TELEVISION RECEIVERS THAT YOU CAN BUY—SEE PAGE 630

Television and SHORT-WAVE WORLD

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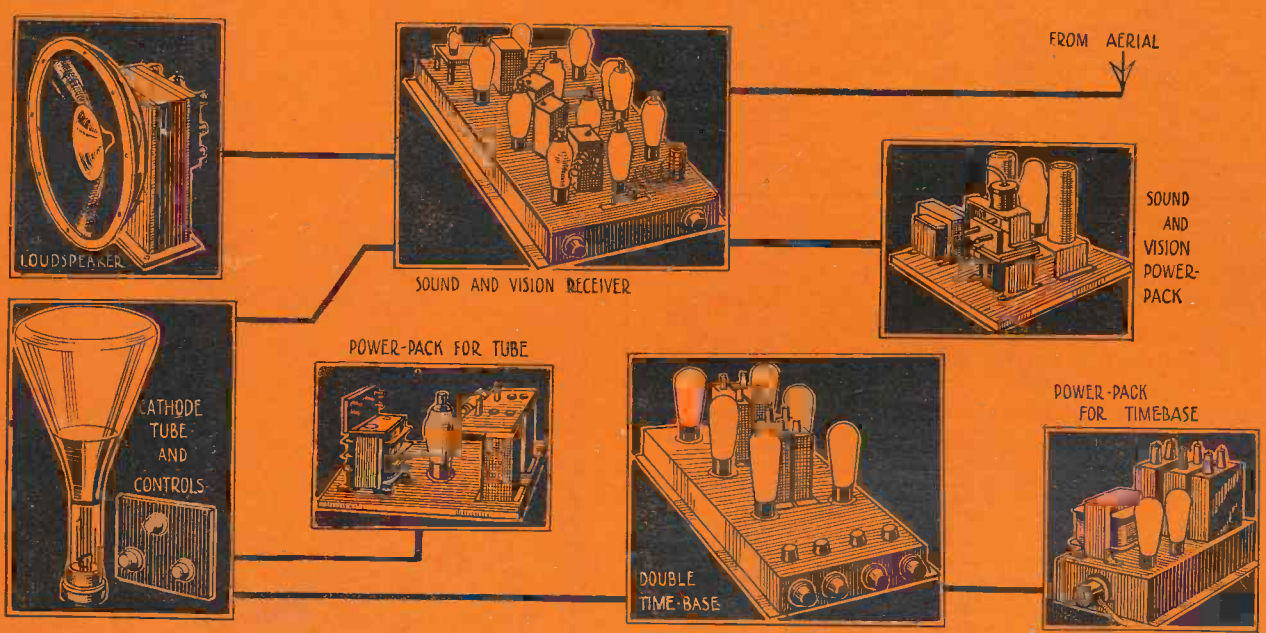

PICTORIAL SCHEME *OF OUR* GUARANTEED VISION RECEIVER

" How to Build " Constructional Article in this Issue

FIRST TELEVISION RECEIVER FOR HOME CONSTRUCTORS

BERNARD JONES PUBLICATIONS LTD.
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THE FIRST TELEVISION JOURNAL IN THE WORLD

No. 105 VOL. IX NOVEMBER, 1936.

TELEVISION and SHORT-WAVE WORLD

Special Features

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COMMENT OF THE MONTH

Television is Here to Stay

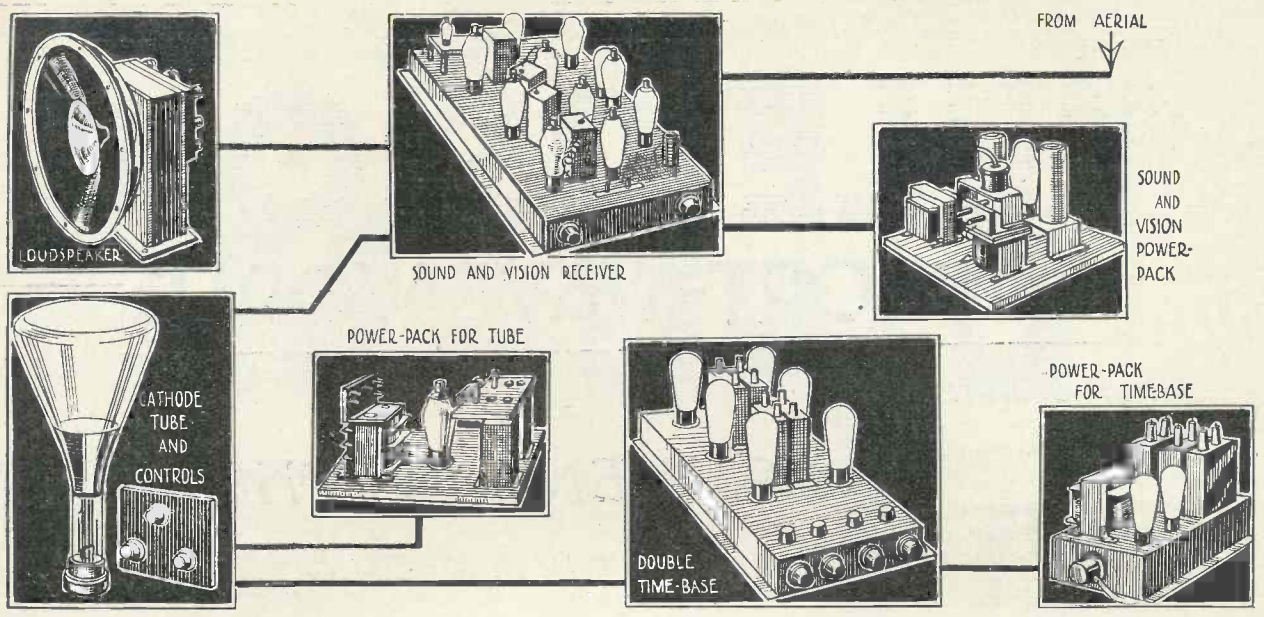
AT this time, when television makes its official debut as an entertainment service, it is as well to remind the public generally—and its detractors particularly—that here we have the commencement of a permanent institution from which most certainly there will be no turning back. Television is just as firmly established as was any other great invention in its infancy, all of which had the same uphill fight.

The results from Alexandra Palace have surprised even those who for years have been struggling to bring this service about, and they have silenced those who but a few months ago were speaking of television as a dream of the distant future. In plain words, the progress made has come as a surprise to everybody. Television starts with the difficult handicap of comparison with the wonderful achievements of the cinema, but even in these early days it stands the comparison well. This country is now well in the forefront of television development and obviously the sane course is to foster this development unhampered by petty jealousies.

The Amateur Takes a Hand

OUR publication of the constructional details of a home-built television receiver has created an enormous amount of interest for it has afforded definite proof that television receiver construction is within the abilities of the reasonably skilled wireless amateur. Hundreds of inquiries have been received regarding this receiver and chiefly they refer to performance and cost. In the former respect we can assure our readers that the results leave nothing to be desired. During the past month demonstrations have been given to a number of independent people all of whom were loud in their praises. In our next issue we hope to publish their opinions. Constructed precisely to our instructions, we affirm that the results are excellent.

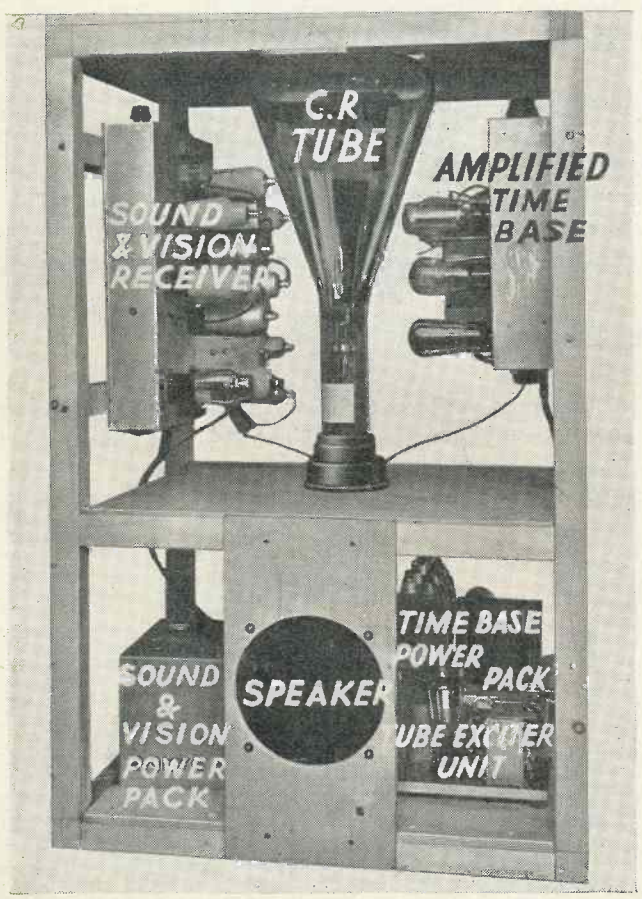
The cost of the receiver will depend to a great extent upon the builder and we can only generalise by saying that it works out at a little over fifty per cent. that of the average commercial article, but in future issues we hope to show how a saving can be effected in some respects. In this issue we have endeavoured to present the constructional details as completely as possible, but as stated last month it is our intention to amplify these in succeeding issues.



"TELEVISION'S" GUARANTEED

CATHODE-RAY RECEIVER—II

COMPLETING THE RECEIVER AND BUILDING THE TIME BASE



This photograph shows the units mounted in the receiver framework. The picture is viewed in a mirror, which is not shown.

"GUARANTEED"

The television receiver here described and illustrated has been designed and produced by experts working on our behalf for many months.

We guarantee that the picture which this receiver gives compares extremely well with that given by a high-class commercial receiver. It follows that if our readers faithfully follow our instructions in every respect they should produce a thoroughly satisfactory receiver, but certain points must be borne in mind. The reader who has never before had an opportunity of experimenting with a high-definition receiver cannot expect to obtain maximum results until he has acquired some little practical experience. Obviously, he must feel his way, just as he had to feel his way years ago when he started to build broadcast receivers at home.

The precise electrical values of the components is a big factor in success or failure. Those that we specify proved correct in our own receiver, but there is some amount of discrepancy occasionally between the rated values and the actual values of components, and slight variation of this kind is far more serious in a television receiver than in a sound receiver.

In spite of our great care to give all details accurately, it is difficult in dealing with a mass of tiny detail to prevent the creeping-in of some little omission or error ; if anything of this sort has occurred in spite of all we have done to prevent it, we will take the first opportunity of publishing a correction.

Subject to the above and to the employment of sound material and components, our readers may, with every confidence, go ahead and build for themselves a first-class receiver which, within the range of the station, will give a good account of the Alexandra Palace transmissions.

We guarantee that our instructions and designs are essentially practical and sound, so much so that we have been able to make an arrangement with a firm of television engineers by which they will, for a moderate fee, bring into working order any receiver which has been built *precisely* to the instructions here given and with which difficulty is experienced.

WHAT THE RECEIVER IS

THIS receiver is the first high-definition model ever presented to the amateur constructor. Its construction and satisfactory performance have settled the question which has been debated for some months — whether it would be possible for the amateur to build his own television receiver.

When the design was first considered the particular needs of the amateur were kept in mind so that the construction would be within the ability of the average person who was possessed of a reasonable knowledge of wireless construction. On this account unit construction was decided upon, the units being contained in a simple wooden chassis in such a way that they are all easily accessible or removable. The drawing on the opposite page shows the scheme of the complete receiver and the drawing below the various units assembled in the chassis. It will be seen that the complete assembly consists of sound and vision receivers mounted on one, metal chassis; a double time base, also one on chassis; three power packs for sound and vision receiver, double time base and cathode-ray tube, a control panel (not shown in the photograph of the complete assembly), a cathode-ray tube and finally the loudspeaker.

Preliminary details of the vision receiver were given in last month's issue and in these pages are given large detail drawings of the upper and under sides of this unit. These drawings used in conjunction with the circuit diagram, which is reproduced, provide sufficient data for the construction of the vision receiver. The sound section will be given next month. Also in this issue full constructional details of the time bases are given together with some information on the power packs. It will be noticed that ordinary wireless constructional practice has been observed throughout and owing to the simple construction of the framework only the simplest tools are necessary.

The complete receiver has been thoroughly tested on the Alexandra Park sound and vision transmissions and gives results comparable with commercially produced receivers.

THE FIRST HIGH-DEFINITION TELEVISION RECEIVER FOR THE AMATEUR CONSTRUCTOR

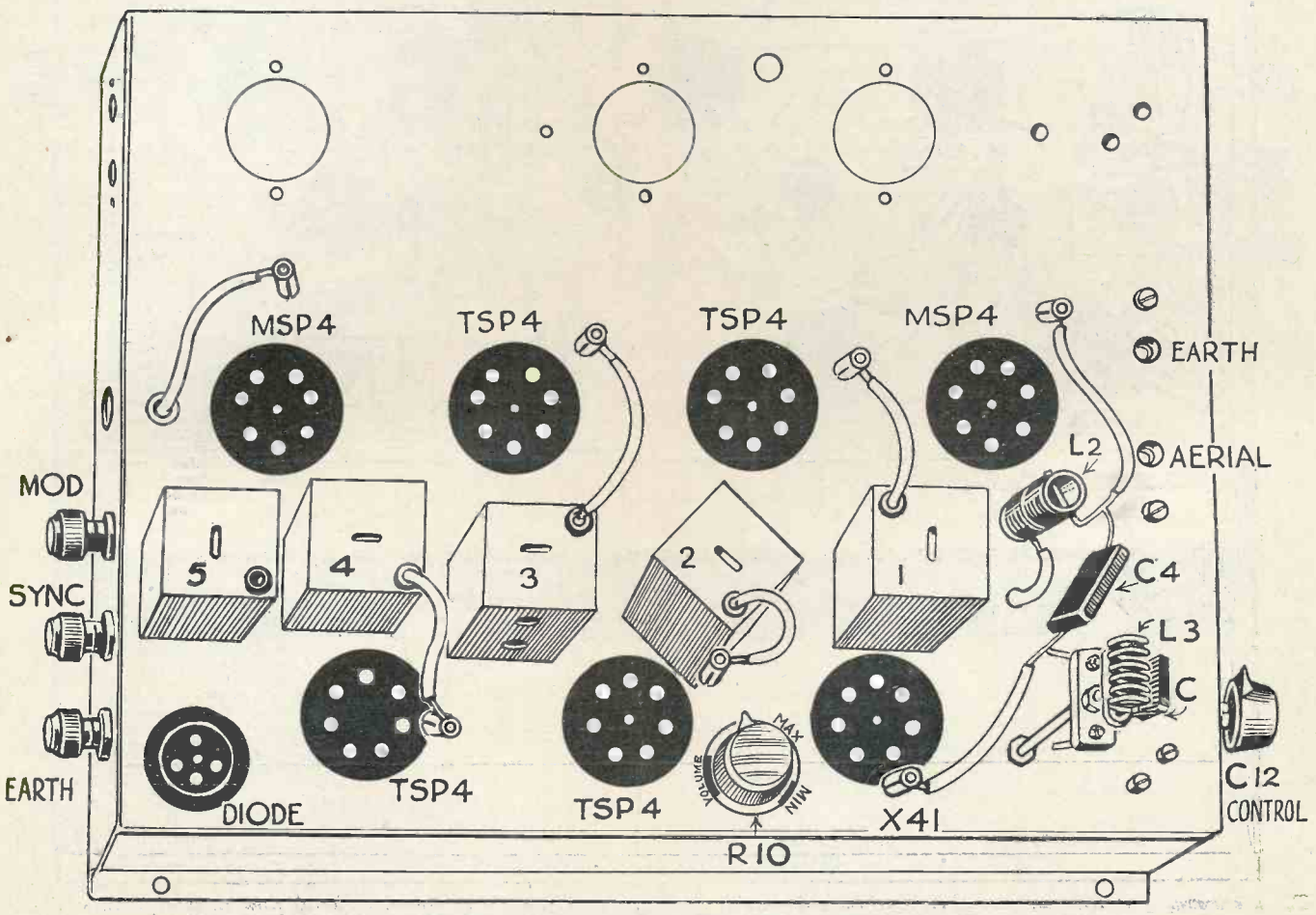


Diagram of the upper side of the sound and vision chassis. Only the vision components are shown in this drawing.

WIRING AND COMPLETING THE VISION RECEIVER

A Small Circuit Improvement

BEFORE describing the actual wiring of the vision receiver a small modification to the circuit is suggested. This modification was undergoing tests when TELEVISION AND SHORT-WAVE WORLD went to press, and it was decided in view of the fact that the alteration only involved a change of the output arrangement to publish the standard arrangement until stringent test of the modification could be made under actual receiving conditions. These tests have proved entirely satisfactory and the necessary alterations have been made to the wiring diagram reproduced. It will be remembered that a special diode unit was employed and that precautions were necessary to ensure that the potential difference between the receiver and cathode-ray tube would not cause a breakdown. In the final arrangement no special precautions are necessary other than that when coupling to the grid of the cathode-ray tube which is by a condenser of such a rating as to effectively isolate the cathode-ray exciter voltage from the receiver.

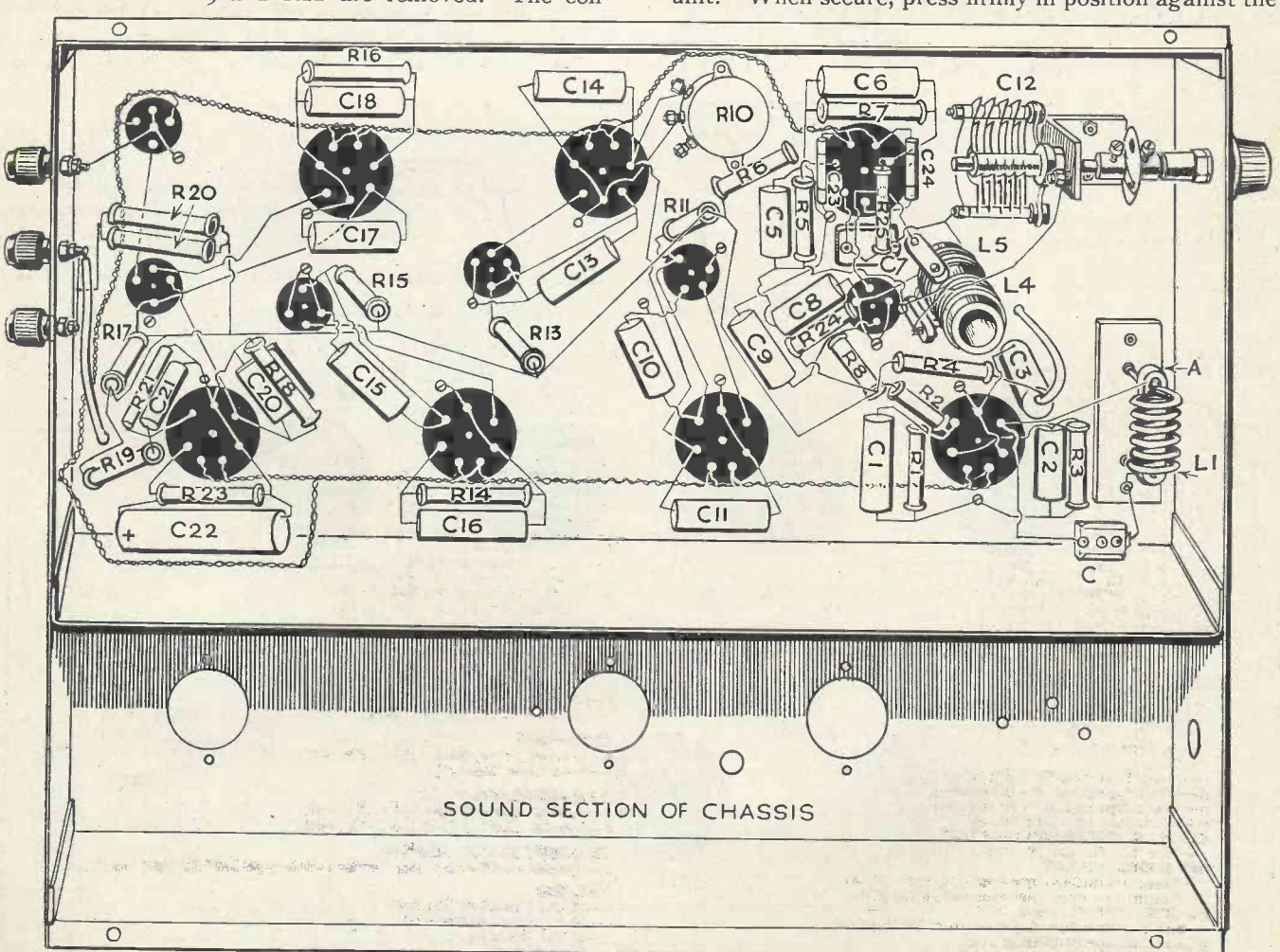
The actual alteration to the circuit is very simple and is as follows: C19 and R22 are removed. The connection to the diode marked " shield return " is taken to the control grid of the MSP4 valve previously functioning as a synchronising valve while the connection marked " shield " is taken to earth of the receiver. The bias resistor of the MSP4 valve should now be 300 ohms with a condenser C4 (value 50 mfd., 12 volt working) across it.

In order to preserve the higher frequencies a lower anode resistance should be employed with this valve. The correct value is 10,000 ohms (two 20,000 ohms in parallel as shown in the diagram were employed in the original receiver).

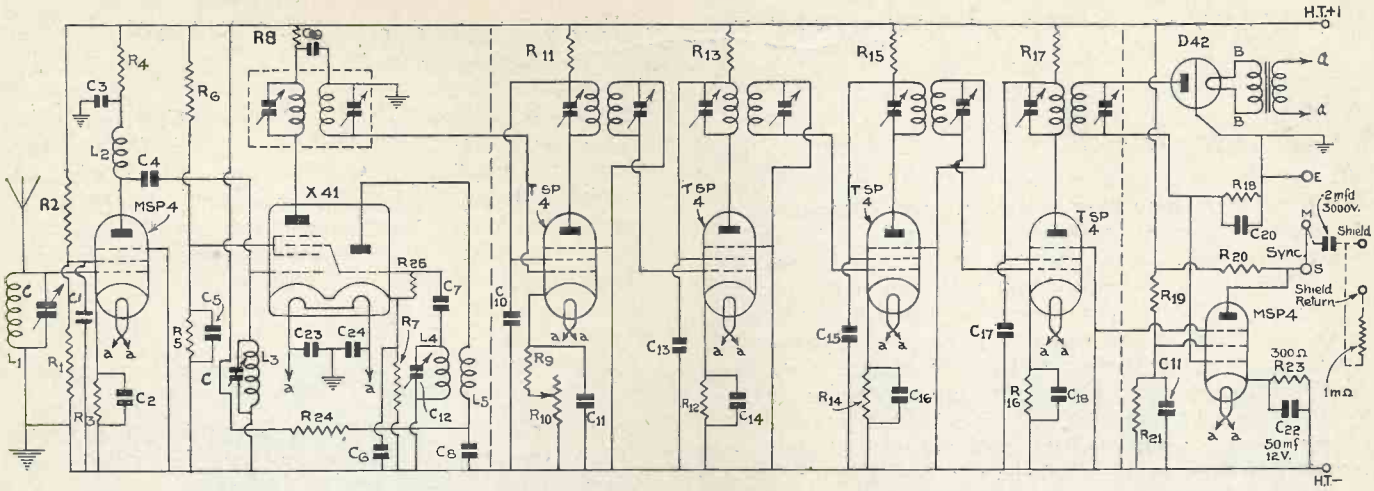
Another point of interest is the optional arrangement to control the first two I.F. valves with the bias potentiometer instead of only the first valve.

Wiring

In carrying out the wiring first connect all heaters with twisted wire. Notice that a complete loop circuit is made as this prevents a voltage drop on the last valves to be connected. Next wire all cathode resistors and their associated condensers. It will be found easiest to twist the wire ends of both condenser and resistance together and solder them into position as one unit. When secure, press firmly in position against the



This is a drawing of an underneath view of the sound and vision receiver showing the arrangements of the components for the vision section only. Minor details have been omitted for the sake of clarity but the layout can be followed if studied in conjunction with the circuit diagram.



The circuit diagram of the vision receiver. The small modification on the diagram given last month and described in detail in the text is given in this diagram.

chassis. It should be noted here that the valve holders should be riveted in position as follows. When looking to the top of the chassis from the front of the set the heater pins of the valves on the left-hand side are placed to the left and those on the right to the right. This will be clear if reference is made to the view of the illustration of the wiring.

Study carefully the position of the holders into which the I.F. cans are plugged. Reference to the illustration will show that they are not all placed in the same position (all the same way round) and, in fact, one is at an angle of 45°. Unless this is carried out correctly, it will be impossible to reach some of the trimmers of the I.F. cans.

The I.F. transformers which have already been mentioned are of a special type and they are supplied pre-tuned, adjusted and completely shielded, so that no difficulty should be experienced with the I.F. amplifier section as a picture is receivable without touching the trimmers. However, when a picture is received they may, if desired, be given a final trim when observing the image. Normally they do not need to be touched. If they are adjusted use a completely insulated screwdriver; that is, one without a metal shaft.

The two on which most effect will be noticed will be the bottom trimmer of the first I.F. and the top trimmer of the last I.F.

The power unit will not present any real difficulty provided precautions are taken to follow the wiring diagram. Notice that separate smoothing is provided for both the sound and vision sections. Connections are made to the receiver via a multi-plug and socket

LIST OF COMPONENTS FOR VISION RECEIVER

CHASSIS.
1—Aluminium to specification (Burne Jones).

CONDENSERS, FIXED AND VARIABLE.
2—30 m.mfd. trimmers type 1023 (C) (Eddystone).
1—.1 type PCP1 (C1) (Bulgin).
1—.1 type PCP1 (C2) Bulgin).
1—.1 type PCP1 (C3) (Bulgin).
1—.0005 type M (C4) (T.C.C.).
1—.1 type PCP1 (C5) (Bulgin).
1—.1 type PCP1 (C6) (Bulgin).
1—.0001 type M (C7) (T.C.C.).
1—.1 type PCP1 (C8) (Bulgin).
1—.1 type PCP1 (C9) Bulgin).
1—.1 type PCP1 (C10) (Bulgin).
1—.1 type PCP1 (C11) (Bulgin)
1—900140 (C12) Eddystone).
1—.1 type PCP1 (C13) (Bulgin).
1—.1 type PCP1 (C14) (Bulgin).
1—.1 type PCP1 (C15) (Bulgin).
1—.1 type PCP1 (C16) (Bulgin).
1—.1 type PCP1 (C17) (Bulgin).
1—.1 type PCP1 (C18) Bulgin).
1—.0001 type M (C20) (T.C.C.)
1—.1 type PCP1 (C21) (Bulgin).
1—.1 type PCP1 (C22) (Bulgin).
1—.01 type 300 (C23) (T.C.C.)
1—.01 type 300 (C24) (T.C.C.)

COILS.
1—6 turn type 1050 (1) (Eddystone).
1—6 turn type 1050 (3) (Eddystone).
1—4 turn type 1050 (4) (Eddystone).
1—4 turn 1050 (5) (Eddystone).

CHOKES, HIGH-FREQUENCY.
1—Type T.U.S.1 (2) (Mervyn).

HOLDERS, VALVE.
7—Chassis mounting type standard, 7-pin (Clix).
4—Chassis mounting type standard, 4-pin (Clix).

PLUGS, TERMINALS, ETC.
1—Aerial connecting plug type 1047 (Belling Lee).
3 terminals type B (Belling Lee).
1—10 point plug type 1251 (Belling Lee).

RESISTANCES, FIXED AND VARIABLE.
1—50,000 ohm type 1 watt (R1) (Erie).
1—50,000 ohm type 1 watt (R2) (Erie).
1—100 ohm type 1 watt (R3) (Erie).
1—1,000 ohm type 1 watt (R4) (Erie).
1—50,000 ohm type 1 watt (R5) (Erie).
1—50,000 ohm type 1 watt (R6) (Erie).
1—200 ohm type 1 watt (R7) (Erie).
1—1,000 ohm type 1 watt (R8) (Erie).
1—100 ohm type 1 watt (R9) (Erie).
1—10,000 ohm variable potentiometer (R10) (Bulgin).
1—1,000 ohm type 1 watt (R11) (Erie).
1—250 ohm type 1 watt (R12) (Erie).
1—1,000 ohm type 1 watt (R13) (Erie).
1—250 ohm type 1 watt (R14) (Erie).
1—1,000 ohm type 1 watt (R15) (Erie).
1—250 ohm type 1 watt (R16) (Erie).
1—1,000 ohm type 1 watt (R17) (Erie).
1—20,000 ohm type 1 watt (R18) (Erie).
1—50,000 ohm type 1 watt (R19) (Erie).
1—10,000 ohm type 1 watt (R20) (Erie).
1—20,000 ohm type 1 watt (R21) (Erie).
1—2,500 ohm typ 1 watt (R23) (Erie).
1—20,000 ohm type 1 watt (R24) (Erie).
1—50,000 ohm type 1 watt (R25) (Erie).

SUNDRIES.
1—Bracket for condenser drive (Mervyn).
1—Cord cable (Mervyn).

TRANSFORMERS, I.F.
4—Special shielded type T1F1 (Mervyn).
1—Special shielded type T1F2 (Mervyn).

TRANSFORMER, MAINS.
1—Special 4 volt with 3,000 volt insulation type TA1 (Savage) (optional)

VALVES.
2—MSP4 (Osram or Marconi).
1—X41 (Osram or Marconi).
4—TSP4 (Mullard).
1—D 42 Osram.

arrangement, and the type obtainable form Belling and Lee will be found to be very suitable. The majority of leads connecting the units together are made in this way through multi cables which results in a very neat final assembly that is easily accessible.

It will be noticed from the schematic drawings that L3 which is the grid coil for the X41, has been used with an Eddystone base which, in turn, is mounted on a piece of threaded rod fixed to the chassis. The other point to notice is that the Eddystone coils L4 and L5 used for the oscillator section underneath the chassis have been placed over a piece of insulating material which is fixed to the chassis. However, if you wind your own coils according to the information given you will be able to leave sufficient length of wire on the ends in order to make them self-supporting.

Both these arrangements are optional and plenty of latitude is permissible at these two points.

It is well to bear in mind that if the sound section is not being constructed at present a resistance capable of dissipating 60 ma. at 300 volts should be connected between HT2 and HT− in order to take care of the load and so ensure that the voltages will not rise on the vision section.

It should be noted that a bracket is joined to the transformer and this carries a socket to which are taken the various leads. Connections are given looking on to the top of the sockets. The smoothing condensers and valve are mounted on a bracket which is secured to the baseboard. The mains input is connected by a Belling and Lee fuse connector. The slot in the side of the metal case then only allows it to be placed in position or removed when the fuse cap is unscrewed. The removal of this fuse, of course, breaks the mains input.

THE ASSEMBLY OF THE TIME BASE

THE double time base circuit, which was shown theoretically in last month's issue, is assembled on a chassis measuring 12 in. by 9 in. by 3 in. deep. Although complete chassis will be available in kit form if required it is proposed to describe the assembly in detail for those who are prepared to make their own apparatus throughout.

The list of components is given in the accompanying panel, and slight variation in the make and size is permissible with the exception of those items starred in the list. In the case of fixed resistances it sometimes happens that the constructor has a stock on which to draw and two may be used to give the value of any one resistance specified.

Chassis Construction

Zinc, aluminium, or sheet steel may be used for the chassis, the latter being preferred on account of the ease with which soldered earth connection may be made. It is conveniently made in three parts—the main body and the two end strips, and drilling should be done before the end strips are fitted in place. The drilling diagram is given on page 618, which, however, does not include minor fixing holes as these are best marked from the components.

Of the two end strips, one carries the four controls intended to project through the top edge of the chassis and top panel of the set, while the other holds the input plug, socket for the deflector plate leads and input to the " shift " potentiometers.

The purpose of the various holes numbered on the diagram is as follows:

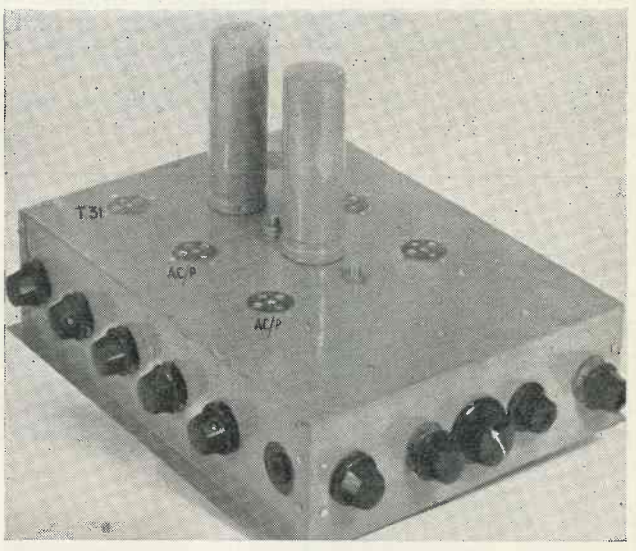
1, Line shift potentiometer;
2, Picture shift potentiometer;
3, Change-over switch;
4, Line synchronising potentiometer;
5, Picture synchronising potentiometer.

The above will be accessible from the top of the cabinet.

6, Bush for synchronising leads;
7, 240-line picture speed (25 cycles);
8, Line amplitude;
9, Picture amplitude;
10, 405-line speed;
11, 405 picture speed (50 cycles).

The 240-line speed control is accommodated on a bracket inside the chassis. All these controls are accessible from the back and sides, and once adjusted, do not need to be altered.

On the main plate of the chassis, the holes are as follows:



The assembled chassis for the scanning circuit. The pre-set controls are at the left-hand side, the adjustable controls on the end in the foreground.

12 and 13. Valve holders for AC/P.
14. Valve holder for thyratron.

These three valves constitute the line frequency circuit.

15 and 16. Valve holders for AC/P's.
17. Valve holder for thyratron.

These form the picture frequency circuit.

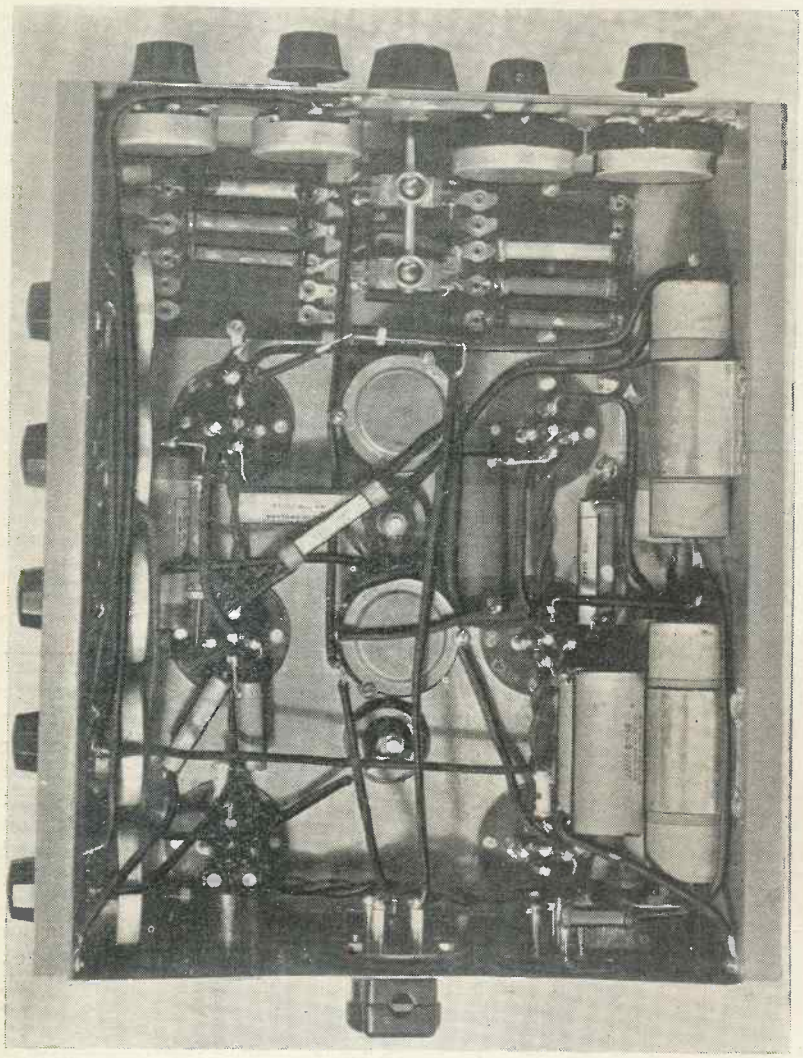
18 and 19. Holes for electrolytic condensers C2 and C9 in the diagram.

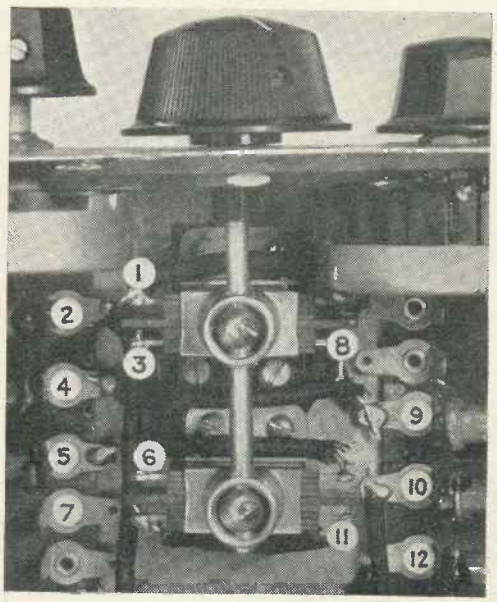
Two further holes will be required in the chassis, midway between holes 12 and 15 and 13 and 16. These

MAKING THE TIME BASE CHASSIS

are to take the spindles of two voltage tapping resistances in the valve anode circuit (R10 and R24 in the diagram). If desired these can be omitted and the fixed resistances used as shown, but if extreme accuracy of adjustment and consequent improvement in scan is required, they should be fitted. Once set, they need not be altered until a new valve is inserted in the push-pull pair.

Before fitting the paxolin strip behind the metal, chamfer the edge by hole 1 so that it fits snugly with the second strip running behind holes 6 to 11. This can be cut at the same time, and after both have been fitted into position they can be secured with screws (6 B.A. ¼ in. round head) or round head rivets, one at each corner. The long strip should have two extra rivets in the centre to keep it tight to the metal. After the strips





Above: Details of the wiring to the change-over switch. Note the insulated bush where the spindle passes through the chassis.

SWITCH CONNECTIONS

1. *H.T. input.*
2. 240 *picture resistance.*
3. *Joined to* 2.
4. 405 *picture resistance.*
5. 405 *line resistance.*
6. *Joined to* 7.
7. 240 *line resistance.*
8. *Joined to* 4.
9. *Anode resistance of AC/P.*
10. *Anode resistance of other AC/P.*
11. *Lead from H.T. to switch.*
12. *Resistance in series with* 10.

Left: View of the underside of the chassis before the final wires are inserted. The line frequency resistance has been omitted to show the change-over switch.

Holes 20, 21 and 22 in the lower flap of the chassis fit a two-pin mains socket (20) Bulgin Type P.20 or its equivalent; a five-pin Belling-Lee socket (21), and a four-pin valve socket (22).

Preliminary Work on the Chassis

After cutting the metal for the chassis and drilling the holes in the main part and side flaps, the end strip containing holes 1 to 5 should be lined with a strip of paxolin or ebonite cut to the dimensions on page 619. This serves to insulate the spindles of all the resistances from the main chassis, which is desirable as some are at 1,000 volts potential to the chassis.

have been fixed on the clearing holes for the potentiometers can be drilled ⅜ in. clearing.

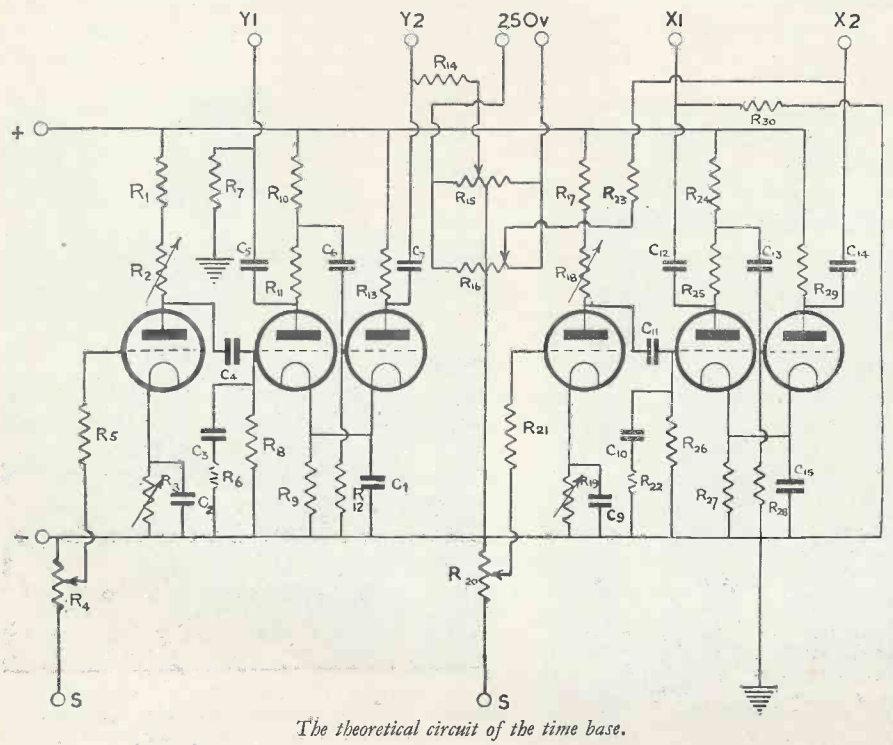
The mounting for the change-over switch can now be made from a strip of paxolin 1 in. by 2 in., held off the underside of the chassis by a packing disc of the same material ½ in. thick. When the two Bulgin switches (Type S.81.B) are mounted, the spindle will then be level with the hole in the centre of the top end piece (Hole No. 3). This hole requires to be ⅜ in. clearing for an insulating bush as the spindle should not be allowed to touch the chassis. Make sure when fixing the switches that they operate the same way to avoid confusion in wiring later. The spindle is 3/16 in. diameter brass and can be purchased with the switches.

The next stage is the fixing of the valve holders,

THE TIME BASE CIRCUIT AND COMPONENTS

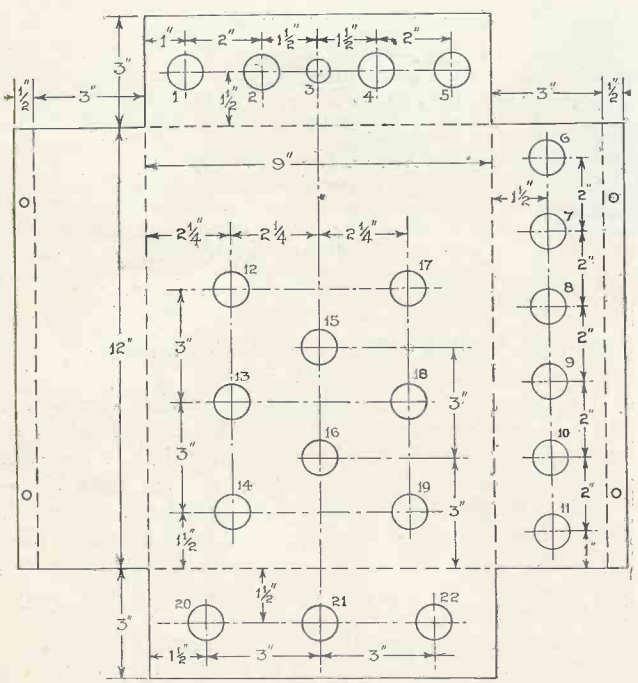
which again can be riveted in place if desired. All should point with the anode socket upwards, i.e., to the end of the chassis which contains holes 1 to 5. To save trouble this should be marked " top end," and the side with holes 6 to 11 marked " back end."

The isolating condensers for the deflector plates now require two clips to hold them against the sides of the chassis, and these can be bent from the same metal as the chassis and soldered into place. It is most important that the condensers are not allowed to shift when



The theoretical circuit of the time base.

COMPONENT	Baird.	VALUES FOR TIME BASE.	DOUBLE E.M.I.
R 1.—		1 megohm	
R 2.—	3 meg.		.5 meg.
R 3.—		50,000 ohms	
R 4.—		100,000 ohms	
R 5.—		150,000 ohms	
R 6.—		Optional	
R 7.—		5 megohms	
R 8.—		2 megohms	
R 9.—		11,000 ohms	
R10.—		30,000 ohms	
R11.—		170,000 ohms	
R12.—		2 megohms	
R13.—		200,000 ohms	
R14.—		5 megohms	
R15.— }		100,000 ohms,	
R16.— }		centre tapped	
R17.—		1 megohm	
R18.—	2.5 meg.		.5 meg.
R19.—		50,000 ohms	
R20.—		100,000 ohms	
R21.—		150,000 ohms	
R22.—		Optional	
R23.—		5 megohms	
R24.—		15,000 ohms	
R25.—		85,000 ohms	
R26.—		2 megohms	
R27.—		5,500 ohms	
R28.—		2 megohms	
R29.—		100,000 ohms	
R30.—		5 megohms	
C 1.—		50 mfd.	
C 2.—		50 mfd.	
C 3.—		.1 mfd.	
C 4.—		.1 mfd.	
C 5.—		.1 mfd.	
C 6.—		.1 mfd.	
C 7.—		.1 mfd.	
C 9.—		50 mfd.	
C10.—		.001 mfd.	
C11.—		.001 mfd.	
C12.—		0.1 mfd.	
C13.—		.005 mfd.	
C14.—		0.1 mfd.	
C15.—		12 mfd.	



Details of the time base chassis.

the chassis is mounted on end as the clearance between the tags and the chassis is small. The position of the condensers is shown in the photograph of the underside.

The end flaps of the chassis can now be fitted into place and held either by rivets or 6 B.A. screws. Each screw in the corner nearest the bottom of the chassis should have a soldering tag fitted beneath it for earthing connections, but in most cases these can be soldered direct to chassis.

The final fittings before the chassis is ready for wiring are: Holes for fastening down the two 5-way group boards on each side of the change-over switch; holes for the sockets in holes 20 to 22. It is not recommended that the mains socket be riveted owing to risk of breakage. The Belling-Lee socket can be mounted with the key slot downwards.

The first stages of the wiring can be completed before the electrolytic condensers are screwed into place as the chasssis can be laid flat without them. The resistances in the centre of the chassis can also be added after a time.

The Circuit

The brief description of the circuit given last month can conveniently be elaborated here so that the constructor has a clear picture of the function of the various components.

It is sufficient to consider only the first three valves

WIRING THE TIME BASE

of the theoretical diagram on page 618 as the circuit is duplicated with slight modifications for the picture frequency.

It is well known that provided the charging potential of a condenser in series with a resistance is kept low the charge takes place at a uniform rate. The bias of the discharge valve on the left of the circuit is therefore adjusted so that the condensers C_4 and C_3 do not exceed 80-100 volts potential before discharge takes place. The potential across the condensers is applied to the grid of the first valve of the push-pull pair, which only receives half the potential of the discharge, C_4 and C_3 being in series. This gives a reasonable

COMPONENTS FOR SCANNING CIRCUIT.

FIXED RESISTANCES— One Watt (Dubilier).
3—1-megohm
1—200,000-ohm
3—150,000-ohm
1—100,000-ohm
1—500,000-ohm
1—85,000-ohm
1—30,000-ohm
1—20,000-ohm
1—15,000-ohm
1—10,000-ohm
1—5,500-ohm

Half Watt (Bulgin).
4—5-megohm
4—2-megohm.

POTENTIOMETERS (Reliance).
2—2.0-megohm
2—0.5-megohm
2—0.1-megohm
2—50,000-ohm
2—100,000-ohm special with centre tap.

CONDENSERS (Dubilier).
2—Type 4001 50-mfd. 12-v. working.
1—Type 3004 50-mfd. 50-v. working.
1—Type 3016 12-mfd. 50-v. working.

B.I. (Mervyn)
4—0.1-mfd. 2,000-v. working, tubular.
2—0.1-mfd. 1,000-v. working, tubular.
2—0.001-mfd. 1,000-v. working, tubular.
1—0.1-mfd. 1,000-v. working, tubular.
1—0.005-mfd. 1,000-v. working, tubular.

VALVE HOLDERS.
6—Chassis mounting 5-pin (Bulgin).

SUNDRIES.
1—5-pin plug and socket type 1260 (Belling-Lee).
1—Type P.20 Mains connector (Bulgin).
1—Type SW.41 5-pin socket (Bulgin).
1—Type P.3 5-pin plug (Bulgin).
2—Bulgin S.81 B. switches (Bulgin).
2—Bulgin C.31 group boards (Bulgin).
2—Valve top caps (Bulgin).

VALVES.
2—Mazda T.31 Thyratrons. or Ediswan HE/A.C.1.
4—Mazda A.C./P.

value of striking potential for the thyratron and avoids overswinging the valves. The rate of charge of the condensers is controlled by the resistances R1 and R2, which are semi-variable. As these give the line frequency they must be altered in value for the 240- and 405-line pictures by means of a changeover switch. For 240 lines the values are 3.5 megohms total and for 405 lines 1.5 megohms total, and these are distributed in the circuit assembly as follows:

240 lines: 2.0 meg. variable, 1.5 meg. fixed.
405 lines: 0.5 meg. variable and 1.0 meg. fixed.

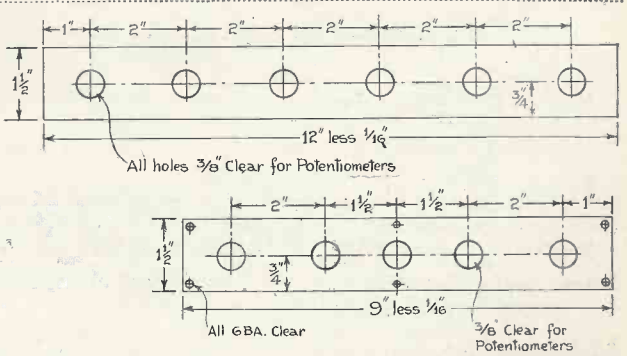
Any other combination could be used, but the above will be found to give smooth control and is sufficient to compensate for variations in capacity. The changeover switch is connected to the H.T. positive and inserts one or other of the resistance chains in the charging circuit.

The thyratron is self-biased by the variable resistance R3 by-passed with the condenser C2. It might be thought that self-biasing of a discharge valve in which the anode current is not flowing continuously is impracticable, but provided that the time-constant of the condenser is sufficient to "hold the bias" the arrangement is quite satisfactory. The value of bias of course controls the amplitude of the picture and line, which varies slightly between the two systems. This variation is small, however, and it was not thought worth the added complication of two adjustments on the bias resistances.

Paraphase Connections

The first valve of the push-pull pair feeds one deflector plate direct through the condenser C5, the plate being marked Y1. A resistance R7 connects this plate to earth, an essential connection if wandering of the spot is to be avoided. In the anode circuit of the valve are two resistances R10 and 11 which are 200,000 ohms in the case of the picture frequency and 100,000 ohms for the line. With high overall voltages, advantage can be taken of high anode resistances to give a long straight portion of characteristic. The anode resistance is tapped for the first 30,000 ohms or so, the tapping being connected to the grid of the second push-pull valve to give the well-known "paraphase" connection.

If the valves are accurately matched this tapping could be fixed at 1/Mth that of the total anode resistance, where M is the stage gain of the valve, but



Details of paxolin or ebonite strips for insulating potentiometers from time base chassis.

in practice it is preferable to be able to vary the tap and check any distortion arising from mismatching. C6, the coupling condenser between the valves, should be able to withstand the full H.T. voltage which may be applied to it if one valve is pulled out of the socket. Both valves are biased by the resistance R9 in conjunction with the condenser C1, and the plate Y2 of the tube is connected to the anode of the second valve through the condenser C7 as before. This plate instead of being returned to earth is connected through a high resistance to a shift potentiometer which is shown as R15, R16 being the corresponding one for the other circuit. These potentiometers are of special construction, having a centre tap brought out in addition to the slider. This tap is connected to earth, and the slider can thus move either "positive" or "negative" with respect to it. The picture can therefore be moved in all directions on the screen.

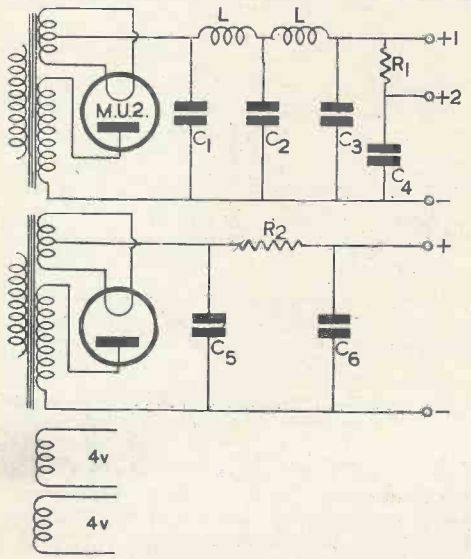
The supply for the shift potentiometers is necessarily obtained from a separate source, as the centre point is earthed, but a simple valve rectifier is all that is necessary as the load is small. The terminals marked S are for feeding the synchronising signal to the grids of the thyratrons, and the amplitude of the signal is varied by the resistances R4 and R20. From the line drawn down the diagram through R20 the circuit is identical with that just described except for alteration in the value to accommodate the picture frequency.

WIRING THE TIME BASE

The values of charging resistance R17 and R18 for the two systems are as follows:

240-line: Total 4.0 megohms, made up of 2.0 variable and 2.0 fixed.

405-line: Total 1.5 megohms, made up of 0.5 variable and 1.0 fixed.



Theoretical diagram of H.T. supply unit for time base and tube. A delay switch operated from the heater windings switches on the H.T. transformers after the cathodes have been warmed up. The two chokes L L are iron cored.

These values are changed by the second changeover switch coupled to the first.

Wiring the Chassis

The wiring of the chassis should be carried out with due regard to the potentials likely to exist between the various leads, and wherever possible high voltage wires should not run close to the metal chassis, unless the user is satisfied with the quality of the insulation. Ordinary systoflex *cannot be relied on* for high voltage at high frequencies, and if no better insulated wire is available, at least two thicknesses of systoflex should be used, one threaded over the other.

Particular points to be noted in the wiring and jointing are as follows:

Take care that no wire ends protrude through the holes in the variable resistance tags to touch the chassis behind them.

See that the tags on the 5-way group boards do not touch the underside of the chassis. It is preferable to bend them up slightly to clear the metal by a good margin. Do not let a blob of solder run down to the chassis from the tag.

The few resistances which are in the wiring must have their joints protected with systoflex, particularly if they are tucked away under a component. Do not let any resistance touch the chassis, even if they are of the insulated type—it is safer.

Take particular care to wipe off all traces of flux from the joints to the valve holder legs and to the multi-pin sockets.

Make sure that all condensers in the wiring are rigidly held and will not flop when the chassis is turned on end. It is a good, if drastic, test to shake the chassis violently when finished and then examine the wiring. If nothing has come out of place you may be confident that nothing will give trouble due to vibration in the finished set.

Finally, watch for loose blobs of solder and stray wire clippings as each joint is made.

When the chassis is ready for wiring, all the components with the exception of the condensers mentioned before and the central resistances should be firmly in place. The resistances in holes 6-11 should all have their tags turned upwards, as also the resistances at the top end of the chassis. The wiring may be commenced with the heaters, which are connected in parallel down both sides of the chassis, the leads being twisted together between the valveholders.

An additional refinement is the screening of these leads in flexible braiding, but this should not be necessary in all cases. A great deal depends on the position of the other wiring, and if obstinate A.C. interference is found later, it may be necessary to rewire with braided flex. The heater leads are connected to the sockets of the 5-pin holder in the centre of the bottom flap, marked 3 and 5. (The numbering of the sockets will correspond with the pin numbering found inside the plug portion.)

After the heater wiring the cathode resistances can be connected across their respective by-pass condensers and soldered in place. The condensers can rest tightly against the chassis at the bottom making sure the polarity is correct. The output condensers to the deflector plates can then be connected, one end going to the anode socket of each valve, and the other to a socket on the five-pin valve holder at the bottom of the chassis.

The convention adopted for the wiring of this holder (which, however, is not important) is:

Grid pin: X1 plate.
Anode pin: Y1 plates.
Filament pin: No. 3 X2 plate.
Filament pin: No. 4 Y2 plate.

The centre pin is earthed to chassis for convenient earthing at a later date. At the same time the 5-meg. resistances can be soldered from the grid and anode pins to earth. The resistances in the filament pin leads will be taken to the tappings on the shift potentiometers at the other end of the chassis and can be left till later.

The grids of the thyratrons can now be connected to the synchronising potentiometers, the wires being tucked under the side panel on the chassis. The bush for the synchronising leads is so placed that these come straight in from the set without liability to interference from the leads in the time-base.

The wires from the mains plug can also be run round the chassis in the corner to the two potentiometers on the top strip, and the centre taps of these can be soldered to chassis or to a convenient tag. The centre tap to the deflector plates will run over the lower wiring and should be left.

Before proceeding further the two electrolytic condensers and the centre resistances should be fitted in. The latter will need insulating bushes for safety, as their spindles are at full H.T. to chassis. Any reliable make

(*Continued on page* 646)

Television again occupied a very prominent place at the Berlin Radio Exhibition although it is not proposed at the present to place receivers on the market. Considerable attention was given to adequate demonstration of the various receivers shown and in one instance, as shown by the accompanying photograph visitors to the exhibition were enabled to see the actual artists and the reproduction on the screens of the receivers simultaneously.

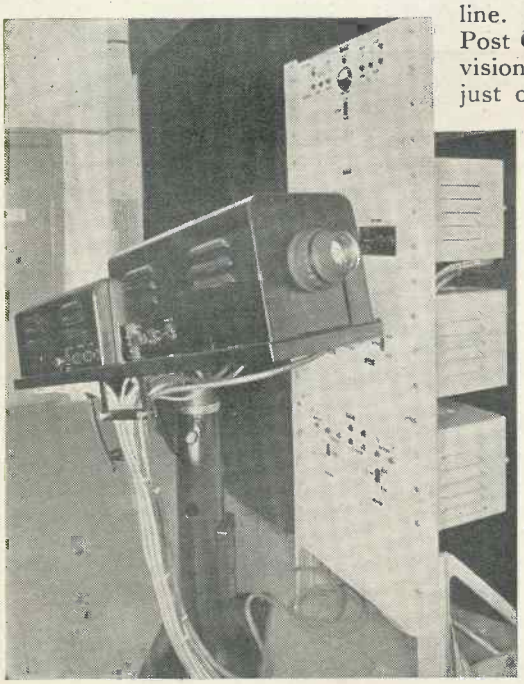
GERMAN TELEVISION PROGRESS

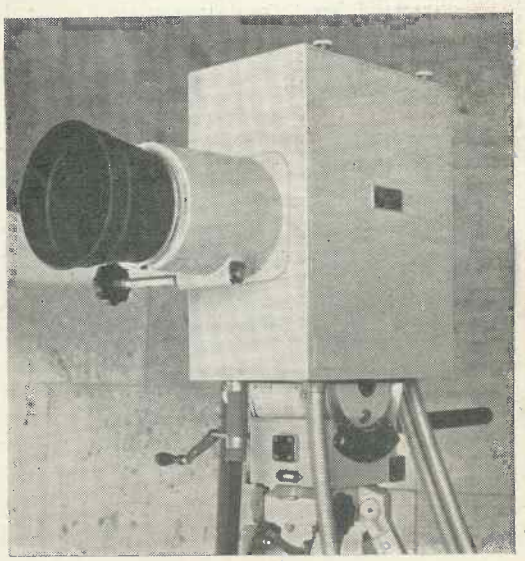
AS REVEALED AT THE BERLIN RADIO EXHIBITION

THE Berlin Radio Exhibition was held from August 28 to September 6, somewhat later this year than usual, due to the Olympic Games, which took place earlier in the month.

As in previous years a good deal of prominence and space was allotted to the television exhibits. It should be explained that the picture standard of the ultra-short wave transmissions is still 180 lines, 25 pictures per second, but that most firms in addition to receiving this picture have concentrated in the past year on raising the definition to 375-line interlaced scanning.

In addition to the Post Office itself, the following firms had stands: Fernseh A.G., Telefunken, Loewe, Lorenz, German Philips and Te-Ka-De. The Post Office had on its stands a large number of television receivers supplied by the various research companies. These receivers, which are all worked on a 180-line definition, picked up a variety of transmissions, sometimes by radio, sometimes by line. An interesting exhibit of the Post Office was a small open-air television stage, which had been erected just outside the Exhibition Hall, on which musical performances and dances of a national character were given, several times each day. These scenes were televised by means of an intermediate film van, or by means of the Post Office's own Iconoscope transmitter. The results in both cases were very good. Furthermore, the Post Office had a mechanical 375-line film transmitter on their stand, and occasionally showed pictures received from this transmitter. These pictures were of very poor quality indeed, considering the high number of lines used. It is no exaggeration to say that these pictures were worse than the 180-line picture radiated from the ultra-short wave transmitter.





The photograph on the left shows the cathode-ray projector and control rack employed by Fernseh A.G. On the right is a picture of an electron camera of the Farnsworth type also used by Fernseh A.G.

PROJECTED CATHODE-RAY PICTURES

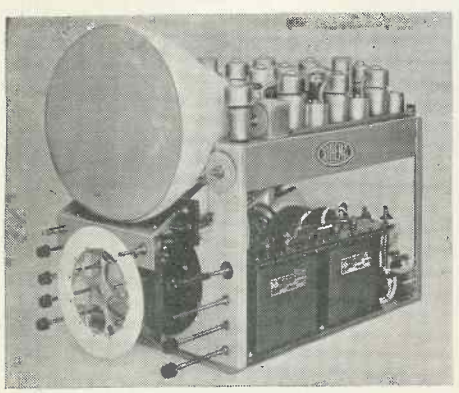
The Berlin-Leipzig television-telephone cables had been extended from the centre of the city to the Exhibition Hall itself, and in the television section two booths were erected where visitors could speak to and see persons in Leipzig, or at one of the two public television offices in the centre of Berlin. Two receivers mounted outside these booths enabled the general public to "tap" both visually and aurally on these long distance conversations.

Fernseh A.G. and Telefunken are the biggest and most powerful of the German television firms, and annually these two firms compete for the laurels of the best picture at the Exhibition, with the firm of Loewe usually as a very close runner-up. The exhibits of these three firms are worth while describing in detail.

Fernseh A.G.

Receivers

Fernseh A.G. showed a series of new home receivers with a picture size of about 7 ins. by 9 ins. In these receivers special attention has been paid to simplicity of handling and to the height of the picture relative to the ground. In addition to these standard receivers the company showed several so-called special receivers which showed cathode-ray pictures of the unusually big size of 12 ins. by 14 ins. The tubes themselves had a diameter of the order of 18 ins. or 20 ins. These receivers are not intended for home use, but for special purposes such as public viewing rooms. The screens are rather curved, but the impression made by these pictures was very good, and seemed to indicate that the public wanted bigger pictures than they can get on an ordinary cathode-ray receiver to-day.



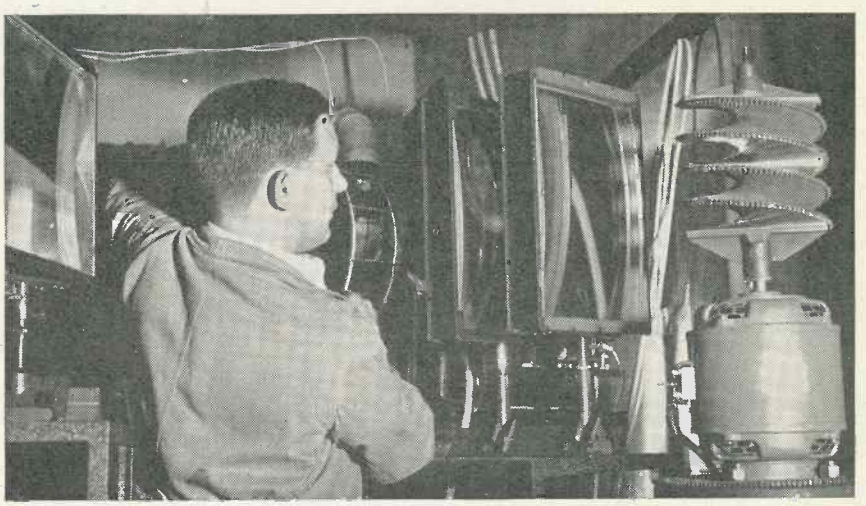
This photograph shows the chassis of the Lorenz receiver.

Other exhibits of this firm was the electron camera of the Farnsworth type, which had been used with a considerable amount of success for transmissions of certain out-door events during the Olympic Games. A special studio had been erected with a small stage from which scenes were transmitted by means of the electron camera. On several days the camera was placed outside the Exhibition Hall and passing street scenes were transmitted to the inside. These transmissions were on a definition of 180 lines, and these pictures were very pleasant.

The 375-line film transmitter using a scanning disc was an interesting piece of work, interesting inasmuch that it showed that even for an extremely high number of lines the Nipkow disc is still a useful piece of apparatus. The transmitter is similar in appearance to the 320-line transmitter exhibited last year. The pictures received from this transmitter were extremely good and amongst the best shown in the Exhibition. The only criticism to be levelled against it was that some of the holes in the scanning disc were blocked up so that the picture suffered from horizontal dark lines. As regards detail, contrast range, and brightness, these pictures were without equal in the Exhibition.

A new development shown this year by all the cathode-ray firms was the projection of reasonably big pictures (that is about 2 ft. by 2½ ft.) from a small but very intense cathode-ray image. It should be said at the outset that the results were in almost every case very disappointing, and the picture shown by Fernseh A.G. was a particularly poor example. The picture was dim and completely devoid of any detail or half tones.

In spite of the great progress made during the last year with the electronic transmission cameras the German authorities feel that the intermediate film methods of transmission still has a great sphere of usefulness. It is for this reason that the German Post Office ordered a second intermediate film van from Fernseh A.G. in addition to the one supplied by this company two years ago. This van is a very remarkable piece of apparatus, beautifully built and giving beautiful results. The definition is, of course, 180 lines. It is interesting to note that the spot-light transmitters used in the television-telephone service were all supplied by this company.



The only mechanical receiver shown was the Te-Ka-De. This photograph shows the 180-line receiver giving a projected picture.

Telefunken

The Telefunken exhibit was remarkably successful both from a technical and from an entertainment point of view. On this stand, also, a special television studio had been built, from which transmissions by means of an Iconoscope were made several hours each day. It was possible for the public to see the actual studio and the received pictures outside the studio simultaneously. The definition was 375 lines and the pictures received on the standard Telefunken receivers were extremely good.

In addition to this camera another Iconoscope was mounted on a plat-

MECHANICAL LARGE-SCREEN PICTURES

form outside the Hall which transmitted street scenes throughout the day with 180-line definition. There was also a second Iconoscope transmitter which scanned with 375-line definition. Yet another Iconoscope was behind the scenes and incorporated in a film transmitter. The three Iconoscopes working on 375 lines were controlled by an elaborate looking rack which contained all voltage and impulse generators, as well as monitors and fading units.

Good Interlacing

The Telefunken pictures were extremely pleasant and remarkable for the fact that in these pictures the interlacing of lines really worked the way it should work, which is still a rare thing. The horizontal definition along the lines was perhaps not as good as those pictures received from mechanical transmitters, but the total impression was excellent. The pictures had a warm sepia colour and were about 7 ins. by 9 ins. Next to the main stand Telefunken had a small theatre (standing only) in which projected cathode-ray pictures were demonstrated.

There were two sets. One showing a 180-line picture about 18 ins. by 20 ins., the other a 375-line interlaced picture about 3 ft. by 3½ ft. This theatre had to be absolutely pitch dark and the pictures were projected on to a pearly screen. The illumination was fairly good when viewed from the centre, but not quite up to a really useful level. Moreover the definition suffered a great deal due to the projection and strangely enough there seemed to be no difference in the detail between the 180- and 375-line pictures. Nevertheless it should be said that these projected pictures were better as regards detail than those shown by the other firms. These receivers are again intended for public viewing rooms and extremely high voltages (20,000) are used.

Loewe 375-line Pictures

Loewe showed a new version of their home receiver working on 375 lines from their own transmitter. This transmitter is also of the mechanical type, but of very unusual design, using an oblique optical system and a scanning disc of a new type, in which the spiral does not follow the usual Archimedean law, but follows a different mathematical function connected with the use of the oblique optical system. The advantages of this system of scanning are supposed to be the automatic generation of the synchronising impulses in their correct phase. The receivers are more compact than ever and use only 13 valves. The controls have been reduced to two!

It is interesting to note that Loewe are one of the few firms who still adhere to the gas-filled relay type of time-base used in conjunction with newly developed saw-tooth transformers. The 375-line pictures shown on these sets were extremely good, very bright, with plenty of detail and contrast. Loewe also showed some cathode-ray projection receivers of a very compact type, showing a picture 16 ins. by 20 ins. on a ground glass screen. These pictures were remarkable for their brightness, but here again the detail suffered enormously compared to the direct pictures viewed on the end of the tube. The cathode-ray projection tubes used in these receivers are extremely cleverly designed, as the tubes themselves contain an immersion lens which is close to the fluorescent screen and directs most of the light rays into the projection lens, which is outside the tube. A clever idea had been introduced here inasmuch as where distortion is introduced by the immersion lens it is corrected by an opposite distortion introduced in the projection lens, so that the final picture of the scan is geometrically correct. The anode voltage of these projection receivers of Loewe is 10,000.

Lorenz Receivers

The firm of Lorenz using the Ardenne type of tube have made considerable progress in receiver design during the last year, and showed what must be quite the most compact form of television receiver yet shown. The set has been reduced in size to about one-quarter compared with last year's model and yet the picture size is the same (7 ins. by 9 ins.). 180-line pictures received by radio were shown and were quite pleasing. This company also had a small theatre attached to their stand in which cathode-ray projection was shown, working on a system produced by this company in conjunction with Professor Rogowski.

The cathode-ray tube in this case was made of metal and was of the continuously evacuated type. An interesting feature of the apparatus was the fact that two different fluorescent screens could be used at will and changed over, the two screens having different colours. The pictures were reasonably bright but again the detail was poor.

The German Philips Company showed two receivers working on 180 lines which gave extremely good and bright pictures.

Mechanical Projection

Of particular interest was the stand of TeKaDe, who are to-day the only exponents of mechanical-optical television receivers in Germany. Two receivers were exhibited, but only one was shown working. This was a 180-line receiver giving a picture of about 2 ft. by 2 ft., projected on to a ground glass screen from a double spiral mirror-screw used in conjunction with a rotating condenser (lens drum). An arc lamp and sealed-off Kerr cell were used and the detail and geometry of these pictures were remarkably good.

These pictures gave an ample demonstration of the superiority of the mechanical systems over the cathode-ray tube when it comes to reasonably big pictures. Moreover the definition of this mechanical picture showed that this system can give superior results for a given number of lines. The second receiver, which was unfortunately not working, was of the crossed mirror-drum type using a small high-speed mirror-drum for line scanning, and a somewhat larger but slower one for the frame scan. Both these methods are being developed by this company for this type of work.

To sum up, the three outstanding features of this year's exhibition were:—

1. The demonstration of 375-line television in conjunction with interlaced scanning.

2. The appearance of the electronic cameras for instantaneous outdoor transmissions.

3. The use of cathode-ray projection, the results obtained by which must definitely be regarded as disappointing.

TELEVISION AND SHORT-WAVE WORLD

NOVEMBER, 1936

THE TELEVISION ENGINEER.

THE ION LINE ON CATHODE-RAY TUBE SCREENS

By Manfred Von Ardenne.

A translation of an article by the author in " Archiv für Elektrotechnik," giving his observations on the presence of negative ion rays occurring principally in the ageing period of high vacuum tubes.

THE following is a brief report of a phenomenon observed at the author's laboratory and independently in the Leybold and von Ardenne Oscillograph Company's laboratory during the manufacture of electron ray tubes in 1935.

In order to avoid burning the fluorescent screen during the formation process of the cathode, lateral displacement of the electronic focus was caused by means of a powerful magnetic field. After only a brief ageing period a beam of slight fluorescent capacity regularly appeared on the fluorescent screen at a place which corresponded roughly to the normal

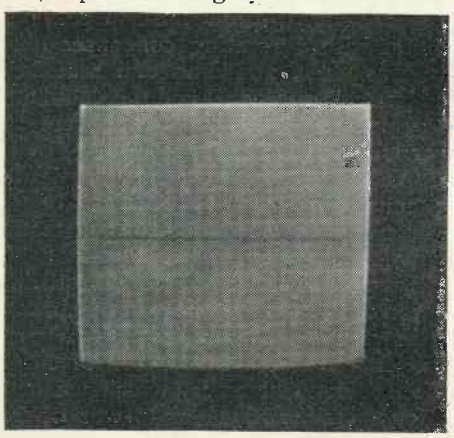


Fig. 1.—Television screen with ion line created during ageing with magnetic vertical deflection and electrostatic horizontal deflection.

undeflected position of the beam. If, during ageing, a television screen was formed on the fluorescent screen, using magnetic deflection for the vertical and electrostatic for the horizontal direction, then a line of reduced luminosity gradually appeared in the middle of the screen. A photograph of such a screen is shown below the dark line in the direction of electrostatic deflection being clearly shown.

The tube used was of the electrostatically focused type.

It was observed that the spot or line of lower screen sensitivity was only present with small anode potentials (under 3,000 volts), and with the higher anode potentials of practical television the phenomenon was scarcely visible. If care is taken during ageing to displace the electron spot and the spot of slight fluorescent capacity laterally by electrostatic means from the picture area, then the blackening of the screen which supervenes on subsequent formation of the cathode after the tube has been some time in action is so very small that it can be neglected. In practical television this phenomenon is therefore scarcely regarded as a source of disturbance at the present day.

From these observations it is evident that the phenomenon involves electrically negative particles of large proportions which are very difficult to deflect magnetically.

Since the phenomenon was established with tubes from which the gas had been carefully exhausted, and principally in the ageing period, only one conclusion remains: namely, that the negative particles must be ions originating in the cathode oxide. With regard to the known theories on the formation process it seems desirable to assume that this is a case of *negatively charged oxygen ions** being released during electrolysis of the oxide.

For singly charged oxygen ions the relationship between magnetic and electrostatic deflection gives the value 0.27 per cent. For doubly charged oxygen ions the value corresponds to 0.38 per cent. These values show such a slight magnetic deflection capacity that deflection fields of some considerable strength are necessary for accurate quantitative confirmation of the theories expressed in the foregoing. Unfortunately the author was not in a position to carry out this investigation owing to lack of time.

As regards the phenomena observed, the question is one of processes similar to those lately established by Freisenwinke.

According to the usual calculation for deflection by a plate condenser, the same deflection sensitivity should result for electron beams and negative ion beams. A more accurate investigation into the electrical deflection of ions and electronic spots, considering the arrangement on which it is based, has nevertheless given rise to the result illustrated by Fig. 2.

According to this, the ion ray is only deflected with about six-sevenths of the sensitivity of the electron ray. An analogous difference may be observed in the action of the electrostatic converging lens.

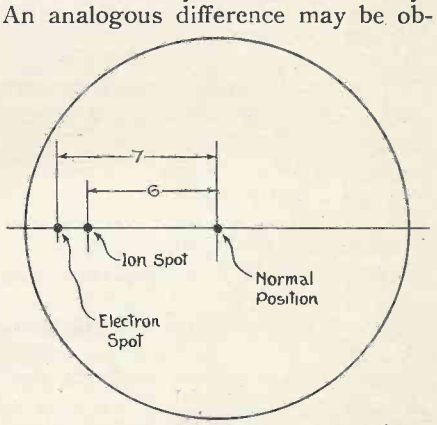


Fig. 2.—Position of the electron spot and ion spot observed with deflection by a condenser field.

If the focusing potentials of converging optics are adjusted in such a way that a sharp electronic focus is obtained, then the ionic focus, which is observed after some time, has a certain lack of sharpness. The diameter of the ionic focus was 3-4 times as large in these cases as the electronic focus.

The reason for this effect lies in the fact that in unhomogeneous fields in the region of the marginal zone of the deflecting plates the path of the ions is influenced by their mass and charge.

* "Archiv für Elektrotechnik," xxix . 10 . 1935.

(*Continued in first col. of next page*)

Scannings and Reflections

THE OFFICIAL OPENING OF ALEXANDRA PALACE

ALEXANDRA PALACE officially takes the air at 3 p.m. on Monday, November 2. The official opening is to be performed by the Postmaster-General, Major G. C. Tryon, and there are also to be speeches by Lord Selsdon, Chairman of the Television Advisory Committee, and Mr. R. C. Norman, Chairman of the B.B.C. The speeches will last for about fifteen minutes and then will be followed by the first actual official transmission, which will be a news reel.

The main feature of the programme will be a variety entertainment with Adele Dixon, Buck and Bubbles, negro entertainers, and the Lai Foons, a well-known Chinese juggling combination.

The evening programme will commence at 9 p.m. and in this will be shown for the first time the television film which the B.B.C. have had in preparation since the commencement of the alterations to Alexandra Palace —" Television Comes to Town," Following this will be the second edition of the " Picture Page," and the transmission will close with a news reel.

CURTAILMENT OF TRANSMISSION TIME

It was the original intention to give three one-hour transmissions per day when the regular services started—that is from 3 to 4 p.m., 6.15 to 7.15 p.m. and 9.30 to 10.30 p.m. The 6.15-7-15 transmission has not been arranged for in the schedule of transmissions for the present. No official explanation has been given for this omission, but it is understood that it is owing to the difficulty of fitting in rehearsals. Each rehearsal must, of course, be treated exactly like a transmission, the only difference being that they are not put on the air. Also the rehearsals must necessarily occupy more time than the actual transmissions, so these facts have resulted in a curtailment of programme time for the time being.

AN EXPERIMENT WITH SCENERY

For one of the test transmissions an experiment was made with the use of scenery, the actual scene being the interior of Canterbury Cathedral. It is stated that Mr. G. Moore O'Farrall has devised an ingenious means of giving the effect of scenery. " For the present," a B.B.C. official said, " it is not intended to disclose the secret of this scenery, but those who see the programme will be able to hazard a guess as to how the scenery has been done. This is the first time we have ever attempted the ambitious job of presenting excerpts from a play, complete with scenery. Of course we have had shows in which the actors were in costume. It has been our custom in the past just to use black and white drop curtains."

ANOTHER TELEVISION CINEMA

Plans have been prepared for the erection of a cinema at Blyth, Northumberland, in which provision has been made for the reception of television and its projection when it is found possible to receive it in the district. This is the second cinema to be built in which the designers have had the foresight to prepare for television, though in this case it appears likely that some considerable time must elapse before this part of the equipment can be put to actual use.

THE FIRST TELEVISION PLAY

" Marigold," the Scottish comedy which ran for 649 performances at the Kingsway Theatre in 1927 and has been revived at the Royalty Theatre, with Miss Sophie Stewart and Miss Jean Clyde in the principal parts, has been chosen for the first public television broadcast of a West End theatrical production. It will be transmitted from the B.B.C. television studios, Alexandra Palace, early in November.

THOSE TECHNICAL HITCHES

Considerable prominence has been given in the lay Press to the few technical hitches which have occurred during the first period of test transmissions. Actually these have been chiefly of a mechanical nature which would be liable to occur with any apparatus which had not had a long period of testing. One was merely due to a water stoppage in the supply used for cooling the valves. This water is fed from a tank on the roof of Alexandra Palace and the trouble was simply due to the feed pipe becoming blocked. This necessitated some alteration in the programme, films being transmitted instead of the studio features as was intended. Other minor troubles have occurred, but this has been the only serious trouble which has developed.

THE BAIRD SYSTEM MAKES THE START

The choice of the transmitting system to be used for the inauguration of the official television service was again decided by the toss of a coin—as was the case for the start of the Radiolympia transmissions—and as in the latter case Bairds again won the toss, so the first week will be occupied by transmissions by the Baird system.

TELEVISION PRICES

Mr. Richard Haigh, British general manager of His Master's Voice, speaking at a dinner of the Publicity Club of London.

" It will not be many years before

" The Ion Line on Cathode Ray Tube Screens "

(*Continued from the preceding page*)

With suitably chosen lens potentials the ionic image of the cathode can be made successfully visible. It appears after lengthy irradiation with the ions, as a negative when the fluorescent screen is diffusely illuminated by low velocity electrons.

In this article the question is left open as to whether the lesser sensitivity of those parts of the fluorescent screen reached by the ions is to be traced to the fact that a polarisation charged is developed or to the fact that chemical changes of the upper surface of the screen have taken place.

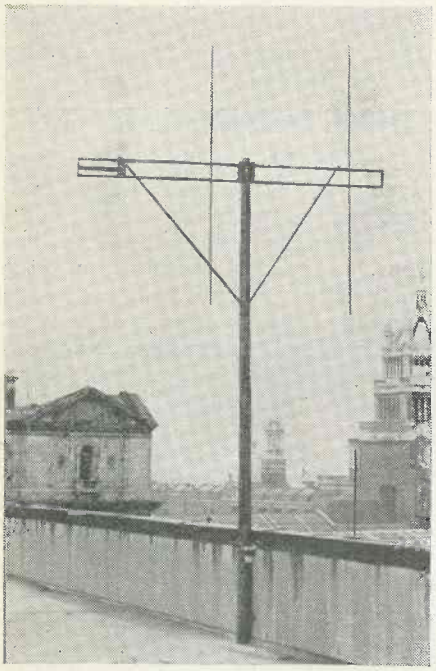
MORE SCANNINGS . . . . . .

prices of television receiving sets will be brought within the realm of the working man," he declared.

"I say that even though the sets may cost £40 to £50, because according to the experience of my firm it is the people of the class of policemen, postmen and tram conductors who are enthusiasts for new devices."

DEMONSTRATIONS AT SOUTH KENSINGTON

Free television demonstrations to the public are being given in the technical section of the South Kensington Science Museum. Visitors are admitted in groups of about a hundred



The aerial on the roof of the Science Museum

and the time they are allowed to stay depends upon the number that are waiting; five to ten minutes is the usual time.

The results that are being obtained are excellent and the public are able to witness the demonstrations under good conditions. Although there is a considerable amount of electrical machinery working in the building there is practically no sign of interference. The receiver used is a Cossor. An ordinary doublet aerial is installed on the roof of the museum and the height of the building necessitates the use of 150 feet of feeder plus an impedance matching device which consists of two parallel wires about fifteen feet long spaced about an eighth of an inch apart. It is evident that this long length of feeder does not result in any loss.

The picture remained perfectly steady for the whole duration of an hour's programme and the only adjustment made to the receiver was an occasional variation of the contrast. It is expected that these demonstrations will be continued for a period of several weeks, and they provide the public with an excellent opportunity of witnessing high-definition television reception.

THE MAN WHO WALKS IN A FIRE

The B.B.C. are certainly displaying some originality in their television programmes, what with the golf lesson, a model aeroplane display, a miniature motor show, we now come to a transmission of Edward Bridgeman.

This gentleman is perhaps better known as the man who walks in fire, for he tests asbestos suitings under working conditions. An actual fire is to be staged in the grounds of Alexandra Palace and he is to demonstrate how he can life-save by means of his asbestos suit.

TELEVISION, PAST, PRESENT AND FUTURE

Tune in to the National programme on October 29 or the Regional on October 31, and hear a feature programme with the above title. This is a chivalrous gesture on the part of the sound broadcasters to introduce the television on Monday, November 2. Laurence Gilliam and Felix Felton are compiling and producing this feature, of tracing the progress of television from the time when it was merely a figment of the imagination.

Contemporary newspaper reports are being drawn upon, very probably leading television personalities will contribute accounts of their experiences.

Listeners will be let into some of the secrets of television broadcasting, for some shots actually broadcast from the television station will find a place in the programme.

NOVELTIES IN THE FIRST WEEK'S PROGRAMMES

Many stage and screen stars are to be featured in a series of television programmes called "Starlight." Television programmes are to follow a definite schedule after November 2 so that the main features will always be broadcast at the same time of the day each week. Here are some of the items to be expected.

Mondays—"Picture Page." A television magazine.
Tuesdays—"Starlight."
Wednesdays—Novelty Items.
Thursdays—Ballet.
Fridays—From a London Theatre.
Saturdays—Vaudeville and children's features.

GERMAN SHORT-WAVES ENCIRCLE THE WORLD

Adolf Hitler is surely making a big effort to have his short-wave programmes heard throughout the world. Programmes, details of which are available weeks in advance, have been arranged for such zones as South Asia, East Asia, Africa and South, North and Central America.

German short-wave stations are on the air 22 hours out of 24 and with such high power that even simple equipment will bring in these programmes quite reliably in even the most distant parts of the world.

Special aerials, which are highly directional to any of the above areas, are in general use, so that they can concentrate on North America, for example, and make reasonably sure that anyone in that zone with a short- or all-wave receiver will be able to tune in to Berlin.

TELEVISION AERIALS

Most makers of television receivers supply their instruments complete with a di-pole or doublet aerial of some kind ready for erection. This

is all very well when the receiver is to be used within a reasonable distance of Alexandra Palace, but there must surely be a number of would-be lookers-in on the edge of the service area where such aerials would not be satisfactory.

It seems that the time is ripe for some energetic manufacturer to produce a simple directional aerial similar to those which can be bought in any radio shop in America, and which are used with such great success by our own Post Office.

In many cases a directional aerial for reception will decide whether or not pictures can be received. Amateurs working on ultra high-frequencies have discovered to their own satisfaction that when a station can barely be heard it can be brought up to very good strength by changing over to a directional aerial.

POSSIBILITIES OF MECHANICAL SCANNING

Edward K. Cohan, Engineering Director of the Columbia Broadcasting Co., was asked his opinion on the possibilities of mechanical scanning with a system using either vibrating elements or scanning discs up to 450 lines. His reply was "While the consensus of opinion in America points to the cathode-ray tube, or a tube of this general type, as the most desirable means of scanning and reproducing a television image, progress is still being made with mechanical systems, notably in Europe, and it would be unwise, at this early date, to rule out the eventual 'perfection' of a satisfactory mechanical system. Line for line reproduction of a mechanical system is superior to an electronic system."

When asked as to the possibility of television remaining on high-frequency waves of between 5 and 6 metres, he replied as follows: "While it is always possible that someone may come along with a revolutionary system which will enable high-definition television to be transmitted in a relatively narrow band, no research work, up to the present time, indicates that this is likely to be accomplished in the near future.

"It may be remembered that four or five years ago Mr. Farnsworth made a statement to the F.C.C. indicating that he was well on his way to the solution of this problem. In justice to Mr. Farnsworth it must be said that he was at that time absolutely sincere in his statement and his opinion was backed up by some of the country's foremost physicists. Further mechanical study by Mr. Farnsworth and his associates have pointed out the fallacy of their prediction."

SHORT-WAVES IN THE AIR

Over London in an aeroplane at 250 miles an hour between the hours of midnight and 3 a.m., Harry E. Bowbyes, of the R.A.F., picked up the Burns Sisters singing in a programme broadcast by short-wave station W2XAF. Bowbyes states that he has rigged up a short-wave receiver in his plane to test what stations could be heard under those conditions during the early hours of the morning.

NEW SHORT-WAVE REGULATIONS

Boyd W. Bullock, Assistant Manager of Broadcasting, G.E.C., in America, states that the status of American short-wave transmitters has now been changed. The method of presentation and call signs has been altered so that instead of hearing "these are stations WGI and W2XAF" the listener now hears the call signs of W2XAD or W2XAF.

Under the new regulations these short-wave stations have been called "International Broadcast Stations" instead of "Experimental Relay Broadcast Stations," the new name being significant of the service rendered.

American short-wave stations are now being heard all over the world, so much so that the time will soon come when sponsored programmes will be a matter of course. At the moment these International broadcast stations are debarred from making any financial gain from their transmission.

AN IMPROVED EMPIRE SERVICE

Some interesting information has been received from Australia about our own Daventry Empire stations. It appears that Daventry can now be heard for over 12 hours a day in Australia even in an average flat location and with a make-shift aerial. In spite of this the B.B.C. are still further to improve their service for they have ordered the erection of a number of high masts to hold new aerial systems. There will be 25 directional radiators giving transmission on 13 different wavelengths, including long and short path routes to Australia. When the old 5XX was the only station at Daventry the site occupied 50 acres, as compared with the present 130 acres which is still rapidly expanding.

THE B.V.A. AND AMERICAN VALVES

At a recent meeting of radio manufacturers, it was strongly hinted that the B.V.A. would authorise the manufacture of British valves with American characteristics. This is probably due to the fact that the less efficient American valves can be made so much more cheaply and with a lower breakage percentage.

This came to light when one of our largest valve makers began to make American type valves for a large British-American set maker. At the end of a period the lower breakage figure on American type valves became very obvious.

Recent Books

Testing Radio Sets, by J. H. Reyner, B.Sc., A.M.I.E.E. (third edition) published by Chapman & Hall, Ltd. Price 10s. 6d. This is a revised and enlarged edition of a book which has already enjoyed a large degree of popularity amongst those who are in any way concerned with the repair and servicing of wireless sets. The treatment of the subject is progressive, a first section dealing with general testing methods and the rectification of faults and the second section with laboratory methods. The book thus caters for the ordinary serviceman and also the more advanced technician who has laboratory equipment at his disposal.

Television Technical Terms and Definitions, by E. J. G. Lewis (Sir Isaac Pitman & Sons, Ltd.). Price 5s. This is a book of ninety-five pages covering the technical terms used in television with an adequate explanation of each. The terms are arranged in alphabetical order and the explanations are worded in an easily understandable manner. Apart from its value as a dictionary of television the book provides a fund of information.

TELEVISION RECEIVERS *YOU* CAN BUY

PRICES :: MODELS :: RANGE :: INSTALLATION

NO less than nine of our largest radio manufacturers are now in a position to supply reliable and simple television receivers that can be used in any home within a wide radius of the Alexandra Palace.

During the early stages of the B.B.C. experimental transmissions it was suggested that the service area would be in the region of 25 miles, so limiting the scope of television to those within the greater London area.

It has since been proved that this area is not so limited as was first suggested. In fact, the range of the Alexandra Palace transmitter may soon be up to 75 miles.

We cannot give a definite ruling as to the maximum distance at which television signals can be picked up for this depends so very much on local conditions, the height of the receiving aerial above surrounding objects, the type of aerial used, and several other similar points.

For guidance, however, we can say that television pictures are being picked up at such places as Cambridge, which is well over 50 miles from the transmitter, Ely, Clacton, Tunbridge Wells and Margate, just to mention but a few.

This will indicate that in favourable circumstances listeners within a reasonable distance from London can hope to receive pictures on standard equipment without going to any great amount of trouble.

All the new television receivers are fundamentally similar in design, in so much as they include two radio units, one for the reception of vision signals, and the other for sound programmes. This does not mean, however, that two aerials are required.

It is most important, particularly as the distance is increased between receiver and transmitter, that the aerial be erected in the best possible position. Very briefly these aerials are of a simple nature, consisting of either a half-wave di-pole, which is generally supplied by the makers, or a half-wave vertical consisting of about 11 ft. of copper tubing.

Owing to their dimensions these aerials can be fitted to the side of a chimney stack or when the receiver is within 10 miles or so of the transmitter, on small insulators along the picture rail near to the actual receiver.

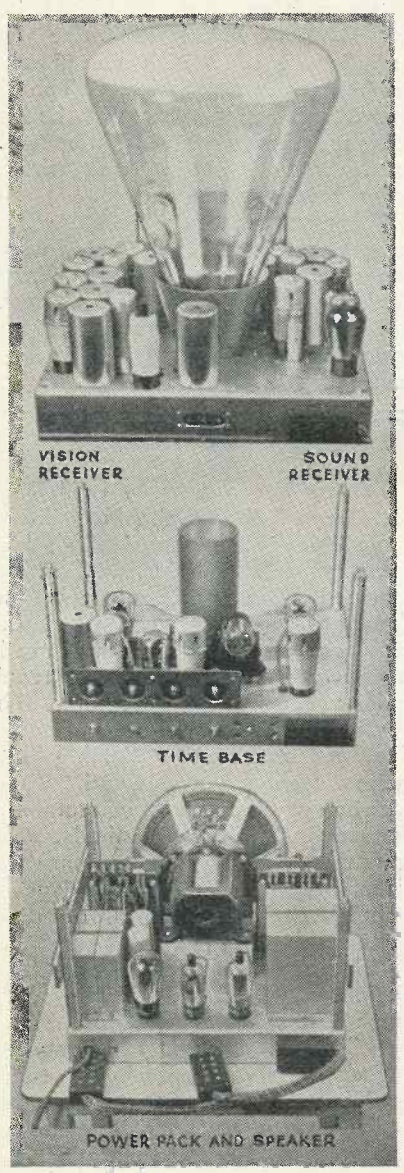
Those listeners who had visions of erecting unsightly poles and putting up a 60 or 100 ft. aerial, should be pleased to know about these simple aerial systems.

Unless a D.C.-A.C. converter is available all television receivers with the possible exception of Ekco-Scophony are designed for operation from D.C. mains only. The current consumed is in the region of a quarter of a unit per hour, so that the running cost, despite 20 valves, etc., is quite small.

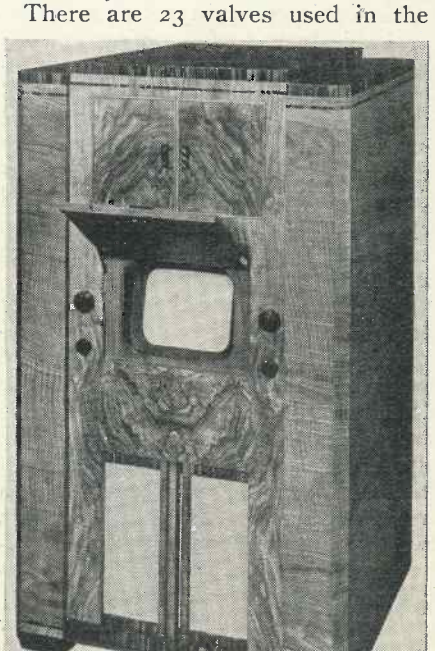
Marconiphone charge 95 guineas for their model 702 and 120 guineas for the 701. The first instrument is for reception of television programmes and the accompanying sound signals, while the more expensive receiver, model 702, is a complete home entertainer as it picks up television in addition to the normal short, medium and long-wave programmes.

His Master's Voice with their "Teleradio" also have two models, one for television and one for television plus normal broadcasting. The first has been designated Model 901, price 95 guineas, and the second, Model 900 at 120 guineas. These H.M.V. models are in appearance similar to their normal large radiogramophones, but with the cathode-ray television tube mounted vertically. The picture is reflected into the room at eye level by means of a mirror fitted into the lid of the cabinet. The picture size for the H.M.V. receivers is 10 ins. by 8 ins.

There are 23 valves used in the



This Murphy television receiver has been designed for easy servicing. The sound and vision receivers are on the same chassis as the cathode-ray tube which is of special construction



When the G.E.C. receiver is not in use it looks very similar to a conventional radiogramophone. The controls are equally as simple.

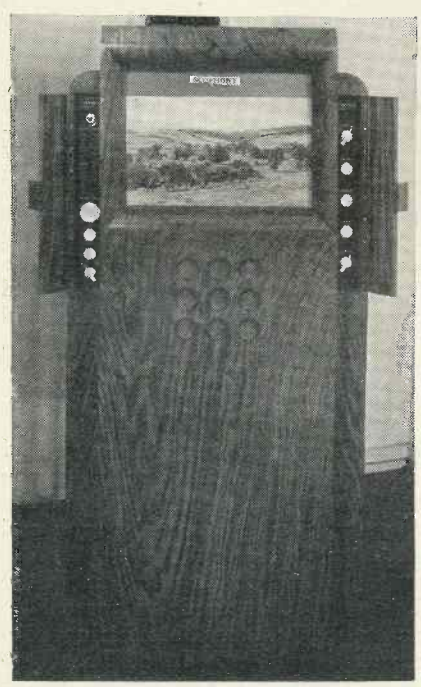
COMMERCIAL TELEVISION RECEIVERS

Model 900 and 22 valves in the Model 901. This may sound a lot but actually there are several units, including sound and vision receivers, with their power packs, time base and synchronising unit, and cathode-ray power equipment, so 23 valves is not such an awful lot after all.

A very imposing instrument is the Cossor Model 237T, which is priced at 120 guineas. As with other manufacturers', it is suitable for the reception of television in addition to high-fidelity reception of leading European broadcasting stations. The picture size is no less than 10 by $7\frac{3}{4}$ ins.,

A second instrument for those who already have a broadcast receiver is available for 105 guineas. This is Model 137T and as far as television is concerned, it is identical to the Model 237T.

Always foremost with new ideas and inventions are the G.E.C. They have two very fine instruments, models BT3702 and BT3701, the first being priced at 120 guineas and the second at 95 guineas. A picture approximately 9 ins. by 7 ins. is obtained on a 12-in. tube, while the method of mounting is just opposite to that in the Marconi or H.M.V. receivers. The tube is mounted almost horizontally, so that the picture is seen directly on the face of the tube.



A feature of the Ekco-Scophony picture is the size coupled with fine definition. This receiver operates on a mechanical system.

Here again, a large number of valves are used, actually 23 in the larger model.

Non-technical users will find this instrument particularly simple to operate, for sound and vision programmes are tuned in simultaneously by means of a common tuning control knob.

With the sound and vision receivers a common high-frequency amplifier is used, so that it is quite a simple matter to connect to a single aerial.

Pye Radio test their receivers at Cambridge, over 50 miles from Alexandra Palace, so that users of their receivers have the satisfaction of knowing that they at least have a range of that mileage.

Their Model 4201 has been priced at 95 guineas, which is a low figure in view of the fact that the sound section has been designed to give high-fidelity reproduction from 50 to 15,000 cycles. Also a large picture is obtained and is seen from the end of the tube, which is mounted horizontally.

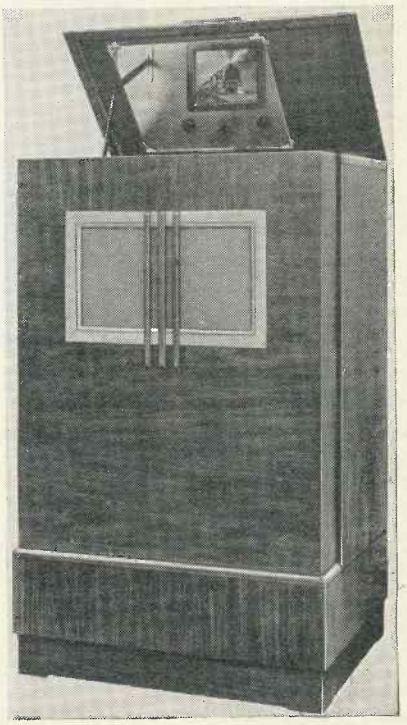
A second model has been introduced but not yet priced, but indications show that it will be round about 130 guineas. It is Model 4200 and includes in addition to television, a short-wave channel of 17 to 52 metres and normal broadcasting from 200 to 2,000 metres.

One of the most conventional looking instruments is the Ferranti, which has been priced at 100 guineas or 115 guineas with normal broadcasting in addition. These instruments are both similar in appearance to their radiogramophones and only have three actually usable controls for reception of vision.

One always associates the name Baird with the creation of television and they have two fine models, T5 and T6. They have not yet priced Model T6 which is television plus normal broadcasting, but their standard television receiver, T5, only costs 85 guineas. This receiver produces a picture 12 ins. by 9 ins., which is viewed in a mirror mounted at an angle of 45 degrees to the tube. Twenty valves are used, while there are seven control knobs, including a common one for the tuning in of sound or vision.

This receiver is 43 ins. in height, 23 ins. wide and 19 ins. deep, so that it is slightly larger than the usual run of radiogramophones.

Murphy Radio have been experimenting for a long time on the production of a television receiver, and they have now produced an instrument which lends itself to simple con-



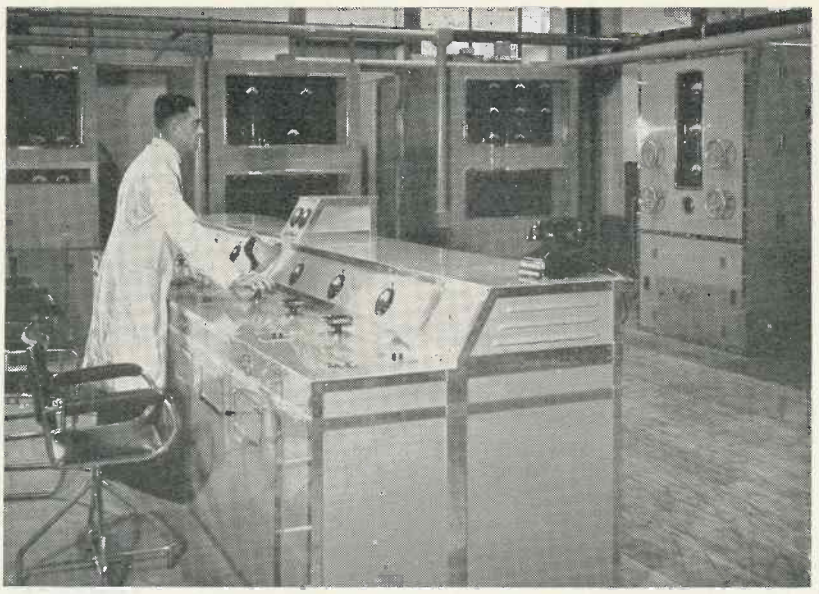
There are two Ferranti models, one including a broadcast receiver. This illustration gives a good idea as to how the Ferranti receivers are constructed.

struction and easy repair in case of breakdown. How the units are made up can be seen from the illustration on the preceding page. It has a total of three control knobs and is suitable for reception of Baird or E.M.I. transmissions.

Any readers who had doubts as to the possibility of television in the home should now be convinced that there is no need to wait. Manufacturers can supply, not from stock, perhaps, but very quickly, while there is every indication that the current models will give lasting service for several years. In the early days of radio expensive receivers went out of date very quickly simply because they were issued immediately they were designed.

With television, receivers were held up until the designs were absolutely complete, so the purchaser of a modern television receiver will not find the instrument completely out of date in a few months.

In ast month's issue we published full details of the television equipment of the B.B.C. Television Station at Alexandra Palace, including a unique pictorial view showing all the essential features and arrangement of the studios, etc. The following article describes the three transmitters which are installed, namely, the Baird and Marconi-E.M.I. vision gear and the B.B.C. short-wave sound transmitter.



Baird vision radio transmitter. Control desk—foreground: modulation amplifiers—background: Power output stage on right.

THE RADIO TRANSMITTERS AT THE LONDON TELEVISION STATION

THE vision radio transmitters at the London television station were provided and installed by the two companies responsible for the systems used, namely, Baird Television, Ltd., and The Marconi-E.M.I. Television Co., Ltd. The B.B.C. provided the sound transmitter and aerials for use with either television system. The three transmitters are housed in separate halls on the ground floor and all the apparatus is uniformly finished in grey cellulose and chromium plating.

In the Baird transmitter hall are situated the final stages of the modulation system used by the Baird Co. and the transmitter and motor generators necessary. The motor generators supply high tension up to 10 kV and some of the lower voltages used for radio lighting equipment and subsidiary supplies. The machines are of a special design to ensure silence in running with a maximum speed of 750 r.p.m., and are laid upon "floating" beds.

The modulation panels are fed from the C panel installed in the control room, separate amplifiers being provided for vision and synchronising, the output in each case being 600 watts.

The transmitter comprises three main panels together with an associated cubicle which holds the smoothing circuits. These panels are:—

(1) Constant-frequency drive equipment having crystal oscillator in a suitably controlled double oven. The frequency at which the crystal oscillates is 1.406 megacycles and it is followed by the necessary frequency doublers and amplifiers which give an output of 100 watts at 45 megacycles. This output is fed through a concentric feeder to the grid circuit of the drive stage.

(2) *Drive Stage.* This stage comprises one demountable water-cooled tetrode having an input of approximately 8 to 10 kW, which is supplied from a 7 kV D.C. generator, the screen being fed from a separate 2 kV generator on the same shaft. On this stage is injected from the appropriate modulation amplifier, the line and frame synchronising impulses which are then amplified and passed to the output stage.

(3) *Output Power Stage.* This stage comprises one demountable water-cooled tetrode having a maximum output of 40/50 kW supplied from a 10 kV D.C. generator and as in the previous stage, the screen is fed from a separate channel coupled to the anode supply machine.

The high-frequency circuits associated with the anode and grids of the last two stages are of special design and where necessary embody novel features in water cooling.

The output of the transmitter is coupled to the B.B.C.'s concentric feeder, through an intermediate circuit which is also water cooled.

In addition to the machines, panels, etc., a control desk is situated in the transmitter hall from which the running of the transmitter, and an observation of the outgoing picture by means of a check oscillograph and Televisor receiving set can be made.

A special feature of the transmitting system is the use of water-cooled demountable tetrode valves which, due to their extreme stability under the exacting conditions called for ensure reliability. In addition, the valves have replaceable electrodes, and although continuously evacuated it is only necessary to use the evacuating pumps for a maximum of 15 minutes per

THE MARCONI-E.M.I. VISION RADIO TRANSMITTER

day. All water-cooling, H.T. and L.T. filament supplies, are covered by interlocking and visual device indications.

Baird Sound Equipment

A sound chain is included to work in conjunction with each type of scanner. In the Telecine scanner a standard sound head is mounted immediately below the scanning gate, and the signal from the photo-electric cell is taken to an amplifier rack, a separate amplifier being employed for each machine. The output from each of the amplifiers is taken to a potentiometer enabling a smooth fade-over to be made from one machine to the other. From this change-over control the output signal passes to the break-jack in the control room jackfield, and from thence to a channel fade potentiometer mounted in the control desk. The fade unit is used either alone or in conjunction with other programme fade units for the insertion of effects, etc.

All incoming lines from programme sources are fed through the jackfield, a device similar to a small telephone exchange, permitting easy coupling and manipulation of the various units.

The output from the fade control unit is fed to a B amplifier and from thence *via* the jackfield to the transmitter, programme checks and modulation meter amplifier.

Intermediate-film Sound System

In the large studio, three microphones are provided together with their own single-stage amplifiers, and the output of each of these amplifiers is fed to a floor control desk. This has three fade units for microphone mixing together with the main recording control for the intermediate-film scanner.

The output from the floor control desk is fed to an amplifier rack and from thence to the control room, and finally, to the intermediate-film recording amplifier rack. The output from this recording amplifier produces a variable density track on the film *via* the recording lamp.

After passing through the intermediate-film processing plant, the film sound track is fed into the reproducing sound head, and from thence the signal is passed to the control room B amplifier and transmitter *via* the jackfield as described in the Telecine chain.

For the spotlight studio one microphone of a similar type is employed. For the purpose of checking the input to the transmitter, and for rehearsal purposes, four loudspeaker checks are provided.

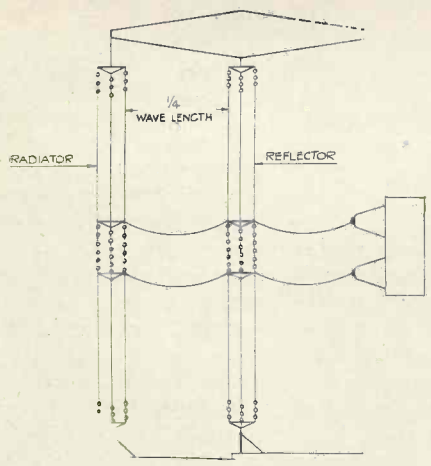
THE MARCONI E.M.I. TRANSMITTER

The Marconi-E.M.I. transmitter consists essentially of a master oscillator, frequency doubler, five stages of carrier frequency amplification and a single-stage modulated amplifier, with the addition of the necessary rectifiers for the main high tension and grid negative supplies having a linear band width of zero cycles (D.C.) to two million per second.

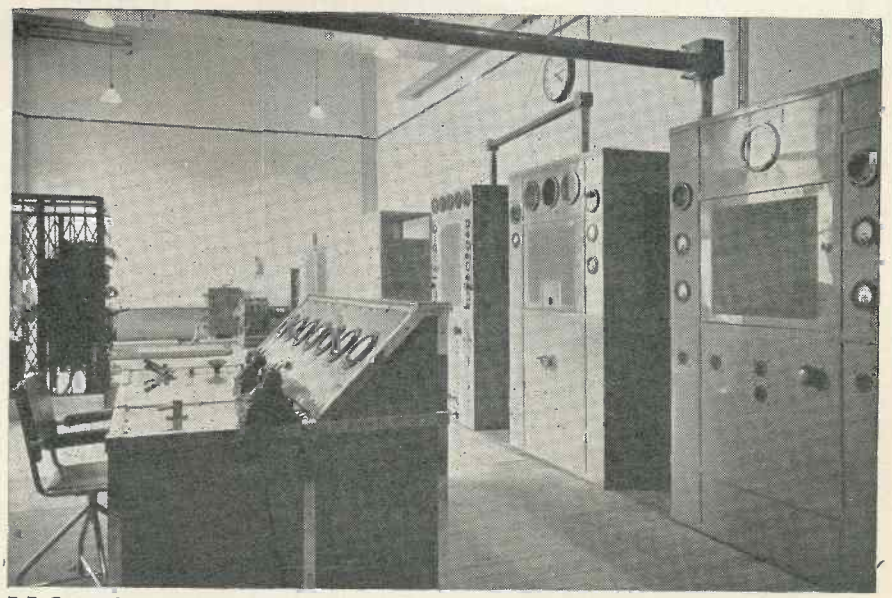
Master Oscillator

The most important unit of the Marconi-E.M.I. vision transmitter is the master oscillator unit which generates at low power a wavelength which corresponds to double that on which the pictures are finally transmitted, representing vibrations of $22\frac{1}{2}$ millions per second.

A modern version of a Franklin temperature compensated coil is employed in the master oscillator, which consists of a single valve (MPT_4) circuit of special design, the frequency of which is maintained at an accuracy of the order of one in 20,000, when the anode



Enlarged view of one dipole radiator element and its associated reflector (there are 8 elements in each aerial).



B.B.C. sound transmitter: control table, left foreground; drive unit and low power H.F. stage, centre background; final power amplifier, centre right; modulator unit, right; power switchboard, left background.

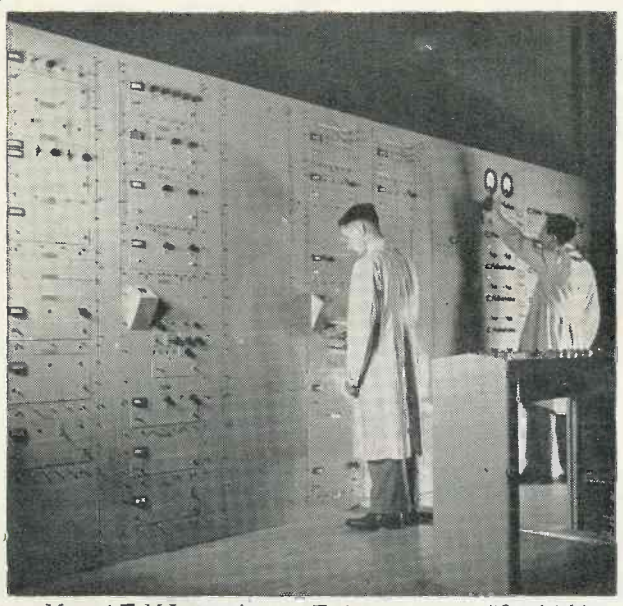
THE B.B.C. SHORT-WAVE SOUND TRANSMITTER

supply or filament voltage does not vary more than plus or minus 5 per cent. The output frequency of this unit is 22½ mc. Expansion or contraction of the inductances mechanically varies tuning condensers which are designed to keep the carrier frequency constant.

Drive Amplifier Unit

The signals from the master oscillator are fed into the drive amplifier unit. The output from the master oscillator on 22½ mc. is frequency doubled by an MPT42 valve following which are 2 MPT42 amplifiers in parallel, followed by one ACT9 stage, the output of this unit being two ACT9 valves in push-pull. The output voltage sweep of this unit is of the order of 1,200 volts.

The magnified H.F. is now passed to the intermediate amplifier which contains 2 CAT15 valves in push-pull. The output of this unit is fed to the final high-frequency magnifier stage which feeds the aerial. This is modulated by the camera-plus-synchronising signals from the camera channel on approximately 3 kilowatts.



Marconi-E.M.I. control room. Emitron camera amplifiers (right), synchronising oscillators (left).

The small but accurate pulses of the master oscillator, having been magnified as stated above to a power of approximately 3 kilowatts, are fed into the final power amplifier unit, which consists of two water-cooled valves having about 6,000 volts high tension supply, and which are arranged to give a linear power output to a specially tuned aerial feeding system.

The power amplifier unit consists of 2 CAT9 valves in push-pull, inductively coupled to the aerial feeder and modulated by the final modulator stage of the camera channel. At " peak white " the power delivered to the aerial is of the order of 17 kW.

THE B.B.C. SOUND TRANSMITTER

The B.B.C. sound transmitter is built in four separate units, each unit being housed in a metal cubicle. The master oscillator (ensuring a stability of plus or minus one part in 100,000) operates at half the carrier wave frequency, and is followed by one frequency-doubling stage and five high-frequency amplifying stages. Modulation is effected at the anodes of the final high-frequency amplifier by choke control; modulator, sub-modulator and sub-sub-modulator stages of the conventional type being employed.

In the final high-frequency stage, two CAT9 water-cooled valves in push-pull are used, and in the main modulator stage three CAM3 valves in parallel. The transmitter is designed to give high-quality sound reproduction and enable full advantage to be taken of the wide frequency band which is available at this low wavelength. The frequency response of the transmitter is substantially flat between 30 and 10,000 c/s., the maximum departure being less than 2 db. over this range, while the low-frequency harmonic content introduced by the transmitting apparatus is very low.

The low-frequency input stage (the sub-sub-modulator) is designed to operate from a signal which has an amplitude equivalent to that employed as a standard at all B.B.C. transmitters.

All the valve filaments are heated by direct current from a motor-generator set, having an output of 300 amperes at 20 volts, the filaments of the early stages being fed through voltage-dropping resistances.

Main High-tension Supply

The main H.T. supply at 6,000 volts D.C. for the penultimate high-frequency amplifying stage, the power-output stage and the modulators is obtained by means of a hot-cathode mercury-vapour type rectifier fed by a step-up transformer and provided with adequate smoothing circuits. Control of the high-tension voltage is carried out by means of a remotely controlled induction-regulator.

All auxiliary H.T. and grid-bias supplies are obtained from metal rectifiers, fed from transformers and provided with suitable smoothing circuits.

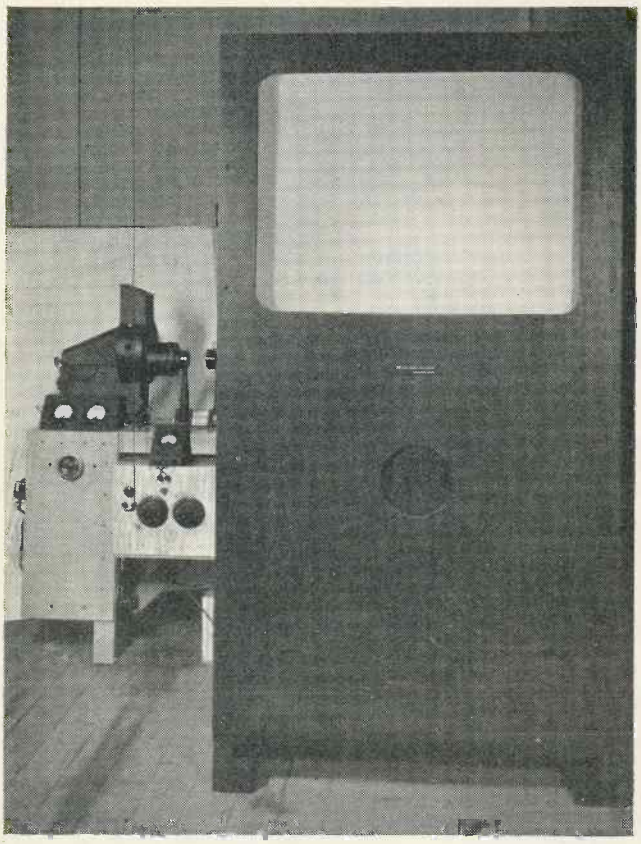
Control Circuits

The main controls are grouped on a control table so that one operator is able to manipulate all the power supplies to the transmitter. All switching operations are effected by remote control, and the switch-gear is fully interlocked to prevent damage to the transmitter by the application of power-supplies in the wrong sequence. In addition, there is a sequence-starting switch which ensures that sufficient time elapses between the application of each succeeding voltage, so as to allow valves and other apparatus to become properly warmed up before the mains H.T. power is applied.

All electrical apparatus is fully protected by means of over- and under-voltage relays and water-flow monitoring devices so that, in the event of the failure of any supply, the whole apparatus is automatically shut down and cannot be restarted until the deficiency is remedied. Additional interlocks ensure that the whole operation of " running-up " is restarted at the beginning, in the event of such a failure.

THE MIHALY-TRAUB SYSTEM UP-TO-DATE

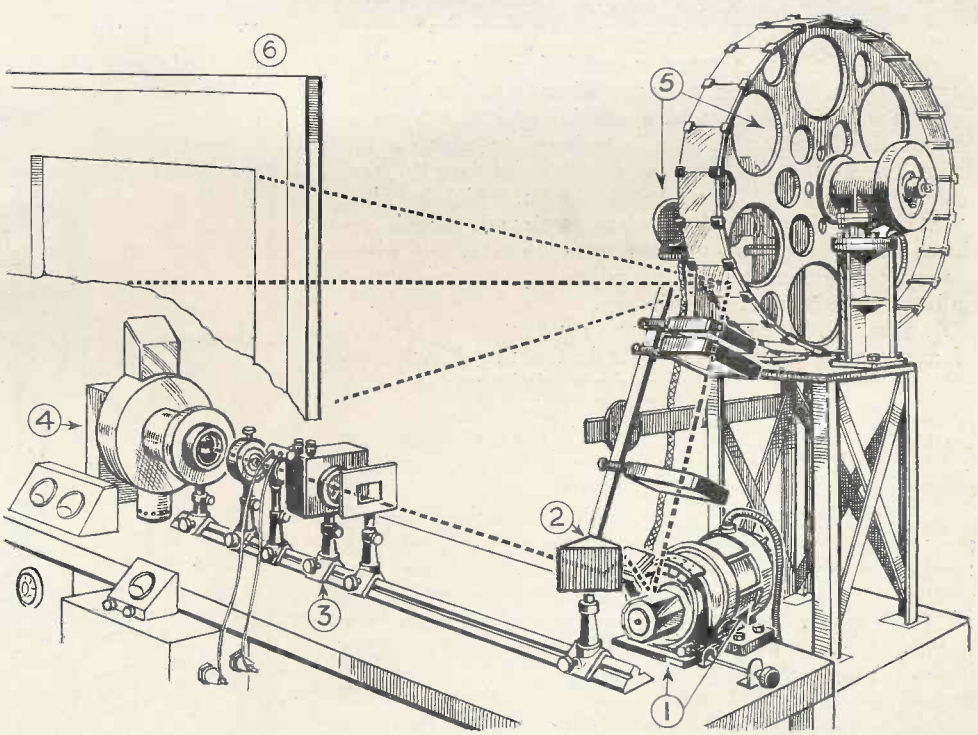
Details of the latest developments. Exclusive to "Television and Short-Wave World."



Above: High-definition medium-size screen receiver. Note the very small arc-lamp used.

Right: Schematic diagram of high definition receiver. The numbers refer to the following units.

1. *High-speed or line scanning unit and motor.*
2. *Prism.*
3. *Light valve.*
4. *Arc lamp.*
5. *Low speed of frame scanner and motor.*
6. *Screen.*

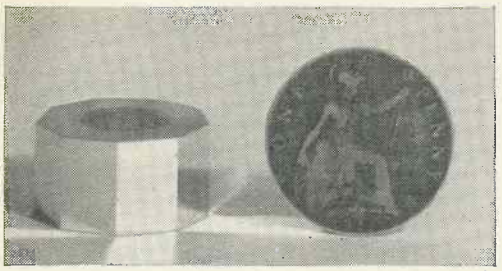


A GREAT deal of interest has always centred round the Mihaly-Traub television system since the original scheme was first evolved. This, it will be remembered consisted of a complete circular ring of mirrors in the centre of which was a double-sided plane mirror which was caused to revolve. A feature of this was the double reflection from the central revolving mirror, the modulated incident light being reflected from the central mirror on to the inner faces of the mirrors comprising the ring and then back again on to the central mirror from which it was projected on to the screen.

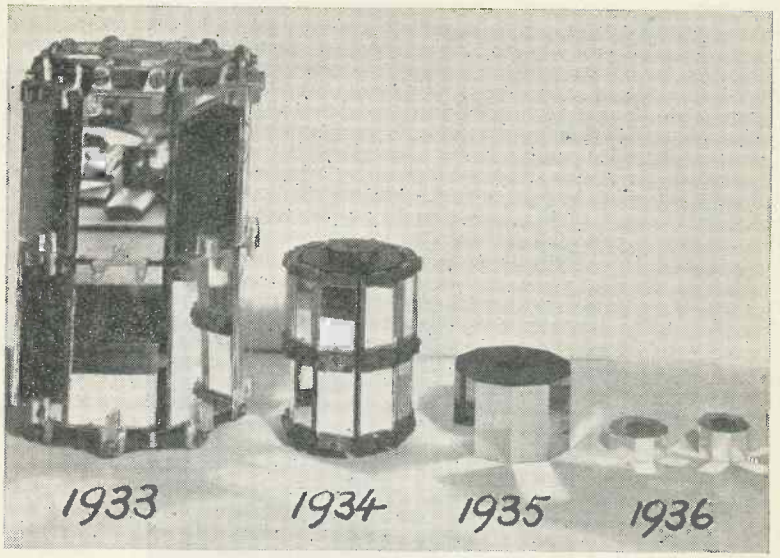
This arrangement presented several advantages over the more othodox methods of producing a scan and therefore a great deal of research work has been done since its first conception with a view to improving the system still further. Although the present system is very different to its prototype the broad working principle has been retained, with the result that very greatly improved results have been obtained.

Instead of a complete circle of stationary mirrors being used there is now only an arc consisting of five inwardly facing mirrors used in conjunction with a 9-sided polygon which acts as a "line multiplier."

In the original type of scanner the circle of mirrors were inclined at different angles to produce the frame scan, but this is now accomplished in another way and all the mirrors comprising the arc are in the same vertical plane and therefore quite easy to set.



Above : High Speed line polygon in the Mihaly-Traub receiver compared in size with a penny.



Right : Progress ! How the "multiplier" polygons of the Mihaly-Traub system have been reduced in size during the last few years.

(All photographs by courtesy International Television Corporation, Ltd.)

In the model we saw the 9-sided polygon is about 2 in. high and 2 in. across the faces and this for a 180-line picture revolves at 6,000 revolutions per minute, or 8,000 revolutions per minute for 240 lines.

The single line image is projected on to the screen by means of a frame scanner consisting of a 24-sided mirror drum. This is of large diameter, but rotates only once per second, and a special optical system is employed whereby the scan is reduced to zero on the drum, which is therefore of small axial length, and resembles a disc. A new optical system, which is called "interlaced focusing," is also employed, which reduces the sizes of some of the optical parts, and gives a very convenient means of adjusting the brightness and the definition of the picture.

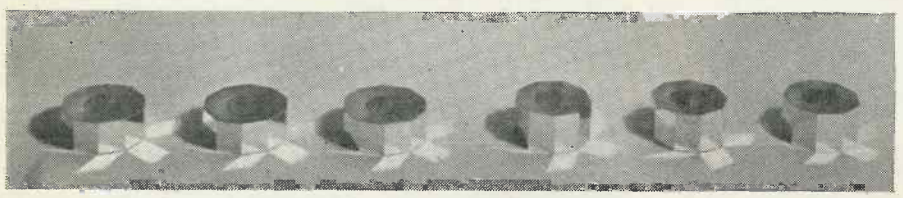
Another feature of this scanning system is the use of a patented method of "static framing" whereby the image is framed independently of the motor. The source of light for picture projection on a screen approximately 2 ft. 8 in. by 2 ft., is a small 10-ampere arc lamp, whilst an entirely new type of light valve is employed.

It is well known, of course, that mechanical systems offer more promising results for large screen projection than does the cathode-ray tube and this has been one of the principal objectives in the development of the Mihaly-Traub system. The apparatus is in bench form with all the units separate and adjustable. Obviously, though, there would be no difficulty in the construction of smaller units.

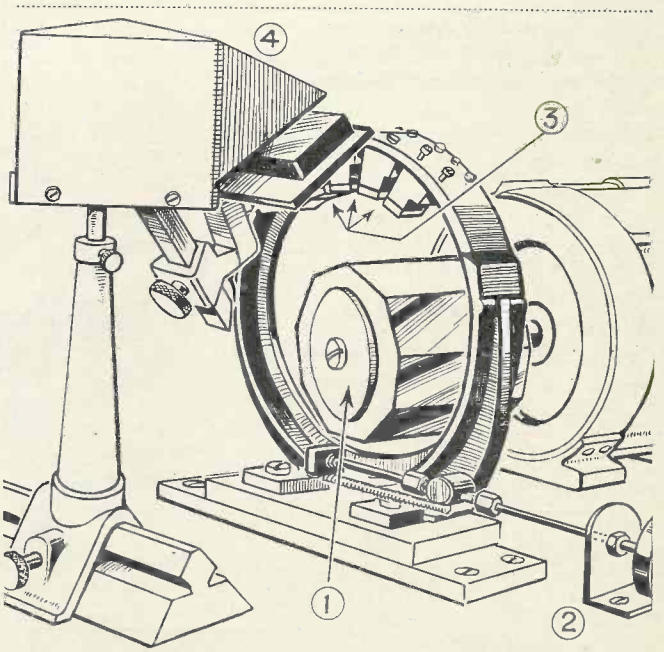
The drawing on this page shows the complete Mihaly-Traub scanning apparatus suitable for producing a picture 2 ft. 8 in. by 2 ft. with, of course, horizontal scanning. Photgraphs are also shown of the high speed scanners and their development from the one of the earlier polygonal scanners which was built up on an aluminium framework. The present scanners are made of solid glass, silvered on the surface by a special process in order to avoid refraction effects.

Both the high speed and low speed scanners are driven by separate synchronous motors. The latter contains 24 plane mirrors all set at right angles to the axis and it is driven at approximately one revolution per second.

(*Continued on page* 668).



Some small "multiplier" polygons for high definition home receiver.



Detailed drawing of the Mihaly-Traub scanner ; the motor is on the right.

1. *Mirror drum or line multiplier, 9 faces.*
2. *Phasing adjustment.*
3. *Ring of mirrors 5 faces.*
4. *Group of prisms and lenses.*

RECENT TELEVISION DEVELOPMENTS

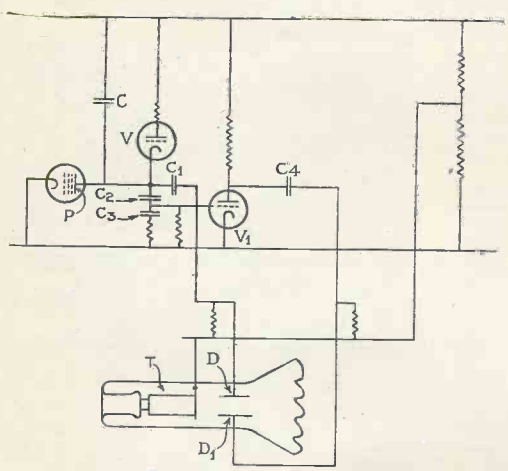
A RECORD OF PATENTS AND PROGRESS

Specially Compiled for this Journal

Patentees :— A. C. Cossor, Ltd., and L. H. Bedford :: C. O. Browne, J. Hardwick, F. Bluthen and E. L. C. White :: I. G. Farbenindustrie Akt. :: Scophony Ltd., and G. W. Walton :: The General Electric Co., Ltd., and L. C. Jesty.

Time-base Circuits
(Patent No. 448,111.)

The two deflecting plates D, D1 of the cathode-ray tube T are supplied with symmetrical driving-voltages from an unsymmetrical time-base circuit, in which the saw-toothed oscillations are produced by charging the condenser C through a pentode P and discharging it through a valve V. The output from the latter is fed to the deflecting-plate D through a condenser C1.



The Cossor time base circuit. Patent No. 448,111

At the same time a second valve V1 is fed with the discharge voltage from a tapping taken between two condensers C2, C3 arranged so as to form a capacity potentiometer. The valve V1 reverses the phase of the impulse, and feeds it in opposite phase through a condenser C4 to the second deflecting-plate D1 of the cathode-ray tube. —(*A. C. Cossor, Ltd.*, and *L. H. Bedford.*)

Television Receivers
(Patent No. 450,675.)

Interfering and spurious signals occurring in the intervals between the scanning of successive lines and frames are suppressed, or made harmless, by being converted into "blacker than black" impulses, so that they do not affect the D.C. component or background illumination of the picture. The amplification factor is also reduced during the "return" scan so as further to reduce the effect of any interference caused by the cutting-off the cathode-ray.—(*C. O. Browne, J. Hardwick, F. Bluthen,* and *E. L. C. White.*)

A Piezo Crystal as a Light-valve
(Patent No. 450,686.)

A piezo-electric crystal Q is first covered with a fine layer of metal, and fine line-gratings A, B are then scratched on its upper and lower surfaces. The gratings also act as electrodes to receive the signal voltage.

A ray of incident light is partly reflected by the lower grating, though some of it passes through, as shown by the arrows in Fig. 1A. The actual amount of light transmitted, and reflected, varies as the crystal vibrates between the dimensions D and d. Because of its comparatively small mass, the piezo light-valve is particularly suitable for handling the high frequencies used in television.—(*I. G. Farbenindustrie Akt.*)

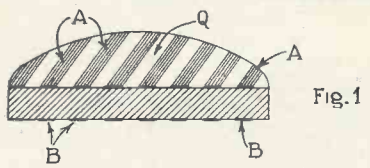
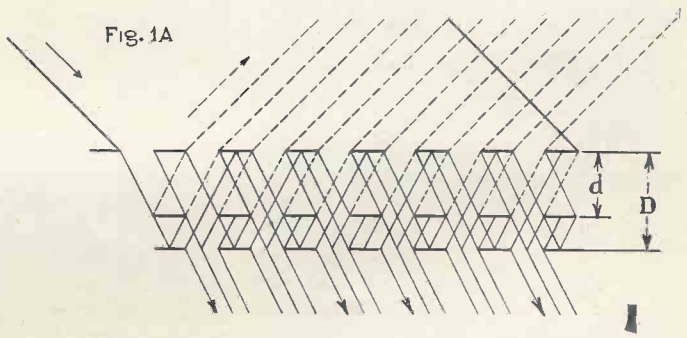


Fig. 1

Fig. 1A



Using a piezo crystal as a light valve. Patent No. 450,686.

Time-base Circuits
(Patent No. 451,117.)

Saw-toothed scanning voltages of equal magnitude and opposite phase are applied to the deflecting plates D, D1 of a cathode-ray tube from the valves V, V1 of the time-base circuit shown. The main condenser C is charged up through a constant-current pentode P, and is discharged periodically by the valve V. A part of the voltage across the pentode P is also fed through a capacity potentiometer C1, C2 to the grid of the valve V1, whilst a part of the anode voltage of that valve is fed back through a common resistance R. The arrangement is stated to keep each sweep of voltage strictly linear.—(*A. C. Cossor, Ltd.*, and *L. H. Bedford.*)

Scanning Systems
(Patent No. 451,132.)

Two rotating mirror-drums are

used, one D for line-scanning, and the other D1 for framing. The ray of light from a source S first passes through two lenses L, L1. The lens L has no power in the plane of the figure, whilst the lens L1 produces a cylindrical image of the source S on the fast-moving mirror-drum D. The beam reflected from that drum is then focused by a lens L2 on the viewing screen V, after reflection from the slow-moving drum D1.

In a plane at right angles to the figure, the lens L is the only one which possesses focusing power, and it throws a cylindrical image of the source on to the screen V. It is stated that the result is to form on the screen V a two-dimensional image, since in one plane it is focused from the mirror of the drum D, whilst in a perpendicular plane it is focused from the source S.

Because the light from S is focused on to each mirror of the drum D in turn, the size of these mirrors can be greatly reduced in the direction at right-angles to their motion, without in any way decreasing their optical efficiency.—(*Scophony, Ltd.*, and *G. W. Walton.*)

"Portable" Television Receivers

(Patent No. 451,980.)

The ordinary television receiver is necessarily a bulky piece of apparatus when mechanical scanning-discs are used, and the tendency likewise is to make cathode-ray receivers as big as possible in order to present a large picture. But in the latter case it is feasible to use a tube so small that it could be worn by the observer more or less as an eye-piece.

According to the invention this is done, and magnifying lenses are fitted to compensate for the loss in size. The portable eye-piece viewer is connected up to the amplifiers and to the time-base circuits by light flexible wires.—(*The General Electric Co., Ltd.*, and *L. C. Jesty.*)

Summary of Other Television Patents

(Patent No. 450,444.)

Wireless transmission of sound and pictures by frequency modulation.—(*H. A. Richardson.*)

(Patent No. 450,463.)

Kerr cell with interleaved electrodes of rectangular shape, which are spaced apart by a dielectric which lies outside the "active" field.—(*Marconi's Wireless Telegraph Co., Ltd., R. J. Kemp*, and *J. J. Mason.*)

(Patent No. 450,986.)

Time-base circuit comprising a discharge valve with a reaction coupling for increasing the rapidity of charge and discharge.—(*General Electric Co., Ltd.*, and *D. C. Espley.*)

(Patent No. 451,042.)

Television system in which the picture is synchronised by signals which are different in amplitude.—(*Radio Akt. D. S. Loewe.*)

(Patent No. 451,451.)

Cathode-ray tube constructed to facilitate the preparation of the fluorescent screen, the application of conductive layers to the "neck" of the bulb.—(*Marconi's Wireless Telegraph Co., Ltd.*)

(Patent No. 451,663.)

Method of maintaining the correct contrast of brilliance in a television picture.—(*J. C. Wilson* and *Baird Television, Ltd.*)

(Patent No. 451,670.)

Sound and picture programmes transmitted on two carrier-waves which are heterodyned by the same local oscillator at the receiver.—(*Radio Akt. D. S. Loewe.*)

(Patent No. 451,959.)

Scanning system in which the so-called "Marx" effect (or dependence of electron emission upon incident frequency) is utilised.—(*H. A. Richardson.*)

(Patent No. 451,724.)

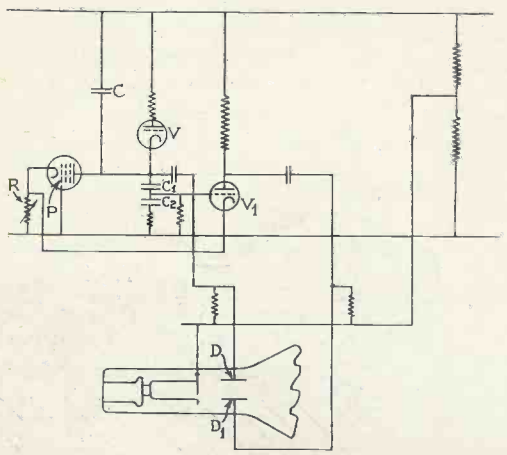
Valve of the electron-multiplier type used as a short-wave oscillation-generator.—(*Farnsworth Television Inc.*)

(Patent No. 451,786.)

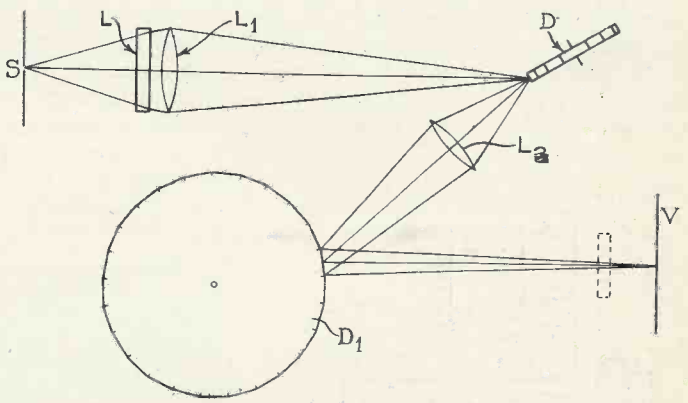
Control network for altering the phase of an isochronous oscillator with respect to a synchronising signal, when receiving television.—(*D. W. Willans* and *Baird Television, Ltd.*)

(Patent No. 452,097.)

Binding-agent for the fluorescent screen of a cathode-ray tube.—(*N. V. Philips' Gloeilampenfabrieken.*)



Time base circuit for keeping each voltage sweep linear. Patent No. 451,117



The Scophony scanning system. Patent No. 451,132

CATHODE-RAY TUBES

A special course of eight lectures on the cathode-ray tube and its applications will be given by Mr. G. Parr, of the Ediswan Co., at The Polytechnic, Regent Street, on Mondays at 8.30 p.m. commencing November 23. The fee for the course of eight lectures is 10s.

Full particulars can be obtained from the Director of Education, The Polytechnic, Regent Street, W.1.

STUDIO & SCREEN

A MONTHLY CAUSERIE on Television Personalities and Topics

by K. P. HUNT
Editor of "Radio Pictorial"

EVERYONE connected with the television world felt genuinely sorry for Gerald Cock, the B.B.C.'s Director of Television, who was stricken low and confined to bed with sciatica at the very hour of his triumph.

He was taken ill just at the beginning of October, and was not present at Alexandra Palace on the opening day of the regular experimental transmissions. This was indeed a stroke of terribly bad luck, and it can be

Da las Bower who has been engaged on the production of the film "Television Comes to London."

imagined what a disappointment this must have been to him, after all the months of work and anxiety.

If Gerald Cock was not present at Alexandra Palace in person, however, he was certainly there in spirit, and all members of the staff were tremendously happy and proud when, on the opening day, a telegram was received from their chief who was confined to his flat in Clubland. It was a simple message of encouragement, signed "The Unwilling Deserter, Gerald Cock."

* * *

Opening day at Alexandra Palace also brought many other expressions of goodwill from a variety of people. I heard, for instance, that one of the good luck messages was in the form of a telegram from Rita Grant, the film actress who, it will be remembered, was seen by "lookers" at Radiolympia in a spotlight interview with Elisabeth Cowell.

Everyone hopes that Gerald Cock will have a speedy recovery. At the time of writing these notes, I hear he is going on as well as can be expected, and hopes to be back in harness probably before my words are in print.

Is it not a tribute to his organising ability that the month's television programmes began without hitch and continued in such an eminently satisfactory manner? Their success proved to the critics as well as to all his friends that Gerald Cock had devised and set in motion at Alexandra Palace a machine which goes like clockwork.

* * *

Mr. D. H. Munro, the Productions Manager at Alexandra Palace, is just as active as ever, and is keeping things humming. Cecil Madden, about whom I wrote last month, is also very busy and his evident abilities in this new field are rapidly being confirmed.

Cecil Lewis is working virtually independently, and already has done what was described to me last week as some "stout work" in developing the O.B. side of television. It was he, for instance, who organised the golf match with Archie Compton and who took charge of the presentation of the recently televised mannequin parade.

Dallas Bower has done a lot of work during the month in connection with the closing sequences of the B.B.C.'s television film entitled: "Television Comes to London." He has also acted as producer in such scenes as Adele Dixon singing the new television song: "Television," which, by the way, was written specially by James Dyrenforth and Kenneth Leslie-Smith.

Stephen Thomas, the other producer, has, I am told, been concentrating principally upon television ballet programmes of which we can expect to see a good deal in the immediate future. He has also been mostly responsible for what should be a very successful series of television programmes entitled: "From the London Treatre."

* * *

Among all these busy people at Alexandra Palace, there are two more whom I must not forget to mention

Bebe Daniels who will appear in the November 3 programme.

—the stage managers, Peter Bax, for instance, has made a beautiful little model of part of Canterbury Cathedral, as it would have been in the time of Thomas á Becket, and which was used in a recent transmission entitled "Murder in the Cathedral."

I was told at "Ally Pally" that this is the first attempt to introduce scenery in television production. I am afraid that is not quite accurate, for if I remember rightly, Eustace Robb used some scenery and models in the old 30-line transmissions from Broadcasting House. Anyway, the experiment is regarded at Alexandra Palace as important, for it is felt that the use of models may be developed

THE FIRST OF THE REGULAR PROGRAMMES

considerably in the near future and may solve many problems of television production.

I have not seen announcer-hostess Elisabeth Cowell during the month, but on inquiry was informed that she has not yet received any offers of marriage or, if so, is managing to keep them quiet!

Everyone was glad to see Miss Jas-

Stephen Thomas, producer of the act featuring Bebe Daniels and Ben Lyon.

mine Bligh back again. As readers know, she is Miss Cowell's colleague on the announcing staff. As a matter of fact, she returned several days before the doctor really gave her permission, and on the first day went straight into the Baird spotlight studio and began work. I am glad to say that Miss Bligh is now looking fit again after her very severe illness, which I hear was much worse than at first supposed.

* * *

That slightly worried and anxious look has now left the face of Miss Mary Allan, the B.B.C.'s television make-up expert, for her problems have not turned out to be anyhing like so formidable as she expected a month ago. She has been delighted, I hear, to discover and settle definitely that the new high-definition television does not need anything more than "straight" make-up.

Not being quite sure what this meant, I inquired, and it was explained to me that a " straight " make-up is one which only emphasises existing features.

It is not necessary to put on any lines which normally are not there, and there is no question of painting in contours or other shading as was necessary with the old 30-line studio technique. Miss Allan, by the way, did some marvellous work during the " Picture Page " transmission.

Looking back hurriedly over the October television programmes, this " Picture Page," consisting of flashes of numerous interesting personalities and so on, must be singled out as an instant success. Cecil Lewis's contributions were also notably excellent. It is quite certain that many of these try-out programmes will be seen again.

* * *

At the time these notes appear, interest will be mainly centred, of course, in the forthcoming programmes for the month of November. In this respect I am sorry that I cannot satisfy curiosity in full, as Mr. E. C. Thomson, the B.B.C.'s popular television Press Officer, informs me that programme details are not yet available. Although Mr. Thomson personally is doing all he can, and the whole of Fleet Street owes him thanks, there is a feeling that the B.B.C. could reasonably be far less secretive about television news.

I am able, however, to give some very brief particulars of the early programmes in November, as it is during this month that the regular programmes really begin. The opening ceremony will take place at 3 p.m. on November 2.

Major G. C. Tyron, the Postmaster General, is to perform the official part of the ceremony, but there will also be speeches by Lord Selsdon, Chairman of the Television Committee, and Mr. R. C. Norman, Chairman of the B.B.C. This will last about a quarter of an hour, and will be followed by a televised news reel.

After that, televiewers will see the interval signal which, as they already know, consists of a clock face. At the top of the screen there will be a weather forecast for the next twenty-four hours, and a note of the television system in use, also, of course, the time, which will be shown by the hands of the clock itself. At the bottom of the screen will be a brief announcement of the next item.

Following this, will be a short variety programme of the cabaret type which, I understand, will be produced by Dallas Bower. The acts on the bill, in the order of their appearance, will be Miss Adele Dixon, Buck and Bubbles, and a Chinese juggling act. Adele Dixon will be singing the new television song. Buck and Bubbles are negro artists, while the jugglers are the Lai Foons, a well known stage act.

The evening programme, at 9.5 p.m. on November 2, is also one of varied interest. The big thing in this programme, I gather, will be the film " Television Comes To Town," but it will also be notable for the second edition of " Picture Page," which is described as a " topical and interest magazine devised and edited by Cecil Madden." Following these two items will be a news reel.

I have been unable to persuade the B.B.C. to give me many further programme details for the first week of November, but I am told that there will be a display of Alsatian dogs on November 3. Also on that day, Tuesday, and every subsequent Tuesday, the " Starlight " series will be continued. Perhaps the outstanding item on November 3, however, will be Bebe Daniels and Ben Lyon, who will be seen in an act produced by Stephen Thomas.

Adele Dixon will sing a new television song in the first regular programme. (Photo : Mannell, London).

I confess I didn't personally see many of the purely experimental television programmes during September, although I made a point of " looking-in " at Henry Hall.

THE TELEVISION ENGINEER

AN EXPERIMENTAL CATHODE-RAY RECEIVER

By Manfred von Ardenne

This article, which formed the subject of a paper read before the Institute of Radio Engineers, U.S.A., describes a television receiver designed by Manfred von Ardenne for the reception of the Berlin transmissions of 180 lines and 25 pictures per second.

FIG. 1 shows the connections in the picture portion of the intermediate-frequency receiver. At an average signal strength of about one-half millivolt per metre the receiver supplied sufficient output when small half-wave indoor aerials were used. Less favourable receiving conditions necessitated outdoor aerials which were connected to the receiver by a transmission line. Usual circuits are used in heterodyne mixer stages.

The scanning standards used in Berlin, namely, twenty-five pictures per second, 180 lines, picture aspect ratio 5:6, necessitate the uniform transmission of a frequency band of about 0.450 megacycle in order to make the vertical detail equal to the horizontal detail. As is well known, the communication band is twice as wide as the modulating-frequency band, in our case 0.9 megacycle. This is needed for perfect reproduction.

With a carrier frequency of, say, 1.0 megacycle (using both side bands), an aperiodic amplifier having a frequency range of about 0.5 to 1.5 megacycles is required. Such amplifiers have been available for many years. Briefly, the stage constants which have been calculated for this frequency band, normal stray capacities, and the specified type of tube are:—

Type of tube, Telefunken RENS 1284
Anode resistance, 5,500 ohms
Self-inductance in anode circuit, 0.3 millihenry
Voltage amplification (within frequency range mentioned), 16-18.

Due to the absence of feedback, screen-grid valves offer considerable advantages, because of the ease of calculation of amplification as well as their satisfactory operation. However, in the valve mentioned above, input and output capacities are from two or three times greater than in other multi-electrode valves which have been used previously. The inductance inserted in series with the anode resistance resonates with the stage capacity, forming an oscillating circuit which is rendered almost aperiodic by the anode resistance, and whose natural frequency is around 1.5 megacycles. The comparatively great voltage amplification per stage could be realised only by the use of this inductance in the anode circuit, despite stage capacities as great as twenty to thirty micromicrofarads. The method of using inductance in aperidoc amplifiers had previously been introduced and applied. It was possible to get the necessary voltage amplification of 10 with relatively few stages and a relatively low anode supply current.

The apparatus could be operated either with both side bands or, preferably, with one side band. Better results were obtained with one side band and, therefore, another frequency curve was chosen, the form of which was arrived at by a design of the coupling unit whose constants differed somewhat from those given above, and by special selection and damping of the transformer supplying the second detector.

The amplification characteristic, increasing from the low-frequency end, reaches its maximum at 0.5 megacycle. Up to about 0.9 megacycle the curve falls off only slightly. The drop is more rapid above 0.9 megacycle, and is followed by a very steep drop at 1.4 megacycles. The carrier frequency is adjusted so that half of the total amount of amplification lies in the range between 0.5 and 0.9 megacycle. In the lower modulation-frequency range where both side bands are demodulated, twice the amplitude is available. This over-accentuation of the low fre-

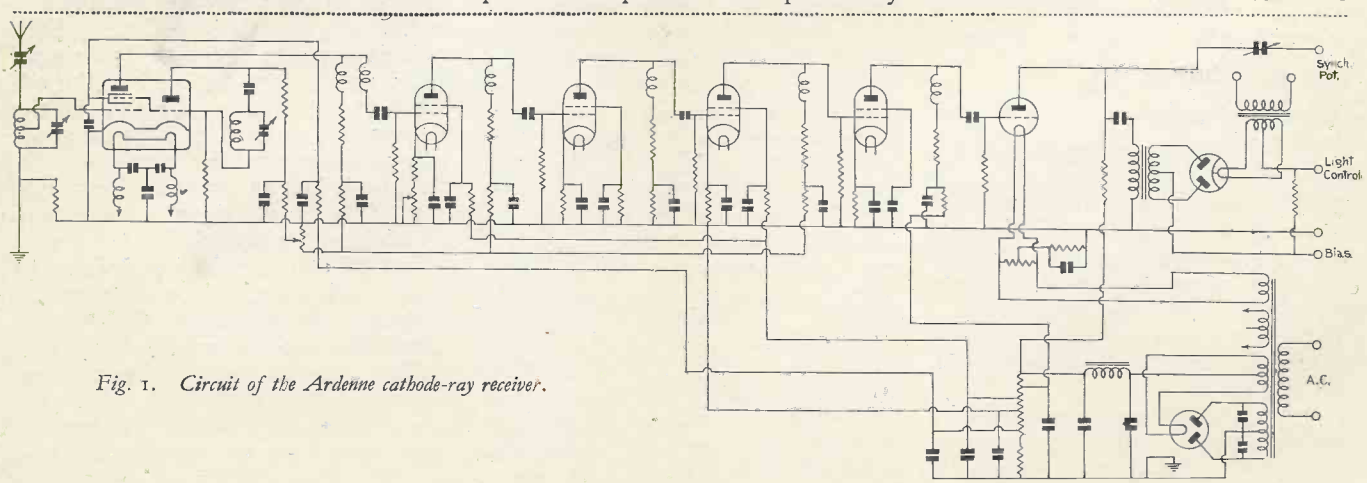


Fig. 1. Circuit of the Ardenne cathode-ray receiver.

quencies is equalised because the amplifier has only half the amplification over this range. The result is a smooth frequency characteristic which rises slightly at higher frequencies.

The frequency response curve corresponds closely to the curve of an amplifier with choke-resistance coupling. The only disadvantage perhaps may be that it is necessary to employ the correct heterodyne frequency. The proper operation of the heterodyne can be simplified by means of simple markings, by using stable oscillating circuits which are only slightly affected by temperature, or, by the use of simple indicators for the carrier frequency, similar to those used with wavemeters.

The difficulties accompanying the use of only one side band can be eliminated to such an extent by means of the above frequency characteristic and by a suitable choice of carrier frequency, that it is not possible to detect, by observation of the picture, that single side-band transmission is being used. This arrangement, single side-band operation, permits the use of modulating frequencies of 0.7 to 0.8 megacycle. This diminishes the band width required for the reception of the Berlin transmissions.

The Second Detector Stage

The voltage appearing at the output of the last intermediate-frequency amplifier stage is fed to the detector and to an amplitude filter which will be discussed later (Fig. 2). The type of modulation used at the Berlin transmitter makes possible the utilisation of the direct-current component of the picture signal for background control.

Direct-current background control is accomplished most directly by coupling the second detector to the grid of the cathode-ray tube. The simplest way is to have rectification take place in the cathode-ray tube itself. Such rectification, however, has the disadvantage that the emission current of the cathode-ray tube is only utilised for a fraction of the time, so that comparatively dim pictures result.

Since a reserve of brightness must be available, rectification within the cathode-ray tube is practically out of the question. More satisfactory results are obtained if a separate full-wave rectifier is placed ahead of the cathode-ray tube, because then sixty to eighty per cent. of the maximum emission current can be utilised. How much of the maximum beam current may be used depends upon the amount of parallel capacity which may be added across the rectifier output to remove the intermediate-frequency components from it. Experience has shown that it is not easy to get perfect results from a full-wave rectifier. At high frequencies large asymmetries are caused by small differences of stray capacities of transformer windings to ground. The alternating of brighter and darker pattern points indicates these asymmetries. Under very unsatisfactory conditions the asymmetry may become so great that one-half of the wave remains unused. To avoid such difficulties it is necessary to increase the intermediate frequency greatly. At an intermediate frequency of six megacycles, it is possible to use satisfactorily a cathode-ray tube with half-wave rectification in the same way as with full-wave rectification, as shown in Fig. 3. The use of shunt capacity across the rectifier output to remove intermediate-frequency components from it tends to decrease picture detail by attenuating the higher modulation frequencies. This method then must be used with care; the trouble may be greatly diminished by the use of a high intermediate frequency. A correct compomise may be made easily by the proper selection of resistance *R* in Fig. 1. This resistance can have a value as high as 10 ohms without noticeably affecting the picture sharpness if the circuit and equipment has little capacity. With a resistor of that value the voltage variations required for modulation of the cathode-ray tube can be attained with a relatively small receiver output. When full-wave rectification was used intermediate frequencies up to 1.5 megacycles were still visible on the television screen.

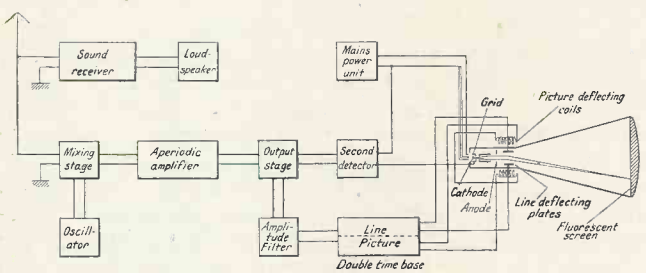


Fig. 2. Schematic diagram of receiver.

An Amplitude Limiting Circuit for the Separation of Constant Synchronising Impulses

The Berlin transmitter is modulated in the following manner:

The darkest shadow of the picture corresponds to a certain residual aerial current, which at present is established at the transmitter at a value between twenty-five and thirty-five per cent. Picture modulation is accomplished by varying the aerial current between this value and the maximum value in accordance with the instantaneous illumination at the element of the picture being scanned. The synchronising signals are transmitted on the other hand by cutting off the aerial current completely. This occurs at the completion of each line and at the completion of each picture. The duration of the synchronising pulses at present is five to seven per cent of the scanning time for a line or a picture, respectively. The resulting large difference in frequency permits the separation of horizontal and vertical synchronising impulses by means of frequency separating circuits.

This procedure, which has shown good results in practice, has the advantage that only a fraction of the transmitter output (at present about one-tenth) is used for synchronising, that is, is lost as far as the transmission of the picture signal is concerned. In addition the cathode-ray tube beam is cut off at the end of each line and at the end of each picture, due to the pulses, so the return traces of the electron beam remain invisible.

This blanking-out effect is necessary, not only for the return of the electron beam to the top of the scan after each complete frame, but also for the return of the beam at the com-

pletion of scanning each line, because otherwise the attainable contrast interval will be limited in accordance with the ratio of the speed scanning —speed re-trace. Moreover, when intermediate-frequency reception is used, the spot intensity also varies periodically during the re-trace. If, therefore, this trace is not blanked out, very disturbing streaks will be visible in the dark portions of the picture.

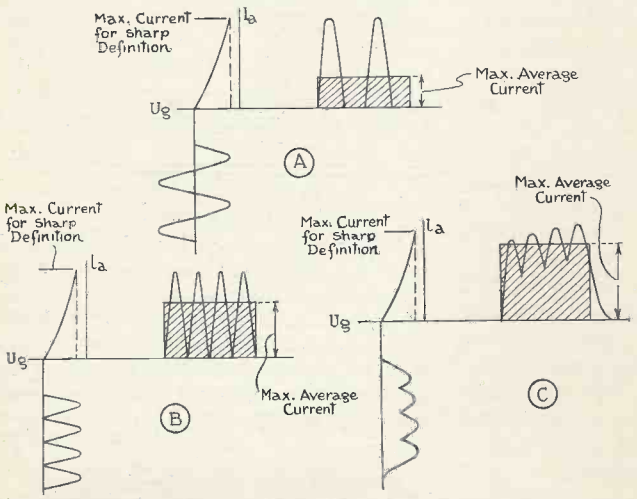


Fig. 3. Variation between intermediate frequency rectification and maximum beam current of the cathode-ray tube.

One of the chief difficulties in television consists in obtaining exactly similar synchronising impulses which are not only entirely free of picture signal content, but also are affected least by the mean disturbance voltage from the receiver. Even very slight variations, particularly in the intensity of the synchronising impulse, suffice to cause a considerable displacement of lines or a change in picture and unpleasant picture flicker. Changes in synchronising impulse intensity naturally have more effect the greater the synchronising power. The problem of securing steady synchronising impulses from the mixture of voltages at the intermediate-frequency output was solved by the insertion of a valve having the characteristic curve shown in Fig. 4. The operating point of the grid of this valve is made strongly negative (in Fig. 4, for example −5 volts), thereby preventing the disturbing voltages during transmission of synchronising impulses from reaching the value at which anode current of this amplitude filter begins to flow.

As soon as the synchronising impulse is over (assuming correct division of the receiver output voltage) a current always flows in this valve, the mean value of which is about equal to half the maximum value of the valve characteristic. This current does not depend on the respective modulation values during the picture modulation interval (i.e., on the picture content), because the characteristic after reaching its upper break drops again. For the type of valve in Fig. 4 and the voltage selected, the drop in the characteristic after reaching its upper break is attained by the familiar current distribution effect (retarded field arrangement). The proper selection of the auxiliary grid voltage makes it easy to bring the drop to a value which gives practically ideal independance from the degree of modulation of the transmitter prevailing during the picture modulation interval.

In the final analysis this process is based on the selection and utilisation of a very small modulation interval at the transmitter, for example, an interval of from twenty to twenty-five per cent. of the total modulation interval so as to allow always the same current. The regularity of the resultant synchronising impulses is so absolute that extremely stable synchronisation is afforded, even without the use of additional frequency selecting stages. The pictures have remained flawless and stable over periods of several hours.

The High-vacuum Tube

High vacuum tubes of the Leybold and von Ardenne Oszillographen-Gesellschaft, Köln-Bayental, were used in the arrangement described.

The electron-optical arrangement of this type of tube operates with double electrostatic concentration according to George, of a similar type to that employed in practically all modern television tubes. In the ordinary design this type of tube has only two deflecting plates which are charged by the horizontal deflection potential. Symmetry, with reference to the anode, is maintained by the use of push-pull output valves to drive the horizontal deflecting plates.

The low-frequency vertical deflection is accomplished by means of deflecting coils fed with current from a relaxation oscillator. These deflection arrangements permit the maintenance of spot sharpness to the extreme edges of the screen. These conditions prevail, not only for wide deflection angles, but also at high beam currents and small sections.

Furthermore, by reducing the distance between the electron gun and the fluorescent screen by the length which is required by a pair of plates, a corresponding increase in the sharpness of the spot results as a corresponding decrease in the over-all length of the tube as compared with a double electrostatic deflection type of tube. Finally, through the use of magnetic deflection in the vertical direction it is possible to adjust precisely the size of the picture from the outside of the tube Thus, all the advantages of requiring a large amount of electrical energy for deflection at the higher frequencies.

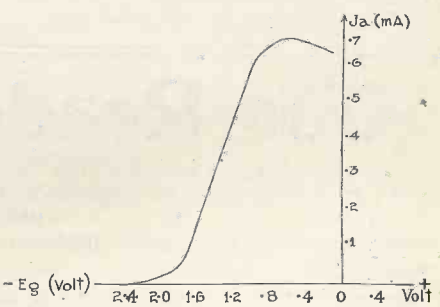


Fig. 4. Characteristic curve of amplitude filter using screen grid valve.

Circuit of the Push-pull Thyratron Relaxation Device

The following method has proved itself to be a simple one for the production of relaxation oscillations which are sufficiently linear for television use.

The voltage difference between the discharge and extinguishing points of a grid-controlled gaseous discharge valve is adjusted to a value that is

small compared with the charging voltage source. The discharge value is chosen so that breakdown occurs at the level of about one-half of the charging source voltage. Under such operating conditions a sufficiently linear rise in current for television purposes is obtained, even when the capacity which is in parallel with the thyratron is charged through a resistance. This is because the portion of the curve used is only a very small part of the central portion of the usual charging curve, and thus it is sufficiently linear.

The resulting relaxation voltage is usually either too small (even if the anode supply of the cathode-ray tube is used as a charging voltage) or, if it is large enough, requires such heavy discharges that the life of a gaseous discharge valve is critically shortened. Also, the relaxation voltage is not symmetrical with respect to ground.

Valves with a large amplification factor are used, as well as anode resistances which are large compared with the internal resistance of the valve. The operating characteristic of a stage designed in this manner is so linear over a wide range (depending on the magnitude of the anode voltage used) that up to seventy or eighty per cent. of the voltage at the anode supply may be linearly controlled. Even with one stage this percentage is as great or greater than may be obtained by charging the relaxation condenser through a valve which gives a constant load current (such as valves using saturation or suitably connected grid valves) without subsequent amplification.

The output voltage is effectively doubled when the push-pull circuit is used. This circuit has the added advantage of providing deflection potentials symmetrical with respect to ground which are required when operating high vacuum tubes. Using such circuits and an anode voltage of 1,000, sufficiently undistorted relaxation voltages of magnitudes up to 1,500 volts have been produced.

The anti-phase voltage required for controlling the grid of the symmetric stage is tapped off of the anode resistance of the main stage. Now, the actual voltage division takes place in the grid circuit of the symmetric stage. This arrangement has the advantage of dividing the hum voltage as well as the signal voltage, so that less smoothing is necessary.

Resistances are also provided in the discharge circuit of the relaxation valves which not only act as protective resistances for the gas-discharge valves, but also have, in conjunction with the output stage, the important function of accelerating the recurrence of the relaxation oscillations. It was possible with these resistances to accelerate the relaxation recurrence to as much as one-third of the original value.

A number of decoupling devices are provided in order to prevent coupling between the two relaxation parts, as well as to prevent reactions of the relaxation potential amplifier on the relaxation generator. Extensive elimination of such disturbances, as well as a high degree of attenuation of the hum voltage, are necessary for stable synchronisation by the impulses of the transmitter.

Television Interference Suppressor.

A novel suppressor for television and other high-frequency signals of a similar nature is now being manufactured by Messrs. A. F. Bulgin, of 64 Holborn Viaduct, E.C.1. This suppressor consists of a high-frequency choke wound on a split grid plug-in adaptor. The valve in the receiver is removed and plugged in on top of the adaptor, so connecting the high-frequency choke directly into the grid circuit.

It is claimed that this choke will definitely remove all traces of television signals on broadcast receivers, and from our own tests of similar apparatus, we can bear out these claims.

This interesting gadget costs 2s. and is designated type number HF25.

Our Readers' Views

Correspondence is invited. The Editor does not necessarily agree with views expressed by readers which are published on this page.

Reception of Alexandra Palace

SIR,

I am pleased to report reception of the television sound and vision signals from 5.40 until approximately 6.10 p.m. to-day (August 27.)

This may be of interest in view of the receiving apparatus used and the position of my listening post.

The position here is approximately 25 miles south of Alexandra Palace with screening by the North Downs and Redstone Hill. This hill is only a quarter of a mile to the north of here and runs across east to west with a fair amount of trees on the slopes and at the top.

A simple di-pole (vertical) was erected on the roof some months ago (anticipation) with a twisted flex feeder (now somewhat weather worn) terminating in a single loop at the receiver.

The receiving apparatus was a rough hook-up used for the first time this evening and consists of an A.C. mains S.G. valve run off an L.T. mains transformer and a 120-volt H.T. eliminator. Screened grid supplied through 25,000-ohm variable resistance supplying approximately 45 volts to grid. Using headphones connected through a 1-1 output transformer in the anole lead the vision signal could be clearly heard and held and then the sound signal about 60 degrees of tuning higher up on the 15 m.m.f. condenser, strength about R5/6. First item heard was apparently " As You Like It," then an extract from the film " Amateur Gentlemen," Chas. Laughton in an unreleased film " Rembrandt."

Results like this on one valve speak well for reception in Surrey and ensure good reception for one county anyway.

B. BENNETT (Redhill, Surrey.)

Reception Range

SIR,—You will be interested to know that Baird Television put in a Televisor here with a di-pole on a thirty-foot mast attached to a tall chimney bringing the top over sixty feet from the ground, and that I can get very good pictures here. I am thirty miles from Alexandra Palace, within a few furlongs one way or the other.

I thought you might be glad of this evidence that the service area will certainly be considerably more than twenty-five miles in favourable neighbourhoods. I suppose the top of my mast is not more than 250 feet above sea level.

ERNEST H. ROBINSON
(Woking, Surrey).

Good Results

SIR,

You may be interested to know I am getting very good results with the semi-tuned R.F. S.W. circuit as shown on p. 347 of your June issue. I have just switched off, 9 p.m., after listening for ¾-hour at R.9 to S.V.H. on 20.55 metres—very good on L.S. This is amongst a surprising list of

W.'s, V.'s, H.'s. Your publication is most useful to the serious listener and constructor.

C. H. GILBERT,
(Wallington, Surrey).

A Pirate Station

SIR,

Will all stations who during the past six months have worked a station signing G5UX on the 40-metre band, please note that this call is being pirated.

G5UX has been working for the past seven years entirely on 20 metres and the QRA is G. A. Hume, 53 Eccles Road, Battersea, London.

The matter is at present receiving the attention of the G.P.O.

G. A. HUME (G5UX)
53, Eccles Road, Battersea, S.W.11.

TELEVISION IN FLEET STREET

A Marconiphone Demonstration with D.C. Supply

DURING the first week of the test transmissions from Alexandra Palace the Marconiphone Company amply demonstrated that an A.C. supply is not necessary for the operation of a television receiver. This is an interesting fact because there is a fairly general idea that alternating current supply is a *sine qua non*.

Marconiphone chose an hotel in Fleet Street for their demonstration and the current supply in this district is 210 volts direct so a rotary convertor was installed as an accessory to the receiver. This, of course, means a slight additional expense in the first instance, but otherwise, judging from the results that were obtained, there is no disadvantage, for, as is well known, these convertors function for very long periods without any attention whatever. Actually, in this case, the " juice " was supplied by putting a shilling in the familiar slot meter. One shilling provided all the current that was required for the whole duration of the programme and presumably there was a good balance in hand at the conclusion.

The receiver used was the Marconiphone Model 701 of which a full technical description was given in the September issue. It is of interest to note that this receiver employs a comparatively small cathode-ray tube and that a special lens is used in front which has the effect of increasing the picture size very considerably. The tube is placed vertically and the picture is seen by reflection in a mirror, the image in the latter being magnified by special lens. This lens appears to have some correcting effect on the curvature of the tube and it was noteworthy that at a distance of about ten feet it was not possible to detect that a lens was used, a matter which was only revealed upon closer inspection.

The reproduction was as near black and white as makes no difference, and there was sufficient contrast and brightness for the pictures to be observed in comfort by an audience of about thirty, a fact which speaks well for the clarity, for a part of the audience was a matter of fifteen feet or so distant from the receiver.

In these early days of test transmissions it is rather difficult to judge the consistency in the performance of a receiver for, of course, minor troubles are being experienced at the transmitting end and it is difficult to dissociate receiver troubles from transmitter faults. For instance, on one or two occasions there was an almost complete wipe out which persisted for a few seconds, which, as the fault rectified itself without any adjustment of the receiver, was presumably due to a fault in the transmission.

Despite the fact that this demonstration took place in the heart of London, with dozens of cars and buses passing every minute, there was no trace of interference, proof that the interference bogey of which so much was made a short time ago barely exists even under the worst conditions.

A feature of this particular transmission was a tour of the stands at the North London Exhibition and it served to emphasise what a valuable commercial asset television could be if developed upon suitable lines. One can visualise a tour of the West End shops. Even at the present stage of development this is not entirely impracticable. What woman will be without a television receiver when this is a regular feature of the programmes?

THE TELEVISION SOCIETY

Lecture Arrangements for the 1936—1937 Session

PROVISIONAL arrangements for meetings for the 1936-37 session have been made as follows:

Wednesday, November 11.—The Baird Television Receiver (lecture and demonstration). T. M. C. Lance, Esq.

Wednesday, November 18.—Informal meeting and discussion.

Wednesday, December 9.—Electron Optics with special reference to Magnetic Focusing. S. Rodda, Esq.

Wednesday, December 30.—Informal meeting and discussion.

Wednesday, January 13.—Kerr Memorial Lecture. Professor J. T. MacGregor Morris, M.I.E.E.

Wednesday, February 10.—Short-wave Receivers for Television.

The first lecture of the session was given on October 14, when Mr. E. H. Traub gave a talk on the German Radio Exhibition.

Informal Meetings

Two informal meetings have been arranged for this year. In view of the rapid developments which are now taking place, it was thought desirable that members might have the opportunity of discussing practical problems in the design and construction of receivers and of comparing results.

It is requested that those members who propose to attend these informal meetings will submit their names to the Lecture Secretary at the conclusion of the preceding meeting or by post, in order that accommodation may be reserved.

Television Optics

Sir Isaac Pitman & Sons, Ltd., have recently published a book under the above title by L. M. Myers, of the Marconi Co. Mr. Myers is a well-known authority on television optics and a contributor to this journal. A review of the book will appear in our next issue.

TELEVISION'S CATHODE-RAY RECEIVER (*Continued from page 620*)

of resistance will do for R10 and R24, provided that it is wire-wound and has an insulated spindle.

It is advisable at this stage (if it has not been done earlier) to mark the various components in pencil to avoid mixing them up in subsequent wiring. The valve holders nearest the holes at the side of the chassis (the back end) should be pencilled " Line " and the others " Picture." Check at this stage that the wiring to the deflector plate condensers is correct with regard to these markings, assuming that the X plates are line and the Y plates picture.

Mark the resistance in the centre between the condensers " picture " and the one above it " line." The resistances can be marked starting from the top: 240 P, L. Amp. P. Amp. 405 P. 405 L.

It will be noted that 240-line is missing from the list. This resistance is carried on a separate bracket and will be fitted on completion of the wiring to the switches.

The remander of the wiring may be completed, using the 5-way group board on the right-hand side (from the back) for the push-pull resistances and the other for the fixed resistances in the charging circuits. The connections to the switches are shown in the separate photograph.

To avoid interaction between the time-bases, separately smoothed H.T. supply is required, and therefore two H.T. + leads are taken to the time base. The socket in the 5-way socket marked 2 is soldered to the end of the variable resistance R17, this lead showing in the photograph, while socket No. 1 is taken to the corresponding tag of the other resistance (" line "). From each of these tags extensions of the leads run to the group boards for supplying H.T. to the resistances. The white resistance in the centre of the chassis in the photograph is between the anode of the " line " valve and the lower end of the variable resistance (R11 in the diagram).

The remaining socket in the input connector (No. 4) is connected directly to earth via the chassis and serves for H.T.–.

The H.T. Unit

The circuit diagram of the H.T. supply unit for the tube and time base is shown in the diagram, and its assembly will be fully described in the next article.

It will be seen that the heaters of the valves in the time base, together with the M.U.2 rectifier filament, are fed from a separate transformer. This ensures that the valves have attained operating temperature before the H.T. is applied and saves a possible breakdown in the insulation.

A D.L.S.1 thermal delay switch is fitted in the primary windings of the H.T. transformers, the heater of the switch being connected to the heater transformer winding. After 30 seconds delay the H.T. is applied to the tube and time base simultaneously and the scanning lines will appear on the screen.

Other points to note are:

The H.T. for the time base is split, the picture frequency being decoupled from the line frequency.

Extra smoothing is incorporated in the time base H.T. to minimise A.C. interference.

The load on the tube H.T. supply being very small (under 1 ma.) the 100,000-ohm resistance shown is sufficient for smoothing in conjunction with the condensers.

For those who do not wish to make up their own units, these can be obtained from the Mervyn Sound & Vision Co. in steel cases ready for connection to the mains.

HIGH TENSION SUPPLY FOR TIME BASE
List of Components.

CONDENSERS.

Time base:
1—2.0-mfd. 1,000-v. working, T.C.C. Type 111.
3—8.0-mfd. 1,000-v. working, T.C.C. Type 111.

Control Panel.
1—0.5-mfd. 4,000-v. working, T.C.C. Type 171.
1—1.0-mfd. 1,500-v. working, T.C.C. Type 121B.
2—1.0-mfd. 500-v. working, T.C.C. Type 95.
1—0.1-mfd. 4,000-v. working, T.C.C. Type 171.
2—8-mfd. 350-v. working, T.C.C. Electrolytic.

TRANSFORMERS (Keston Mfg. Co.).

Tube H.T.:
See May issue.

Time Base: Primary: 0-200-220-240.
Secondary: 1,000 v. 20 ma.

Bias and Shifts. Primary: As above.
Secondary: 250-0-250 v. 10 ma.
2-0-2 v. 2 amp.

Heaters: Primary: As above.
Secondary: 2-0-2 v. 6 amps.
1-0-1 v. 2 amps.
4 v. 1.5 amps.
1-0-1 v. 1.5 amps.*

* The last winding must be insulated to stand 3,500 volts to the remainder.

CHOKES.
2—100-henry 30 ma.

RESISTANCES (Erie).
1—2.0-megohm 2 watt.
1—1.5 megohm 1 watt (or 1.0 and 0.5).
1—1.0-megohm 1 watt.
1—0.4-megohm 1 watt.
2—0.1-megohm 1 watt.
1—2,000-ohm 1 watt.
1—2.0-megohm ½ watt.
1—1,000-ohm ½ watt.

POTENTIOMETERS (Reliance).
1—0.5-megohm.
1—0.1-megohm.

COMPONENTS.
3—Baseboard mounting 5-pin valveholders (Bulgin).
4—Terminal blocks (Belling-Lee).
Terminals: H.T. + 1; H.T. + 2; H.T. +; H.T. – L.T.A.C. (2 off) D.C. (2 off).
Mains input plug and fuses (Belling-Lee).
Mains switch (Bulgin).
Screened flex.

The Tube Exciter Unit

In the May issue was described the tube exciter unit, but a modification is made in that the heater for the tube cathode is not obtained from the H.T. transformer; instead it is coupled to the time base filament transformer in a unique way. The cathode-ray tube heater winding has to be well insulated as it is at the full cathode-ray tube potential difference to earth, so we connect a very small transformer having a 4-volt primary and a 2-volt secondary. Such a method has many advantages that will be apparent and we take pleasure in publishing the arrangement, for the first time, in this issue.

The alternative is to provide this winding of the time base heater transformer and a note of this is made in the list of components.

The exciter unit and the vision and sound receivers were specially commissioned by us from W. J. Nobbs, F.T.S., A.M.I.R.E., and the modification to the method of heating the cathode-ray tube filament has proved practical in every way.

NEXT MONTH: THE SOUND RECEIVER AND DETAILS OF POWER PACKS.

"Making a High-Quality Microphone"

(Continued from preceding page)

microphone, and for this, the finest carbon granules should be used. Suitable granules, of 250 mesh, can be obtained from Le Carbone, Ltd., Spencer House, South Place, London, E.C.2, and ½ oz. will be sufficient. A small paper funnel should be held over the filling hole, and the granules poured in until the diaphragm space is filled. The hole should then be filled with a Rawlplug and screw, of the type with a separate chromium head to cover the slot.

In use, a microphone transformer of approximately 20-1 ratio should be employed, with a polarising voltage of about 6-9, depending on the sensitivity desired. The microphone should be resiliently mounted, either by standing it on sponge rubber, or if prefered, it may be drilled and fitted with screw eyes for suspension in a stand.

Technical Books.

We have received from W. & G. Foyle, Ltd., of 119-125 Charing Cross Road, W.C.2, a copy of their catalogue of books on technical subjects. This is a list of new and second-hand books dealing with over 450 technical subjects. Messrs. Foyle have a special department for technical books and are able to supply practically any book that may be required.

"The Mihaly-Traub System Up-to-date."

(*Continued from page* 636).

Light modulation is accomplished by a special cell developed in the laboratory of the International Television Corporation, details of which, on account of the patent position, cannot be disclosed at the present time.

One of the photographs accompanying this article shows the screen upon which the picture is projected; this is of ground glass and, of course, the picture is projected from the back.

Results with the Mihaly-Traub System

The demonstration of this receiver which we were privileged to witness was from loops of film and news reels by wire from an adjacent transmitter; it was, of course, a demonstration of the possibilities of the scanning arrangements. The actual definition at the time was 180 lines though, as remarked before, there would be no difficulty in producing a scan of practically any number of lines by suitable adjustments of motor speeds and the type of scanner employed.

Obviously any defects in the composition of a picture of large size are more clearly revealed than in the case of a small picture and it speaks well for the Mihaly-Traub scanning system that no defects were observable, the picture being perfectly even with adequate illumination.

An interesting experiment was made of viewing the picture through a reducing lens which had the effect of making the picture appear of approximately the same size as that ordinarily obtainable with a cathode-ray tube and it was quite evident that it compared exceedingly well with the letter ; it was bright and the detail was excellent.

As both scanning motors were driven from the mains the matter of synchronising did not arise, but we are assured that there will be no difficulty in this respect when receiving broadcast transmissions; in this case, of course, the picture remained perfectly steady the whole time.

In our opinion the Mihaly-Traub system holds great promise as a means of providing large screen pictures or for a comparatively simple system for use in the home type of receiver.

Short Waves from Australia.

We have received from Messrs. Amalgamated Wireless (Australasia), Ltd., who operate stations VK2ME in Sydney and VK3ME in Melbourne, the following details as to the transmission times of these two stations during November. VK2ME will be radiating as follows:—

	Sydney Time.	G.M.T.
Sundays,	4 p.m.-6 p.m.	06.00-08.00 p.m.
	7.30 p.m.-11.30 p.m.	09.30-13.30 p.m.
Mondays,	Mdt.-2 a.m.	14.00-16.00 p.m.
VK3ME:	Melbourne Time.	G.M.T.
Nightly Monday to Saturday (inclusive),	7 p.m.-10 p.m.	09.00-12.00.

VK3ME operates on a wavelength of 31.5 metres or 9,510 kc., and VK2ME, "The Voice of Australia," on 31.28 metres or 9,590 kc.

TELEVISION AND SHORT-WAVE WORLD

NOVEMBER, 1936

TELEVISION DEVELOPMENTS

A NEW LARGE DIAMETER TUBE FOR TELEVISION REPRODUCTION

TYPE 12H TUBE

The Ediswan Type 12H tube has a screen diameter of 12" giving a television picture 10" x 7½" without distortion.

The screen is of special material giving a close approximation to a black-and-white picture.

Specification:

Indirectly heated high vacuum tube.

Heater Volts - - -	2.0
3rd Anode Volts - - -	6000
2nd Anode Volts - - -	1200
1st Anode Volts - -	150-400
Sensitivity (mm./V.) -	-950/V*

*V = anode volts

List Price **£15.15.0**

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