

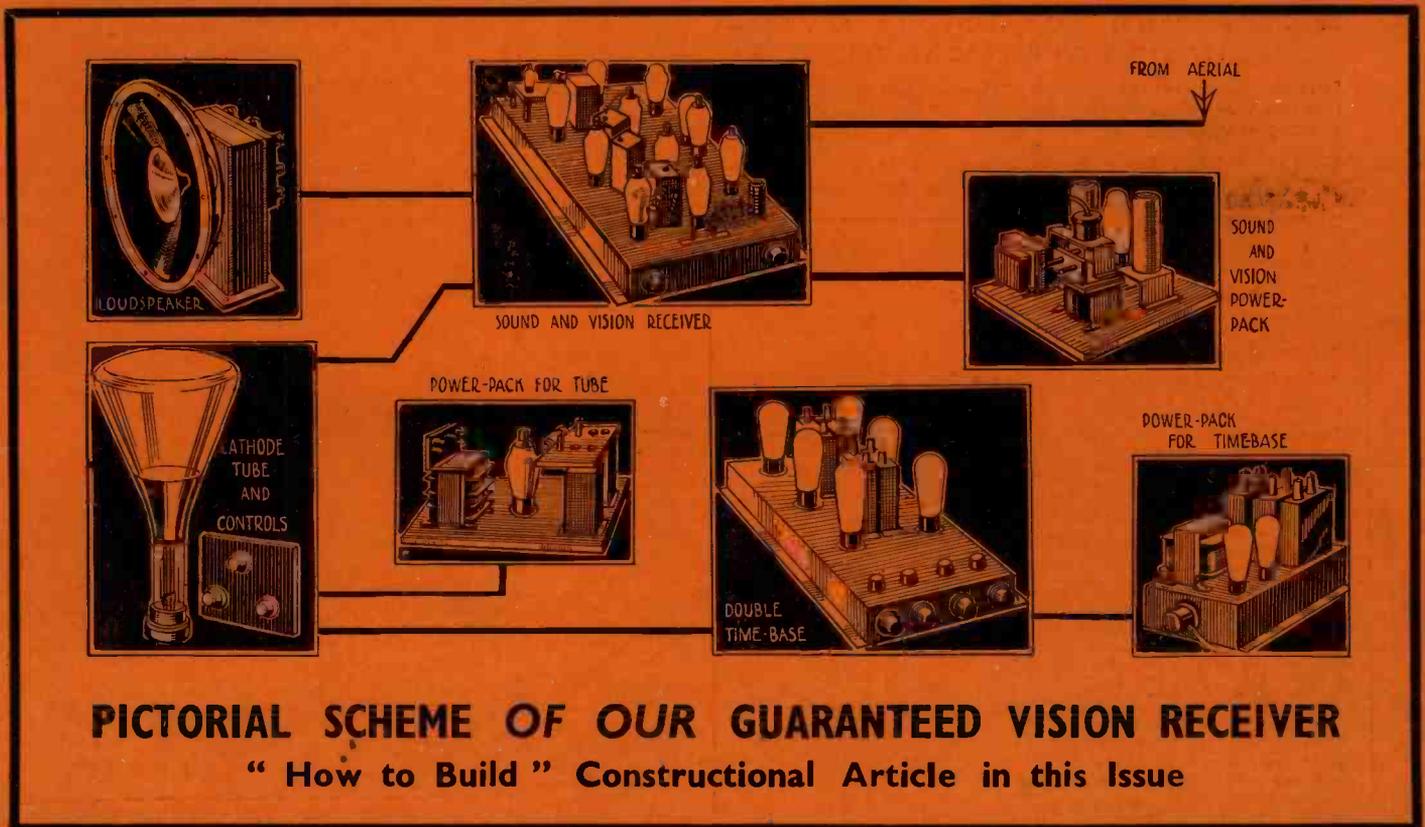
# Television

and *SHORT-WAVE WORLD*

1/-  
MONTHLY

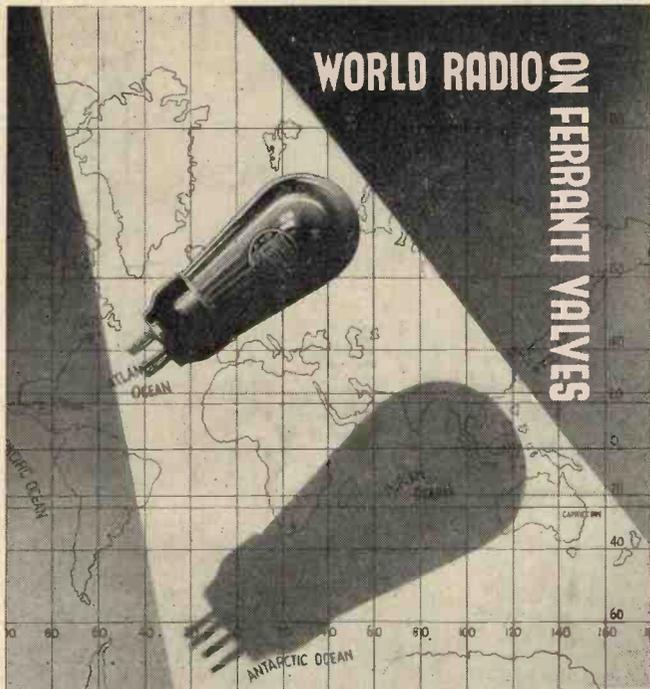
NOVEMBER, 1936

No. 105, Vol. ix.



**FIRST TELEVISION RECEIVER  
FOR  
HOME CONSTRUCTORS**

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



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"I've made good what was bad,  
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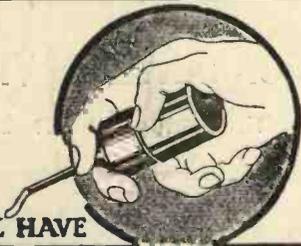


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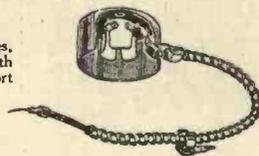
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List No. K.62 (knob as shown) Price 8d. each.

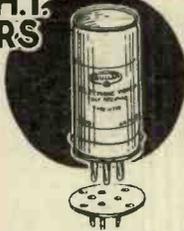
**ELECTRO-MAGNETIC RELAY**



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RECOMMENDED  
AGAIN & AGAIN  
**BULGIN**  
QUALITY RADIO  
AND TELEVISION  
COMPONENTS

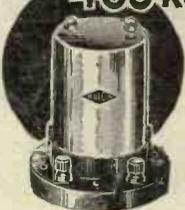
**COUPON**

To Messrs. A. F. Bulgin & Co., Ltd.,  
Abbey Road, Barking, Essex.

Please send me Catalogue No. 156 "M" for which I enclose 3d. stamps.

NAME .....  
ADDRESS .....  
(Block Letters Please) .....

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The Bulgin I.F. Liner operates from A.C. or D.C. mains of 200-250 volts. It employs neon-modulation using our well-known midget neon-lamp connected in an oscillating circuit. It gives an output, isolated from the mains, which may be fed indirectly into an I.F. or F.C. stage for accurate I.F. tuning.

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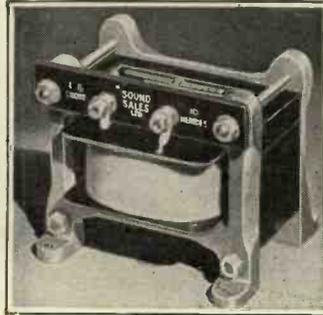
**INSTRUMENT KNOBS**



Two new Bulgin Knobs of pleasing design giving excellent grip for switches, etc., and providing positive indication of position. Moulded in polished black bakelite with white-filled indicator-line. Standard 1/2 in. bore, steel grub-screw.

List No. K.78—Instrument Knob—Price 6d. each.  
List No. K.60—Large Instrument Knob—Price 6d. each.

**CHOKES by SOUND SALES**



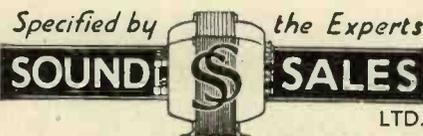
Because "Sound Sales" Chokes are of such rigid construction they overcome chatter, parasitic hum and feed-back distortion, so often traceable to loose windings and laminations. You are safe in using "Sound Sales" Chokes. In the October issue they were specified for the "Tobe Receiver." Now they are again specified.

L. F. CHOKE

20-HENRY TYPE **15/-**  
"W.W." C.I.

Sound Sales literature on Television and Radio products, Free.

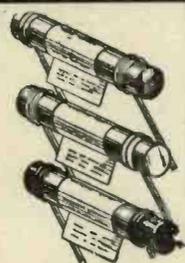
**SOUND SALES**  
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With built-in mains switch 5/-  
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# Mullard

As in Radio reception so now in Television ; Mullard are to the front in the design of Cathode Ray Tubes and special valves for use in Television receivers. Cathode Ray Tube type E46-12 has been designed for high intensity, high definition picture reception. This tube has a 12 in. screen of special material giving a black and white picture with a high degree of brilliance. We recommend the following valves for use in Television receivers :—



Television tube type E46-21.

Price £15 15 0

#### VALVES FOR TELEVISION RECEIVERS.

Type	Purpose.	Price on application
TH4	S.W. Frequency Changer ...	...
TSP4	High Slope H.F. Pentode ...	...
GT4H	Gas triode valve ...	...
TT44	Time base amplifier valve ...	...
HVRI	High tension rectifier ...	...

#### CATHODE RAY OSCILLOGRAPH TUBES

Type	Screen diameter	Price
E40-G3	70 M.M. ...	4 15 0
4002 4002A	95 M.M. ...	6 15 0
E42-G6 E42-B6		
E46-G9 E46-B9	220 M.M. ...	12 0 0

**MULLARD WIRELESS SERVICE CO., LIMITED**

MULLARD HOUSE, 225 TOTTENHAM COURT ROAD, LONDON, W.I.

# TELEVISION

## and SHORT-WAVE WORLD

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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 AND SHORT-WAVE WORLD

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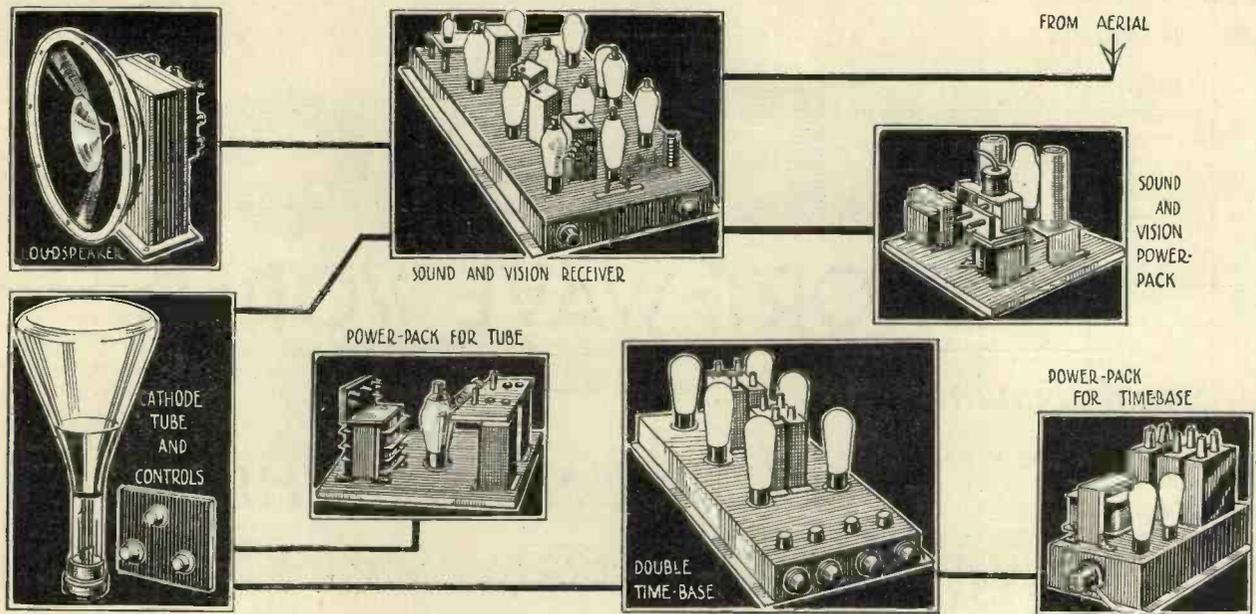
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# “TELEVISION’S” GUARANTEED

## CATHODE-RAY RECEIVER—II

### COMPLETING THE RECEIVER AND BUILDING THE TIME BASE

#### “GUARANTEED”

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

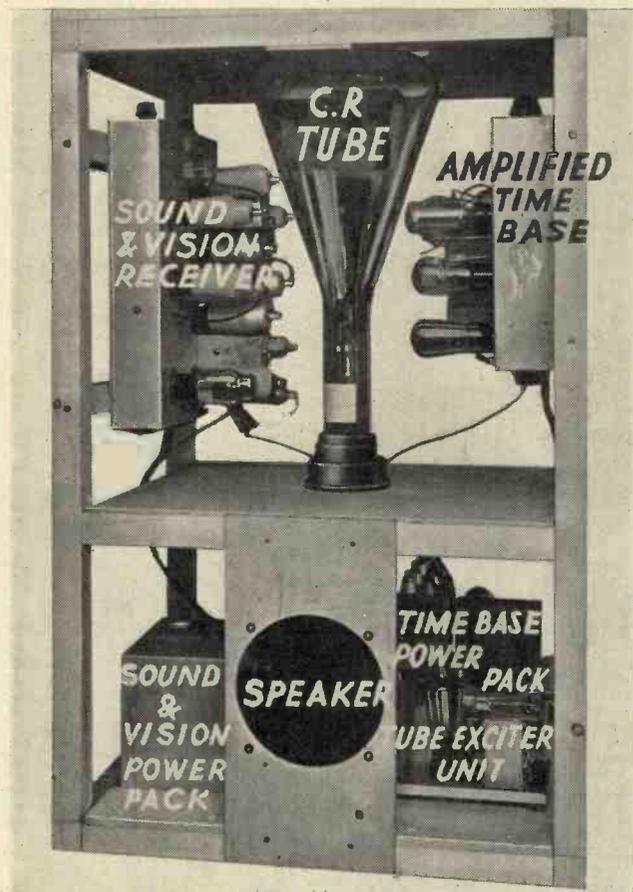
We guarantee that the picture which this receiver gives compares extremely well with that given by a high-class commercial receiver. It follows that if our readers faithfully follow our instructions in every respect they should produce a thoroughly satisfactory receiver, but certain points must be borne 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.



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

## WHAT THE RECEIVER IS

**T**HIS 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

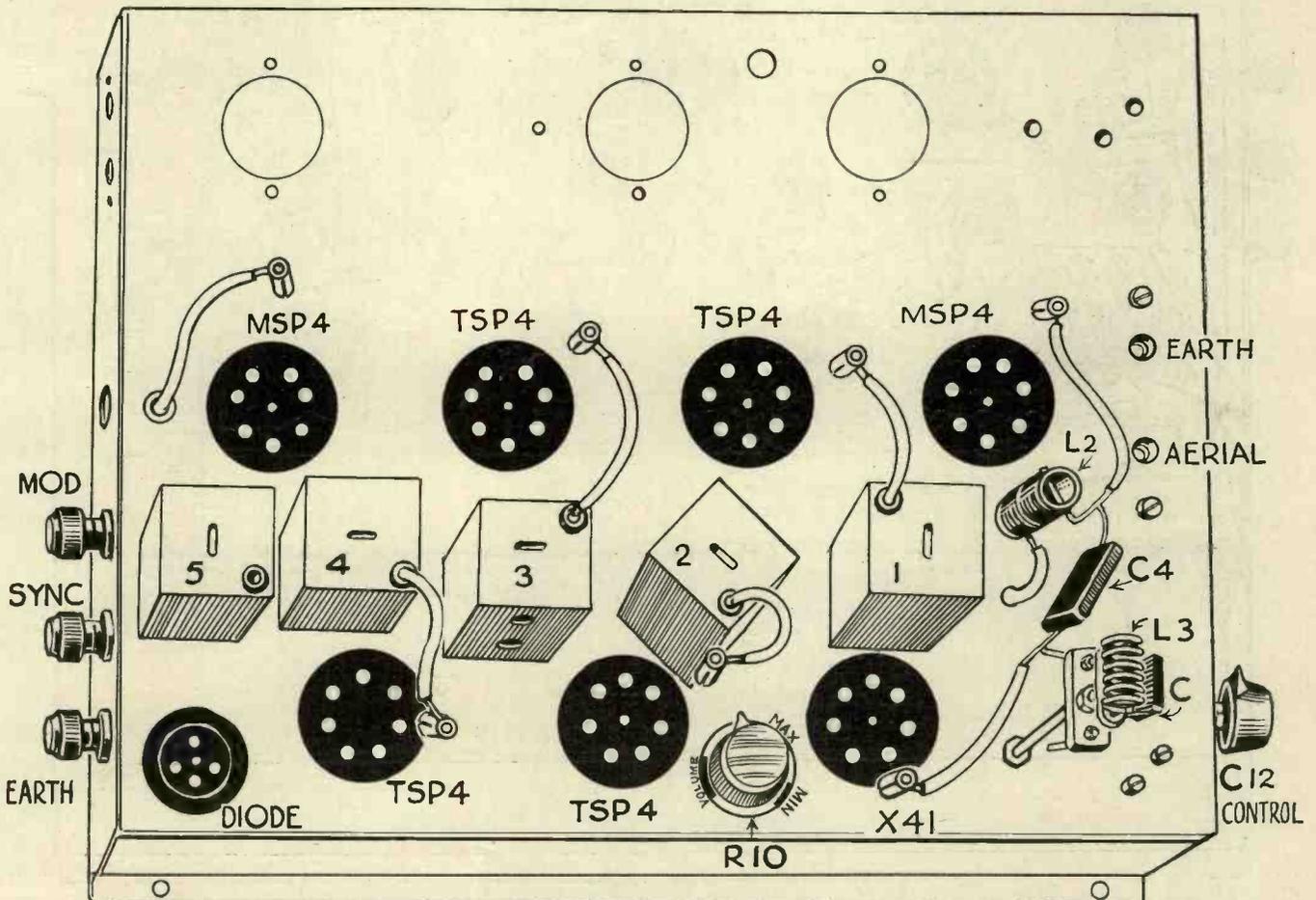


Diagram of the upper side of the sound and vision chassis. Only the vision components are shown in this drawing.

## 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 con-

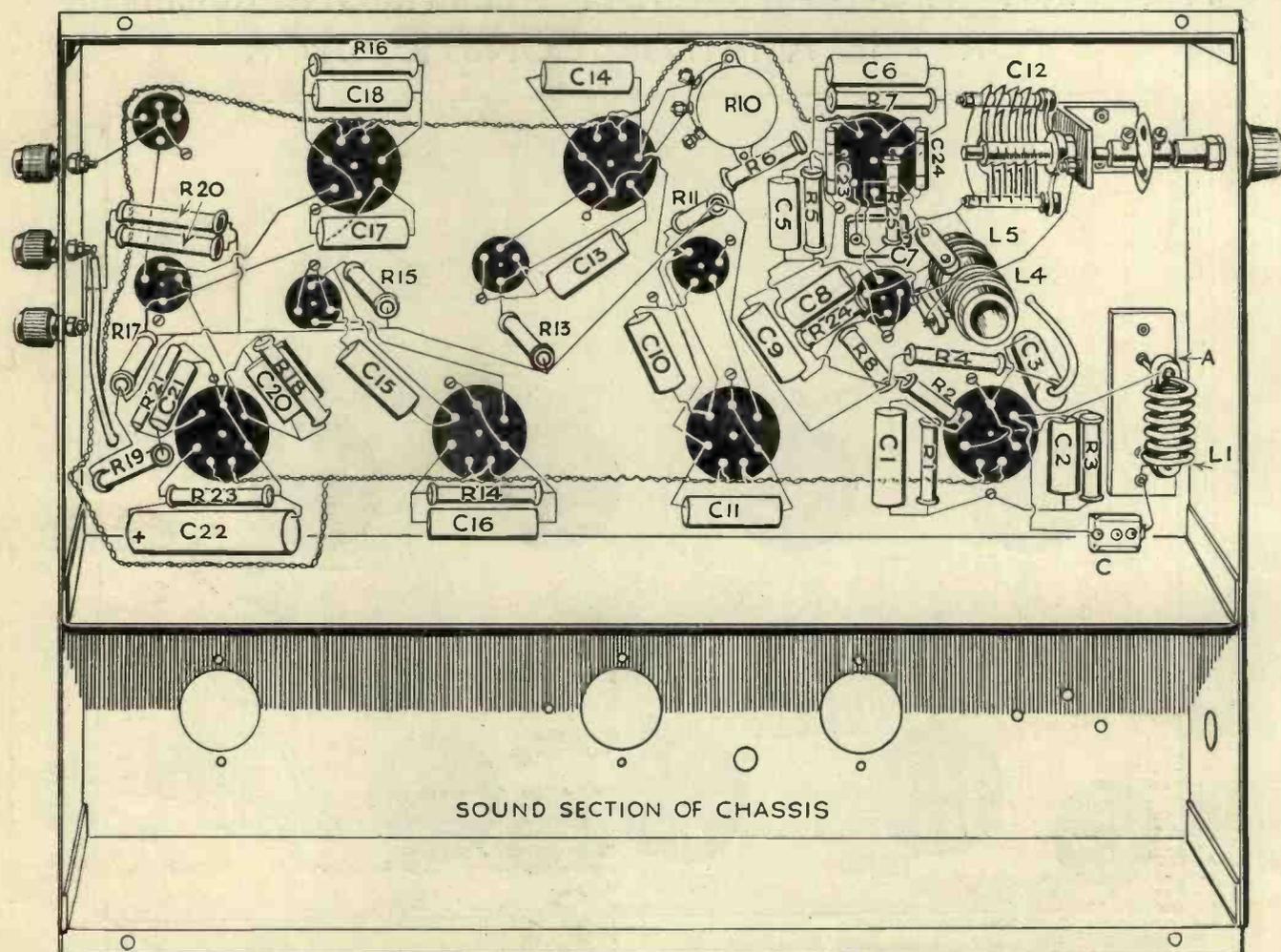
nection to the diode marked "shield return" is taken to the control grid of the MSP4 valve previously functioning as a synchronising valve while the connection marked "shield" is taken to earth of the receiver. The bias resistor of the MSP4 valve should now be 300 ohms with a condenser C4 (value 50 mfd., 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).

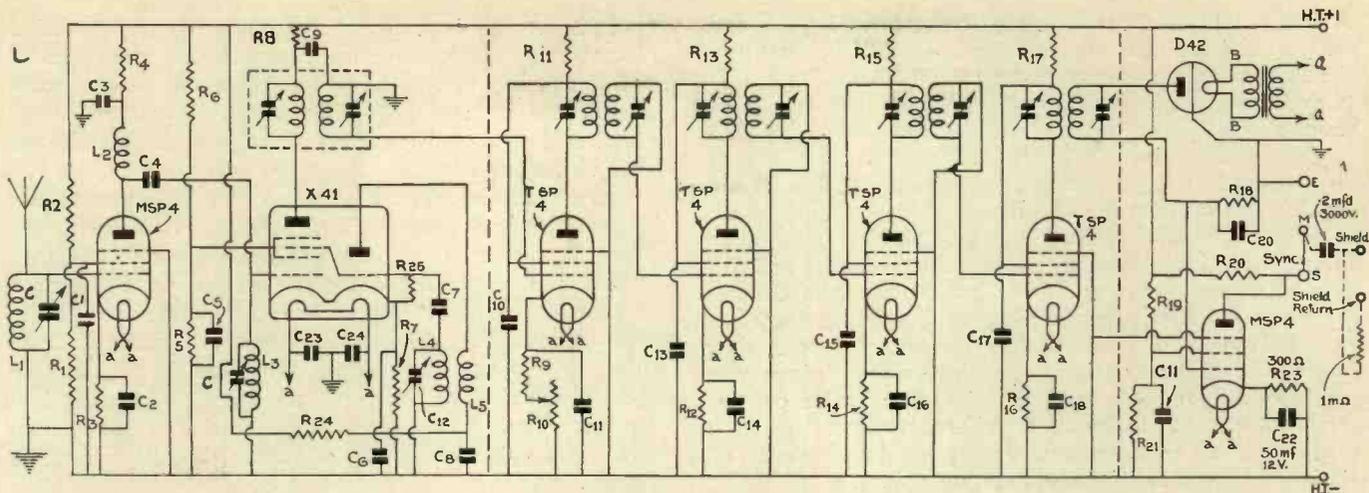
Another point of interest is the optional arrangement to control the first two I.F. valves with the bias potentiometer instead of only the first valve.

### 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 screw-driver; 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 type 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 TrF1 (Mervyn).
- 1—Special shielded type TrF2 (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 from 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 L<sub>3</sub> which is the grid coil for the X<sub>41</sub>, 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 L<sub>4</sub> and L<sub>5</sub> 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 HT<sub>2</sub> and HT<sub>-</sub> 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

**T**HE 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.

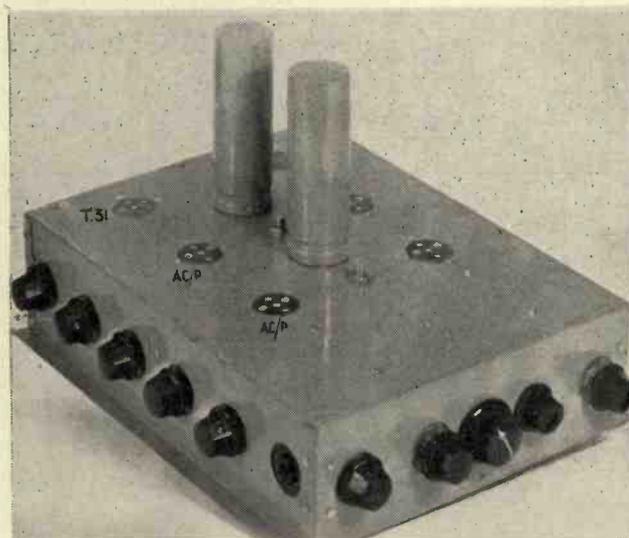
- 6, Bush for synchronising leads;
- 7, 240-line picture speed (25 cycles);
- 8, Line amplitude;
- 9, Picture amplitude;

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 thyatron.

These three valves constitute the line frequency circuit.

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

17. Valve holder for thyatron.

These form the picture frequency circuit.

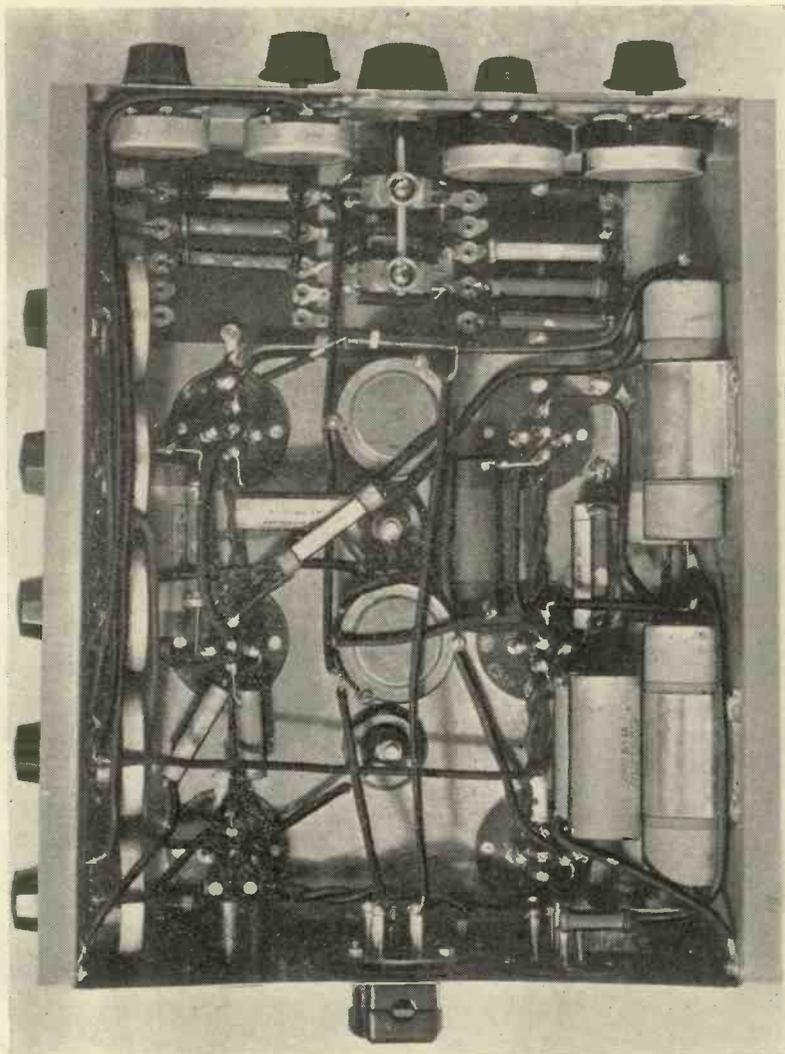
18 and 19. Holes for electrolytic condensers C<sub>2</sub> and C<sub>9</sub> in the diagram.

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 ( $R_{10}$  and  $R_{24}$  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.

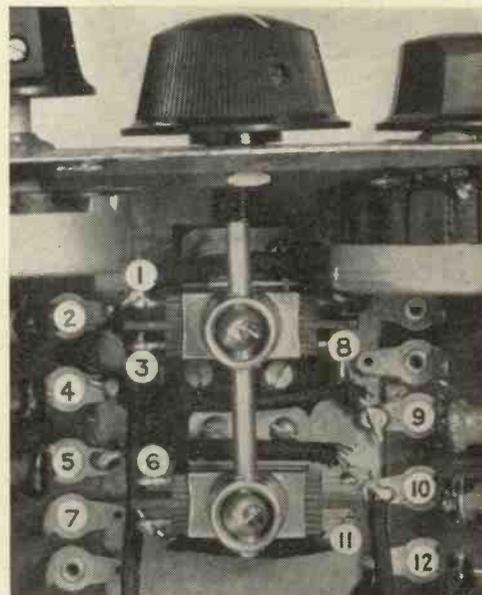
Before fitting the paxolin strip behind the metal, chamfer the edge by hole 1 so that it fits snugly with the second strip running behind holes 6 to 11. This can be cut at the same time, and after both have been fitted into position they can be secured with screws (6 B.A.  $\frac{1}{4}$  in. round head) 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



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.



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.

have been fixed on the clearing holes for the potentiometers can be drilled  $\frac{3}{8}$  in. clearing.

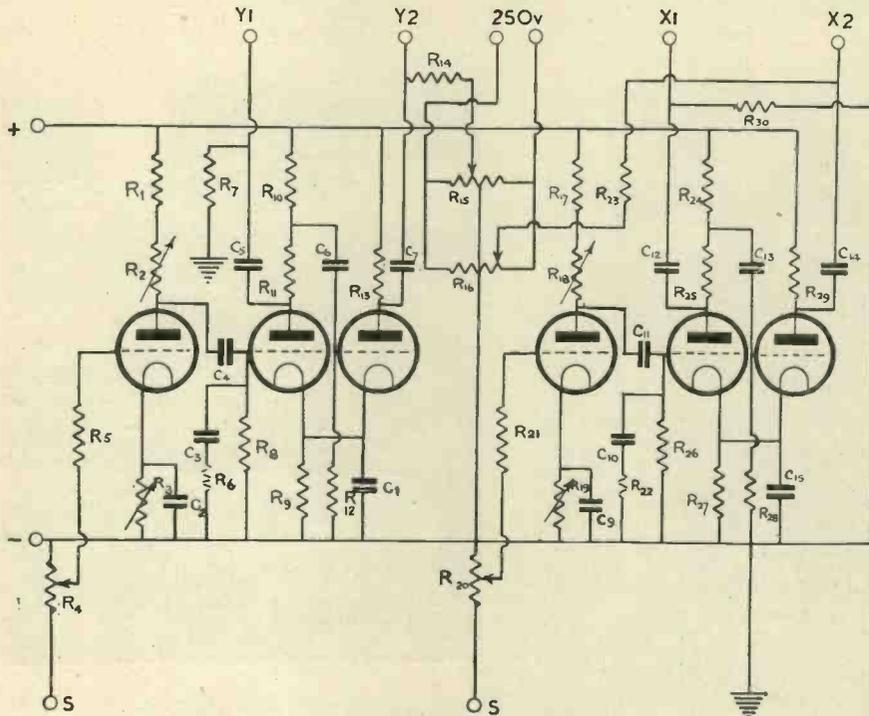
The mounting for the change-over switch can now be made from a strip of paxolin 1 in. by 2 in., held off the underside of the chassis by a packing disc of the same material  $\frac{1}{2}$  in. thick. When the two Bulgin switches (Type S.81.B) are mounted, the spindle will then be level with the hole in the centre of the top end piece (Hole No. 3). This hole requires to be  $\frac{3}{8}$  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  $\frac{3}{16}$  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

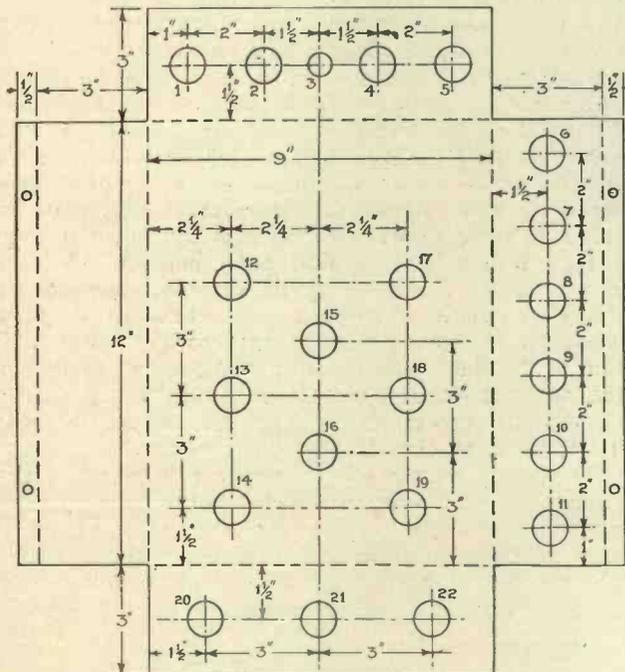
which again can be riveted in place if desired. All should point with the anode socket upwards, i.e., to the end of the chassis which contains holes 1 to 5. To save trouble this should be marked "top end," and the side with holes 6 to 11 marked "back end."

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	VALUES FOR	DOUBLE
Baird.	TIME BASE.	E.M.I.
R 1.—	1 megohm	
R 2.—	3 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.	
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 8.—	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 chassis 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<sub>4</sub> and C<sub>3</sub> 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<sub>4</sub> and C<sub>3</sub> being in series. This gives a reasonable

COMPONENTS FOR SCANNING CIRCUIT.	
<b>FIXED RESISTANCES— One Watt (Dubilier).</b>	<b>B.I. (Mervyn)</b>
3—1-megohm	4—0.1-mfd. 2,000-v. working, tubular.
1—200,000-ohm	2—0.1-mfd. 1,000-v. working, tubular.
3—150,000-ohm	2—0.001-mfd. 1,000-v. working, tubular.
1—100,000-ohm	1—0.1-mfd. 1,000-v. working, tubular.
1—500,000-ohm	1—0.005-mfd. 1,000-v. working, tubular.
1—85,000-ohm	
1—30,000-ohm	
1—20,000-ohm	
1—15,000-ohm	
1—10,000-ohm	
1—5,500-ohm	
<b>Half Watt (Bulgin).</b>	<b>VALVE HOLDERS.</b>
4—5-megohm	6—Chassis mounting 5-pin (Bulgin).
4—2-megohm.	
<b>POTENTIOMETERS (Reliance).</b>	<b>SUNDRIES.</b>
2—2.0-megohm	1—5-pin plug and socket type 1260 (Belling-Lee).
2—0.5-megohm	1—Type P.20 Mains connector (Bulgin).
2—0.1-megohm	1—Type SW.41 5-pin socket (Bulgin).
2—50,000-ohm	1—Type P.3 5-pin plug (Bulgin).
2—100,000-ohm special with centre tap.	2—Bulgin S.8r B. switches (Bulgin).
<b>CONDENSERS (Dubilier).</b>	2—Bulgin C.3r group boards (Bulgin).
2—Type 4001 50-mfd. 12-v. working.	2—Valve top caps (Bulgin).
1—Type 3004 50-mfd. 50-v. working.	<b>VALVES.</b>
1—Type 3016 12-mfd. 50-v. working.	2—Mazda T.31 Thyratrons. or Ediswan HE/A.C.T.
	4—Mazda A.C./P.

value of striking potential for the thyatron and avoids overswinging the valves. The rate of charge of the condensers is controlled by the resistances R<sub>1</sub> and R<sub>2</sub>, 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.

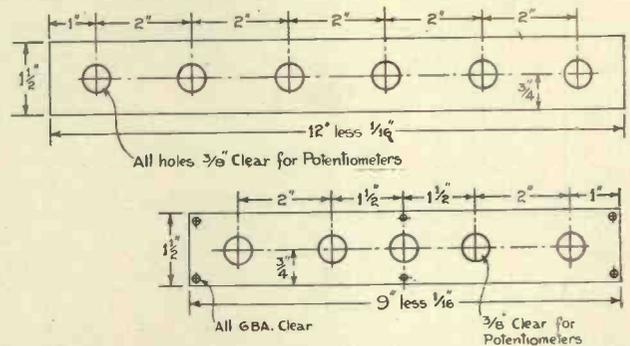
Any other combination could be used, but the above will be found to give smooth control and is sufficient to compensate for variations in capacity. The changeover switch is connected to the H.T. positive and inserts one or other of the resistance chains in the charging circuit.

The thyatron is self-biased by the variable resistance R<sub>3</sub> by-passed with the condenser C<sub>2</sub>. 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 C<sub>5</sub>, the plate being marked Y<sub>1</sub>. A resistance R<sub>7</sub> 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 R<sub>10</sub> and R<sub>11</sub> 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. C<sub>6</sub>, 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 R<sub>9</sub> in conjunction with the condenser C<sub>1</sub>, and the plate Y<sub>2</sub> of the tube is connected to the anode of the second valve through the condenser C<sub>7</sub> as before. This plate instead of being returned to earth is connected through a high resistance to a shift potentiometer which is shown as R<sub>15</sub>, R<sub>16</sub> 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.

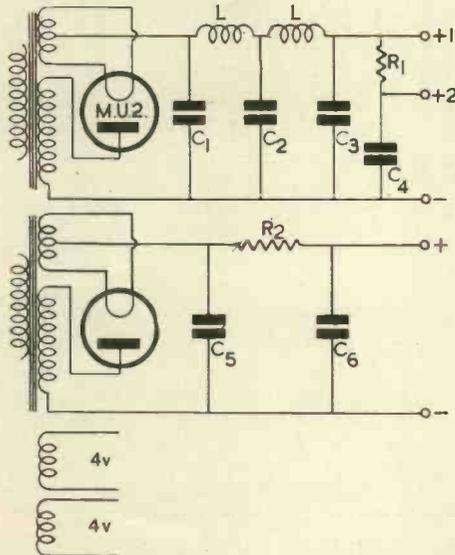
The supply for the shift potentiometers is necessarily obtained from a separate source, as the centre point is earthed, but a simple valve rectifier is all that is necessary as the load is small. The terminals marked S are for feeding the synchronising signal to the grids of the thyratrons, and the amplitude of the signal is varied by the resistances R<sub>4</sub> and R<sub>20</sub>. From the line drawn down the diagram through R<sub>20</sub> 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 theappings 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)

NOVEMBER, 1936

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

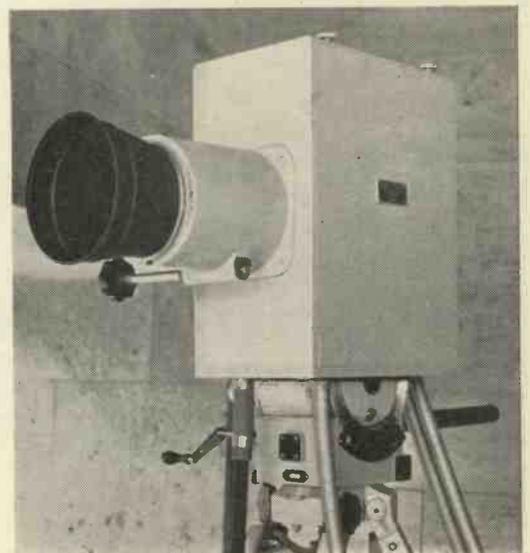
concentrated in the past year on raising the definition to 375-line interlaced scanning.

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

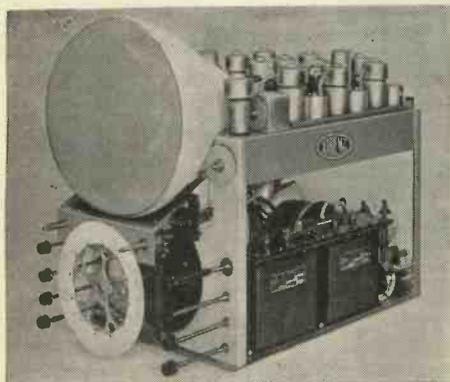
The Berlin-Leipzig television-telephone cables had been extended from the centre of the city to the Exhibition Hall itself, and in the television section two booths were erected where visitors could speak to and see persons in Leipzig, or at one of the two public television offices in the centre of Berlin. 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

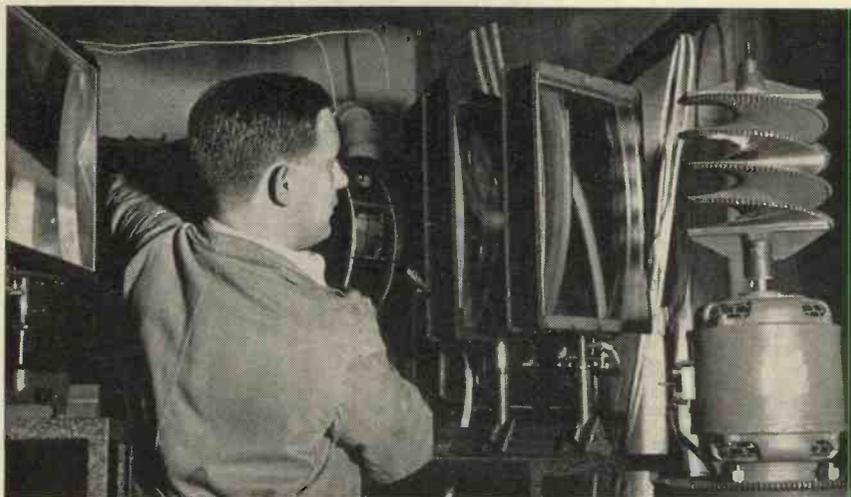
Fernseh A.G. showed a series of new home receivers with a picture size of about 7 ins. by 9 ins. In these receivers special attention has been paid to simplicity of handling and to the height of the picture relative to the ground. In addition to these standard receivers the company showed several so-called 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



*This photograph shows the chassis of the Lorenz receiver.*

they can get on an ordinary cathode-ray receiver to-day.

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



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

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 inter-

mediate 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.

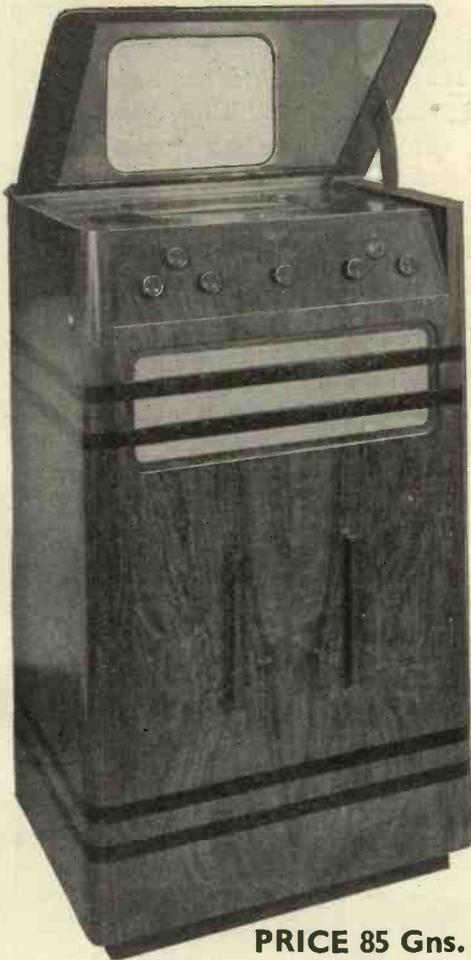
### Telefunken

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-

# BAIRD TELEVISION LTD.

WORLD PIONEERS & MANUFACTURERS OF  
ALL TYPES OF TELEVISION EQUIPMENT



PRICE 85 Gns.

BAIRD TELEVISION, LIMITED, announce that their "Televisor" receiving set Model T.5. is now ready for immediate delivery from stock.

Authorised dealers who have qualified for a Baird Certificate of Proficiency, have been appointed within the service area of the B.B.C. television station. A complete list will be supplied on written application to the Company at Crystal Palace.

"Televisor" receiving sets give a brilliant black and white picture 12" x 9" on the "Cathovisor" cathode ray tube, which is of unique design and guaranteed for a long life.

These Sets give results on both systems of transmission unequalled in size, detail, brilliance and colour, with the accompanying sound, and are operated on A.C. Mains, or on D.C. Mains with a suitable D.C./A.C. converter. The controls are extremely simple for either system.

## TELEVISOR RECEIVERS MIRROR THE WORLD

Head Office :

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66, HAYMARKET,  
LONDON, S.W.1.**

'Phone : Whitehall 5454

# TELEVISOR

REGISTERED TRADE MARK

Studios and Laboratories :

**CRYSTAL PALACE,  
ANERLEY ROAD,  
LONDON, S.E.19.**

'Phone : Sydenham 6030

# FOR FREQUENCY CONVERSION ABOVE 10 MEGACYCLES

use the  
**OSRAM X41**  
(TRIODE HEXODE)

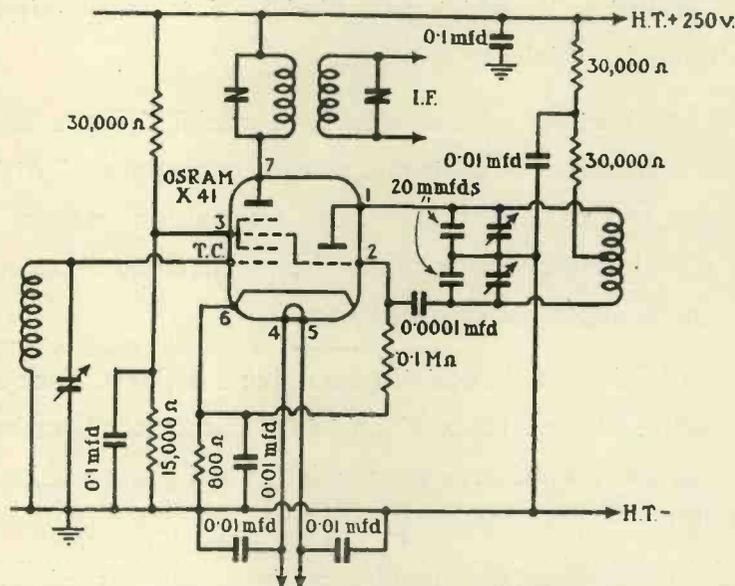


Diagram of Colpitt's circuit suitable for Ultra-short Wave. Frequency Conversion, using Osram X41 valve.

The OSRAM X41 is an Indirectly Heated Triode Hexode multiple valve for A.C. heating.

The Triode Hexode has been designed to overcome the various causes of trouble that are inherent in other forms of frequency changer, particularly at ultra-high frequencies. It has the following advantages :

1. Oscillations generated by the triode modulate the hexode cathode stream by electron-coupling on to a mixer grid.
2. Almost complete absence of interaction between the triode and hexode sections.
3. High conversion gain due to high impedance.
4. High mutual conductance in the triode section.

The OSRAM X41 has been found efficient as a Frequency Changer down to wavelengths of 5 metres, providing suitable precautions are taken in the circuit and layout.

# Osram Valves

MADE IN ENGLAND

## 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.

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

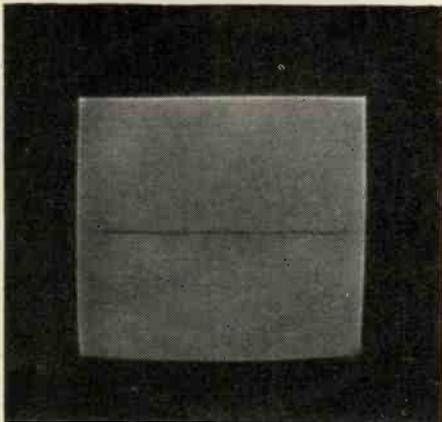


Fig. 1.—Television screen with ion line created during ageing with magnetic vertical deflection and electrostatic horizontal deflection.

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 pro-

cesses 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 ob-

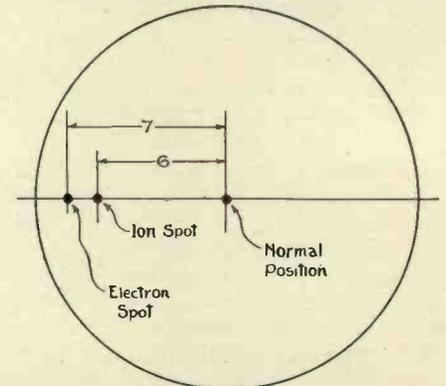


Fig. 2.—Position of the electron spot and ion spot observed with deflection by a condenser field.

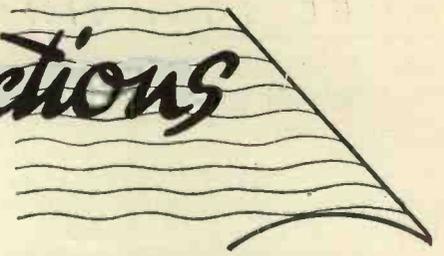
served in the action of the electrostatic converging lens.

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

**A**LEXANDRA 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

"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.

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

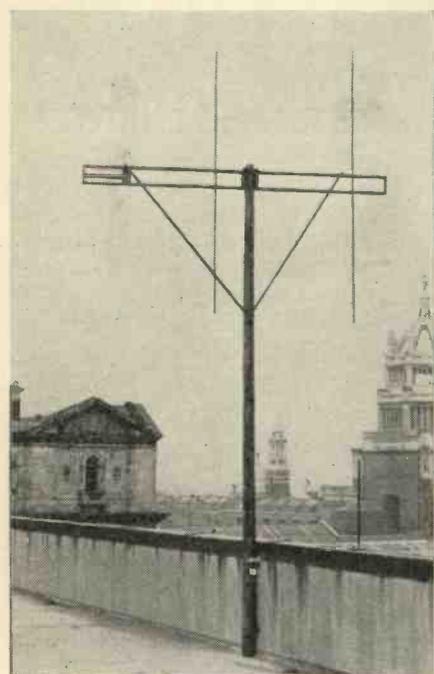
**MORE SCANNINGS**

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 Cos-sor. 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

**Read**

**"TELEVISION  
AND  
SHORT-WAVE  
WORLD"**

**Regularly**

## AND MORE REFLECTIONS

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 W<sub>2</sub>XAF. 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 W<sub>2</sub>XAF" the listener now hears the call signs of W<sub>2</sub>XAD or W<sub>2</sub>XAF.

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. Reyer, 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.

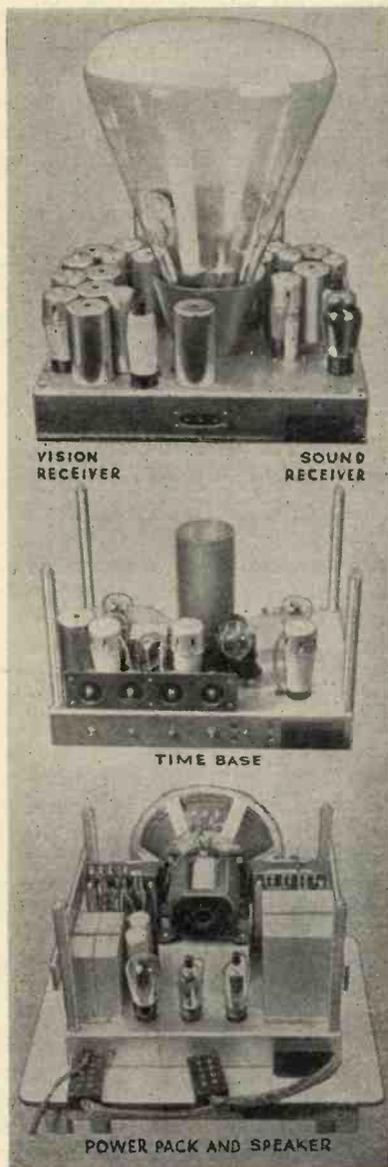
Unless a D.C.-A.C. converter is available all television receivers with the possible exception of Ekco-Sco-

phony 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.

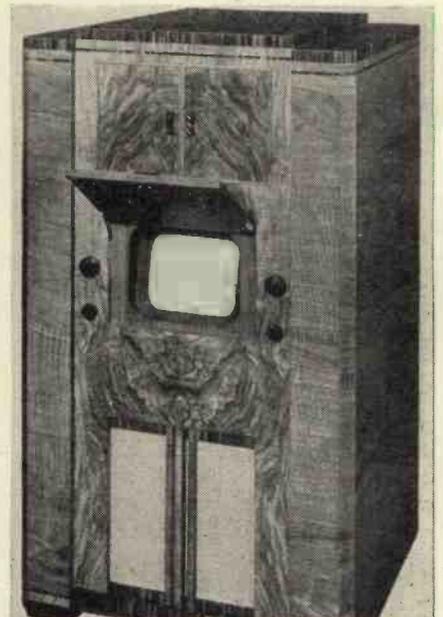
Marconiphone charge 95 guineas for their model 702 and 120 guineas for the 701. The first instrument is for reception of television programmes and the accompanying sound signals, while the more expensive receiver, model 702, is a complete home entertainer as it picks up television in addition to the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

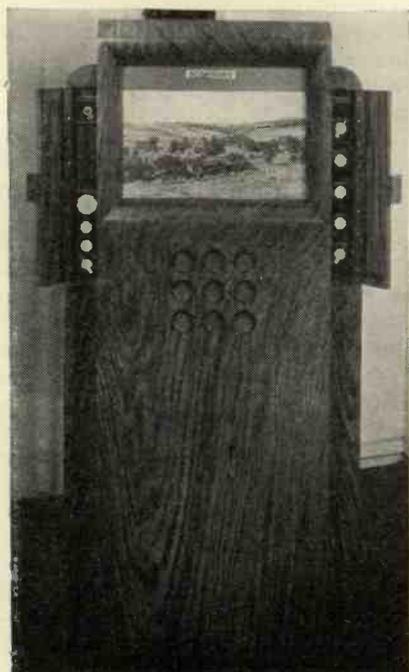
## COMMERCIAL TELEVISION RECEIVERS

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 7½ 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.

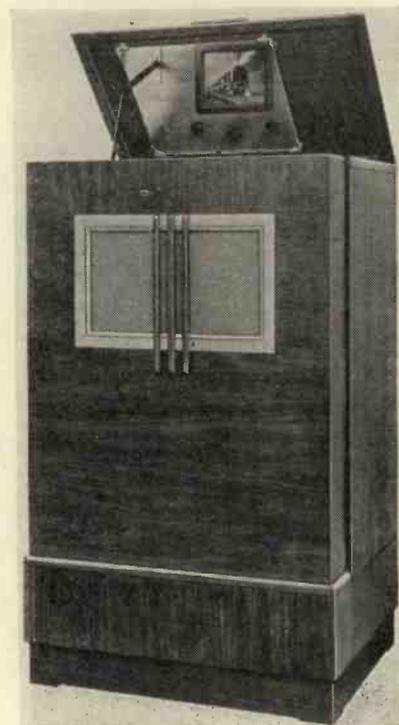
A second model has been introduced but not yet priced, but indications show that it will be round about 130 guineas. It is Model 4200 and includes in addition to television, a short-wave channel of 17 to 52 metres and normal broadcasting from 200 to 2,000 metres.

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 last 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 arrange-



ment 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.

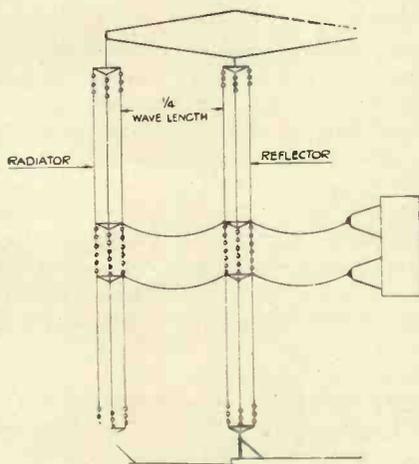
## THE MARCONI E.M.I. TRANSMITTER

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.

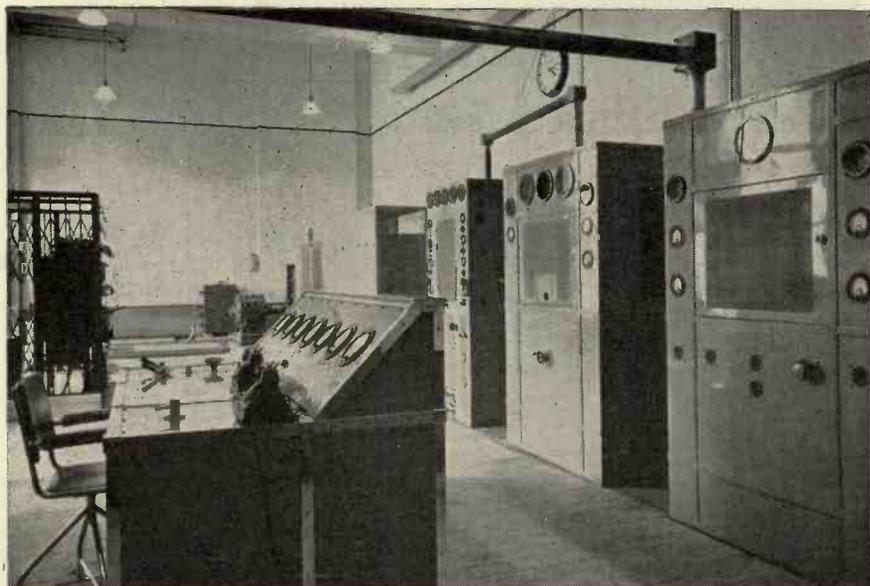
### Master Oscillator

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<sub>4</sub>) 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.

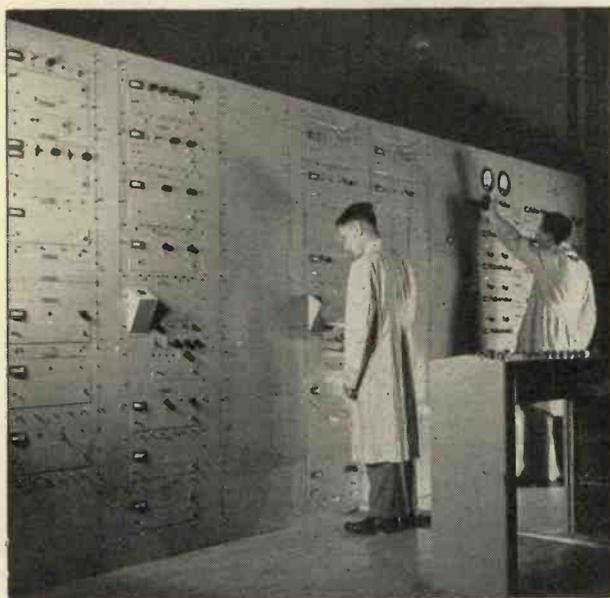
## THE B.B.C. SHORT-WAVE SOUND TRANSMITTER

supply or filament voltage does not vary more than plus or minus 5 per cent. The output frequency of this unit is  $22\frac{1}{2}$  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  $22\frac{1}{2}$  mc. is frequency doubled by an MPT<sub>42</sub> valve following which are 2 MPT<sub>42</sub> amplifiers in parallel, followed by one ACT<sub>9</sub> stage, the output of this unit being two ACT<sub>9</sub> 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 CAT<sub>15</sub> 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 CAT<sub>9</sub> 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 CAT<sub>9</sub> water-cooled valves in push-pull are used, and in the main modulator stage three CAM<sub>3</sub> 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

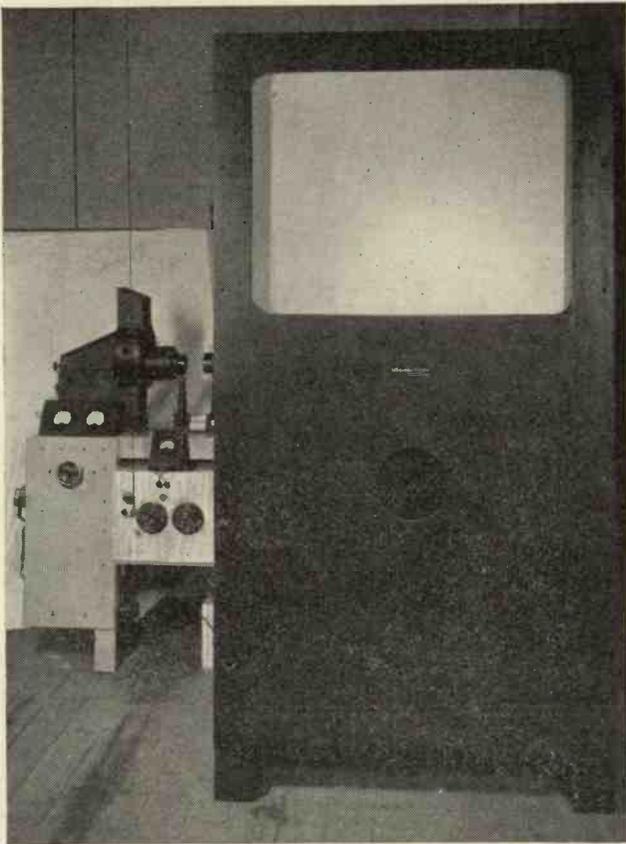
*Details of the latest developments. Exclusive to "Television and Short-Wave World."*

to the central mirror from which it was projected on to the screen.

This arrangement presented several advantages over the more orthodox 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."

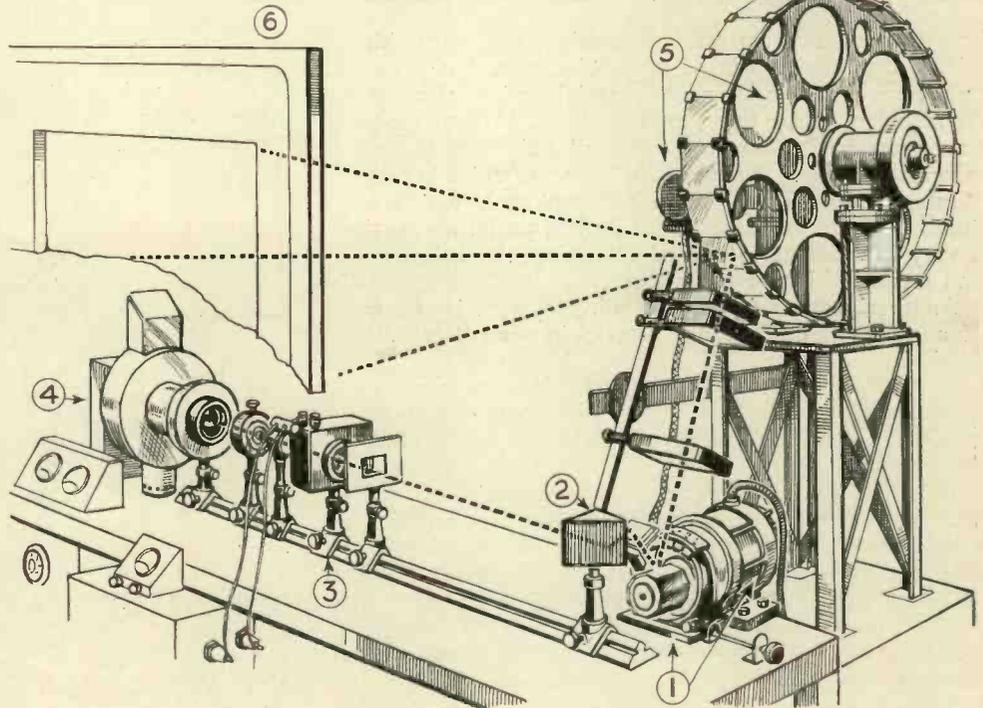
In the original type of scanner the circle of mirrors



*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

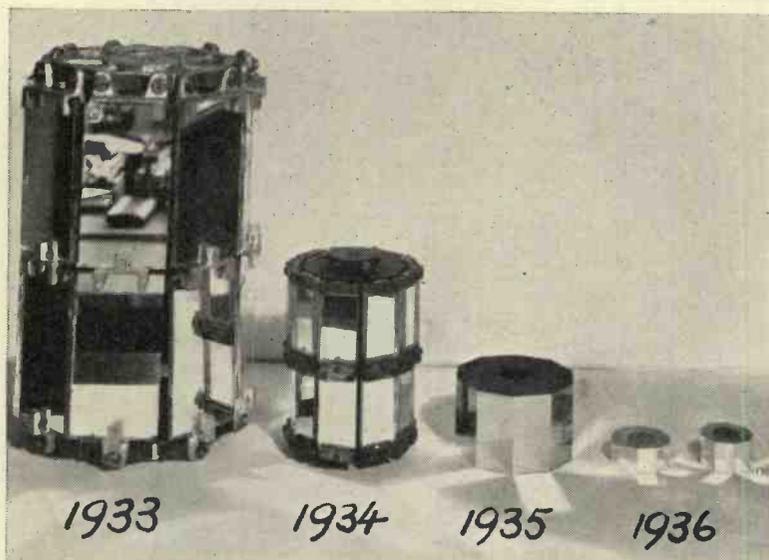
were inclined at different angles to produce the frame scan, but this is now accomplished in another way and all the mirrors comprising the arc are in the same vertical plane and therefore quite easy to set.



*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.)*

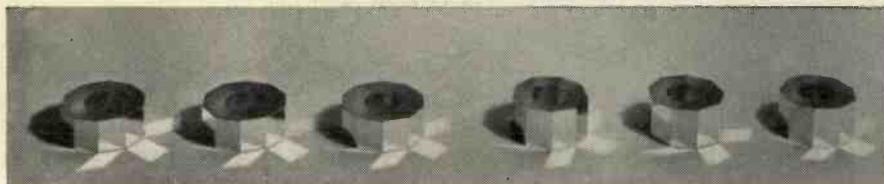


In the model we saw the 9-sided polygon is about 2 in. high and 2 in. across the faces and this for a 180-line picture revolves at 6,000 revolutions per minute, or 8,000 revolutions per minute for 240 lines.

The single line image is projected on to the screen

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



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

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.

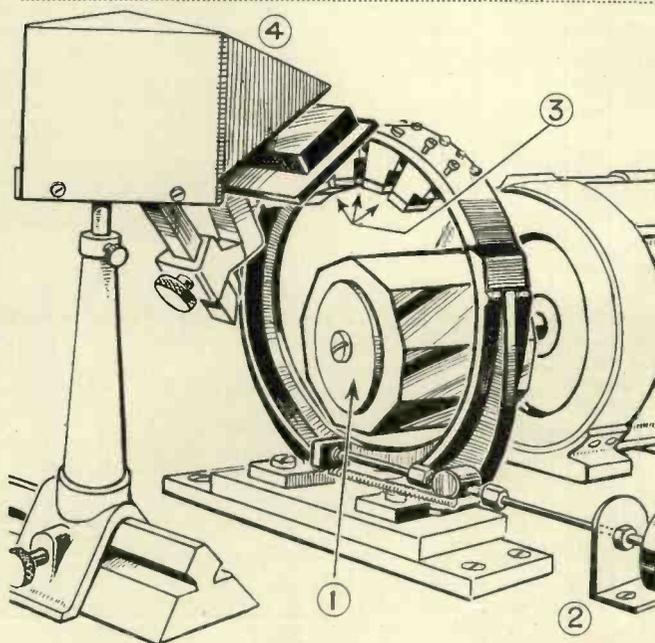
Another feature of this scanning system is the use of a patented method of "static framing" whereby the image is framed independently of the motor. The source of light for picture projection on a screen approximately 2 ft. 8 in. by 2 ft., is a small 10-ampere arc lamp, whilst an entirely new type of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

to the axis and it is driven at approximately one revolution per second.

*(Continued on page 668).*



*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.)

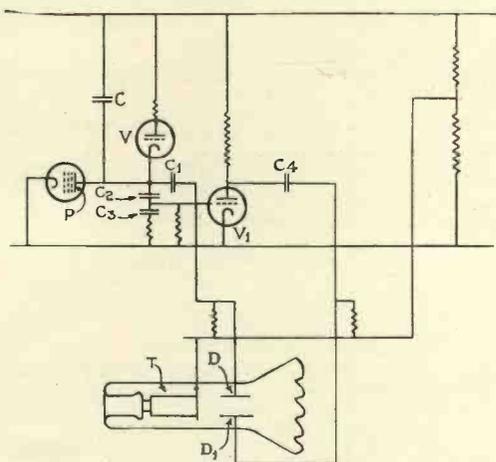
The two deflecting plates D, D<sub>1</sub> of the cathode-ray tube T are supplied with symmetrical driving-voltages from an unsymmetrical time-base circuit, in which the saw-toothed oscillations are produced by charging the condenser C through a pentode P

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 cut-

the piezo light-valve is particularly suitable for handling the high frequencies used in television.—(I. G. Farbenindustrie Akt.)

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

Saw-toothed scanning voltages of equal magnitude and opposite phase



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

and discharging it through a valve V. The output from the latter is fed to the deflecting-plate D through a condenser C<sub>1</sub>.

At the same time a second valve V<sub>1</sub> is fed with the discharge voltage from a tapping taken between two condensers C<sub>2</sub>, C<sub>3</sub> arranged so as to form a capacity potentiometer. The valve V<sub>1</sub> reverses the phase of the impulse, and feeds it in opposite phase through a condenser C<sub>4</sub> to the second deflecting-plate D<sub>1</sub> 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

ting-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,

are applied to the deflecting plates D, D<sub>1</sub> of a cathode-ray tube from the valves V, V<sub>1</sub> 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 C<sub>1</sub>, C<sub>2</sub> to the grid of the valve V<sub>1</sub>, 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

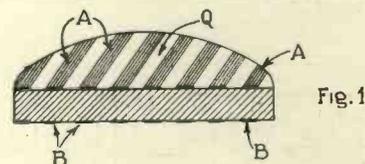
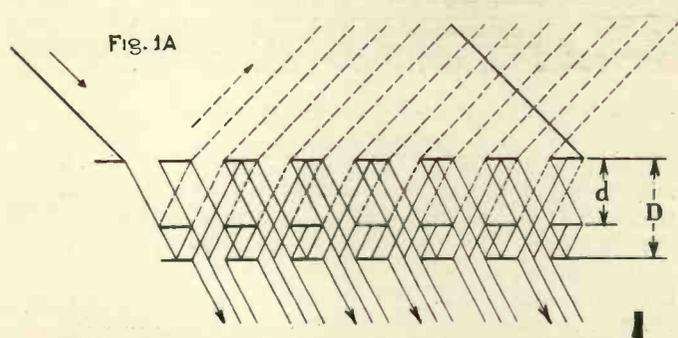


Fig. 1



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

used, one D for line-scanning, and the other D<sub>1</sub> for framing. The ray of light from a source S first passes through two lenses L, L<sub>1</sub>. The lens L has no power in the plane of the figure, whilst the lens L<sub>1</sub> 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 L<sub>2</sub> on the viewing screen V, after reflection from the slow-moving drum D<sub>1</sub>.

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

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 elec-

picture.—(*J. C. Wilson and Baird Television, Ltd.*)

(Patent No. 451,670.)

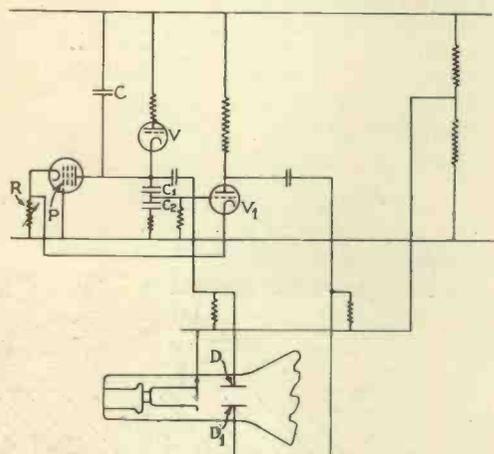
Sound and picture programmes transmitted on two carrier-waves which are heterodyned by the same local oscillator at the receiver.—(*Radio Akt. D. S. Loewe.*)

(Patent No. 451,959.)

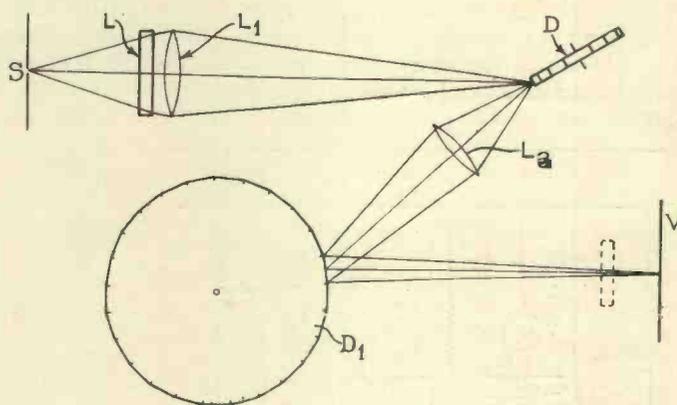
Scanning system in which the so-called "Marx" effect (or dependence of electron emission upon incident frequency) is utilised.—(*H. A. Richardson.*)

(Patent No. 451,724.)

Valve of the electron-multiplier



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



The Scophony scanning system. Patent No. 451,132

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

trodes 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

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.*)

**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



*Dallas 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 pro-

ducer, 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 anything 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, viewers 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.

# 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 aperiodic 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-

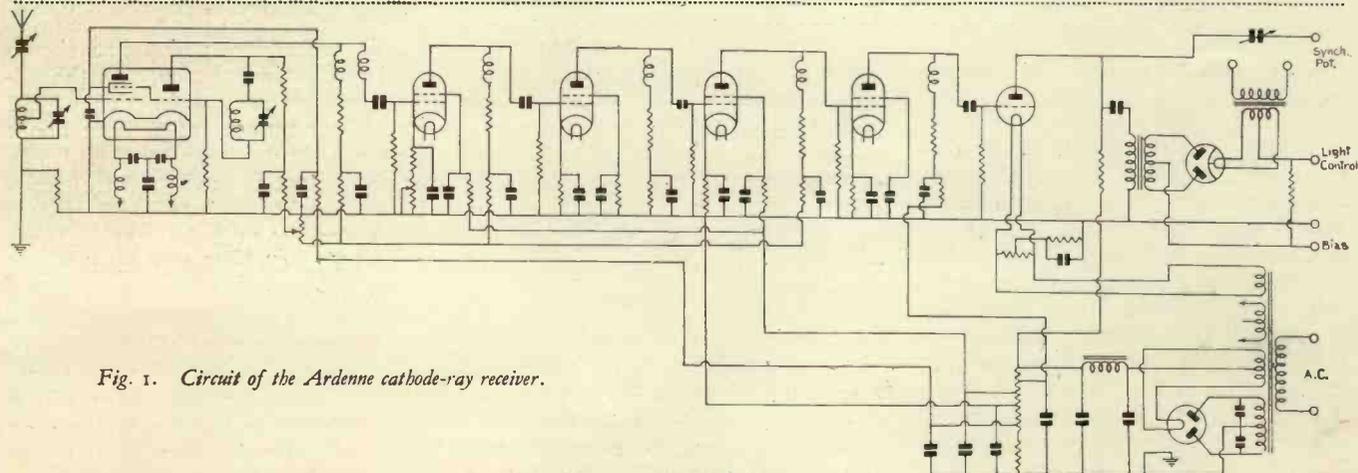


Fig. 1. Circuit of the Ardenne cathode-ray receiver.

THE TELEVISION ENGINEER — ARDENNE 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 per-

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

high intermediate frequency. A correct compromise 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.

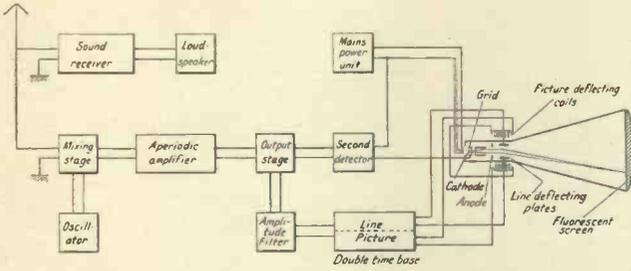


Fig. 2. Schematic diagram of receiver.

haps 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

a 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

**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-

THE TELEVISION ENGINEER ————— ARDENNE RECEIVER

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

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 characteris-

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

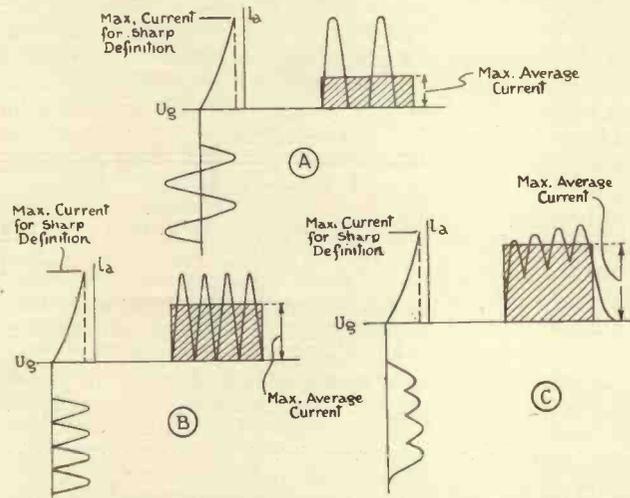


Fig. 3. Variation between intermediate frequency rectification and maximum beam current of the cathode-ray tube.

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.

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

tic 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 independence 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

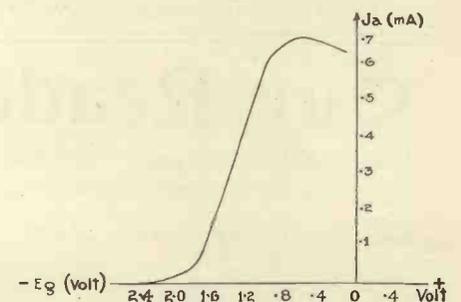


Fig. 4. Characteristic curve of amplitude filter using screen grid valve.

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.

### Circuit of the Push-pull Thyatron 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 thyatron 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 anode 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

NOVEMBER, 1936

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 sta-

tion signing G<sub>5</sub>UX on the 40-metre band, please note that this call is being pirated.

G<sub>5</sub>UX 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 (G<sub>5</sub>UX)  
53, Eccles Road, Battersea, S.W.11.

## TELEVISION IN FLEET STREET

### A Marconiphone Demonstration with D.C. Supply

**D**URING 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 im-

practicable. 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

**P**ROVISIONAL 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 remainder 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 III.  
3—8.0-mfd. 1,000-v. working, T.C.C. Type III.  
**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 hooks (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.**

# An Amateur

By Kenneth Jowers

# Communication Receiver

*In the January issue we described this receiver for the use of amateurs requiring a highly sensitive set, for operation between 30 and 1.5 mc. Owing to its success and popularity amongst amateurs, we have been requested to re-publish the details together with some features which have been added during the past six months. Also, by special request, a blue-print SW209 is now available.*

**T**HIS receiver, originally designed last November, has now been in use continuously for almost a year. It speaks well for the original design that after this long period only very minor additions have been made which do not alter the fundamental circuit in any way. This is rather an important point for even with commercial receivers, little ideas come to mind which could be embodied in order to improve results.

However, since the original design the only alterations made have been the addition of an "R" strength meter, an optional potentiometer for controlling the voltage on the detector valve, and a higher capacity coupling condenser in the H.F. stages.

The receiver was designed specially for DX reception on amateur bands and for listening to the American commercial stations which can be received well enough to be of entertainment value. A receiver to fulfil these demands has to be capable of high sensitivity with minimum noise level.

For that reason a battery operated 2 H.F. circuit has been used, but it has been adapted to include many refinements that in recent years have been omitted from large receivers.

The old argument as to whether to use a straight or super-het set does not arise now for it is generally agreed that for real sensitivity and low noise level a straight set is more satisfactory.

## Coil Matching

There is always considerable difficulty in matching up three coils so that

they maintain their sensitivity on all wavebands. In a way this trouble can be overcome by using internal preset condensers, but even this arrangement does not allow for the use of standard commercial plug-in coils.

To overcome this difficulty a new system of tuning was decided upon so

view of the great sensitivity and DX properties of this type of set it is obvious that to use it on one or two bands only would be a real waste, so that in addition to the 160- and 80-metre bands, it had to be very efficient on all other bands. This, of course, means that a band-spread condenser on 160 metres

*A meter and dial light have been mounted on to the panel, otherwise the lay-out is the same as the original receiver.*



that standard commercially wound coils could be used without ganging troubles.

Tests were then made to determine whether or not three tuned stages offered any material advantage over two tuned stages. We have noticed that by omitting the intermediate tuned stage, the decrease in gain and selectivity was so slight as to be completely ignored.

This enabled band-set condensers to be used in conjunction with a main band-spreader, so making it a simple matter accurately to match up the two tuned coils to any waveband. In

would be too large on 20 metres, and vice versa.

## Band Spreading

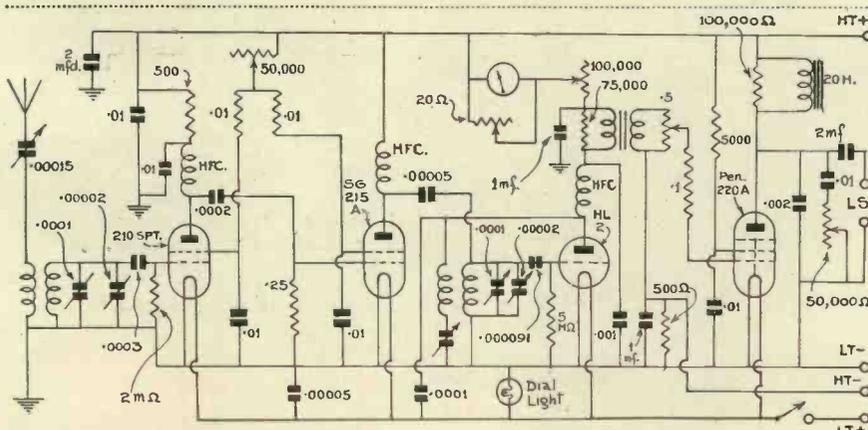
Two bandspread condensers were ganged together and arranged so that over 20 metres the amateur channel covered almost two-thirds of the dial. This gave good band-spreading on 10, 20, 40 and 80 metres, but unfortunately on 160 metres the 15 mmfd. condensers would not cover the whole band.

In view of the relative unimportance of this band it was decided not to bother about the tuning so much on 160 metres, for the band-set condensers could be adjusted to give complete coverage. It simply means that the 160-metre band has to be tuned in two steps.

Band-setting condensers at once made the use of special coils quite unnecessary, for coils of different makes and inductance can be used, the differences being taken up by the band-setting condensers. Actually, all one has to do is to set the band-setters until each coil is tuned, for example, to 40 metres, and then to cover the amateur band with the band-spreaders.

## The Circuit

The final circuit is shown in the



*This circuit is almost identical with the one originally published in the January issue. It is well worth while, however, making the suggested modifications to obtain maximum results.*

# The H.F. Valves :: H.F. Decoupling :: Air-spaced Condenser

diagram and consists of four valves used in the following way. The aerial is fed into the primary of the first coil through a .00015-mfd. series aerial con-

## Screen Voltage

High tension for the two screens is

couple this with a .01-mfd. condenser. The input to the grid of a triode detector is fed through a .00005-mfd. pre-set condenser and to obtain really smooth reaction on all wavebands this can be adjusted to give most satisfactory results.

The tuning arrangements for the detector circuit are identical with those in the first stage except that the band-setting condenser is actually mounted on the panel. Although the rotor of the band-setting condenser is at earth potential, do not rely on the automatic contact to the panel but make a separate contact from the rotor to the metal chassis.

The grid condenser in the detector stage is an air-spaced .00091-mfd., an unusual type and capacity, but the improvement in results can hardly be credited. Noise level is reduced very appreciably, while the detector circuit as a whole is more efficient than when using the standard type of condenser.

Considerable trouble was taken to determine the best value of the grid leak. A 2-megohm to L.T. negative was quite satisfactory, but decreased gain somewhat. The potentiometer across the filament supply helped this, but results were equally good when a 5-megohm leak was taken to L.T. negative, so cutting out the potentiometer.

## An H.F. Filter

Particular care was taken in the design of the detector and L.F. stages,

### Components for AN AMATEUR COMMUNICATION RECEIVER

#### BASEPLATE.

- 1—20-gauge zinc 16½ in. by 9½ in. (Peto Scott).
- 1—Wood strip ½ in. by 16½ in. by 9½ in. (Peto Scott).

#### CABINET.

- 1—Metal type 1034 (Eddystone).

#### CONDENSERS, FIXED.

- 6—.01-mfd. type 411 (Dublier).
- 1—.0001-mfd. type 665 (Dublier).
- 1—.001-mfd. type 4511 (Dublier).
- 1—.002-mfd. type 4511 (Dublier).
- 2—.2-mfd. type BB (Dublier).
- 2—.1-mfd. type 4513 (Dublier).
- 1—.00005-mfd. type 665 (Dublier).
- 1—.000091-mfd. air spaced type SW81 (Bulgin).

#### CONDENSERS, VARIABLE.

- 1—.0002-mfd. type 957 (Eddystone).
- 2—900/20 (Eddystone).
- 2—.0001-mfd. type 1054 with ½ in. spindles (J.B.).
- 1—.00005-mfd. type 1087 preset (J.B.).
- 1—.00015-mfd. type 1053 with ½ in. spindles (J.B.).
- 1—.0002-mfd. type 1087 (J.B.).

#### COILS.

- 2—Sets type 959, 4-pin (Eddystone).

#### CHOKES, HIGH-FREQUENCY.

- 2—Type CHN (Raymart).

- 2—Screen H.F.P.A. with spade tags (Wearite).

#### CHOKE, LOW-FREQUENCY.

- 1—Ni-choke II (Warley).

#### DIALS.

- 1—Wide vision type 973 (Eddystone).

- 2—1027 (Eddystone).

#### HOLDERS, VALVE.

- 1—5-pin chassis type less terminals (Clix).

- 5—4-pin chassis type less terminals (Clix).

#### PLUGS, TERMINALS.

- 4—Terminals type B marked Aerial, Earth, L.S.x, L.S. (Belling-Lee).
- 2—Wander plugs marked H.T.x, H.T. (Clix).
- 2—Spade terminals marked L.T.x, L.T. (Clix).

#### RESISTANCES, FIXED.

- 2—10,000-ohm type HW15 (Bulgin).
- 1—500-ohm type HW2 (Bulgin).
- 1—5-megohm type HW36 (Bulgin).
- 2—100,000-ohm type H.W.25 (Bulgin).
- 1—75,000-ohm type HW24 (Bulgin).
- 1—5,000-ohm type HW10 (Bulgin).
- 1—500-ohm type WE10 (Bulgin).

#### RESISTANCES, VARIABLE.

- 2—50,000-ohm potentiometers (Erie).
- 1—500,000-ohm potentiometer with switch (Erie).
- 1—100,000-ohm potentiometer (Erie).

#### SUNDRIES.

- 1—Flexible coupling piece type 1009 (Eddystone).
- 1—Dg dial light with B206 bulb (Bulgin).
- 2—Aluminium screens to specification (Peto Scott).

- 2—Extension control rods type 1008 (Eddystone).

- 2—Panel brackets (Bulgin).

#### TRANSFORMER, LOW FREQUENCY.

- 1—Type AF6, 1—7 ratio (Ferranti).

#### ACCESSORIES.

##### ACCUMULATOR.

- 1—2 volt, 45 amp (Exide).

##### BATTERY, HIGH TENSION.

- 1—Super capacity 120 volt (Vidor).

##### VALVES.

- 1—210SPT Met. 4-pin (Cossor).

- 1—SG215A Met. 4-pin (Mazda).

- 1—HL2 Met. (Mazda).

- 1—PEN220A (Mazda).

denser, this condenser becoming progressively more effective as the frequency is decreased. On 160 metres it can be shorted out of circuit so as to give maximum gain. This is done by simply bending over the edge of the outer rotor plate so that it shorts on the stator when all the plates are in mesh.

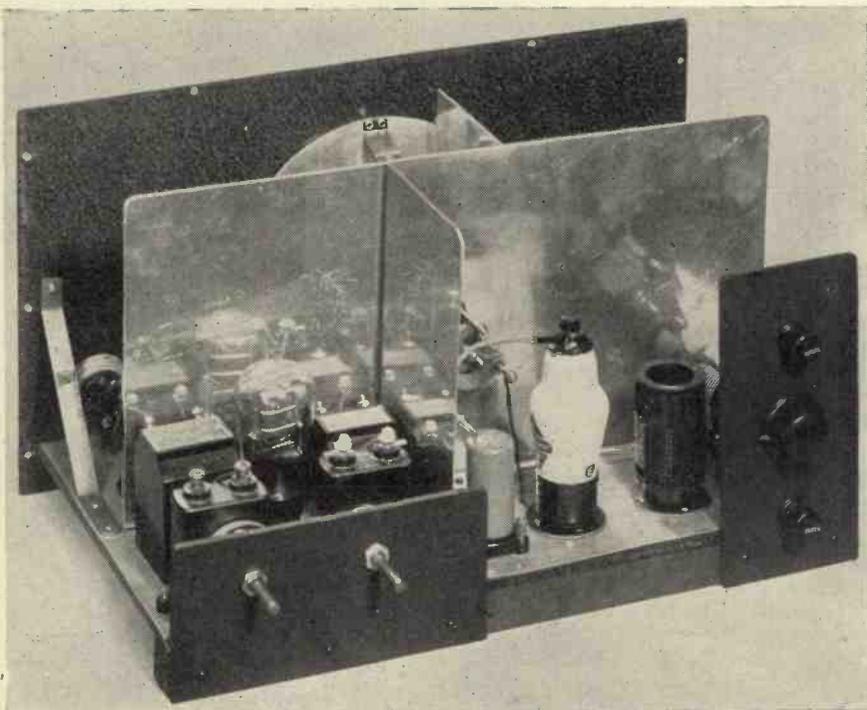
Across the grid of this coil is a .0001-mfd. band-setting condenser and in parallel with a .00002-mfd. band spreader. The band-setter is mounted on the rear screen which can be seen in the plan view. This screen is at earth potential, so that only one wire need be connected to the band-setting condensers, and that is to the stator. The first H.F. valve is a four-pin pentode with the suppressor grid connected internally. This valve is no better than a screen-grid on the lower frequencies, but gives a decided boost to weak signals on the higher frequencies.

Tests during the last few months have shown that a screen-grid valve of the SG215A type is more effective than the pentode in the second stage, so those who have already constructed the receiver would be well advised to consider this change-over.

Incidentally, between the anode and the grid of the first and second valves was a .00005-mfd. pre-set condenser. This, however, has now been changed to a .0002-mfd. pre-set condenser. The screening grids of the two H.F. amplifiers are linked together through 10,000-ohm resistances and decoupled by .01-mfd. condensers.

controlled by means of a variable potentiometer enabling the optimum gain to be obtained.

It is most important to include a 500-ohm resistance in series with the anode of the first H.F. amplifier and to de-



The detector voltage control should be mounted on the middle dividing screen. The resistance must be of the dead-spindle type.

NOVEMBER, 1936

# L.F. Gain :: Tone Correction :: 20-metre Results

for this end of the receiver can cause a lot of trouble. First of all, the H.F. choke in the anode of the detector, besides being specially selected, is by-passed to earth on both sides. It is of the Raymart CHN type, which appears to be particularly suitable for this circuit. On the anode side is a .0001-mfd.

a 5,000-ohm resistance is connected in series with this grid and by-passed with a .01-mfd. condenser.

In the anode circuit of the PEN220A is a small L.F. choke in parallel with a 100,000-ohm resistance. This, in conjunction with 2-mfd. condenser, forms the choke filter output circuit. Finally,

The case supplied by Eddystone is fitted with a metal panel of quite light gauge to which the tuning drive and escutcheon can be fitted without any trouble. A template is given so that it is almost impossible to make any mistake when cutting the holes. Notice that there are five front panel knobs. First is the aerial band-setter, second a detector grid band-setter, third, tuner; fourth, reaction; fifth, volume and on-off switch.

These controls are arranged so that the front panel looks quite symmetrical. The baseboard is 16 ins. by 9½ ins. by ¾ in., and is covered with a sheet of 20-gauge zinc. Zinc is used because wire can be soldered directly to it.

Across the underneath of the baseboard is fitted a runner of wood 16 ins. by ¾ in. by 1 in., which is simply to keep the baseboard off the bottom of the metal cabinet. A 1-in. clearance is required to take the six valve holders and the various small condensers and resistances.

## A Rigid Panel Essential

Even though the panel is screwed to the cabinet with 10 bolts, it is really advisable to use two angle brackets so as to make quite sure that there can be no panel movement to upset tuning. This is most important on 10 and 20 metres.

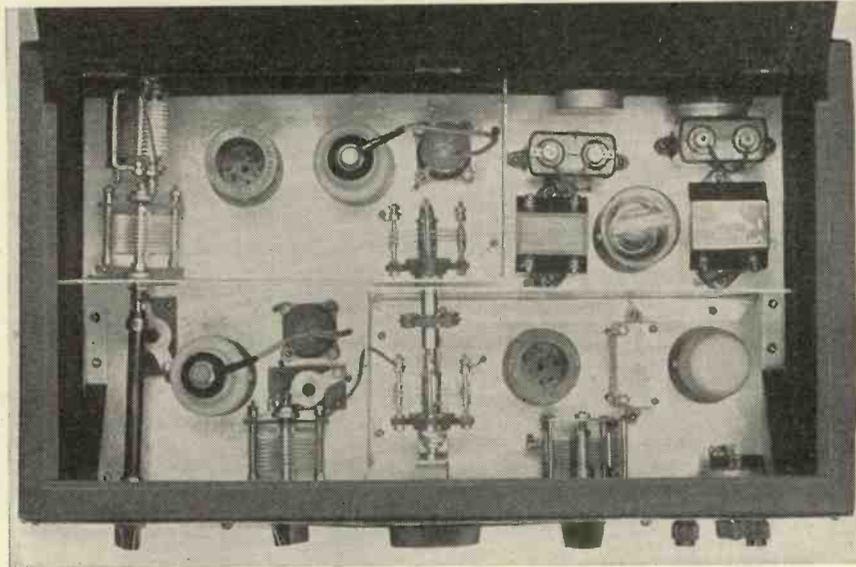
The Sifam milliammeter connected in the detector H.T. lead is shunted with a 20-ohm variable resistance. The resistance should be varied so that the total consumption in the detector stage only registers 1 ma. on the meter. In this way quite a reasonable measure of signal strength can be obtained by checking the downward deflection on the meter.

## Operation

Operation does not need any comment for all the controls are perfectly flexible. A point, however, is that reception down to 28 mc. is perfectly satisfactory, while sensitivity is of a high order. During a brief test the following 28 mc. phone stations were heard, Canadian VE1GH, Cuban CO6OM, American W9BHT, W3AUC, W5DDP, while 10-metre C.W. reception included four continents.

On 20 metres an average of 50 stations per week are being worked with the greatest of ease. Other bands are equally satisfactory. During the original tests 5VT on 1916 kc, and G2OV on approximately 1923 kc, were separated quite easily. With a short aerial and a screened wavetrap duplex working is quite successful on 40, 20 and 10 metres, providing, of course, the normal precautions are carried out.

Constructors can obtain a blueprint of this receiver for 1s. 6d. from our Blue-print Department.



The suggested modifications do not in any way alter the original layout so that readers with the first model can take advantage of the improvements made without any difficulty.

filter condenser while on the H.T. side is a .001-mfd. This stops H.F. most effectively and at the same time prevents any arc over in the output pentode, due to surges.

An addition in this circuit is the potentiometer governing the voltage applied to the anode of the detector. This is mounted on the screen which divides the detector from the first H.F., and should be pre-set. Any potentiometer other than the one specified should be examined to make sure that it has a dead spindle, otherwise there may be a short circuit of H.T. to the metal screen.

Volume control is a ½-megohm potentiometer across the second grid of the L.F. transformer and so as to keep the number of controls as low as possible and still retain flexibility, the on-off switch is embodied in this control. While in the L.F. stage the L.F. transformer has been changed to a Ferranti AF6 with a ratio of 1-7, for this gives enormous gain. Those readers, of course, who are only interested in amateur reception and do not need large volume need not change the transformer from the one originally specified.

In series with the grid of the output pentode is a 100,000-ohm series resistance, which removes all traces of H.F. in the output stage. Although the auxiliary grid can be run at maximum potential, by reducing this slightly the anode current is materially reduced without decreasing gain, so to that end

a .002-mfd. condenser is connected from the anode of the PEN220A to chassis.

### THE BLUE PRINT.

We have had so many requests for details regarding small constructional points that we have issued a full-scale blue print. The number is S.W.209 which can be obtained from TELEVISION AND SHORT-WAVE WORLD, Chansitor House, 37/38 Chancery Lane, W.C. 2. The price is 1/6 post free.

Tone correction, although not necessary from a quality point of view, is essential when receiving weak signals that are inclined to be overcome by mush. This tone corrector consists of a .01-mfd. condenser in series with a 50,000-ohm variable resistance from the anode of the output valve to the chassis. The control knob is actually at the back of the metal case next to the variable screen voltage control.

Grid bias is obtained automatically for the output pentode by means of a 500-ohm resistance between H.T. negative and L.T. negative, by-passed with a 1-mfd. condenser.

### Power Supply

As the entire receiver takes 22 ma. a bias of approximately 11 volts is applied to the pentode. Those readers who are confined to accumulators or dry batteries for high tension are advised to use a PEN220 with a 400-ohm bias resistance as this will reduce the total consumption to 10 ma., a much more reasonable figure.

# Heard on the Short Waves

By Kenneth Jowers

**D**URING the past six or eight weeks I have been spending most of my time working on the 20-metre band which has proved very productive of really good DX stations.

It has never been possible accurately to forecast just when the band will open up. During the first week in October 20-metre phone stations could be worked from about 10 p.m. onwards and then suddenly during the second week of October, British stations began contacting American and Canadian amateurs as early as 6 o'clock in the evening.

A feature of this band has been that while American amateurs were receivable for almost 24 hours of the day, no G stations were able to contact for more than an hour or so continuously.

## G-VK Contacts

Several reports have come to hand on low-power G stations contacting Australia on phone. I have in mind in particular G6KV in Laindon, who had an R6-7 Q5 report from VK. His power is, I believe, still only 10 watts, although he may now have increased to 25 watts. But in any case it is a very meritorious performance.

I heard a VK and an NY come back to G6IF who is also a low-power station, while G5UK was obtaining very good report from LU. 5UK's input is well on the right side of 50 watts. It is, of course, the more powerful stations, such as 5NI, 5ML, 5JO, 6XR, etc., that have been putting out the best signals, but despite all this quite a number of 10-watt stations have been receiving R7-8 reports. 2XV in Cambridge has also been getting out very well, and although he is more than 20 miles from me the ground wave of his 20-metre transmission is usually R7-8.

## 10 Metres

W1CCZ tells me that the 10-metre band has been far too erratic for his liking as it only opens up for one hour a day and at a time which cannot always be predetermined. On the other hand, I have heard a number of W's on 10 whenever I have listened, but that must be merely luck.

G8's are still monopolising the 40-metre band and the QRM is now getting so heavy as to make operation almost impossible. The 160 metre band is improving very much, for in addition to noise level reducing, most of the stations who use that band are at present inoperative.

G6GO is working duplex with Dutch stations, while G2KT is also very active and the report from G5MM is still read on Tuesday evenings.

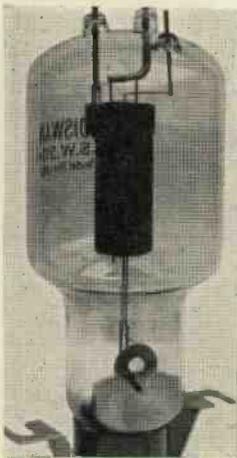
I understand from G5JO that the 80-metre band should be fairly good this winter, for Canadian stations are now

coming over with a fair degree of consistency. It will be remembered that last winter 5JO was making quite a number of contacts on this band with America and obtaining really very fine reports.

## America and the U.H.F.

There is a general interest in 5 metres which has increased considerably since the B.B.C. started regular 7-metre transmissions, so that U.H.F. receivers could be reliably checked. I notice that the Columbia Broadcasting Co. are experimenting on the ultra high-frequencies with two stations on a frequency of 31,600 Kc. W2XDV in New York operates from 11 p.m. to 5 a.m. on weekdays and from 6.30 p.m. to 11 p.m. on Saturdays and Sundays. W9XHW in Minneapolis operates weekdays from 10 p.m. until 5 a.m., Saturdays and Sundays 1 p.m. until 5 a.m., also on a frequency of 31,600 Kc.

These stations are designed for high fidelity transmissions and radiate the C.B.S. medium-wave programmes. As



*This is the British answer to the American high-power transmitting valves. It is an Edison ESW 204 carbon-anode triode suitable for its full output of 250 watts down to 5 metres. Anode, grid and filament mid-tap contacts are brought out through the top of the bulb.*

some of the 9-10 metre police stations have been heard in this country, it is not unreasonable to assume that listeners will be able to hear W2XDV and W9XHW.

Talking of high-frequency stations, the following are also working on 31,600 equal to a wavelength of 9.49 metres. W2XDU, in New York City, W4XCA in Memphis, W8XAI in Rochester, New York, W8XWJ in Detroit.

## The Commercial Stations

W2XE on 13.94 metres is putting over a really fine signal most days between 12 and 2. Last Saturday I heard an organ recital for over half-an-hour. The volume was sufficient fully to load

my receiver, giving an output of over 10 watts. This station at the moment seems more reliable and has a greater peak strength than W8XK on 13.93 metres.

For many years my most reliable station has been W3XAL on 16.87 metres and if ever I wanted to convince somebody of the reliability of short-wave reception I used to tune in W3XAL. I have been badly let down in the past few weeks, for this station has been most inconsistent. So much so that I have had to rely on W2XAD, the General Electric station.

A very good local station is HAS3, located in Budapest, which operates on a wavelength of 19.52 metres. Make a very special point in tuning in this station next Sunday at 2 o'clock and enjoy a really good hour's programme.

Listeners who are keen on logging new distance stations should jot down these details about HI3C, La Voz De La Feria. This station, in the Dominican Republic, operates on a frequency of 6,730 Kc., equal to 44.57 metres and is on the air every day from 5.30 p.m. to 7 p.m., and 11.30 p.m. to 1 a.m. Sunday schedule is 5.30 p.m. to 8 p.m. Reports are welcomed and verification cards will be sent.

The U.S.S.R. have introduced a new Moscow station, RW96, which operates on a frequency of 9,600 Kc. SM5SX, in Sweden, is now doing a little broadcasting on behalf of the Swedish Government on 11,770 Kc., and also on the 20-metre band between 11 p.m. and midnight.

## Dutch Programmes

The two Dutch stations PCJ and PHI are now putting out good programmes that can be received in this country without difficulty. Here are the schedules, PCJ on Sundays 12 to 1 p.m. on 15,220 Kc., and 7 to 8 p.m. and 1 to 2 a.m. on 9,590 Kc. On Tuesdays PCJ operates between 9.30 and 11 a.m. on 15,220 Kc., and from 6.30 to 8 p.m. on 9,590 Kc. On Wednesdays PCJ operates from 1 to 4 p.m., on 15,220 Kc., and from 12 midnight until 3 a.m. on 9,590 Kc. PHI also broadcasts on 17,775 Kc. every day except Tuesday and Wednesday, from 1 p.m. until 3 p.m.

The tapped-on aerial has never interested me very much, particularly on the lower frequencies, but just recently I have been giving this type of aerial an extensive trial and the results have been surprisingly good. Actually, I have been having a 67-ft. top with the single line loosely coupled to the tank coil. The coupling coil was, of course, parallel tuned with one end left up in the air.

# A Single-valve 240B Transmitter

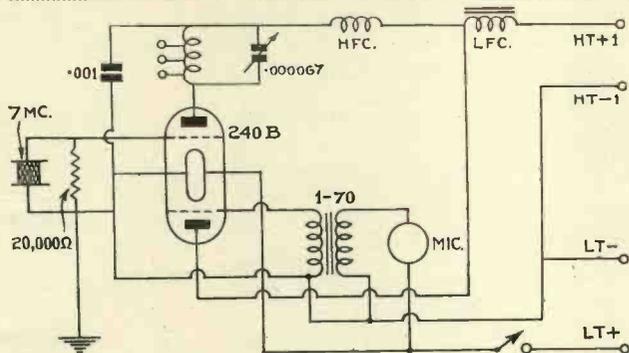
By B.R.S. 1636.

The 6A6 transmitter created so much interest amongst amateurs that it has now been built for use as a stand-by transmitter. Experimenters, however, have asked us for a battery operated version. This article describes the construction of such a unit, while the blue-print No. SW210 is available.

BESIDES providing a considerable amount of amusement, this little one-valve transmitter can be treated very seriously, for it has quite

Some schoolboys made up this transmitter from advance information supplied and have had every success with it. They have, of course, obtained an

For that reason, we realise that this unit will have a very big appeal amongst youthful experimenters as for the first time it will enable them to build a simple transmitter with less trouble than it takes to construct the average short-wave receiver. Even though only one double valve is used, the apparatus is crystal controlled, gives good quality on phone and actually can be used by the serious experimenter with a full radiating licence on most of the amateur bands.



Wavelength is governed by the coil and crystal. The output is ample on 160 and 80 metres, but unless a 20-metre crystal is already on hand this band is best left alone.

## The Circuit

A rough check on the circuit will give some idea as to how the transmitter is arranged. The Class B valve, actually a Cossor 240B, is used as an oscillator and modulator. This valve is a twin triode with a common filament and de-

a wide range on either C.W. or phone. The original tests were entirely satisfactory, R7 reports being received over a distance of 30 miles. Subsequent tests with a tapped-on aerial have enabled us to work French and Belgian stations QSA5.

This does not sound particularly good, but it must be remembered that the entire transmitter, which includes what is virtually a speech amplifier, can be run from a standard H.T. battery or mains unit, for the total current consumption is between 10 and 15 ma.

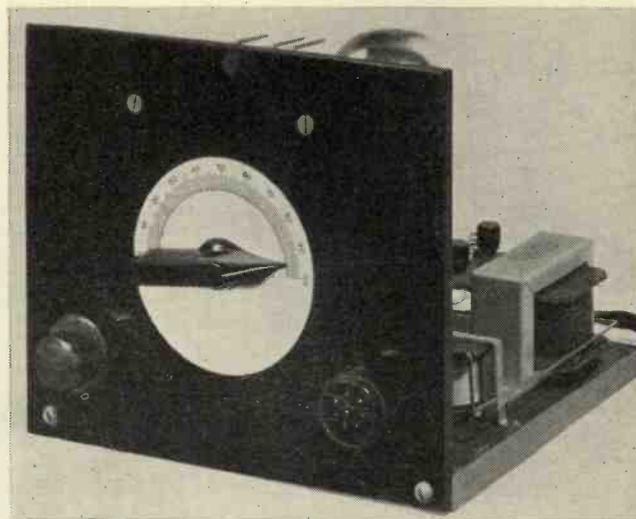
None of the components are of a special type and most of them can be obtained from any good radio dealer.

## Home Built Coil

The coil is home-constructed and is made in such a way that it can be wound and completely finished in less than five minutes by even the most inexperienced constructor. Altogether there are only eight or nine components that have to be mounted and as the entire baseplate is only 6 ins. by 7 ins., there is no need for us unduly to stress the simplicity of this little transmitter.

artificial aerial licence which enabled them to make all their adjustments to

On the left-hand side is the rotary on-off switch with the microphone plug and jack on the right. The tuning drive is not geared owing to the low-capacity tuning condenser.



experiment with voltages and values of grid leak so as to obtain maximum radiation, and in fact to gain a working knowledge of how a simple crystal oscillator functions.

signed for Class B operation. As can be seen from the circuit one triode section is used as a low-frequency amplifier. A high-output microphone is fed into the primary of a 70-1 microphone transformer which supplies an appreciable voltage to the grid of the triode section. Energising voltage for this microphone is obtained from the filament supply, so that one switch only is used to cut out the transmitter, modulator and energising voltage.

The second triode has in its grid circuit a quartz crystal of the frequency required. This actual unit has a crystal with a frequency of 7,288 kc., which is right on the edge of the amateur band, so missing most of the interference which one experiences with a crystal in the middle of the band.

## Components for A SINGLE VALVE 240B TRANSMITTER

### BASEBOARD AND PANEL.

- 1—Wooden baseboard 6 in. by 7 in. by ½ in. (Peto Scott).
- 1—Ebonite panel 7 in. by 6 in. by ¼ in. (Peto Scott).

### CHOKE, HIGH-FREQUENCY.

- 1—Ceramic short-wave type 103 (B.T.S.).

### CHOKE, LOW FREQUENCY.

- 1—Type HT35 (Wearite).

### COIL.

- 1—40 metre to specification (Peto Scott).

### CONDENSER, FIXED.

- 1—.001 mfd. non-inductive tubular (T.C.C.).

### CONDENSER, VARIABLE.

- 1—Type UVC67 .000067-mfd. (B.T.S.).

### DIAL.

- 1—Type 1027 (Eddystone).

### HOLDER, VALVE.

- 1—7-pin ceramic type UH7 chassis (B.T.S.).

### RESISTANCE, FIXED.

- 1—20,000-ohm type 1 watt (Dubilier).

### SUNDRIES.

- 1—Type J2 jack (Bulgin).
- 1—Quartz crystal with holder for 7-Mc. (Q.C.C.).
- 2—Yards twin flex (Peto Scott).

### SWITCH.

- 1—Type S91 (Bulgin).

### TRANSFORMER, MICROPHONE.

- 1—Type LF35 (Bulgin).

### MICROPHONE.

- 1—Type UM (B.T.S.).

### VALVE.

- 1—Class B type 240B (Cossor).

## Making the Coil 3 Watts Input :: The Aerial

This point is rather important if satisfactory results are to be obtained with low power. If, on the other hand, the transmitter is to be used on different wavelengths, the crystal should be ground to the band required, while the coil will have to be altered with regard to inductance, to match up with the crystal frequency chosen.



*The microphone unit is made by B.T.S., but it was fitted to this home-made stand.*

The crystal is anchored down to earth, but across it is a 1-watt, 20,000-ohm resistance to provide bias for the transmitting side of the 240B.

### Power Supply

20,000 ohms gave the greatest output with 150 volts high-tension, but if the high-tension can be increased, the grid resistance should be increased to correspond. This resistance is the only variable quantity in the entire transmitter, and it will pay to vary it to obtain best results. In fact it will pay to use a variable resistance in this position until the correct value has been obtained, when it can be replaced with a fixed resistance of the value determined by using the variable resistance.

### Making the Coil

The coil is rather special. It uses a length of screwed low-loss former made

by Peto-Scott. This is suitable for use right down to 10 metres. It is wound with 20 turns of 18-gauge tinned copper wire and is mounted, as can be seen from the illustration, directly on to the panel above the variable condenser. Two little bushes, made from wander plug heads just space the coil off the panel by about  $\frac{1}{4}$  in.

Three tapings are made on this coil, one being in the centre, others being made equal distances between centre and end. But more about these tapings later.

The H.T. side of the coil is connected to a high-frequency choke and bypassed to earth by a .00-mfd. condenser. Without this condenser, the transmitter will refuse to oscillate. Also, if a different type of high-frequency choke is included, make sure that it does not resonate at the frequency of the crystal. This choke is soldered directly on to the last turn of the coil, so making the connections short and rigid. The H.T. side of the choke is then fed into the low-frequency choke, to which is connected also the output from the modulator. In this way the speech currents are impressed on the carrier, so giving modulation.

The percentage of modulation depends on the output from this modulator valve, but with 150 volts, ample output is obtained.

### Output

On 40 metres the transmitter has an input of about 3 watts and about 2 watts on 20 metres. This may not sound very much, but it is surprising just how

much can be done with this low power providing conditions are reasonably good and the interference is not too bad.

Those who are going to use a dummy aerial should make up two coils, the second one being without any tapping points. This second coil has to be tuned and should have in series with it a small flash-lamp bulb. It must be mounted end-on to the anode coil, roughly tuned to resonance, and then tests made to give maximum light in the bulb.

### The Best Aerial

An end-on aerial is ideal for the radiating amateur. The correct tapping point has to be determined by experiment, but with the coil shown, as there are four points from which to choose, this is quite simple.

To obtain the correct length of aerial, convert the frequency of the crystal into metres and multiply by 1.56.

A blue-print is available for those who have not tackled a transmitter before, and it can be obtained from our Blue-print Department, TELEVISION AND SHORT-WAVE WORLD, 37 Chancery Lane, London, W.C.2, for a shilling. Simply quote No. SW210.

It must be clearly understood that even with a simple transmitter of this kind a Post Office permit must be obtained. Applications should be made to The Office of The Engineer-in-Chief, Radio Division, Armour House, Aldersgate Street.

An artificial aerial licence can be obtained without the need of a Morse Code test.



*There is plenty of room on this little baseboard so that construction is very easy. The 240B is mounted on a chassis-type valve holder, which is raised off the baseboard.*

# A Beginner's Transmitter

By KENNETH JOWERS

*We feel that beginners will appreciate this type of constructional article in which we are to describe the construction of a simple transmitter in simple stages. The input is for 10 watts, but it can be adapted for 25 watts without any great expense.*

Briefly, the transmitter will be suitable for any waveband between 20 and 160 metres, and for inputs of between 10 and 30 watts. This means that the beginner restricted to 10 watts input, can go right ahead with his experiments and ultimately, when his licence is extended to 25 watts, increase his carrier without additional cost.

There are two power packs, one for the transmitter and one for the modulator, which will be described in subsequent issues, while the actual modulation can be either in the suppressor grid or anode as required, but these points will all be dealt with in rotation.

Stations using similar rigs have been working the entire world without much difficulty, so this transmitter will soon become extremely popular.

## Low Cost

Cost is always of primary importance, and as we intend only describing one unit per month, the expenditure is spread over a fairly long period. In this issue we have given a list of components which refers strictly to the crystal oscillator stage. In the next issue will be the push-pull pentodes and their associated components and perhaps the first power pack.

We have shown the entire circuit for the crystal oscillator and push-pull power amplifiers, but remember that we are only dealing with the simple crystal oscillator circuit up as far as the link coupling section.

The entire transmitter is accommodated in an Eddystone 4-tier rack which is supplied complete with chassis and panels. It is very compact so that the finished article looks very much like an American commercial transmitter. This rather proves that even though trans-

mitting licences are issued for experimental purposes, there is no need for them to be built in a hay-wire manner.

## Crystal Control

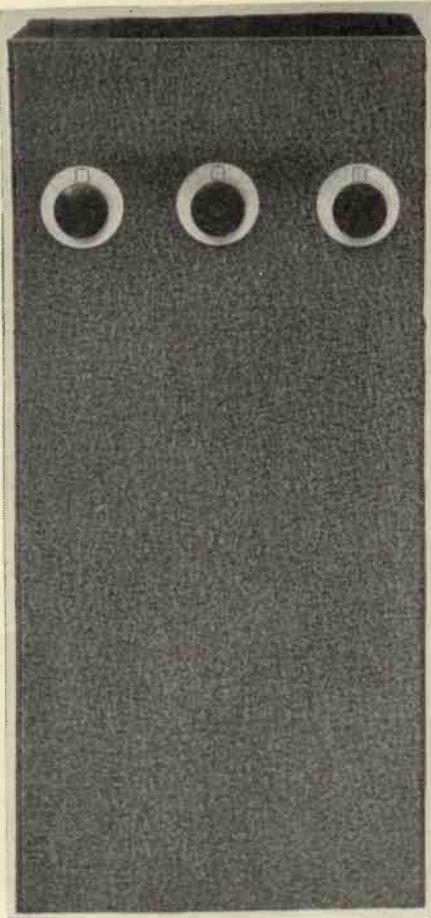
Choose a crystal with a frequency somewhere in the middle of the 40-metre band. A good spot is around 71,000 kc. The crystal oscillator valve is the Tungstram 0-15/400, with approximately 300 volts on its anode. The crystal is connected between grid and earth of this valve, bias being obtained by means of a 25,000-ohm resistance. Also in this circuit is a filter consisting of a conventional high-frequency choke and a .002d.-mfd. by-pass condenser. The layout of these components can clearly be seen from the illustration.

As a C.O. anode tuning condenser, we have chosen a standard .00016-mfd., Polar, which is bolted directly to the panel. Owing to the use of a split-stator tuned circuit there is no need to isolate the condenser as the rotor plates are connected to earth.

## The Negative Return

Do not, however, rely on the automatic contact to the panel for the negative return. Clean the chassis of black enamel just beneath the tuning condenser, and fix a 2 B.A. bolt and nut with washers and soldering tags on both sides. Take all of the earth connections in the crystal oscillator stage to this one common point. Do not simply take the earth return to the nearest point on the chassis.

Directly across the filament terminals of the C.O. valve holder, connect a pair of .01-mfd., type 670 condensers, again taking the mid-point to the common earth connection.



*This is just the beginning. The three controls are for the C.O. and P.A. grid and anode stages. When the transmitter is finished there will be meters in the centre with the switching circuit at the bottom.*

## The Crystal-Oscillator

THE previous series of articles dealing with transmission for the beginner in a theoretical manner proved most popular. Not only did it appeal to the semi-technical amateur, but also to the licensed operator who was not quite so well up in theory.

Interest in transmission is growing very quickly, so for that reason it is intended in this new series to describe a transmitter for the beginner consisting of a crystal oscillator, link coupled to a pair of pentodes in push-pull.

Each stage will be described separately and before the following stage is described all operating data on the previous stage will be given.

In this way it is hoped to provide a transmitter of the highest efficiency that can be made up by any reader without any possibility of failure. All the little snags and troubles that crop up in the construction and operation will be described.

## Constructional Data

Current values, voltages, resistance and condenser values, how to make coils, methods of coupling, and tuning, etc., will all be described in detail.

### Components for A BEGINNER'S TRANSMITTER, CRYSTAL OSCILLATOR SECTION

#### CHASSIS, RACK AND PANEL.

1—4-tier rack type 1048 (Eddystone).

#### CONDENSERS, FIXED.

1—.002-mfd. type 620 (Dubilier).

2—.01-mfd. type 670 (Dubilier).

#### CONDENSER, VARIABLE.

1—Type E two-gang .00016-mfd. (Polar).

#### COIL, FORMER.

1—4-pin type CT4 (Raymart).

#### CHOKES, HIGH FREQUENCY.

1—Type 1010 (Eddystone).

1—HF22 (Bulgin).

#### CRYSTAL AND HOLDER.

1—7-Mc. with enclosed holder (Q.C.C.).

#### DIAL.

1—Type 1026 (Eddystone).

#### HOLDERS, VALVE.

2—5-pin ceramic type SW21 (Bulgin).

#### METER.

1—0/50-M/a type 2 in. (Ferranti).

#### PLUGS, TERMINALS, ETC.

1—Terminal saddle four contact (Eddystone).

#### RESISTANCES, FIXED.

1—25,000-ohm type 2½ watt (Ferranti).

1—10,000-ohm type PR11 (Bulgin).

#### SUNDRIES.

1—Insulated bracket type 1007 (Eddystone).

1—1b. 18-gauge enamelled covered wire (Peto Scott).

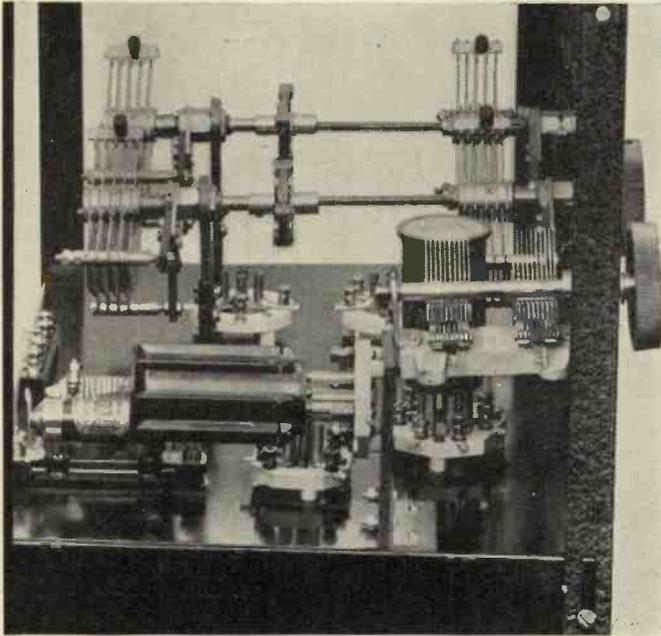
#### SWITCH.

1—S80T (Bulgin).

#### VALVE.

1—0-15/400 (Tungstram).

## Coil Making and Link Coupling



Mount the components for the crystal oscillator stage in this manner. How the P.A. stage is constructed is to be described in the December issue.

### The First Coil

The anode coil has to be mounted horizontally on a home-made bracket. The idea is to prevent stray pick-up between the C.O. and P.A. grid coil. When tuned with the specified condenser, the C.O. anode coil needs 20 turns of 18-gauge enamel-covered wire wound with a slight gap between turns. The CT4 Raymart coil former is already grooved so that the coil windings are automatically gapped the correct width.

much about the correct amount of coupling.

Obtain about 1 ft. of thin flexible rubber-covered wire and on the bottom end of the coil close to the end of the C.O. anode winding put on one turn. Just simply make one loop and pull it tight with a knot, just like tying up a parcel. Drill a fairly large hole through the former, take the two ends of the flexible wire to the anode and filament pins on the coil former. For the time being, that completes the crystal oscillator coil

A four-way terminal strip carries fila-

break switch are not mounted in the crystal oscillator circuit, but actually above the power pack. This makes for neater wiring and a more symmetrical layout.

### Construction

A small point to remember in the construction is that the spindle on the Polar condenser is rather on the long side, so this should be cut off as required. Also put two nuts on the back of the panel so that the bush of the .00016-mfd. condenser does not come through too far, otherwise the condenser knob will not lie flush on the tuning dial.

### Valve Holder Fixing

This is only a minor detail but it makes the transmitter look so much more neat and tidy. Also when fixing down the ceramic valve holders, screw down both bolts together, otherwise there is a very great tendency for the holders to crack.

That is all the constructional work there is to do for the time being. Get all those components screwed down as can be seen from the illustration, and wire up with fairly heavy gauge wire as neatly as possible. In the next issue there will be described the push-pull stage, how to make the split stator condensers and tuning coils.

### Tungram High-voltage Vacuum Rectifiers

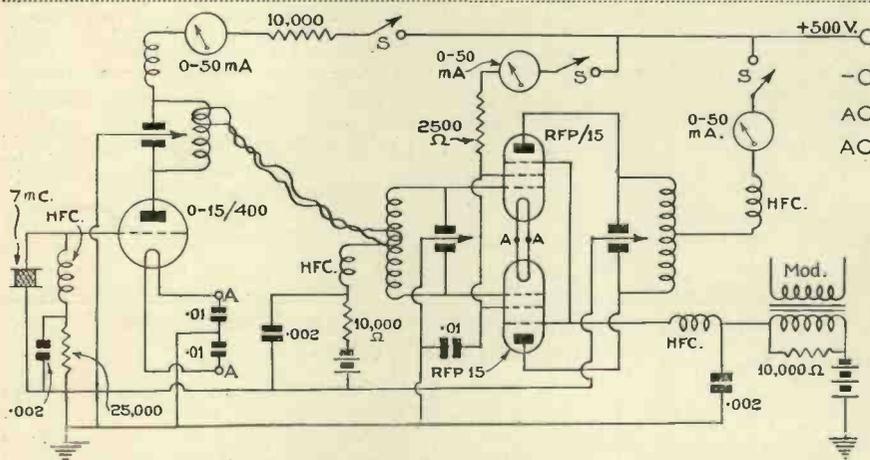
We have long considered the introduction of a high vacuum rectifier for television work to be long overdue. The Tungram Co. have now introduced the V-20/7,000 rectifier which is of the half-wave type with a high vacuum and directly-heated cathode. Owing to the high voltage the anode connection is brought out to an insulated terminal on the top of the bulb. This valve is suitable for providing a D.C. supply for cathode-ray tubes, time bases and other apparatus requiring a high potential at moderate current.

It is fitted with a Tungsten filament, while the output may be controlled by variation of filament current, a very useful feature.

The characteristics are as follows:—

- Filament voltage, 4.0 V.
- Filament current, 2.3 A.
- Max. anode voltage, 7,000 V. rms.
- Max. D.C. output, 20 ma.
- Max. inverse peak voltage, 15,800 V.
- Overall length, 5½ in.
- Diameter, 2 in.
- Price, 16s.

This valve should fulfil a big demand as television constructors have been wanting a rectifier of this type.



In this issue the crystal oscillator stage is covered. Wire up as far as the link coupling circuit.

This winding is terminated to the grid and filament pins, leaving the anode and second filament pin for the link coupling coil. The link coupling coil is very easy to wind on as at this juncture there is no need to bother very

ment supply and 500 volts H.T. Between the anode coil and the positive H.T. terminal connect the H.F. choke. This choke is the Eddystone 1010. Notice that the current meter, voltage dropping resistance, and make-and-



# Variety on the Short Waves

By Malcolm Harvey

*Just a rough idea of what can be heard on the average all-wave receiver is explained in this article. Remember that short wave stations can be received from mid-day onwards from America.*

**P**ROGRAMMES for women or with a feminine interest are rather ignored in this country, in fact, in Europe as a whole. I believe there are one or two talks on cooking, and so on, broadcast from time to time, but these are mainly of the lecture type with no very great appeal.

These feminine programmes are just a small point. Special items are not featured by European stations as they are in America, so for that reason one gets a distinct change of atmosphere by making a special point of regularly tuning in on the short waves.

The women's programmes broadcast by the N.B.C. and C.B.S. companies

feature of the domestic programmes, for as radio appeals to all and sundry, none of the suggestions entail very much expense.

Housewives in this country will be able to obtain quite a lot of new ideas to brighten up the menu by listening to the "Farm and Home" programme from Pittsburg.

Another good item comes on at 3 p.m. through Schenectady, entitled "Style and Shopping," in which latest fashions are described, or the trend of design in hats and clothes, finishing up with a résumé of the current prices operating in the larger American towns. They also advise housewives of what they

Hollywood some new and old songs at 6.30 each evening. Their act includes a guitar and two pianos, and they certainly do put some rhythm into their singing. This turn is relayed from Hollywood through the usual east coast short-wave stations.

Talking about relaying, the Americans certainly can show us something when it comes to long-distance relays. They think nothing of linking up San Francisco with New York without any time delay at all in the tie-up. This is pretty good considering the distance is over 3,000 miles.

"Happy" Jack Turner is now putting out a good programme sponsored by the N.B.C. at 6.45 every other evening. He is a regular contributor to short-wave variety and he certainly makes the most use of his half-hour, for he sings more songs, cracks more jokes in thirty minutes than anyone would think possible.

Make a point of listening to the Lang Sisters, who some people consider as serious rivals to the Three Boswells. They can be heard most Saturday afternoons at 4.30 via W2XAD.

## Baseball

I have heard the last four ball games broadcast from W2XAD, the last of which was a heroic battle between the Yankees and Giants. President Roosevelt was a spectator, while the commentator was somewhat like our Canadian friend, Bob Bowman. These ball games are relayed on Saturday afternoon at a variable starting time of between 5 and 7 p.m.

News bulletins receive special attention in America. They give a short résumé of world events in about ten minutes. The two principal news reelers are Boake Carter and Lowell Thomas, who broadcast at odd times, but always at 11.45 from Pittsburg.

Of course, when it comes to news, our own British Empire stations should not be ignored, for GSB and GSD broadcast 20 minutes of news at 7.55 a.m., GSH and GSG at 1 o'clock, GSH, GSG and GSS around 3 p.m., while on Sundays a weekly news letter compiled in a chatty style is broadcast six times during the day. If you want to try out these news bulletins, listen next Sunday at 7.55 a.m., 1 p.m., 3.55 p.m., 6 p.m., and, if you like, at 1 a.m.

## European Broadcast

At 10 p.m. on Sunday nights a British band, usually Joe Peterson's, broad-

*(Continued on page 658)*



*The master control room of the National Broadcasting Company's Radio City headquarters. Through these switch banks the operators can switch the N.B.C. programmes from the studios to the various networks composed of 85 N.B.C. associate stations from coast to coast.*

are of a very novel type which I feel sure would appeal to English housewives if they realised that they are receivable on short-waves with great consistency.

## Farmhouse

### Hints

A programme entitled "Farm and Home" is broadcast most days from Pittsburg at 5.30. This title does not sound particularly interesting, but it is rather misleading.

As a general rule the programme is split up into sections consisting of light musical items followed by hints and tips which really are quite helpful, while occasionally the farmer's wife is induced to divulge some of her secrets in jam or pickle making. From time to time recipes are given on some little known dish which can be made up quite cheaply. Cost, by the way, is quite a

should pay for standard commodities.

All of these domestic programmes, which are broadcast in the morning over in America are, of course, received in this country from about 3 p.m. onwards, which is a most convenient time for the average housewife.

The early evening programmes, at least evening as far as we are concerned, are now coming in quite well with the darker evenings. There are some really good variety shows which should not be missed. At 6 p.m., Joseph White, the well-known baritone, sings a number of songs for about a quarter-or-an-hour. He brightens up his programme with some short tales and snappy remarks somewhat on the "Flotsam and Jetsam" style.

## A Hollywood Turn

The "High Hatters," consisting of two boys and a girl, broadcast from

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Deferred Terms if desired.

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**“Variety on the Short Waves”** (Continued from page 656)

casts from the Bristol Hotel in Copenhagen. This programme can be received via the Danish National short-wave station on 49.95 metres. It will be received by this medium much more reliably than on medium or long waves.

Sundays are very good for short-waves and it is then that one realises that there are no less than 200 programmes broadcast on short-waves. I have not calculated very carefully, but I should imagine that this is a greater number than one would pick up on medium or long waves, so you see what you are missing without an all-wave receiver.

Buddy Shepherd with his show “Music from the Musicals,” is now a regular feature from W2XAD at 10 p.m. every Sunday evening. It consists of vocal selections by Buddy Shepherd, accompanied by organ, violin and saxophone. Some of the items are really very old but the style and presentation are always new.

Play-by-play descriptions of this year's baseball games are to become regular features broadcast by W2XAD and W2XAF. The series is scheduled to begin at 6.30 p.m., but preliminary details, including the teams for the day, will be given at 6.15. W2XAF, which normally starts its transmission period for the day at 9 p.m., will come on the air at 5 p.m. during these games.

The famous American baseball commentator, Red Barber, has been chosen to take charge of the Notre Dame ball games. His commentary will be broadcast through several short-wave stations, including W8XAL, on a wavelength of a little under 50 metres. He will be describing the games between Pittsburg and the Irish on October 31, Navy versus Notre Dame in Baltimore on November 7, Army versus Notre Dame in New York on November 14, and from Minnesota on November 21, and Los Angeles on December 5.

Father Coughlin will be broadcasting over a special network of 33 stations, including W8XAL at midnight every Saturday until November 21.

Jack Benny has been signed up to broadcast at 11 p.m., every Sunday, from now on over W8XAL, sponsored by the N.B.C.-Red network. He will be assisted by Mary Livingstone.

**These Stations are Good for Variety**

Station.	Call Sign.	Metres.
Pittsburgh	W8XK	13.93
Wayne	W2XE	13.94
Bandoeng	PLE	15.93
Bound Brook	W3XAL	16.87
Wayne	W2XE	16.89
Zeesen	DJE	16.89
Budapest	HAS3	19.52

Schenectady	W2XAD	19.57
Zeesen	DJQ	19.63
Eindhoven	PCJ	19.71
Zeesen	DJB	19.74
Amateurs		21.42
Suva	VPD	22.94
Moscow	RW59	25.00
Pittsburgh	W8XK	25.27
Daventry	GSN	25.38
Boston	W1XAL	25.45
Paris (Radio-Colonial)	TPA4	25.60
Medellin	HJ4ABA	25.62
Tokio	JVM	27.93
Tokio	JVN	28.01
Rome	2RO	31.13
Sydney	VK2ME	31.28
Philadelphia	W3XAU	31.28
Lyndhurst	VK3LR	31.32
Bombay	VUB	31.36
Zeesen	DJA	31.38



Major Edward Bowes does not need any introduction. He originated the Amateur Hour which has now been copied by the B.B.C.

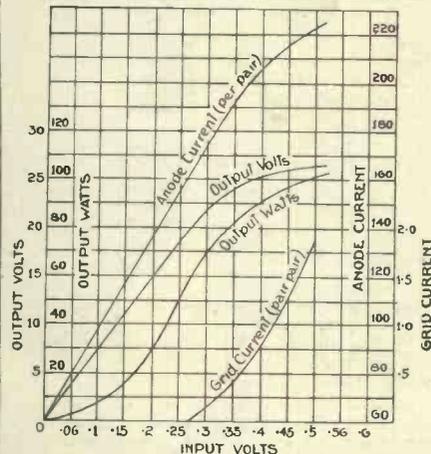
Zeesen	DJN	31.45
Schenectady	W2XAF	31.48
Melbourne	VK3ME	31.55
Daventry	GSB	31.55
Budapest	HAT4	32.88
Hong Kong	ZCK3	34.29
Prangins	HBP	38.48
Amateurs		42.86
San Jose	TIPG	46.86
Parede	CT1GO	48.40
Pittsburgh	W8XK	48.86
Halifax	VE9HX	48.92
Calcutta	VUC	49.10
Chicago	W9XF	49.18
Bound Brook	W3XAL	49.18
Johannesburg	ZTJ	49.20
Bowmanville	CRCX	49.26
Nairobi	VQ7LO	49.31
Philadelphia	W3XAU	49.50
Cincinnati	W8XAL	49.50
Boston	W1XAL	49.67
Zeesen	DJC	49.83

**“A Q.P.P. 70-Watt Power Amplifier”**

(Continued from page 655)

Two mercury vapour valves are used in a full-wave rectifier circuit without reservoir condenser, but with a buffer choke of special design in conjunction with a 8-mfd. condenser. This choke and single condenser provides the total smoothing for the output stage. The earlier stages are fed from a full-wave vacuum rectifier of conventional type.

The output of the two rectifiers is arranged in series so that the bias for the output valves may be drawn from the pre-amplifier H.T. supply. Delayed



This curve gives a true idea as to the total output that can be obtained with varying input levels.

switching must be used either by automatic methods or by hand.

Notice that one heater winding is required for the driver valves and input stage. The phase-split valve having a potential of approximately 100 volts between cathode and earth is provided with a separate heater supply, the centre tap of which is connected to the cathode of the phase-split valve.

It is necessary to connect two .1-mfd. condensers in series across the winding feeding the early stage rectifier in order to suppress parasitic R.F. generation which is otherwise set up. This would otherwise modulate both the early stage high tension supply and the output bias. 50-ohm. resistances in the anode circuit of the mercury vapour rectifiers suppress a similar R.F. current in the main H.T. circuit. To be effective the resistances must be wired to the anodes of the valves by the shortest possible path.

Total anode to anode load is 12,000 ohms and for matching to a power amplifier valve in a transmitter the secondary should match up correctly. A suitable transformer for this purpose can be obtained from Mr. N. Partridge, of Messrs. Bryan Savage, who have had considerable experience with this type of work.



# Making a Transverse Current Microphone

By Lionel E. Pickering

*There is a big demand amongst amateurs for a quality microphone. We feel that this unit which can be home constructed will fulfil that demand.*

**H**IGH-QUALITY microphones for the amateur transmitter or public-address man present one of the most difficult problems in the installation. If he invests in a high-quality instrument, the output is so small that he has to add one or more stages to his equipment, entailing further expense and complication. On the other hand, if he tries to save this by using a microphone of high output, there is a serious loss of quality.

## Types of Microphone

There are four commonly used types of microphone, *viz.*, carbon, condenser, moving coil, and the velocity or ribbon types. Of these, the carbon type is the most popular, because it is robust, sensitive, and can be designed to give very high quality. The highest quality carbon microphone made is the Reisz, used

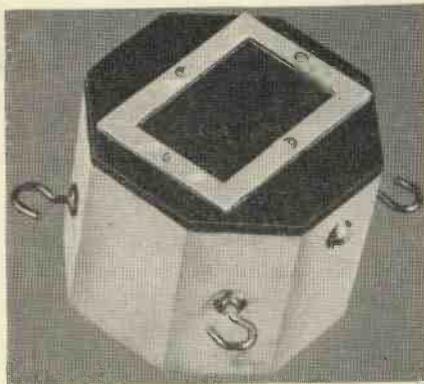


Fig. 1.—The Finished Microphone.

extensively by the B.B.C., but it is very insensitive.

The author has been experimenting with this type for some time, and has modified it so that whilst it retains its original high quality, the output is considerably greater than that of most examples, and in addition, it can be built with the minimum of tools and trouble.

## A Commercial Finish

Fig. 1 shows a photograph of the finished microphone and Fig. 2, the dimensions of the marble employed. As is shown, a recess  $2\frac{1}{4}$  in. by  $1\frac{1}{2}$  in.,  $\frac{1}{8}$  in. in depth, should be formed in the front of the block, and two holes  $\frac{3}{16}$  in. in diameter drilled in the positions shown from front to back of the marble. Two more  $\frac{3}{16}$  in. holes should also be made, one from the front and one from the top of the block, to meet each other in

the centre. Eventually this passage will be used for filling the microphone.

White Sicilian marble is the best to use, and it is strongly advised that the block, with the recess already worked and the holes drilled, be ordered to specification from a marble works.

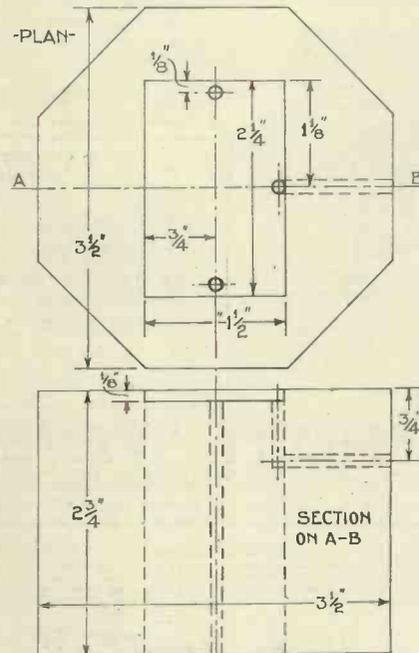


Fig. 2.—Dimensions of Marble Block.

Next, a piece of  $\frac{3}{16}$  in. or  $\frac{1}{4}$  in. ebonite should be cut to the dimensions of the microphone front, and an opening to coincide with the recess in the marble should be cut away by fretsaw.

The frame for the front may either be cut from a piece of  $\frac{1}{16}$  in. brass to the dimensions shown in Fig. 3, or it may be soldered up from brass strip. A piece of wire gauze is soldered over the frame, and eventually serves as a protection for the diaphragm of the micro-

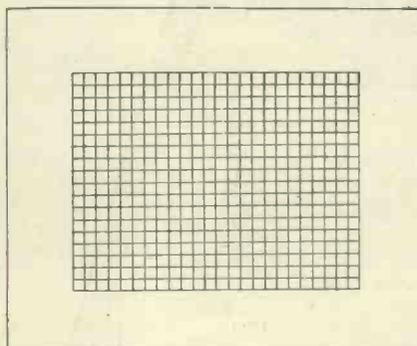


Fig. 3.—Completed Microphone Front

phone. This completed grille should be sent to a plating works for chromium plating, and at the same time two pieces of brass,  $1\frac{1}{2}$  ins. by  $\frac{5}{16}$  in. by  $\frac{1}{16}$  in., should be forwarded with instructions to gold plate them.

The assembling can next be proceeded with. Take two terminals, the Belling Lee type "B" is very suitable, and solder a 4-in. length of tinned copper wire exactly on the end of each. These terminals should be screwed in the holes in the block of marble, from the back, with the help of a couple of Rawlplugs. They will cut their own threads in the Rawlplugs and the two wire ends will be left projecting from the front of the block.

Drill a small hole in the centre of

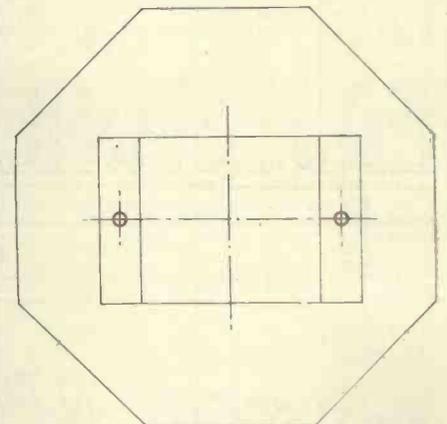


Fig. 4.—Microphone Electrodes in position.

each of the two gold plated strips of brass, thread them over the projecting wires as shown in Fig. 4, and secure them with a small drop of solder. The remaining lengths of wire should be cut off close to the strips and, if necessary, filed off slightly until below the front face of the marble block.

For the diaphragm, either mica or cellophane may be used. Cellophane is more sensitive, but it is not so stable in damp atmospheres. On the whole, however, the author prefers it to mica. Smear a film of Rawlplug "Durofix" over the front surface of the marble, stretch the diaphragm evenly over it, and leave to dry.

The rest of the assembly is simple. Secure the grille, gauze side down, over the opening in the ebonite with small chromium plated screws, and then cement the ebonite to the face of the marble, over the surround of the diaphragm, with more "Durofix."

It remains only to fill the completed

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

NOVEMBER, 1936

# MERVYN SPECIFIED

FOR

## 'TELEVISION'S GUARANTEED'

### CATHODE RAY RECEIVER

**3,500 volts smooth D.C.** This rigid simple unit as used in "Television's" receiver costs in kit form only 72/6d. or built as a complete unit ready for use £4/10s.

**1,000 volt unit** and the L.T. unit for the time base are just as reasonable. In fact if it's a power unit for Television, it's safest to buy MERVYN proved and tested units.

**CONTROL PANEL** with either high resistance or low resistance network, together with necessary condensers cost in kit form only 48/-.

MERVYN offer at a reasonable cost the special deflector coupling condensers .1MFD 2,000 volt at 3/6d. each.

The Condensers for coupling the output of the radio receiver, .1MFD. 4,000 volt working, cost only 7/-.

**VISION RECEIVER**, proved on Alexandra Palace Transmissions, single control. Price including 8 BVA valves £16/10s.

The Complete Kit of parts for the time base is available either as a set of parts or semi assembled.

It is worth your while to buy MERVYN—see our advertisement in last month's issue. All apparatus is obtainable through your dealer. In case of difficulty send your order direct to :—

**THE MERVYN SOUND and VISION CO., LTD.**  
4, HOLBORN PLACE, LONDON, W.C.1 Telephone: HOLborn 7709  
Managing Director : W. J. NOBBS, F.T.S., A.M.I.R.E.

#### "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  $\frac{1}{2}$  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 preferred, 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.



Continental Type V.8.

### Clix Chassis Mounting VALVEHOLDERS

On page 599 of the October Issue of this journal we dealt with the complete range of Clix Valveholders. In this issue you will notice that the designers of apparatus described use no less than three different Clix types.

#### BRITISH STANDARD TYPE

4-pin 5d. 5-pin 6d.  
(without terminals)

#### AMERICAN STANDARD TYPE

5-pin 8d. 7-pin 10d.

#### CONTINENTAL SCREENED TYPE

7-pin (For use with Ostar Ganz valves) 1/8d.

You will agree that this is a wonderful tribute to the efficiency of Clix products which, we assure you, can be relied upon for perfect contact as well as long and faithful service. Send for Clix latest illustrated Folders "T.S" on Components and Valveholders.

*Yours faithfully*

LECTRO LINX LIMITED

79 ROCHESTER ROW. LONDON S.W.1.

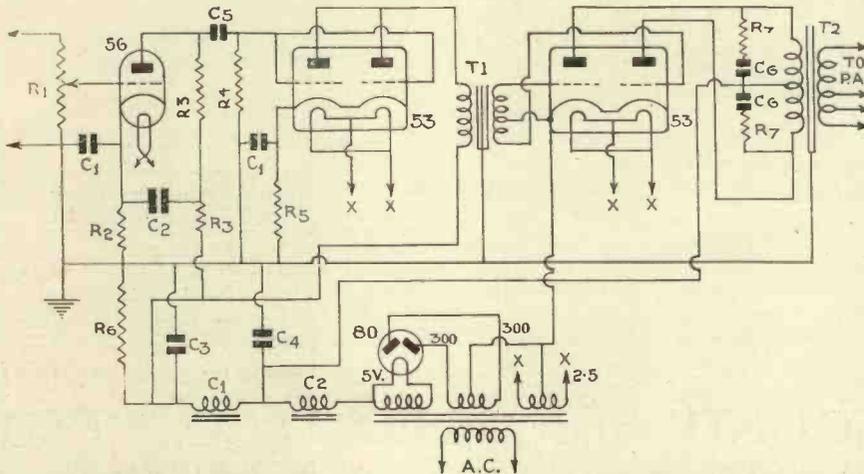
# A Push-pull Class B Amplifier

Although this amplifier gives an output of at least 10 watts, the total valve cost of the four valves used is only 14s. This point should interest intending constructors of comparatively high output amplifiers.

**A**MATEUR transmitting licences allow the operator to use a maximum input of 10 watts. This means that for full modulation about

always a problem, but a suitable unit can be obtained from Raymart to suit type 53 valves in Class B. The actual modulators, 53's, are used in the normal

For modulation purposes the output transformer should have a secondary with an impedance that will match up to the power amplifier valves to be modulated. Those who intend to use the amplifier for loud-speaker work should obtain a special output transformer that will match up to the loud-speaker or loud-speakers in circuit.



The second two valves in this amplifier are 53's twin triodes normally designed for class B operation. The first 53 has both halves wired in parallel with the second 53 used normally.

5 watts of audio are required. Now that the regulations permit of 25 watts input after a reasonable time has elapsed, an audio input of between 10 and 12 watts are needed.

## Low Valve Cost

Those interested in public address work will find that 10 watts or so are ample for normal requirements, so that this simple Class B amplifier should have a very wide appeal. Also, the total valve cost is only 14s., which is extraordinarily small. We consider that the amateur on low power who wants to use phone should consider this little amplifier, for it will give him all the modulation he wants with a 10-watt carrier and quite a high percentage modulation with a 25-watt carrier.

The first valve is a triode 56. The input from the microphone is fed into the grid circuit of this through the normal head amplifier or high-ratio microphone transformer, the gain being controlled by a ½-megohm volume control. This valve is then R.C. coupled to a 53, which is a twin-triode with its grid and anode circuits strapped together. R3 has a value of 50,000 ohms, which is suitable as external anode impedance to the 56 and decoupling for this valve. R4, the grid resistance, has a value of ½ megohm, but there is absolutely no need to decouple the grid circuit in this stage.

The Class B driver transformer is

way, having the grid circuits coupled to the split input transformer with the anodes across the primary of the split output transformer. It is most essential that across the anodes the tone correction-cum-stabilising device, consisting

## For a Relay Rack

The entire amplifier can be mounted on a chassis 16 ins. by 8 ins. by 3 ins., although with a little juggling it can be made to fit a standard Eddystone 15-in. transmitter rack.

In our opinion this is the cheapest way of obtaining sufficient audio to modulate either a 25- or 10-watt transmitter. It should also be realised that if at a later date a really high output is needed, an additional Class B stage can be coupled to this amplifier, giving outputs in the order of 50 and 100 watts.

## Leeds and District Radio Society.

A new society has been formed in Leeds with the object of catering for and bringing together all radio enthusiasts. Meetings are held every Monday at 7 o'clock at their headquarters, Azelea Street, Beckett Street, Leeds, 9. Anybody interested should write to the Hon. Sec., J. Kavanagh, 63 Dawlish Avenue, Leeds, 9.

## Components for A PUSH-PULL CLASS B AMPLIFIER

- CHASSIS.**  
1—Chassis, 16 by 8 by 3 in., aluminium (Peto Scott).
- CONDENSERS, FIXED.**  
1—4-mfd. electrolytic type 401 (C1) (Dubilier).  
1—2-mfd. type LSA (C2) (Dubilier).  
1—4-mfd. electrolytic type 0283 (C3) (Dubilier).  
1—50-mfd. type 402 (C4) (Dubilier).  
1—0.1-mfd. type LEG (C5) (Dubilier).  
1—0.05-mfd. type LEG (C6) (Dubilier).
- CHOKES, LOW-FREQUENCY.**  
2—WW/C1 (Sound Sales).
- HOLDERS, VALVE.**  
3—American type chassis, small 7-pin (Clix).  
1—American type chassis 5-pin (Clix).
- RESISTANCES, FIXED AND VARIABLE.**  
1—500,000-ohm potentiometer (R1) (Erie).

- 1—5,000-ohm type 1 watt (R2) (Erie).  
1—50,000-ohm type 1 watt (R3) (Erie).  
1—500,000-ohm type 1 watt (R4) (Erie).  
1—950-ohm type 3 watt (R5) (Erie).  
1—30,000-ohm type PR15 (R6) (Bulgin).  
1—7,500-ohm type PR10 (R7) (Bulgin).
- TRANSFORMERS, LOW-FREQUENCY.**  
1—Class B driver transformer type T6750 (Raymart).  
1—Class B output transformer type T6759 (Raymart).
- TRANSFORMER, MAINS.**  
1—Special to specification (Eves Radio).
- VALVES.**  
1—American type 56 (Premier Supply Stores).  
2—American type 53 (Premier Supply Stores).  
1—American type 80 (Premier Supply Stores).

of 7,500 ohms resistance plus a .05-mfd. condenser be connected.

## A Special Mains Transformer

Messrs. Eves Radio make a suitable mains transformer giving 300-0-300 at 80 ma., which is applied to the type 80 rectifier. In order to obtain complete smoothing two chokes are needed with three condensers. C3 has a value of 4 mfd. and C4 8 mfd.

R6 is a bleeder resistance of 30,000 ohms which stabilises the high-tension voltage and at the same time discharges the high-capacity fixed condensers. This component is most important.

## Surrey Radio Contact Club.

This society, which was formed last year, has been very successful, and owing to its greatly increased membership, has had to find new quarters. In future the meetings will be held at "The Alhambra," 25 Wellesley Road, W. Croydon.

An excellent series of lectures has been arranged for the present season, and instruction in matters within the scope of the society, both elementary and advanced, is available to members. Anyone interested should apply to the Hon. Secretary, E. G. Taylor, G5XW, at 35 Grant Road, Addiseombe, Croydon.

# Noise-free Short-wave Reception

*We are keenly interested in any aerial system that is likely to overcome the high noise level that is very prevalent in large towns or near traffic routes. We have been trying the Belling-Lee "Eliminoise" aerial system with great success, so we are passing the details on to our readers.*

**D**URING the past few years the short-wave receivers installed in our laboratory have not been able to work at maximum efficiency during the day-time owing to local interference emanating from rotary convertors, violet-ray apparatus, and similar equipment.

Although the Post Office have endeavoured to assist us, all they could do was to locate the source of the interference. They had not the power to enforce the owners of the apparatus to fit suppression gear.

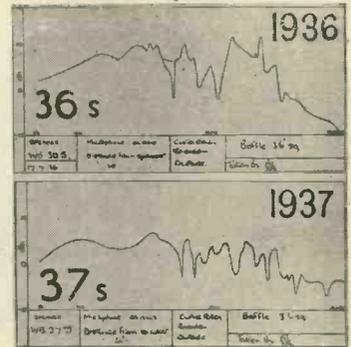
It appears that there is little likelihood of legislation being passed that will enable the Post Office to take the necessary steps to wipe out man-made static. So for that reason we advise all readers who cannot obtain noise-free reception to give very serious consideration to the modern noise-suppression aerial. We have been trying all types of aerial, both British and foreign, and have found the Belling-Lee Eliminoise system particularly effective.

source or conductor of interference. The trouble is, that when a receiver is operated in the usual way, it is probably situated in a strong interfering field set up by either mains conducted interference or direct radiation, and some part of the aerial and earth system, not to mention the wiring of the receiver itself, is introducing these unwanted noises to the set.

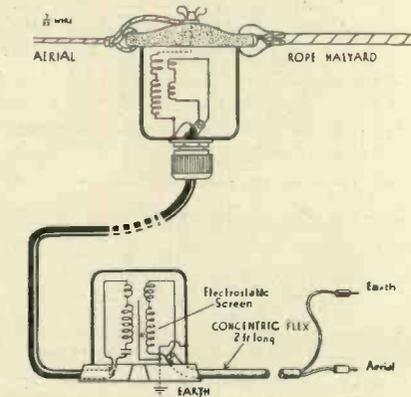
### How it works

The "Eliminoise" principle consists in erecting an efficient aerial outside the field of interference and in coupling it to the receiver by means of a highly efficient screened transmission line. This consists of a twin cable with

*(Continued on page 669)*



## Why do they sound so MUCH better?



*The aerial transformer case is actually used as the insulator. It is connected to the transformer at the set end by a special low-loss cable.*

### The Principle

The theory on which the "Eliminoise" system is based can be briefly described in the following way. A field of interference is set up by any source or conductor of interference and unless precautions are taken, any receiver that is operated within that field, or of which the aerial and earth system enters the field, will reproduce noises depending on the sensitivity of the set, and the form of the interference, etc.

The strength of this interfering field becomes weaker in a vertical direction and as a rule can hardly be detected at a distance of twenty feet above the

Cabinet Models		
37SC (Senior) ... ..	63/-	
37JC (Junior) ... ..	49/6	
37CC (Cadet) ... ..	39/6	
37BC (Baby) ... ..	29/6	
Chassis-Models		
37S. ... ..	42/-	
37J. ... ..	32/6	
37B. ... ..	23/6	
37M. ... ..	17/6	

The larger models are available on Hire Purchase through your dealer. Terms from 7/6 down.

To the eye there is little apparent difference between one year's speaker and another. It is natural, therefore, that when his ear notices the newest Stentorian's marked improvement in performance, the listener should ask "How? Why?"

Complete answers would occupy several books, for a whole year's work by eight enthusiastic designers cannot be described in a few words. Here, however, are two important points:

### Further improvement in magnetic material

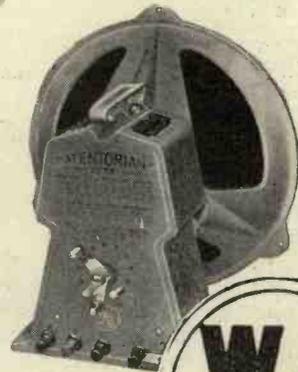
An alteration in the magnetic alloy has brought about 15 per cent. increased flux. Hence the greater volume and range. (Note: the material is exclusive to 1937 Stentorians.)

### New Seamless Cone

W.B. Engineers have evolved the first seamless cone to offer advantages over the special "seamed" type used before. This new cone is manufactured in the W.B. factory from an exclusive and carefully prepared pulp. It reduces resonances enormously.

These two points provide a partial answer only—for every part of the new design has been studied, experimented with, and improved. The extra results as seen in the above curves (taken from 1936 and 1937 Stentorian Senior Speakers) are definite and substantial.

This new reproduction is available to you—Ask your dealer.



## 1937 STENTORIAN

Permanent Magnet Moving-Coil Speakers

WHITELEY ELECTRICAL RADIO Co., Ltd. (Vision Dept.), MANSFIELD, Notts.

# An A.C.-D.C. Phone-C.W. Transmitter

By John Lucas G2HK

We were interested in the design of this QRP. A.C.-D.C. transmitter by which G2HK keeps in contact with other local transmitters without increasing the QRM on 40 metres with his higher power transmitter. A blueprint is not available.

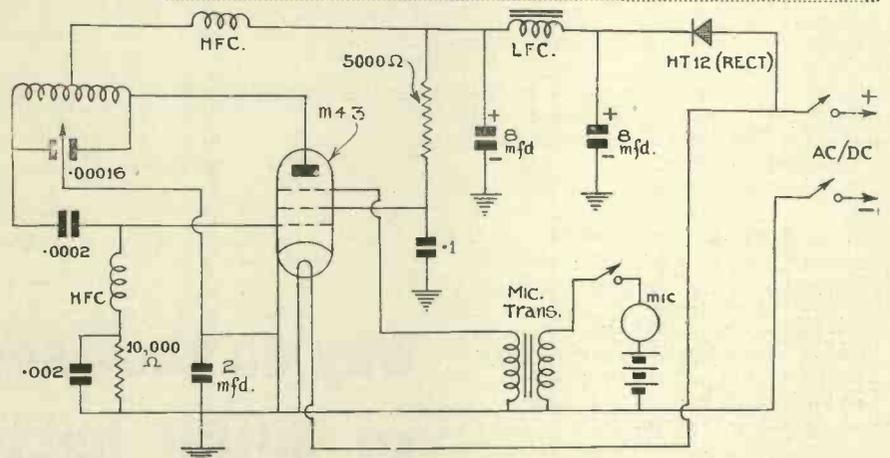
**H**ALF-AN-HOUR on the 40-metre band on a Saturday afternoon or a Sunday morning shows quite clearly that a lot of the stations use their normal transmitters for DX work and for contacting local stations which perhaps are only a mile or so away. There is no need for me to emphasise the waste of this method and the increase in QRM which results.

For some time now I have been using a single-valve transmitter which is suitable for A.C. or D.C. operation which has given R9 carrier reports over quite long distances. The average reports on phone have been R8 with good quality, which is surprising in view of the simple equipment.

There is, of course, the other point of view, why not use the 5-metre band, but here again, even though the Americans use 5 metres for local work, this idea has never caught on amongst British amateurs. Half-way house is this one-valve 40-metre transmitter,

if it is on hand, by all means include it, for it makes the transmitter more flexible.

the carbon type is fed into the suppressor grid through a high-ratio transformer, there is really ample modulation



A key can be inserted in either the cathode or screen-grid circuit.

## Components for the A.C./D.C. PHONE/C.W. TRANSMITTER

### CHASSIS AND PANEL.

1—Zinc chassis 7½ in. by 6 in. by 1½ in. by 1/16 in. (Peto Scott).

1—Panel 8 in. by 6 in. by 1/16 in. zinc (Peto Scott).

### CHOKE, HIGH-FREQUENCY.

1—Type 1022 (Eddystone).

### CHOKE, LOW-FREQUENCY.

1—Type LF40 (Bulgin).

### COIL FORMER.

1—6-pin with base (Colvern).

### CONDENSERS, FIXED.

1—.0002-mfd. type M (T.C.C.).

1—.002-mfd. type tubular (T.C.C.).

1—2-mfd. type BB (Dubilier).

1—1-mfd. type BB (Dubilier).

2—8-mfd. electrolytic (T.C.C.).

### CONDENSER, VARIABLE.

1—Type E two-gang .00016 mfd. (Polar).

### HOLDER, VALVE.

1—7-pin continental screened chassis type (Clix).

### RECTIFIER.

1—Type HT12 (Westinghouse).

### RESISTANCES, FIXED.

1—5,000-ohm type 3 watt (Erie).

1—10,000-ohm type 1 watt (Erie).

### SUNDRIES.

Connecting wire and sleeving (Peto Scott).

2 dozen 6 B.A. nuts, bolts and washers (Peto Scott).

1—Type J2 jack (Bulgin).

### SWITCH.

1—Type S123 (Bulgin).

### TRANSFORMER, MICROPHONE.

1—Type LF35 (Bulgin).

### VALVE.

1—Pentode type M43 (Ostar Ganz).

for normal requirements. There is no need to bias the pentode or to apply any potential to the suppressor grid. The screening grid, however, requires a slightly lower voltage than the anode, so a 5,000-ohm resistance is connected in series with the screen and the H.T. supply.

This resistance is rather critical, for if it is of too high a value the radiation drops off very rapidly.

### The Tuning Circuit

A simple Hartley circuit was chosen, tuned with a .00016-mfd. double gang condenser, so obviating the need for an anode to earth by-pass condenser.

The coil was wound on a Colvern 6-pin former and consists of 14 turns of

(Continued on page 666.)

which is just as simple to build as a 5-metre rig of similar power.

### High-voltage Heater

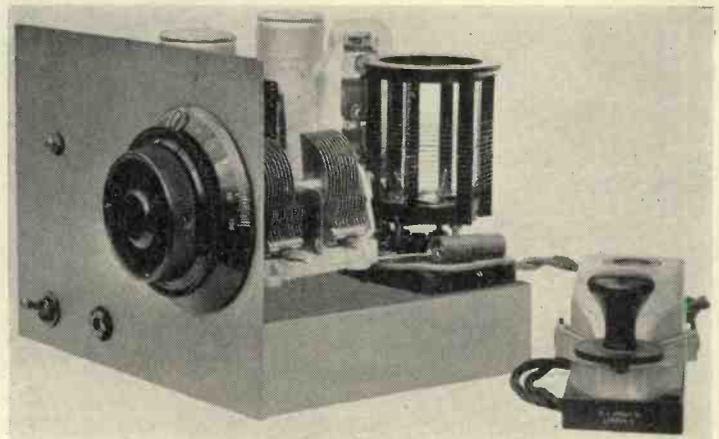
Expense being quite an item of importance, a standard A.C. valve with mains transformer, etc., proved far too costly, so for that reason an Ostar Ganz pentode with a high-potential heater was chosen. This valve runs directly from the mains and has a 240-volt heater of the low-current type.

H.T. from A.C. is obtained by means of an H.T.12 Westinghouse rectifier with a single L.F.40-type Bulgin choke plus two 8-mfd. electrolytic condensers. In this way the rectifier works half-wave on A.C. and is a passenger on D.C. Of course, if the transmitter is permanently to be used on D.C. mains, then the rectifier can be omitted, greatly decreasing the cost. If, however, a recti-

### 5 Watts Input

The average input to the M43 is about 5 watts, while if a microphone of

*With a split-stator condenser the spindle is at earth potential so overcoming the need for bushing. Shown in the illustration is a jack for the microphone.*



**The**

**POLAR**  
SHORT WAVE 2 GANG  
TYPE 'E' CONDENSER

Soldered brass vanes mounted on "Steatite" base. Available for baseboard or panel mounting.

PRICE  
One .00016 x .00016 required, also made in single type .00016 5/-.  
**10/6**

*Specified for the*  
**BEGINNER'S TRANSMITTER**

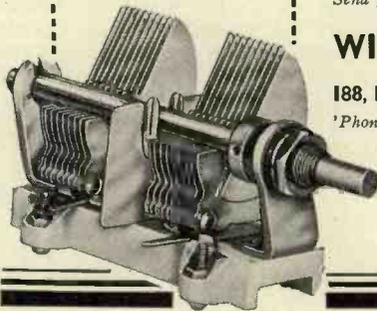
Send for latest list of Polar and N.S.F. Components.

**WINGROVE & ROGERS**

LTD.

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'Phone: Temple Bar 2244. Works: Old Swan, Liverpool.



Ⓐ 9991

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WIJYN G2NO RADIO LTD.

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NEW R.K.35	67/6	EIMAC 50T ...	90/-
JOHNSON 50-watt Sockets	8/6	EIMAC 150T ...	£7 10 0
JOHNSON 6-in. Aerial Spreaders ...	6d.		
TOBE DEUTSCHMAN Ham Band Tuner, Air Trimmers ...			£6 10 0
TOBE Seven Tube Ham Band Receiver, Complete Wired ...			£20 0 0
TOBE Seven Tube All-Wave Receiver, complete ...			£21 0 0
HAMMARLUND Comet Pro's, several to clear at ...			£24 0 0
HAMMARLUND Porcelain Tube Sockets, all types, 2/-; Coil Forms, 4-pin, 1/6.			
U.T.C. Class "B" Transformers: VM.1, 28/6; VM.2, 39/6; VM.3, 57/6; T.30, 46's to 46's, 15/-; T.30, 46's to 3,500 and 5,000-w. Load, 18/6.			

**Hallicrafters 1937 Models are due this week.**

**HOWARD BUTLER METERS**

20, 30, 50, 100, 150, 200 MA. (Flush Fitting Bakelite) ...	5/9
WHITELEY Midget P.M. Speakers ...	18/6
TAYLOR 866 Tubes ...	11/6
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N.V.908. 3-in. Cathode Raytube ...	85/-

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Ahead of all others. 6 Models to choose from.

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Any Instrument may be purchased under Painless Extraction.

Include in your Order:—R.S.G.B. Guide, 6d.;

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'PHONE ORDERS:—You can telephone your Order after 7 p.m. for 1s. For your convenience our Office Hours during Winter will be Monday and Tuesday 9 a.m. to 7.30 p.m.; Wednesday and Friday 9 a.m. to 8.15 p.m.; Saturday 9 a.m. to 9 p.m.; Thursday 9 a.m. to 1 p.m. only.

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**PRINCIPLES OF RADIO ENGINEERING**

By R. S. GLASGOW, Associate Professor of Electrical Engineering, Washington University. 511 pages, 9 x 6, illustrated ..... 24/-

In this important new book, intended primarily as a text for senior electrical engineering students, the author aims to give a thorough presentation of the fundamentals of radio communication and the application of these principles. Considerable space is devoted to the theory and application of the vacuum tube and its associated circuits to communication systems.

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Provides effective radio school and home-study material for prospective and experienced radio operators of all classes. Covers the principles of radio, radio equipment and power apparatus as applied to radio broadcasting, marine, police, aeronautical and amateur radio. Includes the entire spectrum of radio wave lengths—ultra-short, short, medium, and long. Covers the requirements of all classes of radio operator licence examinations.

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Including Applications for Distant Control of Industrial Processes and Precision Measurements

By JAMES A. MOYER, Director of University Extension, Massachusetts Department of Education; Member of Federal Commission on Radio Education, and JOHN F. WOSTREL, Instructor in Radio Engineering, and Supervisor in Charge of Industrial Subjects, Division of University Extension, Massachusetts Department of Education. Third edition. 635 pages, 5½ x 8, 485 illustrations ..... 24/-

A practical manual describing the action of vacuum and gaseous tubes and their use in radio receivers and for numerous industrial purposes. This edition marks a thorough revision and enlargement of the book, giving special attention to tubes in electric television systems, ultra-short-wave tubes, and developments indicating the trend of tube design and application.

**McGraw-Hill Publishing Co., Ltd.**

Aldwych House

London, W.C.2

(Continued from page 664)

20-gauge enamel-covered wire centre tapped. The turns are spaced approximately 1/16 in.

**Condenser and Leak Values**

The grid condenser has a value of .002-mfd., with a grid leak of 10,000 ohms. This value is dependent rather on H.T. voltage, which is particularly noticeable on D.C. After the transmitter has been put into operation, make several tests with this grid resistance to obtain maximum radiation.

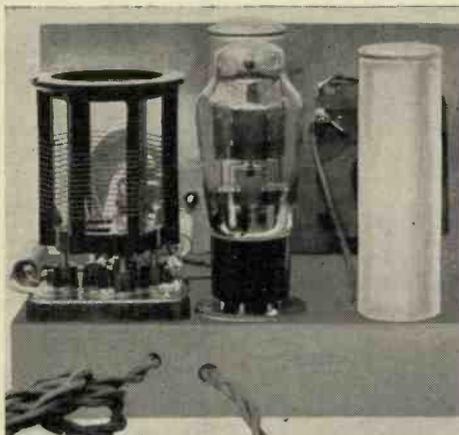
Another point about D.C. mains. It is essential that the smoothing-frequency choke be of the low-resistance type, otherwise there will be a fairly considerable voltage drop, which will decrease the efficiency.

**The key position**

If it is intended to use a key, which is sometimes necessary, make provision either to connect it in the main H.T. supply or in the cathode. Whichever method is chosen is merely a matter of personal taste.

Construction is very simple and can be seen from the illustration. The variable condenser is mounted directly on the panel, the rotor being connected to panel and earth. One bolt holds the

Westinghouse rectifier firmly to the panel, while the on-off switch and microphone jack are mounted through both panel and chassis. On the top of the chassis are mounted the coil holder, the valve holder, electrolytic condensers, and both grid and by-pass condensers. The balance of the compon-



*This pentode valve has its heater connected directly across the power supply. No mains transformer is needed with this circuit.*

ents are mounted beneath the chassis in any convenient form.

**Wide Range**

Though the transmitter was designed

to cover just a few miles, it has already proved capable of putting out a signal all over England. It is hoped during the next few weeks to contact some good DX stations on phone, but this is merely a matter of choosing a QRM-free frequency on the 40-metre band.

**"Ham-Aid" QSL Cards**

Now that amateurs are beginning to make their transmitters on commercial lines, there is a very definite demand for engraved plates or panel transfers. We have received from Messrs. Tillotson Bros., of 55 Commercial Street, Morley, Yorkshire, who are better known perhaps as G6XT, a packet of their transfers which cost only 1s. 9d. These transfers can be put on to wood or metal and certainly improve the appearance of the transmitter.

The following are some of the transfers that can be supplied. Frequency doubler, key, microphone, crystal oscillator, electron coupled oscillator, tritrit oscillator, Class B amplifier, buffer amplifier, etc.

Their QSL cards are really intriguing. No blocks are required and yet the call sign stands out from the card and can be supplied in colours.

The rates are very competitive for their type, ranging from 8s. a 100 up to 24s. for 500.

**PREMIER SUPPLY STORES**

**THE LARGEST RADIO MAIL ORDER HOUSE IN EUROPE!  
GET OUR QUOTATION FOR YOUR TELEVISION GEAR**

**SHORT-WAVE COILS** 4- or 6-pin types. 13-26, 22-47, 41-94, 78-170 metres, 1/9 each with circuit. Special set of 3 S.W. Coils, 14-150 metres, 4/-, with circuit. Premier 3-band S.W. Coil, 11-25, 19-43, 38-86 metres. Simplifies S.W. receiver construction, suitable any type circuit, 2/-.

**COIL FORMERS**, in finest plastic material, 1 1/2 in. loss ribbed 4- or 6-pin, 1/- each.

**CONDENSERS**, super ceramic S.L.F. .00016, .0001, 2/9 each; double-spaced, .00015, .00025, .00005, 3/- each. All brass with integral slow-motion .00015 tuning, 3/9; .00015 reaction, 2/9.

**SHORT-WAVE KIT** for 1 valve receiver or adaptor, complete with chassis, 3 coils 14-150 metres, condensers, circuit, and all parts, 12/6. **VALVE GIVEN FREE.**

**2-VALVE S.W. KIT** complete with valves, 19/6.

**3-VALVE S.W. KIT**, 1-v-1 complete with valves, 40/-.

**MAINS TRANSFORMERS**. Premier wire-end type with screened primaries.

H.T. 8 & 9 or H.T. 10 with 4 v. 4 a. C.T. and 4 v. 1 a. C.T., 8/6.

250-250 v. 60 m.a., 4 v. 1 a., 4 v. 2 a. and 4 v. 4 a., all C.T., 8/6.

350-350 v. 120 m.a., 4 v. 1 a., 4 v. 2 a. and 4 v. 4 a., all C.T., 10/6.

500-500 v. 150 m.a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 19/6.

500-500 v. 200 m.a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-5 a., also 5 v. 3 a. for 83 or 523 Rectifier, 25/-.

Any of these transformers with engraved panel and N.P. terminals, 1/6 extra.

**AUTO TRANSFORMERS**, step up or down, 60 watts, 7/6, 100 watts, 10/-.

**PUSH-PULL CLASS "B" AMPLIFIER**. Complete Kit of components for above including valves and special Transformers as described in this issue can be supplied.

**MAINS VALVES**.amous Europa 4 v. A.C. types, 4/6 each; H.L., L., S.G., Var.-Mu-S.G., H.F.-Pens., Var.-Mu-H.F. Pens., 1-, 3- and 4-watt A.C. directly-heated output Pentodes. Full-wave rectifiers, 250 v. 60 m.a. A.C./D.C. types. 20-volt .18 amp. S.G., Var.-Mu-S.G. H. H.L., Power.

Following Types all 5/6 each. Full-wave rectifiers 350 v. 120 m.a. and 500 v. 120 m.a. 2 1/2 watt indirectly-heated Pentodes.

**AMERICAN VALVES**. Genuine American DUOTRON all types, 3/6 each. Hytron super quality, 3 months' guarantee, all types, 5/6. New Metal Glass Valves, all types, 6/6.

**MILLIAMMETERS**, moving-iron, flush 2 1/2", all ranges from 0-10, 5/9. Visual tuning, 6 or 12 m.a., 5/- Moving-coil meters. 2 1/2" 0-1 m.a., 18/6; 3 1/2" 0-1 m.a., 22/6. Multipliers, 1/- each.

**ELECTROLYTICS** U.S.A. 4, 8 or 12 mfd. 530 v. peak, 1/9 each. Dubilier, 4 or 8 mfd. 500 v. 3/-; 50 mfd. 50 v. 1/9; 25 mfd. 25 v. 1/-. T.C.C. 4 or 8 mfd. 650 v. 4/-; 15 mfd. 50 or 100 v. 1/-; 50 mfd. 12 v. 1/6 mfd. 50 v. 6d.

**PAPER CONDENSERS**. W.E., 250 v. working 4 mf. 2/-, 2 mf. 1/-, 1 mf. 6d.; 350 v. working 4 mf. 2/6, 2 mf. 1/6, Dubilier 500 v. working 4 mf. 4/-; 800 v. 4 mf. 8/-; Wego 450 v. working 1 mf. 1/-, 2 mf. 1/9, 4 mf. 3/-; 700 v. working 2 mf. 2/-, 4 mf. 3/6; 1,650 v. working 1 mf. 3/6, 2 mf. 5/6.

**TRANSFORMERS**, latest type Telsen R.G.4 (list 12/6), 2/9. High Grade Push Pull Input Transformers 4/6.

**ELIMINATOR KITS** for A.C. mains. 120 v. 20 m.a., or 150 v. 25 m.a., 10/-, tapped S.G. det. and output Complete Kit with long-life valve rectifier (replacement cost only 2/-).

**SPEAKERS, MAGNAVOX**. Mains energised, '154', 7" cone, 2,500 ohms 4 watts, 12/6. '154 Magna', 5 watts, 25/-; '152', 9" cone 2,500 ohms, 17/6; '152 Magna', 9" cone, 2,500 ohms, 6 watts, 37/6. Magnavox P.M.s.—'254', 7" cone, 16/6; '252', 9" cone, 22/6. Reliable P.M.s. 10/6; Balanced armature speaker units 3/6 each. **Potentiometers** by well-known makers. All values up to 1 meg. 2/-; with switch 2/6.

**GRAMOPHONE MOTORS**. Collaro Gramophone Unit, consisting of A.C. motor, 100-250 v. high quality pick-up and volume control 45/-; Collaro motor only, 30/-; Collaro Universal Gramophone Motor, 100-250 v. A.C./D.C., with high quality pick-up and volume control, 67/6; Collaro Universal Motor only, 49/6; Edison Bell double spring motors, including turntable and all fittings, 15/-; CosmoCORD Gramo unit, comprising A.C. motor, pick-up, and volume control (list 55/-), 35/9.

**SUPER CERAMIC "FREQUENTITE"** valve holders 4-, 5-, 7-pin chassis or baseboard, 6d.

**2-GANG ALL-WAVE COILS** (H.F. transformer and aerial coil). Cover 12/2,000 metres in 4 bands, integral switching. 1-v-1 circuit supplied, 12/6.

**MICROPHONES**. Post office type with transformer, 4/6; post office transmitter capsules, 1/6; super transverse current microphone large output, 45/7,500 cycles ± 2 DB, 30/-, transformer 5/-, table stand 7/6.

Push back wire 6 yds. 6d.; Screened wire 3d. yd., twin 4d.; 1 watt resistors any value 6d., 4 watt 1/-, 8 watt 1/6, 15 watt 2/-, and 25 watt 2/6. Tubular Condensers any value up to 75 mfd. 6d.; Resin-cored Solder, 9 ft. 6d.

See full page illustrated adot. in last month's Television

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ORDERS should be addressed to—JUBILEE WORKS, 167, LOWER CLAPTON RD., LONDON, E.5. Dept. T. Phone: Amburst 2833 (Private Branch Exchange). Callers, as usual, to 20-22, HIGH ST., CLAPHAM, S.W.4. (Macauley 2381), and 165 and 165a, Fleet St., E.C.4 (next to Andersons Hotel). (Central 2833). NOW READY Send 4d. in stamps for NEW ILLUSTRATED GIANT CATALOGUE AND VALVE LIST.

The  
**WEARITE**  
H. T. 35 SMOOTHING CHOKE

Specified for the  
**SINGLE VALVE  
240 B  
TRANSMITTER**



The H.T.35, like all the chokes in this series are specially layer wound—the inductance being adjusted by the air gap. Tested to 1,000 volts. Characteristics:—30 henries 50 ma., 1,600 ohms.

**PRICE - - 10/6**

**OTHER H.T. CHOKES IN THIS RANGE INCLUDE**

Type.	Inductance (henries).	Current (m/A.).	Res. (Ohms.)	Price.
H.T. 05	0.25	250	7.7	7/6
H.T. 11	10	120	210	10/6
H.T. 12	20	75	400	10/6
H.T. 13	40	50	875	10/6
H.T. 14	120	30	2000	10/6
H.T. 15	20	30	650	7/6
H.T. 16	60	15	1850	10/-
H.T. 25	20	50	850	7/6
H.T.410	40	100	250	17/6

Send for the new  
Wearite Book of  
Components.

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740, HIGH ROAD - TOTTENHAM  
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For Television's  
**GUARANTEED CATHODE RAY  
RECEIVER . . .**

the designer specifies a  
**SAVAGE GUARANTEED MAINS  
TRANSFORMER**

Once again, Savage Guaranteed Transformers have been specified for a Television circuit. Generosity of design, good regulation and freedom from over-heating are the outstanding characteristics of Savage Transformers. You cannot do better than follow Television's lead.

200-250, 50 cycles, screened primary, 300-0-300, 120 m/A., 4 v., 2 amps., centre-tapped 4 v., 8½ amps., centre-tapped 4 v., 4 amps, centre-tapped Type TA2. Price, 46/-.

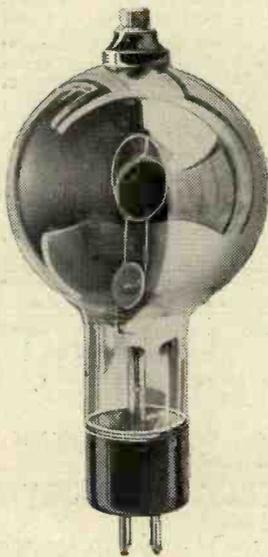


Input, 4 v., 50 cycles; Secondary 4 v. 1 amp. Insulated for 3,000 v. working, Type TA1. Price 12/-.

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SAVAGE  
LIMITED.**

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RECEIVERS**

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NATIONAL NC100, with valves, power pack and speaker ...	£35 0 0
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TOBE-DEUTSCHMANN, Communication Kit, with built-up tuner, air-trimmed, valves, power pack and speaker ...	£15 10 0
A.C.S.-EDDYSTONE SPECIAL, 5 metre Transceiver, In metal cabinet, valves, handset, and telescopic aerial...	£12 10 0

We also stock a variety of components, receiving and transmitting valves, special aerial systems, "Bug" Keys, microphones, and Pre-Selector Units. Postal Service a speciality.

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BROMLEY, KENT**

'Phone : Ravensbourne 1926.

**"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.

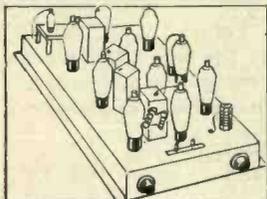
In our opinion the Mihaly-Traub system holds great promise as a means of providing large screen pictures or for a comparatively simple system for use in the home type of receiver.

**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.	

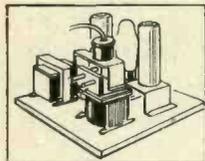
**TELEVISION AND SHORT-WAVE WORLD KITS**



SOUND AND VISION RECEIVER

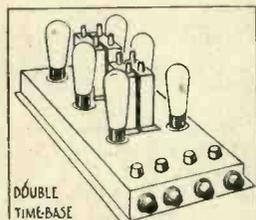
**TELEVISION RECEIVER**  
(October and November issues)

**VISION RECEIVER**  
Complete Kit, exactly as specified, including ready drilled chassis ... **£7 19 6**  
7 Specified Valves  
£5 10 0 extra.



SOUND AND VISION POWER-PACK

**POWER UNIT**  
Complete Kit, exactly as specified, including baseboard and metal cover ... **£5 14 0**  
1 Specified Valve  
10/6 extra.



DOUBLE TIME-BASE

**TIME BASE**  
Complete Kit, exact to specification, including drilled metal chassis ... **£7 6 11**  
6 Specified Valves  
£5 10 0 extra.

We specialise in the direct supply of all "TELEVISION" Kits and built-up instruments.

**PROMPT DELIVERY AND SATISFACTION GUARANTEED**  
Please send for lists:—

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33, St. Martin's Court, Charing Cross Road, W.C.2. Phone: TEMple Bar 1923.

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A NEW COURSE OF INSTRUCTION,

We have pleasure in announcing that our new "Television" Course has met with remarkable success. The enormous demand for the Course has shown, beyond any shadow of doubt, that it fills that long-felt need which we anticipated when we went to such trouble and expense in its preparation. We shall be happy to send full details of this special "Television" Course on request. Particulars are also available of other Courses in all branches of Wireless, Television, Talking Picture Engineering, etc., and of the easiest way in which to prepare for the A.M.I.E.E., A.M.I.W.T., A.M.I.R.E., etc., Examinations.

We teach by correspondence, and guarantee "NO PASS—NO FEE." Our Technical Consultant is Professor A. M. Low.

Send for full particulars to-day. Free and without obligation.

**THE BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY**  
337, SHAKESPEARE HOUSE, 17/19, STRATFORD PLACE, LONDON, W.1.



**PIEZO QUARTZ CRYSTALS**

A Q.C.C. 7 Mc. (40-m.) Crystal is specified by the designers of the

**SINGLE VALVE CLASS B TRANSMITTER**  
AND  
**THE BEGINNERS' TRANSMITTER**

Our new 1936-37 catalogue of short-wave transmitter and receiver components, sent post free for 1½d. stamp.

**THE QUARTZ CRYSTAL CO., LTD.**  
63 & 71, Kingston Road, New Malden, Surrey

Telephone: MALDEN 0334.

**"Noise-free Short-wave Reception"**

(Continued from page 663)

an outside screen, the function of the latter being to prevent the down lead part of the aerial from picking up interference. By the use of such an arrangement, signals are picked only where interference is weak, and a high signal-to-noise ratio is obtained.

In order to minimise the losses due to inherent capacity of the cable which acts as the feeder between the aerial wire and the receiver, a step-down transformer is fitted close to the aerial and out of the field of interference. This unit transforms the pick-up energy at aerial circuit impedance to that at approximately a fifth of the value and applies it to the two conductors of a cable which composes the transmission line. The surge impedance of this cable for which the transformers are designed is approximately 110 ohms.

The metal screening outside the cable acts as an electrostatic shield which accounts for the fact that there is no pick-up on the transmission line itself.

The transformer consists of short and long-wave windings on the same former and is wound to resonate on useful wavelengths on the short-wave band with an even response on broadcast bands.

A receiver is coupled to the transmission line by means of a second transformer in which the line impedance is raised to match the impedance of the receiver.

Our tests have shown that with this aerial in circuit and efficiently erected, almost all traces of local interference are eliminated. By local interference we mean sources such as motor car ignition, domestic appliances, including refrigerators, electric signs, dental and medical apparatus, electric lifts, etc.

The loss in signal strength is so slight as to be absolutely inaudible by ear. Actually the figure is approximately 5 db., which with a modern receiver, including automatic volume control, is absolutely negligible.

**Clearance of Government Surplus Stores**

We strongly advise our readers to write to E. J. Galpin, of 75 Lee High Road, Lewisham, S.E.13, or to 'phone Lee Green 5240, for the latest list of Government surplus stores.

Apparatus at unbelievably low prices are being cleared at present and include such items as 1/4 h.p. motors for 15s., a 2,000 volt 500 m/a dynamo for £2 10s. Frequency meters with 8 in. dials 15s., a galvanometer for 7s. 6d., G.P.O. relays to work from 2 m/a for 7s. 6d., pedestal microphone for 7s. 6d., high-current 30-henry smoothing choke for 1s. 3d., unspillable accumulators 2s. 6d., a visual wavemeter for 10s., a G.P.O. preselector 4s. 6d., and many other items at similar prices.



**A.C./D.C. TRANSMITTING UNITS.**

The Ostar-Ganz Crystal Oscillator unit is suitable for 80 or 40 metre operation. It is complete with rectifier and smoothing circuit and forms the basis of a complete transmitting station. The price complete is £8 8s. A Power-Amplifier unit to follow the Crystal Oscillator is available at £4 4s. and is designed for an input of up to 10 watts. If both units are purchased at the same time a special price of £10 10s. is quoted for both kits.

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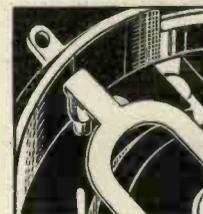
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# The Short-wave Radio World

## The Class C Audio Amplifier Applied to Regenerative Receivers.

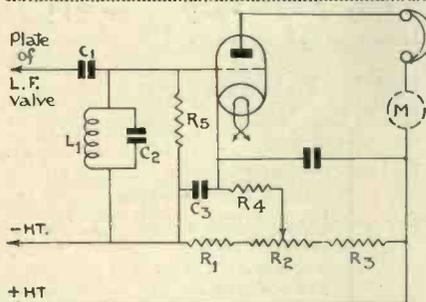
A REALLY useful scheme designed by W9FYK is explained in the October issue of "QST." Some operators like slight modulation on signals, others prefer a piercing D.C. note, but all agree that the best condition is that there should be no sound in the headphones other than the signal being received.

The diagram, Fig. 1, shows a Class C amplifier of conventional type. It is actually an adaptation of a background noise reducer designed for use when copying short-wave press signals, but nevertheless offers many possibilities for application to amateur work.

This amplifier may be used with any short-wave receiver having a reasonable amount of gain, and properly constructed to have a high signal to noise ratio—provided the receiver is equipped with a power output valve to ensure plenty of drive for the Class C stage. W9FYK uses the amplifier with a conventional four-valve tuned radio-frequency receiver with extremely satisfactory results.

### Coupling

The output stage of the receiver is coupled to the Class C amplifier through the condenser  $C_1$ . The condenser-coil combination,  $C_2L_1$ , is not absolutely necessary but it was found to eliminate a low-frequency "hash" present in the output when bias was adjusted nearly to the point of anode current cut-off. In addition it serves to peak the amplifier at about 500 cycles. This coil is



## A Review of the Most Important Features of the World's Short-wave Literature.

bias for Class C operation. Resistance  $R_2$  is variable, the arm being connected to the cathode through a 15,000-ohm resistance  $R_4$ . In this way the cathode can be made positive with respect to ground, so the grid may be placed at a negative potential with respect to the cathode and variable from nearly Class A to Class C conditions.

In operation a signal is tuned in and the bias control adjusted to the point where all background noise drops out. The strength of the signal will decrease but slightly, although a change in tone is generally noted.

It has been found that a certain minimum difference must exist between the strength of the desired signal and the strength of the background noise level to ensure satisfactory operation. Unfortunately, this limits the usefulness of the device. The extent of this limitation, however, will depend on the receiver, location, frequency band and operator. Whereas the DX operator listening to weak or fading signals may find the gadget of little value, the consistent operator having schedules with high-power stations will find his reception made much more satisfactory.

Incidentally, the milliammeter in the anode circuit can be used as a means of comparing signal strength. It is particularly useful when the signals are loud enough to permit of satisfactory

Fig. 1.—This circuit was originally used to receive press signals.

operation of the Class C amplifier as a background noise reducer.

## An Emergency Transmitter

An emergency transmitter is almost an essential part of the average amateur station, particularly where there is any possibility of a breakdown in power supply. A transmitter has been designed by members of the A.R.R.S. and is described in the October issue of *Radio*. It is a simple two-valve affair operating from dry batteries or a small vibrator converter of the new Bulgin type.

### Crystal Control

It is crystal controlled so eliminating the need of a monitor and is suitable for 160-, 80- or 40-metre operation. Inputs of 10 to 12 watts to the 71A provide ample signal strength for all normal requirements without imposing too great a load on the power supply. The choice of valves used in the transmitter centre on those of the directly-heated cathode type, so as to achieve the minimum filament current supply and at the same time to permit of filament switching during the silent periods of a QSO.

The circuit is practical and standard in every respect. A pentode crystal oscillator type 6A4 is capacitively coupled to the grid of an anode neutralised 71A. With 250 volts on the anodes of both crystal oscillator and amplifier and a current of 40 to 50 ma., both output and stability are all that can be desired.

(Continued on page 671)

## NOTICE

LARGE AMERICAN MANUFACTURER OF RADIO CONDENSERS DESIRES ENGLISH CONNECTION, TO MAKE SAME PRODUCTS UNDER PATENT PROTECTION ON ROYALTY BASIS. PRESENT PRODUCTION 35,000 PER DAY, USED BY U.S.A. GOVERNMENT. WRITE TO:

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the primary of an output transformer with about half the turns removed.

A resistance network across the H.T. supply is used to obtain the necessary

# Varley

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FOUR NEW CIRCUITS. We have recently published four new circuits which are giving excellent results with our new ganged units. No. 1 (BP 111) Mains Superhet for 110 k.c. No. 2 (BP 112) Battery Superhet for 465 k.c. No. 3 (BP 113) Three-valve Mains Receiver with band-pass tuners. No. 4 (BP 114) Screened Grid Battery Three with Pentode. Blueprints now ready. Nos. BP111, BP112, BP 113, 6d. each. [No. BP 114, 3d. Post Free.

OLIVER PELL CONTROL, LTD., BLOOMFIELD ROAD, WOOLWICH, S.E.18. WOOLWICH 2345

(Continued from page 670)

A 71A has been used because of the better efficiency that can be secured as an R.F. amplifier than higher gain valves at low anode voltage and high anode current. One 71A is as effective as a pair of 01A's with only half the filament current. There is also a better transfer of excitation from the high-impedance anode circuit of the oscillator valve to the high-impedance grid circuit of the 71A. The grid leak is of a slightly lower value than usual giving a greater output with the low anode voltage, although the efficiency is slightly lower than when using a 50,000-ohm leak.

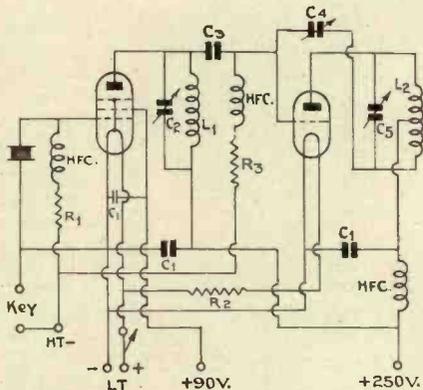


Fig. 2.—Frequency stability is assured by crystal control.

Component values are as follows:—

- R1 10,000 ohms, 2-watt.
- R2 4 ohms, 1-watt.
- R3 35,000 ohms, 2-watt.
- C1 .004 mfd., mica 500-volt.
- C2 100 mmfd. variable.
- C3 100 mmfd., 500-volt.
- C4 15 mmfd.
- C5 100 mmfd.
- L1 } 35 turns No. 20 d.c.c. on 1½-in.
- L2 } former with L2 tapped at centre.
- RFC 2.5 mh. chokes.

This transmitter can be constructed in a small portable carrying case and if used with a vibrator converter the entire power supply can be mounted internally. For C.W. operation it has a wide range and is very suitable for emergency use. The constants and coil values as given are for 80-metre operation and shown in Fig. 2.

**New Offices for Tungram.**

Messrs. Tungram Electric Lamp Works have now moved to larger premises at Tungram House, 82/84 Theobalds Road, W.C.1. This four-storey building houses all offices including the technical and publicity departments and will have a phone number of Holborn 3563, 4 and 5.

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**X-RAY TRANSFORMER.** Input 154 volts 50 cy. single phase, out 110,000 volt. 10 K.V.A. Perfect condition. £10. C.F.

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**WESTON & TURNER MOVING COIL MILLIAMP METERS,** 2½ in. dial. 0 to 100 M/A. 10/6. Post 6d. Thermo Ampmeters, 0 to 1½, 12/6; 0 to 12, 15/-

**WESTON MOVING COIL MILLIAMP METER** 0 to 500 M/A 3½ in. dial, 16/6.

**HIGH GRADE SWITCHBOARD,** volt and amp-meters, 12/6 each. Post 1/- Please state your requirements.

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**ISENTHAL VARIABLE RESISTANCE,** to carry 10 to 15 amps., fitted 0 to 15 a/meter and Pilot Lamp, as new 17/- C.F.

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**ELECTRIC LIGHT CHECK METERS,** kilowatt hour type, 200/250 v. single phase, for subletting, etc., 6/- each. Post 1/-

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**DYNAMOS** for Lighting or Charging, all shunt wound, fully guaranteed. 100 volt 10 amp., 60/-; 50/75 v. 12 a., 65/-; 40 v. 15 a., 70/-; 150 v. 1 a., 17/6; 100 v. 3 a., compound, 30/-; 200 v. 3 a., compound, 50/-; 20 v. 5 a., compound, 30/-; Aero dynamos, 12 v. 8 a., 10/-, all C.F.

**CHARGING RESISTANCES** or Shunt Regulators, Stud switcharm type, 12/6 each, to suit your requirements.

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*Note the Principal Contents of the  
October issue*

Convention Report — 56 Mc Activity In NorthWales—Inter-stage Impedance Matching Filters — Amateur Radio in New Zealand — Research and Experimental Sections — Soliloquies from the Shack — Book Reviews — Trade Notes — Morse Practices — District and Empire Notes.

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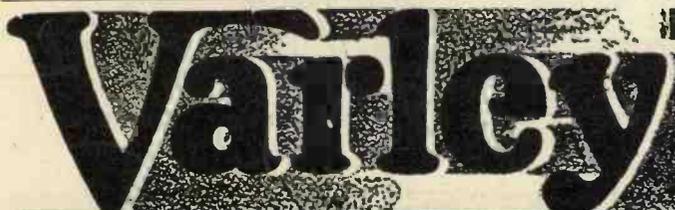
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