AN AERIAL PRE-AMPLIFIER

PRACTICAL TELEVISION

AND TELEVISION TIMES

1/-

EDITOR F. J. CAMM

A NEWNES PUBLICATION

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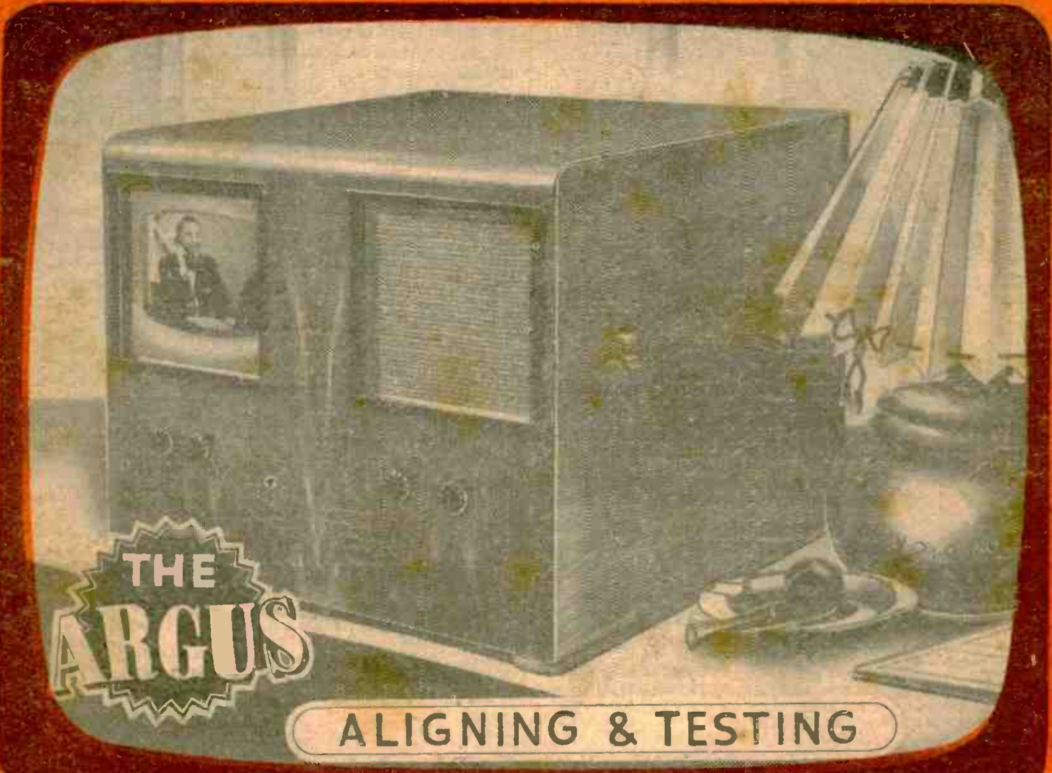

FEATURED IN THIS ISSUE

PRACTICAL TELEVISION
& "TELEVISION TIMES"

Editor: F. J. CAMM

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Televiews

THE EVER GROWING AUDIENCE

APPROXIMATELY 1,386,000 television licences were current in Great Britain and Northern Ireland at the end of February of this year, and for the second month in succession the number of television licences has increased by more than 100,000. Thus, in the space of two years, television licences have increased by over 1,000,000. The total number of broadcast receiving licences, including the television licences, is 12,637,000. Our enquiries show that whilst the number of receiving licences for sound-broadcast receivers continues to rise, the amount of time spent in listening to radio programmes is decreasing, and the time spent in viewing continues to rise. Viewers are an ever growing audience, and it seems reasonably certain that at the present rate of accretion there will be 5,000,000 viewers within the next five years. Any two television programmes are seen by more people than visit a successful theatrical show in the whole of a year. Sales of TV receivers now exceed the sale of broadcast receivers.

The statistics given do not take into account the number of viewers, considered to be at least 100,000, who have not taken out licences.

TV MAINTENANCE COSTS

A READER asks us whether his maintenance costs for a commercial TV receiver over the last two years, which have amounted to £16 4s., are exceptional. He says that during that period he has had to replace 12 valves and one C.R. tube. Upon protesting to the makers he was informed that this may be considered as normal for any type of receiver. We can assure the reader that this is not so. Our own "P.T." receiver has been in regular use for the past two years and the replacements have been nil.

Valves, being consumable items, are considered by the manufacturers as items which should be replaced by the user, as obviously the number of hours the receiver is in use cannot be covered by an extensive guarantee, although manufacturers do, as a fact, guarantee tubes and valves for a period of at least six months. It is our experience that tubes retain their characteristics for two years at least. However, we invite our readers to relate their experiences in our correspondence columns.

PURCHASE TAX RELIEF SCHEME

MR. J. STANLEY, of Colliers Wood, has propounded a scheme for the relief of Purchase Tax on TV tubes. He argues that it is a hardship when, just outside the guarantee period and having paid a considerable sum in Purchase Tax when buying the receiver, a further quite large sum must be paid in tax should a new tube be required. He has submitted his scheme to a number of newspapers and periodicals and also to a Member of Parliament. Briefly, he suggests that the G.P.O. licence form should be printed with an additional, coupon fixed by the normal perforation method this coupon containing the licence number, date of issue and name and address of the purchaser. By presenting this slip to the retailer Purchase Tax can be remitted from the sale of one TV tube, the retailer forwarding the slip through the proper channels for refund, and the slip being filed against the TV licence record. The sponsor of the scheme says that there is no likelihood of a black market in these slips because of the possibility of their own set failing. As all tubes are guaranteed for six months, it could be made a rule that the slip is only valid for three months after issue, unless a licence had been held previously. The scheme would permit one tube per year per licence.

On the face of it the scheme would appear to have merit, but we foresee a number of snags in its operation. Unscrupulous people would find plenty of loopholes, for it is not true to assume that a new tube is required every year by every viewer.

"TELEVISION PRINCIPLES AND PRACTICE"

WE have just published an important new handbook entitled "Television Principles and Practice." It costs 25s., or 25s. 8d. by post, and contains 215 pages. The chapters are: The BBC Television System; The Television Camera: From Transmitter to Receiver; Projection Receivers; Stereoscopic and Colour Television; Time Bases; D.C. Receivers: Aerials; A London-Birmingham Converter; Servicing; Interference: A Pattern Generator; Choosing a Receiver; the Beveridge Report; Dictionary of Television Terms, and a fully cross-referenced index. The edition is necessarily limited by the paper position, so copies should be ordered without delay.—F. J. C.

Interference Limiters

A REVIEW OF SEVERAL COMMERCIAL SYSTEMS

By S. A. Knight

(Continued from page 493 April issue.

REFERRING to the Murphy circuit (Fig. 11) the suppressor is built around two diodes D1 and D2 (a single DD 41 in the actual circuit), and operates after a triode amplifier which is part of a double-diode-triode. The anode load of the triode R1 is very low (22 kΩ) but the gain of the stage must be limited to ensure that the interference pulses are adequately retained. The signal appears at the cathode of D1 and at normal modulation frequencies the anode follows the cathode potential ; thus the signal is applied to the grid of the output valve through the coupling C4R4. The anode voltage of D1 is derived from the audio signal at the anode of the output valve, rectified by D2 whose load is R3, D1 and R2 in series, and the voltage present across C3 is directly proportional to the amplitude of the signal. Condenser C2 (stray capacity in the circuit) thus has its charging rate dependent upon the signal amplitude, and hence the limiting action also depends upon the signal amplitude. There are no adjustments to be made to this circuit, which is a point of some importance, and the designers state that no distortion to the signal occurs below 10 kc/s.

Other Systems

The possible variations of the basic limiter circuits are almost without number, and two particularly interesting circuits are found in G.E.C. receivers. The first of these is shown in Fig. 12, and is incorporated in the Model BT1091A. A double-diode is used but is shown in the diagram as separate diodes D1 and D2. D2 is connected to the grid of the output valve and rectifies the audio signal so that a negative potential is developed across R2C3 practically equal in value to the peak level of the signal. This potential biases the anode of D1 so that the signals fed to its anode through C1R1 and C2 are insufficient to allow the valve to conduct. On the arrival of a pulse of interference the time constant of R2C3 (10 MΩ and 0.01 μF) is so great that the anode of D2 cannot follow the pulse wave-form, and so the bias level on D1 anode remains steady. As, however, the interfering pulse is also applied to the anode of D1 the potential at this point rises above cut-off value and D1 conducts and applies a large degree of negative feedback to the grid of the triode amplifier. The amplitude of the interfering pulse is consequently reduced. In the absence of noise D1 is maintained in a non-conducting condition not only by the negative potential at the anode, but also by a standing bias developed across R3 in the cathode of the triode, and so distortion on signals of low amplitude is minimised.

On Models BT7092 and 7094 the noise suppressor takes the form of the circuit shown in Fig. 13 and utilises a diode D1 and an R.F. pentode V1. The audio signal is fed to the grid of V1 and the anode of D1, and the cathodes of the two valves are connected together through an artificial transmission line of approximately 5 μS delay. V1 operates as a cathode-follower, and under no signal conditions D1 anode is biased by the potentiometer R1 to just conduct. When the circuit is operating the signals appear at the anode and the cathode of D1 at approximately the same level but with a 5 μS phase-time delay due to the action of the delay line. Interference pulses appear as positive potentials at the diode anode, but the cathode cannot rise in sympathy until the lapse of 5 μS. The diode consequently conducts and provides a low impedance path from the grid of V1 to chassis for the interfering pulse.

Vision Interference

The problem of interference suppression on the vision side of the receiver is rather easier of solution than is the corresponding problem on sound. Interference on vision is not as psychologically objectionable as the same thing produced as a noise, and for this reason conditions of suppression are not as critical and the maximum tolerable limit of the interference is somewhat greater.

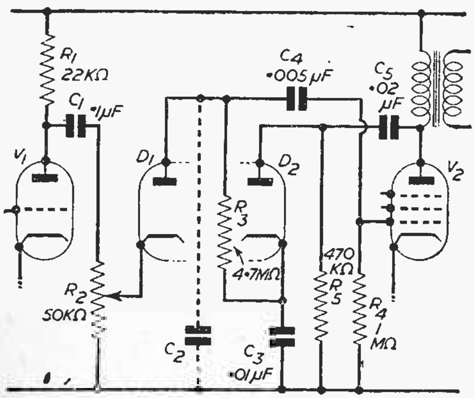


Fig. 11.—Circuit due to Murphy.

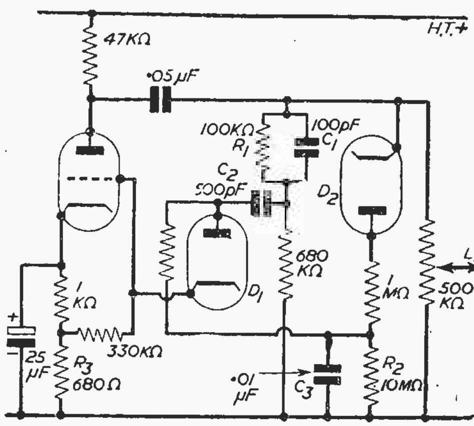


Fig. 12.—This is a good scheme—found in G.E.C. receivers.

For once in a while this fact is a fortunate one from the designer's point of view, as it would be no simple matter to design a limiter that would follow the video waveform as those so far discussed follow the audio waveform, because in general the pulse character of the interference is little different from the overall shape of the video signal. The only solution lies in a simple form of amplitude chopping that will limit the interfering

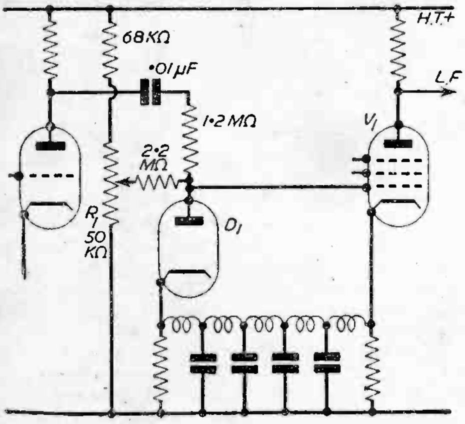


Fig. 13.—Another arrangement used by G.E.C.

pulses to the maximum (peak white) level of the signal, anything below this level being accepted along with the picture modulation.

An interfering pulse of short duration should theoretically only produce a small bright spot on the tube screen, but in practice the electron beam is defocused by the overloading produced by the noise when the tube is driven far above normal peak white level. The spot then becomes a large blob and a large area of the picture is obliterated. By limiting the interfering peaks to the maximum white level of the picture, focus is retained and the only effect on the screen is the appearance of extremely small white spots that do little or nothing to mar the image.

A simple diode limiter may be included in the circuit immediately after the detector, but in general it is connected directly to the tube input electrodes or at the output of the video amplifier, whichever happens to be most convenient. A thoroughly typical circuit is shown in Fig. 14. and is so used in Vidor television receivers. One half of the double-diode valve acts as the normal vision detector and the output is passed through the filter C1L1 to the grid of the video amplifier. The output at the anode of this valve is returned to the anode of the other diode, the cathode of the diode being taken to the junction of R1 and R2 connected across the H.T. supply source. Normally the diode is held in a non-conducting condition, the cathode potential being more positive than the anode ; on reception of a high amplitude interfering pulse the video amplifier anode swings towards the potential of the H.T. supply and the limiter conducts, thus providing a low impedance path for the interfering peak.

The values assigned to R1 and R2 in this circuit are chosen, in relation to the maximum possible positive excursions of the video signal at the anode of the video amplifier, so that the diode cathode voltage just exceeds that at the anode when peak white signals are being handled. R1 and R2 could, of course, be replaced by a variable control so that the actual level at which the diode conducts is adjustable, and in some receivers this is done. This refinement takes care of alterations in the peak white level introduced by adjustments to the contrast control, but in general the setting of such limiters is not critical over a wide range of contrasts and the fixed potentiometer for cathode bias is sufficiently effective. When the video amplifier is fed from the cathode of the

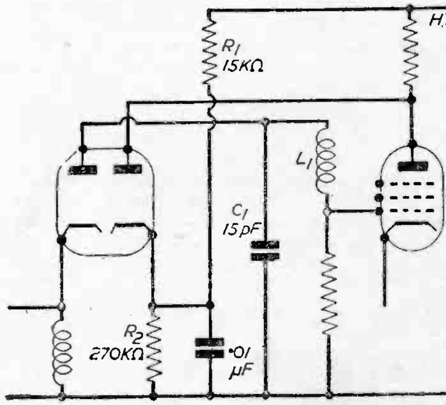


Fig. 14.—This is a Vidor arrangement.

detector, i.e., with positive-going signals, the limiter diode must be reversed also, the cathode being connected to the video amplifier anode.

A modification of the circuit is found in some H.M.V. and Cossor receivers ; Fig. 15 shows the circuit used on H.M.V. Models 1805 and 1806. Here the cathode of the limiter diode D1 is biased positively with respect to the anode by the setting of the potentiometer R1 and so is rendered normally non-conductive. The cathode also couples to the anode of the video amplifier through a condenser C1 of 0.1 μF capacity. When interference occurs and the signal exceeds the peak white level set by R1 the anode of the diode limiter goes positive and the valve conducts. An 180 deg. out-of-phase signal is then applied through C1 through D1 to the grid of the video amplifier and the interference is neutralised. On Cossor models a negative detector output necessitates the reversal of the limiter diode and C1 has a value of 0.5 μF.

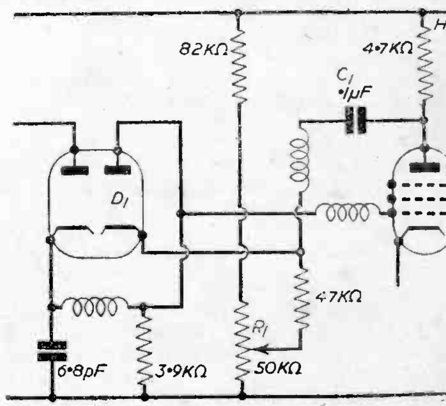


Fig. 15.—H.M.V. and Cossor both make use of this idea.

A more elegant form of this sort of limiter consists of an inverter stage which is arranged to invert the interfering pulse and apply it to the tube in opposite phase so as to cut the brightness to zero for the pulse period. The interference therefore takes the form of black spots instead of white ones. This may be an advantage but is obviously a point which depends upon the tastes of the viewer.

How Does It Work?

A circuit of this form which can be used in place of the existing diode limiter is shown in Fig. 16, and is of G.E.C. design for inclusion in their receivers. The inverter valve is an R.F. pentode and it is left as an exercise to the reader to follow the mode of operation.

The cathode of the picture tube is normally fed with negative-going signals from the video amplifier.

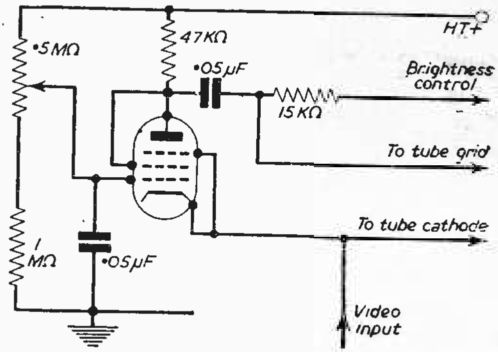


Fig. 16.—Another G.E.C. arrangement.

AERIAL NOTES

FOR best results an aerial should be at least one wavelength above earth. Below this, ground reflection is likely to reach the aerial out of phase and of sufficient strength to reduce signal pickup.

As the roof in lots of cases can be considered earth this would mean a mast of something over 20ft. where the aerial is secured to the chimney. This is not usual. It is more common to see the aerial carried on a mast of from 10ft. to 15ft. There is probably some loss, but not enough to justify the complications involved in raising the aerial higher, except in special cases or with an "X," which can be carried on a lightweight mast.

Theoretically the efficiency of a multirod aerial is reduced more than that of an "H" aerial when both aerials are less than one wavelength above earth. Practically I have never been able to prove this to my own satisfaction.

Comparisons

Where a multirod and an "H" are mounted on the same roof at the same height and both properly matched, it is reasonable to assume that the signal arriving at the receiver from the more efficient multirod will be stronger than that from the "H." Unfortunately this is not always so. In fact in a number of cases where comparisons have been possible, the customer has preferred the "H."

The makers of aerials do not turn out multirods just because they cost more. Very extensive comparison tests are carried out and these have proved that the multirod is more efficient beyond any doubt.

The one thing that is not usually allowed for in aerial construction is change in polarisation.

Polarisation

In this country the transmitted wave is vertically polarised but, due chiefly to changes in contour of the land, ducting is likely to occur and the wave arriving at the receiver aerial any great distance from the transmitter is more than likely at some angle other than vertical.

The multirod, with its fairly narrow angle of acceptance, would be affected more by any change of phase in polarisation than either the "H" or the "X," both of which have broader acceptance angles.

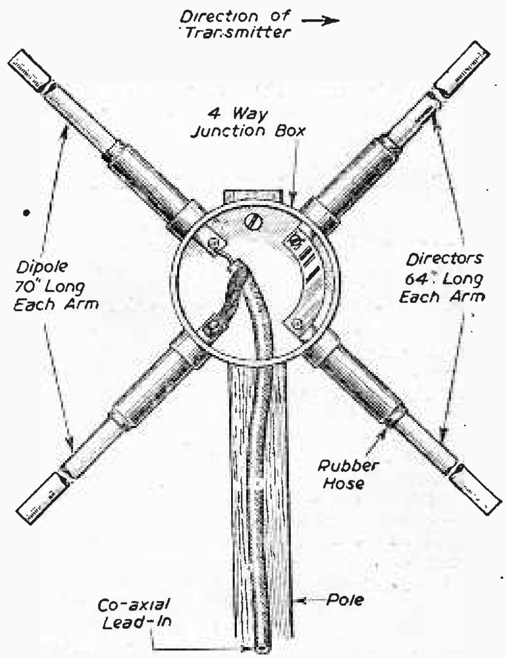
Using an "X" aerial, this being the only type of aerial I could mount on a swivel so that I could manoeuvre it when hoisted into position, I carried out the following tests. Looking towards the transmitter, I tilted the aerial from vertical to the right. Reception was not too good and the picture with the aerial vertical was rather poor. Up to ten degrees tilt to the right there was no noticeable change. From then on the picture deteriorated and at twenty degrees the picture was very poor and any further increase in tilt lost the picture.

Starting again from vertical I tilted the aerial to the left. At an angle of about fifteen degrees the picture had improved to fair and remained fair for a further ten degrees, then deteriorated.

I repeated the procedure several times to allow for fading and eventually established that a tilt of about fifteen degrees to the left was the best position.

I tried again some days later when reception was good. This time the aerial had to be varied over a much greater angle to produce deterioration, but the best position was still about fifteen degrees tilt to the left.

—R. PINKNEY.



An experimental "X" aerial built by a reader and described in our issue dated November last.

The "ARG

BUILDING OUR

Free Bluepri

TELEVISION

3.—FURTHER TRIMMING NOTES AND SIM FAULT FINDING

NOTE:—Reprints of the Blueprint and instru

THE tuning cores of the vision receiver should be adjusted so as to provide maximum quality starting with the last one feeding the detector and working back to the aerial coil.

It will probably be found that the picture is inclined to jump and will have black lines running diagonally across it. This is due to sound breakthrough, and the rejector coils L6 and L7 should be adjusted to eliminate this interference. To obtain maximum sound rejection it is a good idea to wait for the close of the evening's transmission when the vision channel has been cut off and the sound channel is radiating the news bulletin. A pair of earphones can be inserted in the anode circuit of the video valve V6, and L6 and L7 adjusted so as to eliminate the sound signal.

As the cores of the vision receiver are adjusted to bring out the maximum quality in the picture it will be found necessary to advance the contrast control to counteract the loss of gain. It will be found best to "stagger" tune the coils, that is, to tune them above and below their peak frequency. This staggering has been partly catered for in the winding of the coils but the quality can be further improved by continuing the process.

The method to be employed is to adjust all cores level ... and L ... turns. ... and the pro...

Final ... Test Card C, which is ... between 10 a.m. and noon.

To receive ... signal, turn up the volume control and simply ad... T2 and T3 for maximum volume, final adjustments being made with the cores of the coils.

Faults

In case any snags arise, here is a brief guide to the more common faults which may occur.

No sound; no vision; no raster.

The fault obviously lies in some part which is common to the whole unit. That can only be the mains supply. Check the on/off switch, mains plug, etc.

A spot only is obtained.

Reduce the brilliance control at once! The fault indicates that neither time bases are working. Check H.T. and filament lines in the time base.

A horizontal line only is obtained.

This indicates that the line time base is functioning but the frame time base is not. Examine the circuits of V17 and V18. Check the height control.

A vertical line only is obtained.

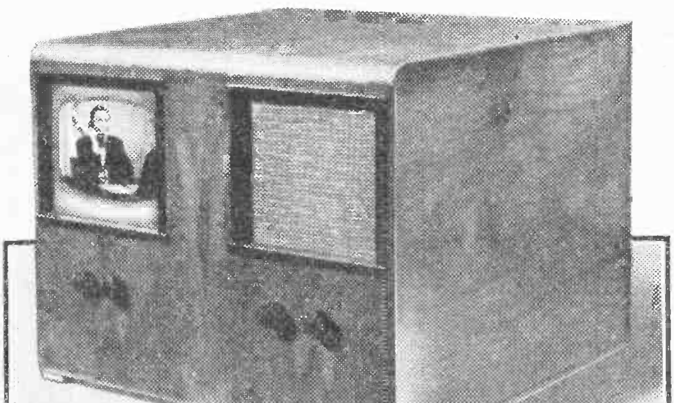
This indicates that the frame time base is functioning but not the line time base. Check V15 and V16 and associated circuits.

The raster is too narrow.

Take out V16; if there is no change or very little change it indicates that this valve or its circuit is faulty. If the raster becomes still more narrow when this valve is removed then it indicates that the valves V16 and V15 are being starved of H.T. Check the supply.

The raster is not tall enough.

Take out V18; if there is no change, or very little change, then it is this valve or its circuit which is at fault. If the raster becomes markedly shorter, then the H.T. supply is at fault and should be checked. Do not forget the height control!



The "Argus" in a cabinet built for it by Messrs Tallon, of Rugby.

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of V1 and the

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.T. are
lly that the
tuned to the

ture O.K.; no sound.
lies in the sound unit
the coupling coil V1 anode
t to the loudspeaker. Check
e anode and grid voltages in the
sound receiver, and trace circuit back
from the loudspeaker.

The picture is upside-down

Reverse the connections to 8 and 12 on the C.R.T. holder.

The picture is left to right.

Reverse the connections to 9 and 11 on the C.R.T. holder.

The picture is "inside-out."

Reverse the connections to 8 and 12 and also the connections to 9 and 11 on the tube holder.

The picture slips sideways.

Due to either too small a sync pulse or incorrect setting of the line hold control. Adjust C58 and/or VR4. If neither of these will lock the picture, inspect the sync valve (V14) and its circuit. Try changing this valve. Also verify that the components in the time base are the correct value. Try the effect of increasing or decreasing R41.

The picture slips up and down.

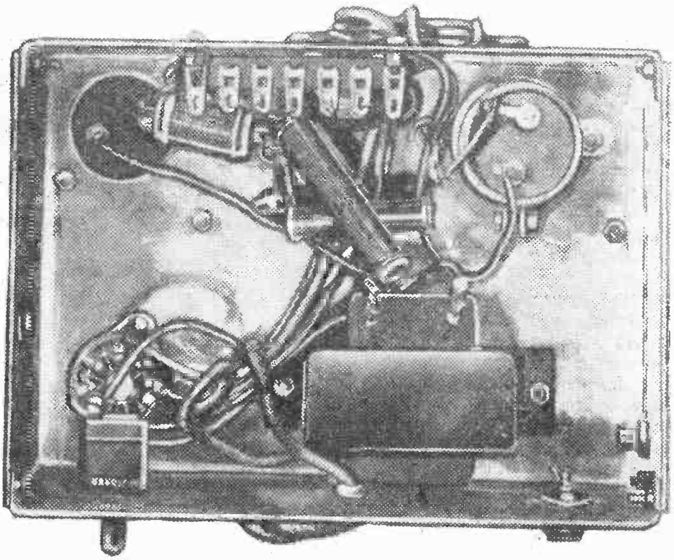
Due either to too small a sync pulse or incorrect value of VR5 setting. If sync pulse appears to be O.K., then try changing R49 to a higher or lower value.

Picture will not hold in any direction.

Fault is either a very weak signal or no sync pulse s reaching either time base. Check circuits of the sync separator and the phase splitter (V13). If the fault is due to a weak signal a pre-amplifier may be required.

Picture seems out of focus, raster is sharp.

If the raster focuses sharply the fault is due to insufficient bandwidth in the vision receiver. The tuning coils should be further staggered.



Underside view of the power pack.

The black parts of the picture are smeary.

The fault again lies in the tuning; circuits will require realignment.

The picture seems covered with snowflakes.

This is due to a weak signal. In this case, a good multi-element aerial is required together, possibly, with a pre-amplifier.

Schools Television Experiment

SIX schools have been chosen to receive the first experimental television programmes for schools. They are :—

Albany Secondary Modern Boys' School, Enfield.

Chace Secondary Modern Girls' School, Enfield.

Higher Grade Selective Central Mixed School, Edmonton.

Hazelbury Secondary Modern Girls' School, Edmonton.

Arnos Secondary Modern Mixed School, Southgate.

Trinity County School, Wood Green.

All six schools are in North London for technical reasons connected with the system of transmission to be used.

The vision signal for the experimental programmes will be transmitted from Alexandra Palace on a special wavelength, and the sound will be conveyed to the selected schools by land line.

The programmes will be broadcast daily at 2.10 p.m. for four weeks beginning on May 5th.

All the programmes will be intended for children of Secondary school age. The twenty programmes will be grouped into five short series dealing, respectively, with science, aesthetics, current affairs, travel and the industrial scene.

The main purpose of the experiment will be to try out a variety of programme techniques and to test their effectiveness for presenting educational material to children viewing in classrooms. The techniques will include the studio presentation of laboratory experiments and demonstrations; the use of animated diagrams and photomicrography; the presentation of film in many ways, including, for example, by a traveller who made it, or by a commentator on current affairs; outside broadcasts, and feature programmes in which studio interview and demonstration will be combined with the showing of suitable film extracts.

SCANNING AMPLIFIERS

THEORETICAL AND PRACTICAL CONSIDERATIONS IN MODERN TIME-BASE DESIGN

By Gordon J. King, A.M.I.P.R.E.

WITH the now obsolete (as far as television is concerned, anyway) electrostatic picture tube, the scanning amplifier is called upon to magnify the voltage generated by the sawtooth oscillator to a magnitude sufficient to deflect the electron beam the full diameter of the tube face. Therefore, in order to secure a linear raster, the tube deflecting plates must be supplied with a sawtooth voltage which varies linearly with time during either a vertical (frame) or horizontal (line) scan.

To achieve similar results with an electromagnetic tube, however, it is necessary for the scanning coils to be provided with a linear sawtooth current. This means, of course, that the scanning amplifier must deliver a power output, and in some respects is analogous to the output stage of an A.F. amplifier.

The amplitude of the saw-tooth voltage or current needed for a full scan depends, in the former case, on the sensitivity factor of the tube only. This factor, however, is connected with the inherent characteristics of the tube, such as the screen diameter, the deflection angle and the final anode potential.

It is usually expressed by the manufacturers in the form of x/V mm. per volt, where x is a figure representing the sensitivity of the tube, V the final anode potential, and the operating sensitivity is the distance in millimetres over which the spot is deflected on the screen for one volt applied across the deflecting plates. It will thus be seen that the sensitivity is reduced as the final anode potential is increased. (See " More About the Cathode Ray Tube," PRACTICAL TELEVISION, October, 1951.)

Similarly, the power needed to energise the scanning coils in a magnetic system depends on the beam velocity, or the final anode potential. The deflection magnitude is thus proportional to the magnetic field strength within the scanning coils, and inversely proportional to the final anode potential.

Sawtooth Amplification for Electrostatic Application

Although from the current commercial television aspect electrostatic scanning is no longer employed, its use is still favoured by a large number of experimenters and, no doubt, a number of the older type receivers are still in service. For these reasons and for the sake of completeness consideration of this method of amplification will not be suppressed.

In most instances the peak amplitude of sawtooth voltage generated by the oscillator is in the region of 50 volts, although in certain circumstances it may be beneficial to accept less with a consequential improvement in linearity. The average electrostatic tube requires about 750 volts peak-to-peak to produce a deflection spreading right across the screen. It is necessary, therefore, for the scanning amplifier to provide a voltage gain of between 15 and 20 times.

Trapezium Distortion

At this stage it will be instructive to consider a form of distortion encountered principally with electrostatic tubes, namely trapezium distortion. Virtually, this distortion is tied up with amplifier design and arises from the influence of one pair of deflecting plates on the sensitivity of the other.

It is well known that the amplified sawtooth voltage must be applied to one plate of each pair (a) and (b) (horizontal and vertical) relative to the other two plates (c) and (d), which should also be in D.C. connection with the final anode (see Fig. 1 (a)).

Due to this, plates (c) and (d) can be regarded as an extension of the electron gun. The instantaneous sawtooth potential of plates (a) and (b) will thus be reflected to plates (c) and (d) and the final anode. Therefore, the potential of this electrode will vary around its mean value. For instance, if a positive potential is on plate (a) the effective E.H.T. voltage on the tube is increased slightly, and since the deflection sensitivity is inversely proportional to the final anode potential the deflection sensitivity of plate (b) will be reduced. The effect of this inter-reaction is that opposite sides of the raster are not of the same length but will take the form of Fig. 1 (b).

If the mean potential of each pair of deflecting plates is maintained unaltered during a line or frame scan the sensitivity of the tube would remain unaffected. Such conditions are achieved by applying the sawtooth

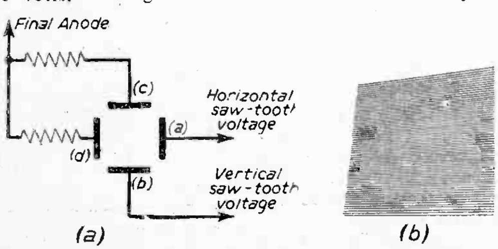
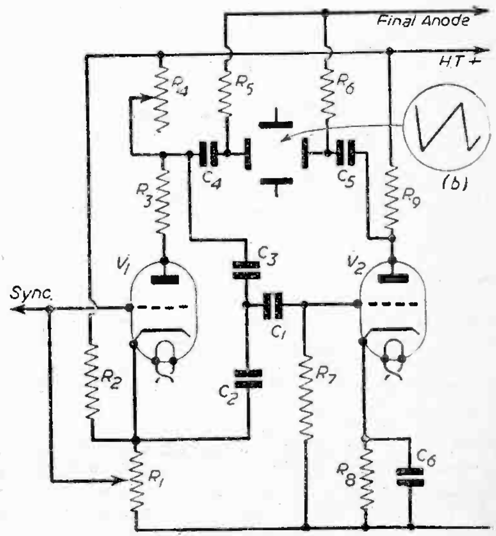


Fig. 1.—Showing the cause of trapezium distortion at (a) and its effect at (b).



(a)

Fig. 2.—A self-linearising push-pull time-base.

deflecting voltages in push-pull so that the potential of one plate of a pair swings positive while the other swings negative by an equal amount.

Push-pull Time-base Amplifiers

Amplifiers employed for this purpose are usually R.C. coupled throughout and operate under strictly linear conditions. This often means that the H.T. voltage necessary to prevent distortion reaches a magnitude similar to the peak-to-peak voltage desired from the output.

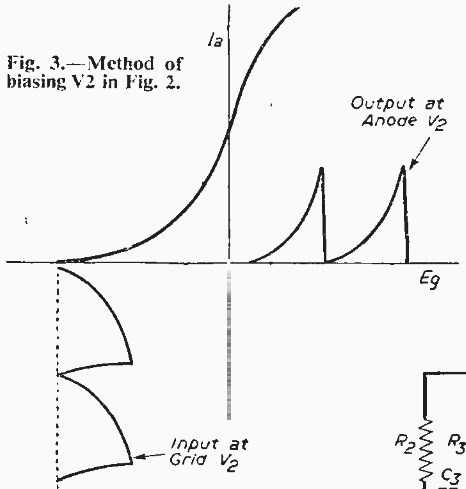


Fig. 3.—Method of biasing V2 in Fig. 2.

A sawtooth waveform may be analysed into a wide spectrum of frequencies and in order to preserve their wave shape the frequency response of the system should be fairly linear up to at least 10 times the fundamental frequency. In the case of the frame amplifier this is readily achieved, but at line frequency it is a different matter, for then the Miller effect and stray shunt capacitances become very important.

Fig. 2 (a) shows an amplified time-base suitable for use where a limited output voltage may be tolerated. In this V1 and associated components form a thyratron sawtooth generator. The output at the anode of V1 is conveyed, via C4, to one of a pair of deflecting plates and thus contributes to 50 per cent. of a full scan.

The potential divider comprising C2 and C3 in series forms the charging capacitor for the thyratron. Their capacitance ratio is arranged so that a portion of the sawtooth output from V1, determined by the gain of V2, is fed to the grid of V2, via C1. This valve not only amplifies the voltage on its grid to a level similar to that on the anode of V1, but it also reverses its phase, so that when the anode potential on the first valve is rising that on the second valve is falling. The deflection produced is proportional to the total voltage difference across them, but as both deflector plates are in connection with the final anode the velocity of the electron beam remains constant and trapezium distortion does not occur.

It will be remembered that the rise in voltage across the charging capacitor (C2, C3) is exponential, and if applied to the frame deflector plates in this form would be evident as a closing up of the lines at the bottom of the picture, or in the case of a line scan the cramping of the left-hand side of the picture. The composite waveform may be made linear by arranging V2 to operate on the non-linear portion of the Eg Ia curve (see Fig. 3). It will be seen that this produces a voltage at the anode of V2 whose curvature is in a direction opposite to the exponential waveform at the anode of V1, the two voltages add together and give a linear output as shown at (b) Fig. 2.

A Paraphase Arrangement

Another form of balanced amplifier is that shown in Fig. 4. The sawtooth oscillator voltage is not applied direct to the deflector plates in this case, but feeds two amplifier valves, V1 and V2—the former feeding the latter in the manner of a paraphase circuit—V2 being the paraphase valve. In practice both valves are of identical characteristics, and R2 is made equal to the coupling resistor (R7) for V2. The outputs are balanced by feeding a portion of the output from V1, via C4, to the grid of V2 by means of the potential divider R5, R6.

Sometimes the circuit takes a slightly modified form—instead of achieving balance in the grid circuit of V2—R2 is split to form a potential divider in the anode circuit of V1, the reduced output at its junction is then transmitted, via C4, direct to the grid of V2, and R6 is made equal to R1.

An arrangement such as this is more susceptible to H.T. ripple voltage, however, since the grid of V2 then receives its full magnitude. The main drawback of the former method is the heavy capacitive loading created by the input of V2, which restricts its use at line frequency.

Irrespective of the arrangement used to obtain equal output voltages from the valves, their inputs must also be equal, and in either case a phase reversal occurs in each valve, thus the output of V1 is in opposite phase to that of V2.

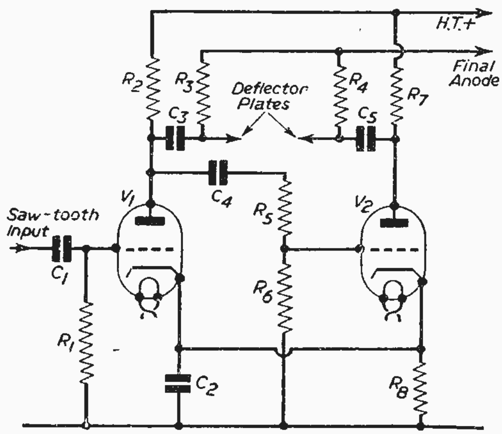


Fig. 4.—A paraphase amplifier.

Electromagnetic Scanning

The counterpart of the deflector plates in electrostatic tubes are the scanning coils in electromagnetic tubes, which need a sawtoothed wave of current rather than a sawtoothed voltage wave.

Scanning coils have not only inductance, but also resistance in their make-up,

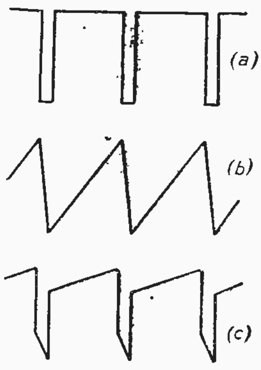


Fig. 5.—Voltage waveforms to produce a sawtooth current in (a) pure inductance, (b) resistance and (c) inductance and resistance combined.

which makes it necessary for the voltage waveform to be of complicated form to drive a sawtooth current through them. In order to produce a sawtooth current through a pure inductance, a waveform as shown by Fig. 5 (a) is required. This is better seen when it is considered that a steady change of current through an inductance as represented by, say, the scanning stroke of a sawtooth waveform will produce a steady voltage across the inductance proportional to the rate at which the current changes.

On the other hand, if the scanning coils were mainly resistive the voltage waveform would have the same shape as the current waveform and so would be sawtoothed (Fig. 5 (b)). In practice, where both inductance and resistance are present, however, it is necessary to combine the waveforms of (a) and (b) in their correct proportions (Fig. 5 (c)), in order to get a sawtooth current waveform.

To achieve the desired waveform, really determined by the ratio of inductance to resistance, the scanning coils may be energised from a source of high impedance. One method would be to connect the scanning coils in series with the anode of a pentode valve and, by the application of a sawtoothed voltage on its grid, a sawtoothed current will be driven through the coils. An alternative method is to drive the scanning amplifier valve with a voltage of waveform similar to that of Fig. 5 (c), when the same result would be achieved.

In order to obtain a correctly positioned raster, it is necessary for the scanning spot to be deflected equally on either side—and above and below the geometrical centre of the fluorescent screen. This is controlled not only by the correct matching of both pairs of scanning coils, but also by ensuring the deflecting currents have no D.C. component.

The latter condition is achieved by coupling the scanning coils to the amplifier either by means of a transformer or an R.C. network, but in each case it is necessary to match the impedance of the coils to the type of valve employed. When the coupling is a transformer,

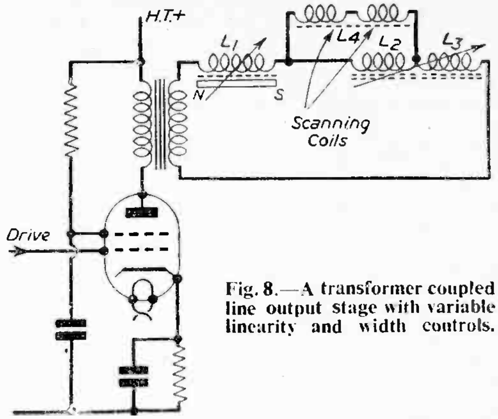


Fig. 8.—A transformer coupled line output stage with variable linearity and width controls.

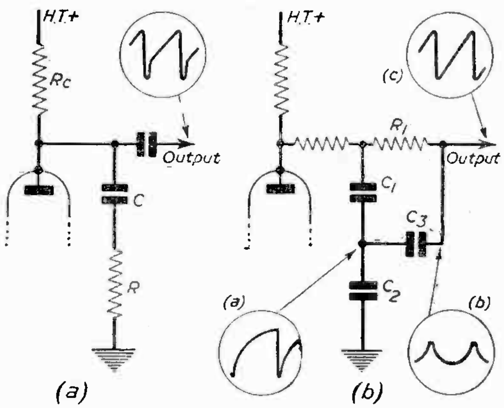


Fig. 7.—Other linearising devices.

low-impedance scanning coils are usually employed, the impedance step-up being performed by the transformer. With R.C. coupling, however, the scanning coils should have an impedance similar to the optimum load value of the output valve, this being the counterpart of the anode load of an A.F. amplifier.

Both methods are used in practice, although R.C. coupling from the line amplifier is rarely employed owing mainly to the generation of a high-voltage back E.M.F. during the line flyback. This back E.M.F. is developed across the scanning coils and is a function of the relationship L di/dt, where di equals the current change flowing through L in time dt. Thus, a high-impedance (and inductance L) coil operating at line frequency will give rise to a very large back E.M.F during the flyback. The fact that a high-impedance coil necessitates a large number of turns of wire makes the use of such a coil at line frequency an impracticable proposition from the insulation aspect. Further, transformer coupling is an essential feature where the E.H.T. for the picture tube is derived from the line flyback (see "Energy from the Line Flyback," PRACTICAL TELEVISION, September, 1951).

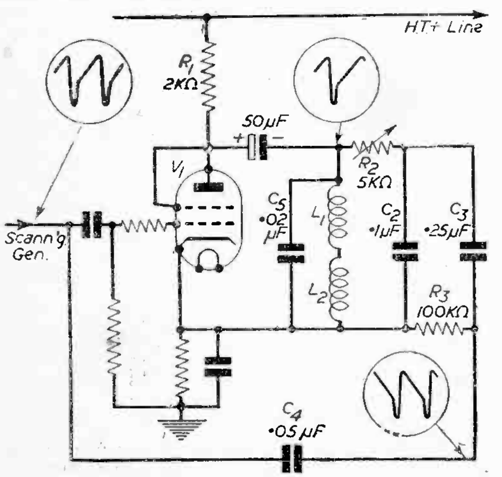


Fig. 6.—A typical R.C. coupled frame output stage, with linearity correction by N.F.B.

Triode Amplifier

Owing to the relatively longer period taken by the frame flyback, the above limitations do not apply and R.C. coupling of the frame-scanning coils is quite often employed. A low-impedance triode valve for the frame amplifier is generally favoured, since then the scanning coils need have less turns for a correct match than for a pentode valve.

R.C. Coupling

The circuit of Fig. 6 depicts a typical R.C. coupled frame amplifier, in which the high-impedance frame-scanning coils L1, L2 are coupled to the valve by means of C1 and R1. On the application to the grid of a saw-tooth voltage, the current through the scanning coils increases progressively until the flyback—when the grid potential changes very quickly from its least negative to its most negative value and the anode of the valve jumps from its minimum to its maximum value—is ready for the commencement of the next scanning stroke.

If the sawtooth voltage is of linear form and the valve is operated on the straight portion of its characteristic curve, the value of C1 must be impracticably high in order to achieve a linear current through the scanning coils. Usually, however, this component rarely exceeds 50 μF and the scan is linearised by modifying the saw-tooth voltage waveform at the grid. This is done by introducing a degree of negative feedback by virtue of the network comprising R2, R3, C2, C3 and C4 connecting the cold end of the scanning coils, to the output of the scanning generator. The output waveform from the scanning generator then approximates Fig. 5 (c). The variable resistor R2 controls the degree of N.F.B. and thus corrects for non-linearity towards the bottom of the raster, while R3 and C3 affects mainly the bottom of the raster. The capacitor C5 assists in preventing the induction of line pulses in the frame-scanning coils, which might otherwise get into other parts of the frame generator and upset the interlacing.

It will be obvious that the current supplied by the valve is the sum of the current in the scanning coils and the current in R1. Therefore, for maximum efficiency R1 should be as high as possible, but since the mean anode current flows through R1 its maximum value is limited, owing to the volts drop across it by the available H.T. Thus, if its value is too great, grid current may flow towards the latter part of the scan—when the anode voltage is at its minimum. The effect of this on the picture will be a foldover or, in less severe cases, a bright line across the bottom of the picture. A compromise is necessary, therefore, in selecting the value for R1, but a value of between 2 to 3 kΩ is suitable in most circuits.

Other Linearising Devices

Apart from negative feedback, other devices for the correction of non-linearity of the scanning stroke are frequently employed. These usually take the form of resistor capacitor combinations included in the coupling from the scanning generator to the amplifier valve. The simplest of these is the inclusion of a series resistor in the charging circuit of the generator proper. Such a method is shown in Fig. 7 (a), where C charges via the charging resistor Rc and R in the normal way. During the flyback period, however, C discharges through R, across which a voltage of opposite phase to that across C is developed. This results in the voltage across the combination (between points (a) and (b)) being zero during the discharging cycle, and the waveform so produced contains both a sawtooth and square-wave component necessary for a linear current change through the scanning coils.

As previously intimated, however, the ratio of saw-tooth to square-wave voltage for a linear current change is dependent on the resistive inductive ratio of the scanning coils. In the above circuit the sawtooth to square-wave ratio is controllable by a variation in the value of R.

Sometimes the charging capacitor is composed of two separate components in series, and an additional resistor capacitor network arranged to correct for the exponential sawtooth output from the scanning generator, Fig. 7 (b). The voltage across C2 rises exponentially with time (waveform (a)), C3 also charges through R1, but the value of R1 is such (high resistance) that C2 charges in less time than C3, consequently C3 is only partly charged by the time the flyback occurs, resulting in a waveform similar to that shown at (b) across C3. The additive effect of waveforms (a) and (b) produce a linear sawtooth voltage (c) at the output.

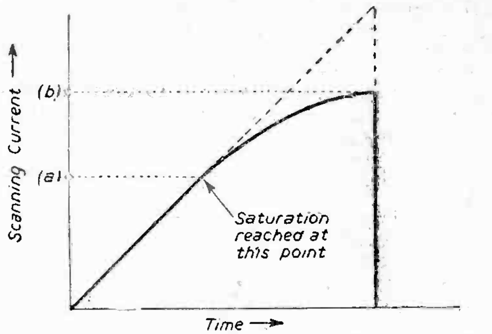


Fig. 9.—Counteracting for the exponential rise in current.

Transformer Coupling

Some designers prefer transformer coupling, even for the frame amplifier, in which case the output valve can be either a triode or pentode. Usually a pentode is employed where there is a limit to the available H.T. (e.g., in A.C./D.C. circuits), since the H.T. needed by a triode is relatively greater.

A pentode is almost invariably used for the line amplifier, together with transformer coupling, which commonly has a step-down ratio from the anode of the valve to *low-impedance* scanning coils. Where E.H.T. is derived from this source, the transformer also includes a separate winding which creates a step-up ratio from the anode winding to the E.H.T. rectifier. The function of this circuit was adequately described in a previous issue of this publication (see "Energy from the Line Flyback," PRACTICAL TELEVISION, September, 1951).

It is worthy of mention that at line frequency the inductive impedance of the line-scanning coils outweighs the resistive, so that for a linear current change through the scanning coils the content of sawtooth driving voltage is less than for the frame circuit and, consequently, the voltage waveform approximates more closely the square-wave pulse of Fig. 5 (a).

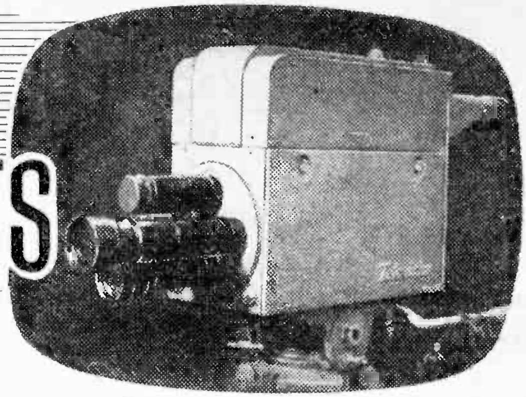
So far nothing has been said about a means of controlling the amplitude of scan, but in the frame amplifier a potentiometer is usually arranged to vary the degree of negative feedback, and thus vary the amplitude of scan. In the line circuits, however, such a method is unsuitable if E.H.T. is derived from the flyback. This is obvious since a reduction of driving voltage will reduce not only the horizontal deflection but also the magnitude of E.H.T.

The usual procedure in these circumstances is to include a variable inductor in connection with the scanning coils and output transformer. The coils L2 and L3 (Fig. 8) are, for this purpose and width-control, affected by moving a high-mu core through them and thus varying their reactance.

It will be observed that L2 is in shunt with the scanning

(*Continued on page* 544.)

Camera IMPROVEMENTS



By D. C. Birkinshaw, M.B.E., M.A., A.M.I.E.E.,
Chief Engineer, BBC

ONE of the most striking facts about the present scientific age is the rapidity with which apparatus required for a particular branch of technology can develop once it has made a start. This is no doubt due to the fact that such a wealth of scientific discovery has now been made in various fields that those engaged in developing a new piece of equipment have a vast array of established techniques in their own and in sister branches of science from which to draw.

The television camera is an excellent example of this state of affairs. In the pre-war years the BBC Television Service was employing two types of camera, both made by Electric and Musical Industries, Ltd. These were:

(1) The Standard Emitron; and
(2) The Super Emitron.

The Standard Emitron camera was used in the two studios, "A" and "B," in the film equipment associated with these set-ups and in outside broadcasts. Its appearance by now will be very familiar to users of this journal.

It is not proposed to describe the operation of the Emitron tube in any detail in this article, since by now the action is doubtless well known. In brief, a lens mounted in the camera housing focuses the light image on to a photo-sensitive mosaic which emits electrons. The resulting deficiency of electrons at a given point on the mosaic is dependent on the brightness of the picture detail focused upon that point. The mosaic is then scanned by an electron beam which re-charges the elements of the mosaic in succession, the charging current naturally varying from element to element and constituting an electric current representing the brightness of the picture details point by point and line by line.

It is light in weight and simple in construction, but perhaps its most important characteristics are the excellent definition which it gives and which is still not surpassed by any of its successors, and the fact that it allows one to take considerable liberties with lighting values while still yielding a pleasant picture. So long as there is plenty of light, by which is meant an incident value of some 250ft. candles, the precise amount is not important.

Insensitivity

As against these advantages, however, the camera is comparatively insensitive by modern standards, and due partly to this insensitivity and partly to the fact that it requires long focus lenses, it is capable of only a shallow depth of focus. By this is meant that objects situated appreciably in front or behind the plane on which the focus is set are not clearly focused and appear blurred. Another matter which causes difficulty in practical studio operation is that the camera is subject to what are known as "shading errors." This may best be explained by saying that if the camera is set up to face a uniformly lit scene, then it will yield an image which is unduly dark in one corner and unduly light in the opposite corner. This departure from faithful portrayal of the scene lighting can be largely counteracted by injecting into the electronic circuits certain recurrent waveforms whose amplitude must be controlled manually for each camera throughout the production. In order to focus the camera, the lens is moved by rack and pinion in front of the tube. A duplicate and ganged lens focuses an identical image on to a ground glass screen from which the camera operator judges his focus.

Nevertheless, it is only fair to the camera to state that due to the excellent design of the associated circuits by E.M.I., Ltd., and the practised operating technique of the BBC engineers, these disadvantages have been so largely mastered that the camera, which is still used today, yields excellent pictures. At the time of writing this article the camera is used, as it always has been, for Drama, many Documentary and other smaller studio programmes; but as will be seen, has been superseded on O.B.s, the Children's Programme, and very largely on Light Entertainment.

The Super Emitron camera was really experimental throughout the whole of the pre-war period. It was based on a new tube, the Super Emitron, differing from the Standard Emitron in that it possessed an "image section" between the lens and the mosaic target. The light from the lens fell upon a photo cathode which was a uniformly conducting photo emissive surface, and the electrons leaving it bombarded a mosaic which was scanned in the same way as the Emitron. This electronic bombardment of the mosaic caused secondary emission which released electrons much as if the mosaic had been bombarded by the original light image. This emission was comparatively stronger, however, with the result that the new camera had about five times the sensitivity of the Standard Emitron. Its use made possible outside broadcasts of external sports events occurring in rather gloomy weather, and indoor events with a moderate amount of additional lighting.

The focusing arrangements for the Super Emitron composed a ganged optical viewfinder on the same lines as that provided for the Emitron.

There was little development during the war, but immediately the Television Service was resumed in 1946, the British television equipment manufacturers and the BBC Engineering Division got together to try to work out a design for an improved camera into which should be built all the features which the three years of pre-war experience had shown to be desirable. It is surprising what a very considerable number of points have to be watched carefully in the design of a television camera which is to be efficient and pleasant to use. The following are among the most important:

(1) The camera should be as light as possible.
(2) It must be balanced.
(3) It should have high sensitivity.
(4) The depth of focus should be considerable.
(5) It should have a choice of angles of view.
(6) It should possess an efficient focusing viewfinder.
(7) It should be built in the form of a number of separately detachable sub-sections.
(8) It should have a remotely operated iris control.

Let us consider in turn these various points and examine the progress which has been made.

Weight

A heavy camera is not only difficult to handle on any type of programme, but is very inconvenient in outside broadcasts. When the rig is being set up the camera may have to be manoeuvred up winding stairs and ladders to high vantage points. It has to be admitted with regret that in this respect there has been no progress whatever in the post-war period. Instead, cameras have grown heavier. This is very largely the inevitable result of endeavouring to build into these cameras the maximum number of useful operational features, each one unfortunately contributing its own modicum of weight to the total. It is rarely that a camera weighs less than 100 lb. and a reduction in this figure still remains the aim of the camera designer.

Balance

A camera whose weight is unbalanced and which is inadvertently released by its operator might fall forward and suffer severe damage. There is a tendency for this to happen, because the aggregate weight of the lenses in the turret is considerable and this tends to pull the camera forward. However, much can be done by siting the supporting point forward of the centre of the base, and in addition a cable entry at the rear will tend to restore balance by pulling the camera down at the rear end.

Sensitivity

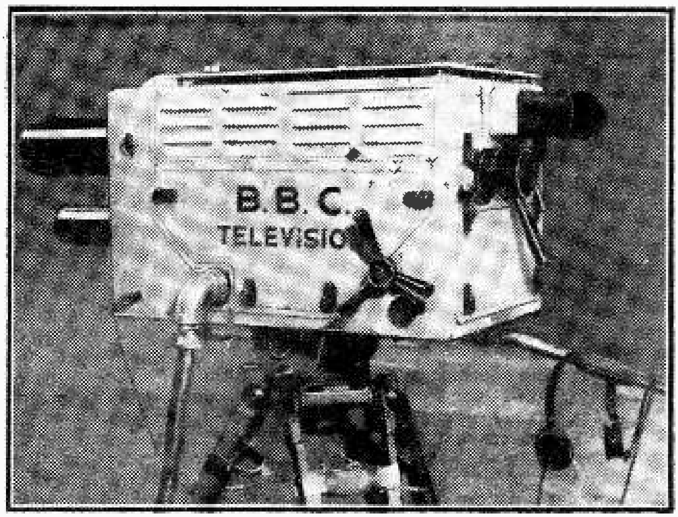
This is a most important characteristic, because not only are lighting costs reduced, but it becomes possible to take the camera to public functions without the need for television to obtrude itself by importing a great quantity of supplementary lighting. It is perhaps in the field of sensitivity that the major post-war advance has been made. The Photicon camera tube, designed by Pye, Ltd., the Cathode Potential Stabilised Emitron, designed by Electric and Musical Industries, Ltd., and the Image Orthicon, fitted by Pye, Ltd., and the Marconi Wireless Telegraph Co., Ltd., are all much more sensitive than the pre-war Standard Emitron. The Photicon tube of Messrs. Pye, Ltd., belongs to the miniature image iconoscope class of camera tube and may be considered to be a modern development from the unminiaturised image iconoscope class to which the E.M.I. Super Emitron belongs. The Photicon tubes are incorporated in the Pye cameras at present used in studio "G" at Lime Grove, from which a great number of Light Entertainment productions are televised. It is a feature of this type of tube that the increased sensitivity is wholly employed in conferring upon the reproduced image an enhanced depth of focus, thus while the lighting intensity in studio "G" is much the same as that in the older studios "A" and "B" at Alexandra Palace, the pictures are better due to improved depth of focus. The Cathode Potential Stabilised or C.P.S. Emitron of Messrs. E.M.I. is fitted in the cameras in studios "D" and "H" at Lime Grove and is in fact even more sensitive than the Photicon, since not only is there greater depth of focus, but there is an economy in lighting values. At present the C.P.S. Emitron is largely employed in Children's Hour productions.

The greatest advance in sensitivity, however, has been reached by the Image Orthicon tube, initially developed in America, but now available in this country, and it is now used almost exclusively for outside broadcasts. It requires a lighting intensity of but 25ft. candles, while at the same time possessing an immense depth of focus. On a bright, sunny day this type of tube is so sensitive that not only have extremely small apertures of $f/64$ to be used, but in addition one or two neutral filters have to be interposed in the light path as it is impossible to get sufficient suppression of the light by the use of the smallest aperture stop alone.

Obviously, the maximum advantage of such a camera is not reaped in these conditions, but at indoor public functions, such as ceremonial dinners or at a football match in the latter part of a foggy winter afternoon, this type of tube is in its element.

Depth of Focus

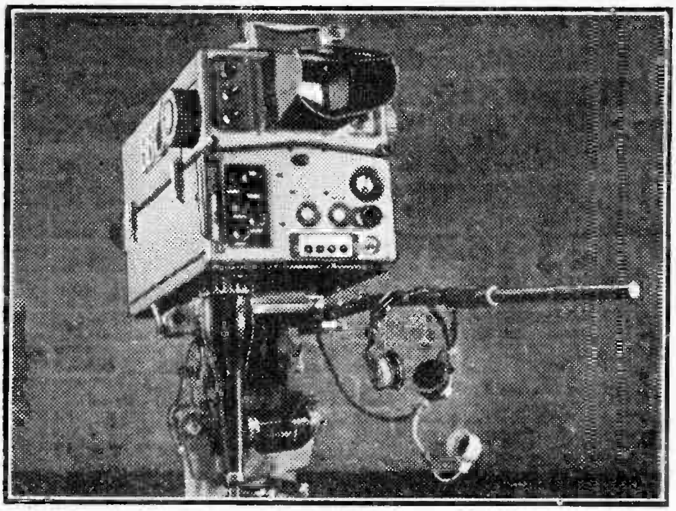
If the depth of focus is poor, then much of the advantage of high definition is lost because such definition is only present in the image of objects situated at the particular distance from the camera at which it is focused. Not only does the picture produced by a camera without deep depth of focus lack clarity, but the



The C.P.S. Emitron camera, with electronic viewfinder. The lens turre is controlled from the rear.

work of the camera operator is rendered much more arduous because he must obviously have a great deal more focusing to do as the centre of interest moves to and from the camera. The property of great depth of focus is an almost automatic attribute of a sensitive camera. For this reason there has been substantial improvement in recent times as the following figures will illustrate.

Using a standard Emitron, the depth of focus when the camera is focused at a distance of 10ft. will be 2ft., that is to say, the camera will bring into sharp focus all objects lying between 9ft. and 11ft. from the camera lens. Contrast this with the results obtained by the modern camera employing one of the foregoing tubes where with the camera focused at the same distance, viz. 10ft., the depth of focus will be 13ft., so that all objects lying between 6ft. 6in. and 19ft. 6in. from the lens will be in focus. The increase of clarity which the modern picture acquires from this cause can not only be assessed from the above figures, but it may be seen by a viewer on his screen.



The Pye Image Orthicon camera. The lens turret is motor-operated.

Angles of View

If a line be drawn between the lens of the camera and the extreme left- and right-hand limits of the scene which it is reproducing, the angle between these lines is called the angle of view. A wide angle will be of the order of 40 deg., and will be used in a studio or outside broadcast where it is desired to give the most panoramic view of the scene. Care has to be taken in employing such a wide angle because there is a tendency for distances from the front to the rear of the scene to be apparently shortened in the image. However, a wide angle view enables scenes of considerable breadth and grandeur to be portrayed within the confines of a small studio. A more moderate angle, such as 20 deg., may be used for general purposes, while the use of a narrow taking angle, such as 6 deg. or 4 deg., enables the camera to take, in effect, a close up of an object in a scene while yet being a considerable distance away from it. This property is of immense value in an O.B., where it is often physically impossible for a camera to be placed close to an object of interest. A particular example of this is a cricket match. Here the camera must be sited outside the boundaries of the field, but should be equipped to give a close-up of a batsman in action. The standard Emitron camera, in use before the war, had a fixed taking angle of approximately 30 deg., and in this respect resembled the ordinary amateur photographic camera, which also has a fixed taking angle. An important post-war development has been the provision of an assortment of lenses for use with each camera, each lens giving a different taking angle. These lenses may be mounted upon a three-, four- or six-lens turret, which is a circular structure, built into the camera in front of the camera tube and enabling the desired lens to be rotated into position. This may be seen from the illustrations on pages 542 and 543, which show the E.M.I. C.P.S. camera, which has a three-lens turret, the Pye Photicon camera, and Pye Image Orthicon camera, all of which have four-lens turrets.

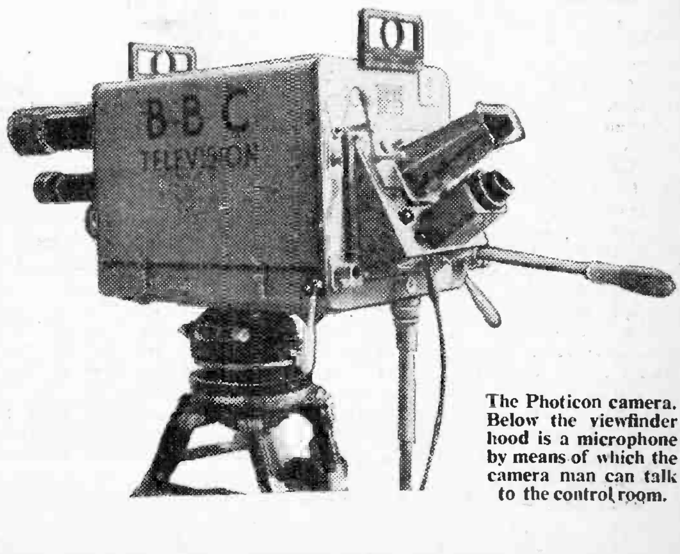
Focusing Viewfinding

Perhaps the most controversial question in television camera design is that of the focusing viewfinder. As its name implies, the object of this device is to enable the cameraman :

(a) To find the view, that is to say, to determine what scene the camera shall portray ; and

(b) To focus the image on the target electrode of the camera tube. (For convenience in design, this is usually done, not by moving the lens, as is the case with the ordinary photographic camera, but by moving the camera tube, the lens being kept stationary.)

The original Emitron camera contained a second



The Photicon camera. Below the viewfinder hood is a microphone by means of which the camera man can talk to the control room.

lens mounted parallel to the main or taking lens and focusing a duplicate image of the scene on to a ground glass screen. The two lenses were simultaneously moved by means of a ganged focusing control so that when the image on the ground glass screen was correctly focused, it could be assumed that the other image on the tube target electrode was also in focus.

It must be remembered, however, that this camera had no turret of lenses so that the single taking lens could easily be duplicated in the viewfinder. It is easy to imagine the difficulty which confronts the designer if he attempts to build the same system on to a turret which has four or even six taking lenses. He immediately requires an exactly similar turret of four or six viewfinding lenses. A camera built on these lines would be impossibly cumbersome and weighty. If we accept the hard fact that there must be only one turret of lenses, we must obviously provide an image for viewfinding by different means. The present system is to build into the camera a miniature television receiver containing a cathode ray tube and suitable scanning arrangements. This is present in both the cameras shown on p. 543, and is examined through various designs of visual tunnel.

Actually, there is a second reason why this type of viewfinding has become necessary. As cameras have become more sensitive, they have become capable of operating in a dim light. Inevitably the position has been reached where many scenes can be televised quite satisfactorily in illumination which is insufficient to give a useful image in an optical viewfinder.

The optical viewfinder possesses the advantage that it can be so designed as to give the operator a view of objects lying just outside the televised scene. Thus, looking into the optical viewfinder, he can see in advance as he pans his camera around whether he is about to televise anything uninteresting or actually undesirable Obviously, with an electronic viewfinder this facility is not so easy to provide.

Sub-sections

This point is not, of course, peculiar to a camera. In any piece of electronic equipment it is desirable to be able to disconnect it in small sections so as to be able rapidly to replace any part that has gone wrong without disturbing the complete circuit. In this respect the modern camera shows a great advance over its pre-war equivalent.

Remote Iris Control

It should be recognised that the lens iris is the natural amplitude control of a television system. All camera tubes are particular about the amount of light they will accept on their targets, and although in the studio one can work to predetermined lighting conditions, in an O.B. the situation is very different. The light from the sun or sky may vary greatly during the course of an afternoon, and even from second to second if the clouds keep passing across the sun. It is too much to expect the cameraman, preoccupied as he is with the composition of his picture and with focusing, to attend to the iris as well, and almost all the modern cameras have irises which can be opened or closed by remote control from the control room.

It but remains to consider a few of the additional features which the latest cameras possess. It can well be imagined that there may be some circumstances where a camera can be installed in a fixed position pointing at some particular object in the scene which it is desired to televise from time to time in a production. Such case might well be the scene of an arena, the pitch in a cricket field, or a particular jump in a steeplechase. If such a camera should be provided with the features of (a) remotely controlled focus, and (b) remotely rotated turret, it would be possible to dispense with an operator, who could be more usefully employed. The camera illustrated at the top of page 543 possesses these two remote features in addition to a remotely-controlled iris.

SCANNING AMPLIFIERS

(*Continued from page* 540.)

coils, and hence more or less of the scanning current flows through L2 as its reactance is decreased or increased. Therefore, a control of scanning current (picture-width) is created by adjustment of the core. L3, as will be noted, is in series with the scanning coils and is arranged in relation to L2 and the core, so that as the reactance of L2 is increasing, that of L3 is reducing. This facility is necessary in order to maintain the total inductance of the scanning circuit constant irrespective of the core position.

Another feature in the line amplifier which is rapidly gaining popularity is a control of linearity by means of a small permanent magnet which is adjustable in relation to an inductor (L1, Fig. 8). The magnet is set so that the scanning current which flows through L1 causes saturation at approximately half of full-scan current. At this point the overall impedance of the scanning circuit reduces. This being the point on the current waveform which changes from linear (nearly) to exponential (see Fig. 9, point (a)). Therefore, from point (a) to point (b) the rate of change of current is reduced, but is neutralised by the fall in impedance at point (a). Thus, a linear rise of current throughout the scan period is obtained (dotted curve). Movement of the magnet alters the field strength, which alters the point on the current waveform at which saturation occurs.

It is hoped that the foregoing notes will assist the constructor in gaining a better understanding of one of the most important stages in a television receiver.

Sponsored Television

MR. CHRISTOPHER MAYHEW, M.P., in a letter to *The Times* recently, said, *inter alia*: "As a viewer and performer, with experience of both sponsored and public-service television, I hope and pray that commercial advertising in any shape or form is resolutely kept off our television screens. Keen advertisers, by their very nature, like large audiences, and the largest audiences are attracted not by the best or most enjoyed programmes, or by those which are most ambitious technically or aesthetically, but by "average" programmes—those which cannot be misinterpreted by anyone, which appeal to no particular taste and no particular intellectual level.

Audience Size

Every broadcaster, of course, likes a large audience, and this is one sign that his programme is successful. But as soon as he starts concentrating on increasing his audience, and not on making his programme as good of its kind as possible, his standards fall. It is a basic principle of good broadcasting that "marginal" viewers must be "shed" where this is necessary to improve the integrity of the programme and thus increase the enjoyment of those who remain switched on. This idea is utterly alien to commercial broadcasting, for which any programme, whether highbrow or lowbrow, that attracts less than the maximum audience is anathema..."

Pioneers of Television

3.—DR. FERDINAND BRAUN, AND THE CREATION OF THE CATHODE-RAY TUBE

KARL FERDINAND BRAUN, electrical physicist of Strasbourg University, and Director of the once-famed Physical Institute of that city. How many scientific people nowadays, even professional physicists and avowed specialists in electro-technics, ever give a thought to his painstaking activities in the realm of electrical studies? But Professor Braun, at least for all present-day television enthusiasts, was a truly important scientific worker. It was he who gave the working cathode-ray tube to the world. True enough, Braun's first cathode-ray tube was rather a puny, meagre and inadequate sort of thing. Yet, it was a beginnihg. It formed the commencement of the long line of electrical tubes which has so marvellously culminated in the giant luminous tube of our day which gives to modern television its very being.

The man who first coined the name "cathode-ray" and, indeed, the one who first observed their creation among the effects caused by the discharge of electricity through a vacuum, was an individual who bore, no doubt proudly, the overwhelming and resplendently Teutonic name of Julius Plücker. Put down, then, Plücker on the list of the world's pioneer television technicians, if you wish. He certainly ought to be there in any really comprehensive list, if only for his persistent dabbling with those then unknown cathode-rays as far back as 1859, or probably even before that time, and for his investigating the effects of magnetism on those rays, for in Plücker's work we have what are really the initial and essential elements of modern television technique.

However the man who, as it were, really first came to terms with the cathode-ray, the individual who first tamed it, directed it and harnessed this ultra-high-speed electron-ray for a specific purpose, was undoubtedly our friend Dr. Karl Ferdinand Braun who, from all accounts, seems actively to have constructed a working cathode-ray tube in 1897, that is just before the close of the last century, and at a period when television was beginning to be thought about and, indeed, even seriously considered, although at that time, it had, at least, another thirty-five years to go before it became a first-rate commercial possibility.

A Teaching Career

Braun led the normal, thoroughly German scientific life. He was born at Fulda, a great German manufacturing city near Frankfurt, on June 6th, 1850, that is some nine years before Herr Plücker came out with his cathode-ray-observations. After being brought up at the great Technical Schools and Universities of Marburg and Berlin, and having eventually gained his Doctor's degree at the latter university, Braun set out methodically on the Teutonic round of patient day-by-day technical teaching which he intended to make his career. His first scholastic appointment did not come until he was nearing the age of twenty-seven. It was at Marburg, in the famous Technical College of that town, but he did not remain at Marburg for very long. From there he went to Karlsruhe, and from Karlsruhe to Tübingen, at each move accepting new and more important posts as Lecturer in Electrical Physics and Technology.

Finally, in 1895, Braun, who was then bordering on his forty-fifth year, was given the very important appointment of Professor of Physics in the University of Strasbourg and Director of the Physical Institute in that old-time, historical city. It was, by far, the most important and, incidentally, the last of various academic journeyings of Professor Braun, particularly so because his Strasbourg appointment left him with ample time to conduct the original investigational work in electrical physics which had always been his aim and his prior ambition.

A curious little man was Dr. Ferdinand Braun. Dapper, portly, with a fresh, red complexion and clear, luminous blue eyes which twinkled brightly through his narrow gold-rimmed spectacles, he seemed to be an almost perfect combination of French vivacity and German heaviness. He was a friend to all his students and particularly to those who showed any marked enthusiasm for their chosen work.

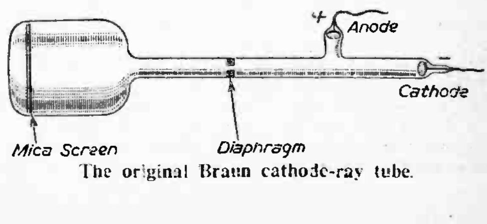
Henrich Hertz's discovery of the electro-magnetic waves which had been previously predicted on theoretical grounds by the Englishman, Clark-Maxwell, greatly intrigued Ferdinand Braun, who at once saw in them a practical and a highly convenient means of signalling over distances. And when Marconi made the first practical application of these "wireless waves" Braun's enthusiasm and eagerness for the new electrical techniques leapt beyond all bounds, as is witnessed by some of the passages in his book, "Wireless Telegraphy through Air and Water."

First Cathode-ray Tube

But previous to this stage, Dr. Braun had already completed one of the most important investigations of his scientific life. This was the making and the study of the first purely cathode-ray tube which he completed in his laboratory at Strasbourg in 1897, soon after his settling in that noted city.

The Braun cathode-ray tube was a very elementary affair, as may be seen from a mere glance at the diagram of it printed herewith. In his earlier days Braun had been familiar with Herr Geissler, the first designer of the small, thin-walled glass vacuum tubes which are so commonly demonstrated nowadays in electro-technical laboratories to show the effects of the passage of electricity through a vacuum, and Geissler himself, in his later years, appears to have aided Braun in the making of a few giant tubes of this nature.

Now, in the operation of any vacuum tube, if the tube is given merely a low degree of vacuum the entire space within it becomes more or less uniformly luminous when the current is passed. As the degree of vacuum within the tube is increased, the uniformity of the tube's luminosity on passing the current is disturbed. The luminosity is broken up into alternate sections or areas of vivid glow and of more or less complete darkness. And as the evacuation of the tube is carried higher and higher, the dark areas increase, whilst the bright luminous



The original Braun cathode-ray tube.

areas within the tube become progressively smaller and smaller until, at very high degrees of vacuum, the last bright area disappears behind the anode plate or electrode of the tube. At extremely high degrees of vacuum, the interior of the tube is almost completely non-luminous, but, at this stage, as Braun himself demonstrated, a new type of ray was being shot off from the cathode surface. This was the "cathode-ray" of which the erstwhile Herr Julius Plücker had spoken of in 1859, and other experimenters had mentioned, but it was given to Ferdinand Braun in his Strasbourg experiments to show that these rays could be made visible at their point of impact with a luminous screen coated with a glow-producing substance, such as one of the platinocyanides of calcium, barium or magnesium, which luminesced brilliantly under the influence of the rays.

Diverting the Rays

Having rendered visible the point of impact of cathode-ray and screen, Braun's next move was to divert the rays out of their essentially straight-line path of travel from the cathode of the tube by the external application of a permanent magnet or of an electro-magnetic field. This, of course, was a direct application of Plücker's former discovery.

In Braun's first cathode-ray tube the stream of rays was narrowed down and formed into a thin pencil by being made to pass through a small metal diaphragm before, ultimately, impinging on a mica plate coated with luminescing material on which it set up a bright spot which could be moved about to any area or point of the screen by magnetic or electro-magnetic control of the ray-pencil as it travelled along the tube.

Braun seems to have been aware that his cathode-rays were actually nothing other than streams of high-speed electrons shot off from the negative electrode or cathode of the tube, but it never occurred to him that the rudimentary electron-ray tube of his would ultimately prove to be the key which would give the entry to the realms of television, for, to Braun, the ultimate possibility of television was a subject which, at that time, was hardly worth a moment's thought.

The Oscillograph

Professor Braun, even if he had been working actively on television possibilities, had hardly a chance to carry out such work with an untramelled mind, for, at this period, wireless communication suddenly arose and seized with vivid intensity the imaginations of all scientific men. He made a few modifications and improvements on the design of his original cathode-ray tube, but it was not until some years after its first construction that, in 1902, he showed how its moving ray-spot could serve to trace out on the screen the various forms of alternating-current waves. Thus, for the first time, the cathode-ray tube, in one of its earliest guises, was converted in a most useful electrical implement—the cathode-ray oscillograph.

Perhaps strangely, when we consider Braun's fund of inborn inventive energy, this investigator never proceeded beyond this stage with his electrical tubes. The interests and intense fascinations of the then rapidly developing wireless telegraphy completely overcame him. He had become, as we might nowadays express it, a fervid wireless experimenter. As early as 1899, he obtained a radio patent for a new tuning system, and he devised the "Braun wireless transmitter" which was subsequently manufactured by Siemens and Halse, of Berlin. It was a spark transmitter working in conjunction with the then standard type of receiving set in which use was made of coherer detection. With this equipment, Braun, in 1899, established wireless communication by telegraphy between Heligoland and Cuxhaven, employing a transmitting aerial some 90 ft. high.

Braun Shares the Nobel Prize

Soon after his creation of the first cathode-ray oscillograph, Dr. Braun joined a small band of other wireless pioneers (von Arco, Slaby and Siemens) to form what became known as the "Telefunken" organisation. Braun devised a method of directional wireless, and among all his activities of this period of his career he found time to share with the oncoming Marconi the famous Nobel Prize for work in wireless communication.

The rest of Braun's life was taken up partly with academic activities and partly with his Telefunken interests. Curiously enough, this ever-active individual, who created for television science the cathode-ray device which was to become the very foundation of its practical success in our days, never made another investigation into the possibilities of a working television system.

At the beginning of 1914 Braun essayed to travel to New York for the express purpose of acting as an expert witness in a difficult matter of litigation which had then involved the Marconi Company. He lingered long in America, and before he could return to Europe, America had entered into the war against the German Powers. So that Ferdinand Braun, who went to the United States as an interested visitor, found himself compelled to remain there on the status of an internee. He tried to make the best of what was for him a thoroughly bad job.

Whether such an unexpected restriction of freedom directly took toll of his health we do not know for certain. But there remains the fact that within a short time the Professor began to fall ill. His condition became worse. A stranger in the land, and, worse still, an enemy national, he was removed to a hospital in Brooklyn. There he lingered for some time. On the morning of 14th August, 1918 his end came. And so, too, less than three months afterwards, came the end of Germany's First World War. Professor Braun had been little interested in the conflict. Indeed, he seems to have deplored it, but he had been caught up in the mill and it had broken him.

Club Report

NORTHAMPTON AREA TELEVIEWERS' SOCIETY

Secretary: G. T. Wilson, 95, Ennerdale Road, Northampton.

AT the Society's March Meeting the speaker was Mr. Cyril Page, who told of his experiences in Korea while filming for the BBC Newsreel.

A very pleasant evening was spent at Croydon, where a party from the Society attended the British Television Viewers' Society's Annual Dinner and Dance. Many BBC personalities were present.

Mr. Eric Robinson, BBC Musical Director, has agreed to become President of the Society.

The Annual Meeting will be held at The Wedgewood Chambers, Abingdon Street, Northampton, on Thursday, April 17th.

A party will be travelling to the Letchworth Society's Annual Dinner and Dance on April 24th. A group attended this function last year. Mr. G. T. Wilson (secretary), Mr. R. North and Mr. Flude hope to make a party up of 24 members for this function.

Members will be visiting the BBC shortwave transmitter at Daventry in May.

Membership now is 285.

Television Technique as an Aid to Observation

EXTRACTS FROM A PAPER BY J. D. McGEE, M.Sc., Ph.D., A.M.I.E.E., OF E.M.I. RESEARCH LABORATORIES, LTD., READ TO THE ROYAL SOCIETY OF ARTS

MODERN television has provided extensions to the human sense of vision which may be used for purposes other than the diffusion of entertainment or instruction. Besides the obvious extension in space of our ability to see, there are the less obvious extensions in the range of wavelengths of light which can be "seen," and in the capacity for visual memory. It is surprising that up till now so little has been done to exploit these very interesting fields. However, there are indications that this phase is coming to an end and it is hoped that the near future will see a rapid development of television technique as an aid to observation. Consequently it may not be inopportune to review those applications which have already been explored to some extent and to outline some others which appear to be worth developing.

The field under review is very extensive and consequently it has been somewhat arbitrarily limited to those cases in which an optical image is scanned to produce an electrical signal which is then transmitted some distance, however long or short, over line or radio, to a receiving point where it is reconstituted to form a pictorial representation of the original image. This excludes many applications of such devices as image converters, photoelectric electron-multipliers, charge storage tubes, etc., which do not fulfil this condition though these devices are closely connected with, and largely owe their development to, television technique.

Space is not available in which to give even a brief outline of television engineering principles, consequently a knowledge of the basic features of a television broadcasting system, such as that used by the BBC, will be assumed and only the special features of the applications described will be noted in detail.

The applications to be discussed fall into the following three catagories :

1. Those in which the essential feature is the separation of the transmitter and receiver.
2. Those in which advantage is taken of the extended range of wavelengths of radiation to which a television pick-up tube can be made sensitive.
3. Those in which the "memory," or capacity to integrate electrical charges produced by an optical image, of pick-up tube is used to extend or facilitate observations.

Spatial Extension of Vision

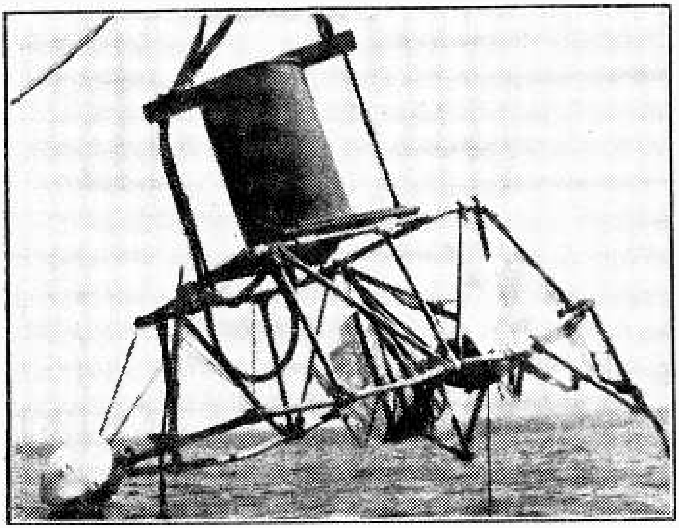
The first group of applications range from those which have the simple object of making interesting scenes visible to a larger audience than can see directly, to those in which the television camera replaces a human observer in a place which is difficult or dangerous for the latter to occupy.

Televising of Scenes to Overflow Audiences

This has been done many times. In such cases entirely conventional television cameras and receivers can be used. A cameraman can operate the camera, and the picture signals can be relayed by cable over the short distances involved to a suitable number of conventional receivers or large screen receivers. However, the equipment used in such an application need not be limited to the standards of broadcast television. A larger number of lines per picture and a correspondingly wider band-width of amplifiers and transmission lines might be used to give greater definition than is practicable for various reasons in a broadcasting television system. In this way, and by judicious use o camera lenses, it would certainly be possible to give a more vivid and detailed picture of proceedings, to those in the overflow audience, than would be had by the underprivileged in the back seats of a large auditorium.

Televising of Surgical Operations

This application has also been explored quite extensively and has two slightly different objectives. The first is to assist in the routine teaching of surgery to students without it being necessary to crowd a large number of them round an operating



The complete underwater television apparatus used for the "Affray" search. The camera is in the cylinder and lights are fastened below.

table in such a way that many of them can see what is being done only with difficulty, while inevitably impeding the essential work of the operating team. The second is to make visible to a really large audience rare operations of special significance.

The technical requirements are the same in both these cases. They are: the best possible quality picture as regards definition, tone gradation, freedom from shading, colour rendering, etc. The camera must be remotely controlled as regards focus, iris diaphragm, and the changing of lenses to give various angles of view and it must be so placed as to give a substantially uninterrupted view of the field of the operation without interfering in any way with the essential work of the theatre.

Again the picture standards need to be limited to those imposed on a broadcasting system. A higher number of lines per picture and a correspondingly greater band-width of amplifiers would be practicable to give pictures of greater detail.

A television system as briefly outlined above was installed by E.M.I. Research Laboratories, Ltd., in an operating theatre at Guy's Hospital, London, by courtesy of the Director of Surgery and operated for six months from May, 1949, on an experimental basis.

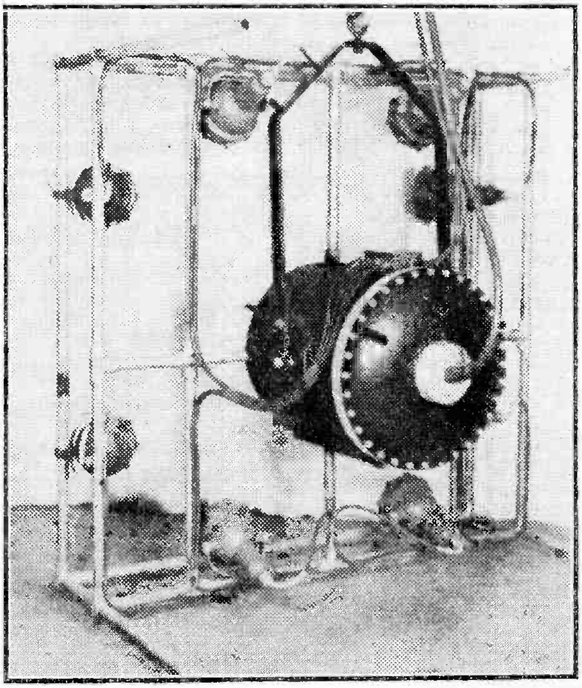
A standard C.P.S. Emitron camera operating on BBC picture standards was mounted with its optical axis horizontal on a level with the standard shadowless "Scialytic" lamp manufactured by Messrs. Technical Lights and Equipment, Ltd. The camera was directed at a mirror placed at 45 deg. on the axis of the lamp. This turned the direction of vision of the camera through 90 deg. downward along the axis of the lamp while neither mirror nor camera obstructed the light. Thus the field of the operation was only obscured when the light also was obscured by the surgeon, which insured a substantially uninterrupted view.

The normal camera control and supply units were housed in a small room outside the aseptic area of the theatre. Here also were located remote controls by means of which the objective lens of the camera could be focused, its iris diaphragm adjusted and any one of three lenses selected. These lenses were of 4in., 8¼in. and 12in. focal lengths, giving angles of view of approximately 24 deg., 12 deg. and 8 deg. respectively, which at the average distance to the operating table represented field areas of 24in. by 18in., 16in. by 12in. and 8in. by 6in. Thus the general location of the operation could be clearly shown, and then as work progressed, by going to the longer focal length lenses, a close-up view of the details of the surgeon's work could be shown.

The sensitivity of the C.P.S. Emitron camera was such that with the normal theatre lighting the objective lens could be stopped down to about f/8, thus giving excellent depth of focus. The high definition of this camera and excellent reproduction of image tones resulted in a very realistic picture—within the limits imposed by a monochrome, 405-line picture. Considerable difficulty was experienced at first with the white smocks of the operating team and the white towels, bandages, swabs, etc. These large white areas tended to overload the camera tube with light before the mosaic illumination from the much darker areas of blood—stained flesh—the areas of chief interest—was sufficient to give an adequate signal noise ratio. This difficulty was minimised by the use of green dyed smocks, towels, etc., in the operating theatre, a practice found to be very useful also in the cinematography of surgical operations.

The remaining difficulty was the overloading of the pick-up tube due to specular reflections from the highly polished surgical instruments. These, being small in area, did not often upset the stability of the tube and, of course, they do not interfere with the surrounding area of the picture. In general they could be ignored, but they nevertheless set a limit to the camera lens aperture and hence to the signal/noise ratio which determines the quality of the picture. In any permanent installation of this kind it would be worth while doing something to reduce the reflectivity of the instruments.

These tests gave useful information as to the value of monochrome television in teaching or demonstrating operative surgery. The verdict of the surgical authorities seems to be that they do not think the advantages warrant the cost. The outstanding lack is colour, which is of great importance in the differentiation of tissue, muscle, nerve, blood vessel, etc. Moreover, in this application the worst of the technical and economic difficulties involved in providing a public colour television service do not arise. However, in spite of several demonstrations of colour television for this purpose, there seems to be insufficient enthusiasm in this country for it to be adopted. The reasons are not at all clear. Is it that television at its present stage of development is judged to be technically inadequate? If that is so, then it is difficult to understand why periodic requests are received for television cameras to relay special operations. If it is that our hospitals cannot afford such equipment, then it is indeed to be deplored that for the want of a few thousand pounds this



Rear view of the latest Marconi underwater camera, surrounded by lighting gallery.

field of development must be neglected in this country.

In the United States the attitude seems to be different. To give only one example, the University of Kansas Medical Centre has used monochrome television for the past two years and has just installed a colour system and reports very satisfactory results. (See *Time*, December 10th, 1951.)

Submarine Television

This is the first of the examples of applications in which a television camera takes the place of a human observer in a place where it is difficult or dangerous for a man to operate. This application was brought dramatically to the notice of the public in September last by the announcement by the Admiralty that the sunken submarine *Affray* had been identified by this means lying at a depth of 285ft. on the bottom of the English Channel using an image orthicon camera made by the Marconi Wireless Telegraph Co.

Divers have been going down in diving suits, diving bells and sealed chambers for some decades, with and without artificial illumination, and television cameras have been operated at distances of up to 1,000ft. from their control unit for some 15 years and could be remotely operated at much greater distances if required. All the important technical problems involved in submerging a television camera had already been encountered and overcome in using cameras and cine cameras under water with and without artificial illumination, and these problems are negligible compared with the difficulties arising and precautions necessary in the operation of a diver. Hence it is somewhat surprising that the first use of this potentially valuable equipment was made only in 1951. In October, 1939, the author and his colleague, Mr. H. E. Holman, attempted unsuccessfully to get this promising field for television explored and pointed out the advantages to be gained in a memorandum submitted at that time.

Before the war the most sensitive television camera compared quite well with the standard 35 mm. cinematograph film but not with the human eye in sensitivity. However, the improvement in the sensitivity of television cameras has been very rapid and now it is fair to say that the television camera compares with the sensitivity of the eye in the "light-adapted," or photopic, state. It is true that the eye in the dark-adapted, i.e. the scotopic, state, is still an order of magnitude more sensitive than the best television camera, but it then loses its ability to distinguish detail and colour. When a BBC television commentator under conditions of bad light has said that he could see more clearly what was going on by reference to the television commentator's monitor than by looking directly at the scene it was probably due to his eyes being in the photopic condition through looking at his monitor. The eye only attains its full sensitivity after being in the dark for as much as 30 minutes and then it can see fairly well in moonlight—equivalent to the illumination of 0/01 feet candles—while no television camera known to the author will give an intelligible picture of moving objects with less than 0/1 foot candles.

Hence, although the human eye of the diver can still see better in poor light under water than the television camera, the latter has so many other fundamental advantages that it seems inevitable that it will open up a vast field of exploration and research in the hitherto almost unknown depths of the oceans. These advantages may be listed as follows :

1. Diving is hazardous work and a television camera can be risked when a diver could not be allowed to risk his life.

2. Diving is a skilled occupation only done by specially trained men who cannot be expected to be experts in any of the highly technical subjects they must examine. All the technical expert can obtain at the surface is a description of what has been seen by a layman.

3. If the diver operates in a "soft" diving suit which allows him mobility, the depth to which he can go is limited and he must be raised very slowly to avoid cramp due to the release of excess nitrogen dissolved in his blood at the high air pressure necessary at great depths. This is a serious hazard and limits the scope of a diver's operations very considerably. With all the latest aid the record depth of dive is only 540ft.

4. Strong tides, bad weather and other considerations may severely limit the time when a diver can work with reasonable safety. This could be extended by the use of a television camera.

5. All of these points have been illustrated in the case of the *Affray*, and how much more vitally important might they not become in a case in which a disabled submarine was not overwhelmed as rapidly as that ill-fated craft.

The diver operating in a flexible diving suit has still one big advantage : he can manipulate tools, etc., while the camera can only look on. However, it seems inevitable that in the near future the camera will be provided with remotely operated arms and hands so that operations can be done by remote control while being observed and directed by the television camera, as is now the practice in plutonium separation plants.

Besides the application to examination of wrecked ships there is the tremendous field of scientific exploration of the ocean bed, and the plant and animal life of the ocean. In view of the urgency of the food problems of the world it is to be hoped that submarine television may be able to make some contribution to exploiting that vast potential source of food, the ocean.

Scottish Recommendation

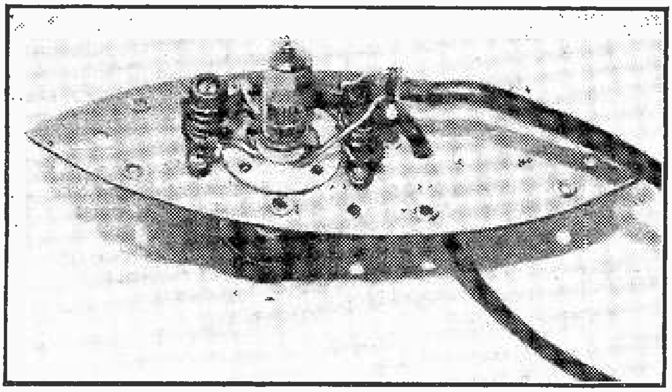
Some three years ago Dr. H. Barnes, of the Scottish Marine Biological Association, proposed that a submarine television equipment should be built and tested for this purpose. An application was made to the Treasury by the Scottish Marine Biological Association under their president, Prof. C. M. Young, F.R.S., for a grant from the development fund. The application was considered by the Development Commission's Advisory Committee for Fisheries Research, who recommended that a grant should be made, and who appointed a scientific group to keep in close contact with the work. This grant was authorised early in 1951, and shortly afterwards a contract was placed with E.M.I. Research Laboratories, Ltd., for the construction of suitable equipment.

In this application the camera will be mounted in a strong steel case, which has a glass window in front of the operative lens and a watertight gland through which the camera cable is brought through the steel cover plate. The camera itself is of the C.P.S. Emitron type, rather similar to that used in the operating theatre, without viewfinder, of course, but with remote control of optical focus, lens iris and lens turret. The camera control equipment will be standard portable units, which can be located at any convenient place on the surface. Watertight lamps, rigged on arms extending from the camera case, are provided to illuminate objects in the water or on the sea bed.

(*To be continued.*)

Makin
Aerial Pre

UTILISING AN EX-GOVERNMENT UNI MOUNTING DIRECT ON THE AERIAL



The complete amplifier without its case.

THIS amplifier, which makes use of an inexpensive ex-Government unit, obtainable from Premier Radio and other advertisers, has been designed for those who are living beyond the fringe area, and for those in difficult situations where reception is weak, or is marred by interference from traffic, etc.

The amplifier boosts the voltages received in the aerial so that a signal of reasonable magnitude is passed along the transmission line. A very weak signal is seriously attenuated if the transmission line is of reasonable length.

Another difficulty overcome by this amplifier is that in weak areas the aerial is erected as high as possible in order to pick up as strong a signal as can be obtained; but the higher the aerial, the longer is the transmission line and the increased gain obtained by the height is partially offset by the additional loss in the line.

On the fringe, trouble is often experienced with interference from passing traffic. A remedy is to erect the aerial in a higher position and to fit the pre-amplifier.

The amplifier is contained in a sleek, streamlined body, and is built from an ex-Government U.H.F. aerial unit. It is actually mounted on the aerial as close to the dipole as possible. The prototype (shown in the photograph) was actually fitted at the junction of the crossboom and the main supporting mast. It weighs only a few ounces.

The completed unit contains the entire pre-amplifier with the 6F12 valve. Power supplies (H.T. and L.T.) are fed to the amplifier by coaxial cables.

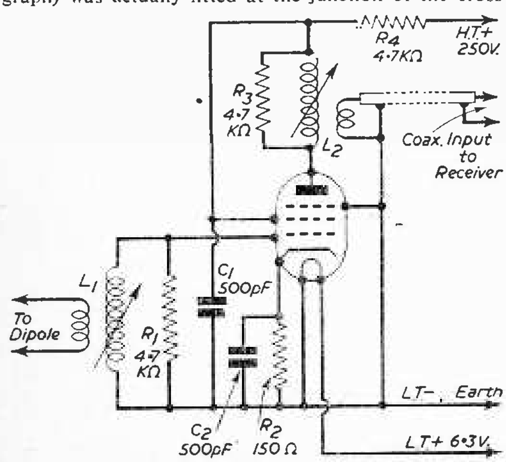


Fig. 1.—Circuit of the Aerial Pre-Amplifier.

Dismantling the Unit

The general appearance of the unit is shown in the photographs. The top lid is removable, being held by three sunk screws which are covered with wax. The screws are easily removed and the top can then be prised off with the blade of a knife.

Inside will be found an EA50 valve which is held in position by a springy clip attached to the copper aerial. The clip is unscrewed and the valve can then be removed.

The existing aerial is held in position by a locking nut fitted on the baseplate; the nut is unscrewed and the copper aerial can then be withdrawn.

To separate the baseplate from the ebonite cover undo all the countersunk screws, and also the locking nuts. The black body can then be withdrawn.

The baseplate holds a cylindrical cover which is removed by undoing two locking nuts; inside this cover will be found a three-pin socket and a 100 KΩ resistor with a 20 pF condenser. These items should be removed.

The EA50 socket can be removed and the hole it leaves should be opened out to accommodate a B7G valve base.

COIL-WIND

Coil	Alex. Palace	Sutton Coldfiel
L1 Primary	2T	1½T
L1 Secondary	7T	5T
	L2 Primary as	
	L2 Secondary	

Circuit

The circuit of the amplifier is given in Fig. 1. The valve used is a Mazda 6F12. The primary of L1 is fed by 80 Ω coaxial or twin feeder directly from the dipole. In the prototype coaxial cable ½in. overall diameter was used so that it completely filled the hole left

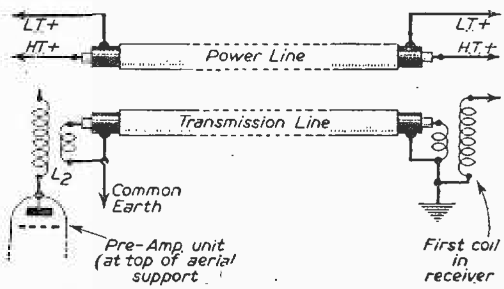


Fig. 2.—Details of the power and transmission lines.

g an
e-amplifier

THIS PRE-AMPLIFIER IS INTENDED FOR

By B. L. Morley

by removal of the copper aerial.

The output from L2 feeds directly into the coaxial transmission line. The outer sheath of this line is earthed and serves not only as a screen, but also as the return path for H.T. and L.T. It is advisable to use ½in. diameter cable for this job.

R1 and R3 act as damping resistors to ensure adequate bandwidth for both vision and sound channels. In very weak areas where single sideband is being received these resistors can be omitted to obtain greater gain.

The number of turns for the coils is given in the table; ⅜in. diameter coil formers are used, tuned by iron-dust cores.

L1 has the secondary wound on first, in bare 22 S.W.G. wire. Spacing between turns is approximately 2 mm. The primary of L1 is 22 S.W.G. covered with systoflex sleeving, and is wound on top of the secondary.

NG TABLE

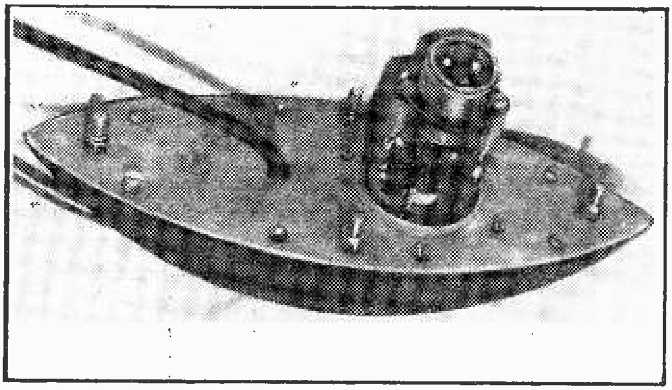
Holme Moss	Kirk o' Shotts	Wenvoe
2T	1½T	1T
6T	5½T	4½T

L1 secondary.
as L1 primary.

L2 has the primary (anode coil) wound first and the secondary is covered wire. It is wound similarly to L1.

The coil formers can be bolted to the baseplate so that they come inside the cover. L2 coil former should be filed to make it ¼in. shorter than L1, so that it will not foul the ebonite lid. The damping resistors (R1 and R3) are wired directly across the coils.

The remaining components R2, R4, C1, C2. are mounted in the space previously occupied by the 100 KΩ resistor and 20 pF condenser, and are held in position in a similar manner. H.T. and L.T. are wired to the pins of the three-pin socket.



Base of the amplifier.

Connections

The input feeder to L1 is taken via the hole in the ebonite case left by the removal of the copper aerial. The output is taken via coaxial cable which is fed through the baseplate, using the hole which originally held the bolt for the copper aerial. This hole will have to be enlarged. The sheath of the cable is earthed by soldering it to a tag fitted under the bolt on coil L2.

Chatterton's compound should be used on each side of the baseplate where the output cable enters to make a watertight seal.

Wiring between the valve base and the coils is made by drilling holes around the periphery of the valveholder. Three holes are required: (i) grid input to valve; (ii) anode connection to L2; (iii) H.T. connection to L2.

The cylindrical cover can be replaced after wiring H.T. and L.T. to the three-pin socket. If a plug is not available for this socket the coaxial feeder which supplies H.T. and L.T. can be soldered directly to the pins of the socket (externally) and the whole enclosed in the cover of an old bakelite two-pin plug, which is covered with insulating tape and sealed against the ingress of moisture.

Having wired the unit, it is advisable to adjust it before mounting it on the aerial. It can be tested as a normal pre-amplifier. The cores should be adjusted for maximum response, and sealed with wax.

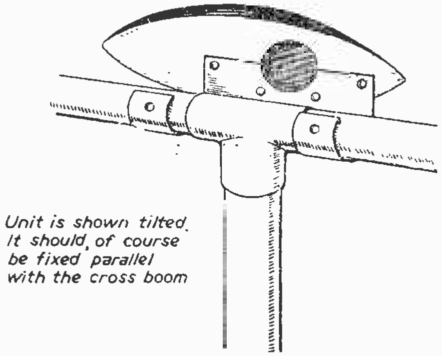


Fig. 3.—Sketch showing the unit fitted to the cross-boom.

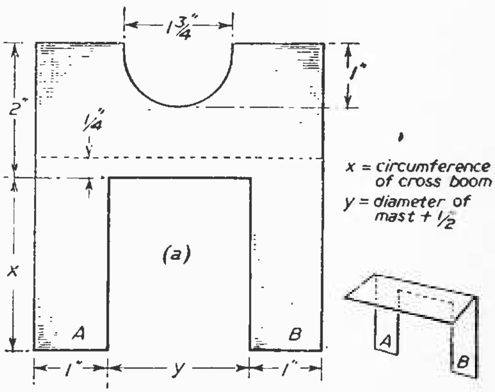


Fig. 4.—Details of the fixing clamp which can be seen in Fig. 3.

Power Supplies

H.T. and L.T. are obtained from the existing power supply lines in the televisor. If the filament line in the televisor is of the series type, then it may be thought worth while to use a separate filament transformer for the pre-amplifier. If this is done it is a good idea to overrun slightly the transformer to counteract the voltage loss in the line to the aerial. For example, if your mains voltage is 230 volts, then the 210 volts tap on the transformer should be used.

Weatherproofing

Now the amplifier will be subjected to all sorts of weather conditions and it must, therefore, be completely watertight. The joint between the baseplate and the ebonite cover must first be sealed.

Obtain some beeswax (available from the cobbler) and melt it in a tin until it begins to smoke. The melted wax should not exude a lot of black smoke—if it does, it is too hot. Great care must be taken with the heating as the wax is very inflammable.

Warm the baseplate and the ebonite cover and pour the melted wax round the edges of both of them. The two should be immediately bolted together while the wax is malleable. Tighten all screws thoroughly.

To prevent any condensation taking place, a small quantity of silica gel can be placed in a muslin bag, and heated on the oven shelf to drive off the moisture. It

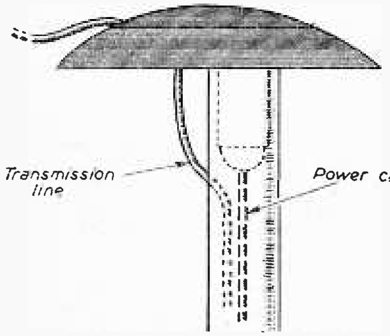


Fig. 5.—An alternative method of mounting the amplifier.

can then be fitted inside the ebonite cover. Approximately one ounce will be sufficient. (A small quantity can be placed inside the cylinder portion of the unit if desired.)

A small piece of sponge rubber is now glued on to the inside of the ebonite lid so that it presses on top of the valve and holds it firmly when the lid is screwed on.

The cable connecting L1 to the dipole is wrapped with insulating tape so as to form a tight fit in the hole in the ebonite cover. Melted wax is then applied to the edge of the ebonite cover and its lid, not forgetting the insulated cable, and the lid is screwed on firmly.

Finally, the countersunk screw holes are filled with melted wax.

The joint on the cylinder where the H.T. and L.T. connections are made should be covered with insulating tape and immersed in wax.

If these precautions are taken no trouble will be experienced due to moisture entering the amplifier.

Mounting

Two methods are suggested for mounting the unit. Fig. 3 shows one method. A sheet of stout aluminium 4in. wide is cut as at (a) Fig. 4, and is bent along the dotted line. It is bolted to the baseplate and the two legs " A " and " B " curled round the cross-boom, one on each side of the mast. They are then bolted in position.

An alternative is to use a piece of dural tubing

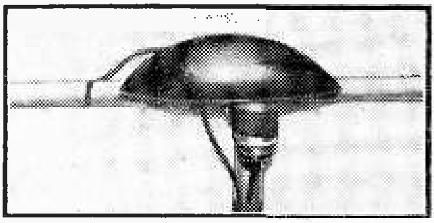


Fig. 7.—Photograph of the Aerial Pre-Amplifier mounted on an actual aerial by the method shown in Fig. 3.

2in. internal diameter. The end is cut and strips are bent back to firm flanges, which are bolted to the baseplate (Fig. 6) with the cylinder inside the tube. The tube is then bolted to the mast at convenient points.

Finally, don't have any qualms about mounting this amplifier on the top of the mast. Modern valves stand up to quite a lot of abuse—and remember the Post Office engineers are using valve amplifiers at the bottom of the sea on certain underwater cables !

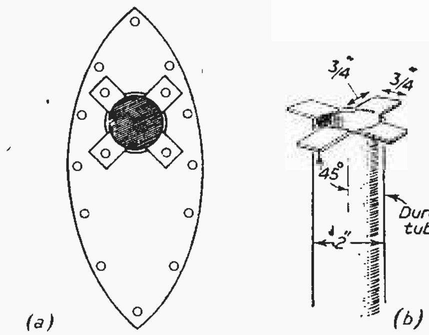


Fig. 6.—Details of the mounting required for the scheme shown in Fig. 5.

The Television Linkage of England and Scotland

A BRIEF TECHNICAL SURVEY OF THE WORK INVOLVED AND HOW IT WAS CARRIED OUT

WITH the official opening of the Kirk o' Shotts television station the BBC has achieved the greater part of its development programme aimed at bringing a television service within the reach of 80 per cent. of the population of the United Kingdom by 1954.

Since the reopening of the Alexandra Palace station on the 7th June, 1946, this ambitious undertaking has been implemented by means of a network of G.P.O. coaxial cables and radio links first between Alexandra Palace and the 30-kilowatt television transmitter opened at Sutton Coldfield on the 17th December, 1949, then from Birmingham to the 45-kilowatt Holme Moss transmitter opened on the 12th October, 1951, and now over a further 250 miles from Manchester to the first Scottish television transmitter at Kirk o' Shotts.

Standard Telephones & Cables, Ltd., have been associated with all stages of the development of the television network, including the design, development and installation for the British Post Office of the coaxial cable which connects the London and Midland transmitters, the coaxial cable and associated vestigial sideband transmission terminal equipment linking the Midland and Northern transmitters, and the micro-wave radio relay system now serving the Scottish transmitter. Equipment for all three stages of the linkage has been produced to meet the technical requirements of the Post Office.

Television Outside Broadcast Facilities

Coaxial cables have been installed by Standard Telephones & Cables, Ltd., for the G.P.O. in the London Area. These short coaxial links are used for collecting outside broadcast television programmes. They centre on Museum Exchange, the principal switching point for the long-distance links.

To places from which outside broadcast programmes are regularly taken there are direct coaxial cables to Museum telephone exchange. These include the Empire Pool and the Stadium, Wembley, and the two cricket grounds at Lords and the Oval respectively. For more general outside broadcast material coaxial cables link the main West End telephone exchanges, such as Gerrard, Mayfair, Victoria and Faraday. Programmes from places within a mile or so of these exchanges may be collected on ordinary telephone cable lines, many of which have also been manufactured and installed by "Standard." There are about 40 miles of "Standard" coaxial cables in the London outside broadcast networks and some of these have been in use since the beginning of television broadcasting from Alexandra Palace in 1936.

The London-Birmingham Coaxial Television Cables

Consisting of three parts—the main cable and a short tail cable at each end—the latest London-Birmingham coaxial cable follows the route of the old Roman road via Watford, Aylesbury, Daventry, Coventry and Birmingham. The main cable, forming part of the Post Office trunk telephone network, covers a distance of just over 121 miles, with 43 repeater stations en route, of which 11 are required for present-day programmes. The cable terminates at Museum Exchange, London, and Telephone House, Birmingham, and the end connections to the transmitters are provided by tail cables between Museum Exchange and Alexandra Palace and between Telephone House and Sutton Coldfield.

The London-Birmingham cable incorporates two 0.975in. and four 0.375in. coaxial tubes. The larger tubes are used, with repeaters designed and made by the G.P.O. at 12-mile spacing, for two-way transmission of 405-line television signals requiring a video bandwidth of approximately 3 Mc/s. Ultimately these tubes may be required for very-high-definition or colour television and frequencies up to 26 Mc/s may be involved with repeaters at three-mile spacing. The 0.375in. tubes are used for broadband telephony purposes, each pair being capable of carrying 600 speech circuits. The whole system has been planned to meet the recommendations of the 1943 Television Committee.

The Birmingham-Holme Moss Coaxial Television Cable & Associated Equipment

Between Birmingham and Manchester there is a Standard Telephones & Cables, Ltd., coaxial cable including six 0.375in. tubes, of which two are used for the transmission of video signals, 16 paper-insulated quads for controlling the repeater stations associated with the coaxials, and 172 paper-insulated quads for local telephone traffic. The repeater stations, with equipment designed and installed by the G.P.O., are spaced at about six-mile intervals.

Beyond Manchester the cable extends through Hyde to Mottram, and from Mottram to Holme Moss the television network has been completed by means of a two-tube coaxial spur cable containing four screened pairs for music circuits and 24 paper-insulated quads for repeater control in addition to the two 0.375in. coaxial tubes.

Vestigial sideband terminal equipment supplied by Standard Telephones & Cables, Ltd., is used with this cable link to translate the video signals to a frequency band suitable for transmission over the coaxial cable.

The Manchester-Edinburgh Micro-wave Radio Link

The latest link in the chain, from Manchester to Kirk o' Shotts, made its successful début on an experimental basis almost a month ahead of schedule when called on at very short notice to permit Scottish viewers to share with their English compatriots in the funeral ceremonies of our late King George VI. This link is a two-way micro-wave radio relay link which operates on the general principle of beamed micro-wave transmissions at a frequency of the order of 4,000 Mc/s over a series of optical paths along a carefully planned and surveyed route connecting the two terminal stations. The total length of this route is 250 miles. The preliminary survey, carried out with portable micro-wave television links of the type supplied by "Standard" for a number of important BBC "outside television broadcasts" during 1950 and 1951, confirmed calculated heights for transmitter and receiver antennae as well as their spacing along the route. Accordingly, each individual micro-wave transmission traverses an average distance of some 30 miles, a total of seven repeater stations being provided for receiving and retransmitting programme signals en route.

Equipment at terminal and repeater stations affords one uni-directional channel from Manchester to Kirk o' Shotts simultaneously with a second similar channel in the reverse direction. Each channel is designed to handle the 0-3 Mc/s bandwidth of a 405-line definition, 50 frames per second, double-interlaced television programme in one direction of transmission. Full remote control and supervisory facilities are provided whereby each terminal station is able to control the operation of the equipment at all points along the route to the other terminal.

To ensure a high degree of reliability, all transmission equipment with the exception of parabolic reflectors and main waveguide feeds is provided in duplicate; the change-over from one set of equipment to the other being fully automatic in the event of breakdown. In the same way, automatic standby sources of power supply have been provided to cater for a breakdown in local public mains supplies.

The intermediate two-way repeater stations are designed to work unattended. Should the occasion arise, however, engineers could adopt them so that locally derived programme material may be injected into the network for transmission in either or both directions. In this way, the Manchester-Edinburgh link not only extends the television service to new areas, but can also facilitate programme contributions to that service from the areas through which it passes.

Transmitting equipment for the micro-wave radio link at Kirk o' Shotts and Manchester is designed to accept the video-frequency bandwidth of 0-3 Mc/s at a level of 1 volt D.A.P. in 75 ohms. The video signal modulates the reflector-cathode circuit of a reflex klystron, oscillating at a basic frequency of the order of 4,000 Mc/s, in such a way that the output frequency is deviated by a total of 6 Mc/s for a change from the bottom of a synchronising pulse to a peak white picture. The R.F. oscillator frequency is stabilised by means of a precision crystal oscillator with a basic or fundamental frequency of the order of 20 Mc/s.

The S.H.F. output from the klystron is fed through waveguides to a travelling wave amplifier and thence to the transmitting antenna. Transmitting and receiving antennae at the terminal and repeater stations consist of waveguide horns feeding paraboloids which are 10ft. in diameter and mounted on steel towers; two paraboloids at each of the terminals and four at each repeater station. The heights of these towers range from 20 to 200 ft. depending on the altitude of the site in relation to the terrain covered by the beamed transmission. The width of each transmitted beam is $\pm 1\frac{1}{2}°$ to the half-power points and the waveguide feed delivers a power of 1 watt to the antenna.

On arrival at the first repeater the frequency modulated S.H.F. wave is passed by means of a waveguide feed from the parabolic reflector to a super-heterodyne receiver. This receiver employs a crystal controlled local oscillator operating at a frequency of 60 Mc/s above the mid-frequency of the incoming signal (or 57 Mc/s above the incoming frequency corresponding to synchronising pulses) to produce an intermediate-frequency band-centred on 60 Mc/s. The I.F. signals are amplified in an amplifier fitted with A.V.C. and again translated to a radio frequency 37 Mc/s above or below the incoming R.F. An automatic frequency control maintains the frequency of the second local oscillator 37 Mc/s above or below that of the first local oscillator.

Unwanted products of the last process are eliminated by means of a filter, the required single sideband being amplified by a travelling wave amplifier to a power of 1 watt and passed to the transmitting antenna.

This process is repeated at each successive repeater station until the other terminal of the link is reached. Here the S.H.F. band from the antenna is passed to a superheterodyne receiver. This receiver, as in the case of the repeaters, uses a crystal controlled local oscillator to produce an I.F. band centred on 60 Mc/s. Thereafter, however, the output from the I.F. amplifier is frequency demodulated in a discriminator which converts the frequency modulated I.F. band to the video frequency range. This is then available at a level of 1 volt D.A.P. in 75 ohms for passing either directly to a television transmitter or further radio link, or via a vestigial sideband system to a coaxial cable network.

To eliminate mutual interference due to multiple path effects, two radio frequencies are employed, these being used in alternate directions on alternate sections. These differ from each other by about 37 Mc/s.

The waveguides and waveguide circuit elements such as attenuators, filters, hybrid-type junctions and switches carrying S.H.F. waves have a rectangular cross-section of approximately 2in. $\times \frac{1}{2}$in. and are made of either brass or copper. The waveguide run from the equipment racks to the horn feed is filled with dry nitrogen maintained under slight pressure in order to preserve the inside surface of the guide from corrosion. Inside the equipment racks it would be inconvenient to fill with nitrogen and maintain a hermetic seal and the waveguide surfaces are protected by gold-plating instead of the varnish finish used for the main run.

An interesting feature of the complete link is the elaborate precautions which are taken against the possibility of interruption of the service. As already mentioned, these include duplication of the majority of the equipment with automatic change-over to standby equipment immediately on failure of the working equipment. In addition, provision is made for remote switching of equipment from control stations at Kirk o' Shotts and Manchester, where the condition of equipment at each station is displayed continuously on a control board. A four-wire land line circuit interconnects all terminal and repeater stations and provides a party line speaker circuit and a two-tone V.F. telegraph circuit which carries the supervisory and remote control signals. The remote control desks incorporate testing and monitoring apparatus designed and manufactured by Kolster-Brandes, Ltd., a subsidiary of Standard Telephones & Cables, Ltd.

Equipment at all stations operates normally from the local three-phase A.C. mains supplies: dynamic voltage regulators stabilising the output voltage to within ± 1 per cent. of nominal being provided for each phase. Standby power-supply equipment for use on failure of the public mains supply comprises a diesel-engine-alternator set which is arranged to start up and take over the load automatically within 15 seconds of a failure of the local public mains supply.

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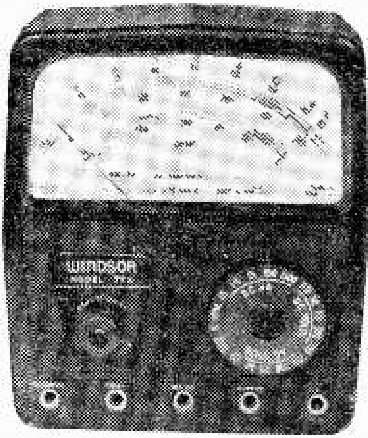

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Aerials and Signal Strength

AN EXPLANATION, FOR THE BEGINNER, OF THE IMPORTANCE OF CORRECT SIGNAL STRENGTH

By W. J. Delaney (G2FMY)

IT is often possible to see adjacent houses carrying totally different kinds of aerial, in some cases such extremes as a single dipole contrasting with a multi-array with directors and reflector. The beginner may well ask what difference the aerial makes and wonder if the expense of the large aerial is justified. We often receive queries from prospective new viewers asking what type of aerial they should fit, and an attempt will therefore be made to give some idea of the differences which may be expected from the various types of aerial. Firstly, to take the broad view, the simple aerial should be used in situations close to a station, whilst in remote areas the multi-array should be used. But this is not the whole story. When asked what type of aerial a reader should use our general reply (if we do not have first-hand information concerning the locality) is that it is not possible to state by just knowing that the situation is so many miles from the transmitter. It is possible to be situated 10 miles from a station and receive a poorer signal than at a point 50 miles away. As has been pointed out in these pages before, the signal follows the contour, more or less, of the ground, and thus at a point behind a hill it might be found that signals are completely absent, due to the screening effect of that hill. The same can apply to a large building, and a small villa situated behind it. On the other hand, where there is only a big stretch of open country without densely wooded areas, hills or buildings, the signal will travel uninterrupted and may be received over long distances at remarkable strength due to the nature of that country.

Signal Strength

Some new viewers may think that they are not concerned with powerful signals (taking their ideas from sound programmes) and imagine that a simple aerial will probably be good enough. This may be so, if the receiver is a model designed for long-distance reception. Most manufacturers now produce two types of receiver —one for normal distances and one for the remoter areas and generally known as a "fringe model." It is not necessary that the latter should be restricted to remote areas and it may be used, with certain precautions, in areas within a short distance of the transmitter. Firstly, it must be pointed out that it is not only the picture intelligence which must be considered when deciding upon the aerial. A much more important factor is the sync pulse which locks the picture and keeps it steady and intact. Both a weak pulse and a very strong one may be objectionable, and will give rise to several faults in the received picture. The commonest is known as "pulling on whites." where the picture becomes broken up in horizontal strips where a white object comes at the right-hand edge of the picture. All those scanning lines which terminate in the white detail will be seen to have moved to one side, resulting in any vertical lines in the picture being "stepped." As the white objects pass out of the picture the lines jump back into position and this obviously spoils what might otherwise be a good picture.

Frame Hold

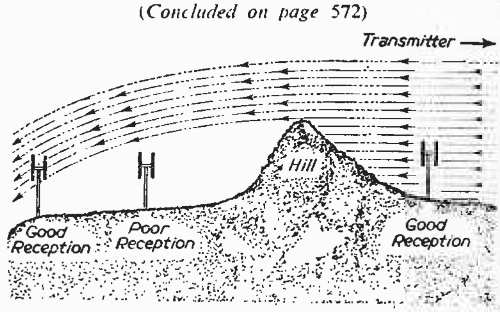
If there should be any local traffic it will also be found that when a car passes, if it is not fitted with a suppressor, not only will the customary white dots be seen on the screen, but the actual picture may slip due to the interference firing the frame timebase at the wrong time. The picture will appear to be rolling either up or down and may even suddenly lock with the black space between pictures in the centre of the screen. If left like this it will probably remain quite steady until another car passes, when the frame will slip again and may lock into its correct position. Another fault which a weak signal will be found to bring in its train is the necessity of setting the line and frame hold controls from night to night. That is to say, when switching off one night, with everything working satisfactorily, it will be found that when switching on the next night the picture will be broken up and have to be reset by adjusting both frame and line hold. It may remain in adjustment all the evening, but the next night will require setting again. It will be seen, therefore, that a certain strength of signal must be obtained for reliable results, and that is why it is desirable to make certain that the aerial is suitable. If, for some reason, an unsuitable aerial has been fitted and troubles of the above kind are experienced, the remedy is to add a pre-amplifier (or change the aerial) so as to increase the signal strength.

If the area is such that a good signal is received and by mistake a too-efficient aerial is fitted, or a wrong model receiver is chosen, it is not a difficult matter to fit an attenuator between the lead-in and the receiver to dispose of the excess signal. This is, of course, a much cheaper process than fitting a pre-amplifier, so it is probably better, when exact details concerning the area cannot be obtained, to err on the side of obtaining too strong a signal. The attenuator may be adjusted to give the required reduction in signal strength, and in general it will be found that this is a good plan to adopt where interference is very bad as the adjustment of the attenuator will result in a reduction in the strength of the interference as compared with the signal, and in some cases may even result in the complete elimination of the interference.

Signal Too Strong

Unfortunately a signal which is too strong can be just as troublesome in certain types of circuit as one which is too weak. In most circuits the sensitivity or contrast controls will, however, reduce the signal to such pro-

(*Concluded on page 572*)



This illustration shows how an aerial can be screened.

TRADE TOPICS

Latest Brimar Teletubes

STANDARD TELEPHONES & CABLES, LTD., manufacturers of Brimar Teletubes, and the first to introduce rectangular cathode ray tubes into this country, announce the first of this series, the Brimar C14BM rectangular teletube, in full production, and now commercially available for the first time. It is estimated that the C17BM, the 17in. version of this tube, will be ready by the middle of the year.

It is not generally realised that the rectangular tubes, being so much shorter in length than the round variety, will have a marked effect on cabinet design in the future, and in particular will enable the television set designer to effect a substantial reduction in the depth of the cabinet. A typical comparison is given below :—

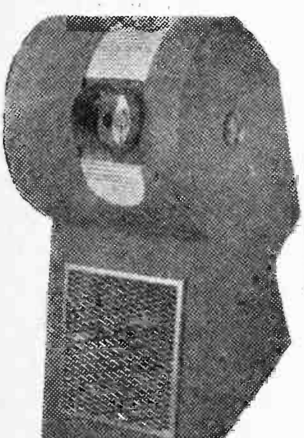
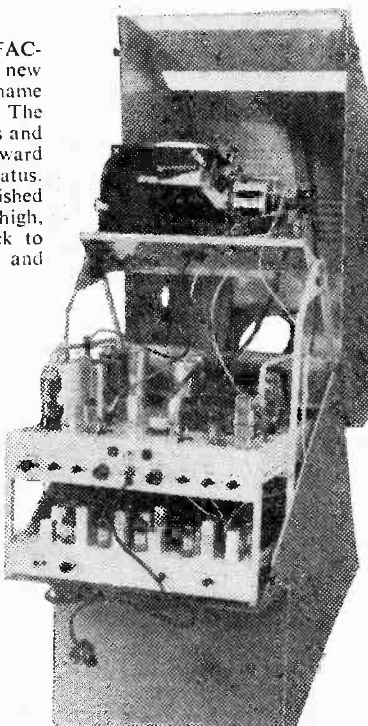
C12B 12in. round tube—length 19¾in.
C12D 12in. round tube—length 19¾in.
C14BM 14in. rectangular tube—length 16⅞in.
C17BM 17in. rectangular tube—length 19⅞in.

It will be observed that the 17in. rectangular tube can be fitted into a cabinet of the same size as the 12in. round tube, and that a 14in. rectangular tube will go into a cabinet 3in. less in depth.

The high-grade aluminizing of Brimar teletubes is already a main sales feature, and set makers in particular will be interested in these large tubes, which will fit into cabinets of smaller size.—**Standard Telephones and Cables, Ltd., Foots Cray, Sidcup, Kent.**

Rainbow Projection Receiver

RAINBOW RADIO MANUFACTURING CO. announce a new projection receiver for which the name "Bowjection" has been coined. The derivation of this name is obvious and the illustrations below show the outward and inner appearance of the apparatus. Contained in a grey crackle-finished steel cabinet, measuring 42in. high, 17in. wide and 30in. overall back to front, it has an adjustable turret and is mounted on large castors for ease of movement. The receiver is specially designed for projection working and throws a picture 4ft. by 3ft. and is thus highly suitable for schools, clubs, hotels, etc. The receiver is designed for A.C. operation only, and is thus isolated from the mains and is supplied complete with a specially-designed screen and screen cabinet. Price and delivery dates will be announced later.—**Rainbow Radio Manufacturing Co., Ltd., Mincing Lane, Blackburn, Lancs.**

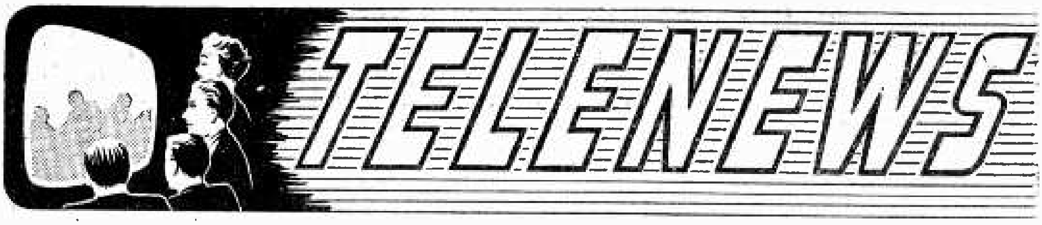
The new "Bowjection" receiver showing the internal arrangement of the various sections.

Spencer-West Converter Unit

A NEW type AC/4 converter unit is announced by Spencer-West.

This unit permits the use of any type of television receiver for the reception of any of the existing or proposed television transmitters. No alterations to the receiver are entailed, the unit being simply connected in the aerial feeder to the receiver. A self-contained power supply unit suitable for operation from A.C. mains of 200-250 v. at 50 cycles is included. For the dealer or user of a television receiver who is now in the service area of a transmitter operating at frequencies other than those for which his receiver is tuned, this unit offers the ideal solution, avoiding as it does complicated and time-expending conversions, with the ever-present risk of spoiling the receivers' performance. In the event of the removal of a television owner to a new district, realignment of the converter unit permits the use of the receiver for reception of the most suitable transmitter. The technical specification has been further improved by the use of new types of valves, and the inclusion of a sound rejector and intermediate frequency rejector. These refinements permit the use of the type AC/4 converter even with super-heterodyne receivers and with receivers whose alignment did not take account of the increasing number of transmitters, and of the fact that the new transmitters would be of a single side-band type.

The original successful feature of employing a double-frequency mixer is retained in the new model. This feature permits individual adjustment of the sound and vision channels. An R.F. stage ensures absence of mixer noise and radiation to neighbouring receivers. The unit is officially recommended by most of the leading manufacturers as a simple satisfactory conversion arrangement, and retails at 15 gns. complete. Models are available for Birmingham/London, Holme Moss/London, and all other possible requirements.—**Spencer-West, Quay Works, Gt. Yarmouth.**



British Radio Exports Still Rising

IN spite of the demands of the defence programme, British radio exports in February again showed an increase, the total value being £2,136,000, which, with the January figures, brings the annual rate to more than £25 million compared with £22 million in 1951.

All four sections of the industry show a substantial increase in January and February compared with the first two months of 1951, the comparative figures, based on Customs and Excise returns, being: 1951 — £2,804,000; and 1952—£4,293,000.

These figures take no account of indirect exports of equipment installed in ships and aircraft or components used in electrical apparatus other than radio and electronic equipment. Half the output of components, it is estimated, is being exported.

H.M.V. 21in. Tube Direct Vision Receiver

HIGHLIGHT of the 1952 Ideal Home Exhibition was the largest direct screen picture, produced on H.M.V. stand.

Special techniques have enabled a metal 21in. Emiscope tube to be developed for use in this model. This tube has an exceptionally wide neck angle which means that a much bigger diameter screen can be obtained without an excessive tube length. It has the special aluminised screen pioneered by E.M.I. in this country and provides pictures of outstanding merit, suitable for daylight viewing.

A special circuit innovation enables the picture quality to be maintained even under fringe area conditions, and the receiver is tunable to all existing or projected BBC television stations. Provisional price, 275 guineas, tax paid.

Television Afloat

SCOTTISH householders are now able to see continuous television, and ships entering the Clyde may have a television set installed on board when they come into dock.

These sets, made by Pye, can be rented by the day for a few shillings as an extension of the service already established on the Thames and Mersey by Rees Mace (Marine), Ltd., a subsidiary of Pye.

The service is greatly appreciated by ships' companies, for television sets cannot normally be hired except on a long-term basis with, in many cases, a wait of three months before the set is installed.

Television Licence Increase

APPROXIMATELY 12,687,000 broadcast receiving licences, including 1,386,000 for television, were current in Great Britain and Northern Ireland at the end of February, 1952. For the second month in succession the number of television licences has increased by more than 100,000.

Motorists are reminded that they need a separate broadcast receiving licence for a wireless set fitted in a car.

Wenvoe on Low Power

IT is announced that when the Wenvoe (Channel 5) station opens—probably in August—it will be on low power for the first period of working, in the same manner as with Kirk o' Shotts. The temporary transmitter will be rated at 5 watts, and therefore any early experiments which readers carry out should be carefully noted as they may prove misleading when the full power is used on the station.

N.E. Disappointment

DEALERS and prospective viewers in the North East were "keenly disappointed" recently that the P.M.G. gave no concrete promise of an early resumption of work on the Pontop Pike transmitter. He stated that the conditions were not ripe for work to be resumed but that the position would be kept in mind. Shortage of materials and labour were such that no indication could be given as to any possible date.

Boat Race Controlled by R.-T.

THE boat race was controlled by VHF radio-telephone from two Port of London Authority vessels.

Especially equipped with Pye PTC 113, the *Nore* and the *Ranelagh* were under the supervision of River Superintendent and Chief Harbourmaster, Commander Coleman, R.N. (retd.). The *Ranelagh* was ahead of the two crews keeping the course clear of obstructions, while the *Nore* was immediately astern of the race. These two boats were in constant touch with each other over the radio-telephone.

Pye Radio Telecommunications provide all the V.H.F. for the Port of London Authority vessels as well as for the P.L.A. Police.

Interference with Wireless Telegraphy

THE Postmaster-General has appointed a third Advisory Committee of twenty-one members from a panel nominated by the President of the Institution of Electrical Engineers, with the approval of the Council, to consider the requirements which might be prescribed in regulations dealing with interference with wireless telegraphy caused by small electric motors.

The members of the Committee are:

Mr. J. R. Beard, C.B.E., M.Sc., M.I.C.E., M.I.E.E., Fel.A.I.E.E. (Chairman); Mr. L. Austin, M.I.P.E. Mr. A. H. Ball, A.M.I.E.E.; Mr. J. I. Bernard, B.Sc.Tech., M.I.E.E.; Mr. N. R. Bligh, B.Sc.(Eng.), A.M.I.E.E.; Mr. J. S. Boyd; Mr. A. H. Cooper, B.Sc.; Mrs. M. Courtney, J.P.; Mr. W. J. Edwards, B.Sc.; Mr. J. Flood, Associate I.E.E.; Mr. F. Gratwick, A.C.I.S.; Dame Caroline Haslett, D.B.E., Companion I.E.E.; Mr. H. J. B. Manzoni, C.B.E., M.I.C.E.; Major C. A. J. Martin, G.C., M.C., B.A., R.E., A.M.I.E.E.; Mr. W. A. H. Parker, M.I.E.E., Mem. A.I.E.E.; Mr. E. L. E. Pawley, M.Sc.(Eng.), M.I.E.E.; Mr. G. F. Peirson, M.I.E.E.; Mrs. C. Renton Taylor; Mr. V. A. M. Robertson, C.B.E., M.C., M.I.C.E., M.I.Mech.E., M.I.E.E.; Mr. W. A. Scarr, M.A.; Dr. S. Whitehead, Ph.D., M.A., M.I.E.E.

Screen Service in Scotland

WHEN Scotland's first televised church service was held recently, at St. Cuthbert's, Edinburgh, worshippers in Glasgow's St. Kenneth's Church took part in the Edinburgh service. The Reverend Thomas Low, of St. Kenneth's, had three TV receivers installed in the church, and three Belling and Lee single di-pole aerials were mounted unobtrusively on the gallery inside the church, the entire installation being carried out by Mr. C. F. Lines, Ekco dealer of Paisley Road West.

The congregation at St. Kenneth's not only saw the Edinburgh service, which was conducted by the Moderator of the General Assembly, the Right Rev. Dr. W. White Anderson, but actively participated, singing hymns and praying with the St. Cuthbert's congregation.

"There was a definite worshipping spirit throughout," said Rev. Low, "and I feel that there is a definite place for this type of worship in our community, particularly if these services are of an historic nature or of particular local interest. We were left with the feeling that we had entered into the worship of another church, and if this could be linked up across Scotland, or, for that matter, throughout the country, it might be the means towards the breaking down of certain barriers which we all deplore."

Television Society

THE Silver Jubilee of the Society will be marked by a dinner at the Waldorf Hotel, Aldwych, on April 25th.

Broadcast Receiving Licences

STATEMENT showing the approximate numbers issued during the year ended 29th February, 1952.

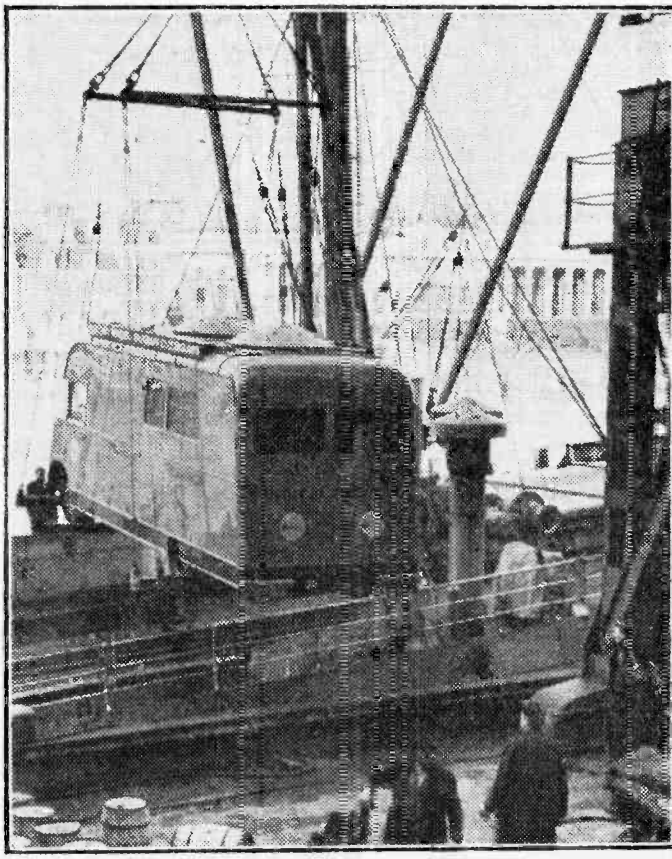
Region	*Number*
London Postal ..	2,407,000
Home Counties ..	1,678,000
Midland	1,773,000
North Eastern.. ..	1,964,000
North Western ..	1,661,000
South Western ..	1,086,000
Welsh and Border Counties	747,000
Total England and Wales	11,316,000
Scotland	1,135,000
Northern Ireland ..	211,000
Grand Total	12,662,000

16 Hours a Week

A NATIONAL daily paper recently conducted a "quiz" to find how much time was devoted to viewing television. The result of the investigation showed that the average family spends 16 hours a week viewing, split between five evenings. Only 39 per cent. view on Saturday afternoon. There is an average of three viewers per set and more than half the viewers do not put out the normal room lights. More than half sit and smoke, but the next favourite pastime whilst viewing is knitting.

European Components for U.S.A.

IT is reported that there is a serious shortage of small components, particularly resistors and selenium rectifiers, in U.S.A., and that the situation is to be relieved by the import of "millions of resistors, potentiometers and rheostats and a substantial supply of selenium cells" from European sources.



A mobile, 3-camera television demonstration van left recently from London Docks for Denmark on board the S.S. Marocco. With this vehicle, a television station on wheels, and an expert team, Marconi's Wireless Telegraph Co., Ltd., will be able to demonstrate British TV in any country. This first team will visit 17 Danish towns in 59 days.

U.E.I. CORPN.,

THE RADIO CORNER, 138, Gray's Inn Road, London. W.C.1 (Phone TERminus 7937)

THE "ARGUS" TELEVISOR
The following items available ex-stock :

MAINS TRANSFORMER
425-0-425v. 200ma., 6.3v. 4a., 6.3v. 4a., 5v. 3a. (postage 1/6) 50/-

E.H.T. TRANSFORMER FOR VCR 97 TUBE
2,500v. 5ma., 2-0-2v. 1.1a., 2-0-2v. 2a. (post 1/6) 37/6

VCR 97 TUBE
Tested full screen for T.V., with base (carriage paid) 45/-

CHOKE
5h. 200ma. (postage 1/-) 6/-

VALVES

EF50 (VR91)	6/6
5U4G	10/-
6V6	12/6
EB34 (VR54)	3/6
EF36 (VR56)	7/6
SP61 (VR65)	4/6
EA50 (VR92)	3/6

POTENTIOMETERS

Less switch	3/-
With switch	4/6

VALVEHOLDERS

I.O. or M.O.	6d.
B9G	10d.
Diode	6d.

RESISTORS

¼w.	4d.
½w.	5d.
1w.	6d.
2w.	9d.
15w. 2.5k.	2/-

CONDENSERS

Mica and Silver Mica	6d.
Tubulars—	
.1mfd.	9d.
.01mfd.	9d.
.05mfd.	9d.
.005mfd.	9d.
.5mfd.	2/-
.03mfd. 2.5kv.	2/6
.1mfd. 3kv. (block type only)	4/6

ELECTROLYTICS

8mfd. 450v.	2/6
8 x 8mfd. 450v.	4/9
16 x 16 mfd. 450v.	7/-
25mfd. 25v.	1/6
50mfd. 12v.	1/6

TRIMMERS
0-30pf. ... ... 7d.

COIL FORMERS WITH SLUGS
¼in. ... ... 8d. ⅜in. ... ... 10d.

P.M. SPEAKERS (less transformer)

5in. Plessey	12/6
5in. Rola	16/6
8in. Plessey	17/6

(Postage 1/6 per speaker)

PENTODE OUTPUT TRANSFORMER 5/-

RDF 1 RECEIVER
The unit reviewed in the October and November issues of this journal for conversion into a Televisor giving **SOUND AND VISION ON THE ONE CHASSIS.** Complete with 14 valves as follows : 5 of SP61, 2 of P61, 3 of EA50, and 1 each CV63, EB34, EC52, 5Z4G, also a complete reprint of the above review (carriage, etc., 5/-) ... ... ONLY 49/6

194 I.F. STRIP
Reviewed in the October issue of this journal. An easily modified I.F. Strip recommended for TV constructors who want good results at moderate costs, or for those who have built televisors but are having trouble in the Vision or Sound receivers. Can be built into any layout, measuring 18in. x 5in. x 5in. Complete with valves as follows : 6 of SP61, 1 of EA50, and 1 of EF36 or EF39 (carriage, etc., 2/6) ... ... ONLY 45/-

MAGNIFYING LENS FOR VCR97 TUBE First grade oil filled (postage, 2/-) ... ... ONLY 25/-

TRANSFORMERS
Manufactured to our specifications and fully guaranteed. Normal Primaries.
425v.-0-425v. 200ma., 6.3v. 6a., 6.3v. 6a., 5v. 3a., 0-2-4-6.3v. 3a. ONLY 72/6
350.-0-350v. 160ma., 6.3v. 6a., 6.3v. 3a., 5v. 3a. ... ... ONLY 42/6
250v.-0-250v. 100ma., 6.3v. 6a., 5v. 3a. ... ... ONLY 32/6
All above are fully shrouded, upright mounting.
Top shrouded, drop through : 260v.-0-260v. 70ma., 6.3v. 3a., 5v. 2a. ONLY 16/6
Universal Mounting: 350v.-0-350v. 80ma., 0-4-6.3v. 4a., and 0-4-5v. 2a. ONLY 18/6
5.5 kV. E.H.T. with 2 windings of 2v. 1a. ... ... ONLY 72/6
7 kV. E.H.T. with 4v. 1a. ONLY 82/6
PLEASE ADD 1/6 POSTAGE FOR EACH TRANSFORMER.

CHOKES 20h. 80-120ma. 9/6
30h. 100-150ma. (post. ea. choke 1/-) ... 12/6

10 VALVE 1¼ METRE RECEIVER ZC8931
For long-distance TV results. Valve line-up is 6 of SP61, 2 of EA50, and 1 each EF54 and EC52, and the 12 Mc/s 6-stage I.F. Strip gives tremendous amplification with ample bandwidth of 4 Mc/s. **EASILY MODIFIED**, full details being supplied (carriage, etc., 5/-) ONLY 59/6

RECEIVER R3118
An A.C. Mains operated version of the above ZC8931, but is infinitely more powerful, having another I.F. Stage and employing 16 valves ; 6 of SP61, 4 of EA50, 2 of EF54, and 1 each EC52, P61, 5Z4 and Y63 "Magic Eye." Built-in power pack operates from 180-240v. A.C. In excellent condition (carriage, etc., 7/6) ... ... ONLY 97/6

Cash with order, please, and print name and address clearly.

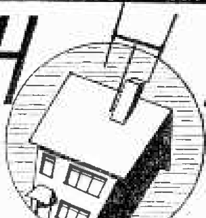
Open until 1 p.m. Saturdays, we are 2 mins. from High Holborn (Chancery Lane Station), 5 mins. by bus from King's Cross

OPPORTUNITIES IN
TELEVISION
144 pages

Pre-Amplifier Tra[redacted]
200/250 v., Sec. [redacted]
6.3 v. at 1.5/2 amp[redacted]
HS150. 350-0-35[redacted]
6.3 v. 3 amps. C[redacted]
Half-shrouded, 30/[redacted]
FS43. 425-0-425 [redacted]

TELEVISION PICK-UPS AND REFLECTIONS

UNDERNEATH THE DIPOLE



By Iconos

WHILE politicians and the general public argue about the merits or demerits of sponsored television, there has been a steady increase in the number of examples of "unsponsored" advertising both on TV and ordinary radio. The mention of the theatrical shows or films in which a TV artiste is currently appearing is regarded with much favour by the artistes' agents and publicity men. "It's equal to an expensive double-column advert in a national newspaper," said one prominent publicity man recently, adding, "and it's all bunce—it costs nothing!" Then there is the advertising value of proprietary goods being seen, more or less inconspicuously, on the TV screen as part of the props or settings of a play or documentary feature. A classic example was recently seen in a documentary feature dealing with the progress and design of shaving implements, concluding with a close-up of a certain make of electric razor. This close-up of the razor brought forth a number of complaints from viewers with strong objections to sponsored programmes! But newspaper competitions and awards for the best television or radio features (culminating in a "grand concert and presentation of awards") undoubtedly bring kudos and glory upon the enterprising newspaper — without offending any viewers. And the television feature, *Current Release*, is nothing more or less than the presentation of trailers of new films being released to the cinemas. In actual fact, short excerpts are shown, which usually prove to be much more interesting and appetising than the usual film trailer with its fusillade of adjectives and mumbo-jumbo of disconnected scenes. I am not aware of anyone objecting to this mild type of advertising. It is evident that there is a very fine dividing line between the acceptable and the objectionable in TV advertising, a borderline as intangible as that between sanity and insanity.

"CURRENT RELEASE"

I HAVE noticed that the sound quality of the films shown in the *Current Release* is definitely of a lower order than either the direct BBC studio sound or some of the best BBC newsreel and documentary film recordings. It is probable that the latter were made using magnetic recording, which is not subject to the many sources of distortion to which photographic recording is subject. An additional factor is that films for reproduction at big volume in large auditoria are naturally subjected to bass cut in recordings which is not required for recordings to be reproduced on loudspeakers in small rooms. Another point about these *Current Release* film extracts is that all types of film are shown, drawn from films with censor certificates in the "U," "A" or "X" categories. Apparently, it is an offence to allow children to see an "X" film or even a trailer for an "X" film in a cinema. Nor can the cinema manager advertise or announce the film without mentioning the class of censor's certificate it carries. The BBC, however, can show all or part of an "X" film without breaking the law.

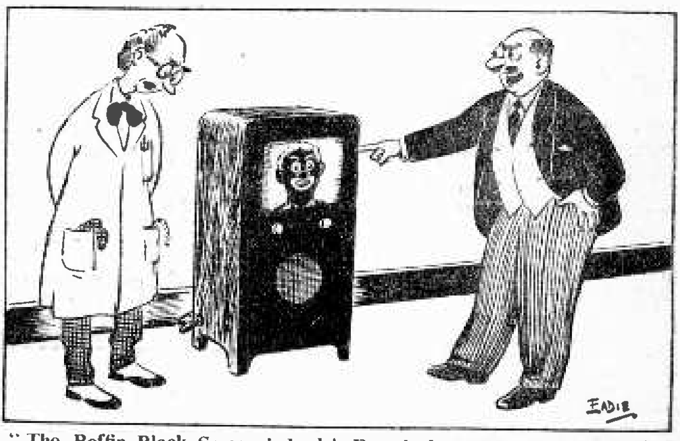
PROBLEMS FOR THE POLITICIANS

THE politicians will have to make up their minds quickly about this matter of sponsored television. While it is reported that Sir David Maxwell-Fyfe, the Home Secretary, and Earl de la Warr, the Postmaster-General, are not yet convinced that sponsored television is desirable, there is no doubt that the majority of Conservative M.P.s would favour the experimental introduction of a limited amount of sponsored television on the existing BBC programmes. Furthermore, they would support the allocation of a special transmission frequency for commercial use, in connection with big-screen television. The Odeon Theatre, Leicester Square, is already wired for big-screen TV, and experimental transmissions have also been made at one or two suburban cinemas and halls. A theatre in the Golders Green district is to be fitted out shortly with the very latest big-screen equipment. But nothing is likely to happen until the new BBC Charter comes into operation in June.

USES OF BIG-SCREEN TV

BIG-SCREEN TV is a field in which Britain holds the lead. Cintel's newest equipment gives a reflected light value from their screen of about 8ft. lamberts compared with the American average of about 2ft. lamberts. Higher light intensities are obtainable by making use of the intermediate film system, in which the picture is received and photo-

PROFESSOR BOFFIN



"The Boffin Black Screen indeed! Everybody looks like a Kentucky Minstrel."

graphed on film, which is developed at a high speed and projected. That is the system used in America by Paramount. Intermediate film systems are not favoured here. Big-screen TV in Britain has largely been confined to closed-circuit demonstrations of various kinds. I hear that the World Dental Congress, to be held at the South Bank Festival Hall in July, may be utilising big-screen TV for demonstrating various special dental techniques and operations to a large audience. Normally, of course, only two or three persons could see the details of dental surgery which, with big-screen TV, can be readily shown to a thousand students at one time.

THE BBC "BEASTS"

I WAS sorry to see *What's My Line* go out of circulation, and the departure of *Picture Page* leaves a gap. *Billy Bunter of Greyfriars School* ends just as it was getting into its stride. But most of these series programmes deserve a revival after a few month's rest. There are lots more adventures of both Billy Bunter and Sherlock Holmes to justify regular annual "seasons" of these classic figures of popular literature. If the BBC decide against reviving these series playlets, then I will have to borrow Bunter's famous epithet and call them "Beasts!"

VIEWING COURSE

THE recent production of Frederick Knott's "*Dial M" for Murder* was a successful "thriller" for TV's Sunday Night Theatre. Providing a "viewing course" on "How to Kill the Wife," the author's involved plot was put over so well by Emrys Jones and Raymond Huntley that until the last few minutes it seemed the erring husband would get away with it. Julian Amyes's skilful direction, and dialogue good enough to dispense with the familiar "who dun it" clichés, overcame the obstacle of the far-fetched script.

CREDIT TITLES

ONCE more, W. Somerset Maugham confirmed his title to be the premier writer for television in *Home and Beauty*. This play, written many years ago, was by no means a period-piece and once again witty dialogue carried the day. Barbara Murray and Barry K. Barnes proved themselves to be thoroughly at home with television technique, and all the production values were first class. The technical qualities of this production matched up to the excellent directorial touches. Incidentally, I note that the BBC play department are beginning to strike a new note by crediting TV plays to a producer and also a director. Let us hope that this does not ultimately land us with those interminable credit titles, mentioning assistants, cameramen, hairdressers and dubbing crews, which confront us at the cinema. BBC policy in this matter should be firm before the rot sets in.

The Oxford and Cambridge Boat Race

ON Saturday, March 29, the BBC again televised and broadcast a commentary on the Oxford and Cambridge Boat Race. The broadcasts were both subject to bad interference.

The sound commentary was made from the launch "Consuta." The equipment in the launch included the normal microphone and amplifiers, together with two frequency-modulated radio transmitters, operating in the high-frequency band. One transmitter was used for the commentary and the other, in conjunction with a receiver, for cueing and intercommunication. The receiving point for the transmissions from the "Consuta" was situated on the roof of Harrods Depository, and from there the sound commentary was fed to Broadcasting House over lines provided by the Post Office.

Two Cameras

For setting the scene and televising the start of the race, two shore based cameras were used, one on the roof of the Star and Garter Hotel, near Putney Bridge, and another on one of the adjacent boat-houses. In addition, two complete camera channels were installed in the launch "Everest." This is a larger and more modern craft than hitherto used and formed the main production point for the broadcast. It is equipped with a spacious cabin which permitted a much more satisfactory layout of the television equipment, whilst at the same time affording it protection from possible inclement weather.

In addition to the cameras and ancilliary apparatus, the "Everest" carried a vision transmitter, two radio vision monitors, a sound transmitter and receiver and an intercommunication radio telephone for control purposes. Power for operating this equipment was obtained from a mobile petrol-driven alternator carried on the launch. Three shore receiving points were established at Putney, Riverside Telephone Exchange, and Mortlake. The vision signals received from the launch were passed by Post Office vision cable from Putney and Riverside Exchange to Olympia, where a switching centre remotely controlled from Broadcasting House, connected either point to Broadcasting House and Alexandra Palace. Snow and water caused a breakdown in one of the camera channels.

Centimetric Link

The vision programme from the launch received at Mortlake was passed by centimetric wave radio link to Riverside Exchange and thence by Post Office vision cable via the Olympia switching centre to Broadcasting House and Alexandra Palace. At the three shore stations provision was also made to handle the sound accompaniment to the vision programme. From the receiving points it was passed over Post Office lines to Broadcasting House and Alexandra Palace.

The cameras used for this broadcast were the Image Orthicon type, made by Marconi's Wireless Telegraph Co. The vision and sound transmitters and receivers in the launch were supplied by Pye, Ltd., whilst the intercommunication radio telephone equipment was of Mullard manufacture. For the centimetric wave radio link between Mortlake and Riverside Exchange Marconi apparatus was used.

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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).

CIRCUIT DESIGN

SIR,—Surely most of the differences between American and British television receiver circuit design which Mr. Eastman notes in his letter in the March issue are the outcome of the fundamental difference between the systems operating in the two countries. In Britain we use positive modulation, increasing brightness corresponding to increasing carrier amplitude, whereas in the American system negative modulation of the carrier is employed, where peak white corresponds to some few per cent. of the maximum carrier amplitude and the troughs of the synchronising pulses correspond to 100 per cent. carrier. The use of such circuit arrangements as flywheel time bases then becomes *imperative* as interference pulses have the same polarity as the synchronising pulses. Again, A.G.C. can quite simply be applied where the system employs negative modulation, but unfortunately this cannot truthfully be said of its application to our system. However, it may well be that A.G.C. is more essential in America where transmitter powers are lower and where choice of channel at the receiver is the accepted thing.

I think also that the *necessity* in American television receiver circuits for the inclusion of one or two of the other features which Mr. Eastman mentions will be apparent when one bears in mind that the D.C. component of the video signal varies inversely with the strength of the received carrier. For example, unless a D.C. restorer is included in the video section then on weak signals, and at times when no transmission is being received, the raster brightness will approach that of peak white which, I imagine, will be very undesirable.

Thus, to me, it does not seem so much a question of why we don't to any large extent employ these special circuit devices nor yet a question of whether American receivers are better than British. Rather is the problem the deeper one "Which is the better of the two systems?"—R. A. JONES (North Harrow).

A.C./D.C. RECEIVERS

SIR,—I would like to reply to Mr. L. D. Tong's observations in his letter on "A.C./D.C. Receivers."

As a service engineer I would agree with some of his remarks, but not all of them, regarding safety precautions. Dealers not resealing grub screws may be correct, but I personally always reseal them, but there is a danger there. Manufacturers to-day are fitting more frequently now spring type knobs without grub screws so that danger is eliminated.

I agree that all metal parts are "live," but reputable manufacturers ensure that it is quite impossible to touch anything *with the fingers* in the normal way.

Owing to the necessity of providing adequate ventilation, however, a great number of apertures have to be left at the rear of the receiver. Even so I do not think owners would probe about with a screwdriver while the set is switched on, and when it is switched off (practically all sets to-day have double pole mains switches), the chassis is isolated from the mains.

From my own experience, too, I have found that all owners treat their sets with a terrific amount of respect, one might say reverence, probably owing to the high cost, with the purchase tax, of to-days receivers.

I would point out that the neon indicator idea, while being good, may still provide a danger point in itself, owing to the human element creeping in, as I could foresee the set being plugged in sometimes the wrong way round and no test taken—I should hate to see a young child touch the exposed "bolt" with the tongue or tip of the nose as children do round furniture.

I feel that the responsibility is the service engineers at the time of installation in the first place, to insure that the set is left safe in this respect, and I personally do so, and where we are called upon to use a two-pin plug point we suggest to the owner it should be changed to three pin, therefore ensuring it is non-reversible after the receiver has been left correctly connected.

In closing I would like to take sides with the manufacturers (the majority) and say that I feel and know that they are not closing their eyes to this problem and are always looking for better ways of making receivers foolproof and safer.—F. W. LOCKE (Birmingham).

5CPI AMERICAN C.R.T. AND PROSPECTS FOR TV

SIR,—I have seen many advertisements concerning the above tube and as being suitable for television.

If any readers have had experience with this tube I should be interested if they could supply me with details of circuits for it, especially the C.R.T. network.—A. P. BALL, "Tredinnock," 10, Honeypot Lane, Brentwood, Essex.

LICENCE DODGERS

SIR,—Mr. Hassell (March issue correspondence), has been misinformed by what he has read, re licence evasions. As an official engaged in the "comb" I can assure him that no old-fashioned methods or scares are used.

The TV detector van is practically infallible, and the basic system will, no doubt, be obvious to anyone conversant with TV circuits.

Another procedure is operated on district statistics, followed by an organised system of visits.

This scheme has been in use in a number of London districts for nearly two years and in one area has consistently yielded 600 to 900 new licences a month, of which nearly 40 per cent. are TV and approximately 10 per cent. car radio. In some instances substantial fines in police courts have followed.

Mr. Hassell's suggestion assumes one radio (or TV) per household, whereas, in fact, many listeners have two or more radios, and a few more than one TV where one licence covers the family and (in some cases) domestics' quarters.

Production of the same licence with different receivers would present the service engineer with a problem.

Contrary to Mr. Hassell's calculations those who build and/or service their receivers without a licence amount to rather over 35 per cent. of home constructors.

In conclusion I would remind Mr. Hassell that crystal receivers as well as UHF Xtal diodes, mikes, 'speakers, pick-ups are widely used to-day.

My associations with radio originated in pre-broadcasting times.—A. C. D. (Name and address supplied.)

USEFUL HINTS

SIR,—I have been carrying out experiments with television equipment on the signal transmissions from Kirk o' Shotts, and have used two of the circuits from PRACTICAL TELEVISION.

There are one or two points which I would like to pass on, as these may be of assistance to other readers.

The 194 Strip, October, 1951, issue : I am using the 194 strip, which was converted, as per circuits in the October, 1951, issue of PRACTICAL TELEVISION. After great difficulty I was able to get the strip working satisfactorily on removal of the resistor No. R.1, in the V.1 anode circuit. Situated here, as we are, a little over 50 miles away from the transmitter, it was found that the four V.R.65 R.F. stages were not just quite sufficient on the power transmitted at the moment. Two further stages were therefore added, which now gives a first-class picture.

Timebase on the £9 Televisor : The timebase circuit I am using is that shown in the December, 1951, issue of PRACTICAL TELEVISION, Fig. 4. This refused to function and, after various try-outs, I eventually found that the sync. separator valve V.14 had the control grid floating in the air, and this was connected to earth with a ½ MΩ resistor between the grid and chassis.

I found that it was not possible to get the line time base running at the correct speed and that the resistor R.53 required increasing from 1 MΩ to 2 MΩ, and on completion of these two modifications the timebase functioned satisfactorily and gives quite good linearity.

I would like to make it clear, however, that I do not consider by my suggestions above that the original circuits were wrong, only these modifications I found were necessary before the units would function satisfactorily in this area.—W. G. ROWELL (Dundee).

A FALLACY

SIR,—There is a fallacy regarding the relative merits of viewing and listening which is being propagated not only in the daily papers, but also in the columns of your journal.

It is surely unimaginative thinking which assumes an inherent superiority of programme merely by the addition of viewed images. In your March editorial, you quote one newspaper likening the blind broadcast to the silent films. The fallacy of this analogy is patently obvious, as anyone who has "viewed" without sound, and listened without vision will have no doubts as to which is the bigger handicap.

However, the fundamental point I wish to emphasise is that *it all depends on the programme material.*

There is little object in the music lover having a visual image of the orchestra, in fact, such an image may properly be described as an unwanted distraction. Certain types of plays lend themselves to visionless broadcasting—the visual images supplied by the imagination being infinitely superior to the limitations of the TV screen. Indeed, there have been several outstanding examples of brilliant playwriting, specifically intended for sound broadcasting. One which springs to mind being, L. du Garde Peach's "Mystery of the *Marie Celeste*" Only those severely handicapped by a gross lack of artistic appreciation would suggest that such an example of radio writing could possibly be improved by the supplement of visual images.

On the other hand, ballet, sporting events and the outside broadcast in general benefit immensely by means of the duo-channel. There is ample scope, too, for the creation of material especially adaptable to the TV medium.

Let us have TV, and more and better TV by all means, but let us not lose sight of the fundamental fact that each medium has its own special place in providing entertainment and broadening the experience of the listening and viewing public.—S. WOODHOUSE-HOLDEN (Ashton-under-Lyne).

MAINS VARIATIONS

SIR,—With reference to reader S. Wood of Stockport regarding mains voltage fluctuations in April issue of PRACTICAL TELEVISION.

I, too, experienced the difficulties associated with badly regulated mains supply, the voltage varying from 190 volts to 230 volts. I managed to obtain from an advertiser an ex-R.A.F. carbon pile voltage regulator which cost in the neighbourhood of £5, and gives good regulation of all voltages above 180 volts. I do not know if these are still obtainable, but suggest he contacts one of the advertisers.

The regulator is set to a voltage slightly lower than the lowest mains voltage, the set adjusted to suit, and the regulator cancels out all rises above this figure.

Hoping this may be of some assistance.—E. W. TEACHEN (Canterbury).

SPONSORED TV ?

SIR,—Amid the hullabaloo which has been raised about sponsored television programmes, the voice of those most concerned has been heard the least.

I refer to the viewer.

It is he who has laid out the money for his expensive apparatus, and it is therefore only logical that he should have some say in the type of entertainment which is offered.

The simple solution to the problem is for a voting paper to be sent to each television licence holder for him to say whether or not he would like to see sponsored programmes for a short time each evening, for a trial period of three months. This should be sufficient to determine their value.

A final vote at the end of the period would settle the matter. I should like every reader who agrees with this scheme to write to his M.P. about it ; we won't get what we desire unless we fight for it ; after all we pay the piper so we should call the tune !—B. L. MORLEY (Bristol).

AERIALS AND SIGNAL STRENGTH

(*Continued from page 559*)

portions that good balance is obtained between black and white and thus leave the sync pulse of sufficient amplitude to function satisfactorily. In other circuits, however, it will not be possible with a signal which is too strong to obtain a satisfactory picture, the contrast being too great resulting in a "soot and whitewash" effect, under which conditions the picture will not be worth viewing, apart from the effect the strong sync pulse may have on the particular timebases used in the receiver. In many respects the effect on the timebases will be very similar to that obtained with a weak pulse with the exception that it will be obvious that the pulse is too strong by the exaggerated contrast in the picture. In some receivers, however, where a sync pulse amplifier may be part of the sync separator circuits, the pulse may be too strong without the picture showing evidence of it. Generally, enquiry from the neighbours or the local television dealer will reveal the type of signal which is obtained in the area and enable one to judge, from the specification of the receiver which it is intended to buy or build, what type of aerial should be fitted, remembering, as pointed out above, that an attenuator is cheaper than a pre-amplifier and generally easier to adjust to give the required results.

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YOUR Problems SOLVED

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

VIEWMASTER—REDUCED SCAN

"I am writing to ask your advice on a problem that has arisen with my Viewmaster TV set. I am using a 9in. tube, and have recently replaced the mains transformer with a W.B.103A auto-transformer as the mains voltage in our district is 210 volts A.C. It improved the picture. But now a fault has developed that will not allow the picture to fill the screen area. The top and bottom edges of the picture do not reach the edges by about $\frac{3}{8}$in. with the height control at its maximum. Also the picture does not extend to the right-hand side of the screen by about $\frac{1}{2}$in., while the left-hand side is drawn out off the screen (this is looking at the screen from the viewing position). Ought I to have made the alterations to increase line and frame amplitude shown in your issue of 'Practical Television' June, '51, or is this only necessary when using a bigger screen?"—R. R. (Northampton).

From the description of the fault which has developed in your receiver we believe MR4 has become faulty and should be changed. Before doing this, however, we suggest you carry out H.T. voltage checks and compare these with the figures specified in the Viewmaster booklet.

With the 9in. tube it should not be necessary to modify the time bases.

CHANNEL 5 COILS ON CHANNEL 4

"I recently purchased a 'Premier' kit in London, in anticipation of the opening of the new Wenvoe station.

"The set in question is constructed to receive the London programmes.

"If I replace the existing London coils with those appropriate to the new Wenvoe wavelengths, should I be able to receive Sutton Coldfield in the period before Wenvoe commences operations?

"I ask this question in the light of the close proximity of the two wavelengths of Birmingham and Wenvoe."—H. E. J. B. (Taunton).

Coils wound for Wenvoe should be able to receive the Birmingham transmission within the range of their cores, and in your case it is well worth doing as you suggest. You will, of course, have to tune any sound traps to the appropriate frequency as well, but this should not be a difficult task. A pre-amplifier will probably be necessary.

FRAME OUTPUT VALVE

"I have an Ekco television with combined radio TS105 purchased in November, '49, and am now having a little trouble with the picture as it seems to roll up from the bottom to a distance of about 2in. and then after different periods of time it goes back to normal. There is also a width of brightness varying from $\frac{1}{8}$in. to $\frac{1}{2}$in. along the bottom at the time which gives me indication that the picture is going to curl up. Can you give me some idea where to look for the trouble?"—L. F. K. (S.E.7).

The most likely cause of this trouble is a failing frame output valve, the rolling-up effect you are experiencing being a form of non-linearity introduced as a result of this. A new frame valve will almost certainly correct the fault.

NEW TUBE FOR VIEWMASTER

"As my Viewmaster manual is almost two years old could you please advise me whether there are any improved tubes (12in.) available since Ferranti T12/46 and Mullard MW22-14C were specified? In the March issue of 'P.T.' I see Mullard advertise the MW31-16 which appears to include an ion trap. Would this tube be suitable for my standard circuit, also, what tube could I use if I adopt the modified circuit for aluminised tubes? For my power supply from D.C. mains I am using a small D.C. motor, 1,500 r.p.m., 4-pole, with sliprings tapped from segments 90 deg. apart. When used with an auto-transformer I get a good sine wave with a small ripple from the commutator segments superimposed on the main waveform. Do you think a full-wave rectifier is necessary in place of MR4 (14-A-86) or is this only advised in the case of vibrator converters?"—H. E. H. (Shrewsbury).

All of the C.R. tube manufacturers now produce improved tubes which may operate with up to 9 kV on the anode, thereby giving brighter pictures. The following are recommended:

G.E.C. type 6705A.
Mullard type MW31-16.
Mazda type CRM123.

The Mullard tube with ion trap can certainly be used with the standard Viewmaster.

If your receiver has been operating satisfactorily with a half-wave rectifier there does not seem any point in changing this for a full-wave type, though for a vibrator converter a full-wave rectifier would be essential.

NON-LINEARITY

"I recently completed a television receiver, but unfortunately cannot get it to operate properly, and I think the trouble is mostly time bases and/or sync separator. I can get a picture of sorts at the top of the tube about 3in. deep, below this the lines open out to about $\frac{1}{4}$in. apart, and the whole lot flickers very badly. The picture is flat and lacks contrast, and is very dull. I am using a 12in. tube G.E.C. type 6706A aluminised, with about $6\frac{1}{2}$ kV on the anode (I intend to boost this to about 8,500 volts from the line output valve!). I am using a transformer to provide the heaters with 10.5 volts at .3 amps: is there any risk of blowing the heater with the surge when I switch on?

All deflector and focus coils are G.E.C. type for this tube. My time bases run side-by-side along the chassis, would it be better to rebuild it more widely separated? Also, would an interlace filter improve the matter?—J. D. (Huthwaite).

The spreading of the lines over the lower part of your raster is obviously due to extreme non-linearity in the frame time-base circuit, and it is to this part of the circuit you must first look. The most obvious point is bad matching of the frame output transformer to the 6V6. You do not state whether the circuit you are using is a published design recommending the components used, but on inspection the form of feedback and coupling used gives the impression that the circuit is a specialised one which may have been designed for different output transformer and coils. A more conventional form of coupling and the use of a high-slope output valve such as an EL33 or KT61 with anode-grid feedback might be more suitable for your purposes; in any case, extensive changes will be necessary to the circuit as it now stands.

The positioning of the chassis has nothing to do with the above, and it is unlikely that an interlace filter of the type you mention will do anything to correct the raster. If your interlacing is bad *after* you have corrected the linearity, the filter should be built in, of course. Your tube heater arrangement should be satisfactory, but with an aluminised a higher E.H.T. (about 8 to 9 kV) is necessary.

"PULLING ON WHITES"

"I have completed and tested my Viewmaster and find that the circle on the test card is slightly to one side. Would you please advise what I can do to correct this fault?"—J. W. A. (Dunfermline).

The fault you describe is known as "pulling on whites" and is possibly due to incorrect alignment of the vision receiver. We suggest carefully re-aligning during the transmission of the test pattern and noting which of the iron dust cores affects this pull.

Occasionally R.21, C.18 or R.20 may cause a similar effect.

R.F. INSTABILITY

"My receiver is the 'Premier' as advertised in 'P.T.' and 'P.W.' using a magnetic tube. I made it up as a table model and it worked quite well, but recently I decided to convert it into a console model. In doing this I had to separate the power pack and sound units. When all was ready I switched on and now find that the vision receiver goes into oscillation before I can increase the gain control to get a picture that will lock in either direction. I have examined all components and even replaced them, particularly in the controlled stages; also the valves, but the trouble still persists; all voltages are correct. If I remove the first R.F. valve I find that I can advance the gain control right up without the screen going all white. Also I find that joining a piece of wire to sound chassis will control the oscillation a little when the other end of wire is joined to vision chassis.—R. B. (Stafford).

The first R.F. stage of the vision receiver is the offending stage in your receiver, but the reason for the appearance of the instability is not so easy to pin down. It appears that coupling of some sort is now taking place through the chassis metal from a later vision stage to the first stage, but the manner in which this is occurring depends entirely on the form of layout you have now adopted. You should try bonding the vision and sound chassis together at various points with heavy flexible leads, but the main point of your work should be the location of a coupling loop. If the trouble persists, you must re-check the first R.F. stage and use only one common chassis return for all the wiring associated with it.

POOR DEFINITION?

"I wonder if you could solve a problem I have with my Viewmaster, fitted with a 12in. Mazda tube? I have had the set going for about eight months and have had a fairly good picture, but it will not resolve the lines on test card C as it should: that is, the lines from the bottom left upwards and the right downwards. I have made many inquiries, but can get no solution to this problem, so would be very grateful for your help if possible.—G. B. (Redhill).

We presume that you can resolve at least some of the wider lines in the gradings, equivalent to 1, 1½, or even 2 Mc/s.

Poor definition, assuming that there are no obvious faults in the receiver, is due to incorrect alignment, and we can only suggest that you re-align the receiver, following closely the instructions in the Viewmaster booklet and, if possible, doing this with the aid of a signal generator.

PICTURE PROPORTIONS

"I have purchased, some three months ago, a R.G.D. 12in. Televisor, model H 1700, incorporating a Ferranti flat-faced tube. The set works well, except that at either side of the mask I have a black strip of approximately ½in. showing, this being the maximum width I can obtain with the width control. If I turn up the contrast control the picture fills the width of the mask, but becomes too bright. I have experimented with various types of aerial without improvement. I suspect the set to be a Sutton Coldfield model that has been converted by the dealer, who does not seem to want to give any service in the matter and maintains that it is in order. Most of my friends have the round-faced tube and the picture in each case fills the mask. I wonder if you could inform me if I am expecting too much?"—E. L. T. (Liverpool).

If your mask is of correct aspect ratio (4 : 3), the picture should fill the area correctly without black bands showing at the sides. If the picture height is sufficient just to fill the mask area correctly, however, and the sides then fall short, then, if the picture is correctly proportioned as per test card C, there is little you can do. Since the picture is expanded by brightness, the E.H.T. regulation is poor, and a reduction in E.H.T. might enable you to fill the area properly. Your aerial system has nothing to do with the fault.

H.T. FAILING

"I have built a set with VCR97 from a kit of parts supplied by Premier Radio. This set has worked splendidly until recently, when it has developed a fault. This consists of a slight hum on the sound and also the vertical edges of the picture have developed a bulge.

This bulge affects the whole picture, which is distorted to the right. The remainder of the picture is all right. The bulge is not always in the same position: sometimes at the top, then in the middle or at the bottom, the position changing only when the set is switched off, and then, of course, on.

"Another fault which comes on very infrequently is a crackling noise in the sound accompanied by shooting black lines across the picture. This may just happen once, or it may continue until the set is switched off. The fault may then not develop again for a few weeks."—R. H. B. (Dalton).

From your description of the fault it seems that the trouble is associated with the H.T. supply to the receiver, and the most probable points to check are the H.T. rectifier valves and all smoothing circuits, particularly electrolytic condensers. The best approach is to replace the latter one at a time by a suitable substitute; a 16 μF. would be suitable for all those already included in the set.

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