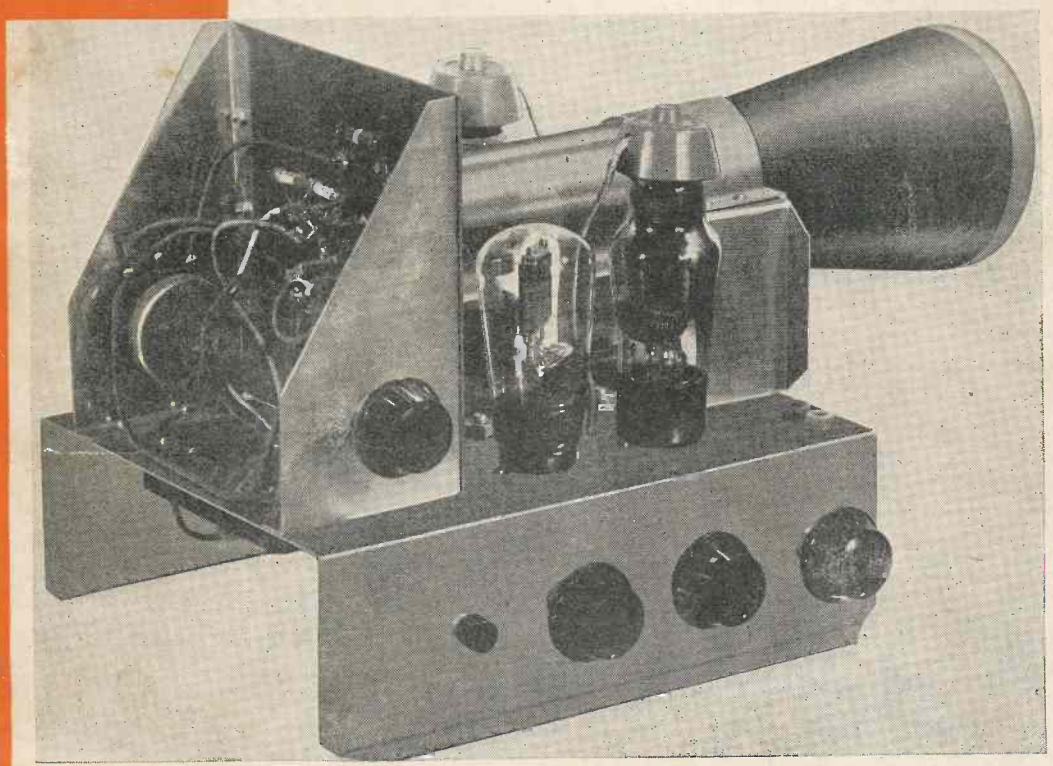
HALVING COST OF OUR TELEVISOR!

Television and SHORT-WAVE WORLD

DECEMBER, 1937
No. 118. Vol. x.
1/-
MONTHLY

SOMETHING NEW : A FINE PICTURE ON A SMALL TUBE



Alternative tube holder and time base unit which with simplified power pack makes possible a televisor at approximately half cost.

CATHODE-RAY TUBES

VALUABLE WORKING DATA and MANY USES EXPLAINED

SHORT WAVES:

SINGLE VALVE TRANSMITTER
S.W. CONVERTER
A
I-V-I RECEIVER

BERNARD JONES PUBLICATIONS LTD.
CHANSITOR HOUSE. CHANCERY LANE
LONDON W.C.2.

THE FIRST TELEVISION JOURNAL IN THE WORLD

No. 118 VOL. X DECEMBER, 1937.

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COMMENT OF THE MONTH

The Small-screen Receiver

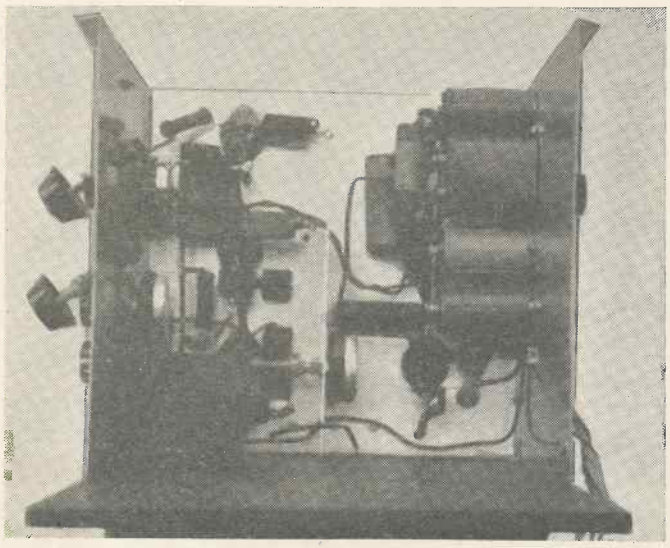
IN this issue we present the first practical constructional details of a television receiver employing a four-inch cathode-ray tube. Reduced picture size may appear to be a retrograde step, but we can assure our readers that there is much to be said for the miniature type of receiver.

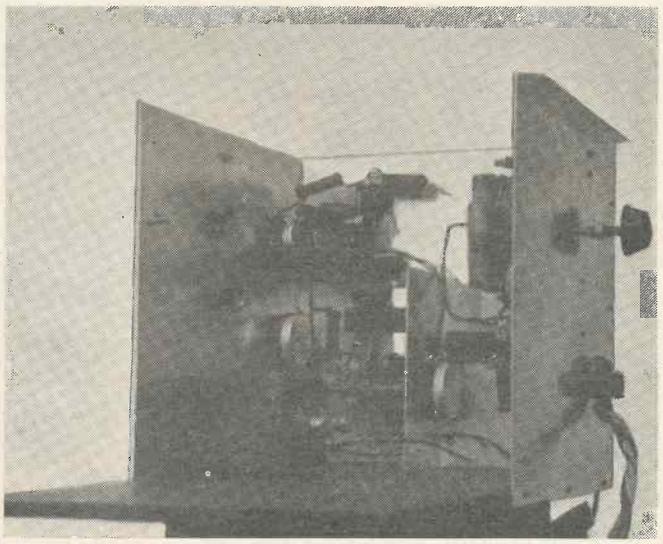
Let us say at once that the small picture produced by this receiver is the equivalent, as regards brightness and clarity, of receivers employing large tubes, in fact its only limitation is the size of the audience for which it will provide entertainment. This disadvantage is largely offset by the reduction in first and operating costs and the fact that considerably lower voltages are employed than is the normal practice, a matter which allows of all-round simplification. In addition a receiver of this description lends itself admirably to an introduction to cathode-ray tube operation and will provide the constructor with the knowledge and confidence to build receivers of a more ambitious type should this be desired on a future occasion. It can be thoroughly recommended to those who are anxious to get an insight into television receiver design.

As will be seen from the constructional details, the televisor comprises the vision receiver described in the October issue with its associated power unit, together with a simple time base unit and power pack operating with a maximum of 1,200 volts, a voltage which is not greatly in excess of that employed in an ordinary broadcast receiver. The entire design is based upon ordinary wireless principles and no more difficulty will be met in its construction and operation than would be the case with an ordinary broadcast receiver.

Television Publicity

JUDGING from the sparse amount of publicity that television receives in the ordinary sound programmes, the conclusion cannot be avoided that there is still a faction at Broadcasting House which is opposed to television. It is not, of course, the B.B.C.'s job to sell television receivers, but with the finest publicity medium in the world available it would appear that it should do its best to popularise the new service, instead of which television is almost totally ignored. It seems clear that there is little liaison between Broadcasting House and Alexandra Palace and such as does exist is of a spasmodic and unorganised character. Properly directed publicity through the sound broadcast channels would do wonders in popularising television.





These two photographs show the time base unit with the wooden partition removed and make clear the assembly of the components.

THE NEW LOW-COST TELEVISOR

FOR SIMPLE HOME CONSTRUCTION

By S. West

PART III.—MORE ABOUT THE TIME BASE :: BUILDING THE POWER PACK :: HOW THE COST CAN BE REDUCED :: DETAILS OF THE MODEL EMPLOYING A 4-INCH TUBE

AS some of the drawings of the time base unit given in last month's issue were rather difficult to read three additional photographs are given here—two showing a front view with the centre wooden partition removed, and the other of the components mounted on the back aluminium panel.

One or two errors appeared in the description of the time base and C.R. tube unit described last month.

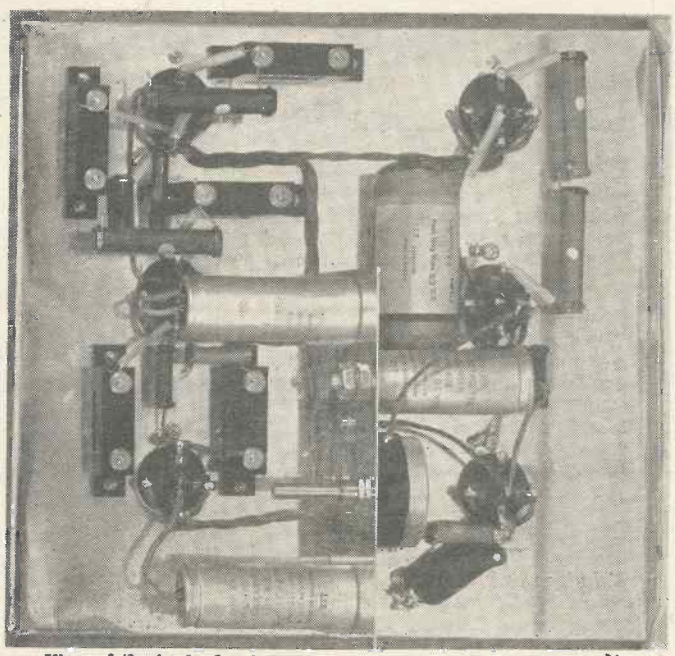
On p. 647, the drawing showing the connections to the C.R. tube socket. On the small panel carrying the resistances R26 and R30, read DX1 for DY2 and DY2 for DX2. For the potentiometers and resistances, read R30 and R33 for R26 and R27, likewise read R26 and R27 for R30 and R33.

For both these cases the theoretical circuits on pp. 648 and 649 are correct.

In the drawing on p. 649 that gives the dimensions of the chassis assembly. The drillings shown for the left-hand side of the time base are incorrect; they show the panel viewed from the wrong side. The correct drillings are shown on the new drawing, p. 709.

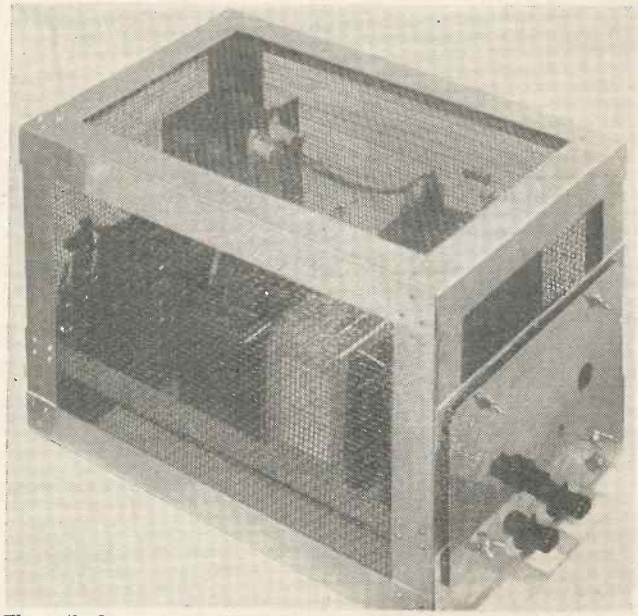
It is possible that some doubt may exist regarding the small metal panel that is shown in the drawing. The dimensions of this are 6 in. by 3 in. as marked. It serves to carry the potentiometer R21 and also to screen the line relay from the frame relay.

The potentiometer R21 is controlled by the bottom knob of the three back controls on the left-hand side and the spindle of R21 is lengthened by means of an



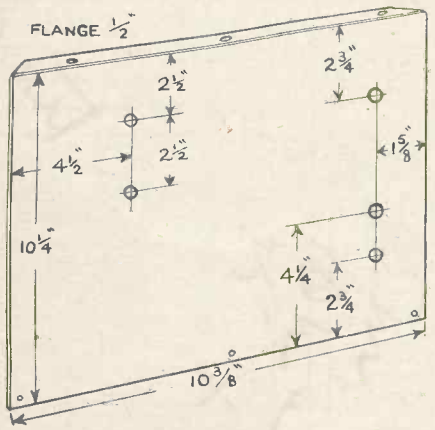
View of the back aluminium panel of the time base with the components assembled.

BUILDING THE POWER PACK FOR 10- AND 7-IN. TUBES



The cathode-ray tube and time base supply unit for use with 7-, 10- and 12-in. tubes.

Eddystone extension spindle to permit this. The panel holding R21 serves as a between bases screen as well as holding the resistance R21.



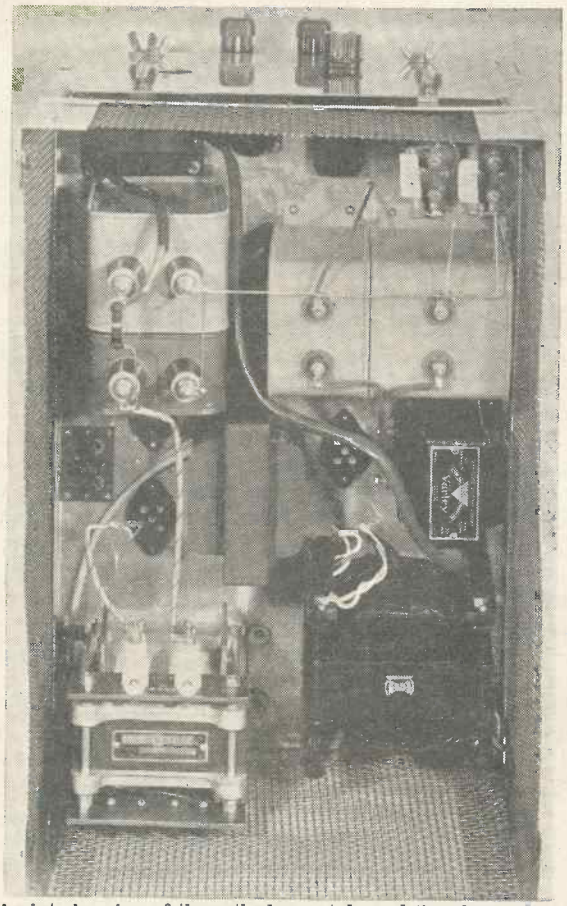
Corrected diagram showing the drilling of the left-hand panel of the tube mount and time base chassis.

The wood partition is also shown as being less in height than the sides. It is the same height.

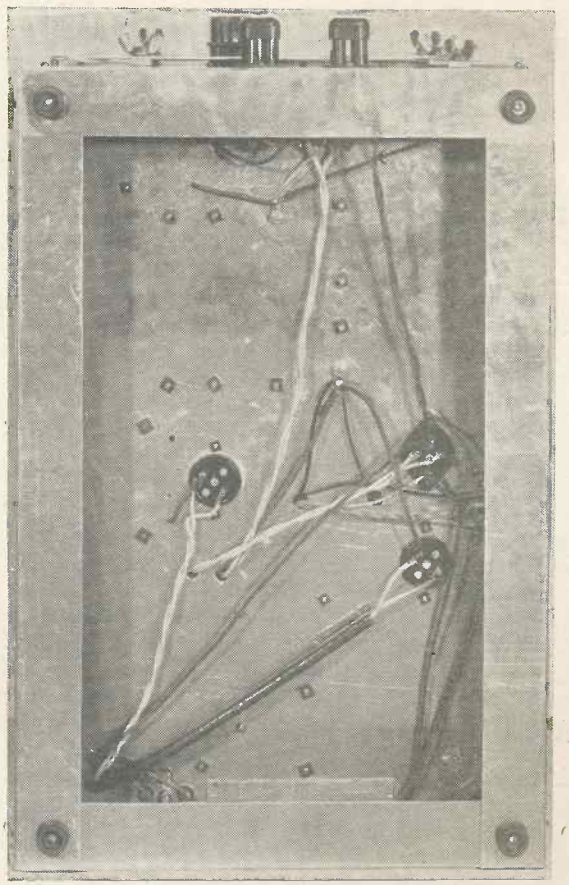
The C.R. Tube and Time Base Power Supply Unit

When the design of a complete television receiver is contemplated, one of the principal details of the design, requiring consideration, is whether the positive or negative pole of the C.R. tube's high voltage unit will be earthed.

A decision on the point is necessary for the remain-

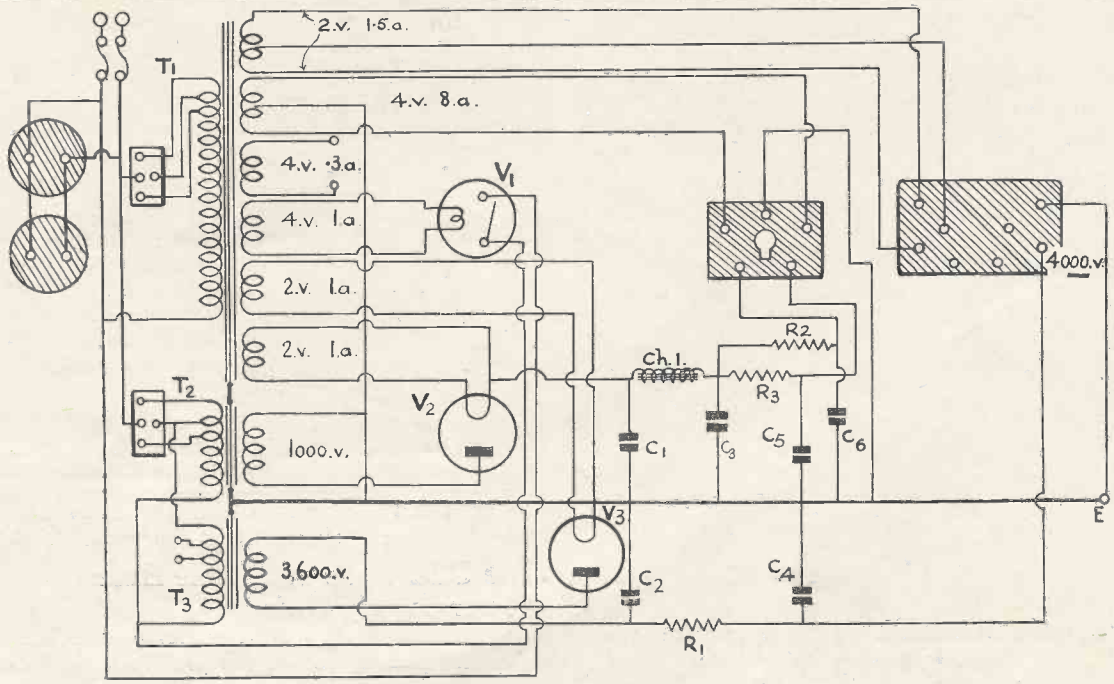


An interior view of the cathode-ray tube and time base power supply unit for 7-, 10- and 12-in. tubes.



Underside view of the tube and time base power supply unit.

SAFETY PRECAUTIONS



The circuit diagram of the cathode-ray tube and time base power supply unit for 7-, 10- and 12-in. tubes.

der of the design is affected according to the arrangement that is to be adopted.

A number of arrangements are possible each of which has its own inherent advantage. A measure of confusion can result when any attempt to arrive at a decision does not take into account certain definite recommendations of the makers of the C.R. tube to be employed.

It can be said, however, that one does not always adhere to manufacturers' recommendations, nor is it necessary always to do so. While this may in general be true, in the particular case under consideration the maker's recommendation is really quite definite. Furthermore, tests made by the writer reveal reason enough for adhering to the recommendation.

The tube employed is an Ediswan. It can be a 10-, 12- or 7-in. type according to the needs and pocket of the user.

The Ediswan Co. recommend that the positive pole of the tube's exciter volts be earthed, failing which it is desirable completely to screen the tube.

If this screening is not carried out the electron beam becomes extremely susceptible to external interference. This interference can be due to the magnetic fields of transformers and similar effects.

The cost of a screen that is suitable for this purpose is about 30s., and there seems no reason for entering into this additional expense.

There are other reasons, that it is not necessary to mention here, that influenced the decision, after very careful thought, to earth the positive pole of the tube's exciter voltage.

Another point that required some consideration was what steps should be taken effectively to prevent accidental contact with the high potential points existing in the power pack.

It was realised that at least during the early stages and possibly in some instances, for some period after, while a suitable cabinet was being constructed, the complete receiver would be used without any external covering.

It was decided to enclose completely the entire power supply unit. The photographs show the arrangement adopted. This screening box is quite simple to make and does not call for elaborate tools or special ability.

The metal framework is carried out in 19 s.w.g. aluminium. The wire mesh is obtainable from most ironmongery dealers. Alternatively, ordinary perforated zinc may be used, though the appearance may not then be so professional.

Matters are so arranged that, before the front panel can be removed for purposes of adjustment to the interior, the supply is necessarily first disconnected.

Other arrangements offering equal safety will occur to the constructor. For example, if the various units are mounted into a framework, it will be a simple matter completely to enclose the bottom deck. The high voltage power unit is then housed in this compartment.

The screening box here described has, however, the advantage of permitting final layout of the complete receiver.

A plan view of the actual power unit is shown. It is seen that although it is not by any means excessively bulky, there is adequate spacing of the apparatus permitting ease of assembly and clean wiring. Especially note the spacing of the connections carrying high voltages.

Toward the front end will be seen the Bulgin 6-way high-voltage socket. This socket carries the current for the C.R. tube's heater also the 4,000 volts for tube excitation. It may also carry the 4 volts for a D.C. restoring diode.

The socket is mounted by means of 2 B.A. studding

POWER UNIT CONSTRUCTIONAL DETAILS

and ½ in. diameter ebonite spacers, so that the sockets are well clear of the deck.

Near to this is the Belling-Lee 5-way socket that carries the heater current for the time base valves, also approximately 1,000 volts high-tension for the time base.

The Belling-Lee fused mains connector is next to this. The two-pin plug with this connector has a flanged head. This flange, as the plug is inserted through the removable panel, renders it essential first to remove the plug, thereby disconnecting the mains, before ingress to the power unit's interior is possible.

The fuses in this component also serve for the vision receiver power unit as the small Belling-Lee 2-way mains connector on the front of the screening box, that connects to the vision receiver power unit, is in circuit with it.

It will be noted that a spare connector is included to serve for any sound receiver power unit that may be used.

A separate earth terminal is included on the screening box for additional safety.

The Clix mains selector boards permit the unit to be used with any mains having voltages of from 200-250 volts. These small boards are obtainable with fused connecting bridges thereby providing an additional safeguard for each circuit.

Two Mazda type MU2 mercury vapour rectifying valves are used. By using two similar valves subsequent replacement is simplified.

A Mazda type DLS1 vacuum delay switch ensures that the the various valve heaters attain their normal operating temperatures before application of high-tension.

Ignition cable of the very best quality must be used to inter-connect the 6-way Belling-Lee high voltage plugs and sockets. All wiring of the unit carrying the tube exciter voltage is kept at least ½ in. from the metal work and the components. Here it is well to remember that the highest voltage exists at the cathode end of the C.R. tube, i.e., the C.R. tube's heater leads are at high potential with respect to earth. The voltages progressively reduce to the 3rd anode which is positive 4,000 volts and is earthed.

The theoretical circuit of the complete power supply unit is given. Three mains transformers are used for, apart from the reduction in the required insulation this permits, the unit becomes flexible and is suitable for universal application.

The insulation of the transformers is such that, if for any reason it is desired to earth the negative pole of the C.R. tube's exciter volts, this may be done with complete safety. It will be obvious and therefore perhaps it is unnecessary to point out that when negative is earthed the heater leads of V3 will require insulating for the full tube's 3rd anode voltage to earth. Also the connection of the heater of V3 to earth is removed and is taken, adequately insulated, to the 6-way socket. The negative end of the H.V. secondary is then taken to chassis. Examination of the theoretical circuit will make clear these remarks.

For the reasons given above it is well to adhere strictly to the transformers specified unless the constructor is well acquainted with the principles involved in high-voltage transformer design.

It will be noted that an additional 4-volt winding is included on the heaters' supply transformer. The purpose of this is for supplying heater current to a diode valve that may be used to restore the D.C. component. If it is not intended to include this refinement this winding may be omitted from the transformer's specification.

Another photograph shows the underside of the unit. No bottom is fitted as it is presumed that the unit will always be used in its correct position. It is as well, however, to warn constructors that high potentials are present on some of the sub-chassis wiring. Consequently a cover is desirable if the unit is to be used in such a position that the underside is exposed.

The various photographs and diagram will ensure no constructional difficulty and the unit will be found simple to build. There is no more complication with a power unit of this description than with that of an ordinary supply unit. The higher potentials present, however, demand extra care being taken.

This unit completes the constructional description of the complete television receiver. In the January number full and precise instructions will be given for connecting and adjusting the entire assembly.

COMPONENTS, VALUES AND MAKES FOR CATHODE-RAY TUBE AND TIME BASE POWER SUPPLY.

TRANSFORMERS:

T.1. Prim. 200-250 v.
Secs. 2 v. 1.5 a.
4 v. 8 a. C.T.
4 v. o. 3a. (optional see text.).
4 v. 1 a.
2 v. 1 a.
2 v. 1 a.
(Heaybeard). Insulated to specification.

T2. Prim. 200-250 v.
Sec. 1,000 v. 20 m/s. (Premier).

T3. Prim. 220 v.
Sec. 3,600 v. 3 m/a. (Sound Sales).

CONDENSERS.

C1 2 mfds. 1,500 v. type 951 (Dubilier).
C2 0.1 mfd. 4,000 v. type 951 (Dubilier).
C3 4 mfds. 1,000 v. type 951 (Dubilier).
C4 0.5 mfd. 4,000 v. type 951 (Dubilier).
C5 2 mfds. 1,000 v. type 950 (Dubilier).
C6 2 mfds. 1,000 v. type 950 (Dubilier).

RESISTANCES.

R1. 100,000 ohms 1W (Dubilier).
R2. and R3. 2,000 ohms 1W (Dubilier).

SMOOTHING CHOKE.

1—Varley type DP9.

SUNDRIES.

2—Belling-Lee valve holders type 35215.
1—Belling-Lee valve holder 4 pin chassis mounting.
2—Clix mains selector boards with fused bridge.
2—Belling-Lee mains connectors type 1014.
1—Belling-Lee 5 way connector type 1260.
1—Belling-Lee fused mains connector type 1098.
2—Belling-Lee valve thimbles.
1—Bulgin 6-way high voltage plug and socket type P100 and P101.

VALVES.

V1, Mazda type DLS 1 vacuum delay switch.
V2, and V3. Mazda type MU 2 mercury-vapour rectifiers.
Chassis, nuts and bolts, ignition cable, high voltage systoflex tubing, etc.

HALVING THE COST!

A PRACTICAL DESIGN EMPLOYING A 4-INCH TUBE

The following section deals with the practical construction of the time base and power unit for a 4-inch tube, employing the same vision receiver. This enables a considerate saving, which is approximately half, to be effected. Excellent pictures are obtainable with small tube and the construction, due to the lower voltages employed, is particularly simple.

IN a short article last month, the writer described the Mullard type A-41/B4 cathode-ray tube and considered its possibilities as a television picture reproducer.

It was pointed out that a great economy was possible because of the low exciter volts required for normal operation of the tube.

It was also remarked, as tests had revealed, that while the picture was small, its definition was extremely good, indeed that it was an accurate miniature of the conventional large tube picture.

The writer gave it as his considered opinion that the picture possible with the small Mullard tube had very definite entertainment value. Furthermore, as the circuits required for operation are in every particular similar to those used with large tubes, that some very valuable experience in the operation of C.R. tubes, particularly as applied to television reception uses, could be acquired by the construction of apparatus to receive the B.B.C.'s television transmissions.

Due to the low voltages and special design of the tube, this apparatus can be constructed at a very reasonable cost.

The receiver used for the tests of the small tube, was that described in the October number of TELEVISION AND SHORT-WAVE WORLD. Construction of this receiver is simple and straightforward. Only through deliberate carelessness can its performance become mediocre.

In the November number it was shown that the original design might easily be modified when it was intended for use in proximity to the transmitter, and that it was possible substantially to reduce the cost of parts and valves by omission of one or two of the three R.F. stages.

Actually all three of the R.F. stages can be omitted. This is not desirable, however, for two reasons. Without an R.F. stage the signal to noise ratio is not satisfactory. There is the possibility of radiation of interference on to neighbouring aerials.

It was felt that there were many amateurs who have desired to construct a television receiver, but had not previously found it possible for financial reasons to do so and these would welcome the description of a unit or units that employed the small Mullard tube and that together with the vision receiver referred to would comprise a complete television receiver.

Such a unit is described here. A study of the list of parts used for it and its power supply unit discloses that the cost is very low. This study will also reveal that a great many amateurs will have already, a number of components sufficiently similar to those specified to permit their being used alternatively.

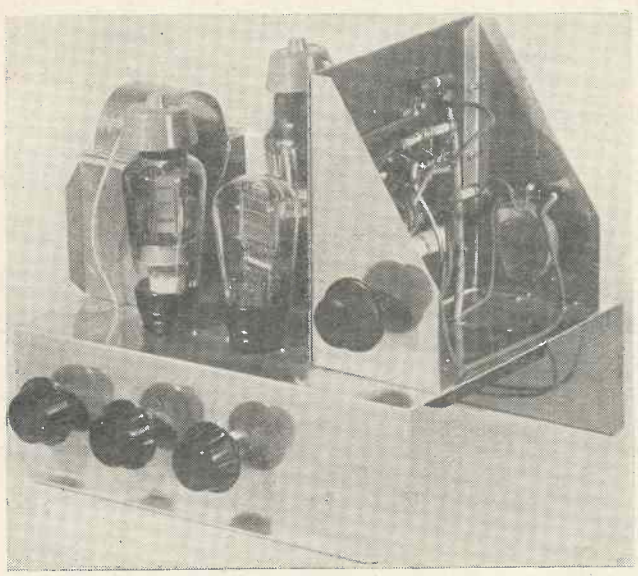
Now before proceeding with the actual constructional details of these units, let us briefly examine the considerations responsible for the arrangement adopted.

It would have been possible easily to include the time base, and the power supply for this, all in one complete chassis, and at first this was the arrangement contemplated.

It was later seen, however, that if the time base was constructed as a single unit, existing power supply units, that might be available, could be utilised. Also the power supply unit described elsewhere in this number, and which is intended for tubes between 7 in. and 12 in., could very easily, by omission of the 4,000 volts components, be used, thus permitting an economical change to a large tube at some later date.

For these reasons a time base unit that employed a separate supply pack was decided on.

The theoretical circuit on p. 713 shows the time bases



This photograph shows the time base unit and tube holder for the 4-in. tube.

and tube connections. The two valves on the left generate the line scan oscillations, those on the right, the frame. The line sweep voltage is applied to the D2 deflector plate while D2′ in accordance with the tube maker's recommendation is strapped direct to the 2nd anode.

To preserve the proportions of the picture in the frame direction non-linearity of the frame sweep voltage is encouraged. This sweep voltage is fed to the D1 deflector plate while D1′ is returned to the 2nd anode.

As the sweep voltages required are not particularly high, smoothing of the time base supply is obtained

with the high value series resistances R25 and R27 in conjunction with the condensers C17 and C18.

The voltage applied to the 2nd anode C.R. tube is about 1,150 volts. This permits a clear and bright picture to be obtained. At the same time the tube is receiving voltages not in excess of those recommended by its makers.

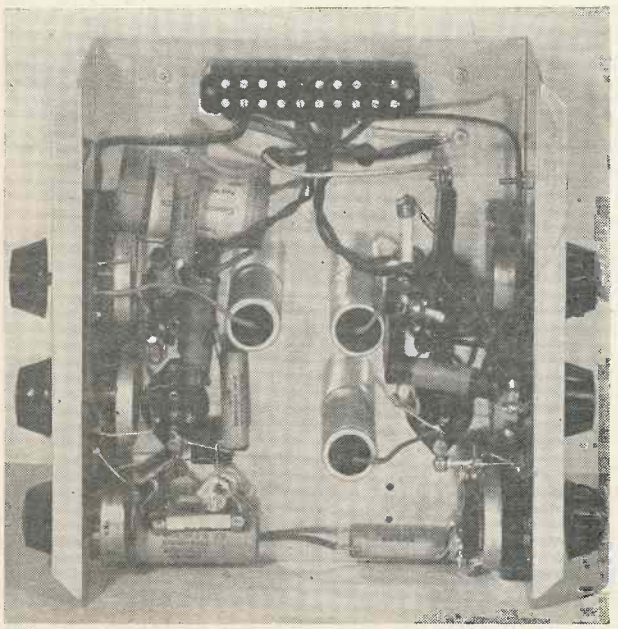
It was pointed out in the previous article that it was not possible to reduce the light spot to the size indicated by theory for a picture with dimensions such as those we are working with, but that, in spite of this fact, the picture definition is extremely good.

Further investigation discloses the reason for this. An examination of the light spot reveals that the illumination of its surface is not uniform and that the light is more intense at the centre. During the scanning of a picture, therefore, when the spot is in motion, the screen illumination is reduced proportionately to the area scanned. The edges of the light spot, being less luminous, tend to disappear, in effect reducing the diameter of the spot. To supplement this effect there is also modulation of the illumination intensity of the light spot when the picture modulation is applied.

There are one or two points concerning the time base and tube assembly unit that may well be described with more detail, as for a large number of constructors this will be their first introduction to the saw tooth oscillation generator. An acquaintance with the principles involved will assist materially construction and a knowledge of operation.

In considering the operation of the time base it is convenient to refer to one of the oscillators only as, apart from the employed constants, the design of both bases is identical.

The valve V1 is the line scan oscillator. The series



This photograph shows the underside of the time base unit for the 4-in. tube.

connected condensers C3 and C4 are charged through the resistances R3 and R4, the value of which controls the rate of charge. At a certain voltage that is determined by the setting of R5, which controls the relay valve bias, the relay valve V1 becomes conductive, rapidly discharging the condensers.

As this voltage, if linearity of sweep is to be maintained, has not sufficient amplitude for deflection pur-

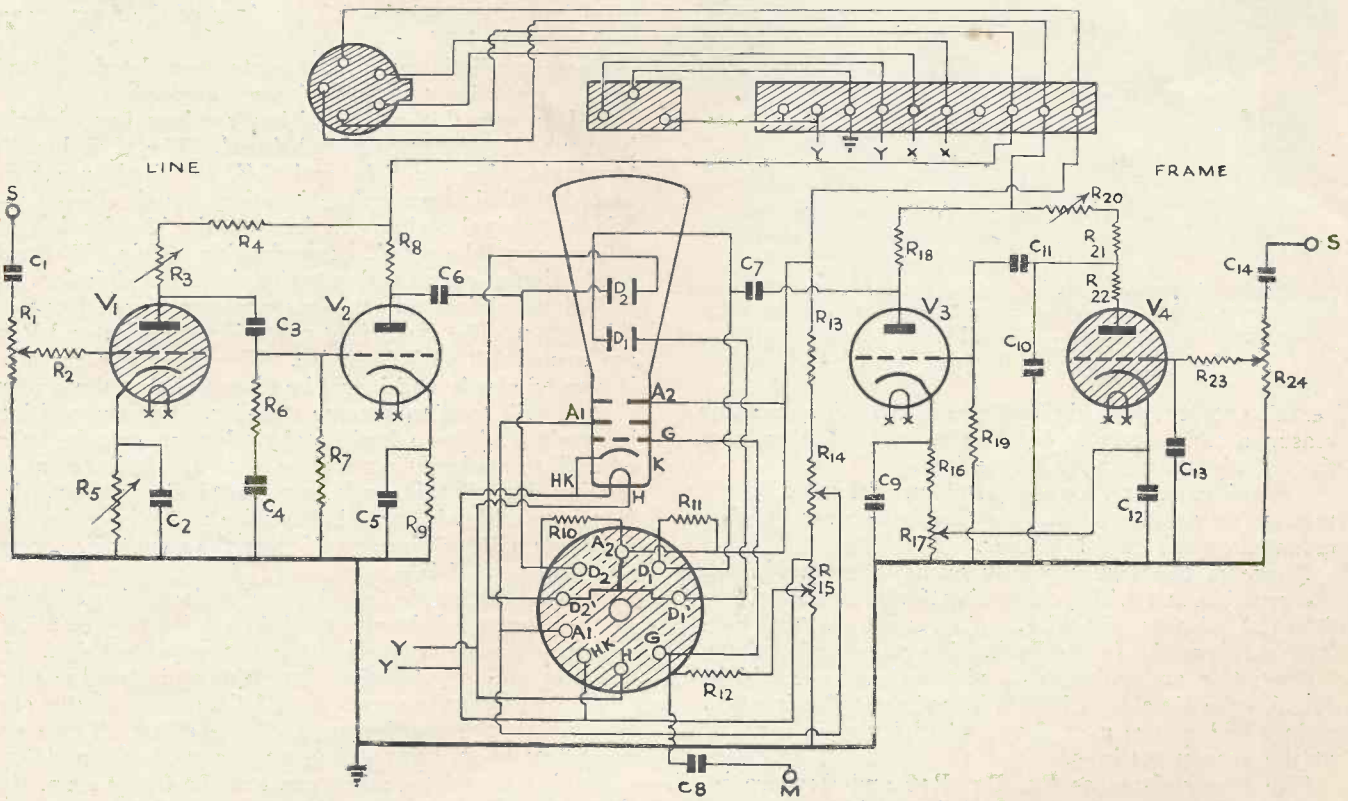


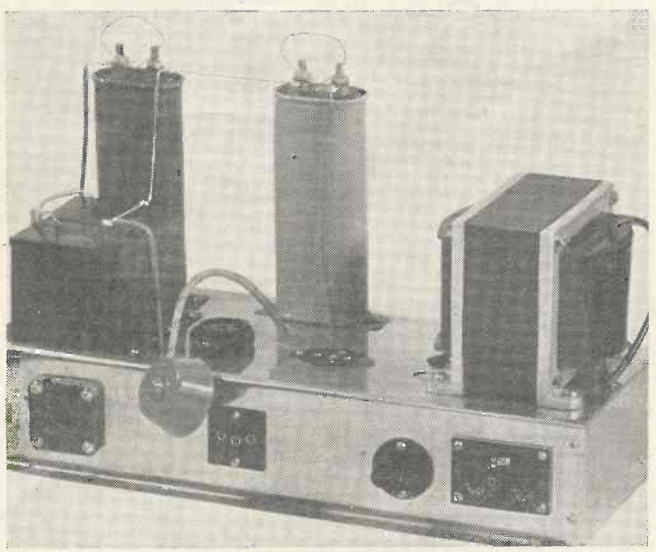
Fig. 1. The circuit diagram of the time base for the 4-in. tube.

poses, a portion of it is applied to the grid of the amplifying valve V2. In order better to handle the higher frequencies involved in the line scan base, the load resistance of this valve is lower than that of the similar resistance in the frame scan base. This amplified voltage is then fed through the condenser C to the tube deflector plate.

The purpose of the resistance R6 is to accelerate the speed of the retrace. It performs this function by developing a voltage during the flyback, that is in opposition to the retrace voltage.

The potentiometer R1 applies the transmitted sync. pulse to the relay valve grid. This valve is arranged normally to fire at a lower speed than the required one. Consequently the arrival of the positive synchronising pulse fires the relay before its natural firing time. The correct operating frequency of the base is therefore accurately maintained by the transmitted synchronising pulses.

A photograph on page 713 shows the time base and tube support. Construction and wiring is simple and straightforward calling for little explanation. A protecting cover may be included at the rear of the tube socket panel thereby avoiding the possibility of acci-



This photograph clearly shows the 1,200 volts power supply unit. Note especially the celluloid protecting covers fitted to the terminals of the voltage smoothing condensers. Fitment of these simple protection covers effectively prevents shock.

dental contact with a high voltage point. For the same reason a small strip of bakelite protects the heads of the bolts holding the resistance R12.

The brilliance and focus controls are mounted on the tube socket panel brackets, the time base controls being mounted on the chassis proper.

Above is the power supply unit. Here again the construction and wiring is straightforward and will be followed without difficulty. Connection to the time base unit is made via the Belling-Lee plugs and sockets.

Operation and adjustment of the time base will be found to be simple. Observation of the following procedure will ensure a minimum of difficulty in arriving at the correct settings.

The four resistances R3, R5, R16 and R19 are set at about half way round their full travels.

In passing it may be mentioned that the resistances R3 and R19 are the charging resistances. Due to the method of furnishing synchronising pulses provided by the vision receiver, that these units are primarily intended for use with, fixed resistances could have been incorporated. However, it was considered that a large number of constructors already might have partly assembled vision receivers, and by incorporating variable charge resistances, the time base is rendered suitable for use with any normal synchronising system.

The tube and valves are inserted carefully and the two units interconnected by means of the 3- and 5-way Belling-Lee plugs and sockets.

Upon switching on, all the valve heaters and the rectifier filament should be seen to be glowing. The delay switch will also be seen to have lighted. Until it acquires a certain critical temperature, however, high tension is not applied to the tube and time base. It will probably be possible also to see the heater of the C.R. tube glowing. After an interval of approximately a minute the delay switch will close and the C.R. tube screen will be seen to be illuminated.

The potentiometer R14 controls the brilliance of this illumination and can now be adjusted to the correct amount to permit the adjustments to the time base to be observed visually.

Illumination of the screen should not be any higher than is required clearly to observe the effect of each adjustment.

Now with the potentiometers R5 and R16 adjust the raster to an approximate square, the corners of which just roll over the edge of the tube screen. The tube may now be approximately focused with the potentiometer R13. Movement of this will be found to affect the quality of the raster illumination and a position will be found where the effect, particularly at the edges, is more sharp and clean. Also as the correct adjustment is approached the flyback lines of the frame scan will become visible.

These preliminary adjustments completed, actual picture reception tests may be commenced.

It is assumed that the vision receiver has already been tuned to the transmitted signal. The M and earth terminals, also the S.L. and S.F. terminals are connected to their appropriate junctions on the vision receiver terminal strip. An increase in illumination of the raster will be noted. Examination of this will reveal production of patterns due to the picture modulation.

The remaining adjustments are now carried out in this order. The sync. feed potentiometers R1 and R23 are turned full anti-clockwise. The potentiometer R19 is rotated slowly and it will be observed that the screen pattern will tend to become steadier. Soon a position is reached where a horizontal dark area may be seen travelling vertically across the screen. Adjustment is continued until this dark area drifts slowly upwards. R23 is now slowly turned clockwise and this horizontal dark line will lock into position at the top of the screen and become invisible.

It will doubtless be found that the picture is no longer of the correct height and a slight readjustment of R16 will be required to restore the correct dimension. It is important to remember that R16 and R19 are to a large extent interdependent. Adjustment of the one will necessitate readjustment of the other. These remarks apply also to the line scan controls R3 and R5.

Having completed adjustment of the frame scan, the line scan adjustment may be commenced.

The potentiometer R3 is rotated slowly. As this

operation is performed, examination of the screen will reveal horizontal lines that at various settings rotate through the vertical. If while these lines are held upright the screen is examined closely, a number of pictures, the number depending on the adjustment, will probably be seen.

There is one adjustment where, when the lines are held vertical and a single picture is formed. This is the correct one and the potentiometer R1 may be rotated clockwise until the picture locks into position. The width is now correctly adjusted as for the frame with the controls R3 and R5.

The picture can now be focused more accurately with the potentiometer R13. Adjustment of this is quite critical and some care is desirable in arriving at the optimum setting.

These time base adjustments are necessarily described at some length, but no particular difficulty in arriving at the correct settings will be experienced if the order of adjustment given above is adhered to.

There is one point that will require attention. If while the preliminary adjustments are being made, the power unit is switched off, a few minutes must be permitted to elapse, to allow the delay switch to cool, before again switching on.

Failure to observe this precaution may result in application of high voltages to the various condensers and a breakdown result.

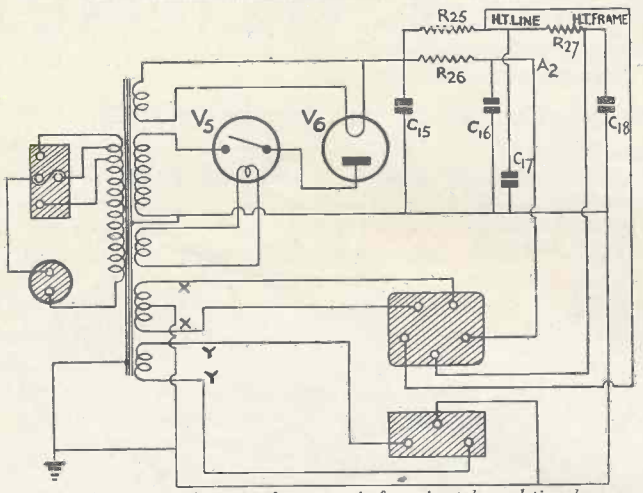
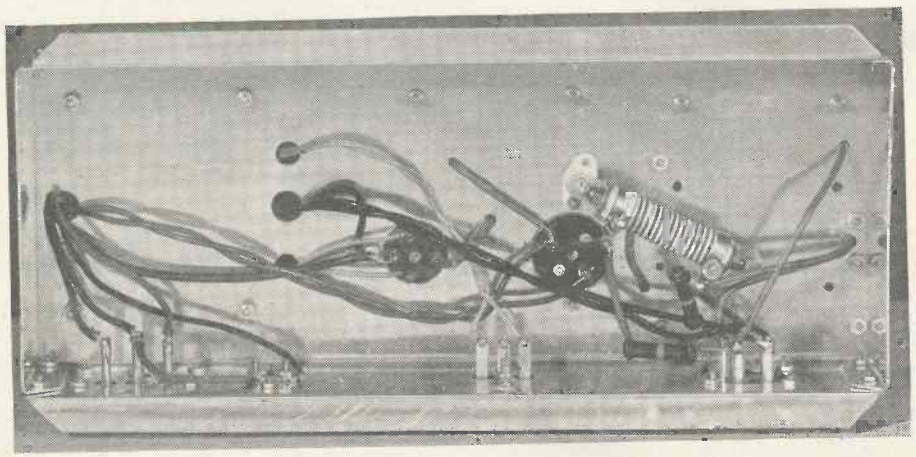


Fig. 3. Circuit diagram of power unit for 4-in. tube and time base.



Underside of power unit for 4-in. tube and time base.

LISTS OF COMPONENTS, VALUES AND MAKES.

C1 0.001-mfd. type 670 (Dubilier).
C2 50-mfds. 12 v. type 402 (Dubilier).
C3 0.001-mfd. type 670 (Dubilier).
C4 0.001-mfd. type 670 (Dubilier).
C5 20-mfds. 50 v. type 402 (Dubilier).
C6 0.005-mfd. type 670 (Dubilier).
C7 0.1-mfd. type 4603/2 (Dubilier).
C8 0.1-mfd. type 4603/S (Dubilier).
C9 50-mfd. 50 v. type 3004 (Dubilier).
C10 0.5-mfd. type 4608/S (Dubilier).
C11 0.1-mfd. type 4603/S (Dubilier).
C12 50-mfd. 12 v. type 402 (Dubilier).
C13 0.001-mfd. 12 v. type 670 (Dubilier).
C14 0.1-mfd. 12 v. type 4603/S (Dubilier).
C15 1-mfd. type 950, 1,500 v. working (Dubilier).
C16 2-mfd. type 950, 1,000 v. working (Dubilier).
C17 2-mfd. type LEG (Dubilier).
C18 2-mfd. type LEG (Dubilier).

RESISTANCES.

R1 20,000-ohms Potentiometer (Reliance).
R2 1,500-ohms Bulgin ½ w.
R3 0.5 megohms Potentiometer (Reliance).
R4 1 megohm 2 w. (Bulgin).
R5 50,000-ohms (Reliance).
R6 1,000-ohms ½ w. (Bulgin).
R7 1 megohm ½ w. (Bulgin).
R8 100,000-ohms 2 w. (Bulgin).
R9 5,000-ohms 1 w. (Bulgin).
R10 1 megohm ½ w. (Bulgin).
R11 1 megohm ½ w. (Bulgin).
R12 1 megohm ½ w. (Bulgin).
R13 0.5 megohm 1 w. (Bulgin).
R14 0.5 megohm Potentiometer (Reliance).
R15 50,000-ohms Potentiometer (Reliance).
R16 8,000-ohms 1 w. (Bulgin).
R17 2,000-ohms Potentiometer (Reliance).
R18 200,000-ohms 2 w. (Bulgin).
R19 0.5-megohm ½ w. (Bulgin).
R20 2 megohms Potentiometer (Reliance).
R21 750,000-ohms 2 w. (Bulgin).
R22 1,000-ohms 1 w. (Bulgin).
R23 20,000-ohms ½ w. (Bulgin).
R24 50,000-ohms Potentiometer (Reliance).
R25 50,000-ohms type PR17 (Bulgin).
R26 50,000-ohms 1 w. (Bulgin).
R27 10,000-ohms 1 w. (Bulgin).

Mains Transformer (Kesto).
Prim. 200-250 volts.
Secs. 4 v. 1 a.
4 v. 1 a.
2-0-2 v. 5 a.
1,000 v. 15 m/A.
2 v. 2.5 a.

VALVES.

2—Type T31 thyraton valves (V1 and V4) (Mazda).
2-Type AC/P triodes (V2 and V3) (Mazda).
1—Type MU2 rectifier (V6) (Mazda).
1—Type DSL1 delay switch (V5) (Mazda).

C.R. TUBE.

Mullard type A41/B4, with holder.

SUNDRIES.

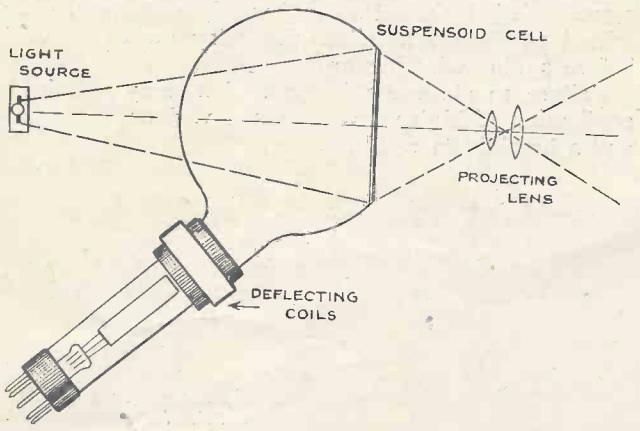
5—5-pin chassis mounting valve holders (Belling-Lee).
1—Type 352/5 valve holder (Belling-Lee).
3—Insulated valve caps type P92 (Bulgin).
1—Midget stand-ox insulator list No. 1078 (Eddystone).
2—Plugs and sockets list No. 1078 (Belling-Lee).
2—Termi als list No. 1001 (marked "shield" and "earth") (Belling-Lee).
1—10-way terminal block (Bryce).
1—Plug and socket (3-way) type 1119 (Belling-Lee).
1—Plug and socket (5-way) type 1260 (Belling-Lee).
Chassis, paxolin panel, wire, nuts and bolts, etc.
1—Clix mains selector board with fixed bridge.

AN ELECTRONIC LIGHT RELAY FOR LARGE PICTURES

By W. H. Stevens

This article describes an entirely new method for large picture production which appears to have great possibilities.

THE possibility of obtaining large-screen television pictures has been attracting much attention of late, and some good results have undoubtedly been obtained under laboratory conditions. With present optical mechanical large-screen pictures, the brightness might be considered sufficient. Large projected pictures from a cathode-ray tube have necessitated high voltages and expensive lenses, the brilliancy leaves much to be desired, and the tubes have had comparatively short life and up to the present the colour has not been pleasing.



Schemetic diagram showing the principle of large picture production by means of suspensoid cell.

It is the purpose of this article to describe a method of obtaining big pictures from a small cathode-ray tube by using the tube to produce a miniature picture, the modulation of which is in the form of varying degrees of opaqueness, rather like a frame of cinematograph film. Then, just as in a cinema, a large picture is obtained by illuminating this small transparent picture and projecting an image of it on to a screen. In this way, the cathode-ray tube is only required to reconstruct the scene from the transmitted information, and this can be accomplished with moderate voltages and a low beam current. The difficult job of supplying adequate, or, indeed, unlimited, brilliancy is left to a local light source, which can be a simple lamp, since it is not itself required to be modulated. In effect, the small picture produced by the cathode-ray tube acts as a relay to trigger off a big picture from a local light source.

The method of obtaining the transparent positive picture is rather interesting. It has been found that a colloidal suspension of graphite in an insulating medium has certain properties which open up attractive possibilities in this direction. The preparation known as "Oildag," manufactured by Messrs. Acheson, Ltd., is a fluid of this nature. If a thin film of this suspension is formed by sandwiching a drop between two microscopic slides, and one of the slides is stroked with a wire at a potential of about a thousand volts, a transparent line appears in the otherwise opaque film. Similarly, such a film on the outside of a cathode-ray tube at the end which normally takes the fluorescent screen, indicates the path of the scanning spot by a transparent line. The effect is greater if the outer glass plate is rendered conducting by painting with a suitable transparent varnish, and connected to the cathode, or other point of fixed potential.

The explanation is believed to be that the graphite, although in minute particles, still retains its characteristic plate-like crystalline form, and that these crystals set themselves along the lines of force just as small pieces of paper tend to stand on end when dropped on to a charged metal plate. When the crystals are all edgwise-on in this manner they offer little obstruction to the passage of light through the film. When the charge on the surface of the glass leaks away, the particles return to their original haphazard orientation by the Brownian movement, and so stop the transmission of light. The speed of their return can be controlled partly by the rate of leakage and partly by varying the viscosity of the oil holding the graphite in suspension.

If such a suspensoid cell is scanned by a cathode-ray beam which is controlled by a vision receiver, a picture in the form of an electric charge is built up on the inner glass plate, a white area, where the beam current is at maximum, being an area of greatest charge. The laminæ of graphite will rotate end-on to the charged glass plate, the rotation being most complete where the charge is greatest, that is, at a full white. Thus a picture will be formed in the cell which is capable of being illuminated and projected.

If matters are arranged to cause the Brownian movement to have its full effect in, say, 1/25th of a second, a picture will still persist even after the scanning beam has passed, and in effect, a storage of picture information results, which simplifies the projection problem since not just one picture point, but a whole frame, is transmitted at once.

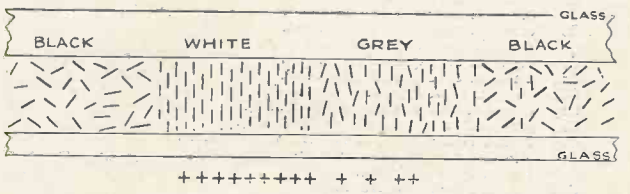


Diagram showing action of suspensoid cell.

Complications arise owing to secondary emission from the glass under bombardment by the electron beam, but this may be overcome by having the side of the cell which is scanned in the form of a photo-electric

(*Continued on page 718*)

1926-1937 THE EVOLUTION OF DESIGN AS EXEMPLIFIED IN THE BAIRD TELEVISION RECEIVERS

Baird television receivers provide the only historical survey in the world of design extending over a period of more than ten years

1926.

THE historic television receiver with which Mr. Baird gave a demonstration to members of the Royal Institution January 27, 1926, showing the transmission of real images between one room and another by television. This was the first time in the world that real television had been shown.

1928.

Large model Baird disc receiver employing a flat plate neon lamp and 24-in. diameter disc having 30 apertures arranged in a spiral trace around the periphery. The vision and sound receiver was accommodated in the table on which the television set was resting.

1929.

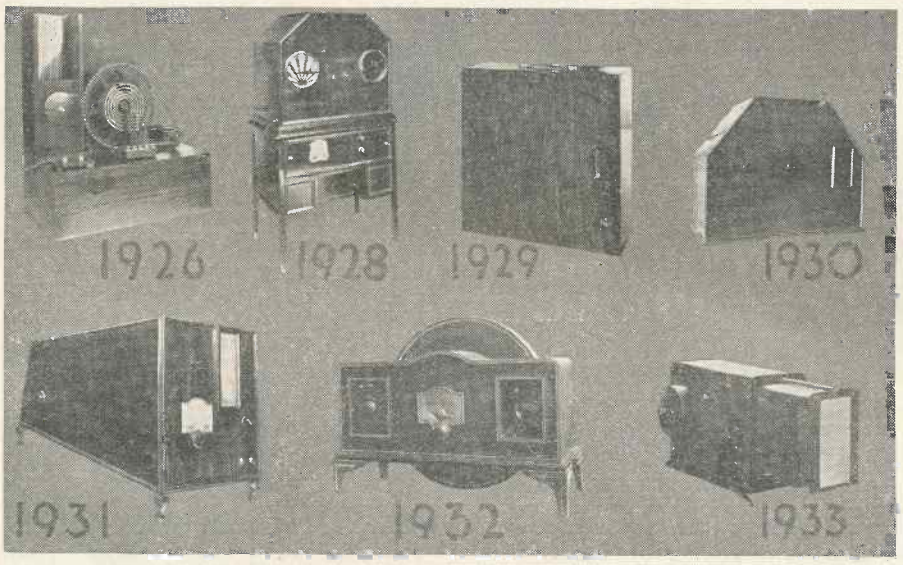
Portable disc receiver employing a smaller type of neon lamp and disc than the 1928 model. This set was used by Mr. Barton-Chapple for the first provincial reception of television, pictures being demonstrated in Bradford on October 8, 1929.

1930.

This disc model receiver was shown for the first time at the 1930 Radiolympia Exhibition.

1931.

A receiver using a mirror drum scanner in conjunction with a hot cathode type neon lamp. The reconstructed picture was projected on to a screen at the front of the set.



1932.

The commercial model disc receiver using automatic synchronising which had a large sale to the public for use during the B.B.C. low-definition transmissions.

1933.

First mirror drum and grid cell form of receiver giving a back projected picture 9 in. by 4 in.

1934.

(a) Large type mirror drum receiver giving a picture 14 in. by 6 in. similar to that installed in the listening room at Broadcasting House.

1934.

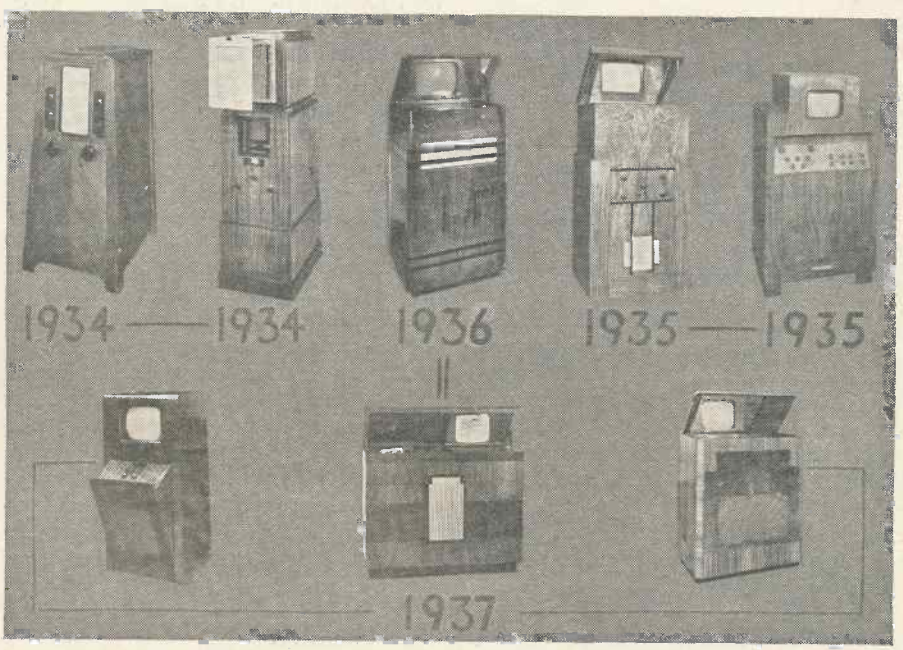
(b) The commercial mirror drum and grid cell receiver developed from the 1933 model. The picture size was 9 in. by 4 in., being viewed on a translucent telescopic screen at the front.

1935.

These two cathode-ray tube receivers were used by the Baird Company during the long series of high-definition television demonstrations which were conducted by them during 1934 and 1935. The signals were transmitted from the studios and laboratories at the Crystal Palace; one receiver gave a picture 12 in. by 9 in., and the other 8 in. by 6 in.

1936.

Baird Television Receiver, Model T5, giving a brilliant black and white picture 12 in. by 9 in. produced on a "Cathovisor" cathode-ray tube—



itself a Baird product. This was the largest picture obtainable on a commercial television receiver, being designed to receive the television programmes radiated from the Alexandra Palace, London.

1937.

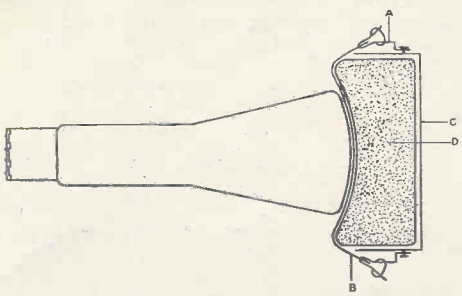
(a) Baird Television receiver, Model T11, giving an outstanding brilliant black and white picture 10 in. by 8 in. viewed directly on the horizontally mounted 12 in. diameter "Cathovisor" cathode-ray tube. The receiver provides excellent picture detail, high fidelity sound, adequate angle of vision and splendid all-wave radio reception.

(b) Baird receiver, Model T13, giving a brilliant black and white picture 13½ in. by 10¾ in., produced on a "Cathovisor" cathode-ray tube. This model represents the latest technical achievement in combined television and radio entertainment for the home. Housed in the handsome walnut cabinet is a luxury television receiver, a high-fidelity all-wave radiogram with automatic record changer capable of playing records of any size in any order.

(c) Baird Receiver, Model T12, giving a brilliant black and white picture 13½ in. by 10¾ in., viewed in a hinged part-mirrored lid, a 15-in. diameter "Cathovisor" cathode-ray tube being mounted vertically in the cabinet. This picture is the largest yet shown on this type of Baird cathode-ray tube. The receiver also incorporates an all-wave broadcast receiver.

PHOTOGRAPHING OSCILLOGRAPH IMAGES

ON p. 670 of last month's issue a description was given of the Mullard E40-G3 miniature cathode-ray tube. In connection with this tube the Mullard Company provide instructions for its operation together with a number of examples of its application, and included in the latter are some hints on obtaining photographs of oscillograph images by very simple methods.



Showing method of obtaining photographs by direct contact.

The simplest method of obtaining a photograph of an image is to place a sheet of sensitised paper directly upon the screen of the tube and allow a suitable exposure time. With this method, of course, no camera is required, but it has the disadvantage that the lines produced are considerably thicker than those on the actual screen and the result is that the finer detail is lost.

A fast bromide paper is recommended for this process and the exposure should be from 2 to 4 seconds according to the intensity of the light spot on the screen.

A better way of employing this method is to use a rubber sponge to press the paper into even contact with the glass, as shown in the diagram. The rubber sponge D keeps the bromide paper fairly evenly pressed up against the screen of the tube, which, of course, is slightly curved. The sponge should be fitted into a tin box (C), the paper being held at each side by stout paper clips (A), as shown. As it is most important that the edges of the paper are in exactly the same direction as the axes of the deflecting plates, care must be taken in positioning it before an exposure is made.

If a camera is used for obtaining a record it is essential that it be of the long extension type or be fitted with a portrait attachment in order that the trace may be photographed approximately actual size. Films or plates with ample sensitivity in the green part of the spectrum are marketed by all leading manufacturers and working with a lens aperture f/4.5, an exposure of 1/10 to 1/2 a second will be required in order to obtain sufficient density with a full-size photograph of a simple stationary oscillogram of a total length of 15 cms. A shorter exposure time will be possible with smaller images, which will probably have a greater light intensity.

An O.B. Transmitter for the National Broadcasting Co.

FOR the first time in America the National Broadcasting Co. is to carry out experiments with a mobile television transmitter for outside broadcasts.

The unit has been constructed by R.C.A. and an extensive series of tests in televising outdoor scenes is to commence immediately. Football and other sports, and news events are listed in the outdoor schedule, but the work is to be strictly experimental, with a view to improving the equipment and methods.

The new mobile television station will consist of two specially constructed motor vans. Apparatus for picture and sound pickup will be installed in one, and a vision transmitter, operating on a frequency of 177,000 kilocycles, in the other. In the metropolitan area, where many tall buildings make high-frequency transmission difficult, it is expected that the working range will be about 25 miles. Ten engineers will be required to operate the two television units. In the experimental field work N.B.C.'s present mobile sound transmitter will be included in the station.

The van containing the vision apparatus will be the mobile equivalent of a television studio control room. It will be fitted with television and broadcast equipment which will include two cameras, vision amplifiers, synchronising generators and rectifiers. The sound apparatus will include microphones, microphone amplifiers and sound mixing panels. All the equipment will be mounted on racks extending down the centre of the van, affording easy access to any part for repairs, and any alterations which may be found desirable.

"AN ELECTRONIC LIGHT RELAY"

(*Continued from page 716*)

mosaic somewhat similar to that used in the Emitron camera. The local light source will then create a positive bias on the mosaic by photo-emission, which is more or less cancelled by the modulated scanning beam depending on the instantaneous current in the beam. Either a positive or a negative picture can be produced at will by suitably fixing the potential on the outer plate, the reversal necessary to render a positive picture when the cell is acting negatively being obtained by changing the phase of the modulating signal on the grid of the cathode-ray tube.

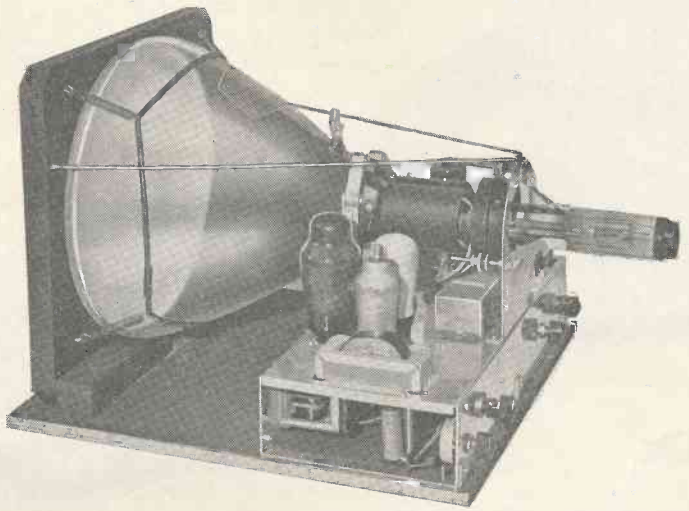
WORLD PIONEERS & MANUFACTURERS OF ALL TYPES OF TELEVISION EQUIPMENT

FIRST IN 1926 FINEST IN 1937

One of the factors contributing to the outstanding success of all Baird television receivers has been the consistently good quality of the " Cathovisor " Cathode Ray Tube. Baird Television, Ltd., as pioneers, have developed this Cathode Ray Tube to a design which fulfils all the conditions for excellent picture resolution.

For modern television, the requirements of the Cathode Ray Tube are that a bright, well-defined picture be formed on the screen by the electron beam, that the picture be in sharp focus all over the screen, that the focus remain always equally sharp with the variations of gradations from light to dark, and that these variations be a faithful reproduction of the original gradations of the scene being televised.

The developments in Cathode Ray Tube technique undertaken by Baird Television, Ltd., have ensured that these factors are complied with by their latest type " Cathovisor " Cathode Ray Tubes, which are the most satisfactory on the market. Not only is the electrode system extremely simple and robust but, due to the type of cathode employed and the magnetic focusing, a high intensity cathode ray beam is produced which results in a very brilliant picture on the screen. Screen grain does not impose a limit on spot size due to the special grading of the material used, and picture definition is outstandingly good.



" Cathovisor " Cathode Ray Tube Type 12MW1, as arranged in one unit for the Baird T11 Receiver.

Every tube receives stringent tests for total cathode emission, modulation range and illumination characteristics, filament rating and screen quality, and following normal picture reconstitution under service conditions, the completed Cathode Ray Tube is subjected to a further high external air pressure test.

A special feature is that each tube is completely electromagnetic in operation. Full details supplied on request together with information concerning scanning and focusing equipment.

TECHNICAL DATA

	TYPE 15MW2.	TYPE 12MW1.
Heater volts	2.2 volts approx.	2.2 volts approx.
Heater amps.	2.5 amps.	2.5 amps.
Peak to peak volts, between black and highlights	16.5 volts.	14 volts.
Maximum electro-magnetic sensitivity	2mm/AT.	2mm/AT.
Modulator/earth capacity	2 $\mu\mu$F (approx.)	4½ $\mu\mu$F (approx.).
Modulation sensitivity (slope)	17 μA/V (approx.)	17 μA/V (approx.).
Anode volts	6,500 volts (working)	4,900 volts (working)
Maximum input power to the screen	3.5 milliwatts/sq. cm.	4 milliwatts/sq. cm.
Screen colour	Black and white	Black and white.
PRICE	**15 gns.**	**12 gns.**

BAIRD TELEVISION, LTD.

Head Office :

Greener House, 66, Haymarket, LONDON, S.W.1

'Phone: Whitehall 5454

Laboratories :

Crystal Palace, Anerley Road, LONDON, S.E. 19.

'Phone : Sydenham 6030

Mullard introduce a new type of Cathode Ray Tube

A.41-G4

THIS NEW TYPE of Mullard Cathode Ray Tube has been specially designed to permit the pair of plates nearer the screen to be used with a non-symmetrical deflection circuit, thus considerably reducing the cost of the associated apparatus.

The design of the focusing electrodes enables an exceptionally small spot size to be obtained over the entire screen area.

Price £6 15s.

COMPLETE WITH SPECIAL SOCKET

ABRIDGED SPECIFICATION

Screen Diameter	4 ins. (approx.)
Heater	4 volts, 1.2 amperes
Maximum Final Anode Voltage	1,200 volts
Deflection	Double Electrostatic
Focusing	Electrostatic

FLUORESCENT COLOUR

A.41-G4	Green
A.41-B4	Blue

Full technical information from

THE MULLARD WIRELESS SERVICE CO. LTD.

Cathode Ray Tube Department,

225 Tottenham Court Road, London, W.1

TELEVISION AND SHORT-WAVE WORLD

BRITISH TELEVISION THROUGH AMERICAN EYES

Here are the impressions of two American radio engineers who have spent a considerable time in this country intensively studying the British television system. A laboratory was set up and in addition to observing the transmissions, measurements and tests were made. We are indebted to "Electronics" (New York) for the information given here.

TWO engineers from the Hazeltine Service Corporation of America, have spent a considerable time in London studying the British television situation at first hand. This article is a report of their impressions and the comparisons they make with American progress.

Good Pictures

The picture of British television, here presented as it appears to American engineers, they say, is that of an operative system giving good stable pictures of acceptable detail, brilliance and interest. Some of the defects and the lines of future improvement are touched upon. That considerable improvement is possible within the band width available is evidenced. Some technical points of interest in the British system are described to point out wherein they differ from the United States proposals and practices. The nature of these differences in standardisation is illustrated by explaining certain features of operation which give improved performance through their use.

British Standards Best

That these British standards constitute a major improvement over present American practices* is an inescapable conclusion, because television is technically successful and an accomplished fact in England.

There is adverse criticism of the time during which programmes may be received and also of the character of the programmes and the fact that there is often repetition.

The criticism is not related to any inability to receive clear steady pictures of good brilliance. It sums up to this, the report states, completely operative television receivers may be purchased in England and a regular programme of good pictures and accompanying sound received. During the coming year nearly every large radio manufacturer will be producing television receivers as well as the regular quota of sound broadcast receivers.

Why this is possible only in Great Britain cannot be answered by simply referring to the Government subsidy of the British Broadcasting Company. In the United States the fact that television is still around the corner cannot be excused merely by asserting that we really are ahead, but that we prefer to wait and be sure; and then we will provide a superior system.

Britain has been fortunate in Government sponsorship, but they have also been fortunate, or wise, in their choice of standards. We, in this country, may have been equally fortunate in not having Government help, particularly if such help would have left us fixed with a less fortunate choice of standards.

We cannot avoid the fact that the situation in the United States is much less favourable. Unless changes are made in the type of signal which is now being used for experimental transmitters, American receivers will be more expensive, more difficult to service and will give performance inferior to British receivers. The bad performance will not be lack of detail in the transmitted picture, since, with its slightly greater number of lines the American picture can be provided with more detail than the British picture. It will be in steadiness and contrast that the American picture will suffer. Even with a more complex receiver the picture may show the fluctuations and loss of synchronism which has been noted in various American demonstrations.

A Laboratory Established

To know with certainty how British television does operate in its first commercial setting, the authors established for the Hazeltine Service Corporation a temporary laboratory this summer in England for the purpose of making a survey. This survey included observing the transmissions and making measurements of the received signals with special equipment designed for the purpose. A major part of the survey called for visits to the transmitting station and contacts with receiver manufacturers and engineers.

First let it be said that the British pictures are remarkably good. They are steady; they are brilliant; they have an exceptional amount of detail. Scenes having a large number of actors on the stage come over clearly. Dancing and ballet subjects are very effective. Close-ups of the stars are, however, still the most effective shots since they emphasise the detail that the scene conveys by allowing careful scrutiny of the details of the face. For such scenes the detail in the highlights of the eyes, lashes, teeth and hair is particularly remarkable.

There is reason to believe that there is more detail in the British transmitted signal than the present receivers can utilise. Improved cathode-ray tubes having better spot size and modulation characteristics are one avenue of development. However, in spite of the excellence of the present signal there is also room for much improvement in the transmission within the standards which have been set.

British Receivers

First, as to reception. The white screens are quite brilliant and the level of black in the transmitted signal is so well maintained that excellent contrast and brilliance results. The resulting black and white picture is easily viewed in an average living room without drawing the shades, provided the receiver is placed to avoid direct reflection of sunlight (or lamp light in the evening) from the face of the tube. In this respect extraneous light seems less objectionable in the case of cathode-ray television than it is in the case of projected pictures such as home-movies.

In viewing the Alexandra Palace

* The U.S. practices and standards referred to are those which (a) employ negative modulation of the carrier wave, (b) radiate a carrier which, through omission of the "d.c.," has no definite level for black, and (c) employ synchronising pulses which are inadequate in amplitude and duration. Recent information shows that not all U.S. stations employ these features.

AMERICAN AND BRITISH METHODS COMPARED

transmissions on a large variety of different receivers there were practically no cases of faulty synchronisation. In general, a receiver, after being switched on, is in a sufficiently steady state in the short time required for the voltages to rise so that the picture lights up on the screen locked in steady synchronism without any tearing of the lines or edges. There is no upset of synchronism when large changes in average lighting occur such as is often the case in transmitting film. The fact that the British pictures are remarkably good should not be forgotten in reading the following critical comments.

Now, as to defects: Motor car static, when excessive, results in a decided snowstorm on the screen. The accompanying noise on the sound channel is, however, much more irritating than the effect on the eye. Even the most excessive disturbances of this type apparently fail to have any disturbing effect on synchronisation. It is of interest that one disturbance which has been known to completely destroy signal and synchronism is the passing of an aeroplane directly overhead.

Good Synchronisation

An example of the extreme in steady synchronisation was the reception of the Alexandra Palace signal at eighty miles distance with a standard receiver. In this beyond-line-of-sight reception the signal was not visible except as a hazy movement of light on a grille of noise. Yet it was easily demonstrated that the grille was synchronised by throwing out the synchronising controls, in which case the horizontal and vertical bars of the framing signals were visible travelling across the screen.

The most frequently observed defect in receiver performance was failure of interlace. Examples of this ranged from no interlace to perfect interlace and included pairing of the lines and in some cases a slow weaving in and out of interlace. Such faults cannot be blamed upon the character of the transmitted signal since there are receivers that give perfect and steady interlace. Possibly the transmitted signal could be modified as to components which could make this problem easier in the receiver design. However, good engineering in the receiver design does solve the problem and without adding to receiver cost.

For studio shots the average illumination employed on the subject is only 200 foot-candles. Although the Emitron tubes are probably the most sensitive and reliable pick-up devices which have been produced they are subject to the inherent defect of shading troubles. In the B.B.C. system, "tilt and bend" generators supply correcting signals to an illumination control unit. These controls require constant adjustment as the programme continues. The result is that two complete rehearsals are required, one of which is before the cameras. This enables the operators to know the corrections to be expected by viewing the programme on the monitors before going on the air. Where a programme is repeated, the improvement of illumination in the second showing is evident. The shading corrections are more difficult for film where the change of scene is more rapid and film subjects are conceded to be inferior to studio shots. The improvement in the successive showings of newsreels is very evident.

Titles on black or white backgrounds are difficult because of the shading effect which is here evidenced in streaking shadows which follow the individual letters or words. There is remarkably little of this streaking in the Alexandra Palace signal but it is frequently evident in the received image.

The contribution of the receivers to such shadows, is due generally to phase distortion. In the better designed receivers such effects seem to have been entirely eliminated and the receiver circuits apparently take advantage of all the frequency spectrum available. The cathode-ray tubes do not in all cases take full advantage of the signal since some may not have as fine a focus of the spot on the screen as others.

Cathode-ray Tubes

Since there is but the one transmitter and no additional ones contemplated in the London area the receivers are of fixed frequency with only a vernier tuning adjustment. Our American problem of tuning over a band to select one of several stations, therefore, has not been faced. Otherwise, England is a wonderful proving ground for all varieties of receivers.

The cathode-ray tubes are of all varieties as to structure, shape, scanning and focus. Generally they operate at about 6,000 volts. The so-called "onion" shape as against the "funnel" shaped tube appears to be favoured because of safety which the curved surfaces give to the design. With the safety factor which properly curved surfaces will give, the use of soft glass envelopes is increasing. At first glance these appear awkward but through good design these tubes of enormous size are completely housed in most presentable cabinets.

Scanning and Focusing Methods

Engineering opinion is apparently well divided on scanning and focus, and during the past year models in these types were available:

(a) Electrostatic focus—full electrostatic scanning, (b) electrostatic focus—full magnetic scanning, (c) Magnetic focus—full magnetic scanning.

All three types are continued and represented in the new models this year. A fourth type is also announced comprising electrostatic focus—electrostatic horizontal scan—magnetic vertical scan.

A minimum of four valves, a maximum of eight, are employed for the functions of synchronising separation and scanning. In this connection and also due to the wide band amplification problem in general a variety of new valves are appearing—particularly high slope valves having mutual conductance of the order of 7 to 10 m/A. per volt.

The scanning of the various receivers, as evidenced by the picture on the screen, is not always perfectly linear. The transmitter signal gives a blanking interval for the line flyback or retrace which is 15 per cent. of the total line time. This is much longer than the 10 per cent. interval proposed for the United States. In micro-seconds the British standard allows for retrace a total of 15 micro-seconds. Since the U.S. system employs a higher line frequency our allowed retrace time is actually $7\frac{1}{2}$ micro-seconds. Nevertheless the achievement of a good linear line trace and a perfect return during the 15 micro-seconds blanking interval is not always accomplished. Some receivers may evidence a lighting on

(*Continued at foot of next page*)

Scannings and Reflections

KINESCOPE PROJECTION TUBE

A NEW projection tube has been developed by R.C.A. technicians under the direction of Dr. Vladimir K Zworykin, Mr. W. H. Painter and Dr. R. R. Law. The new projection Kinescope is designed to produce a clear image 18 by 24 in. in size

In the first demonstration of the projection tube by radio-transmitted images, the show consisted of both motion picture film and live entertainment. The show was picked up by Iconoscope cameras in the N.B.C. studios at Radio City, relayed by co-axial cable to the transmitter in the Empire State Tower, and from this point broadcast to receivers on the 62nd floor of the R.C.A. Building.

MORE MONEY FOR TELEVISION

In answer to a question by Commander Fletcher on November 8, the Postmaster-General said that the proportion of licence revenue payable to the Corporation would be subject to review soon on account of the development of television. The expenditure incurred in the new service would then be taken into account. An announcement concerning the introduction and scope of the service would shortly be made by the B.B.C.

The capital expenditure incurred on the television service up to September 30, less depreciation written off, was £112,000, and the revenue expenditure up to that date, including depreciation and programme, engineering and staff costs, was £346,000.

"JOURNEY'S END"

Journey's End was the most ambitious dramatic experiment yet attempted in television. The play lasted seventy-five minutes and severely taxed the resources of the limited studio space, but the atmosphere of the play came over well.

THE C.B.S. TRANSMITTER

The Columbia Broadcasting System's new television transmitter is now being given its first power tests at Camden, N.J., and will be ready for delivery to New York early in January.

It is to be installed on the 73rd and 74th floors of the Chrysler Building. There it will provide television programmes from the nearby Grand Central Station studios.

THE CENOTAPH CEREMONY TELEVISED

For the first time in history, the Cenotaph ceremony in Whitehall on Armistice Day was televised and use was made on this occasion for the first time of a newly developed ultra-sensitive Emitron camera. This new camera is ten times more sensitive than those previously used for outside broadcasts and will enable scenes to be picked up under adverse lighting conditions. The unfortunate episode of interruption of the silence was clearly visible on the screens of receivers and viewers thus had first-hand knowledge of what was happening.

EXTRA HOURS FOR TELEVISION

It is understood that early in 1938 television broadcasting will occupy four hours per day instead of the present two. One of the extra hours will be at a fixed time in the early evening and the other will be variable in order to suit any outside events which are suitable for transmission by the new medium.

TELEVISION AT SEA

Recently the Cunard-White Star liner *Britannic* picked up television pictures from the Alexandra Palace when passing down the English Channel, 30 miles from the south coast. This is believed to be the first occasion that high-definition television has been received by a ship at sea. Both the afternoon and evening transmissions were received.

After messages had been received from the ship reporting the successful reception, the television station transmitted the first "Telephotogram" to a ship at sea. This was a visual message of greeting to the Captain, officers, crew and passengers. A request was made from Alexandra Palace that the message should be photographed. Further tests are to be made on board the *Britannic* on its voyage across the Atlantic.

BOXING TOURNAMENT

Boxing offers some of the biggest thrills of the television screen, as was proved when the amateur championships were televised from the Alexandra Palace concert hall in February last. Another tournament will be featured in television in the evening of December 2 when bantam-weight, feather-weight, and welter-weight contests will be fought under the auspices of the Alexandra Amateur Boxing Club. It is hoped to televise one or more of these.

The bantam-weight match is between C. C. Gallie (Cardiff), Junior Champion of Great Britain, 1935, 1936, 1937, and F. Salmon, the English international amateur boxer. J. Harrington (Cardiff) is paired with J. O'Berg (Hull) in the feather-weight contest. S. Stockton, runner-up Junior Championship of Great Britain, 1935, will meet T. Quill, English international, in the welter-weight contest,

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"BRITISH TELEVISION THROUGH AMERICAN EYES"

(*Continued from preceding page*).

the left side of the picture due to a slow retrace. A slight crowding or narrowing of objects, also generally at the left side of the picture, frequently gives evidence of imperfect line linearity. Frame linearity is generally good and there is little or no evidence of hum troubles from the 50-cycle mains.

It is rather evident that many of the defects discussed are rapidly being ironed out by experience. Such progress can, of course, only be realised where a standard and regular transmission is available.

The fact that careful engineering is required to achieve good line scanning with the 15 per cent. blanking interval has already been discussed. It seems clear that the art is much too young to reduce this interval and be fair to set manufacturers. Similarly adequate duration and amplitude of synchronising pulses is essential to set manufacturers for tolerance in design.

MORE SCANNINGS

One of the television cameras will probably be supported on a steel cradle giving an uninterrupted view of the ring. Another will be operated from the ring-side. Both will use telephoto lenses when occasion demands.

A 90-MINUTE PLAY

A ninety-minute play, the longest yet attempted in the studios at Alexandra Palace, will be televised in the afternoon programme on December 6. It is " Once in a Life-time," a funny satire on American film methods, by Moss Hart and George Kaufmann.

Joan Miller, television's " Picture Page " girl, who has already appeared in many dramatic productions at Alexandra Palace, will take the part of May, a member of an unsuccessful music hall trio, who "cashes in" on the sudden arrival of talking pictures by opening a school of elocution. By taking a correspondence course in the subject, she is able to keep one less ahead of her class. George and Jerry, the companions, who accompany her to Los Angeles, are also caught up in the film machine, to meet with adventures which should make splendid entertainment on the television screen.

The action is quick moving, and the scenes, ranging from a cheap lodging-house via Pullman cars to Los Angeles hotels and film studios, chase each other with a rapidity that will keep the television cameras busy.

ST. ANDREW'S DAY TELEVISION

Two American tourists" do " Scotland in a St. Andrew's Day programme which will be televised both afternoon and evening on November 30. " Stands Scotland . . . ?" is the title of this essay in contrasts, which in reality is a satire on present-day glorification of Scotland. The programme, devised by Andrew Cruickshank and Reginald Beckwith, will contrast the real Scotland of the misty Highlands with the popular stage and Hollywood versions.

"Stands Scotland . . . ?" will employ some of the devices of sound broadcasting, such as a team of narrators, and it should be interesting to note whether this fusion of sound and television technique is effective. Presentation will be by a Scotsman, Moultrie R. Kelsall, who, before his recent appointment as television producer, was responsible for many dramatic broadcasts in the Scottish Region.

TELEVISION FROM ST. GEORGE'S HALL

No official confirmation is as yet forthcoming regarding the report that the variety programmes from St. George's Hall are to be televised, but it seems clear that this is the B.B.C.'s intention if certain technical difficulties can be overcome. Formerly adequate lighting appeared to be a snag, but with the recent development of a more sensitive camera there now remains little trouble on this score and probably the greatest trouble is the placing of the cameras so as not to interfere with the view of the audience. Tests are being made of various arrangements and the outcome of these seems very hopeful. It appears very likely that in the near future the variety programmes will form part of the regular television broadcasts.

TELEVISION AT CHRISTMAS

The Christmas television programmes, which open on December 20, will, it is hoped, be representative of the best yet radiated from Alexandra Palace. The season begins with a display of Christmas toys in the afternoon and evening programmes on December 20. " The Ghost Train," Arnold Ridley's thriller, will be performed on the same afternoon.

The afternoon programme on December 21 will include a star production of " Hundred Per Cent. Broadway," Cecil Madden's all-American cabaret show with David Burns and the Merriell Abbott Girls from the Dorchester. Arthur Marshall, the " school-mistress " broadcasting star, will make his television début in the afternoon on December 22, and the " Picture Page " programmes on that day will have a special Christmas flavour.

" Hansel and Gretel," Humperdinck's fairy-tale opera, will be televised in the evening programme on December 23, and will be repeated a week later. The leading parts will be taken by children acting in mime with vocal accompaniment " off-stage." The B.B.C. Television Orchestra, conducted by Hyam Greenbaum, will be specially augmented for the occasion. On Christmas Eve, Jack Payne and his Band will appear in both the afternoon and evening shows.

A Christmas edition of " Coffee Stall " will be televised in a snow-storm on the same afternoon.

CHRISTMAS DAY

Christmas Day programmes will open with a short address by the Rev. Pat McCormick. Viewers will then be taken into Alexandra Park for a football match between the Alexandra Palace Football Club and a Welsh team. On Christmas evening Harry Pringle will introduce a Music Hall Cavalcade with old-time artists. The studio will be decked out as an Edwardian music hall and an audience will be present.

Mr. Gillie Potter will be among the stars making solo appearances in the Christmas programmes. He will be seen in the evening programme on December 20 and again in the afternoon programme on Christmas Day. Noni, the clown, and his partner, who visited Alexandra Palace in the early days of television, will make a joyful reappearance in the afternoon programme on December 23. It is hoped that Lydia Lopokova, the celebrated ballerina, will appear in the different rôle of story-teller on December 23, recounting the adventures of Little Red Shoes in the afternoon programme. In the evening programme on the same day, Marcel Boulestin, the cookery expert, will explain how wine should be served. Irène Prador, the Viennese soubrette, who is one of the first stars created by television will sing German, French and English songs in the evening programme on December 24 and again on Christmas night. On Christmas Eve, Nicholas Bentley will draw cartoons and a commentary will be supplied by Captain Robert Hartman. The outstanding musical event will be a pianoforte recital by Irene Kohler in the afternoon programme on December 21.

On Boxing Day Reginald Smith hopes to present a television pantomime.

A winter sports programme will be transmitted on December 30 and on the last day of the old year a music-hall performance will bring more old-time artists to the television cameras in an informal setting.

. . . . AND MORE REFLECTIONS

ENGLAND-AUSTRALIA ON 5 METRES

Full confirmation has now been obtained of the new long-distance record set up by the Australian amateur station, VK2NO, on 5 metres. His phone transmissions from Sydney were picked up by Mr. Mellanby, of Pwllheli, North Wales, and the received data has been checked, so removing any possibility about the authenticity of the reception.

In future, VK2NO is keeping a regular schedule with the Belgian station, ON4AU, so that English listening stations, or those transmitting on 5 metres, should keep a lookout for a possibility of co-operating and making an England-Australia two-way phone contact.

AN AERIAL ON WHEELS

A remarkable innovation has been made at the new PCJ station owned by Philips and located at Eindhoven. The power of this station has been raised to 60 kW, and in order to overcome the difficulty of erecting numerous aerials to cover all directions, a special revolving aerial system has been designed.

American amateur stations have used a similar idea on a small scale, but never before has a commercial broadcaster erected such an aerial. Briefly, the aerial consists of two lattice masts 195 ft. high, mounted on a girder bridge, which is in turn mounted on a centre pivot and eight wheel trucks. The whole system turns on a circular steel track, the circle of the outer rail being 145 ft. in diameter with a 40 ft. inner circle. This aerial can be erected in any direction so that signals can be beamed on any particular part of the world. The aerial system proper consists of 12 vertical di-pole aerials on each mast, each aerial being fed separately with an input of 60 kW.

RECEPTION ON SHORT-WAVES

Reception conditions on short-waves again seem to be most peculiar. Despite the fact that wide claims are being made for reception of commercial broadcasters from all parts of the world, the fact remains that amateurs of every nationality are in complete agreement that conditions at the present time have never been so consistently bad. There are periods when it is absolutely impossible to hear a station more than a thousand miles distant on 20 metres.

There are also periods when a complete fade-out has been experienced of all signals, both commercial and amateur. Immediately after such periods it has often been noticed that long-distance and very local stations can be heard simultaneously, which is most unusual. During one of these spells stations in Scotland, Ireland and the east coast of America were able to maintain continuous contact for a period of ever 90 minutes.

It appears, however, that the 10-metre band is not subject to such extraordinary variations. On this wavelength between the hours of 1 p.m. and 7 p.m., stations from all over the world can be heard most consistently and operators know that outside these times the band will be completely dead. Despite the shortness of the time when this band is active it is at least helpful to know just when stations can be heard.

POLICE TRANSMITTERS USE TELEPHONY

The attitude of those in charge of police transmitters seems to be changing, for there is now a more general tendency to use telephony instead of telegraphy, as in America. Those users of true all-wave receivers covering the 140-, 160-metre band should make a point of hearing some of the interesting transmissions which emanate from police transmitters at Nottingham, Manchester, Glasgow, etc. Although the London police transmitter is at present using telegraphy, there seems to be a definite indication that when a suitable wavelength has been allocated telephony may be used, at least in certain circumstances.

SHORT-WAVE CONTEST

During the period February 5 to February 27, the Radio Society of Great Britain will be staging their annual B.E.R.U. contests. The success of these contests depends very largely on the number of stations operating on telephony. These contests, of course, are for those stations operating with telegraphy and if the telephony stations remain silent during the contest period the telegraphy stations can make contact with the very minimum of interference. It is hoped, in the circumstances, that telephony stations will remember this point and reduce their transmissions during the contest period unless they too revert to telegraphy.

At the moment there are a number of stations which consistently use telephony so that their value to the State is greatly decreased. In Australia every amateur is obliged to use a certain amount of telegraphy so that his operating is kept up to a definite standard. The idea in mind is that in case of national emergency amateur transmitters could as a whole be taken over as radio operators without an undue amount of additional training. This, however, is only possible if operators keep up their proficiency with telegraphy.

Technical Books for Christmas

THERE is nothing quite so suitable for Christmas presents as a good book, particularly when it is presented to somebody who is technically minded and can appreciate something like "Radio Engineering," "Communication Engineering," or the "Fundamentals of Vacuum Tubes." These three books have been chosen out of the huge number published by McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2, and are about the best of their class.

"Radio Engineering," by F. E. Terman, Professor of Electrical Engineering, Stanford University, is priced at 30s. net, and includes 813 pages and 475 illustrations. Chapter headings include Vacuum Tube Amplifiers, Modulation, Radio Transmitters, Radio Receivers, Television and Radio Aids to Navigation.

"Communication Engineering," by W. L. Everitt, Professor of Electrical Engineering, The Ohio State University, is also priced at 30s. net and is a step-by-step analysis of the problems confronting the radio and television engineers. Amongst the chapters included are Filters, Bridge Circuits, Modulation and De-modulation, Class A Audio Frequency Amplifiers, Class A Radio Frequency Amplifiers, and Electro-Mechanical Coupling.

One of the best books of its kind is "Fundamental of Vacuum Tubes," by Austin V. Eastman, M.S., Assistant Professor of Electrical Engineering, University of Washington. In the 438 pages is included practically everything that the advanced radio engineer is likely to want regarding radio valves. Also included is data on photo-sensitive cells and all kinds of valves of a similar type. The price of this book is 24s. net.

HIGH-VOLTAGE POWER SUPPLY UNITS FOR TELEVISION

By S. West

WHILE a comparatively large number of published circuits, commercial vision receiver reviews and transmitter power pack designs, has acquainted the amateur with the fundamentals of high-voltage power units, the design of these units to provide the high voltages required for television receiver operation, that is the C.R. tube and time base voltages, can present a number of disconcerting pitfalls to the uninitiated.

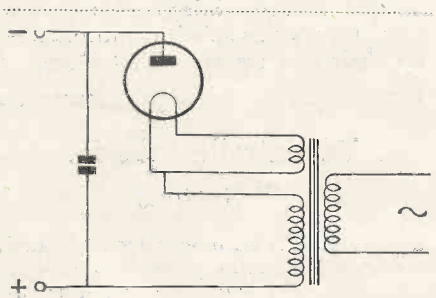


Fig. 1a. Circuit of half-wave rectifying arrangement.

Also, as revealed below, an acquaintance with the principles involved is very desirable if damage is to be avoided when any change of the operating conditions that the apparatus is designed for is undertaken.

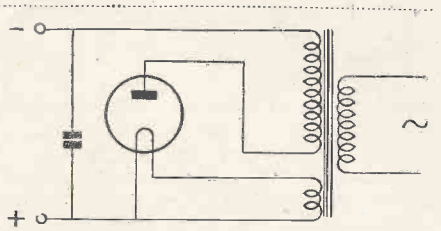


Fig. 2a. Circuit for use with earthed negative.

Considering first the exciter volts required for C.R. tube operation, these voltages are quite high, usually for 10 in. and 12 in. tubes, approximately 4,000 volts.

Fig. 1a gives the circuit of a half-wave rectifying arrangement that is largely used to provide these voltages. In order better to consider the circuit, its essentials are reproduced by Fig. 1b. Here the voltages occurring at each end of the secondary are represented by the curved line; this will assist in an understanding of the manner of operation. The shaded portion represents the rectified half-cycle.

It is seen that the maximum peak voltage that can occur across the high voltage secondary is 1.4 × volts r.m.s. of the secondary. This is also the maximum voltage that can occur across the reservoir condenser.

The maximum voltage across the rectifying valve is twice this value during the non-conductive half cycle.

It is well thoroughly to grasp these facts as they are fundamental of any rectifying system.

If the positive of Fig. 1 is earthed (the various factors governing the desirability of positive or negative earthing are later considered) it will be seen that the inside end of the H.V. secondary is earthed. As a consequence very little insulation is required. The rectifier winding, and, of course, the outer of the H. V. secondary, as they are common, will require to withstand 1.4 × volts r.m.s. of the secondary to earth. If, as is customary, the transformer is wound with the rectifier filament secondary on the outside, the minimum of insulation is entailed.

Now consider the same arrangement when negative is earthed. Then the inside end of the H.V. secondary will require to withstand 1.4 × volts r.m.s. of the secondary to earth, the ouside twice this voltage.

If a unit designed for positive earthing is used with a negative earth, it is easy to see that a breakdown will almost certainly result.

The arrangement, Fig. 2a, is more suitable when negative is earthed. Fig. 2b, again reproduces the essentials of this circuit.

It will be seen that here, the H.V. secondary insulation is the same as for the other circuit. The rectifier filament winding will, however, require insulating 2 (1.4 × volts r.m.s.) to the high voltage secondary and half this voltage to earth.

When positive is earthed, employing the circuit of Fig. 2, it is seen that the inside of the H.V. secondary will require insulating for 1.4 × volts r.m.s., the outside end for twice this voltage. The rectifier filament winding insulation to the secondary is the same as for negative earthing, but does not require insulating to frame.

From the foregoing it will be apparent that if the high voltage is furnished by a winding insulated for the inside end 1.4 × volts r.m.s., the outside end for twice this voltage, and the rectifier filament voltage is provided by a winding insulated to the full voltage on a separate transformer which can conveniently be that supplying the voltages for the time base valves' heaters, etc., we have an arrangement that has universal applications at very little additional cost.

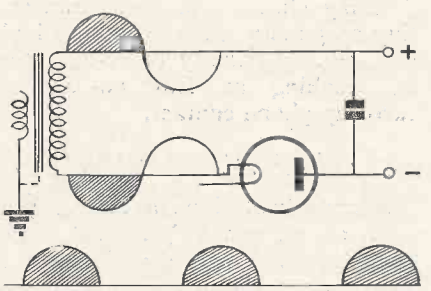


Fig. 1b. The characteristics of the circuit shown by Fig. 1a.

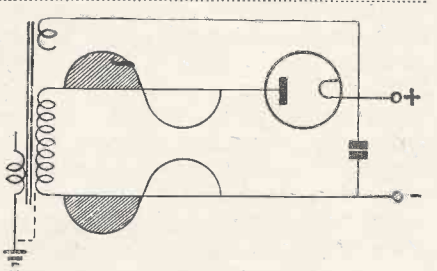


Fig. 2b. Characteristics of circuit shown in Fig 2a.

This is the scheme adopted for the power unit designed for use with the televisor described in the October and November issues. Its practical construction is fully dealt with in this issue.

Another arrangement that has much to commend it is shown by Fig. 3. This shows what is known as a "voltage doubler" rectifier.

TRANSFORMER DESIGN FOR POWER PACKS

Consider first the rectifying valve V2. When A swings negative in respect to B, V2 conducts, charging the condenser C2, the maximum voltage occurring across C2 being 1.4 × volts r.m.s. of the H.V. secondary winding.

During the following half-cycle, A swings positive with respect to B

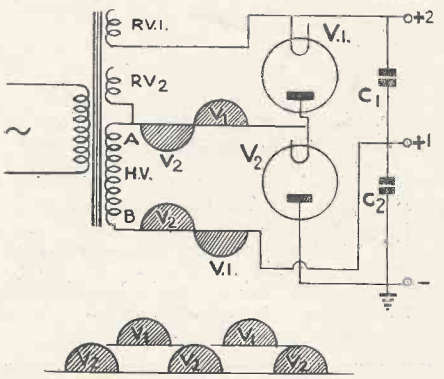


Fig. 3. Circuit of voltage-doubler rectifier.

and V1 conducts, charging the condenser C1. Again, the maximum voltage across C1 is the same as C2; that is, 1.4 × volts r.m.s. of the H.V. secondary.

C1 and C2, it is seen, are in series; the voltages across these condensers is therefore additive. Thus a maximum voltage of 2(1.4 × volts r.m.s.

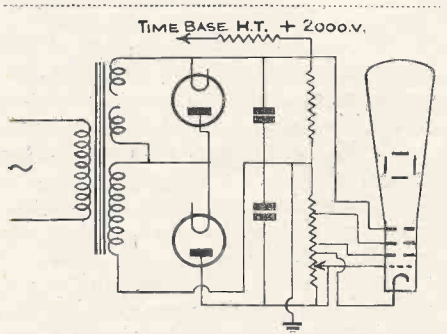


Fig. 4. Voltage-doubler circuit permitting positive earth.

sec.) occurs between +2 and negative. There is also half this voltage between positive 1 and negative.

These two voltages may very conveniently be used to furnish power for the time base and C.R. tube, thereby combining the two units into a single economical arrangement. The voltage available between negative and positive 1 will be rather higher than that required for normal operation of the time base if the total voltage is to be sufficient for satisfactory tube operation. However, this is not a disadvantage, indeed the excess voltage may be dropped across series resistances, sufficient smoothing thereby being obtained to permit omission of smoothing chokes in the time base H.T. supply thereby effecting still further economy.

Unfortunately it will be obvious that it is only possible to employ this arrangement with a negative earth, unless matters are arranged as shown by Fig. 4.

Before leaving the voltage doubler circuit let us again consider Fig. 3 and determine the degree of insulation demanded for the various transformer windings.

The H.V. secondary will only require to have a voltage output of about half that needed for the half-wave rectifier arrangements of Figs. 1 and 2. To simplify, let us assume that this will be 2,000 r.m.s. volts.

Referring to Fig. 3. It will be seen that when B swings positive in respect to A V2 conducts, charging C2. B is therefore 2,800 volts above earth. When B swings negative in respect to A, V1 conducts, charging C1 2,800 volts above C2, so that A will require insulating 5,600 volts from earth. As RV2 and A are common, RV2 will obviously require insulating for the same voltage. Similarly, the winding RV1 will require to be insulated for 5,800 volts from RV2. The maximum voltage appearing across C2 is 2,800 volts and that across C1 the same. Therefore the maximum voltage that can occur between RV1 and earth is 5,800 volts, plus the voltage drop across the rectifier that is conducting. As this voltage drop is small, it may be ignored, as has been done for the similar preceding cases.

Now throughout this reasoning we have been considering circuits with positive and negative earths and have even referred to an arrangement with an earthed centre point. It may well be asked, why not decide once and for all which pole it is better to earth and design accordingly. The fact is, however, that a certain arrangement is usually more suitable for a particular case, consequently it is desirable to design the power units with reference to the remainder of the complete vision receiver.

Fig. 5 shows an arrangement employing a D.C. feed to the C.R. tube grid, thereby retaining the D.C. component. If negative of the C. R. tube exciter volts is earthed as shown by the broken line, any variation of the brilliance control R will affect focus as the cathode is moved nearer the other tube electrodes. For this reason it is preferable to connect the negative direct to the cathode of the tube. The earth connection is then

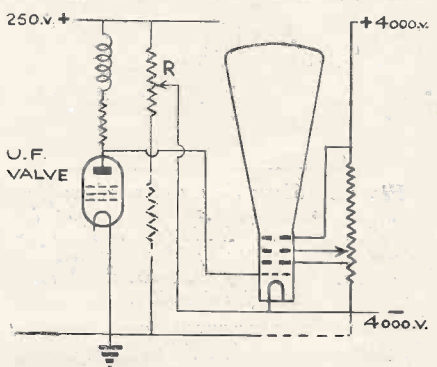


Fig. 5. Arrangement employing a D.C. feed to the cathode-ray tube grid.

completed through the lower limb of the potentiometer R. Bias for the tube is derived from the vision receiver H.T. supply. It is preferable, in order to avoid the possibility of allowing the C.R. tube grid to become positive in respect to the cathode, to include a fixed resistance in series with the potentiometer.

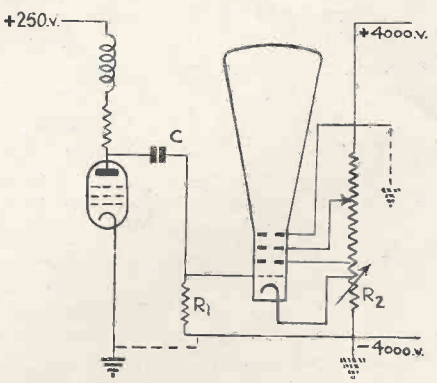


Fig. 6. Circuit allowing either positive or negative to be earthed.

It will be seen that earthing the positive pole of the C.R. tube exciter volts is not possible when using this arrangement.

Fig. 6 shows another arrangement that is extensively used. When this circuit is employed either negative or positive may be earthed. The grid of the C.R. tube is returned through the high resistance R1. Brilliance is

controllable by variation of the resistance R2. When positive is earthed with this arrangement, the condenser C will require to withstand the full tube 3rd anode voltage, and the resistance R1 is necessarily returned to the end of R2.

It is seen that due to the condenser C the D.C. component is not retained,

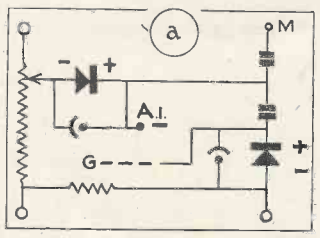


Fig. 7a. Shows the use of metal rectifiers (Westinghouse type J.25) for restoring the D.C. component. It will be noted that modulation is applied to the grid and first anode of the tube. When only grid modulation is used, a single unit suffices.

in either case, with this arrangement, and it is necessary to restore it by means of a diode or similar device (see Fig. 7).

If it were not for the desirability of connecting negative of the tube volts direct to cathode as explained above, it is possible that with a low cost design, a single power unit would satisfactorily provide all the power required for operation of the entire receiver, that is, it would furnish exciter volts for the tube, and in addition, the current for the time base and vision receiver, permitting retention of the D.C. component as well. Whether in practice this difficulty precludes such an arrangement remains to be seen.

Other factors will, of course, present difficulties. For example decoupling will require to be rather elaborate. However, the decoupling requirements for a vision receiver are not particularly stringent.

Additional to the considerations above affecting the earthing requirements of the C.R. tube supply volts, another factor requires attention. It is essential that each deflector plate of the C.R. tube be returned to the 3rd anode through a suitable value resistance (2-5 megohms). Consequently these plates will be at the same potential as the 3rd anode. If negative is earthed the condensers through which the sweep voltages are applied will require to withstand the full 3rd anode voltage; as there are four of these they represent a comparatively expensive item. Their cost is, however, partly offset by the reduced cost of the modulation feed condenser, and wholly offset by the cost of the apparatus required to reintroduce the D.C. component, if it is felt that this should be applied with the picture modulation. Recapitulating, it would seem that one arrangement is as good as another; perhaps that shown by Fig. 4 is the more economical. It thus becomes chiefly a question of individual choice and the arrangement most expedient to the remainder of the receiver design will be used.

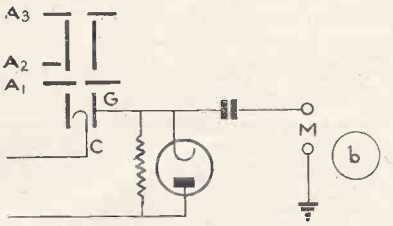


Fig. 7b. Shows a method of restoring the D.C. component by a diode valve. This diode is connected across the load resistance in the tube grid circuit and virtually rectifies the signal potential. The resistance of the load is thus reduced proportionately to the increase in video signal amplitude, thereby correspondingly increasing the picture brilliance. The heater winding of the diode will require insulating for the same amount as the modulation feed condenser.

SCOPHONY, LTD., WIN AN APPEAL

LAST June, Scophony Ltd., brought an action against Ernest H. Traub, International Television Corporation, Ltd., and I.M.K. Syndicate, Ltd., claiming an injunction restraining the three defendants from inducing Scophony's employees (three were named) to break their contracts of service or to disclose secret information regarding Scophony's business. The Judge held that Mr. Traub—one of the three defendants—had acted improperly, but his efforts were unavailing because of the loyalty of the Scophony servants, and that as there was no evidence that Mr. Traub would be any more successful in the future than he had been in the past, the Judge could not grant the injunction asked for and had no alternative but to dismiss the action with costs.

In due course Scophony, Ltd., appealed against that judgment. On October 29 last the Court of Appeal reversed the judgment of the Lower Court and gave Scophony the injunction claimed against the three defendants.

The Master of the Rolls, in his judgment, said that Scophony is a company doing research and inventive work in connection with television. The two defendant companies are interested also in television. Mr. Ernest H. Traub, the first defendant, is or was at the relevant time the responsible manager of both defendant companies. Now the work in which both the research companies are engaged is work of novelty which requires and demands a high degree of competence on the part of their employees. The three servants whose names have come into the story were under stringent service agreements prohibiting them from disclosing confidential matters, and were in possession of information, the disclosure of which to the defendants would cause the plaintiffs irreparable damage.

It appears to me, said the Master of the Rolls, that once it is established (a) that the defendants through their servant Traub have been endeavouring wrongfully to persuade employees of the plaintiffs to disclose information of a confidential nature, and (b) that the disclosure of that information will cause irreparable damage to the plaintiffs, it is not right to draw the inference that those attempts will be no more successful in the future than they have been in the past. The plaintiffs are entitled to be protected against the risk of attempts of the kind succeeding. It appears to me, said the Master, that all the essential elements are present in this case for giving the Court the duty to grant an injunction to restrain attempts of this kind.

Lord Justice Romer and Lord Justice Mackinnin agreed with the Master's judgment, Scophony's appeal being allowed with costs of the action in the first Court and of the Appeal.

Recent tests in Germany with line transmissions have enabled a distance of 350 miles to be covered, over which distance satisfactory definition was was obtained.

British research experts have now, in the laboratory, been able to demonstrate that pictures can be transmitted over 400 miles of land line with a quality picture superior to that obtained in Germany.

MARCONI-E.M.I. TELEVISION—

A YEAR'S MOST NOTABLE PROGRESS

We give below abstracts from the speech of Mr. Alfred Clark (Chairman of the Company) at the Sixth Ordinary General Meeting of Electric and Musical Industries, Ltd., on Friday, November 12, a speech which deserves permanent record as a clear and authoritative statement of the position of television to-day. All our readers will be aware that Electric and Musical Industries, Ltd., are the owners of the Marconi-E.M.I. system.

THE mobile equipment to which I referred last year as having been ordered by the B.B.C. was duly completed and delivered, and this apparatus was employed in the televising of the Coronation Procession at Hyde Park Corner, with remarkable success, in spite of most depressing weather conditions, which rendered the task so much more difficult. Television viewers were enabled to enjoy the sight of the Royal Coach with a view of their Majesties clearer perhaps than most of those who lined the route.

This portable equipment has made possible also such things as the delightful series of transmissions from the Zoo, the championship tennis matches at Wimbledon, the ambitious broadcasts from the film studios at both Pinewood and Denham, and, more recently, the successful broadcast of the Lord Mayor's Show. In some of these the link between the scene and Alexandra Palace has been by wireless transmission, while in others it has been by a special cable with its terminal equipment invented and patented by us, of which some 14 miles have been laid down connecting the West End of London with Alexandra Palace.

These broadcasts have competed in popularity with the transmissions from the studio at Alexandra Palace. From there a great many successful indoor programmes have been sent out, and they are evidence of the courage that is being shown by the earnest group of enthusiasts who are striving to create a new art in the television studio.

The Emitron Camera

Work on the Emitron camera, to which I made reference last year, has proceeded with particular success. Those cameras employed at Alexandra Palace and on the mobile van during the year have been of extreme precision and of a sensitivity sufficient to enable scenes to be picked up with less lighting than that of an ordinary film studio. They have been considered as having set a standard, and we have actually supplied the Emitron, with its equipment, which is being installed in the new high-power television transmission station at the Eiffel Tower in Paris.

A New Camera

Certain discoveries, however, by our scientists and engineers have enabled them to achieve a considerable advance on this standard Emitron camera, which will be of great importance in television broadcasting. The sensitivity of this new instrument is in the nature of approximately ten times greater than that of our standard Emitron. This means that, with this apparatus, it will be possible to televise scenes in an ordinarily lighted public theatre and out-of-doors in very unfavourable light conditions. To those of you who may be technically minded, I would add that it picks up a scene at a much wider angle than at present, and has a much greater depth of focus, so that scenes may be taken on a much wider and deeper stage. It was used for the first time to televise the Cenotaph ceremony with outstanding success.

Receiver Sales

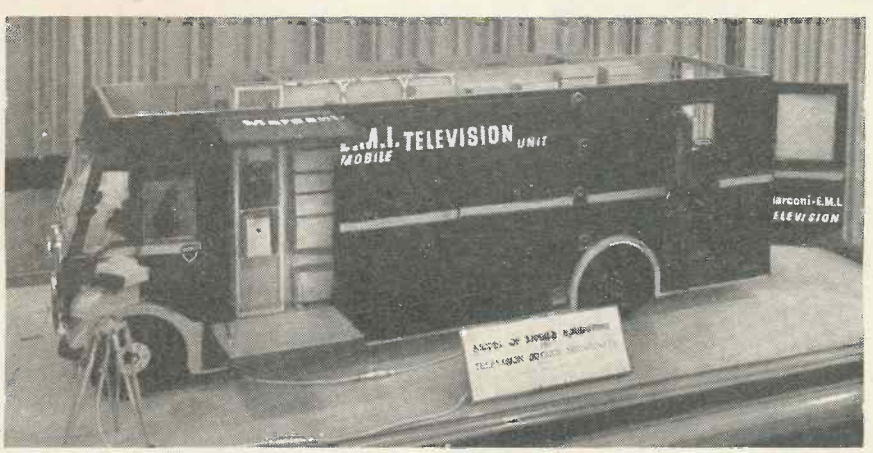
In view of this bright story of achievement you will expect to learn of large, or at least shall I say substantial, sales of television receiving sets. Frankly, sales have been disappointing, and a discussion here of the cause seems appropriate.

Price has been referred to sometimes as a deterrent to their popularity, but, on reflection, this seems an unlikely reason when one considers that the selling price of a television set to-day is comparable with that of a radio-gramophone, an instrument which has been sold in thousands at even higher prices.

There is, however, another and perhaps more convincing reason which has been advanced, and its force will be appreciated by all of those who possess television receiving sets. I refer to the large proportion of programmes which are being sent out and which have little or no entertainment value.

Programmes—Special Effort Necessary

It is within your knowledge that in this country television broadcasting may only be done by the B.B.C.—a policy with which we, of course, agree. But although we may not do it ourselves, we are deeply interested, nevertheless, in the successful carrying out of the broadcasting, for upon it depends in great measure the popularity of television and the extent of the sales of television receiving



A scale model of the Marconi-E.M.I. mobile equipment for outside television broadcasts. At the left is the Emitron camera.

THE BRITISH LEAD IN TELEVISION

sets. Are we not justified in feeling that, in the case of so wonderful an invention, a special effort should be made to see that the daily programmes are worthy of it?

Through lack of funds the installation of the studios at Alexandra Palace has been on too small a scale, and the general layout is, in no sense, commensurate with the requirements. The staff there is forced to work under the greatest difficulties, and, in view of what they have achieved, they are to be congratulated. They are not granted the financial means to enable the broadcasting to be carried out on an adequate basis.

There have been a sufficient number of splendid broadcasts to reassure anyone who has had the good fortune to see them of the high entertainment value of television. The Press is enthusiastic over the production of "Journey's End," but these successful ones have been far too few and mixed with them have been items of the utmost mediocrity due, without doubt, to a too scanty purse. As we all know, television will transmit to viewers an inferior actor or singer as accurately as a good one, and it is purely a question of expenditure of money whether first-rate artistes are employed. But unless they are it is impossible to expect much entertainment to result.

More Money Required

Television is being held back, we hope only temporarily, because of a lack of the necessary grant of funds for its exploitation. Such a grant should be sufficient to enable the B.B.C. to provide longer programmes with artists of first rank, and adequately to equip and carry on the necessary technical services in the studios.

The radio manufacturers of this country who are looking forward to the expansion of the television set market as a necessary development of their industry are fully alive to the needs I have expressed, and we hope that the Government will chose the simple expedient of an adequate grant.

We should greatly deplore the adoption by our Government in relation to television in this country of any of the methods practised abroad which involve the dependence for programmes on receipts from paid advertising.

The British Lead

It is now generally conceded by impartial observers that in television England leads the world. Engineers from all over the world, including France, Germany, and the United States, have visited us that they may learn the newest developments.

Philips' Cathode-ray Tubes

ALTHOUGH Philips' tubes are not readily available in this country we feel that the following abridged data will be of interest to experimenters if only for comparative purposes with the table of tubes printed elsewhere in this issue.

Altogether there are ten new Philips' tubes, of which six are for oscilloscope work and four primarily intended for television. Models 3951 and 3952 both have screen diameters of 160 mm., have 4-volt 1-amp. heaters and operate with a maximum 2nd anode voltage of 2,000 and require a negative grid voltage of 35. Model 3951 has a yellow-green screen and 3952 a blue-violet colour. Models 3957 and 3958 both have a screen diameter of 95 mm., and operate with 1,000 volts on the second anode, 600 on the first anode, and require a negative grid voltage of 45. Model 3957 has a yellow-green screen and 3958 a blue-violet screen.

Two other tubes, type 3971 and 3972 also have 160 mm. screens and are almost identical with models 3951 and 3952, being of a high-vacuum type with double electrostatic deflection. The tubes differ only in the fact that they have side contact bases instead of the more normal prong base, while the deflection plates instead of being taken to a contact on the bulb are connected to separate base contacts. This causes slightly higher inter-electrode capacity but has many compensating advantages.

Tube type 3962 has a screen diameter of 220 mm., and is intended for television work. It has a 4-volt 1-amp. heater, will handle a maximum second anode voltage of 6,000 and a maximum third anode voltage of 1,200, requiring a grid voltage of negative 60. It is intended for double electrostatic operation and gives a black and white picture.

A new tube is the DW31-2 of the high-vacuum type giving a black and white picture. It has two pairs of deflecting plates so disposed that the movement of the beam is in two directions at right angles to each other. Brief technical data shows that it requires 4 volts at 1-amp. on the heater, will handle 5,000 volts on the third anode, 1,700 volts on the second anode and 250 volts on the first anode. Grid cut-off voltage is negative 60.

A similar tube is the MW31-2, which is constructed for magnetic focusing and double electro-magnetic deflection. Maximum second anode voltage is 6,000, maximum first anode voltage 250, with an accompanying grid cut-off voltage of minus 60. Screen diameter is 311 mm.

The largest tube in this range is the MW39-2. It has similar characteristics to the MW31-2, but has a screen diameter of 390 mm. The maximum second anode voltage is 6,000, the maximum first anode voltage 250.

Chassis Units for the Low-cost Televisor

Although the various chasis employed for the Low-cost Televisor have been designed in order that the construction will be within the ability of the average amateur who has only a limited number of metal-working tools, no doubt there are many amateurs who prefer to obtain these units ready made. The Mervyn Sound & Vision Co., Ltd., 4 Holborn Place, London, W.C.2, can supply all the chassis units ready drilled and only requiring assembly by means of small screws and nuts.

Television Components

Readers who desire to build up the various low-priced television units described in the issues of recent months and who have difficulty in obtaining components suitable for this work, or who wish to buy the units ready for assembly, should get in touch with Messrs. H. E. Saunders & Co., of 4 Gray's Inn Road, W.C.1, who have specialised in the requirements of amateur and professional experimentors for many years. The firm is always pleased to help experimenters with practical difficulties and give advice.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

Specially Compiled for this Journal

Patentees: The British Thomson-Houston Co., Ltd., and J. Moir :: Marconi Wireless Telegraph Co., Ltd., and G. F. Brett :: Baird Television, Ltd., and J. L. Baird. :: Baird Television, Ltd., and L. R. Merdler :: Baird Television, Ltd., and D. M. Johnson :: K. H. Barbour

Regulating Picture Brightness

(Patent No. 469,813.)

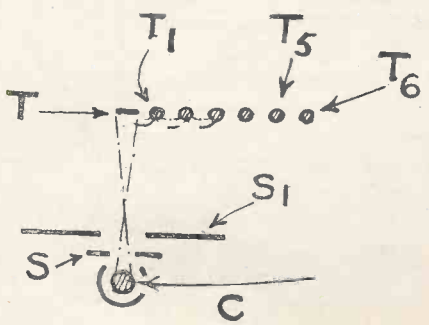
IN order to keep pace with incidental variations in the background illumination of a picture that is being televised, it is necessary to handle currents so low in frequency that they approximate to a direct-current component.

In order to preserve and amplify them, the coupling between the detector valve used at the receiving end, and a succeeding amplifier stage, is arranged so that the normal signal frequencies are transferred through a resistance-capacity combination from the anode of the detector, whilst the low frequencies, including the D.C. component mentioned, are developed across a second resistance inserted at the cathode end of the detector valve. This latter resistance is directly connected to the grid of the amplifier valve.—*The British Thomson-Houston Co., Ltd.*, and *J. Moir.*

Electron Multipliers

(Patent No. 469,900.)

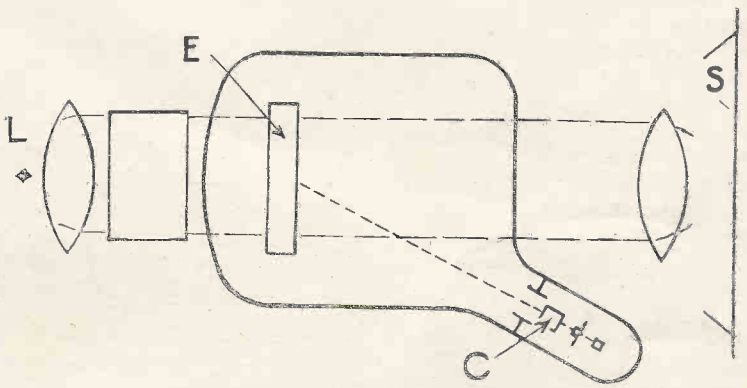
Primary electrons from a cathode C are focused by screens S, S1 on to



Electron multiplier. Patent No. 469,900.

a target electrode T, where they produce secondary electrons. These are caused to impinge, in turn, upon a series of other targets T1—T5 made in the form of stretched wires. The wires are spaced one or two millimetres apart, and are biased in an ascending order of voltage, each being ten or twenty volts more positive than its left-hand neighbour.

The output current is collected by the last wire T6, which acts as an anode. Owing to the narrow spacing between the target electrodes, no special focusing is required to ensure that the stream passes in turn, from one to the other, on its way to the output anode T6.—*Marconi's Wireless Telegraph Co., Ltd.*, and *G. F. Brett.*



Electronic light relay. Patent No. 470,347.

Scanning Systems

(Patent No. 470,347.)

The ordinary fluorescent screen of a cathode-ray television receiver is replaced by an electrode E which contains crystals of quinine sulphate in a colloidal solution. Normally the crystals are arranged higgledy-piggledy fashion, and are not transparent; but under the influence of the electron stream from the cathode C of the tube, they "set" themselves in such a way as to pass light from a lamp L on an external viewing-screen S.

The amount of light passed through the "crystal" electrode E depends upon the intensity of the electron stream, and since this is, in turn, controlled by the incoming signals, an image of the televised picture is thrown upon the screen S. The size of the received picture is thus made independent of the size of the cathode-ray tube.—*Baird Television, Ltd.*, and *J. L. Baird.*

Trapezium Distortion

(Patent No. 469,673.)

Owing to the different radial distances of the apertures in a scanning disc, and to similar effects when a mirror drum is used, the original rectangular outline of a picture is distorted into a trapezium or wedge-shaped area. This naturally causes a certain amount of distortion particularly near the margins of the screen.

The difficulty is overcome by giving the scanning aperture a real or apparent displacement during the process of scanning.

As shown in the figure the curved slots S on a scanning disc D are made to intersect with a slot S1 on a fixed mask M, and the area so formed constitutes the effective scanning aperture. The slots S are suitably curved to correct for the type of distortion in question.—*Baird Television, Ltd.*, and *J. L. Baird.*

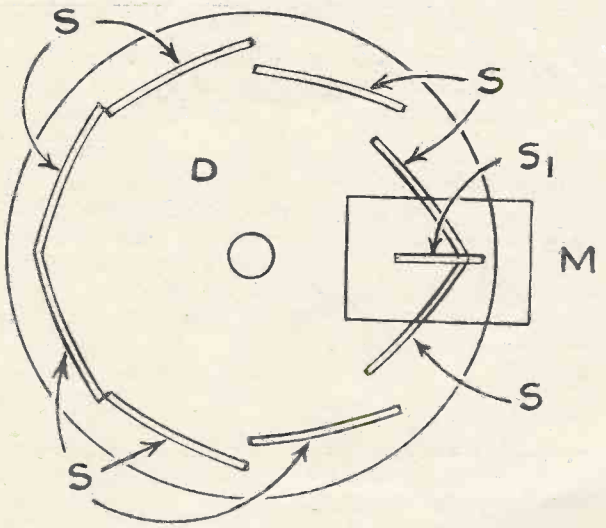
Television Receivers

(Patent No. 470,920.)

When a set is fitted with an illuminated indicator dial there is a danger that the glow from it will dis-

tract attention from the picture shown on the viewing screen.

To avoid this, the dial is located underneath the viewing screen, and the illuminated slit is set at such an angle to the cabinet that it can easily be seen by anyone operating the control knob, though it is screened from the eyes of an observer situated at the normal viewing distance from the screen.—*Baird Television, Ltd.*, and *L. R. Merdler.*



Method of preventing trapezium distortion. Patent No. 469,673.

Saw-Toothed Oscillators

(Patent No. 470,922.)

Scanning voltages for the electron stream of a cathode-ray tube are generated by a single pentode valve of which the first two grids are back-coupled. The main condenser is in the circuit of the control grid, and is charged up through a variable resistance from the H.T. source until the grid voltage rises sufficiently to set the pentode into oscillation. The oscillations last until the condenser is discharged, the frequency being stabilised by synchronising signals applied to the suppressor grid of the pentode.

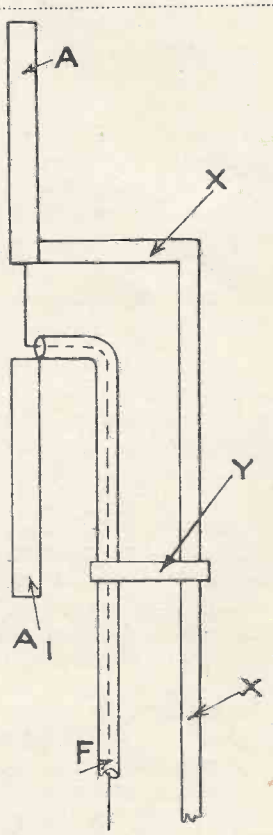
The initial timing of the scanning voltage is adjusted by varying the resistance in the charging circuit of the condenser, whilst its amplitude is controlled by a second variable resistance included between the control grid and cathode.—*Baird Television, Ltd.*, and *D. M. Johnstone.*

Television Aerials

(Patent No. 471,434))

Because of its exposed and elevated position, the dipole type of aerial used for receiving television is rather more open to danger from lightning than the ordinary horizontal type of broadcast aerial.

As shown in the drawing the two quarter-wave limbs A, A1 of the aerial are connected to the receiving set by a coaxial feed-line F, the outer sheath of which is connected to the lower limb, and the centre wire to the upper limb, as shown. The feed line is bent away at right-angles, for a short distance from the point of connection to the aerial limbs.



Television aerial. Patent No. 471,434.

A lightning-protector x is connected to the lower end of the limb A and is similarly bent out at right-angles to it so that it lies parallel to the feed-line. The lower end of the protector is, of course, earthed, but a bridge-piece Y is connected at such a distance that the two conductors form a rejector circuit of the Lecher wire type. This prevents the signal currents from being led away to earth.—*K. H. Barbour.*

Summary of Other Television Patents

(Patent No. 469,823.)

Method of making the mosaic-cell screens used in cathode-ray television transmitters.—*H. E. Holman.*

(Patent No. 469,907.)

Cathode-ray television receiver utilising the "afterglow" effect.—*E. Michaelis.*

(Patent No. 470,496.)

Method of concentrating the electron stream in a cathode-ray television receiver.—*Radio-Akt. D. S. Loewe.*

(Patent No. 470,729.)

Coupling circuits for an amplifier intended to handle a wide band of frequencies, such as are used in television.—*Telefon-Akt. L. M. Ericsson.*

(Patent No. 470,752.)

Generating saw-toothed oscillations for scanning by means of a back-coupled valve of the multi-grid type.—*Telefunken Ges. für drahtlose Telegraphie m.b.H.*

(Patent No. 470,785.)

Method of cutting out disturbing effects produced during the "fly-back" scanning movement in an electron camera.—*Baird Television, Ltd.*, and *V. A. Jones.*

(Patent No. 470,885.)

Cathode-ray television receiver in which the glass contour is designed to prevent optical distortion.—*Corning Glass Works.*

(Patent No. 470,921.)

Method of winding and mounting a resistance wire for handling currents of the order of 50 megacycles.—*Baird Television, Ltd.*, and *L. R. Merdler.*

(Patent No. 471,066.)

Scanning system utilising a light cell which is also subjected to transverse waves of supersonic frequency.—*Scophony, Ltd.*, and *G. Wikkenhauser.*

THE TUBE OF MANY USES

In this article G. Parr outlines the numerous applications of the cathode-ray tube apart from television reception and shows how it is one of the most useful aids in modern research.

THE uses of the cathode-ray tube are so many and so varied that it is now almost indispensable to the research engineer. It enables

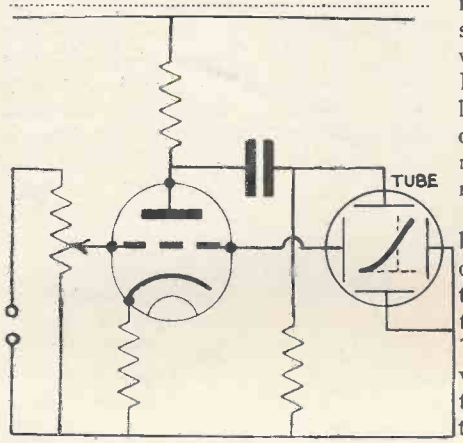


Fig. 1. Theoretical circuit for recording valve characteristic curves by a cathode-ray tube.

him to observe accurately phenomena varying at rates from several seconds to less than a millionth of a second, to record minute variations between two standards, to speed up production testing, and to do a host of other things which would formerly have required more elaborate and expensive apparatus.

Apart from radio there are uses for the tube in heavy engineering, motor engineering, physics, biology—in fact there is hardly a branch of

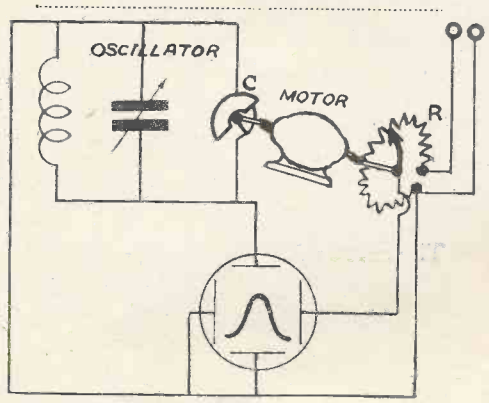


Fig. 2. How a response curve can be drawn on the screen. The resistance R is moved synchronously with the trimmer C.

science in which it cannot be found of use.

To appreciate the wide field of application it must be understood that the cathode-ray tube is fundamentally a sensitive indicating instrument which is independent of frequency and which has no inertia—that is, it responds instantaneously to the slightest variation in the potential which is applied to its deflector plates. If the variation is too rapid to be followed by the eye a special compound on the fluorescent screen enables the movement of the beam to leave a mark which can be studied at leisure.

The power required to deflect the beam is negligible and hence the tube can be connected to circuits in which the presence of a load would upset the constants or affect the tuning. This, however, does not apply to very high frequency circuits in which the capacity of the deflector plates themselves is comparable with the capacities employed in the circuit.

The electrostatic deflecting system makes the tube a voltmeter, the deflection of the beam in either plane being directly proportional to the potential difference between the plates. Thus it can be made to indicate the peak value of the voltage in any circuit, the distance moved by the spot on the screen being calibrated by reference to a D.C. supply. The tube can then be used to show curves in which the vertical and horizontal scales are in terms of volts. If, as is more usual, one scale is to be in values of current, the deflecting voltage can be obtained across a resistance in the circuit and the scale converted to current by an appropriate factor.

For example, in investigating the characteristics of a rectifier circuit the horizontal plates can be connected across a portion of the load resistance, the resulting deflection being proportional to the load current if the resistance remains constant.

The dynamic characteristics of a valve can be shown on the screen by the circuit of Fig. 1. The grid voltage input is applied to the horizontal plates of the tube, amplified if necessary by means of a transformer, while the vertical plates are connected across the output of the anode circuit. The variation of input and output can then be observed by altering the swing applied to the grid.

In radio circuits it is frequently required to know the frequency response of tuning units, the voltage developed across the coil being plotted against frequency. This can be done by the cathode-ray tube if a relation between voltage and frequency can be obtained for the horizontal scale. The simplest method of doing this is by means of a condenser and resistance mounted on a common shaft. The condenser forms part of an oscillator circuit which is connected to the tuning circuit under test and the resistance is connected to the deflector plates of the tube (Fig. 2).

For each position of the condenser vane a known potential is applied to the plates from the moving arm of the resistance, and the horizontal

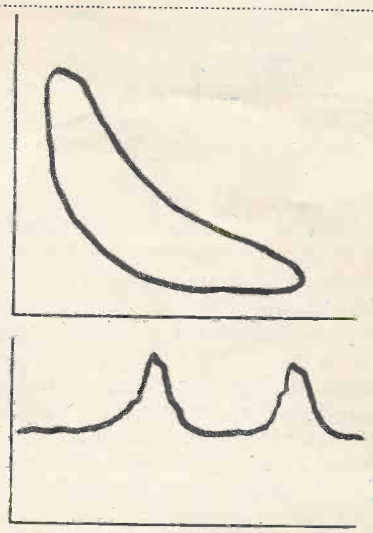


Fig 3. An indicator diagram of an engine (top) and a curve of explosion pressure (below).

movement of the beam is thus proportional to the position of the condenser and to the frequency of the oscillator. This simple method has been developed into a precision instrument in which the frequency of the oscillator is varied several times a second within definite limits, the frequency response curve being drawn on the screen each time to present a continuous curve which can be accurately scaled.

When a linear time base is connected to the horizontal deflector plates the variations of potential from any source can be studied in relation to time. These variations may be of two kinds—recurring or non-recur-

ring. An example of the former is the familiar audio frequency waveform which appears stationary on the screen if the time-base is synchronised to the frequency of the input. Non-recurrent waves such as those of the spark occurring between points or transient impulses on power lines are observed with a time base giving a single sweep across the screen, the commencement of the sweep being

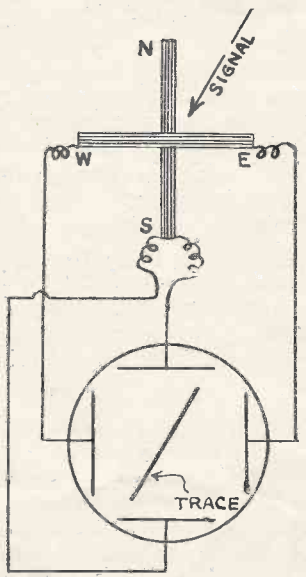


Fig. 4. Diagram to explain the use of the tube as a direction finder.

synchronised with the occurrence of the transient. It is in these cases that the recording camera is of use, the spot being focused on to a strip of moving film or bromide paper. In such an arrangement the time base is, of course, unnecessary, the movement of the film providing the necessary time scale.

Engineering Uses

In mechanical and motor engineering the tube has been used to reproduce the conditions existing in a cylinder of an internal combustion engine when the mixture is fired. The pressure developed by the exploding gases is converted into potential difference by using a piezo-electric crystal or other arrangement for converting mechanical movement into electrical pressure. The curve on the screen can be made to show the variation of explosion pressure with time in a similar manner to waveform reproduction, or the tube can be made to show the "indicator diagram" of the engine. In this, the vertical scale is proportional to pressure and the horizontal scale is proportional to the displacement of the piston in the cylinder. To obtain the latter scale the deflector plate potential is obtained from the movement of the crankshaft (Fig. 3).

In one form of engine indicator developed by the Cossor Co. the horizontal timing was developed from a cam attached to the shaft which was cut so as to vary an aperture between a beam of light and a photo-cell. The light falling on the cell was thus proportional to the movement of the shaft, which is in turn proportional to the piston displacement, and after amplification the cell output was used to provide the horizontal deflecting potential.

Another ingenious use of the photo-cell and the cathode-ray tube is in the recording of the light emitted from a lamp in various directions, obtaining the so-called "polar curve." In a method developed at the Brighton Technical College the light from the lamp is reflected into a photo-cell by a system of rotating mirrors. The spot is caused to rotate on the screen of the tube in synchronism with the movement of the mirrors and the variations of light intensity round the lamp are reproduced as indentations in the circular trace on the screen.

Direction Finding

Apart from industry, one of the most useful applications of the tube has been in direction finding and in the "radio-beacon"—the device which enables ships and aircraft to be steered on any course even though the visibility is obscured by fog. The theory of the tube direction finder is simple, depending on the fact that the movement of the beam is controlled by two deflecting forces at right-angles. If we imagine the plates of the tube to be connected to two frame aerials, as shown in Fig. 4, the voltage developed across each frame will depend on the angle at which the incoming signal arrives. The voltage is applied to the deflector plates through an amplifier and will thus be proportional to the strength of the input signal. The beam will accordingly be deflected into a position on the screen dependent on the relative strengths of the deflecting forces and the angle which the trace makes on the screen will indicate exactly the direction from which the signal is arriving.

A great deal of research has been done with direction-finding apparatus in the investigation of atmospherics. The movement of the spot on the screen responds instantaneously to the arrival of an atmospheric disturbance and indicates from whence it came.

Medical Uses

In the medical field the cathode-ray tube has helped to diagnose disease and to keep a check on the efficacy of the treatment to be followed. It has been known for many years that nervous and muscular actions were accompanied by electrical impulses transmitted along the nerves, but their detection has been

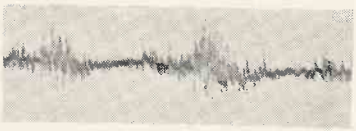


Fig. 5. Typical tracing obtained from the electrical impulses of a nerve.

difficult owing to their very low value (some tens of microvolts) and the difficulty of amplifying and recording them.

With modern amplifying valves it is possible to obtain a magnification of several million and the output is then applied to the deflector plates of the tube.

For recording the electrical impulses developed by the heart, electrodes are strapped to the arm and leg and the wave observed with a linear time scale of slow speed. The average heart beat occupies 0.8 second and to enable this to be observed easily a slow-running time base is used with a screen having a long afterglow. The cardiogram then leaves a trace on the screen lasting several seconds, enabling it to be observed at leisure. If a film is used to obtain a photographic record the progress of disease can be studied and the effect of various stimulants on the heart's action.

The curve of Fig. 5 shows a typical tracing obtained on the screen from the electrical impulses in a nerve. The rhythmic nature of the bursts of impulses corresponds to the respiration.

It is not generally known that a sensitive cathode-ray tube can be used as a compass without any extraneous attachment!

If the tube is unshielded the beam is affected by the earth's magnetic field and hence will move according to the direction of the lines of force.

CATHODE-RAY TUBE TERMINOLOGY

Apparent Line Width: The apparent line width (the visible or recorded width of the moving spot) can be different from the apparent spot size of the stationary spot because screen luminescence is dependent upon the duration of excitation.

Apparent Spot Size: When the spot size is measured visually or from a photographic record, the resultant spot size is not necessarily the true spot size; therefore, the terms " apparent spot size " or " apparent spot diameter " should be used in such cases.

Beam Current: The current in the electron beam at the screen, usually measured in microamperes.

Beam Voltage: The instantaneous voltage of the electron beam at any point; usually referred to as the voltage of the beam at the point of deflection, where the beam voltage is substantially the same as the second anode voltage.

Candle Power-Distribution Characteristic: This characteristic shows how the candle power of a luminescent screen varies when the screen is viewed at different angles. When plotted it is invariably represented by a polar curve illustrating the luminous intensity of a cathode-ray tube in a plane of the tube axis and with the screen at the origin.

Deflection Sensitivity (Electrostatic): The ratio of the distance which the electron beam moves across the screen to the change in potential difference between the deflection plates; this is usually expressed in millimetres per volt. The sensitivity varies inversely with the beam voltage at the point of deflection.

Deflection Sensitivity (Magnetic): The ratio of the distance which the electron beam moves across the screen to the change in the flux density producing the motion. The sensitivity may be expressed in millimetres per gauss, but due to the difculty in the determination of flux density, it is often more practical to express the sensitivity in millimetres per ampere-turn, or simply in millimetres per ampere. It varies inversely as the square root of the beam voltage at the point of deflection.

Defocused: A term used to describe a spot which is not optimum with respect to shape and size.

* This term is more often used in U.S. than in this country.

The following list of definitions are accepted in both this country (with slight modifications) and in America. The full list of British definitions in cathode-ray tube practice will be found in the B.S.I. Glossary of terms used in Electrical Engineering.

Efficiency, Gun-current: The ratio of the beam current to the current which leaves the cathode. This ratio, multiplied by 100, gives the gun-current efficiency in per cent.

Efficiency, Screen Actinic: The measure of the ability of a viewing screen to convert the electrical energy of the electron beam to radiation which affects a certain photographic surface. This term should be expressed in microwatts per watt, but is often expressed for ease of measurement in terms of actinic power per watt relative to a screen of well-known characteristics.

Efficiency, Screen Luminous: The measure of the ability of a viewing screen to produce visible radiation from the electrical energy of the electron beam. The efficiency should be measured in lumens per watt. For convenience of measurement, however, it is usually expressed in candle power per watt, because candle power is a measure of the luminous flux per unit solid angle in a given direction and can be converted to lumens where the candle power-distribution characteristic of the screen is known. It is the usual practice to measure candle power in the direction normal to the screen.

Efficiency, Screen Radiant: The measure of the ability of a viewing screen to produce luminescence from the electrical energy of the electron beam. The efficiency should be expressed in microwatts per watt, but due to the difficulty of making absolute measurements is more often expressed in radiant energy per watt relative to some screen of well-known characteristics.

Fluorescence: The luminescence emitted by a phosphor* during excitation. As applied to a cathode-ray tube, this term refers to the radiation emitted by the viewing screen during the period of beam excitation.

Line Width: The true width of the moving spot measured at right-angles to its direction of motion.

Luminescence: The term describing all forms of visible and heat-visible radiation which depart widely from the black-body radiation law. It can be divided according to the means of excitation into many classes, such as: candoluminescence—the luminescence of incandescent solids; photoluminescence—the luminescence created by exposure to radiation; chemi-luminescence—the luminescence created by chemical reactions; electro-luminescence—the luminescence given off by ionised gas; bio-luminescence—the luminescence emitted by living organisms; tribo-luminescence—the luminescence created by the disruption of crystals; crystallo-luminescence—the luminescence excited by emissions from radioactive materials; galvano-luminescence—the luminescence phenomena observed at electrodes during some electrolysis; cathode-luminescence—the luminescence produced by the impact of electrons, etc. In cathode-ray tubes, cathode-luminescence is principally involved; therefore, the luminescence of the screen is that radiation which is produced by the impact of the electron beam.

Luminescent Spot: The spot formed on the screen of a cathode-ray tube at the impact point of the focused electron beam.

Pattern Distortion: When the electron beam is moved by changing fields, a pattern is formed on the screen; the waveform of the spot movement will be identical with the resultant waveforms of the electrical phenomena producing these fields unless there is pattern distortion present. This distortion takes many forms, such as: amplitude, frequency, phase, brightness, persistence, spot size, etc.

Persistence Characteristic: The relation showing the brilliance of light emitted by a cathode-ray tube screen as a function of time after excitation. This characteristic is generally shown in a curve where relative brilliance as the ordinate is plotted on a logarithmic scale against time on a linear scale. " Relative brilliance " is used to denote luminous intensity per unit area evaluated in arbitrary units.

Phosphor: The solid material in the screen which produces luminescence when excited by the electron beam.

Phosphorescence: The luminescence emitted after excitation. As applied to a cathode-ray tube, this

(*Continued on page 765*)

CATHODE-RAY TUBE CHARACTE

References.	SIZE. Screen Dia. Approx.	MAKE	Type No.	Screen Colour.	Length m.m.		Heater Characteristics. Volts.	Heater Characteristics. Amps.	Max. Voltage. 3rd Anode.	Max. Voltage. 2nd Anode.
	1-INCH ..	R.C.A.	913	Green.	139	H.V.	6·3	0·9		
	2-INCH ..	COSSOR.	3277	Blue.	467	H.V.	0·6	1·25	3,000	600
		DUMONT.	24-XH	Green.	192	H.V.	6·3	0·6		600
	3-INCH ..	Marconiphone.	4/1	Green.	410	H.V.	4	1.3		1,000
		MULLARD.	E40-G3	Green.	165	H.V.	4	1		800
*		R.C.A.	906	Green.	292	H.V.	2·5	2·1		1,200
†		R.C.A.	906	Blue.	202	H.V.	2·5	2·1		1,200
		STANDARD.	4096AB	Blue.	260	H.V.	2	1·65		2,000
	4-INCH ..	COSSOR.	3237	Blue.	345	Gas.	0·6	1·25	1,500	
		MULLARD.	A41-G4	Green.	349	H.V.	4	1.2		1,200
‡		STANDARD.	4050AG	Green.	330	Gas.	0·5	0·9		
	5-INCH ..	COSSOR.	3273	Blue.	417	H.V.	0·6	1·25	10,000	2,000
		,,	3232	Blue.	401	Gas.	0·6	1·25	1,500	
		,,	3278	Blue.	490	H.V.	0·6	1·25	10,000	2,000
		,,	3236	Green.	409	Gas.	0·6	1·25	1,500	
§		EDISWAN.	5H	White.	450	H.V.	2	1·5		3,500
¶		R.C.A.	1801	Yellow.		H.V.	2.5	2.1		3,000
		,,	904	Green.	407	H.V.	2·5	2·1		4,600
		,,	905	Green.	414	H.V.	2·5	2·1		2,000
	6-INCH ..	COSSOR.	3276	White.	407	H.V.	0·6	1·25	3,000	600
++		MULLARD.	E42-G6	Green.	450	H.V.	4	1		2,000
++		STANDARD.	4063AW	White.	535	H.V.	2	1.85	6,000	1,800
§	7-INCH ..	EDISWAN.	7H	White.	510	H.V.	2	1·5	6,000	1,200
		STANDARD.	4050BG	Green.	460	Gas.	0·5	0·9		
	9-INCH ..	EDISWAN.	9MH	White.	528	H.V.	2	1·5		
		Marconiphone.	6/5	White.	570	H.V.	4	1·3		6,000
		R.C.A.	903	Green.	518	H.V.	2·5	2·1		7,000
		,,	1800	Yellow.	518	H.V.	2·5	2·1		7,000
	10-INCH ..	EDISWAN.	10H	White.	560	H.V.	2	1·5	6,000	
		FERRANTI.	T10	White.	610	H.V.	2	1·5		
++		MULLARD.	E46-G10	Green.	580	H.V.	4	1	5,000	1,700
		STANDARD.	4095AW	White.		H.V.	2	2	5,000	1,700
		COSSOR.	3241	White.	580	H.V.	4	0·9	5,000	1,000
	12-INCH ..	BAIRD.	12MW1	White.	570	H.V.	2·2	2·5		
		COSSOR.	3242	White.	670	H.V'	4	0·9	5,000	1,000
		,,	3272	White.	655	H.V.	0·6	1·25	5,000	650
		EDISWAN.	12H	White.	660	H.V.	2	1·5	6,000	1,200
		,,	12MH	White.	700	H.V.	2	1·5		
		FERRANTI.	T12	White.	610	H.V.	2	1·5		
		MULLARD.	E46-12	White.	660	H.V.	4	1	5,000	1,700
		,,	M46-12	White.	680	H.V.	4	1·2		6,000
**		Marconiphone.	6/6	White.	697	H.V.	4	1·3		6,000
	15-INCH ..	BAIRD.	15/MW2	White.	850	H.V.	2·2	2·5		
		FERRANTI.	T15	White.	700	H.V.	2	1·5		
		MULLARD.	E46-15	White.	680	H.V.	4	1	5,000	1,700
		,,	M46-15	White.	750	H.V.	4	1·2	6,000	

* Long-persistence. † Short-persistence. ‡ Also in blue. § Also in blue and green.

BAIRD CATHOV

As Baird cathode-ray tubes are entirely electro-magnetic here are given the sensitivity figures together with the peak to peak volts for their 12 and 15-in. tubes.

ERISTICS OPERATING DATA ON OSCILLOGRAPH AND TELEVISION TUBES AVAILABLE IN GREAT BRITAIN

	Max. Voltage. 1st Anode.	Beam Cut-off Voltage.	Operating Characteristics. 3rd Anode Voltage.	2nd Anode Voltage.	1st Anode Voltage.	Def-Sensitivity. X1 and X2 mm/V.	Def-Sensitivity. Y3 and Y4 mm/V.	Modulator Earth Capacity. uuF.	Def. Plate Capacity. CD_1D_1' uuF.	Def. Plate Capacity. CD_2D_2' uuF.	PRICE.
	500										1 17 6
0	250	—250	3,000	600	250	0·12	0·12	10	11	11	8 8 0
0	300	—60		500	100	0·17	0·19				
0	200	—12		800	160	0·6	0·55				6 6 0
0	300	—30		800	200	0·19	0·12	6·7	2·9	3·7	3 10 0
0	400	—60		1,200	345	0·27	0·29				
0	400	—60		1,000	285	0·33	0·35				
0	400	—40		800-2,000		380/V	360/V	18	2·2	3.3	
		—150	600			0·5	0.4	9	5	5	5 10 0
0	500	—45		1,000	400	0.39	0·28	6.5	4.5	5.5	6 15 0
	2,000	+15			350	260/V	260/V		3·2	3	5 5 0
0	300	—350	10,000	2,000	300	0·075		4·5	0·7		12 12 0
		—150	1,000			0·375	0·25	9	5	5	7 10 0
0	300	—300	10,000			0·09	0·09	4·5	0·7	0·7	14 14 0
		—150	1,000			0·375	0·25	9	5	5	7 10 0
0	400	—60		800	400	0·45	0·45				8 8 0
0	1,000			3,000	1,000						
0	1,500	—140		4,600	970	0·07		10			
0	600	—60		2,000	450	0·19	0·23	10	3	1·5	
0	250	—200	3,000	600	250	0·13	0·12	10	11	11	8 8 0
0	600	—35		2,000	400	0·32	0·26	12	6	7	8 8 0
0	250	—25	5,000	1,350	150	650/V	650/V	15	5	3·5	8 10 0
0	400	—60	3,500	1,200	250	0·12	0·12				10 10 0
	2,000	+15			350	440/V	440/V		3.2	3	6 10 0
	6,000	—30-60			4,500						9 9 0
0	1,000	—20		4,000	800						11 11 0
0	2,000	—120		7,000	1,360			12			
0	2,000			7,000	2,000						
		—100 to 250	4,000	1,200	400	0·12	0·12	15	15	15	12 0 0
	5,000	—50			4,000						
0	250	—60	5,000	800	250	0·12	0·11	15	5·5	6·5	12 12 0
0	250	—30				0·85					
0		—330	5,000	1,000		0·096	0·095	14	11	11	12 12 0
		—18			4900						
0		—330	5,000	1,000		0·12	0.12	4·5 14	11	11	12 12 0 15 15 0
0	250	—250	5,000	650	250	0·16	0.15	10	11	11	15 15 0
0	400	—60	5,000								
			4,000	1,200	250	0·17	0·17	15	15	15	15 15 0
	6,000	—30 to 60			5,000						13 13 0
	5,000	—50			4,000						
0	250	—60	5,000	1,400	250	0·17	0·13	15	5·5	6·5	15 15 0
0	250	—60		5,000	250			6·0			12 12 0
0	1,000	—20		4,000	800						15 15 0
		—20			6,500			2			15 15 0
	5,000	—50			4,000						
0	250	—60	5,000	1,400	250	0·15	0·13	15	5	4	21 0 0
	250	—60		5,000	250			6·0			15 15 0

green. || Magnetic. ¶ Combination of electrostatic and magnetic. ** Also green.

HOVISOR TUBES.

	Electro-magnetic sensitivity	Peak to peak volts
Type 12 M.W.1	2 m.m./A.T.	14
„ 15 M.W.2	2 m.m./A.T.	16.5

Telegossip

By Lumen

An Outsider's Impressions

RECENTLY I had a long chat with Mr. Imago Gomez, Director of *Radio Revista* and *Ciencia Pouplar,* two well-known South American journals. Mr. Gomez has been touring Europe and the United States for the express purpose of studying the television situation in different countries at first hand. His impressions, as an outside observer, therefore, are of value and interest. He was greatly impressed by the state of development that had been reached in this country and he contended that we were far ahead of anything which he had seen elsewhere either in Europe or America.

On the Continent

In Germany there was considerable reluctance on the part of the concerns engaged in television development to give any demonstrations and when eventually they were prevailed upon to do so the demonstrations were under laboratory conditions and the results were comparatively poor. He formed the opinion that although the scanning frequency (441 lines) was higher than we have here there was such considerable loss in various directions that the picture detail was only equal to 180 lines. In the course of his tour of these concerns, which included Fernseh and Telefunken, there was a great amount of secrecy and officialdom and he was invariably accompanied by officials who kept a very watchful eye upon him. Of course, the Germans may have more up their sleeves than they were prepared to show Mr. Gomez, but he came away with the idea that what has been accomplished in Germany has been staged for propaganda purposes and that the Germans are a long way from any real practical development. It is an interesting point that this impression obtained at the time of the Berlin Exhibition. Estimates of receiver costs, such as he saw, were round about £80.

In Paris he was also disappointed with the results that are being obtained though the system now being used is very similar to our own—that is Iconoscope cameras are being used though there is a difference in the synchronising method which does not appear very satisfactory. Until recently the new Eiffel Tower transmitter has been operating experimentally on a power of three kilowatts, which has lately been increased to five. Synchronising, even at short distances—that is, three or four miles—is unstable and picture quality is poor. The impression was formed that the French engineers are as yet lacking in practical experience in receiver design and in some of the fundamentals of transmission.

Developments in America, he thinks, have reached a more advanced stage than either in Germany or France, but here again all demonstrations were under laboratory conditions, and American methods as used up to the present are not so good as ours, a point which is borne out by the report of American engineers on the British system, which appears on another page of this issue. Allowance must, of course, be made for the fact that there is no regular schedule operating in these countries and that in some cases the demonstrations were purposely arranged, but even so, Mr. Gomez is of the opinion that we in this country have obtained a very substantial lead.

British Television

On another page in this issue is a report from two American engineers who have investigated British television at close quarters and have some very complimentary things to say about it. Certainly it is difficult to understand why the American systems are not unanimously in favour (or favor) of D.C. working seeing that it is so successful. When Dr. P. C. Goldmark, of the Columbia Broadcasting system, was over here he was very much impressed by the B.B.C. transmitter, and it is probable that his recommendations will be based on what he has seen. One of his assistants is Mr. J. C. Wilson, late of Baird and Ferranti, whose book has recently been published. Dr. Goldmark did a lot of work on an optical television system of his own invention at one time, but no doubt it has been temporarily displaced by the cathode-ray tube.

"Televisione"

A new journal has made its appearance in Italy with the above title containing articles in French, German and English, besides Italian. von Ardenne has contributed an article to the first issue on the possibilities of utilising ultra-short waves, and points out that seven years ago he proposed to transmit simultaneously on the same short-wave carrier several other carrier frequencies modulated with different acoustic frequencies.

This scheme was not pursued at the time owing to lack of experience of ultra-short wave technique, but it is worth development in the light of modern research experience.

With a slight knowledge of French and Latin it is quite easy to get the gist of the Italian articles, and one giving the Italian equivalents of British and American television terms is worth quoting:

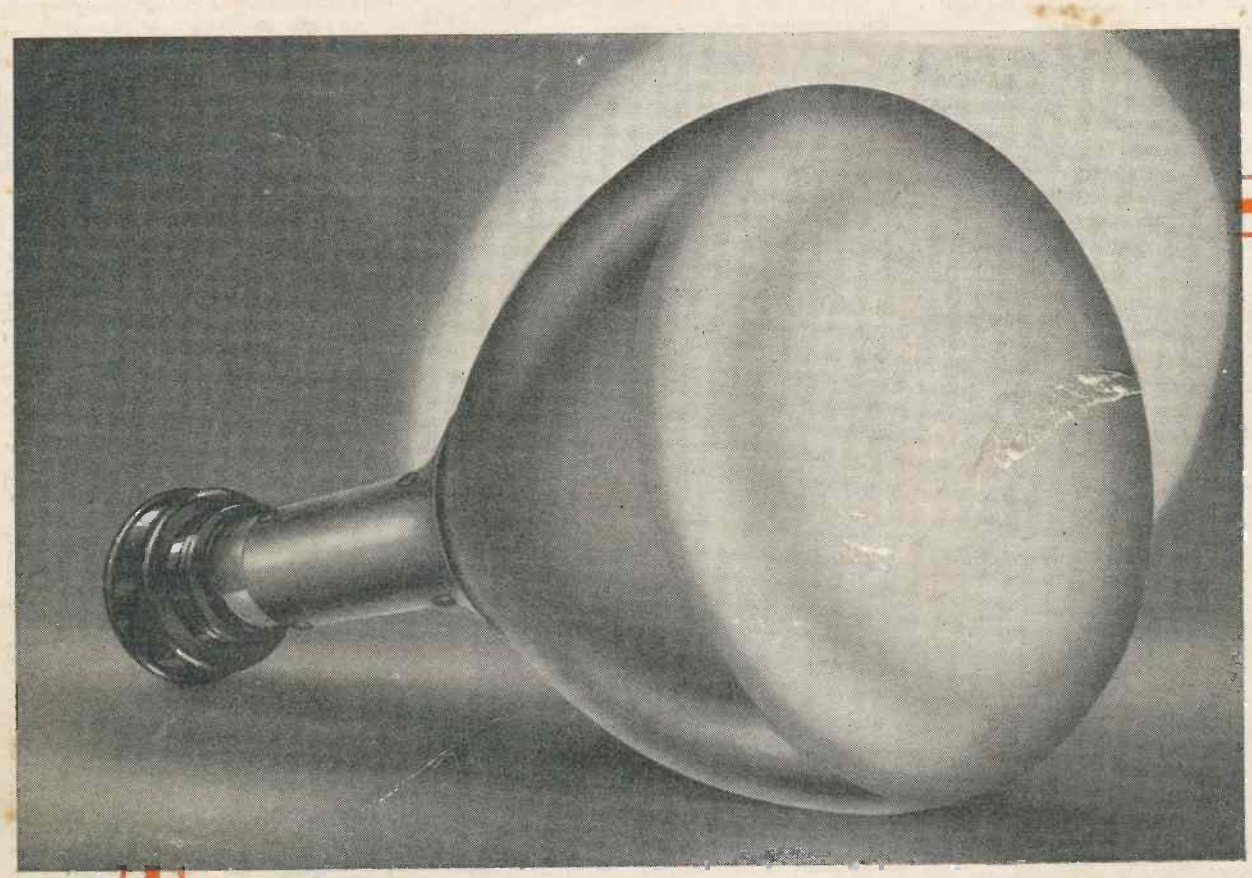
"Pairing-off"—espressione usata per indicare il difetto che si verificata quando nell'analisis alternata, le linee non sosono egualmente distanziate.

"Retrace Time" (Flyback)—tempo che passa tra la fin di un'analisi verticale e l'inizio della successiva ovvero fra la fine dell'analisi di una linea e l'inizio della successiva.

Pretty, isn't it?

Technical Hitch

What a pity the B.B.C. should have had one of their rare technical hitches on the night of Messrs. Jesty and Winch's paper to the Television Society. They were just demonstrating the effect of an illuminated surround on the tube screen when one of those depressing blanks occurred accompanied by gramophone records. It is quite a long time since the B.B.C. have had a hitch, so we cannot grumble. One happened to synchronise with a visit of members of the Women's Electrical Association to the works of one of the cathode-ray tube manufacturers, and after a long and careful explanation of the marvels of television they were rewarded with the spectacle of a blank screen



The NEW

COSSOR

TELEVISION CATHODE RAY TUBE

The Illustration *shows the 3241 K.S. tube fitted with a mu-metal screen which obviates interference from external fields.*

THE acknowledged fineness of trace obtainable with Cossor Cathode Ray tubes has been obtained by the use of a remarkably small cathode. This feature is retained in the new tube by the adoption of a more robust indirectly heated cathode construction.

In incorporating the modifications entailed in the electron optics of the earlier part of the electrode system other advantages have been introduced which are of particular value in Television. A considerably improved modulation characteristic and sensitivity are secured, in addition an uniform distribution of the light spot has been obtained, thus the lines of the Television picture appear less obvious with a marked improvement in picture detail and contrast.

TYPE 3241 K.

Giving a black and white picture of great brilliance.
Picture size, 8" x 6½"

PRICE £12.12.0

Type 3241 K.S. fitted with Mu-Metal shield against external fields 25/- extra.

Indirectly heated Cathode	4v. 0.9 amp.
Max. anode voltage	5000
Bulb diameter (overall)	295 mm.
Screen diam.	280 mm.
Tube length (overall)	580 mm.
Standard 12 contact Television Tube base.	

Full details of this tube and the full Cossor Range will be sent on application to Instrument Dept.

A. C. COSSOR LTD., HIGHBURY GROVE, LONDON, N.5

CA 3513

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