between V3 and V4 via C12. In this case the body of



Figs. 3, 4 & 5.—Details of the inter-compartment screen and the coil-formers.

the coupling capacitor is in the V3 compartment, as far as possible from the C8 coupling capacitor, and the lead is taken through the central screen by the middle hole drilled through both the rear of the sub-chassis and the screen—i.e. the hole to which trimmer No. 3 was secured in the original unit. The lead is then taken up to the coil L5, which, like L6, is bolted to the central screen above the valve grid. Thus both the fourth R.F. stage, V4, and the mixer, V5, have their respective coils very close to their top caps. In each case the coil former can be bolted through one of the original trimmer holes.

The coupling between V4 and V5 has already been explained, since this connection is made through the metal tube coaxial connector. It merely remains to connect the grid clip of V5 to the ceramic feedthrough bushing and to L6.

The earth connections of L5 and L6 are made to soldering tags bolted down under the coil feet securing nuts. It will be obvious that these two coils lie in the horizontal plane above their valves and that they must therefore be tuned—i.e. the cores must be adjusted—from the right-hand side looking at the face of the complete receiver. A long insulated screwdriver enables any necessary adjustment to be made: the cover may be left off the unit for this purpose or two holes may be drilled in the cover to permit trimming.

The oscillator coil also lies horizontally above the oscillator valve, but in this case a different coil former is employed by the writer. Other types of former could also be used. The former chosen is an Aladdin iron-cored type as shown in Fig. 5, mounted by having its neck inserted through one of the trimmer holes in the central screen of the oscillator compartment. The hole may be reamered slightly to make the former neck a tight push fit. The grid of the valve is connected to the coil via the grid capacitor, and the grid leak is earthed by being sweated on to the screening compartment wall—a hot iron makes the joint without difficulty. A lead from tag No. 4 on the oscillator valveholder is brought up through an adjacent hole left by a pressed-out soldering tag and connects the screen of V6 to the coil. R14, the screen supply resistor, is connected directly between the same tag on the valveholder and the appropriate point of the group board below the chassis.

The two trimmer capacitors employed to tune the oscillator are both of the Philips concentric type with a maximum capacitance of 30 pF., and so may be salvaged from the trimmers removed from the original circuit. The parallel trimmer is supported by being mounted across the coil lugs, whilst the "series" trimmer, C18, is sweated between the appropriate coil lug and earth—once again, earth in this case is the nearest screening wall. The oscillator thus has three possible adjustments—the coil core, the parallel tuner C17, and the series trimmer C18. The main tuning should be carried out by using the core and C17, but C18 is useful as a fine trimmer and also as a means of controlling the final oscillator power injected into the mixer. The greater the capacitance of C18 the less is the oscillator injected power.

Adjustment

The whole unit is very simply adjusted either on the signal itself (on its first trial it worked immediately it

COMPONENTS LIST

(Existing parts and valves in the R.F. unit are not listed.)

R1, R5, R9, 82,000 ohms, ½ watt.
R2, R6, R10, R14, 10,000 ohms, ½ watt.
R3, R7, R11, 220 ohms, ½ watt.
R4, R8, R12, 1,000 ohms, ½ watt.
R13, 22,000 ohms, ½ watt.
C1, C2, C3; C5, C6, C7; C9, C10, C11; C13, C14, C15 — 0.001 μF 350 v.w. mica.
C4, C8, C12, 200 pF 350 v.w. mica.
C16, 50 pF 350 v.w. mica.
C17, C18, 3-30 pF trimmers from unit.
V1, V2, V3, 6AC7.
3 Octal sockets.
Length of coaxial feeder.
Aluminium sub-chassis.
Soldering tags, wire, sleeving, etc.
L1, 1½ turns 28 S.W.G. enam. at earthed end of L2.
L2, 5 turns 28 S.W.G. enam. spaced own diameter.
Start with tight coupling between L1, L2 and vary for best results.
L3, L4, L5, each 5 turns 28 S.W.G. enam. spaced own diameter.
L6, 3½ turns 28 S.W.G. enam. Spaced own diameter
L1-L6 wound on ¼in. diameter formers with brass slugs. Vary spacing between turns to obtain correct tuning range.
L7, 2½ turns 28 S.W.G. enam. close wound at bottom of former, ¼in. diameter.

was plugged into the R1355 and brought in the Sutton Coldfield sound carrier at full strength) or by signal generator. Once the four R.F. stages and the oscillator have been adjusted to give a signal it is perhaps best to line up on the vision carrier, when the bandwidth and general characteristic can be set by visual inspection.

It will be noted that the R.F. coils are shown in Fig. 1 as having no parallel damping resistors, whilst the anode load resistors are possibly rather high. These points were of course deliberately introduced into the design to maintain a high gain, and in a better reception area the bandwidth could be broadened by adding damping resistors and employing lower anode loads. The use of anode chokes in place of resistors is a further possibility, but probably greater screening would then be necessary. It is hoped that when the unit is adapted for the Cardiff frequency the signal strength will permit of a general broadening of response so that the one unit will serve for both vision and sound, giving two separate I.F's. The vision I.F. will be fed to the R1355 as at present and the sound I.F. tapped off for supply to a separate sound I.F. strip. This, however, is so far only a suggestion for further experiment.

Constructors should remember that the heater demand of the high gain R.F. unit is rather heavy—3.15 amps.—and so a substantial transformer must be used in the R1355 power pack. The H.T. line demand is not too great and is of the order of 40 mA, which the common power pack should be able to supply without difficulty.

A further experiment which the writer hopes soon to test is to employ a grounded grid triode or a cascode input stage to improve the signal-to-noise ratio of the unit.

HOLME MOSS STATION

Some Details of the New Northern Transmitter which is to be Opened Later This Year

THE television transmitting station now being built at Holme Moss will be the second high-power station to be completed under the B.B.C.'s post-war plan for bringing television within reach of more than 85 per cent. of the population. Construction began last year, and it is expected that the station will be ready to start broadcasting television programmes about the middle of 1951.

The Holme Moss site is about nine miles to the south-west of Huddersfield, fronting the Woodhead road. It is the most remote and lonely place yet chosen for a B.B.C. station, but its elevation—over 1,700 feet above sea level—makes it ideal for television transmissions, because with the very short wavelengths that are used, the range depends in the main upon the height of the transmitting aerial. Many other sites were investigated by the B.B.C.'s research engineers before this one at Holme Moss was finally chosen. The possibilities of each of the more likely sites were tested by setting up a mobile transmitter with an aerial suspended from a balloon 600 feet above the ground and recording the strength of the signal received from it, using a van in which a continuous recording could be taken as the surrounding countryside was toured. From these records field-strength contour maps were prepared showing the probable service area of a high-power transmitter at each site, so that their merits could be compared.

The Site

The site covers an area of 150 acres, and on it are being constructed a building for the transmitters, an annexe for a sub-station and garage, and a 750-foot mast to carry the transmitting aerial. In plan the main building is similar to its counterpart at the Sutton Coldfield station, being shaped like an L. One wing is for the transmitters and their associated equipment, and the other will be given over to offices, a viewing room, and amenities for the staff. The construction of the building is somewhat different from that at Sutton Coldfield because of the exposed position of the Holme Moss site and the severe weather which prevails from time to time in these parts. The outer walls are faced with local stone, and for protection against the weather, all windows are double glazed. The possibility that the engineers may get marooned on the station when the roads are snowed up has been catered for too. An extra room has been provided for them to live and sleep in, and there will be beds and blankets and a month's supply of food in readiness for this emergency.

The building contractors are John Laing and Son, Ltd.

Equipment

In the main building there will be two transmitters, one for vision and one for sound, both designed and manufactured by Marconi's Wireless Telegraph Co., Ltd. The vision transmitter is to have a power output of approximately 35 kilowatts, and will employ grid modulation on the output stage. Its valves will be air-cooled except for the output stage, which will be water-cooled. The sound transmitter will be similar to the one at the Sutton Coldfield station, with a power output of 12 kilowatts.

In addition, space has been provided for medium-power standby sound and vision transmitters to be installed. This precaution has been taken in case the weather during the next few months is so bad that the main transmitters and their aerial cannot be got ready in time for the preliminary test transmissions to be started on them by mid-1951.

The station will get its electricity supply for the transmitters, and also for lighting, heating and cooking, from the British Electricity Authority by underground cable. Two cables, coming from different sources, have been installed, so that if the supply on one of them is interrupted, the station will still be able to carry on by changing over to the other.

The Aerial

About 25 yards from the main building is the mast for the transmitting aerial. When completed it will be 750 feet high and have an all-up weight of over 100 tons. For the first 610 feet the cross-section is triangular, each face being 9ft. wide; above this there will be a cylindrical section 100 feet high and 6½ feet in diameter, of which about 18 feet has been erected to date; and on top of this a tapering square-section topmast, 40 feet high, to which will be fixed the transmitting aerial. In the surface of the cylindrical section there are to be 32 slots designed for v.h.f. (very-high-frequency) broadcasting in case a v.h.f. transmitter for sound broadcasting is installed at Holme Moss in the future. The mast is held vertical by four sets of stays of pre-stressed steel wire rope, some of which weigh as much as 9lb. per foot run. In the main, the mast is similar to the one at the Sutton Coldfield station, except that it has no lift and has been designed to withstand the more severe conditions which may be expected owing to its exposed position and elevated side. Following the usual practice the base is located by a small steel ball mounted in a socket, forming a pivot which allows the mast some angular movement in high winds. The mast was designed and is being erected to the B.B.C.'s specification of structural requirements by British Insulated Callender's Construction Co., Ltd.

The transmitting aerial from which both the vision and sound components of the television programme will be radiated will consist of eight vertical dipoles arranged in two tiers. Each dipole will have a built-in electric heater to prevent the surfaces from being covered by ice or snow, which would spoil the performance of the aerial.

There will also be a smaller mast, 150 feet high with a simpler aerial to serve as a standby in case any trouble develops on the main mast or aerial.

Programmes

The Holme Moss station will broadcast the same programme as the Alexandra Palace and Sutton Coldfield stations. The vision signals will come from London via Sutton Coldfield, and thence by the special coaxial cable which the G.P.O. are installing.

The area within which reception of the television programme from Holme Moss can be relied upon is expected to be roughly rectangular in shape, stretching from Lancaster to Bridlington in the north, and from Birkenhead to Grimsby in the south. This area has a population of over 11 millions, and includes almost the whole of the West and East Ridings as well as most of Lancashire. Whether or not reception will be satisfactory at any particular place near the boundary of the expected service area cannot be predicted, because the answer depends upon several local factors, including the height of the receiving aerial and the strength of electrical interference in the vicinity.

Frequencies

The vision transmitter will operate on a carrier frequency of 51.75 Mc/s (5.8 metres) and the sound transmitter on 48.25 Mc/s (6.2 metres).

G.E.C. Developments

A MATTER affecting the use of germanium in crystal diodes and triodes has been the development of a source of supply in this country. Previously imported from the United States, germanium is now extracted from certain flue dusts by a process evolved by the G.E.C. Research Laboratories in co-operation with Johnson Matthey and Co., Ltd. The element is now commercially available in the form of the metal or its oxide. Germanium rectifiers are now in large scale production and are replacing thermonic valves in certain positions in television receivers.

The use of crystals has not lessened the demand for the more conventional valves. Changes have taken place in the design of receiving valves. At ultra-high frequencies serious losses and "drift" are caused by the long interval leads used in earlier valves, hence development of the "all glass" valve.

Miniature valves became necessary when radar was installed in aircraft. The extension of television and the need for economy in materials have established the miniature valve for more general use.

Complete ranges of valves for battery-portable A.C. operated and A.C./D.C. operated broadcast receivers have been developed in miniature size and are in mass production.

The E.H.T. rectifier U37, a small tubular valve 12 mm. in diameter and 45 mm. long, is in general use for television receivers. The A.1714 is another miniature for specialised low noise operation.

New 19inch Tube

A NEW directly-viewed picture tube of the metal-cone type for use in television receivers is announced by R.C.A. It has a high-efficiency, white fluorescent screen on a face made of frosted Filterglass to provide increased contrast and reduced specular reflection. Utilising magnetic focus and magnetic deflection, the tube (19AP4-B) provides pictures of high quality.

The frosted Filterglass face plate incorporates a neutral light-absorbing material which reduces ambient-light reflections from the phosphor and reflections within the face plate itself in a very much higher ratio than it reduces the directly viewed light of the picture. As a result, improved contrast is obtained. In addition, frosting of the face diffuses any reflections from bright objects which might otherwise be objectionable.

A rounded-end picture 17¾in. x 13in. is obtained by utilising the full-screen diameter; or a rectangular picture 15⅝in. x 11¾in. with rounded corners is obtained within the minimum-useful-screen area.

Use of the metal cone not only makes practical a construction which weighs substantially less than a similar all-glass type, but also makes practical the use of a higher quality face plate than is commonly used on all-glass tubes.

The 19AP4-B has a deflection angle of approximately 66 deg., large screen area in relation to tube diameter, an ion-trap gun which requires only a single-field, external magnet, and a small-shell duodecal 5-pin base.

London/Birmi[ngham] Converte[r]

A Unit to Enable You to Use an A.P. ... Reception of Sutton Coldfield witho[ut] ...

By GORDON J. KING, A.M.Br[it.I.R.E.]

WITH the opening of the Sutton Coldfield (channel 4) transmitter many persons who were using London (channel 1) receivers found that a better signal could be obtained from the new transmitter coupled with the fact that the signal/noise ratio was improved, this being so since the magnitude of ignition and electrical interference reduces as one proceeds up the spectrum from channel 1 to channel 4. As it was with the opening of the Sutton Coldfield transmitter, so it will be with the opening of the new transmitters. Many people who at the moment are using fringe area reception may soon find they are no longer in the fringe area, but within the service area of a new transmitter, which of course will be functioning on a different channel. For those people to enjoy to the full television entertainment within the service area their receivers will have to be converted to respond to the new wavelength, and this, in most cases, is rather an expensive modification, and in the case of a T.R.F. receiver not very practicable. Again, once the receiver has been modified it would require another expensive modification if it is desired to put the receiver back to the original frequency should it be moved to a different part of the country.

The trend in modern television design is to make the aerial, mixer, and oscillator coils tune over the five B.B.C. television channels, and since most designers seem to be settling down to the superhet principle this is made comparatively easy. This article is primarily intended for the many who are using the older type of receivers which, as far as channel changing is concerned, has been rendered obsolete, and also for the experimenter who would like to check the other transmissions without having to redesign the receiver.

The writer is located on the fringe of both London and Birmingham stations, and due to the cleaner signal from channel 4 many people wished to have their receivers converted to that channel soon after the station went on the air. Hence, the writer was prompted to design a small converter that could be fitted to the inside of the receiver cabinet and as far as possible derive its power from the receiver H.T. and L.T. supplies. There is no reason why the mechanical details of this converter should be adhered to, since many constructors may have their own ideas; so long as the earthing and screening is given due attention snags should be few.

The Circuit

After a fair amount of experimenting the circuit shown in Fig. 1 was decided upon. As will be seen, a single frequency-converter is used; the additional expense of a double converter was not considered necessary in this case, since very good definition with negligible image interference is obtained. It will be noted that the aerial is isolated from the chassis, this being necessary where the converter is to be used with an A.C./D.C. type of receiver since the chassis may be at mains potential. The damping created by the aerial, plus the input impedance of the valve, is sufficient to obviate any further damping across the tuned circuit L1. V1 is a Mazda 6F13 and is connected as a conventional R.F. amplifier. This stage was found to be necessary to reduce the noise of the converter stage, and also to bring second channel interference to a minimum.

V2 is a Mazda 6C9, capacity-coupled to the output of V1. This imposes extra damping across L2, which again renders it unnecessary to use a damping resistor. The triode section of V2 is connected as a local oscillator, and is arranged to generate on a frequency of 16.75 Mc/s, being the frequency difference of channel 4 and channel 1. L3/4 are the oscillator coils. Capacity-coupling is also used between the anode of the Heptode and L5; this is tuned to the incoming signal minus the L.O. frequency, i.e., to the frequency of channel 1. L5 is tapped to feed the signal to the receiver. The fairly high values of R2 and R5 are included to decouple any unwanted signal from the H.T. line, and also to limit the total current consumption of the converter to approximately 15 mA. at 230 volts. Most television receivers are capable of supplying an extra 15 mA. without any ill effect.

Construction

The chassis is constructed from a 2-oz. St. Julien tobacco tin that has approximate dimensions of 4½in. by 3in. by ¾in. Fig. 4 illustrates the drilling details of the chassis and requires no further explanation. Three aluminium screens divide the tin into four compartments, a, b, c and d, as shown in Fig. 4. It should be noted, however, that this is a top view of the chassis and the compartments so shown are as they would appear if viewed through the top of the chassis. The components that are accommodated by each compartment can be seen from Fig. 1. The under chassis illustration shows the position of the three-way tag strips that are used to anchor the smaller components. The lid of the tin

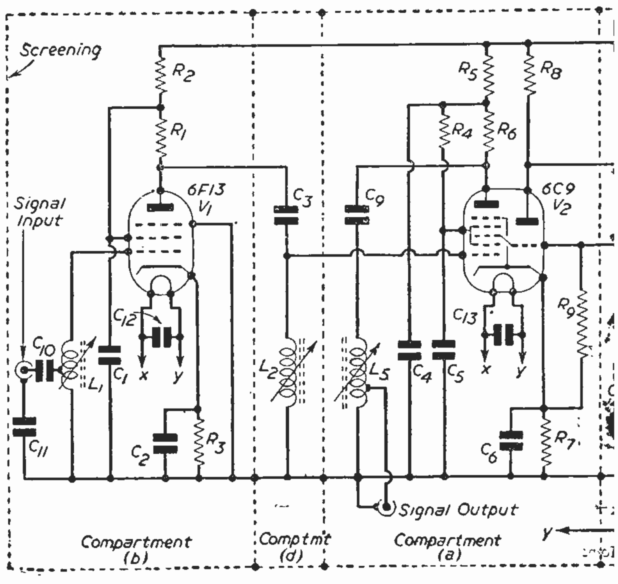


Fig. 1.—The circuit diagram.

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Receiver for the
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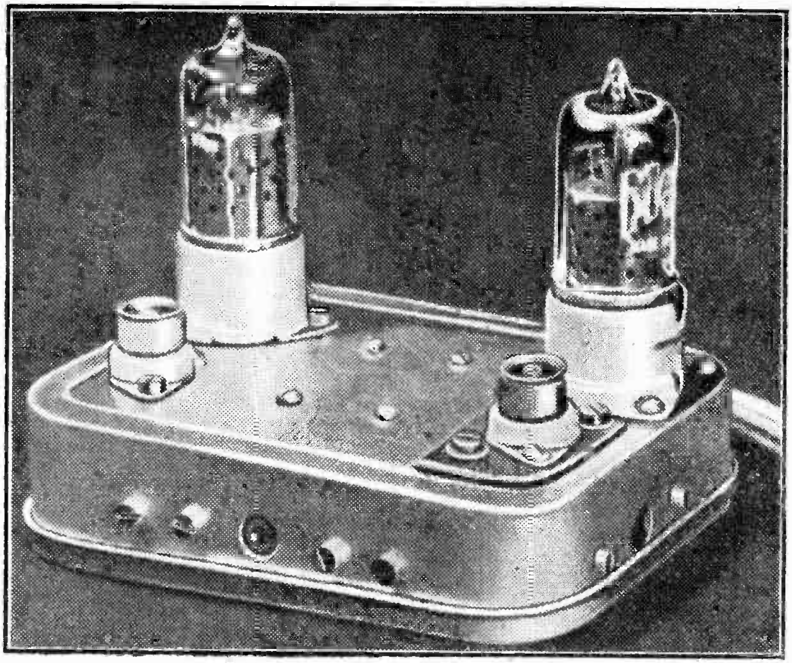
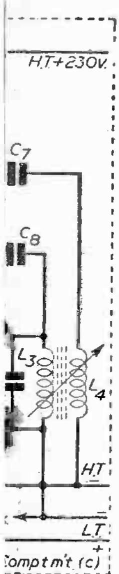
I.E.T.



The finished unit, showing trimmers and co-axial connectors.

forms the base of the chassis, and this may be drilled and fitted to the inside of the receiver cabinet. For mounting, the tin is simply pushed on to the lid and on this type of tin is a very good fit. It will be found best to produce the three screens first and fix them temporarily into the chassis; this will facilitate locating the position for the coils and other holes. They are formed from aluminium strip $\frac{13}{16}$ in. wide, and are drilled to accommodate interconnecting leads. Two holes are drilled in the section of screening that divides compartment c from compartment a to allow connection from the frequency changer valve to the oscillator coupling capacitors C7 and C8. The lower corner of this screen is also cut away to pass the H.T. and L.T. interconnecting wires; a similar cut in the lower corner of the screen c, b is used for the same purpose. A hole is drilled in the screen a, d so that connection can be made from the grid of the mixer valve to L2 and C3. The screen b, d is also drilled for a connection between the anode of V1 and C3. The aerial input socket is isolated from the chassis where necessary by a piece of paxolin, the method used being clearly illustrated in the "top view" photograph of the converter. The fixing holes for this assembly are not shown, since their position will vary according to the size of the paxolin used. When the drilling has been completed the paint may be removed from the tin with a little acetone; this will produce an attractive "silver-plated" finish.



LIST OF COMPONENTS

C1, C2, C3, C4, C5, C6, C7, C9, C10, C11, C12, C13. .001 μF. Hunts Midget Moldseal Type :—W99. List No. B819.

C8, 50 pF Silver mica. C14, 25 pF Silver mica.

R3, R7, 220 ohms. R1, R6, 5,000 ohms. R2, R5, 10,000 ohms. R8, 100,000 ohms.

R4, 15,000 ohms. R9, 25,000 ohms. All resistors $\frac{1}{4}$ watt.

4 Aladdin Coil Formers, $\frac{3}{8}$in. dia., complete with cores.

2 B8A Valve-holders.

2 Belling-Lee Co-axial Sockets, Type L604/5.

8 3-way 1in. Tag Strips.

VALVES : V1, Mazda 6F13. V2, Mazda 6C9.

The Coils

The four coils are wound on Aladdin formers of $\frac{3}{8}$in. diameter and use standard cores. All windings start $\frac{1}{4}$in. from the base of the former.

L1. Close wound 4 turns, tapped at 1.5 turns at the earthy end. Wire, 30 S.W.G., d.c.c.

L2. Close wound 3.5 turns. Wire, as above.

L3. Close wound 9.5 turns. Wire, as above.

L4. 5 turns interwound at the bottom end of L3. Wire, 40 S.W.G., d.c.c.

L5. Close wound 7.5 turns, tapped at 1.5 turns at the earthy end. Wire, 30 S.W.G., d.c.c.

Mounting Order

It will be found best to mount the valve-holders, co-axial sockets, tag strips and the coils before finally securing the screens in position. Star washers should be used on the fixing of the co-axial sockets and the tag strips, between the chassis and metal part in each case; this will ensure perfect earthing. Before mounting the aerial coil L1, it will be necessary to wire the aerial isolating capacitors C10 and C11 to the aerial socket.

A 2-position tag strip is used for this purpose and is secured in position by the fixing bolt that holds the paxolin square to the chassis. The capacitors should be mounted underneath L1 and earthed direct to the chassis. It should be remembered, when fitting the valve-holders, to make sure they are so positioned as to keep the signal leads as short as possible. Fixing holes for the holders have not been shown since their positions may vary with different makes of holder. The screens can now be securely bolted into position, again using star washers.

Wiring

Since space is rather limited great care should be taken when soldering, as prolonged heat may ruin the midget capacitors. A small soldering iron is a great asset for constructional work of this nature. The power input leads are taken through a rubber grommet that is positioned in the side of the chassis. The L.T.+ lead is taken direct to the heater tag of V1 and the H.T.+ lead is anchored to the inner tag of the corner tag strip in the corner of compartment b. The negative leads are soldered to the centre tag on the same tag strip. The interconnecting leads for H.T. and L.T. are taken through compartment d and underneath coil L3/4, keeping as close as possible to the corner of the chassis. The H.T.+ lead is terminated at the inner tag of the tag strip that is positioned in the corner of compartment a. The coils are next wired to their appropriate tags and connections on the valve-holders. The oscillator coils are wired thus: The lower end of L3 is connected to earth, the upper end is connected to the oscillator grid capacitor C8. The lower end of L4 is connected to the oscillator anode capacitor C7, and the upper end is earthed. Resistors R2 and R5 are positioned between the two outside tags on the corner tag strips and the wiring is commenced from the valve-holders up. The general placing of the smaller components is left to the constructor, and with a little care and patience a very neat job can be made of the wiring and the general appearance of the finished converter.

Feeding Power to the Converter

Where the converter will be required to obtain its power from an A.C. receiver, and where the receiver heaters are 6.3 volts, the heater supply lead from the converter is connected across the heater winding of the mains transformer. In the case of an A.C./D.C. receiver a small heater transformer is employed to supply the converter with L.T. A transformer will also be necessary if the heater supply is other than 6.3 volts in an A.C. receiver. The primary winding of the transformer is connected to the receiver side of the receiver's on/off switch, as shown in Fig. 2.

H.T. is picked up from any convenient point from the receiver H.T. network. It should be remembered, however, that the converter consumes approximately 15 mA. at 230 volts, therefore if the supply is taken from a decoupling resistor in the receiver the resistor will drop additional voltage, and also the power dissipated by it will be greater. Hence, the part of the circuit being

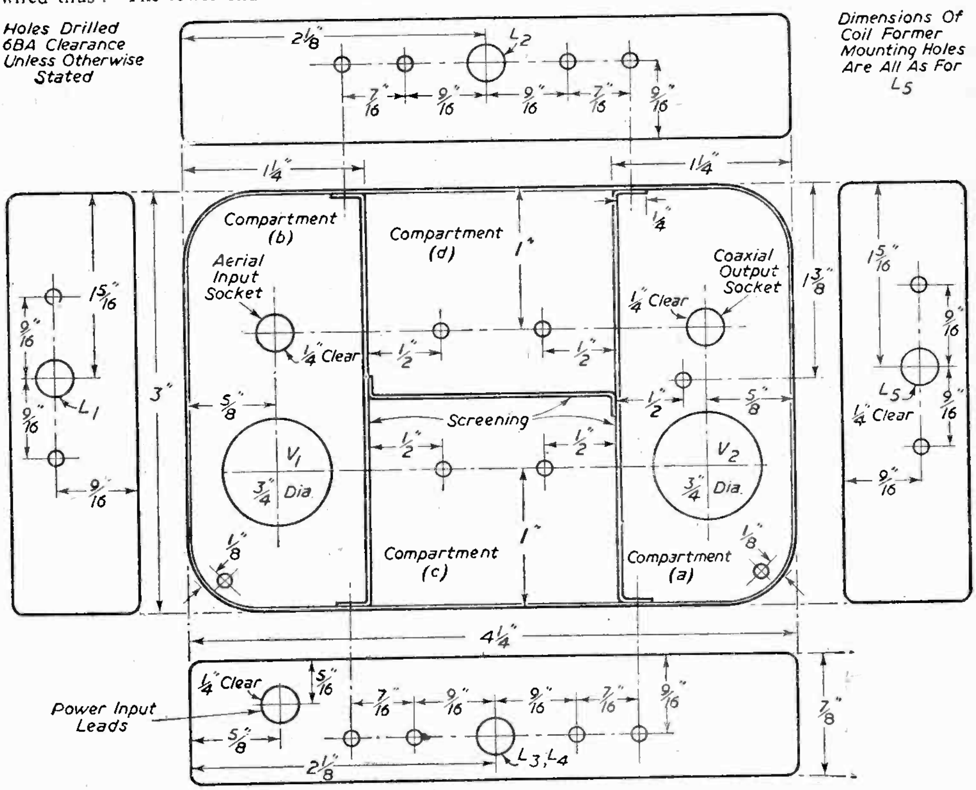
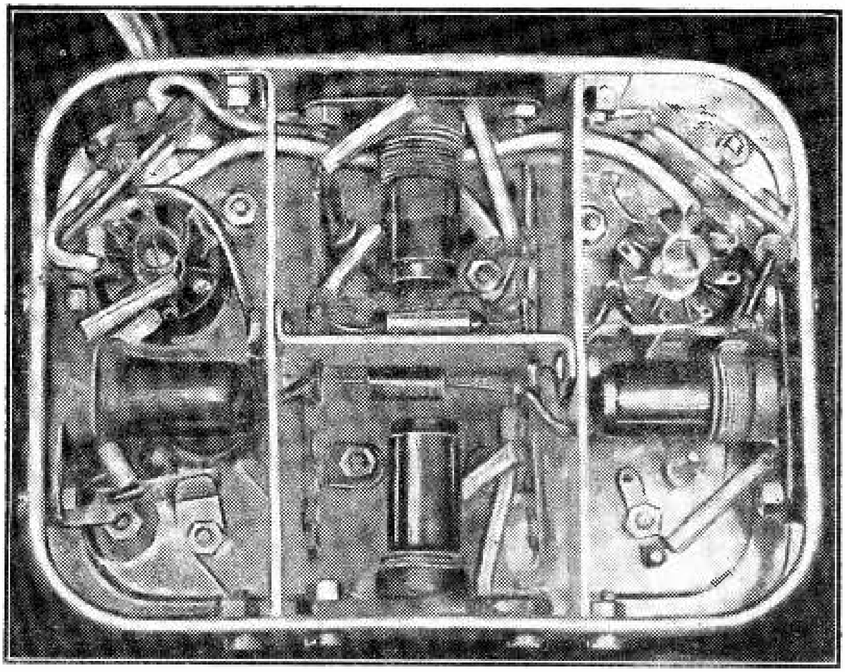
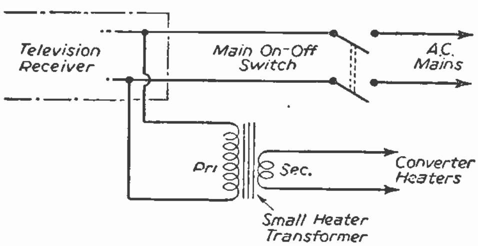


Fig. 4.—Top view of "chassis," showing position of screening. Holes are drilled 6BA clearance unless stated otherwise.

supplied from it will be starved, and it will also tend to overheat. It may be found easier to obtain H.T. from the main H.T. line via a resistor-capacitor combination, as shown in Fig. 3. The value for R is calculated by dividing the difference between the H.T. line voltage and 230 by .015. In most cases it will be found that a 1-watt resistor will be of sufficient size. On certain receivers the main H.T. current is passed through the focus coil, and the extra current taken by the converter may alter slightly the focus setting. This may be corrected if desired by slightly shifting the focus coil along the neck of the C.R.T. A H.T. negative is taken direct to the chassis of the receiver (this lead may also be used for the L.T. return when the receiver is supplying L.T. to the converter), not forgetting that with an A.C./D.C receiver this may bring the converter chassis to mains potential. It is a good point to check if the "hot" side of mains is connected to the chassis; a small neon bulb or a voltmeter may be used for this purpose.



A view of the inside, showing screening.



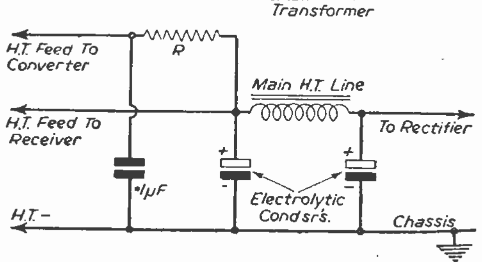


Fig. 2 (Top).—Use of additional heater transformer, and Fig. 3 (Bottom)—a decoupled H.T. feed for the converter.

Alignment

The converter is connected to the receiver aerial socket by a length of co-axial cable. Test Card "C" is used for alignment purposes, although a modulated signal generator is a great help in finding the approximate frequency for the L.O. Should such a device be available, a fairly strong modulated signal of 58.25 Mc/s is fed into the aerial socket of the converter. The cores of L1, L2 and L5 should be set to their midway positions, L3/4 is then adjusted until the modulated signal is heard, this will decide the approximate position for the L.O core.

The signal generator is now replaced by the aerial. Advance the volume control until the sound transmission is heard; L3/4 is then peaked for maximum sound. Increase the contrast setting if necessary, and adjust L1, L2 for a balance between sound and vision, not taking too much notice of definition at this stage. L5 is then adjusted together with slight adjustment of L3/4 for maximum definition. These adjustments are repeated, and with a little patience the 3 Mc/s bars should be resolved. One of the converters so produced by the writer was completely aligned without the use of a signal generator; using the Saturday morning rendering of Test Card "C," the L.O. was soon brought to resonance with the help of the B.B.C. test tone radiated on this transmission.

PROJECTION TELEVISION—3

Report of a Lecture Given to the Institute of Practical Radio Engineers to Honour the Memory of the late Mr. D. F. Harrison

By EMLYN JONES, B.Sc., A.M.I.E.E.

IT will be seen that a part of this negative voltage built up across C_2 in Fig. 16(a) is applied as a bias to the pentode. The pentode, however, also builds up a biasing voltage itself, by grid-current rectification of the input wave, and a proportion of this bias appears across C_2. This bias, in turn, is applied to the anode of the diode, so that unless the peak positive voltage across the coupling coil exceeds the bias which C_2 receives from the grid-rectification action, the diode does not rectify.

Now let us see what happens if a very heavy current is taken by the C.R. tube. The resonant circuit is heavily damped, and so the peak voltage applied to the diode is small. Because of the bias it receives from the pentode, therefore, the diode does not conduct and might just as well not be there at all. The voltage regulation is just that corresponding to the input power of about 22 watts, and is therefore poor. This corresponds to the right-hand portion of the V—I graph of Fig. 16(b).

Now as the load current is gradually reduced, the voltage peak applied to the diode increases, until a point is reached at which the diode starts to rectify. From this point onwards, instead of the pentode biasing off the diode, the diode biases off the pentode, so that its grid waveform drops from the full line to the dotted positions in Fig. 16(c). However, as the pentode is biased off, its peak anode current and the energy which is imparted to the inductance are both reduced. This means, of course, that the voltage applied to the diode is reduced, i.e., *the diode tends to maintain the voltage constant.*

The V—I curve therefore flattens out as shown in Fig. 16(b) and its slope is no longer controlled by the power input. The diode controls the power in such a manner that the voltage is substantially constant, up to a critical point, and then falls rapidly away when this point is reached.

The beauty of this system is the closeness with which the curve can be made to fit the ideal set by the requirements of the C.R. tube. It is impossible to damage the tube by turning up the brilliance control too far, since the maximum screen dissipation cannot be exceeded.

The Complete Unit

Fig. 17 shows the complete circuit of the E.H.T. unit. The components enclosed in a dotted line are contained in a sealed oil-filled can. This enables a compact unit to be made without trouble from corona. The simple inductance of Fig. 12 now takes the form of a multi-winding transformer which supplies the heaters of the rectifiers. The core material of this transformer is "Ferroxcube," a new low-loss ferro-magnetic material. Because very little energy is lost in the core it is possible to dissipate most of the surplus energy in the rectifier heaters. The two diodes of the double-diode triode valve are strapped together and serve as the regulator diode, while the triode portion is the blocking oscillator needed to supply the input waveform to the pentode. The 25 kV supply is brought out in a polythene cable to a moulded cap designed to fit the glass shroud on the MW6-2 C.R. tube. This cap also encloses a resistor which, together with the 450 pF capacity contributed by the MW6-2 C.R. tube, provides additional smoothing.

In Fig. 18 which shows the complete EHT unit, the oil-filled can and 25 kV lead are clearly shown. The former is easily replaced, as a complete assembly, by removing the two clamps and unsoldering three connections.

The three components of the projection equipmetn have now been described, and we have seen how a magnified image can be projected out of the optical box to be focused on some plane in space. It is necessary to provide a viewing-screen to make this image visible. This fact is usually taken for granted probably because one is so used to the presence of a white screen in the cinema. It is not at all apparent, however, why this screen is required, since the television picture is focused in space, and light from it is proceeding towards the viewer. This is shown in Fig. 19, the rays being focused on a piece of plain glass, and to understand the function of the viewing screen it is necessary to discover why such a system is inadequate.

Why Have a Viewing-screen ?

The viewers regard a point on the screen as bright if light from it is entering their eyes; if no light enters their eyes from a certain point that point is dark to them, even though a great deal of light may be passing through it —to go somewhere else ! Thus A sees a bright area at X and B sees one at Y, but both would regard Z as dark.

It is necessary for light to be *scattered* from every small region of the screen into the eyes of each member of the audience if they are to be able to see the picture that is focused upon it. One way of achieving this is to etch the glass, when the irregular surface scatters the light in all

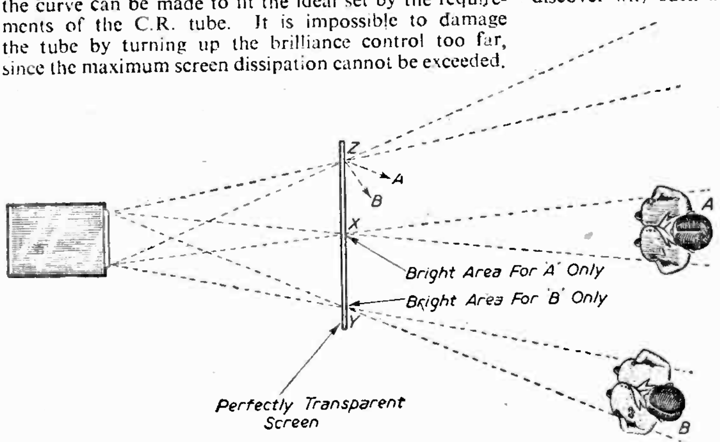


Fig. 19.—Diagram showing the function of a viewing screen.

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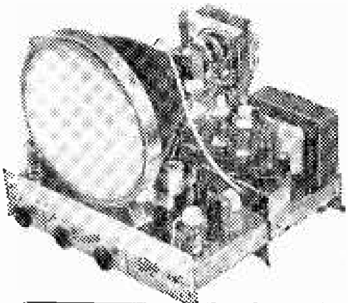

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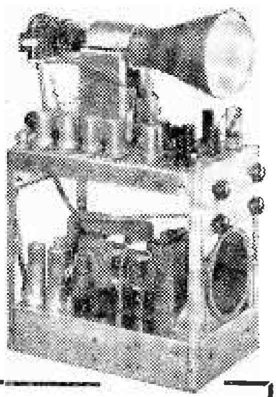

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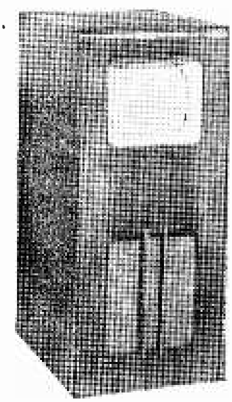

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directions, as shown by the dotted arrows A and B. This makes the point Z become luminous to A and B, and the same applies to all the other points on the etched screen. Thus the whole picture becomes visible to all the viewers.

Although etched glass makes a cheap, simple and robust screen, it has two serious disadvantages.

So far we have discussed the basic principle upon which a viewing-screen works. If light is focused on one part of the screen to form a bright part of the picture, the screen must scatter this light in such a manner that some of it enters the pupils of the eyes of every viewer, wherever they may be situated. Each viewer will then see that part of the screen as a bright area. If no light is allowed to fall on another area of the screen, that portion cannot scatter light for the very good reason that there is none to scatter. It is, therefore, seen as a dark area by the viewers. In this way the light and shade of the picture is built up.

Now there is no point in scattering the light up towards the ceiling, or down towards the floor; this only wastes valuable light, since one does not normally find viewers there! One important factor in screen design is, therefore, to restrict the scattering of light to a certain definite region in which the eyes of the viewers are normally placed, and in this region to scatter it in such a manner that all the viewers see pictures of equal brightness.

Polar Diagram of Brightness

The variation of brightness with viewing angle is best shown by means of a "polar diagram." In Fig. 20 the full line shows such a diagram. Here the apparent brightness of the screen when viewed at any angle is shown by the length of a line drawn at that angle through the point O. Thus if to a viewer at A the screen has 10 units of brightness, line O*a* is drawn 10 units long. The same viewer moves to B and finds only 8 units of brightness and so O*b* is drawn 8 units long. The points *a*, *b*, *c*, etc., are joined up to form a smooth curve, and this is the polar diagram of brightness for that screen.

Our ideal polar diagram would therefore be as shown dotted, the brightness remaining uniform over some angle θ, on either side of the axis, and falling to zero outside this angle. (For reasons we need not go into here, this is only true if the brightness is measured with a proper *brightness* meter. If the measurement is made with a photo-electric meter, which is a *light* meter, the ideal curve is one in which the length of the line varies

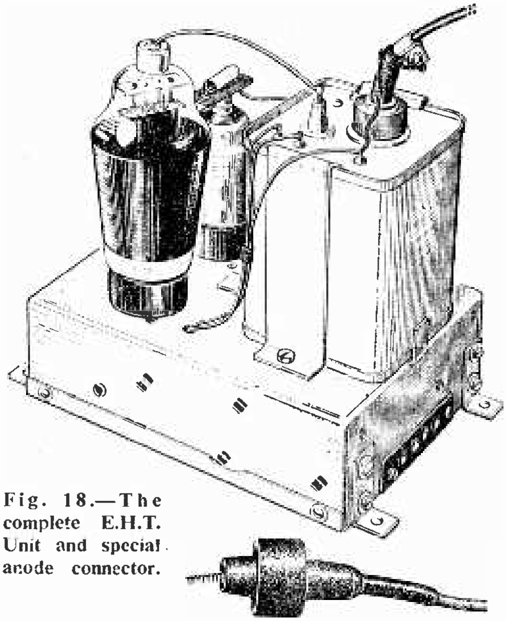


Fig. 18.—The complete E.H.T. Unit and special anode connector.

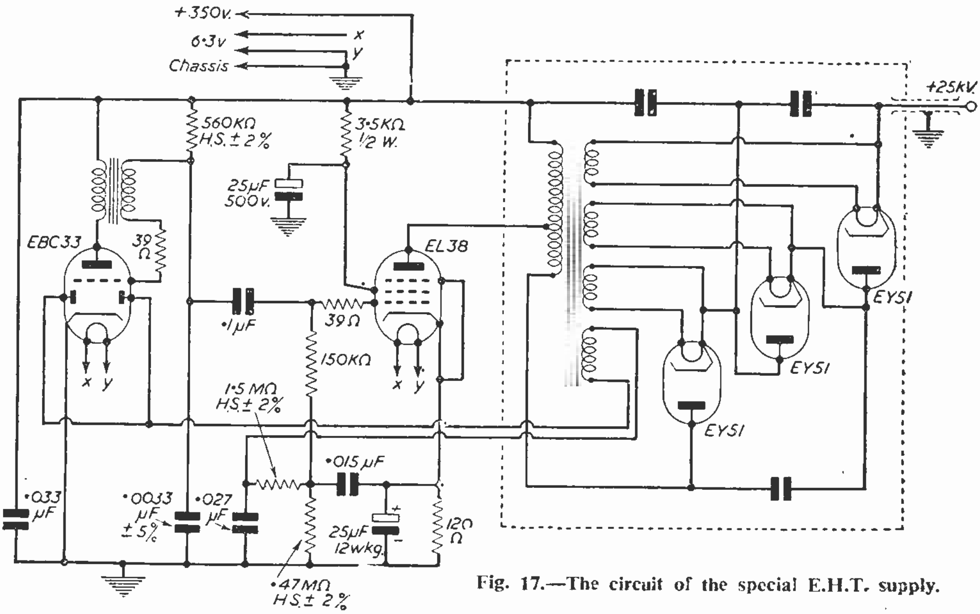


Fig. 17.—The circuit of the special E.H.T. supply.

as the cosine of the angle between the viewer and the axis.)

Now, unfortunately, the angle θ over which uniform brightness is required is different in the horizontal and vertical planes because the heads of seated viewers may occupy a wide angle from side to side, but only a narrow angle up and down. The polar diagram of the ideal screen would, therefore, be much narrower in a vertical plane than in a horizontal plane.

The "Gain" of a Viewing Screen

To talk of the "gain" of a viewing-screen at first sight seems rather silly. Since a screen cannot give out any more light than it receives it must have a light gain of less than unity and one might think it better to talk about a loss, rather than a gain.

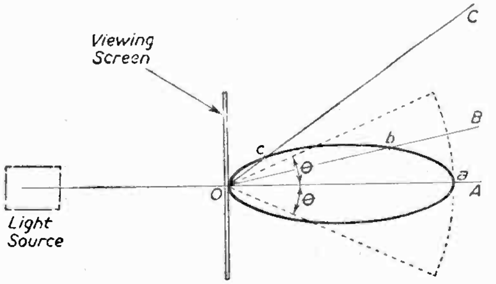


Fig. 20.—The polar diagram of brightness. The full-line curve is for an etched glass screen. The dotted curve is the ideal.

The important thing to note, however, is that total light and brightness are two different things. For example, this page is being illuminated by a window, or a source of artificial light, and it has a certain brightness. If now you interpose a lens between the light source and the paper you can redistribute the light falling on the page to make some portions brighter and others darker, and if you adjust the lens to produce a sharply-focused spot the brightness "gain" at that spot may be very large indeed. The total amount of light has not been changed, but over a certain area there is a gain in brightness.

We have seen that one of the functions of a viewing-screen is to distribute the light over a certain area only, and in so far as it achieves this it produces a gain of brightness in that area, and a loss elsewhere. Naturally the smaller the area in which the light is concentrated the greater will be the gain in brightness. This means that a screen having a narrow polar diagram should have a high brightness gain and vice versa.

The gain is measured by comparing the brightness of the screen with that of a perfectly diffusing surface receiving the same illumination. A perfectly diffusing surface is one which appears equally bright from any direction; in practice a block of compressed magnesium carbonate is used.

Gains of 5 are commonly found in screens having good polar diagrams. Narrow-angle screens may have gains up to 15 and wide-angle screens may be as low as 2.

Screen Reflectivity

When discussing the highlight brightness of a television picture we mentioned that figures of peak brightness should not be taken too seriously, since they represent only half the story. The other half could be called "peak darkness" the minimum brightness obtainable in the dark areas. It is the *ratio* between the blackest black obtainable on the screen, and the brightest white which is of importance, rather than the absolute average brightness of the picture. The latter is already many times greater than that seen in the average cinema.

One of the major factors which determines peak darkness is the presence of general room lighting. Nowadays many people prefer to look-in with a certain amount of ambient lighting present, even in the evenings when complete darkness is easily possible. Since negative light has not yet been discovered it is not possible to make the dark areas of the picture any blacker than the brightness of the screen surface when illuminated only by the room lighting. It is therefore obvious that a substantial increase in contrast ratio may often be obtained merely by an adjustment of room lighting designed to prevent light from falling directly on the television picture. On the other hand, if the screen surface is a poor reflector of light it will appear dark even under the most adverse conditions of room lighting, and therefore this property of low reflectivity is a very important one in a viewing-screen.

Fortunately for projection television the best viewing-screens have a very much lower reflectivity than the face of an ordinary cathode-ray tube. Consequently, for the same contrast ratio, the peak brightness necessary is much lower for a projected picture than for a directly-viewed picture. This makes the projected picture much "easier on the eye," since it is not necessary to sit looking at an intensely bright object for long periods. The projected picture has more of the qualities of a photograph, in which the quality largely depends on the depth of the blacks.

Low reflectivity is achieved by ensuring that the screen surface is optically smooth and by painting the inside of the projection cabinet with a matt black paint. Room light must be prevented from reaching the viewing-screen from behind, for example, through ventilation holes at the rear of the cabinet.

Large-screen Projection

By concentrating on Fig. 19 we have restricted our discussion to what is called "back projection," the screen being between the source of light and the viewer. This is, of course, not the only method. In the cinema "front projection" is usually employed, the viewer being placed between the source of light and the screen.

Obviously a front-projection screen must be a good light reflector, and consequently it is extremely difficult to design such a screen which will, at the same time, provide good blacks in the presence of room lighting. Front projection is, therefore, not recommended for home use as very few rooms can be blacked out adequately on a bright summer's afternoon.

These screens do have their uses, however, for large audiences where a large picture is essential. The highlight brightness falls in inverse proportion to the screen area, and in order to maintain an adequate contrast ratio an almost completely dark room is essential.

Under proper conditions a remarkably good picture is obtained and audiences of 100 have enjoyed television shown in this way on a standard home-cine screen 3ft. high by 4ft. wide.

For this equipment the projection unit was identical in every respect with the standard equipment described in this series except that the corrector plate was designed for the longer throw required.

(To be continued)

X-Rays on Alexandra Palace

No. 3.—Outside Broadcasts—By the Marquis of Donegall

WE start, as usual, at Alexandra Palace. There is nothing like seeing a man who was one of the few who started the whole O.B. television business. After that we shall move to one of de Lotbinière's conferences; and then, who knows, to an Outside Broadcast television, "somewhere near London."

Philip H. Dorté shares the same view of London in *his* office as did Norman Collins when he was Controller of television. I've never seen this famous view at its best, yet :—mist ! Says Philip Dorté :

"The first O.B. television was the Coronation, except for various local experiments in the grounds of Alexandra Palace. Moultrie Kelsall was the moving spirit in these. On Saturday afternoon we had C. H. Middleton 'pottering', or Major Faudel-Phillips teaching Youth how to ride a pony. Sheep-dog trials or somebody trying to explain to Leslie Mitchell how an O.B. unit worked.

"After the televising of the Coronation procession on May 12, 1937, the Mobile Unit went back to the manufacturers for 'completion' and overhaul ! Its next appearance was for Wimbledon. We had a fortnight's holiday during which we came to the conclusion that only the novelty of the Coronation broadcast could have accounted for its success. Except in long-shot the commentary bore little relation to the events on the screen.

"This required thought, as I found out in the next two years. For to train the lens and the eye of the commentator on the same objective simultaneously for a sustained period is one of the great problems of television reporting technique.

"You see, at Wimbledon in 1937, television was using the radio commentary of Grisewood, Wakeham or Brand. An exciting thing would happen on the screen, but the commentator would be describing a celebrity's arrival. Maddening for viewers !

"I assured myself that such troubles as these would not be encountered next time. After the holiday I was planning the next O.B. and that was to be Freddie Grisewood accompanying the television cameras to a series of visits to Regent's Park Zoo. Here, all would be plain sailing, with Grisewood sometimes 'in vision,' or welcoming visitors to Pets' Corner or feeding the sea-lions.

"I suddenly remembered that Ndansia Kumalo of Matabeleland, who played the part of his uncle, King Lobengula, in the film 'Rhodes of Africa,' once said, between shots in the foot-hills of the Matoppos : 'The microphone is like a dove which, as I move and speak, swoops down and plucks the words from my lips.'

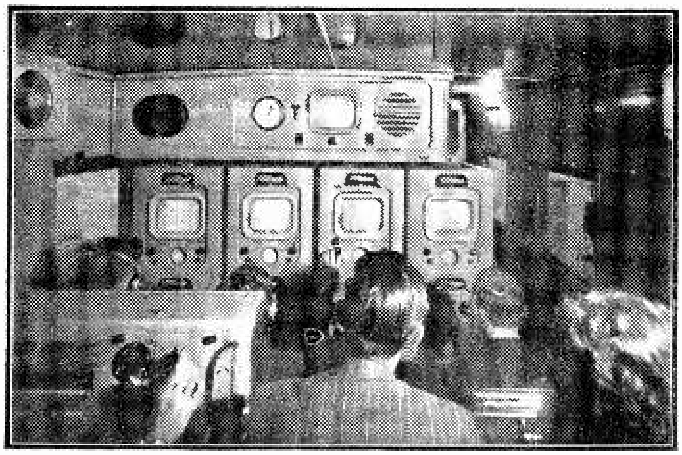
"So, on this particular Zoo broadcast with Grisewood, I suddenly spotted a pitchfork and persuaded the engineers to suspend the microphone between the two prongs of it, and thus, by holding it up above the camera, so to position the 'mike' that it could 'swoop like a dove.' Then I asked the Press photographer to include the pitchfork microphone in any of the photographs he might take. This worked like a charm because viewers did not see the microphone on the screen, but the newspapers published the photographs and some very important B.B.C. officials saw them. The result was that the B.B.C. bought a portable microphone boom and issued it to the Mobile Television Unit.

"Two other things during what I call the first era of television—that was, of course, before the dramatic close-down caused by the war.

"For instance, we did a fleeting visit to the Arsenal stadium at Highbury, where George Allison demonstrated to viewers how he trained his cup-final winners. And, at the end of September, 1937, we moved to Pinewood Studios at Iver Heath. Here, Captain the Hon. Richard Norton—now Lord Grantley—treated us and the viewers to all the secrets of film-making. I remember Maurice Chevalier, Nova Pilbeam, Jack Buchanan, June Knight, Sonny Hale, Jessie Matthews and Roland Young were among those televised either on the set or in their dressing-rooms, while René Clair and Alfred Hitchcock were among the several famous directors seen at work or play.

"The only person who flatly refused to be televised was Merle Oberon. But it must be said in fairness that she was being built up as the ideal star for colour pictures at that time and did not want to appear in black and white on the television screen.

"The first O.B. of importance following the film studio efforts at Pinewood was to have been that of the Cenotaph ceremony in Whitehall on the morning of the 19th anniversary of Armistice Day. The preparations for this were somewhat complex and, in the meantime, Gerald Cock put forward the suggestion that, as the Mobile Unit would anyway be in the neighbourhood of



An inside view of an Outside Broadcast van, showing the monitors.

Whitehall, testing, it might as well give viewers a look at the Lord Mayor's Show on November 8, 1937. So it was sitting, not in view, between the two cameras in Northumberland Avenue that Grisewood, with a pair of earphones on so that he could hear to what point I was directing the cameras, was able to give a proper synchronised commentary on an event which was, so to speak, unpredictable.

"Most of this went very well, but my cup of bitterness was not yet filled for, as the crowds dissolved, I 'mixed' to an emptying street and asked Grisewood to sign off and mention the dispersing spectators. Unfortunately Grisewood did not hear the word 'dispersing.' As the cameras were viewing an almost empty Northumberland Avenue, Grisewood was gazing into the distance at London thronging the Tube entrance and he was saying: 'And so, ladies and gentlemen, the Lord Mayor's Procession moves on; the crowds remain almost as dense as ever, as you can see for yourselves'!" Screen full of empty street!

Then came the story in which Dorté told me he had to make the greatest decision of his life. It was the Outside Broadcast Television of the Cenotaph ceremony on November 11, 1937.

Everything was set up, and the ceremony began to be televised in the normal manner. Suddenly, as will be well remembered by those who were there, a maniac attempted to make a gesture against the King.

Dorté had to make a quick decision. Should he put his camera, or cameras, on the incident, or should he carry on with the ceremony as though nothing had happened?

The incident was most dramatic. The maniac made very little progress, for he was overcome by the police and private detectives from every side. He was taken away unconscious.

"I made a snap decision," said Dorté, "to miss the exceptional news angle, considering that the smooth running of the Cenotaph ceremony was the more important of the two."

A Scoop Missed

Nevertheless I felt that when Dorté was telling me the story he rather felt that, as a newsman, he had certainly missed a scoop, and when I consider his story of how the police dealt with this maniac I am rather inclined to agree with him.

Personally I think that it is good for the public—this has nothing to do with what Dorté told me—to know just how the British police deal with people like that maniac, and the result is not very pleasant telling. Perhaps that may discourage others.

Dorté says that it was the quickest and most efficient piece of work that he has ever seen in his life.

A New Book

Quite apart from our long talk, he lent me the manuscript of a book which he hopes to publish telling the whole story of Outside Broadcasts of television up to what he calls "the end of the first Television Age." In this fascinating manuscript, which I hope will one day be published, he tells the story of the black-out of television as follows:

"On September 1, 1939, five full-length plays were in rehearsal and many more were in preparation. Plans were laid for many more Outside Broadcasts. It was to have been a television winter on the biggest scale yet.

"For the present, however, all these plans are laid aside. One day we may hope that all the eager striving band of specialists will reassemble under their queer futuristic mast in Alexandra Park to resume the world's first high-definition television service. But whether that happens soon or late, we had our glorious hour. Television was here—you couldn't shut your eyes to it.

"I was neither at Olympia nor Alexandra Palace on that fateful September 1. In the late afternoon of August 23, we had finished televising the ablutions of the Giant Panda at Regent's Park Zoo. Freddie Grisewood and I were enjoying a belated cup of tea when an expected telegram was delivered. Twenty-four hours later I was in R.A.F. uniform many miles from London and the first intimation I received that television had actually closed down 'for the duration' was the brief statement radiated in the six o'clock News during the gloriously sunny evening of that otherwise black Friday."

Now we come to the "second era" of television. I find myself at a morning conference, 25, Marylebone Road, of S. J. de Lotbinière, Head of Outside Broadcasts (Radio and Television). De Lotbinière comes of a French-Canadian family. His grandfather, I think he said, was born in Quebec, but came over here and joined the British Army. Personally, I think he must be Irish, because his next statement was that, "If I had had a great-great-great grandfather fighting with Montcalm on the Heights of Abraham against Wolfe, the British would never have conquered Quebec at all!"

Here, of course, I was soon completely out of my depth. They were having a post-mortem on the televising of the Boat Race.

What I gathered out of the whole thing was that these boys now have four mobile units: one Marconi using image orthicon cameras; one E.M.I. unit with CPS-emitron cameras and two Pye units which use photicon cameras.

Camera Choice

Choice of camera for particular events takes considerable thinking out because it includes choice of lens, angles and the amount of light available. They told me that the units are chosen to deal, as specialists, with the particular requirements of the event concerned.

I also learned that the B.B.C. has just ordered two new mobile control rooms: one Pye and one Marconi.

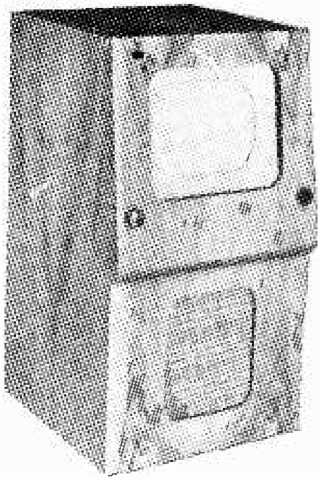
Moving to the Zoo to televise the unpredictable Brumas—not to mention Ivy—I learned that the special television cable covers the West End of London, running from Broadcasting House to Piccadilly, Trafalgar Square, and down Whitehall to the Houses of Parliament. After that it goes along the Mall to Buckingham Palace and takes in Victoria.

This is the original pre-war cable and is not strictly co-axial because it consists of two balanced wires. Since the war new co-axial cable has been installed to the Oval, Lord's, Wembley, Olympia, Earls Court, Lime Grove and the Riverside telephone exchange at Hammersmith for the Boat Race.

Apart from this cable it is possible, for events within a mile or two of it, to use the ordinary telephone wires.

For greater distances, of course, it is necessary to use radio links employing the fire-escape aerial or the new micro-wave equipment which was first used for the Boat Race. On a much larger scale, the boys used this method for the transmission from Southend.

So as I sat in the Reptile House waiting for Brumas to appear on the television screen, Keith Rogers, the producer, and Denis Monger ("as in fish"—when anybody fails to understand his name over the telephone), told me about the impossibilities of dismantling the whole bag of tricks and getting it "rigged" again for the next Outside Broadcast television programme.



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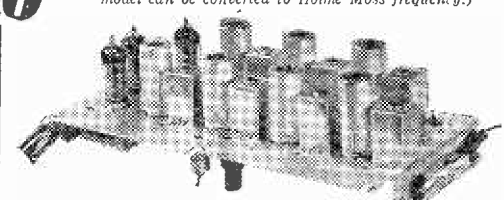

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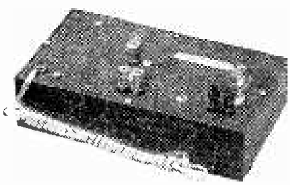

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My Early Experiments

By Prof. A. M. LOW (President of the Institute of Patentees; Past President British Institute of Radio Engineers)

THERE are some things which are bound to happen, and I have noticed that invention is almost as much the slave of fashion as a woman's hat. That is why it takes a little courage to see the future, although so much of it is very obvious.

As an example, think of the cinema. One used to be quite happy to look at magic lantern slides of a cottage, or the King opening Parliament, in fully hand-painted and very gorgeous colours. But as we became quicker in our minds we wanted movement, and slides with a raging sea or floating clouds were introduced. That was the time, whether we knew how or not is nothing to do with it, when we could be sure that moving pictures were soon to arrive. Such things as the Zöetrope pointed the way.

A little curve-plotting is useful in such cases. Try, for example, plotting time and speed of travel against each other and you will find that speed has steadily risen for centuries. Odd jumps in the curve due to traffic variations are quite incidental. The main tendency is there all the time.

It was this system of continuity which gave me what was then a queer idea. I had always been interested in relative motion and found it valuable in the design of automatic machinery to be able to adopt a "butterfly on the wheel" attitude so that the exact motion could be studied as if stationary.

Noticing that the flicker of a cinematograph could make carriage wheels stand still or move backwards, it seemed to me that a projector with a synchronous escapement would be valuable, and with it I made a number of experiments upon the exhaust valves of internal combustion engines. Valves could be seen to bounce, apparently to stand still, and thus have their characteristics observed. Much the same process I applied to drops from carburettors passing between two glass screens in an attempt to study vaporisation.

And then it seemed obvious. Why not divide a picture into squares and send them so that each one appeared to stand still and so that the time of sending of all the squares of which a picture was composed was within the limits of retentivity?

At that time radio was not well tuned, and I realised that one wire with a current in impulses such as those received by a coherer and relay was all that could be expected. All these simple things seem so clear that I am almost ashamed to admit how long a time they occupied me and how carefully I checked each stage. But the final, rough idea was a very natural outcome.

I designed a honeycomb of cells with a "rocking contact" and a revolving commutator which moved in such a way that two sets of cells could each be connected at the right moment. The total block could also be covered within retentivity limits.

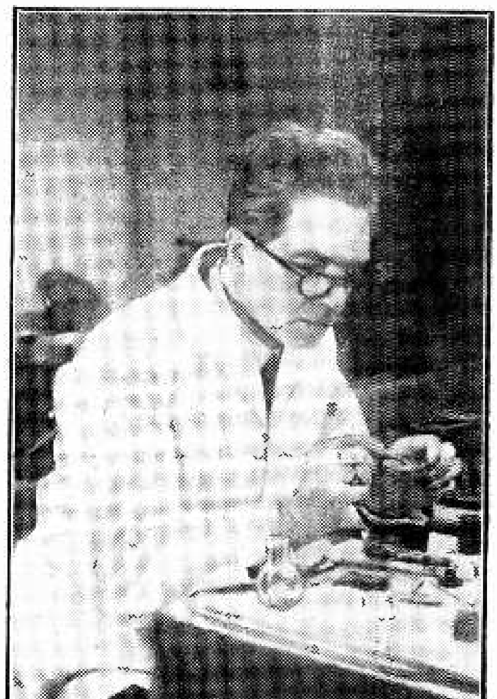
I patented the idea after giving a very poor demonstration of the principle alone at a lecture on the cinematographic study of moving parts before the Institute of Automobile Engineers. It was not until I reached home to find about twenty Press representatives that I worried much about the possibility of vision at a distance, although the machine was to be called the Televista.

Nearly every journal imaginable published an account. I have many hundreds of press cuttings of which one in particular delighted my friends, for on one side of the page was Consul, the billiard-playing monkey, and on the other, myself. Many postcards alleged confusion between the captions. Here are two extracts from current journals.

2nd June, 1914.

Aberdeen Press

Dr. A. M. Low, a young consulting engineer in London, has discovered how to transmit vision by wireless telegraphy. The other day Dr. Low made an experiment with his invention before the Institute of Automobile Engineers. . . . In appearance the apparatus is similar to a large camera. It is quite a simple apparatus, Dr. Low said, on the cinematographic principle applied to known methods of dealing with photo-telegraphy. Screens consisting of a large number of cells of selenium compositions are used. . . . The screen receives a number of pencils of light, which are reproduced in rapid succession on the transmitter, thus giving a reproduction of whatever moving object is in front of the transmitter. By simply having two synchronously timed instruments, it is quite easy, Dr. Low says, to use the apparatus without wire at all. .



Professor Low at his work-bench.

30th May, 1914.

Birmingham Press

. . . The scientist uttered a remarkable prophecy. "I am certain," he said, "that the time will come when people will be able to see themselves by wireless. I daresay I shall be dead by that time, but I am positive that in time, say 50 years, people sitting in a room in London will be able to witness a scene taking place on the deck of a steamer in mid-Atlantic. Mark my words, half a century hence people will say of us: 'How funny! The people in those days could not see a man without going to look at him!'"

Another prediction upon which Dr. Low ventured was that one of his machines could be planted in a field and used for the study of military operations taking place at a distance! This would be introducing a new complication into warfare, and would be, realising with a vengeance Napoleon's idea of strategy "seeing what the enemy is doing on the other side of the mountain".

It was not until I had spent time and money, not a great deal, but a vast sum to me at the time, that I realised how essential is the fashionable moment to invention. Not one single person of all those I approached would spend a penny upon development.

War broke out soon after and I was eventually asked by the War Office if the principle could be adapted to seeing both dials of an horizontal base position finder; and by the Royal Flying Corps, then a few huts on the War Office roof, if similar ideas could be used to guide a miniature aeroplane for attacking Zepps.

Joining the R.F.C., where I commanded the Experimental Works, I produced the British V.1., or "A.T.", as it was called by Sir David Henderson, who said to me, "We must call it an aerial target so that this thundering lie will deceive anyone who hears about our research."

Under extreme secrecy we made various models, the actual plane being constructed by de Havilland and eventually flown on Salisbury Plain, with Sir Henry Segrave shouting orders to myself at the controls. I was only an observer, not a pilot. The machine was launched by compressed air. I had gyroscopes and a complete control system later taken up by the Admiralty for tests on radio-controlled boats.

As a Flying Officer I achieved the excitement of my majority with a proud heart. I was also made a Lieutenant-Commander and then gazetted back again to the Royal Air Force. I was lucky to receive two Mentions and little else, for the Awards Committee told me that as an experimental officer I was only doing my duty, whereas, if I had been in the A.S.C., as it was then, I would have been eligible for hard cash.

Perhaps I had one award after all, for when I was sent to San Sebastian to inspect an alleged death-ray I was stood the biggest dinner I have ever had, at an hotel full of German submarine officers in mufti.

But to return to television, as I tried to do at the time. I even took out a patent for a condenser screen made by fine saw cuts; very nearly the iconoscope it seems nowadays. Again no one cared and I let the patent lapse. Most of these patents where taken out during the 1914 war. There was, I remember, one for electrically controlled rockets, and another idea dealt with a magnetic amplifier for radio valves.

In all my experiments at the time I did not find a single individual who thought that my invention had any business possibilities. It caused loud laughter, and commercial men summed up the situation by saying, "Even if developed it would never be of any use!" Humorists drew cartoons showing butchers holding up a joint for the housewife to see at home, and even motor-cars seeing at night in safety, but no one thought beyond the joke that if one could see through a brick wall some protection would be necessary for bathrooms.

You will note that comment was very modern, and I ought to make one point clear. It is that the Press were not only generous and thoughtful as usual, but they saw possibilities and offered to give openings to anyone who might be tempted to investigate. My designs were published in proceedings of the I.A.E., in 1914, and here is another amusing reminder of the times.

30th May, 1914.

The Times

An inventor, Dr. A.M. Low, has discovered a means of transmitting visual images by wire. If all goes well with this invention, we shall soon be able, it seems, to see people at a distance. Whether Dr. Low will be regarded in the future as a benefactor or the opposite depends upon something more than the degree to which the business will be mismanaged by the Government Department that will certainly absorb it so soon as private enterprise and capital shall have made of it a going concern. . . .

Was it worth while? Yes, a thousand times. The Army Council made me an Honorary Assistant Professor of Physics at the Royal Artillery College, and I had the satisfaction of thinking that television was not only bound to happen but was certain to give pictures to the world in colour as well if this should be needed.

Years later I made an oscillographic indicator and used infra-red to study the hot spots of engines, but to see people at a distance was what I really wanted. No terror in travel and more and more senses to be used to give life to silent films was what I realised to be a necessary part of progress.

I have had many inventions thought to be amusing at the time, of which self-winding watches, contact eyeglasses, and even a machine for reproducing handwriting or pictures by untuned radio, are examples. The latter, incidentally, came to me as the result of watching a pencil wobbling on an eiderdown when I sat on the end of the bed and thought that waves in the ether might also be made to do something if directional control could be achieved.

I have made audiometers, gas generators, extensometers and various peculiar things. I have even tried to find out how quickly certain flies rub their wings together to produce a buzz; but of all that will make me laugh longest and last I give the prize to television when pictures arrive from the Continent without the faintest hope of interference by our delicate-minded censors.

I often say that what is good enough for to-day is much too bad for to-morrow. But to be able to add "I told you so" is always a rare and wicked pleasure.

TELEVISION LIGHT

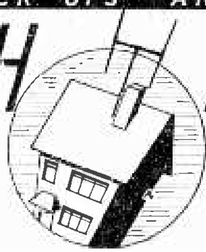
THE Courtney Pope television light consists of an upward reflector with a weighted base for use with 60 watt Pearl lamp. In the top of the reflector is a circular piece of ¼in. plate glass suitably ventilated. The object of the fitting is to throw light on to the ceiling without giving a visible source to reflect in the screen of the television set.

The purpose of the glass is either to insert artificial flowers in the holes or on which to stand a short cut-glass flower bowl, thus illuminating the flowers from below and making a decorative feature of the fitting. Another use of the fitting is in sick rooms where the direct light would worry patients.

The complete item is finished in Princess Bronze stove enamel.

TELEVISION PICK-UPS AND REFLECTIONS

UNDERNEATH THE DIPOLE



By Iconos

B.B.C. AND THE FILMS

ADMINISTRATIVE executives of the B.B.C. and the Film Industry have never been the best of friends. In fact, for a long time they have scarcely been on speaking terms. Now and again this atmosphere of mutual suspicion has broken out into open opposition, if not open warfare. There was the newsreel squabble (which led up to the B.B.C. starting its own newsreel), the battle of the current film releases on TV (which resulted in all but the oldest cinema films being banned from TV), and the interminable guerilla warfare regarding artistes' credits (" by permission of the J. Arthur Rank Organisation "). The future bristles with problems of copyright, the developing and printing (or not) of TV newsreels on Sunday, and heavy pressure from several trade unions connected with films and the theatre. At the moment, the B.B.C. is cleverly boxing its way through a maze of hazards from the left and the right, with both sides desperately endeavouring to guard their vested interests.

FILM AND TV CO-OPERATION

IT is therefore highly satisfactory to find that in the engineering side of both the B.B.C. and films, matters are on a more friendly and co-operative basis—a basis, moreover, which may ripen into mutual assistance. The British Kinematograph Society recently invited leading B.B.C. TV engineers to the reading of an important Paper on " Economic Influence on Studio Lighting," and encouraged them to take part in the discussion which followed the reading of the paper. Collaboration between British film and TV technicians is tending to follow the line taken in America, where the Society of Motion Picture Engineers has changed its name to the Society of Motion Picture and Television Engineers, usually known as the " S.M.P.T.E." The British Kinematograph Society (B.K.S.), however, is concentrating its television activities on technical production matters, and leaving the specialist field of receiver and transmitter design to the long-established and go-ahead Television Society. Production equipment covers a wide range of apparatus which is common to both film and TV studios, and there are very many subjects which can be beneficially explored as a result of this new *entente*. An interesting pointer of things to come can be seen in the proposed venue of the " Studio Visit " of members of the B.K.S., an annual affair which was held last year at the Ealing studios, and in 1949 at the A.B.P.C. studios, Elstree. The B.B.C. have invited the B.K.S. to visit the Lime Grove television studios for their 1951 " Studio Visit " in May, and I understand that it will be organised in a manner appropriate for a body of professional engineers and craftsmen, with a discussion for the exchange of ideas to follow the trip around the plant. Let us hope that in the course of time the Big Executives will follow the example of their respective engineers and bury the hatchet.

FRUSTRATIONS

RESIGNATIONS from the administrative side of television have been much publicised, but at the same time there have also been losses of personnel on the technical and creative side. This is unfortunate. All these resignations seem to be the result of " growing pains " of the young television side of the B.B.C., chiefly arising from a sense of frustration of effort caused by the attitude of the parent body at Broadcasting House. Television is now more than a lusty infant, and many B.B.C. people feel that it will not make real progress until it breaks away on its own. But even if the Television side was given its own charter, it would still possess the weaknesses which are inherent in the parent body—the paralysing effect of monopoly. Competition is required, and this could be provided if two or three evenings a week were made available for sponsored programmes. Perhaps the Beveridge Report will throw some light on this subject. Meantime the B.B.C. staff not yet afflicted with " frustrationitis" seem to be carrying on very well.

MONEY TALKS

I HAVE formed the impression that the B.B.C. boys are not overpaid—in fact, many very responsible jobs requiring special qualifications are paid at rates far below those of competitive industry. That is what

PROFESSOR BOFFIN

" Hic—Hello, B.B.Shee ? Sheems to me you are slightly out of hic—focush ! "

some of the B.B.C. engineers say, at any rate. On the other hand, B.B.C. jobs are looked upon by some people as being more in the lines of the Civil Service, with an atmosphere of permanency unheard of in the rough-and-tumble of the entertainment business. Superannuation schemes, pensions and long holidays, and liberal supplies of committees, agendas and red-tape support this point of view. Salaries are therefore appropriately lower. Nevertheless, various trade unions are attempting to recruit members of the Alexandra Palace and Lime Grove studios, holding out rosy promises of the results of negotiation outside of the B.B.C. Staff Association. I must say that it would be a great pity if outside trade unions got any kind of control of B.B.C. staff affairs, particularly in the case of one union which is very politically conscious, and is virtually Communist controlled. The remedy surely lies in the B.B.C. reviewing its salary rates and bringing them up to the standard which would be paid if television in Britain was competitive.

"ARTISTIC FREEDOM"

ARISING from the shelving of a C.O.I. film, "Four Men in Prison," there has been an outcry in certain "artistic circles" about the restrictions imposed upon producers, directors and writers working under Government sponsorship. This film has been held up by the Magistrates' Association on the grounds of inaccuracy. Pleading for complete freedom of expression, notwithstanding the existence of a definite "brief" upon a subject to be filmed, John Grierson said, "Does the piper—under these new conditions of monopolistic Government censorship—invariably call the tune to the artist; and may he at will breach the implicit contract with the artist?"

PROPAGANDA

ALL fair-minded viewers and cinemagoers will sympathise with Mr. Grierson's plea. But the fact must be faced that at the present time some of these artistic geniuses may have a private axe to grind, an ulterior motive, or even a foreign government to serve, though I am sure that this does not apply in the case of "Four Men in Prison." It is obvious that the B.B.C. has become much more careful in these matters than the C.O.I.; and individuals with crack-pot or cranky ideas are much less encouraged than heretofore. Just think what *might* happen if some of these long-haired "intellectuals" were given a free hand. Most of them, like the man who made the prison film, might be harmless enough. But the Gilbertian situation could arise of good British public money being used to pay for Communist propaganda on film or television. I am not referring to the type of propaganda heard on the English-spoken broadcasts from Moscow or Warsaw, where potential Lord Haw-Haws speak poison-loaded words with honeyed British accents. These broadcasts fool nobody. Foreign interests are better served by undermining the confidence of the people in the British way of life, our institutions, our laws and our industry, by the clever shaping of documentary subjects on film or television, to serve this purpose. Such a possibility cannot be disregarded. It is obvious that the B.B.C. is alive to it—for which we must be thankful. Very careful checks should be made on the bona fides of producers of documentary subjects whose "briefs" concern controversial subjects. B.B.C. and C.O.I. please note!

TV MUSICAL COMEDY

PANTOMIME and musical comedy do not seem to be a strong suit at the Alexandra Palace, or at Lime Grove, now increasingly used. The much heralded pantomime "Cinderella" proved to be under-rehearsed and with poor comedy material. This was a great pity, because Jack Hulbert usually comes over TV very well. It seems to me that when tackling this type of production more care should be taken with the casting. Pantomime and musical comedy have many things in common; the basic plot may be slight and the situations familiar, but there is always opportunity for the comics to get to work with their own particular material—and this is not necessarily verbal. Leslie Henson, TV's most successful musical comedy comedian, scored a record number of laughs in "Bob's Your Uncle," but these arose not particularly from the lines of dialogue but from his inimitable delivery of them—and from his wonderful clowning. The TV audience, fed regularly with smart, slick review material, finds the going hard when sitting through an hour or so of material of the well-tried "corny" variety.

SLAPSTICK ON TV

SOME of the comedians of the past would have revelled in television. W. H. Berry, the veteran comic of so many musical comedies at the Adelphi Theatre, would have scored a big hit with his well-timed clowning and his inevitable collection of comedy stage "props." So would Billy Merson, the Brothers Egbert and Wilkie Bard, whose antics in pantomime convulsed audiences all over the country for many years. The Crazy Gang, with Bud Flanagan, Naughton and Gold, and Nervo and Knox, are not seen at all on television, for contractual reasons, but there is a big opening for the crazy type of low comedy on TV. Richard Hearne, however, is occasionally seen in good burlesque sketches, and with a company of comics and stooges could build up a new tradition of TV slapstick comedy. Everyone wants a good laugh these days—not the gentle chuckle aroused by polite comedy—but the so-called "belly-laughs" which are the special province of the low comedians of the music halls.

THE COMICS' GRAVEYARD?

OF course, music hall comedians miss the audience reaction to which they time their "business" and "gags." And the invited audience so often sounds like a claque, dutifully laughing and applauding at appropriate moments. One well-known comedian confessed to me that he was frightened to death by the TV camera and the tension in the television studios. "It reminds me of giving an audition to a hard-boiled manager in an empty theatre," he said. "There he is, seated in the front row of the stalls—and he seems to be saying, 'Now then, Mr. Comic, *make me laugh*'." The biggest problem the producer of TV low comedy has is to build up the atmosphere which inspires these gifted clowns to give of their best. I think that an audience is essential, even for musical comedy, but it is important that the audience should be given its head. Given the atmosphere and the right mood, low comedy will televise well and delight viewers.

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AT least one manufacturer is now producing a television receiver in which a special selector device is fitted to enable the receiver to be tuned to any one of the British television channels. The use of the superhet principle, with a specially designed frequency changer, simplifies the arrangement and it is thus unnecessary to make different receivers for each station.

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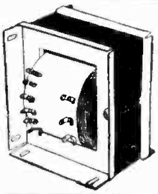

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Correspondence

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).

USING THE VCR97

SIR,—It is some time now since the subject of the above was discussed in your correspondence columns, but I think my experience in this connection will still prove of interest to those who may not have yet achieved satisfactory results with their equipment.

I refer specifically to the lack of interlace, or pairing, that occurs so commonly, sometimes unsuspected, as in the case of your correspondent who complained of "gaps between the lines." That the fly-back lines, visible on increasing the contrast, are observed to interlace correctly is no proof that the picture itself is also interlacing if a Transitron/Miller oscillator is used, as this type of oscillator is capable of being triggered both on fly-back and on commencement of scan, and it is necessary to be more than ordinarily careful to avoid unwanted coupling from the line time-base.

The usual two-valve paraphase frame time-base is, therefore, not permissible owing to the capacitive coupling in the VCR97 and associated leads. The remedy I adopted is to feed the saw-tooth output of the oscillator valve in seesaw paraphase to one half of a 6SN7, which is itself similarly coupled to its other half, the output to the deflector plates being taken from the anodes of the 6SN7. (Amplitude control can conveniently be incorporated in the first coupling by making the point of balance of the seesaw arms variable with a suitable value potentiometer.) The heavy negative feedback thus employed is sufficient to correct valve non-linearity. With 2.5 kV. E.H.T. and only 430 v. to time-base amplitude is sufficient to over-scan the tube in the Y direction and a still adequate scan in the less sensitive X direction. I use 100 kΩ anode loads and a 2 kΩ unbypassed common cathode resistor.

In addition for full reliability of interlace I recommend that synchronisation should be applied to the frame oscillator in the form of steep-sided pulses, using the principle described by W. T. Cocking in "Television Receiver Servicing," p. 268 (2nd edition). I use the following circuit which gives splendid results. Negative-going sync. pulses at the anode of the pentode sync. separator are differentiated by a condenser and resistor of time-constant .04 millisecs., say, 200 pF. and 200 kΩ, and applied to the grid of a second pentode limiter biased to cut-off. Its cathode is fed from a potentiometer network across the H.T. supply so that it is normally about 70 v. positive. The screen is also fed from the network from a point about 140 v. higher and both are decoupled to chassis with .1 μF. With an anode load of 27 kΩ steep-sided frame pulses appear at the anode and are applied through a small condenser (less than 10Ω pF) to a tapping on the suppressor-leak of the Miller oscillator.

I hope this information will be of use to those who, like me, are restricted by the purse to the humble VCR97.—PHILIP H. MORRIS (Paddington, W.9).

VCR140

SIR,—The whole snag with the VCR140 for T.V. is its long afterglow.

I tried using one in a home-built televisor with both the full and reduced E.H.T., but have not found it satisfactory.

A good picture is obtained on the back of the screen in blue. A picture of a stationary object (e.g., Test Card) appears on the front of the tube in a yellowish-brown. This colour would be quite tolerable, but when the picture changes the last object still shows (due to afterglow) on the new picture and in moving shots highlights show through in blue. Also considerable detail is lost. This may easily be confirmed by inspecting the picture on the front and back of the screen.

In my opinion the tube is not suitable for T.V.—D. R. ELDERKIN (Lydd).

SIR,—One of the firms which advertise the VCR140 C.R.T. has informed me, in answer to my inquiries, that this tube gives a reasonably good picture but cannot compare with the standard type TV tube, due to its persistence. I should also like to hear from any readers who have used the tube—results, operating data, etc. As Mr. Sunman said last month the price makes it a most attractive proposition !

As I live in the fringe or outer fringe area, I have followed with the greatest interest the animated discussion between Messrs. Thomasson and West over the Cascode pre-amplifier. May I hope that the outcome of it all will be a modified circuit diagram and/or an article on the construction of such a pre-amplifier ?—J. B. BROLLY (Southampton).

SERVICING

SIR,—I have been interested in the recent series on servicing, but would like to point out for the benefit of others that things are not always what they seem. Although, as pointed out in the article, most symptoms indicate the *source* of a fault the location of the item responsible may be a very long and tiresome business. For instance, I recently had a set in which a fault indicated that the video stage was causing the trouble. Every component associated with the stage, including a substitute valve, was tried but with no improvement. An examination of the circuit showed that the interference suppressing valve was fed in such a way that a faulty condenser in the lead from the last R.F. stage resulted in a bias being applied to the suppressor, which in turn short-circuited the R.F. of the video stage. So a careful study of the circuit is always desirable when a fault has been located, and I have found that it is usually the unexpected which is responsible.—H. LOWTHER (Hampstead).

TEST SIGNALS

SIR,—I have made a receiver and am fairly satisfied with the results but I have a complaint to make against the B.B.C. I am out at the office all the week and never get a chance to see the Test Card. When adjusting the receiver on pictures I find that changes of scene are usually accompanied by changes of camera and there seems to be no two cameras at A.P. which give the same results. Thus I get a good picture of the announcer and then on, say, comes the first act and it's all fuzzy. I then start to tinker with trimmers, only to find that I cannot improve things. Why cannot we have a steady signal for test, such as the Test Card, sometime during the week-end (after lunch-time on Saturday)?—G. BINGLEY (Maidstone).

[*We have asked the B.B.C. to consider the question of Test Card "C" transmissions for the benefit of amateur* *constructors, but they say they have no spare cameras or telecine equipment available outside the present periods of use. They will keep the matter before them, however, and when additional equipment is available may do something to help the constructor.*—Ed.]

AUTOMATIC GAIN CONTROL

SIR,—Have any of your readers experimented with A.G.C. which seems to find much popularity in America. Amongst other defects this scheme is also supposed to suppress aeroplane flutter and is claimed to be better than the A.C./D.C. network feeding the tube. It may be, of course, that their system of horizontal polarisation may enter into this, but as I have at the moment only a commercial receiver with which I do not wish to tamper, I should like to know something of these other schemes for the time when I start experimenting.—J. READ (S.W.8).

VIDEO STAGES

SIR,—I have been spending quite a lot of time lately with video stages and should like to pass on some of my findings to others who find so much interest in trying out new ideas. After trying parallel and push-pull pentodes, tetrodes and triodes, I have found best results to be obtained with an American 6AG7, a very high-slope valve. I am using an anode load of only 1,500 ohms, 300 volts on the anode, 150 volts on screen, 150 ohms unbypassed bias resistor and no correction chokes of any kind. The drive for the tube which is cathode-modulated is taken straight off the video anode and the tube is, of course, supplied by an isolated heater winding. There is a difference about the picture obtained by this stage which is quite noticeable, but I can't describe it. Apart from the definition all edges are very sharp, due, I think, to cutting all time-lagging items out of the circuit. Can other readers give the results of their experiments in obtaining sharper and "cleaner" pictures, especially so far as concerns the smear which is generally found on the side of dark objects (see the rectangle at the top of the Test Card ?—L. WALDE (N.W.9).

IMPROVING VIDEO L.F. RESPONSE

SIR,—You publish this month (January) an article by D. Cave under the above title. If any L.F. deficiency lies in the vision side of a receiver the fault is not likely to be inadequate time-constant of the video R.C. coupling where D.C. restoration is incorporated.

In such a circuit the time-constant of the R.C. coupling need be no longer than will cause a negligible voltage drop over the duration of one line scan. Therefore 50 pF in conjunction with 1 megohm will produce less than 2 per cent. distortion, and the usual value of .1 μF and 1 megohm is 2,000 times better than this ! Experiment confirms that a .001 μF condensor with 1 megohm is more than adequate.

However, the principle applied to a video coupling without D.C. restoration, an oscilloscope amplifier, or even an audio stage, would no doubt work admirably. —P. H. MORRIS (W.9).

Facts and Figures

THE following data shows how the present Television Service has grown, and gives some future statistics.

Licences

Numbers up to the present are :—

June, 1946	1,300
March, 1948	45,500
December, 1948	93,000
December, 1949	240,000
October, 1950	511,000
December, 1950 .. .. (approx.)	555,000

Estimated numbers up to April, 1953 are :—

April, 1951	600,000
April, 1952	1,025,000
April, 1953	1,575,000

Finance

Actual expenditure on television in the past three years and estimated expenditure during the current year are as follows :—

	Revenue Expenditure	*Capital Expenditure*	*Total*
1947-48 ..	£648,000	£74,000	£722,000
1948-49 ..	£786,000	£283,000	£1,069,000
1949-50 ..	£1,070,000	£914,000	£1,984,000
1950-51 (estimated) ..	£1,500,000	£1,202,000	£2,702,000

Coverage

The timetable for the erection of television stations provides for a service to be available to approximately 85 per cent. of the population, i.e., 40¾ million, by 1954, the dates being :—

	Date of Completion	*Power kw.*	*Population Served*
Holme Moss (North of England)	Mid 1951	35	11 million
Kirk O'Shotts (Central Scotland)	End 1951	50	3½ million
Bristol Channel (Wales and West of England) ..	Mid 1952	50	3½ million
Newcastle	1952	5	2½ million
Southampton	1952	5	1 million
Belfast	1953	5	¾ million
Aberdeen	1953	5	¼ million
Plymouth	1954	5	¼ million
Alexandra Palace ..	Opened 1946	17	12 million
Sutton Coldfield,	Opened Dec. 1949	35	6 million
Total			40¾ million

Sutton Coldfield is the most powerful television station yet constructed anywhere in the world.

Equipment

The following table will show how the main items of equipment have been introduced into the Service :—

Studio and O.B. Equipment (Fully Operational Units only)

	July 1946	*March* 1948	*Dec.* 1950	*Mid* 1951
Studio Camera Channels (excluding telecine) ..	6	6	14	14
Telecine Machines	2	2	7	10
Telefilm Recording Machines	—	—	2	2
O.B. Units (each with 3 active camera channels) ..	2	2	3	5
O.B. Radio Link Equipments (Vision)	2	2	2	6

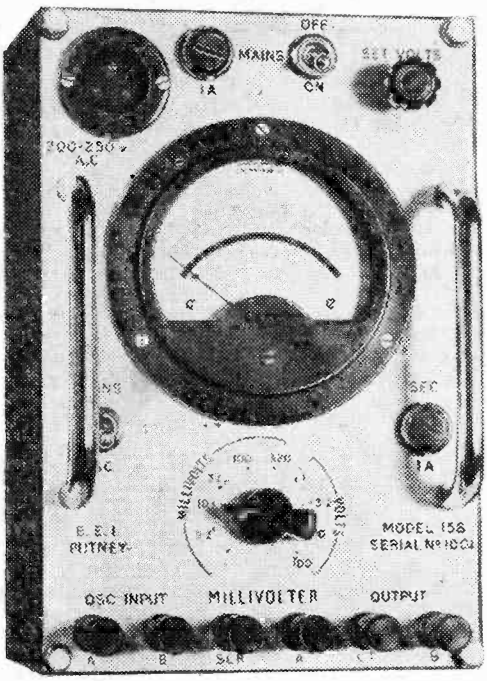
TRADE TOPICS

Peak-to-peak Millivolter

THERE are many operations in laboratory, workshop and field in which a calibrated source of voltage is desirable. The characteristics required in such an application may be summarised briefly as follows :—

1. A reasonably low voltage should be obtainable.
2. The voltage should be known to within 1 per cent.
3. The source impedance should be so low that no circuit normally met with will cause a shunt loss exceeding 1 per cent.
4. A sufficiently high voltage for direct calibration of cathode-ray oscilloscope tubes should be available.
5. The output should be balanced or unbalanced at will.
6. Provision should be made for the use of A.C. mains voltage or external oscillator tone.
7. The readings should be made by a circuit which responds to peak-to-peak voltage rather than R.M.S. volts.
8. The source should be adequately screened.

All the above-mentioned requirements are covered by the B.E.I. millivolter, illustrated below.



The Millivolter referred to above.

Designed for operating voltages of 200 to 240 v., 40 to 100 cycles, it measures 6in. x 9in. x 5in. overall.

The meter is a 4¼in. diameter moving-coil mirror-scale with knife-edge pointer, scaled 0-100 and 0-32, connected in a special peak-to-peak circuit.

The ranges covered are as follows :

Step	Full scale deflection	Source Impedence
1	1 m.V.	1.2 —0— 1.2 ohms
2	3.2 m.V.	1.2 —0— 1.2 ,,
3	10 m.V.	1.2 —0— 1.2 ,,
4	32 m.V.	1.2 —0— 1.2 ,,
5	100 m.V.	1.2 —0— 1.2 ,,
6	320 m.V.	1.2 —0— 1.2 ,,
7	1 volt	4.62—0— 4.62 ,,
8	3.2 volts	15.42—0— 15.42 ,,
9	10 ,,	50 —0— 50 ,,
10	100 ,,	500 —0—500 ,,

The price is £18.10s.

British Electronic Industries, 28, Upper Richmond Road, Putney, S.W.15.

Rainbow Pre-amplifier

THIS unit has a built-in power supply using Westinghouse rectifier and may be used with A.C./D.C. receivers as well as A.C.-only models.

The amplifier valve is a Mullard EF91 and gives excellent signal-to-valve-noise ratio.

The staggered input and output transformers are iron cored and well damped to preserve as far as possible the overall response.

Seventy-five ohms balanced, as well as coaxial input and output connections are provided, the coaxial being of the Belling Lee type as used on many commercial receivers.

The amplifier is contained in a black crackle finished steel case, measuring 8⅜in. x 4¾in. x 2⅜in., and may be mounted directly on the back of most receivers.

The price is £5 17s. 6d.

Rainbow Radio Manufacturing Co. Ltd., Mincing Lane and Mill Lane, Blackburn, Lancs.

Change of Address

SUSSEX Electronics Ltd. have taken much larger premises and have moved from the Riley Road address to the address below. The telephone number remains Brighton 24446.

Princes Works, 10, Princes Street, Brighton, 1.

"Television Circuits"

THE second edition of this handy book is now available, and in addition to those circuit arrangements dealt with in the first edition there are some new ones. A new sync separator is described, with grid modulated tube, as well as a new line time-base which incorporates an output transformer. Whilst the book does not deal with the theory of operation it gives circuits and lists of components for everything needed to make up a complete television receiver capable of the highest picture quality, and which includes, of course, the Haynes products. The book costs 1s. 6d., post free, from :

Haynes Radio Ltd., Queensway, Enfield, Middlesex.

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