USING SMALL TUBES : SOME PRACTICAL POINTS

Television and SHORT-WAVE WORLD

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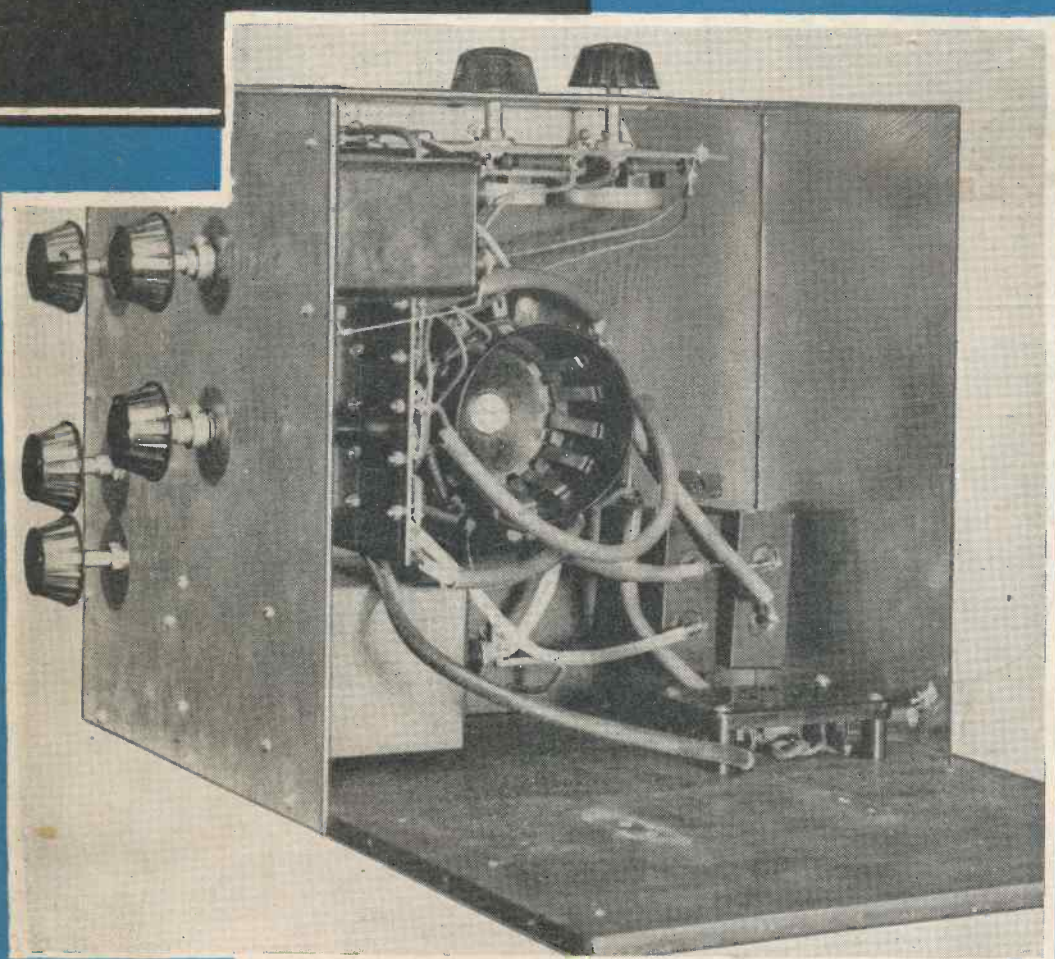

HALVING COST OF HOME-BUILT TELE-VISOR

HOME-CONSTRUCTOR LOW-COST TELEVISOR
Showing the Time Base and Tube Mount.
(See page 644)

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COMMENT OF THE MONTH

The Problem of the Cheap Receiver

IN the early part of this year we went to some pains to ascertain the factors which were preventing the average amateur from building his own television set. These factors, it was soon proved, were cost and complication.

At the time it did not appear that either of these could be reduced to any great extent, but it was decided to explore every possibility, and in carrying out a large number of tests and experiments we were fortunate in securing the collaboration of Mr. S. West.

It was evident that from the home-construction point of view only standard components and valves must be employed and that the actual construction of the complete equipment must be no more difficult than the average mains receiver. Also it was appreciated that the receiver should be "elastic," or in other words that without any fundamental alteration it should be suitable for reception beyond the ordinary service area or, with a little modification, for purely local reception.

With these objects in view several experimental receivers were built and from the experience obtained a final design evolved and detailed information on its construction was commenced in the preceding issue of this journal. This receiver in its original form has a range of approximately 65 miles and employs a 10-in. cathode-ray tube, and gives very fine results. For more local reception the cost can be reduced by using a fewer number of stages in the receiver.

The cost of a television receiver depends primarily upon picture size, and a little explanation will make it clear why this is the case. The complete televisor consists of a number of units—the vision receiver, the time bases, the power supplies, and the cathode-ray tube. Whatever the size of picture desired *the vision receiver remains the same* and its only modification would be for long-distance or local reception. With a smaller tube, however, it is possible to effect economies in several ways. Considerable saving can be effected in the power supply units, as lower voltages are employed, which means cheaper transformers and condensers. Economies can also be effected in the time bases by the employment of special design and finally, of course, the cathode-ray tube is much cheaper.

So great a saving is possible that the cost of the complete receiver, when using a small tube, is *half* that of the normal arrangement and therefore *not greatly in excess of an ordinary wireless set.*

The same vision unit as described last month is used, for as has been mentioned earlier, *the vision unit is fundamental,* whatever size of tube is used, and readers may be assured, therefore, that in building this they have *the nucleus of a televisor capable* of producing pictures from 1 in. to 12 in.

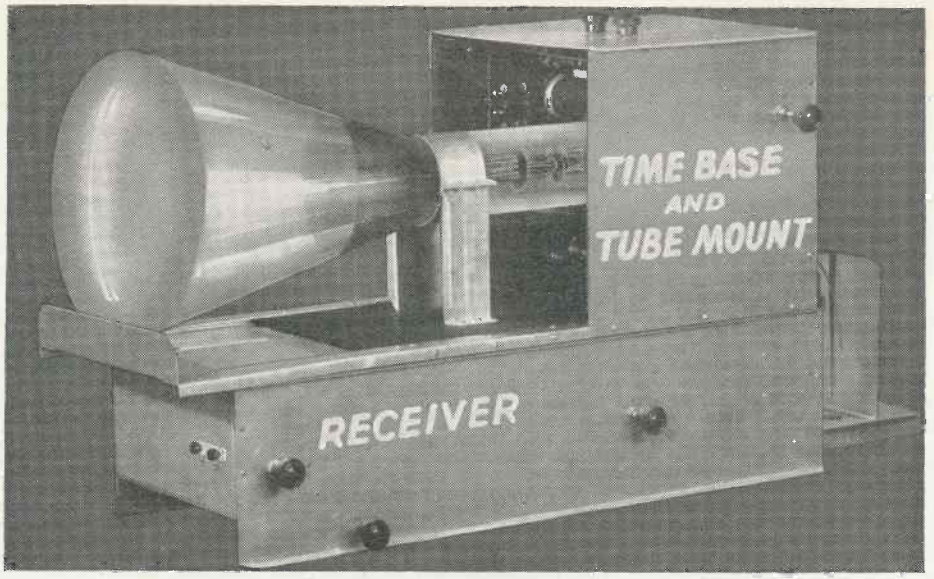
An article by Mr. S. West explaining some of the technical considerations in the employment of a small tube appears on page 657.

Alteration of publishing date : Will readers kindly note that in future "Television and Short-wave World" will be published on the first day of each month.

LOW COST

SIMPLE UNIT CONSTRUCTION

STANDARD COMPONENTS



THREE RANGES

AMPLE RESERVE OF POWER

NOVEL SYNCHRONISING

THE NEW TELEVISOR FOR EASY HOME CONSTRUCTION

Designed by S. West

PART II.—REDUCING THE NUMBER OF STAGES FOR LOCAL AND MEDIUM DISTANCE RECEPTION :: THE TIME BASE, THE CATHODE-RAY TUBE NETWORK AND THE RECEIVER POWER PACK

The first part of this article was published last month (October) and it described the construction of the vision receiver which, together with the time base, receiver and tube power packs comprise the complete vision equipment. In this issue details of the time base, tube network and receiver power pack are given. The final unit, the tube power pack, will be described next month.

This televisor is the result of several months experimental work in the provision of a suitable design for amateur construction. Cost is low, all components and valves are standard and readily obtainable and the unit construction is so simple that it is virtually impossible to go wrong.

It is designed to be suitable for three ranges—65 miles, 35 miles and 20 miles according to the number of vision-frequency stages incorporated. Either a 10 in. or 7 in. cathode-ray tube can be employed.

The construction is just as simple as any ordinary wireless set and requires no special knowledge. Lining up is of the simplest character and the time bases are very simple to adjust. The amateur constructor can have every confidence in his ability to build the receiver and get excellent pictures immediately.

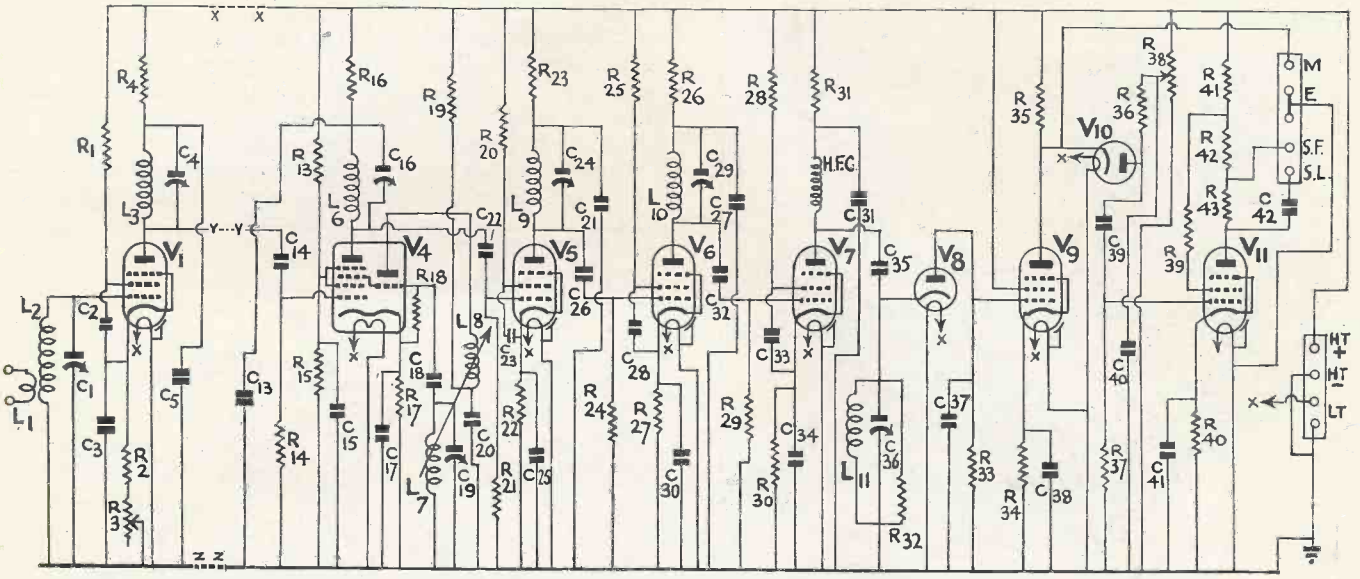
TELEVISION to a large extent follows conventional radio practice. Amateurs who have had experience in tuning and adjusting normal broadcast receivers will have no difficulty whatever in adjusting a vision receiver, though certain additional technique is ordinarily required because of the need for inclusion in a complete vision receiver of the time base, which is a departure from ordinary radio practice.

With a normal sound receiver we get noises that, even in the worst cases, have something recognisable about them and it is a relatively simple matter to complete the tuning while aurally observing the effect of each adjustment.

With a vision receiver, the actual transmitted scene, or perhaps more correctly, the synchronising pulses accompanying the scene, can be heard. The actual receiving section of the complete outfit can, therefore, be adjusted, more or less accurately, by listening to the signal with headphones or a fairly sensitive loudspeaker. If this signal, however, is applied to the C.R. tube, the chances of a picture resolving are extremely remote, the reason being that the time bases are not operating at their respective correct frequencies.

Adjustment of a time base of the usual type is outside the knowledge of the home constructor. He has not previously handled anything that is similar to it.

CIRCUIT OF THE VISION RECEIVER FOR LOCAL RECEPTION



This diagram shows the circuit of the vision receiver modified for local reception. If it is compared with the circuit given last month it will be seen that two vision-frequency stages have been cut out. The two stages removed are shown below and from these and the key letters X, Y, Z it will be clear that the removal of either one or two stages according to the distance at which it is wished to use the receiver (20 miles one vision frequency stage, 35 miles two stages and 65 miles three stages, is quite a simple matter and does not affect the design in any way. It is suggested that no alteration be made to the actual chassis in the event of using a fewer number of stages as the saving that would be effected is trivial.

It has been observed by the writer that with previous home-constructed vision receivers, the novice experiences his greatest difficulty with the initial adjustments required to the time base.

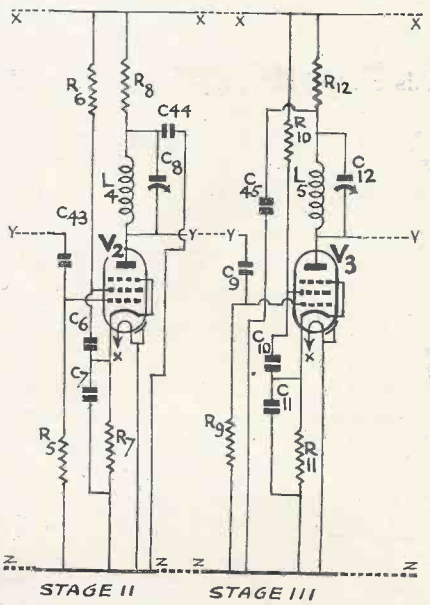
The reason for this is simply that he has a large number of controls to manipulate. These controls are all more or less interdependent and he is able to get such a large variety of combinations, that the correct adjustment becomes elusive and until he gets something resembling the transmitted picture, he is literally groping blindly.

It is not an easy matter to give operating instructions for a time base. If a normal time base employing a Thyratron relay to generate the saw tooth oscillations is considered, the controls are: Relay bias, charging resistance, paraphase tapping resistance, synchronising feed and picture shift, i.e., there are five controls and this is for one base only, either frame or line. There are thus twice this number of controls for the complete time base.

In giving adjustment instructions for this type of base, initially the picture shift and perhaps the paraphase feed controls may be ignored. We still have, however, six controls to adjust.

It is usual to specify the approximate size to which the raster is to be adjusted. Then a description of the effects when the correct adjustment is approached are detailed. It is not at all easy to describe these effects. Furthermore, they are too transitory to photograph. Obviously some simpler arrangement is very desirable.

Now a time base can be what is termed "Self running," i.e., one in which the voltages are generated at approximately the correct frequency. Accurate control is maintained by the transmitted synchronising pulses. Or it can be what is termed a driven or distant controlled time base, that is, the operation is entirely controlled by the transmitter.



This diagram shows the two stages removed and it will be apparent that the procedure is the same for either one or two. The key letters X, Y, Z indicate the original connections

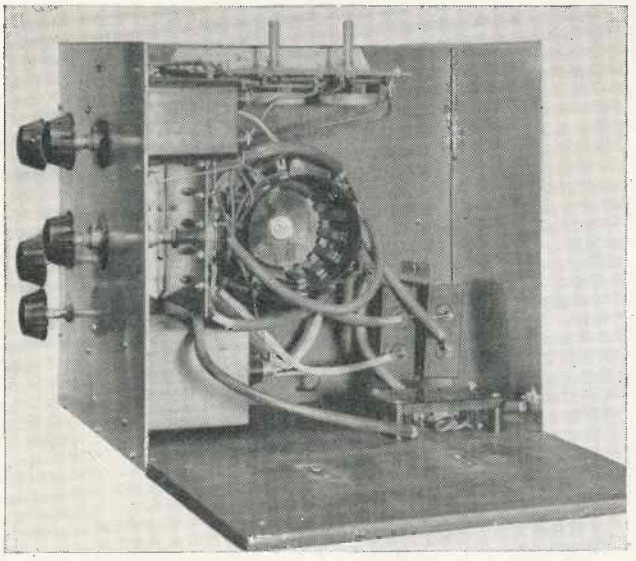
Each type have their respective advantages. In general it may be said that the first, which is almost exclusively used in most contemporary designs, is more stable with a fluctuating signal and when interference is present. The second has the advantage of adjusting itself when the synchronising pulses are applied.

A combination of the two principles would seem the ideal.

The method employed in the vision receiver unit to separate the synchronising pulses gives a pulse free of picture content and of constant amplitude.* For this reason it is possible to use a time base that is, as has

* A New Synchronising Control System. Paul D. Tyers, page 609, October issue of *Television and Short-Wave World*.

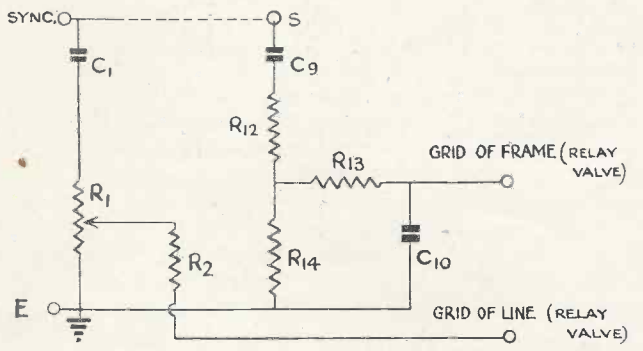
BUILDING THE TIME BASE



This photograph shows the front of the time base and the tube mount. A detailed drawing showing the wiring is given on the opposite page.

been suggested above, the ideal, i.e., a combination of the two systems described.

Full constructional details of this time base are given here. Its adjustment is extremely simple. Actually, there is only one control, incorrect adjustment of which will destroy the recognisability of the picture. With this control correctly set, an extremely simple task, as it is only necessary to watch the screen and rotate the control until the picture appears, the remaining controls can be finely adjusted so that the picture is of the correct size and proportions.



The circuit of the synchronising pulse application network.

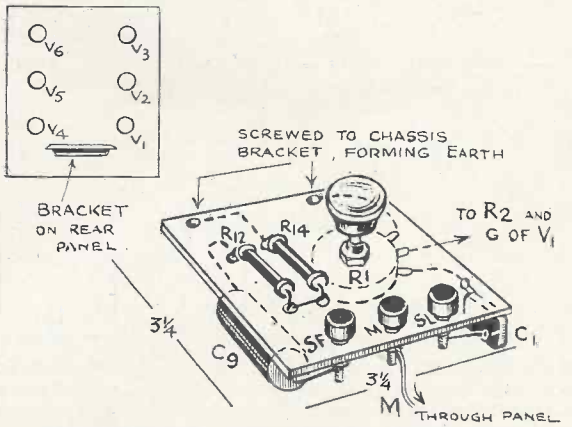
The question of proportions of a television picture is rather important. If the voltages fed to the deflector plates of the C.R. tube are not sensibly symmetrical, form distortion often occurs.

This type of distortion is not to be confused with that occurring when the height/width of the picture is incorrect. When this is so, the distortion applies to all parts of the picture. Figures are either tall and elongated, or squat and broad.

With non-symmetrical deflecting voltages, this distortion is restricted to a part of the picture. One form of it is for features to be elongated towards the top of the picture, exaggerating hair and brow.

In general it may be assumed that if opposite sides of the raster are parallel, the deflector plates' voltages are balanced. The method of correctly adjusting the controls to ensure an optimum picture will be fully dealt with in the operating instructions.

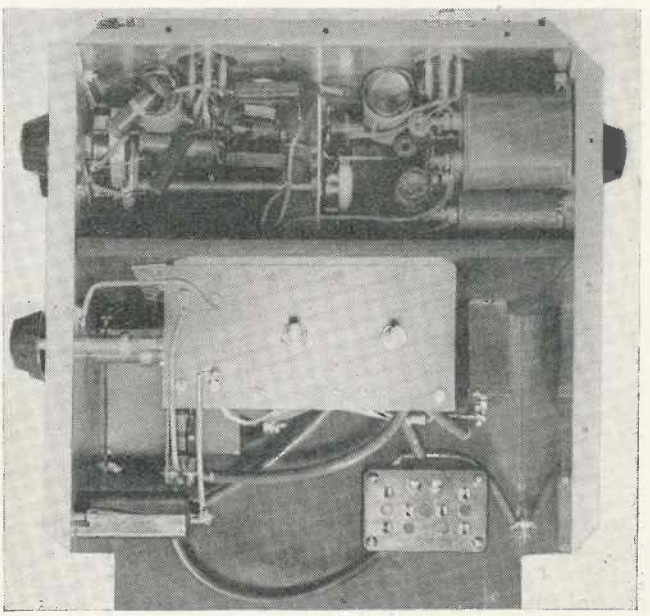
If the photographs of the time base are studied, it will be seen that the assembly takes the form of a complete self-contained unit, that also includes the C.R.



The synchronising pulse application network panel.

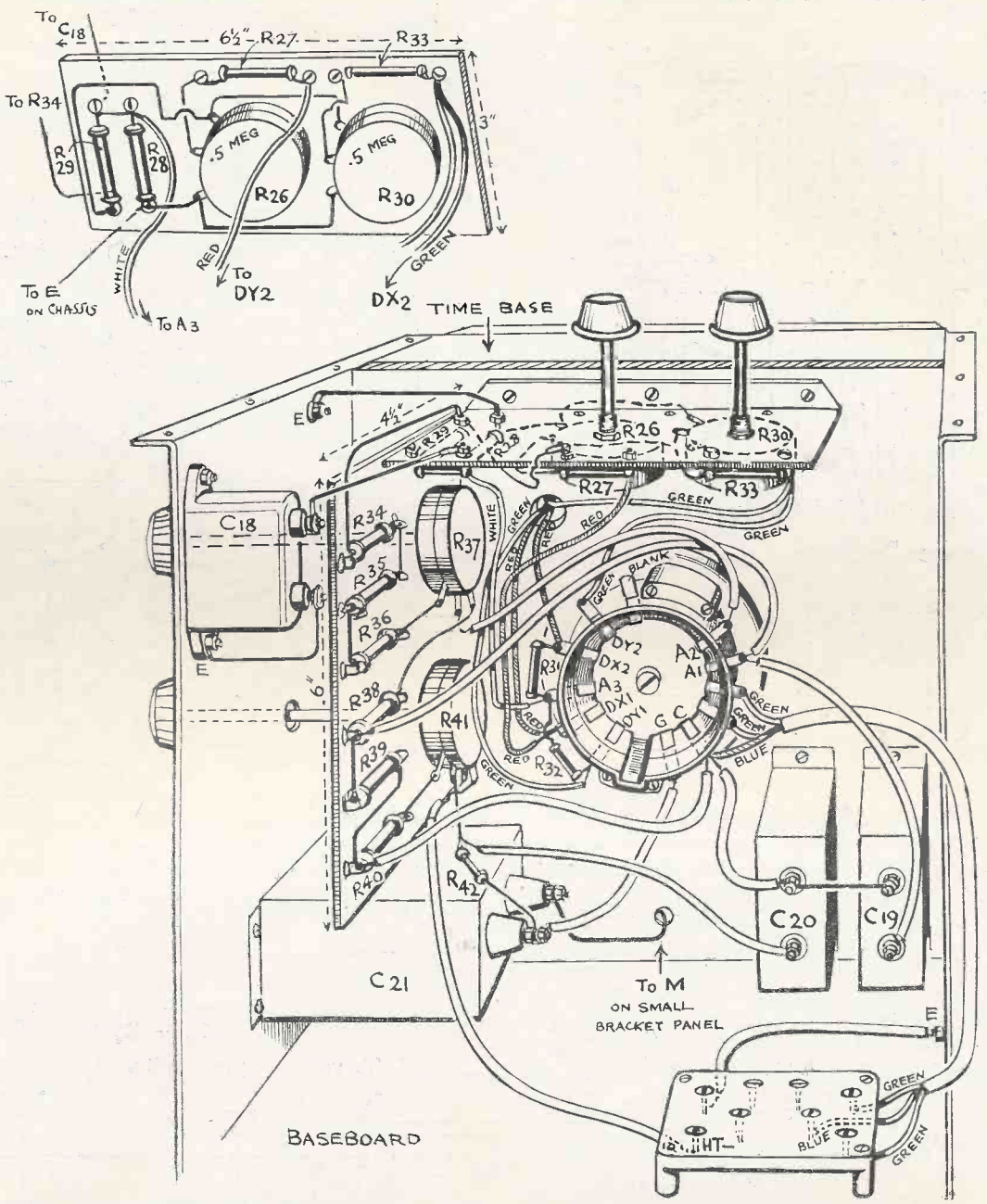
tube electrode potentials network, tube base and support. This method of assembly permits short connecting leads. Also as the high-voltage potential divider is enclosed, possibilities of unpleasant accidental contact are eliminated. It will be observed that the necessary controls are grouped accessibly around the end of the tube.

The theoretical circuit of the time base is shown on page 648, and it will be seen that the number of components is minimal. The charging resistances in the anodes of the type T.31 relays are fixed. Correct operating speeds are approximated with the variable



A plan view of the time base and tube mount with the top removed.

THE TIME BASE WIRING



This drawing shows the front assembly and wiring of the time base and tube mount.

bias controls of these two valves. Picture size is, with certain reservations, controlled by the resistances R8 and R23.

A large number of valves have been tried and no troubles at all have been experienced owing to this simplification. There is a remote possibility, however, that the characteristics of a relay may differ largely from the average. In this case it is a simple matter to increase or decrease slightly the resistance R3. It is not considered, however, that this eventuality will arise, as the large number of valves used in tests may be said to be representative of any normally purchased.

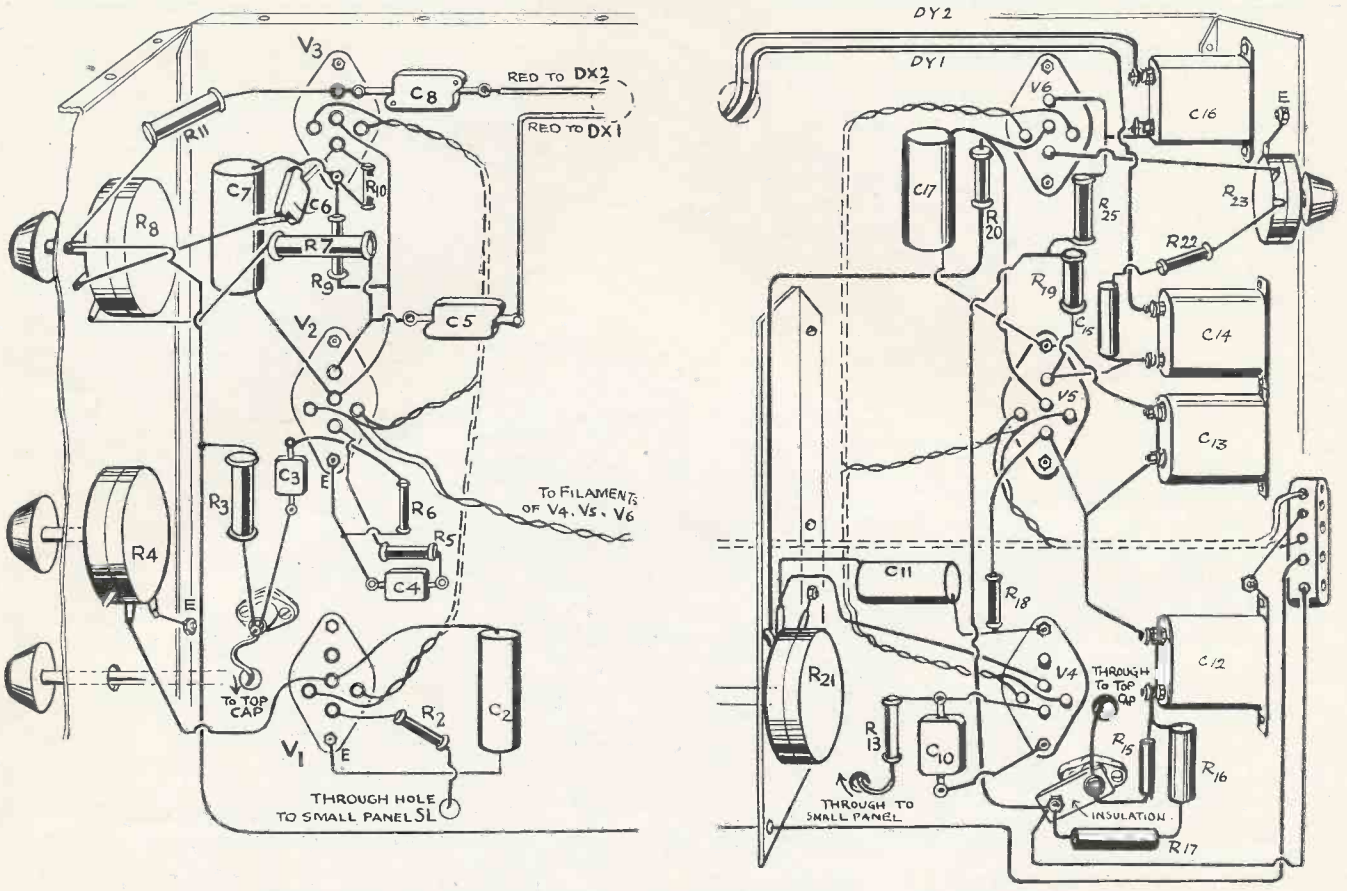
It may be mentioned here that the picture size is inversely proportional to the C.R. tube's third anode volts. It is well, therefore, to ascertain that this voltage is correct before attributing any difficulty in securing the correct picture size to a fault in the time base.

The synchronising pulse application network is shown on page 646.

Considerable latitude is permissible here and for this reason the unit is not actually incorporated in the time base proper. At the outset, in the interests of economy, the potentiometer R1 may be replaced by two fixed resistances proportioned R/5R with R approximately 5,000 ohms.

The potentiometer is, however, invaluable for impart-

MORE ABOUT THE TIME BASE



Assembly of components and wiring of left- and right-hand sides of time base chassis.

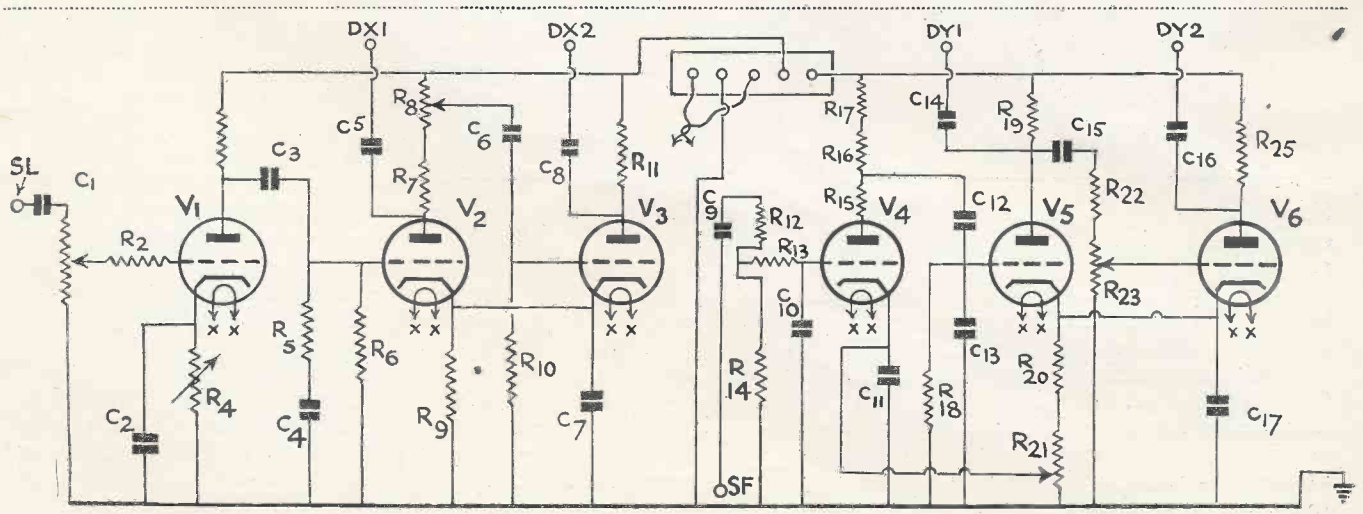
ing a fine control to the line base. It is in any case desirable when interference is heavy.

Liberties may be taken with the frame pulse feed network as this is not at all sensitive.

The circuit of the tube electrode potentials network shows that a shift voltage for correctly centring the picture is derived from the 3rd anode end of this network. The total series resistance of the network across the tube volts is 4.95 megohms = R1 plus the potentiometer network from which the picture shift potentials are derived. The total resistance of this

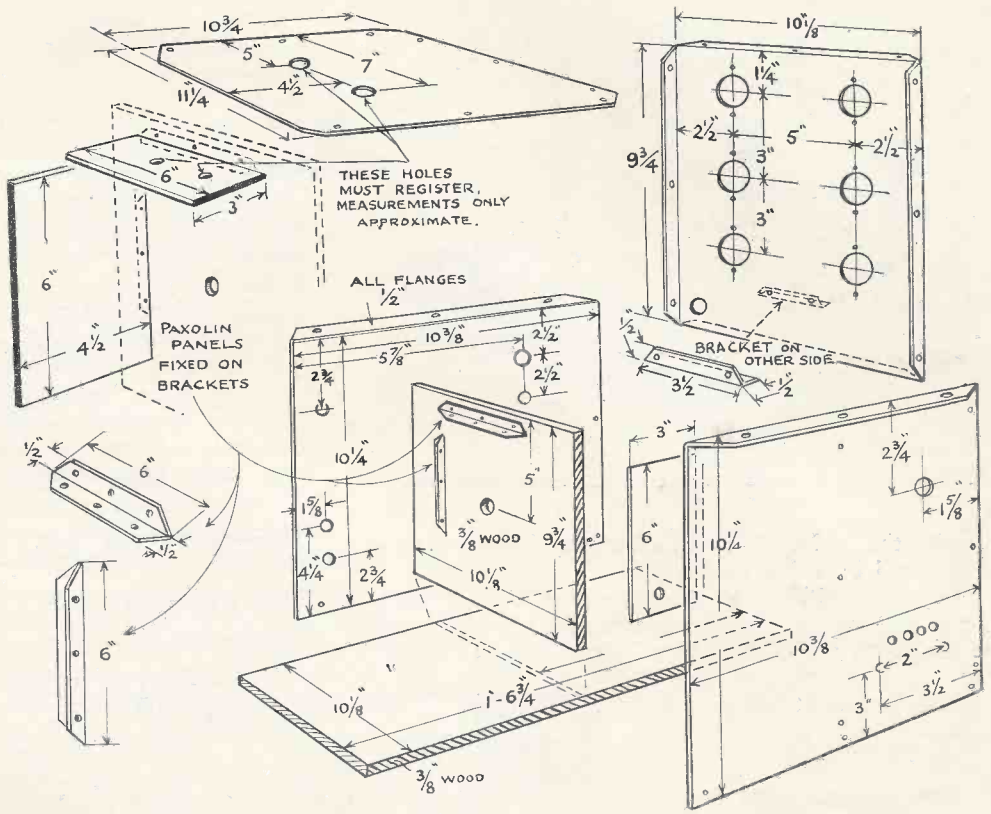
$$= \frac{1}{\frac{1}{5} + \frac{1}{5} + \frac{1}{1}} = 0.2 \text{ megohms} = R_2.$$

The available shift potential thus $= \frac{R_1}{R_1 + R_2} \times E$, where E = full tube H.T. volts = 4,000 volts.



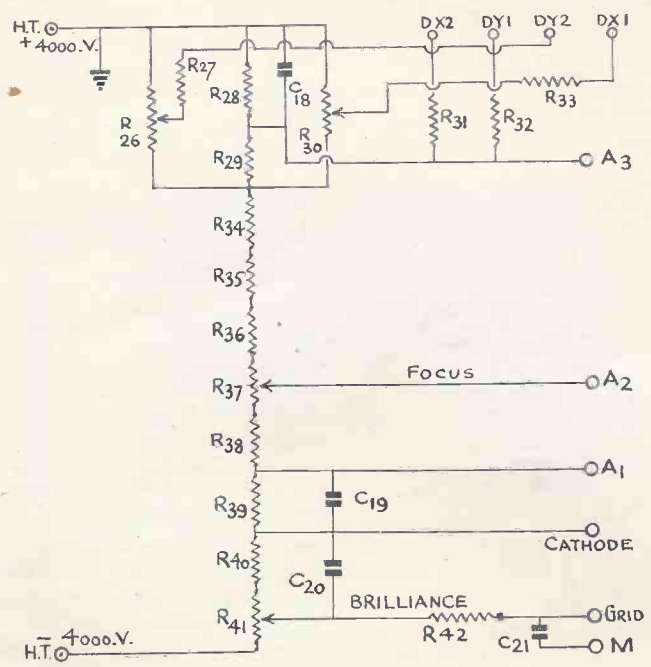
The theoretical circuit of the time bases.

THE TUBE ELECTRODES POTENTIALS NETWORK



This drawing gives the constructional details of the time base chassis. Sheet aluminium is used with a wooden dividing partition on which the tube holder is mounted.

There is, therefore, a voltage available for centring the picture of 155 volts approximately or half this voltage each side of the 3rd anode. This voltage has proved adequate in all cases.



The theoretical circuit of the cathode-ray tube resistance network.

It is permissible to ignore any current taken by the tube electrodes in calculations such as those above as these currents are of a very small order.

Due to the characteristics of individual C.R. tubes varying, it may not be possible to focus the tube correctly when using the specified network. Correct focus of the tube is achieved when it is possible plainly to see each line composing the raster.

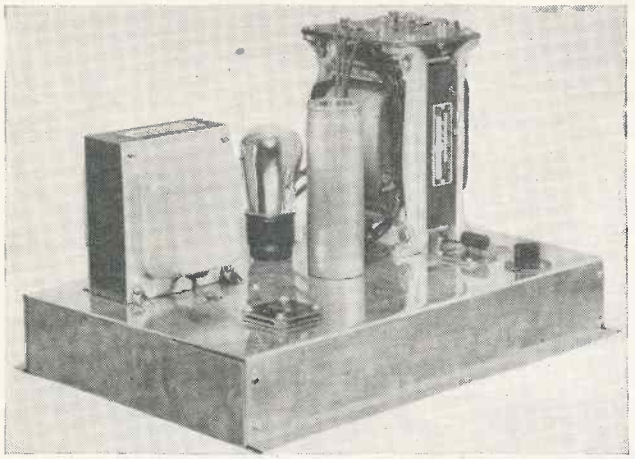
In this event the value of R38 may be slightly varied. Correct focus is important, otherwise definition suffers. The cases of the condensers C19 and C20 must not be allowed to come into contact with the chassis, each other, or any earthed point. If the constructional directions are adhered to this condition is fulfilled.

The protecting cover of the C.R. tube base may be left off as there is no possibility of accidental contact with its terminals. This facilitates connection of the X and Y plates through their high resistances to the 3rd anode by the simple expedient of fitting them to the base terminals. The diagram makes this clear. They are the resistances R31 and R32.

It is advisable to use heavy rubber covered cable to the tube heater and cathode. Similar cable must be used for the high voltage (4,000 volts) negative lead to the unit. Elsewhere the insulation of good quality, slide-back wire will be adequate.

For the C.R. tube heater and H.T. supply a Bulgin 6-way high-voltage plug and socket is used. The time base power is supplied via a 5-way Bryce block. This makes it impossible to confuse the supplies. At the same time it ensures ease of connection between units.

WIRING THE TUBE H.T. SUPPLY



This photograph shows the complete vision receiver power pack.

Actually the entire vision receiver may be moved and reconnected in a few moments.

The H.T. voltages to the time base are comparatively high and reasonable care should be taken with the wiring to avoid short circuits occurring at a later date.

Great care must be taken with the disposition of the wiring and components comprising the tube H.T. network. The voltages necessary can leap quite large gaps, particularly when dust has accumulated, thereby encouraging the break over by providing a low resistance path.

It is, perhaps, as well to repeat the warning so often given, regarding the high voltages used in vision equipment.

Under no circumstances must adjustments be made to the interior of the chassis with the supply on. It is advisable also to ensure that condensers are not holding a charge.

If these simple rules are adhered to there is no danger whatever.

If tests of the unit are made before the final operating instructions are given, observation of the following precautions will avoid possible damage to the C.R. tube.

The resistance R41 is turned anti-clockwise to the extent of its travel.

Having switched on, turn this control clockwise until the raster is just visible. If this control does not affect the raster illumination and it is very brilliant, switch off at once and check the connections. Particularly examine the resistance R42. If everything is in order it should be possible completely to extinguish the raster when R41 is turned full anti-clockwise.

If the raster is small in size it is advisable to open it up with the controls R4, R8, R20, R23, in order to spread the electron bombardment evenly over the screen.

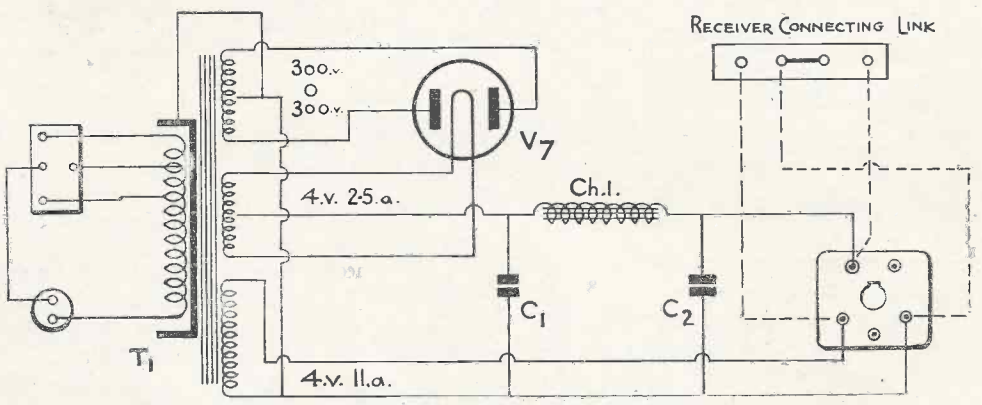
It is well to cultivate the habit of turning the raster out before switching off and to turn it up to the required brilliance after switching on.

It should not be thought that because these precautions are described at some length, the use of a C.R. tube is in any way hazardous. On the contrary, it is a very simple piece of apparatus to use.

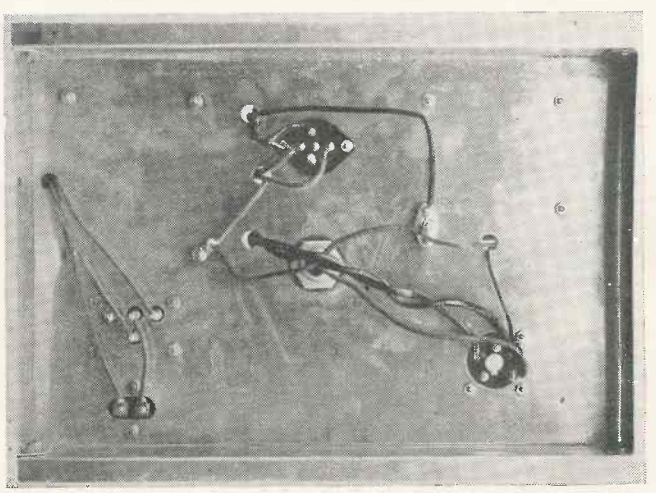
Few constructors have, however, had previous experience of C.R. tubes and these few notes will doubtless prove of some assistance.

The Receiver Power Pack

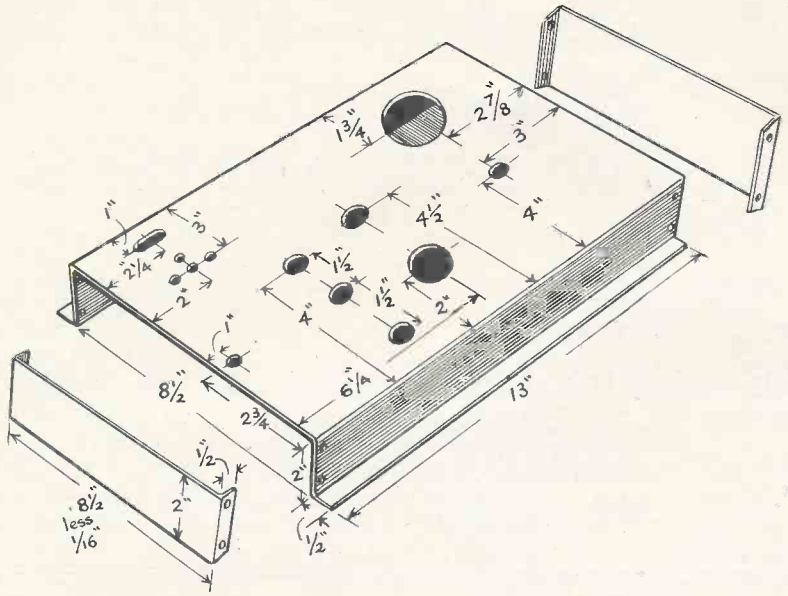
The vision receiver power unit is so straightforward that very little description is required.



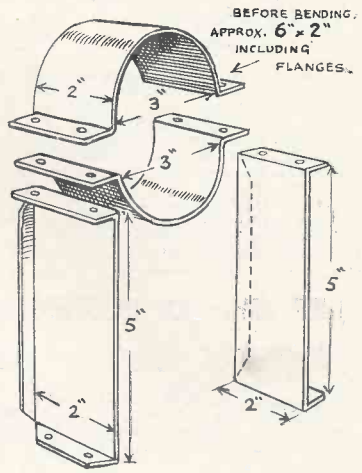
The circuit of the vision receiver power pack.



Photograph showing the underside of the vision receiver power pack.



Constructional details of the vision receiver power pack chassis.



Details of cathode-ray tube support.

The components are assembled on an aluminium chassis. The drawings make their disposition clear and also give all chassis dimensions.

An indirectly-heated rectifying valve is employed, as this permits the heaters of the various valves in the vision receiver to attain their correct operating temperature before the H.T. voltage is applied.

No fuses are fitted as the time base and C.R. tube power pack will include these.

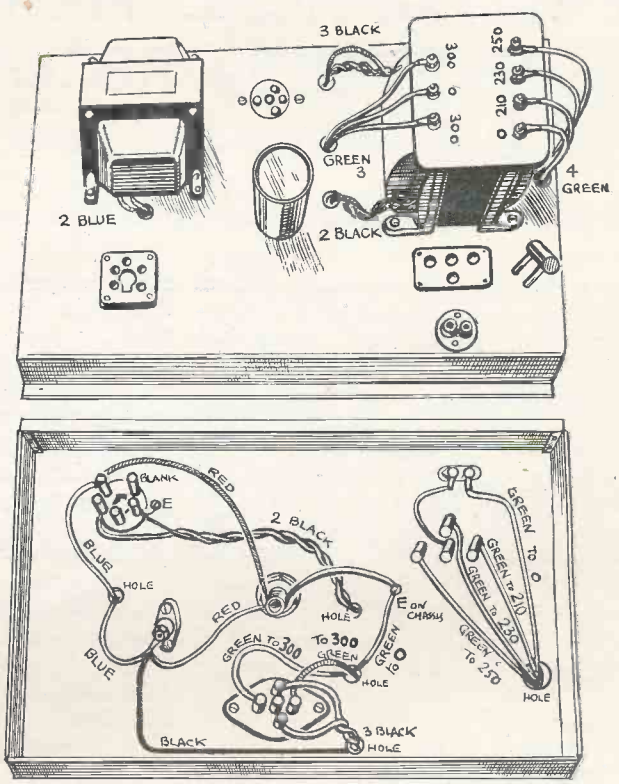
Mains connection is made with a Belling-Lee connector. A Clix selector board permits the transformer primary to be regulated to suit any mains voltages between 200-250 volts.

The heaters and H.T. voltages are supplied via a Belling-Lee 5-way plug and socket. It will be seen that no separate earth lead is used, for as one side of the heaters is connected to the chassis, this is unnecessary. Care must, of course, be taken to connect the heaters to the correct plug terminals. The transformer is fitted with an electrostatically screened primary.

The power unit is capable of delivering approximately 300 volts at 100 milliamps., with 4 volts at 11 amps. for the heaters.

Its compact dimensions are well in keeping with the rest of the design and make for easy assembly as the transformer and choke leads are sufficiently long to be used as the larger part of the wiring.

The arrangements for making the various connections have been considered with a view to avoiding confusion, also to render it extremely simple to interconnect the various units comprising the complete assembly.



Drawings showing the component assembly and wiring of the upper and underside of the vision receiver power pack.

LIST OF COMPONENTS, VALUES AND MAKES, FOR TIME BASE AND TUBE HIGH-VOLTAGE SUPPLY NETWORK

RESISTANCES.

R1 50,000 ohms Pot. (Reliance)
R2 150,000 ohms (½ watt) (Erie)
R3 1 megohm (2 watt) (Erie)
R4 50,000 ohms Pot. (Reliance)
R5 2,000 ohms (½ watt) (Erie)
R6 1 megohm (½ watt) (Erie)
R7 75,000 ohms (2 watt) (Erie)
R8 20,000 ohms Pot. (Reliance)
R9 5,000 ohms (1 watt) (Erie)
R10 1 megohm (½ watt) (Erie)
R11 100,000 ohms (2 watt) (Erie)
R12 30,000 ohms (½ watt) (Erie)
R13 20,000 ohms (½ watt) (Erie)
R14 1,500 ohms (½ watt) (Erie)
R15 1,000 ohms (1 watt) (Erie)
R16 1 megohm (2 watt) (Erie)
R17 0.5 megohm (2 watt) (Erie)
R18 1 megohm (½ watt) (Erie)
R19 200,000 ohms (2 watt) (Erie)
R20 5,000 ohms (1 watt) (Erie)
R21 5,000 ohms Pot. (Reliance)
R22 1.5 megohms (½ watt) (Erie)
R23 0.5 megohm Pot. (Reliance)
R25 200,000 ohms (2 watt) (Erie)
R26 0.5 megohm Pot. (Reliance)
R27 1 megohm (½ watt) (Erie)
R28 0.5 megohm (1 watt) (Erie)
R29 0.5 megohm (1 watt) (Erie)
R30 0.5 megohm Pot. (Reliance)
R31 1 megohm (½ watt) (Erie)
R32 1 megohm (½ watt) (Erie)
R33 1 megohm (½ watt) (Erie)
R34 2 megohms (1 watt) (Erie)
R35 1 megohm (1 watt) (Erie)
R36 0.5 megohm (1 watt) (Erie)
R37 0.5 megohm Pot. (Reliance)
R38 0.5 megohm (1 watt) (Erie)
R39 0.35 megohm (1 watt) (Erie)
R40 0.1 megohm (1 watt) (Erie)
R41 0.1 megohm Pot. (Reliance)
R42 (1 megohm (1 watt) (Erie)

CONDENSERS.

C1 0.001 mfd. type 760 (Dubilier)
C2 50 mfds. 12 v. type 402 (Dubilier)
C3 0.001 type 620 (Dubilier)
C4 0.001 type 620 (Dubilier)
C5 0.005 type 620 (Dubilier)
C6 0.005 type 620 (Dubilier)
C7 20 mfds. 50 v. type 402 (Dubilier)
C8 0.005-mfd. type 620 (Dubilier)
C9 0.1 mfd. type type 4423/S (Dubilier)
C10 0.003 type 670 (Dubilier)
C11 50 mfds. 12 v. type 402 (Dubilier)
C12 0.5 mfd. type 950, 1,000 volt working (Dubilier)
C13 0.2 mfd. type 950, 1,000 volt working (Dubilier)
C14 0.1 mfd. type 950, 1,000 volt working (Dubilier)
C15 0.1 mfd. type 103. T.C.C.
C16 0.1 mfd. type 950, 1,000 volt working (Dubilier)
C17 50 mfds. 50 v. type 3004 (Dubilier)
C18 2 mfds (Dubilier), type BB.
C19 1 mfd. type LEG (Dubilier)
C20 1 mfd. type LEG (Dubilier)
C21 0.1 mfd. 4,000 volts working, (T.C.C.)

SUNDRIES.

2—Extension spindles. List No. 1008 (Eddystone)
1—5-way connecting block (Bryce).
2—Insulated valve caps. List No. P92 (Bulgin)
3—4B.A. Terminals
1—6-way high voltage connector. List No. P100 & P101 (Bulgin)
3—Sheets paxolin, 6 ins. x 3 ins., 6 ins. x 4¼ ins 3¼ × 3¼ (Peto-Scott)
Chassis, nuts and bolts, ignition cable, etc.
6—5-pin chassis mounting valve holders (Belling-Lee)

VALVES FOR TIME BASE

V1 Mazda T31
V2 Mazda AC/P
V3 Mazda AC/P
V4 Mazda T31
V5 Mazda AC/P
V6 Mazda AC/P

LIST OF COMPONENTS, VALUES AND MAKES FOR VISION RECEIVER POWER PACK

1—Mains Transformer. type 300T/100 200-250 volts Primary
Secs. 300-0-300 at 100 milliamps
2-0-2 at 2.5 amps
4 volts at 11 amps (Sound Sales)
1—Smoothing choke 60 henries, 80 milliamps type 60/80T (Sound Sales)
1—8-8 mfd. electrolytic condenser type 9203E (Dubilier)
1—3-way mains selector board (Clix)
1—Mains connector, List No. 1014 (Belling-Lee)
1—5-way plug and socket, List No. 1260 (Belling-Lee)
1—Valve holder, List No. 1135 (Belling-Lee)
1—Midget stand-off, List No. 1019 (Eddystone)

VALVE.
V7 Mullard IW3 (Rectifier)

NEW OPTICAL METHOD OF TELEVISION RECEPTION

A RECENT SCOPHONY DEVELOPMENT

(French Patent—817 994, Scophony Limited and F. Okolicsanyi).

THIS patent describes several new methods of television reception employing supersonic waves. Some of these methods dispense entirely with the high-speed scanner, some with the slow-speed scanner as well. The common feature of the various combinations is that two light relays are placed in the light path of a light source. The light passes successively through the two relays. At least one light control is of the supersonic type, the other is either similar or of the Kerr cell type. Electrically, the one is fed with the picture current, the other with the synchronising signals.

In one of the examples the patent indicates that the light of a constant light source is modulated in the orthodox way by a Kerr cell. The light then passes through a liquid cell in which a quartz crystal generates supersonic waves. The associated high-frequency oscillator is suppressed until the saw-toothed synchronising impulses permit the oscillations for a very short time. A wave group is started from the crystal and can be made visible on a screen with the usual interference methods and with the light modulated by the Kerr cell. In conjunction with a mechanical slow speed scanner the picture is then built up. This system is suitable for any practical line number, because the starting of the wave group is effected without time lag and in a most direct way, since time bases, etc., are not necessary.

The electrical connections are interchangeable and another example of receiver design can be demonstrated by feeding a Kerr cell with the synchronising signals and the supersonic cell with the picture current. In this case a kind of supersonic record is projected from the crystal into the liquid and if the cell is long enough, the record will persist for the duration of a line. The Kerr cell then stroboscopically projects the picture cell, flashing each line in turn on the screen. An increased light efficiency is obtained if the light source also flashes synchronously with the Kerr cell.

We understand that the above system is producing practical pictures—that is, receiving the B.B.C. transmissions. It appears to be a third type of reception, providing a new method of scanning in addition to the existing mechanical and electronic methods. The supersonic cell cannot be regarded as replacing mechanically moving solid scanners by liquid ones, since it is not the movement of liquid which effects the scanning, but purely the propagation of compression waves in the liquid. The device is, therefore, inertialess.

We hope to publish full details of the scheme, described by the inventor, Dr. Okolicsanyi, in next month's issue of TELEVISION AND SHORT-WAVE WORLD.

The next issue of Television and Short-wave World will be published on Wednesday, Dec. 1st.

THE INVENTOR OF RADIO

There is still considerable controversy as to who was the inventor of radio. It is claimed in certain quarters that scientists Hertz, Lodge and Popoff, discovered the existence of electric waves many years before Marconi ever thought about it. During a patent action in America, Judge Townsend stated, " other inventors venturing forth on the sea of electrical movement met the rising tide of the Hertzian waves and allowed them to roll by without appreciating that this new current was destined to carry onward the freight and traffic of the world's commerce. They noted their manifestations, suspected their possibilities, disclosed their characteristics and hesitated, fearing the breakers ahead, imagining barriers of impracticable channels and shifting sand bars. Marconi daring to hoist his sails and explore the unknown current first disclosed the new highway."

A NEW IDEA FOR LARGE-SCREEN PICTURES

DETAILS OF A SUGGESTED SCHEME FOR EMPLOYING THE CATHODE-RAY TUBE AS A LIGHT VALVE

ONE of the disadvantages of the cathode-ray tube is that the "effects" which it produces are confined within a glass vessel which must be absolutely airtight. If the cathode beam could be made to operate in air it is probable that better use could be made of it than the production of fluorescence. Many suggestions have been made for utilising the beam in a different manner with the object of allowing greater latitude in its use, but although several of these are ingenious none as yet appears to have reached the stage of practical development, if we exclude optical projection of the actual light spot which, of course, entails an intensely bright spot and certain consequent difficulties in its production.

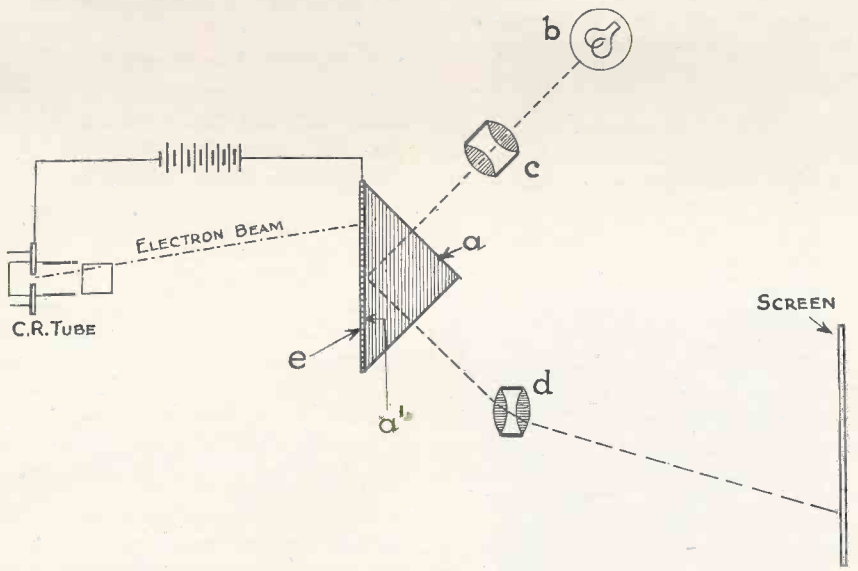
An idea to make the beam act as the control of a light valve is the subject of a patent* which has been granted to Marconi's Wireless Telegraph Co., Ltd., L. M. Myers and E. F. Goodenough. This light valve is of a new and special type and is external to the cathode-ray tube, though in practice it would form part of its complete assembly.

In order to make the idea and its method of working clear it will be helpful to outline the physical phenomena which it is believed underlie the principles involved.

It is well known that if two bodies have their surfaces brought very near together there is an attractive force between them. For example, if two pieces of glass having optically planar surfaces be placed with those surfaces together a substantial force is required to pull them apart. Similarly, two pieces of polished mica when placed together will at once form optical contact even in air, while a similar phenomenon is exhibited with liquids—for example, the adhesion between a mercury surface and a copper plate.

The generally accepted explanation of these physical facts is that the molecules disposed within a substance are subject to electrostatic forces of surrounding molecules, the electrostatic forces within the substances being so balanced that the molecules take up a particular disposition characteristic of the substance. These forces exerted within a substance are represented by the term "cohesion." At the surface of a substance, however, the forces exerted on the molecules are not in balance, there being an unbalanced force such that attraction will occur between the surface of the substance and that of another body close thereto. This attraction is generally termed "adhesion."

Since in accordance with the above theory the adhesion between two bodies is due to electric attraction, it should be possible to neutralise this attraction, and thereby reduce or cancel out adhesion, by suitably charging electrically one of the bodies. Experiment has shown that adhesion can be reduced or cancelled out in this way.



The suggested scheme for the employment of a combination of cathode-ray tube and prism as a light valve

Varying Reflective Power

The working principle of this suggested valve makes use of the above fact, namely, that adhesion between bodies may be controlled or varied electrically. For example, by providing a large number of minute bodies in combination with an optically prepared surface of another body, the positions of the former may be varied by varying the electrostatic state of charge and so the optical characteristics of the combination will be altered.

It is proposed to employ this phenomenon by causing it to vary the reflective power of a prism, the arrangement being as shown schematically by the drawing. A totally reflecting prism (a) occupies the large end of a cathode-ray tube, there not being, of course, the usual fluorescent screen. Light from a source b is projected via a suitable lens system c and the prism on to a viewing screen. The light, therefore, passes into the prism and is totally reflected from the reflecting surface a1 and then passes through a further lens system d to the screen. The totally reflecting face of the prism is optically polished and

(*Continued at foot of next page*)

* Patent No. 466,031.

Telegossip

By Lumen

Verbiage

MOST of us know the story of the doctor who advised his patient to include a proportion of carbonised carbohydrates in his diet, which on inquiry turned out to be common or garden toast. This peculiarity of the medical profession, which seeks to wrap up a simple description in a wealth of abstruse terms, seems to be infecting the television profession.

In a recent text-book we find the simple term " focusing " replaced by the word " fasciculating," which is certainly in the O.E.D., but is no better for having been brought out. The B.S.I. glossary does not use it, and I very much doubt whether any manufacturers would appreciate being asked for a " magnetically fasciculated tube." He would probably charge extra for it.

Another word in the same book is " Bildpunkt " for picture element. We are slowly absorbing the word " raster " since there seems to be no exact equivalent in English, but why go out of one's way to translate picture element into German? It would look much prettier in Latin as *puncius scenarum,* but wouldn't help the unfortunate beginner who is trying to master a new science. No, let us try and keep to the simple terms and leave the complication to the theory of the subject.

Communal Television

What has happened to those luxury flats which were being piped for television? Are the occupants looking in every night? Have they a set of sockets marked " Video," " Sync." and " Sound," or, as I strongly suspect, just a communal aerial and have to button their own sets on to it? Perhaps some luxury flat dweller will let me have his experiences. Talking of flats, I heard of a case the other day where a television set showed a violent snowstorm effect at intervals, in spite of the fact that there were no neons, cars or other objectionable things in the neighbourhood. Quite by accident it was found that the snow scene coincided with the movements of the person next door, who happened to be a bit heavy-footed, and on tracking down the trouble it was found that the water pipe, which served as an earth connection, crossed a bit of conduit under the boards. The ponderous tread of the neighbour had caused the pipe to make intermittent contact with the conduit, and since neither of them were doing their job efficiently all sorts of stray interference was getting back to the set. Moral: A sound connection to the water pipe is not always a sound connection to earth. Also, old conduits were not screwed as is the practice nowadays, and they weren't very particular with the bonding either, apparently.

Haywire

The radio experimenter who scorns neat layouts and soldered joints—(you know the type—a piece of plywood that has been used for four years, the condensers hanging on by one screw, and the bias battery hanging on its flex) will have been almost killed (literally) by television.

Fancy trying to wire up an H.T. circuit on a breadboard with odd bits of flex! And yet there are still some of them who pursue their way happily. One went into a dealer's the other day and said " I have the parts of an old ..... Four, and I have just got a second-hand short-wave kit. Can I use them to build a television set?" The dealer tactfully said it would be a difficult job, and inquired where the H.T. supply for the tube was coming from. " Oh," said the enthusiast, " I've got four old eliminators, and I thought I'd put them in series."

A Pioneer Society

I note with interest that the Television Society starts this month on its tenth session with the good wishes of all who know what an uphill fight the pioneers had in the early days. It was formed at the suggestion of Mr. Baird in 1927, and two of the original founders, Mr. Denton and Mr. Mitchell, are still in honorary office in the Society. Very wisely, the Council have dissociated themselves from any commercial organisation and have confined their activities to purely television matters. The enthusiasm of the members and the full attendance at the monthly meetings shows that the Society fills a definite place in present-day scientific activities.

The Society has a special appeal to the amateur worker in television as there is no other method by which he can hear the views of professional television engineers and discuss his own problems with them. Readers of this journal would do well to ask themselves if they are not missing an opportunity of furthering their knowledge of the subject by neglecting to apply for membership which is open to all interested in television. Particulars of membership are given elsewhere in this issue.

" A New Idea for Large-screen Pictures."

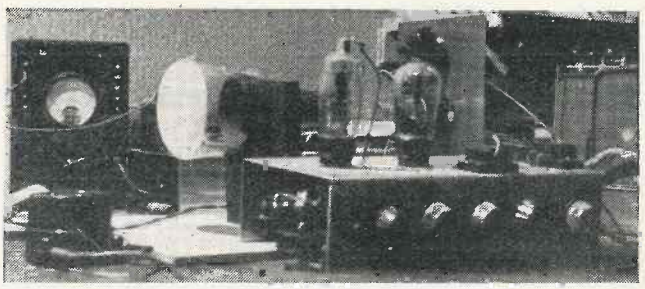
(*Continued from preceding page*)

upon this face are scattered extremely small particles, such as mica crystals, of a thickness not amounting to more than about 100 molecules. These particles are represented in the figure by the broken line.

Owing to adhesion effect, optical contact will normally take place between the crystals and the prism face, and with such optical contact existing the prism will cease to totally reflect by reason of the absorption effect of the particles. If, however, at any particular point on the face of the prism the small particles be so charged electrically as to cancel out or reduce the adhesion force, so that optical contact ceases to exist, the prism will be totally reflecting at that point.

For the purposes of obtaining television pictures it is proposed to scan the mica or other particles upon the totally reflecting face of the prism with a cathode beam so that the reflecting qualities of the prism at the individual elements of its operating face will be varied in accordance with the television signals. Other suggestions are made for the employment of the underlying principle, as, for example, the use of carbon particles and also a very thin mica sheet which can be caused to vary its contact with the prism face, and although so far as is known no practical development has as yet been made on the lines indicated, the idea is an ingenious suggestion for the development of a light relay or amplifier which would simplify the production of large-screen pictures.

Experiment has shown that excellent pictures are obtainable on small tubes with a resultant very great economy



in receiver cost. This article is a preliminary to a series describing the practical construction of a really cheap receiver.

HALVING RECEIVER COST!

THE POSSIBILITIES OF SMALL TUBES

By S. West

A LARGE proportion of the cost of a home-constructed television receiver is accounted for by the C.R. tube and the high voltage gear that its use entails.

Recently a small high-vacuum C.R. tube primarily intended for oscillograph work was introduced by Mullards. This tube, designated the A41-G4/B4, has a 4 in. diameter screen, employs electrostatic deflection and focusing and requires an anode voltage of 1,000-1,200 volts. Two types of screen are available, either blue or green. A special electrode assembly is employed that enables a non-symmetrical deflection circuit to be used with one set of deflector plates.

To amplify this last statement somewhat it may be said that it is customary to use a push-pull output to the deflector plates of an electrostatically operated C.R. tube in order that the voltages applied to these plates may be balanced in respect to earth. This is necessary, otherwise the picture suffers from trapezium distortion. This distortion would not be important if shape only were affected. Unfortunately, however, the entire picture area is distorted.

It occurred to the writer that it might be possible to use this tube as a television picture reproducer, as its characteristics appeared quite suitable.

A few preliminary calculations were first made to ascertain the size of picture that could be accommodated on the 4 in. screen.

The formula for finding the picture size is

$$H = \frac{D}{\sqrt{1 + r^2}} \quad \text{and} \quad W = \frac{D}{\sqrt{1 + \frac{1}{r^2}}}$$

where H = height of picture.
W = width of picture.
D = diameter of the tube screen.
r = ratio W/H = 5/4 = 1.25.

This is derived from the fact that the square on the hypotenuse, i.e., the diagonal of the picture and therefore the diameter of the tube, is equal to the sum of the squares on the two sides.

Converting to m/ms for convenience. The diameter 4 in. = 103 m/ms. approximately.

Thus a picture 80 by 64 m/ms. can be accommodated on the screen of the tube. We can permit the corners to roll over the edge of the tube a little and aim at a picture, say, 90 by 72 m/ms.

The deflection sensitivity of the tube is given as .39 mm/V. for one set of plates and .28 mm/V. for the other.

If we assume that the plates with the lower sensitivity are to be used for the large dimension of the picture we calculate the deflection voltages necessary when connected in this way, then regardless of the arrangement ultimately used, the deflecting voltages will prove adequate.

The long side of the picture is to be 90 m/ms. The voltage required to deflect the spot to this measurement is $\frac{90}{.28}$ volts, that is 320 volts approximately.

So far everything has been quite simple. We have not yet considered,

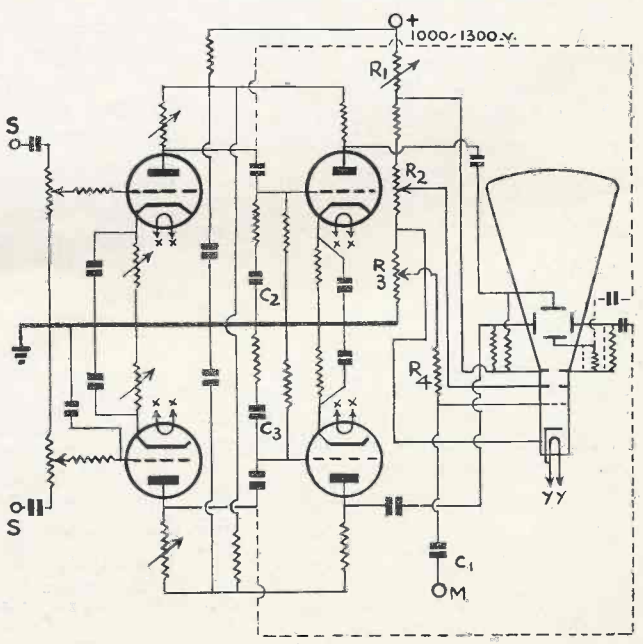


Fig. 1

The resistance R1 reduces volts applied to the second anode. It should be noted that any change to its value necessitates slight readjustment of the focus potentiometer R2. Symmetrical deflection is furnished when the X and Y plates are connected as shown by dotted lines. The values of C2 and C3 must then be accurately calculated.

EXCELLENT PICTURES ON A SMALL TUBE

however, the permissible size of the light spot with this small picture.

The picture vertically is composed of 405 lines, The light spot should therefore not exceed $\frac{72}{405}$ m/ms. diameter. That is, .18 m/m. diameter. Now it is not possible to reduce the light spot to this size with this type of tube. We can reduce it somewhat by increasing the anode voltage, but this is not desirable. It should be remarked that the above observations do not take into account that part of the picture relegated to purposes of providing synchronism. This eases the position somewhat.

At this juncture it was decided to make a rough test with a picture this size, utilising gear that was already connected. Accordingly the picture on the screen of a 10-in. tube was reduced to the dimensions that the small tube can accommodate.

In spite of the fact that the tube was not focused, definition was quite good. It would therefore seem, although this is a little difficult to explain, that for a small picture the spot diameter may exceed the thickness of a line.

It was therefore decided to conduct some tests with the small Mullard tube.

The receiver employed for these tests was that designed by the writer and described in the October issue. For those desirous of effecting a large economy and content with a small picture, the small tube offers an alternative that will give some excellent entertainment and some very valuable experience in the handling of C.R. tubes, as the circuits employed are in every way similar to those required with a large tube.

The time base circuit and tube network used for the tests are shown by Fig. 1. It will be seen that the same H.T. supply is used for the tube and time base, the reason for this being that a 1,300-volt power pack was already available. It is not necessarily the best arrangement. The resistance R3 controls brilliance and R2 focus.

The adjustment of this latter resistance is critical and some care was necessary in arriving at the optimum setting. The resistance R1 was fitted partly to reduce the H.T. applied to the second anode and also to observe the effect of increasing volts on this electrode above normal.

Existing 10,000-cycle and 50-cycle saw-tooth voltage generators were used to furnish sweep voltages. These were modified to provide an unbalanced output, i.e., two valves only in each were used, a relay and a triode amplifier.

Modulation was applied through the condenser C1, the grid of the tube being returned through the 1-megohm resistance R4. As the cathode end of the tube is earthy, it is obviously preferable to use a direct grid connection obtaining bias for the tube from a potentiometer across the vision receiver H.T. supply. See Fig. 2. The method used was, however, more convenient. It will be noted that no means for centring the picture are provided. For the initial tests this was not considered necessary and subsequently it was found that the picture was almost central in spite of this. No doubt in some cases a shift voltage will be required. It is a very simple matter to provide this.

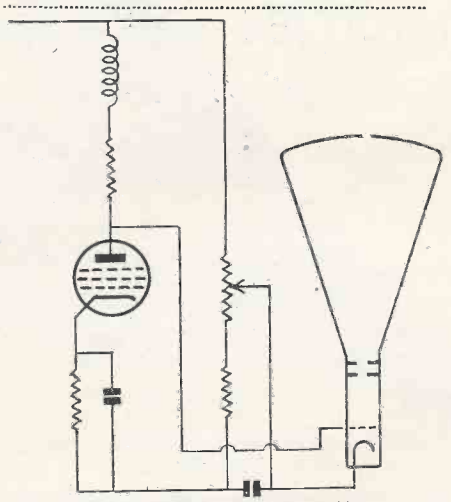


Fig. 2. Method of obtaining bias

This arrangement was then connected to the output of the vision receiver. With the brilliance and focus controls correctly adjusted a good picture was obtained.

It was observed that the picture tended to compress at the base, the top half of the picture being elongated. Several alterations were made to the slow speed base which effected improvement. It is considered that it may be desirable to use some form of symmetrical deflection to one set of plates. At the time of writing no such arrangement has been tried. It is desired to avoid this complication if possible. There was found to be an optimum arrangement of deflector plate connections to obtain the best proportions and shape for the picture.

The tube is very simple to use. The writer used a tube with a blue screen. This gives a pleasant picture. Due probably to the robust composition of the screen, the picture when viewed through the glass walls of the tube seemed very much brighter than when viewed in the usual way. (It is hoped to arrange for the production of tubes with a normal black and white screen.—Ed.)

An entire evening programme was enjoyed with the small tube. The small size of the picture and its unusual colour assume unimportance after the first few minutes viewing.

It is possible easily to read all captions, including those in the "News reels." The individuals comprising a group are quite clear and defined. In brief it can be said that the picture is an accurate miniature of the conventional large tube picture and it has very definite entertainment possibilities. The low cost of the tube and the gear associated with it places television within the reach of a vastly increased number of home constructors.

Will readers kindly note that the December issue will be published on the 1st of the month, Wednesday.

Television Lectures

A series of lectures on television is to be given on Tuesday evenings from 8 p.m. to 10 p.m., by Mr. H. J. Barton-Chapple, B.Sc., A.C.G.I., D.I.C., A.M.I.E.E., at the L.C.C. Norwood Technical Institute, Knight's Hill, West Norwood.

The syllabus is very comprehensive and includes the following: Historical development; reasons and methods for scanning; electron cameras; limitations; correcting devices employed; radiating the vision signal; types of modulation; ultra short waves; signal range; electrified layers in atmosphere; forms of light modulation and control; photo electricity; modern photo-electric cells and electron multipliers; co-axial cable distribution; cathode-ray tubes; time base generators; electrostatic and electromagnetic operation; synchronising; different types of complete television receivers, etc.

Scannings and Reflections

HOME CONSTRUCTION

TECHNICAL constructors are beginning to realise that they can make their own television receiver much more cheaply than was at first anticipated, if they are prepared to build some of the components. The mystery which surrounded the design of television components in the early days is now being slowly dispersed. Constructors are finding that I.F. and H.F. coils can be very easily made and at very low cost, and, as some seven or eight coils are generally required in every receiver, the home-constructed coil represents a very big saving.

Careful buyers can also obtain components at very reasonable prices by asking for radio components rather than television components, which appear automatically to be priced higher.

BRITISH LEAD IN TELEVISION

One of the clearest indications that Britain leads in the design of television transmitters and receivers is shown by the number of visitors that have come from foreign countries to gain first-hand knowledge of our developments. Not only are we ahead technically and theoretically, but we have put our knowledge to every practical advantage. Visitors from most European States, America, Australia, South Africa, and even Persia, have come along and been most agreeably surprised at the progress made in the last year or so. Perhaps some of these foreign countries have been wise in letting us do all the spade-work for they can now go ahead with their own installations without having to worry very much about experimenting with transmitters and receivers. British design will apparently be used in most parts of the world.

FIVE-BAND ALL-WAVE RECEIVERS

The introduction this year of a number of all-wave receivers covering the 7-metre sound channel has helped the sale of television receivers more than was at first expected. Many listeners in the television service area who have been hearing the accompanying sound transmission sent out from Alexandra Palace have had their curiosity aroused to such an extent that they have purchased a television receiver in order to see all that is going on. When all sets cover 7 metres so that listeners can get some idea of the television programmes then a further increase in sales of television sets can be expected.

Modern all-wave receivers with higher efficiency and effective automatic volume control have to a great extent made reception of short-wave signals more certain, but so much more could be done if our Colonial and foreign transmitting friends could realise just how important it is to use multi-wavelength transmitters. Probably the Americans do more in this line than any others, with perhaps the B.B.C. as a very good second. For this reason alone British listeners tune in to American short-wave stations most of all.

W1OXDA

Those who like hearing unusual transmissions should make a point of endeavouring to pick up station W1oXDA, which is the call sign of the schooner *Morrissey,* which is now coasting off Labrador. This schooner is actually on a scientific expedition but has on board a very powerful 20-metre short-wave transmitter with which it keeps in contact with American and other stations. Those who have a good all-wave receiver will be able to hear this vessel most evenings after about 9 p.m.

TELEVISION MAKE-UP

Owing mainly to the efforts of the make-up expert, Mary Allan, at the Alexandra Palace, artists are finding that the make-up required when facing the television camera is, if anything, less than that required in the film studio. Those who have seen the two television announcers, Elizabeth Cowell and Jasmine Bligh, have remarked on the fact that their studio make-up is very slight and would pass unnoticed out of doors. Some notable people who have been televised have declined to be made up with, apparently, very little loss.

LINKING SOUND AND VISION PROGRAMMES

It is interesting to note that the B.B.C. are toying with the idea of relaying, for the benefit of those having vision receivers, the Saturday night variety from St. George's Hall. There are a number of technical difficulties, but first of all, the co-axial cable which now links B.H. with the Alexandra Palace has to be moved to St. George's Hall.

There is also the problem of fixing the Emitron camera on the stage at St. George's Hall in such a way that it will not affect the view of the audience. However, it is hoped that these difficulties will be overcome and that by the middle of December television programmes will include the excellent variety now restricted to the use of medium wave listeners.

This is but the beginning of a general improvement in television programmes for there is no reason why some more of the better sound transmissions cannot be televised. This will save the B.B.C. money, for if they can make one programme serve for both sound and vision, then so much the better.

A RELAY FROM ELSTREE

Those who saw the relays from the Pinewood Film Studios must have realised that this was but an introduction to outside broadcasting. The Pinewood relay was one of the most successful ever carried out via the television van, and it is hoped that the new relays from Elstree, which are scheduled for November 23 to the 26 inclusive, will be equally as popular amongst viewers. Associated British Pictures control the Elstree studios, and it is hoped that Charles Laughton will be televised, for he will be on the "set" during the period when the relays will take place.

MORE SCANNINGS . . . . . .

A NOEL COWARD PLAY FOR TELEVISION

Mr. Noel Coward has cabled from America permission for the televising of his play "Red Peppers." Those who were fortunate enough to see "To-night At 8.30," will remember that "Red Peppers" was one of the famous one-act series featured in it. It is being broadcast on November 1 and 5, and is being produced by Reginald Smith. The part of George Pepper is to be taken by Richard Murdoch, and Marjorie Sandford will be Lily Pepper. This will be the first Noel Coward play to be televised.

RELAYS TO THE NORTH POLE

The Russian expedition to the North Pole appears to be well looked after. They have been in contact with amateur transmitting stations in various parts of the world, including two from Britain, and are in communication with Moscow, so that messages from relatives are sent every day. At the end of September a special relay of music was sent from Paris via Moscow to the North Pole, and reports just received indicate that 100 per cent. reception was obtained. There does not seem to be any limit to the tie-ups that can be made on short-waves, and in fact, the difficulty seems to be of finding new out-of-the-way spots that have not so far been brought into prominence by means of short-wave broadcasting

RECEPTION ON 10 METRES

Those who have a modern all-wave receiver that covers the 10-metre band should make a point of listening occasionally on this channel during the afternoons. Although, generally speaking, there are about 20 hours a day when the 10-metre band is almost devoid of signals, the odd four hours are well worth finding. After lunch most days, particularly when the weather is good, signals can be picked up from all over the world at unbelievable strength. There is also a curious mixture of stations, such as American, British, European, Australian, and even Siamese, which have been heard in the space of one hour.

TRANSMITTERS FOR EMERGENCY USE

In America they make every use of miniature 5-metre transmitters for relaying Press messages on race tracks, and even on police cars. In this country the 5-metre and ultra-short wave bands generally are ignored by commercial bodies, but this apparently is due not to lack of imagination but to the failure of the various people concerned to obtain the transmitting permit from the G.P.O. One of the leading London boroughs has been endeavouring to obtain permission for the fitting of a 5-metre transmitter and receiver to a fire-engine, the idea in mind being to keep in touch with the fire station when a telephone is not handy. So far their endeavours have been fruitless, for they have completely failed to obtain the necessary licence.

AMERICAN BIG-SCREEN TELEVISION

A new type of television receiver has been developed in the Kolorama laboratories at Irvington, New Jersey. The tests have been most successful with a screen 4 ft. by 5 ft. in size, with fair definition. This apparently is the first public demonstration of big-screen television in America, but from reports it does not appear to have reached the standard of results given by British receivers of a similar type. The American picture is shown on a glass screen, and the cathode-ray tube has been completely eliminated.

THE LORD MAYOR'S SHOW

On November 9 is to be televised the Lord Mayor's Show, and it is felt that this relay will be quite as successful as the televising of the Coronation. Three cameras are to be in use in Trafalgar Square, so that a comprehensive view of the procession will be obtained as it moves down the Strand and turns into Northumberland Avenue. Two cameras will be used for long shots, while a third is being erected in a position to obtain excellent close-ups.

ARMISTICE DAY

An interesting problem has arisen over the televising of the Cenotaph Service on November 11. Again three cameras are to be used, of which two are to be at first-floor level on Richmond Terrace. The third is to be used for a long-shot down Whitehall, and including Big Ben. It is hoped that precisely at 11 o'clock the face of Big Ben will be televised, but this rather depends on weather conditions. If the weather is dull, then everything will be satisfactory, but if the sun should be shining, it so happens that on November 11 it will be directly over Big Ben at 11 a.m. and will be shining in the lens of the camera, so making transmission impossible. The televising of the Cenotaph service will be rather a big thing, for it will include long-shots of the King, and of everything that happens during the morning.

Alteration of Publishing Date

Commencing next month the publishing date of Television and Short-Wave World will be the 1st of each month.

VALVES FOR AMATEURS

During the past few months more than the usual quota of American valves suitable for amateurs have been imported into this country.

This, fortunately, seems to be a blessing in disguise, for no less than four British valve-makers have decided to produce valves suitable for amateurs, both as regards characteristics and price, and to do so without delay. It appears that the small market always quoted by our prominent valve-makers is not quite so small as it was made out to be. Hence the sudden interest in amateur activities.

A NEW PROGRAMME FROM ALEXANDRA PALACE

Those who saw the "Mizzen Cross Trees" series of presentations by Stephen Thomas, will be glad to know that a similar series is scheduled for November 1 and 5, entitled "Powder and Pipe Clay." It will be remembered that "Mizzen Cross Trees" dealt with early sea shanties. "Powder and Pipe Clay" is a presentation of soldiers' songs since the days of Agincourt. The earliest song to be dramatised is the Agincourt song, written in 1415.

The Tipperary of Cromwell's day, Lillibullero, also Polly Oliver, and several other songs of a similar type, will be re-lived. This programme will call for very quick changes, for soldiers are to be shown in period costumes, while for one section there will be a number of French women soldiers, or vivandières, of the Post-Revolution era. Irene Prador is to be featured in this programme.

AND MORE REFLECTIONS

TELEVISING SPORTS EVENTS

There is a considerable amount of apprehension in certain quarters over the success of the special football game televised from Highbury. This experiment was most successful, for in spite of the smallness of the screen it was possible to identify each player. Sports promoters feel that this may have the effect of reducing attendances at London matches, so very shortly a decision is to be taken as to whether television and football games are to " get together."

INTERFERENCE TO RADIO

Not so very long ago a committee was set up to investigate the problem of interference to broadcasting. Certain suggestions were put forward and it seemed at the time as if interference to radio would eventually be overcome. To date, however, nothing very much has happened, despite the fact that interference is now much more of a problem than it was a year ago, owing to the more general use of all-wave receivers. Those who are operating television receivers also find a considerable amount of local interference which sometimes spoils synchronising and the picture. It is about time that legislation made it possible for the Post Office to eliminate the interference after once it has been located. At the present moment, although their efficient detector vans are more than capable of finding local interference, they have no power to stop it even when it has been found.

Probably if the B.B.C. television outside broadcasts are ruined a little more often by preventable interference, then something may be done.

JOURNEY'S END

A very fitting transmission for November 11 is *Journey's End*, the famous war play by R. C. Sherriff, which is to be televised during the evening performance for a period of one hour. The production will be handled by George More O'Ferrall, and it is hoped to reproduce the atmosphere of the trenches by the use of film sequencies in addition to sound and other effects.

BIG-SCREEN TELEVISION IN CINEMAS

The new Odeon Alhambra, in Leicester Square, is to have a big-screen television installation. This is quite an innovation, and if satisfactory, every Odeon cinema within the television service area will be so fitted. Just how this television is going to be used has not been made quite clear, but it is supposed that important events, such as the Boat Race, will be televised direct to cinema patrons.

GERMAN TELEVISION

Work on two new mountain-top television transmitters in Germany is still progressing. They will probably be finished by the end of this year, although at the moment the scaffolding has not been removed from the higher parts of the Brocken tower. It will be very interesting to find out just how far transmissions from Brocken tower can be received.

AMERICAN POLICE AND TELEVISION

The American police method of lining up suspected criminals before a whole crowd of interested persons for identification purposes is well-known by means of the many films that have been made of this particular feature. This system is to be extended, and a recent demonstration at the N.B.C. Headquarters at Radio City has proved that the line-up of criminals and suspects could be televised to a large number of police stations in a given area. This would increase the possibility of suspects being identified owing to the large number of people who could watch the parade simultaneously.

The Television Society.

10th Session, 1937-38

THE following lectures are announced by the Society for the opening of the Tenth Session:

Wednesday, November 10, at 7.30 p.m.—" Television Images—An Analysis of their Characteristics," by L. C. Jesty, Esq. (Assoc. Mem.), and G. T. Winch, Esq., of the G.E.C. Laboratories.

Wednesday, December 15, at 7.30 p.m.—Demonstration of the " Murphy " Television Receiver, by K. S. Davies, Esq. (Fellow).

All the above meetings will be held in the Physics Lecture Theatre, University College, Gower Street, London, W.C.1.

Tickets of invitation are available to non-members on application to the Lecture Secretary, G. Parr, Esq., 68 Compton Road, N.21, and full particulars of membership can be obtained from him, or from the General Secretary, J. J. Denton, Esq., 25 Lisburne Road, N.W.3.

Miss Patience, the "dream girl" of the National Broadcasting Company's television technicians, has become a reality. She is a beauty created exactly to specification for the Iconoscope camera; strong enough and patient enough to withstand the rigors of the long experimental periods.

MULTIPLIER PHOTO-CELLS

A DESCRIPTION OF TWO NEW TYPES THAT ARE COMMERCIALLY AVAILABLE

Baird Multiplier photo-cell type ML.

SECONDARY-EMISSION photo-cells are now a commercial article. Baird Television, Ltd., produce two types employing the Weiss principle of secondary emission which are specially suitable for the amplification of weak signals with a wide frequency band without distortion. The advantages of this type of cell are a very high gain without the disadvantages of valve amplifier stages such as the Schott effect, instability and microphony.

The multiplier photo-cell combines the principles of secondary and photo-electric emission. If an electron strikes a metal surface at a sufficiently high velocity, the impact may cause secondary electrons to leave the surface. The ratio of secondary electrons to primary depends upon the nature of the surface and the velocity of the primary electrons and with suitable conditions factors of 8 to 10 are obtainable. Secondary emission starts when the velocity of the primary electrons is approximately 10 volts and rises to a maximum between 250 and 500 volts.

As the mechanism of secondary emission is similar to primary photo-electric emission, and not akin to amplification by ionisation, which introduces a time factor into amplification, the output of the multiplier follows the modulation of the primary emission without time lag even at the high frequencies required for television. The only attenuation is that due to the very small inter-electrode capacity of the electrodes.

Baird multiplier photo-cells are at present available in two main types: Type MS has a small cathode of 15 sq. cms. for use with a concentrated light beam, while type ML has a large cathode of 250 sq. cms. for diffused light operation. Other cells can also be supplied to suit individual requirements.

How the Cell Functions

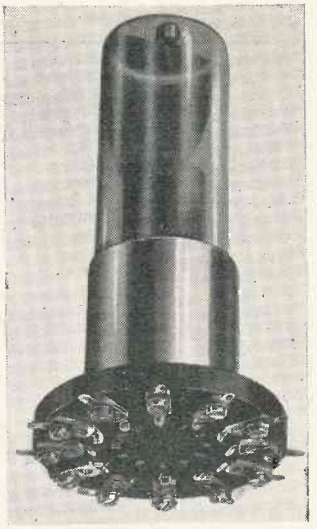
The Baird Multiplier photo-cell has a chain of secondary amplifying stages, and the electron current passes in sequence down the chain, being amplified at each stage. The stages consist of grids, the surfaces of which are specially prepared and treated to have a high secondary factor. The primary electrons incident upon the first grid liberate secondaries at low velocity which are attracted by a positive potential through the meshes to the second grid. This they strike with sufficient velocity to liberate further secondaries, which are in turn attracted onward down the chain.

The grids are parallel circular discs inside a metal screen with an aperture to allow the electrons from the photo-electric cathode to reach the first grid.

A secondary emitting plate is provided at the end of the multiplier, and the electrons from the last multiplying grid impinge on this. As mentioned earlier, a secondary factor of 8 can be obtained by a solid surface and hence a large multiplication takes place in the last stage. The electrons liberated from the plate are collected by an unsensitised open mesh grid and pass into the output circuit of the multiplier.

Technical Data

The photo-electric cathode has a primary sensitivity of about 30 micro-amperes per lumen and as it has the usual spectral sensitivity for caesium the cells may therefore be used for infra-red detection and the amplification of infra-red signals. For special requirements rubidium cells can also be supplied.



Type MS Multiplier photo-cell for use with concentrated light beam.

Multiplication

The overall multiplication obtainable with these cells is, of course, dependent upon the number of stages and the voltages supplied to each stage. Satisfactory results have been obtained, using an overall voltage of 1,000 to 1,500 in the 9-stage multiplier, which corresponds to 100 to 150 volts only between successive stages. Under these conditions, an overall multiplication of 10,000 to 20,000 can be obtained, but using higher voltages and/or more stages any factor of multiplication can be obtained. The limit to the useful number of stages used and voltages applied is governed by the output current, which should not exceed 1 milliampere to ensure stable operation. The amplification factor per stage is dependent upon the voltages applied to the grids and is variable up to 4. The ratio of signal to unwanted background noise is of the order of 200 times that given by a thermionic valve amplifier of equivalent gain.

The electrical connections to supply the potentials to the multiplier grids can be made from a potentiometer supplied with direct current from a rectifier or batteries, and the output circuit connections will depend upon particular requirements. These cells have an extremely long life.

SCOPHONY, LTD.

The telephone number of Scophony, Ltd., of Thornwood Lodge, Campden Hill, London, W.8, has now been changed to Park 9494.

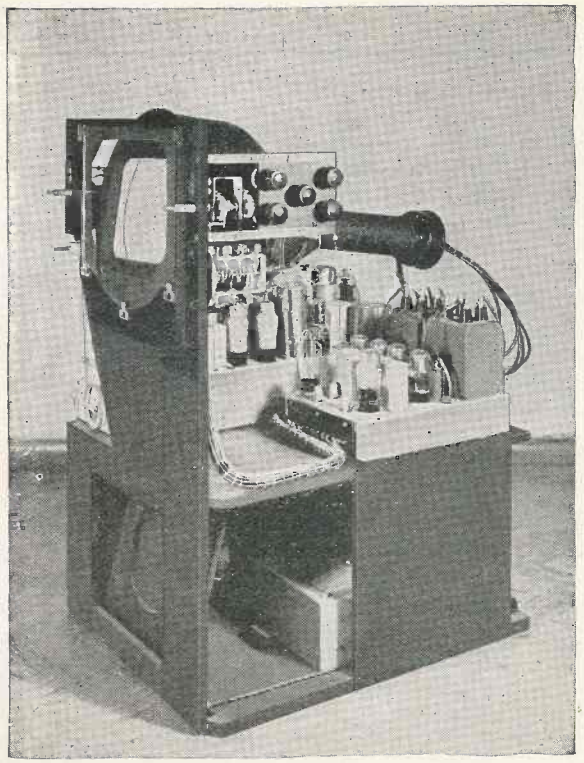
THE TELEVISION ENGINEER

THE DESIGN OF THE G.E.C. TELEVISION RECEIVER

(MODEL BT 3701)

By D. C. ESPLEY, M.Eng., A.M.I.E.E., and G. W. EDWARDS, B.Sc., D.I.C.
Research Laboratories of The General Electric Co., Ltd.

This article gives data of the design of the G.E.C. Model BT3701 television receiver and includes the circuit arrangements of the several units employed.



The chassis of the G.E.C. television receiver showing the sound and vision receiver beneath the cathode-ray tube and the time base on the right.

THE receiver channel itself is of the superheterodyne type for both the vision and sound signals according to the G.E.C. system in which a single local oscillator provides the heterodyning frequency for the two carriers. It is thus possible by tuning to the sound signal, as in a normal radio receiver, to obtain simultaneous correct tuning adjustment for both channels.

The local oscillator frequency is located between the incoming carriers at 41.95 mc. giving sound and vision intermediate frequencies of 0.45 mc. and 3.05 mc. respectively

The general arrangement of the receiver is shown in Fig. 1. Sound and vision signals, received on a common aerial, are first amplified by a single radio frequency stage and fed to a frequency changer, both of which provide common amplification for the two signals. The sound and vision modulated I.F. carriers are separated in the frequency changer anode circuit and fed to their respective I.F. amplifier channels. Following I.F. amplification the sound channel is largely of conventional design. The vision signal after rectification is fed to a single stage picture frequency amplifier supplying the necessary modulation voltage for the cathode-ray tube. A separator stage feeds synchronising impulses to two time bases providing the scanning voltages for the cathode-ray tube.

Operating voltages for all parts of the receiver are obtained from a power supply unit.

For the purpose of description, the receiver can conveniently be divided into three parts:

Receiver unit—sound and vision channels.
Time base unit.
Power supply unit.

Vision Channel

The vision channel consists of an R.F. amplifying stage followed by a frequency changer, five I.F. stages, signal rectifier and picture frequency output amplifier with synchronising signal separator.

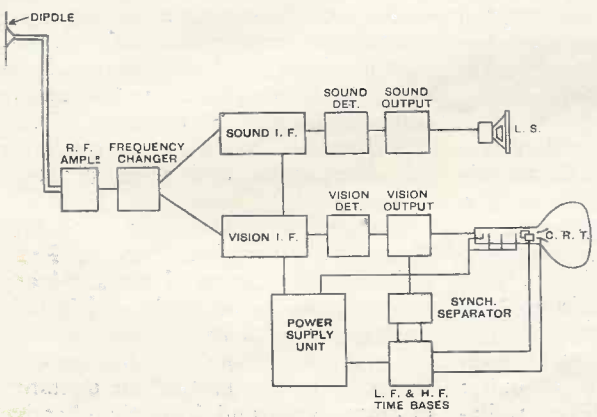


Fig. 1.—Schematic diagram of receiver circuit.

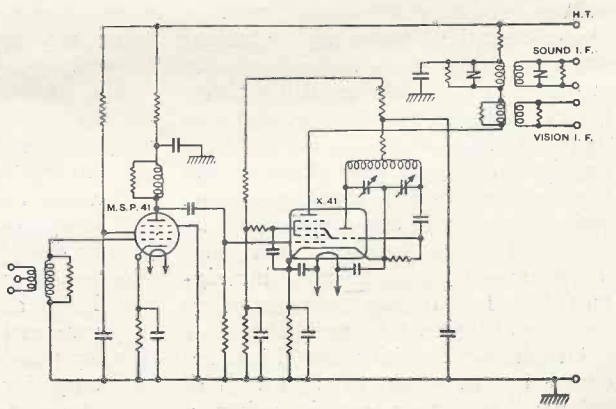


Fig. 2.—R.F. Amplifier and frequency changer.

R.F. AMPLIFIER AND FILTER UNIT

It will be considered under the following sections:—

Aerial and input circuit.
R.F. stage and frequency changer.
I.F. amplifier stages.
Rectifier and picture frequency amplifier.
Synchronising signal separator.

The concentric feeder from the dipole aerial is terminated at the receiver end in a step-up transformer to match it to the input circuit of the first valve. This transformer also serves the purpose of reducing the effect of any direct pickup on the feeder.

Since the aerial is used to receive both sound and vision signals, the secondary is tuned to 44 mc. by the grid-earth capacity of the R.F. amplifier valve (pentode, MSP41) and damped by a terminating resistance to cover the necessary band width of both the sound and vision channels.

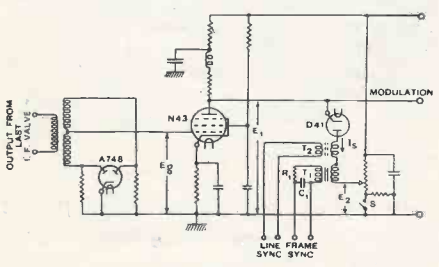


Fig. 3.—Signal rectifier and output circuits.

R.F. Amplifier (MSP 41) and Frequency Changer (X41)

The conversion of both sound and vision incoming carriers to frequencies suitable for I.F. amplification is obtained by the use of a single local oscillator situated between the two carriers.

The triode portion of an X41 (triode-hexode) frequency changer provides the local oscillator frequency of about 42 mc. The resulting difference frequencies of 0.45 mc. and 3.05 mc. in the anode circuit of the hexode, produced respectively from the 41.5 mc. sound and the 45 mc. vision carriers, are separated by means of filters tuned to these mid-band frequencies. The resulting signals are fed to the corresponding sound and vision I.F. amplifiers.

Oscillating stability has been secured by the use of a low loss balanced oscillator circuit using a high Q coil and a series gap low contact resistance condenser of rigid construction.

Oscillator Voltage and Tuning Range Constancy

The circuit shown by Fig. 2 gives a maximum oscillator voltage of 10 volts and a conversion conductance of 570 microhms at 42 mc. A tuning range of 35 mc. to 55 mc. is obtained.

Radiation

Interference between adjacent receivers is in general much more serious on vision than on sound due to the wider frequency band transmitted, and to its effect on synchronism as well as picture definition.

It is normally caused by difference frequencies produced between the local oscillator and the unwanted neighbouring radiation, or between the incoming signal and the neighbouring radiation, appearing with the required I.F. signal within the transmission range of the I.F. filters.

The former is the more serious, since, when present, its amplitude is far greater than any other type.

After the signal rectifier the beat between these two frequencies appears as an irregular striation, over the area of the picture, of frequency dependent on the frequency of the interfering signal.

By the disposition of the local oscillator frequencies in the G.E.C. receivers, the most serious form of interference (i.e., the appearance of the interfering local oscillator as the image of the transmitter signal) is eliminated.

It is, however, considered necessary to reduce the radiation to such a level that no appreciable interference could be produced, even in an aerial situated some few yards away and using any possible intermediate frequency.

This result is obtained:—

(*i*) by the use of a complete high conduction screen within the normal chassis which is at this point also arranged to form a complete second screen.

(*ii*) by the provision of complete decoupling for all leads carrying R.F. at their exit from both screened compartments.

(*iii*) by provision of a high frequency amplifier, acting as a buffer stage, to prevent direct radiation from the X41 grid circuit.

By these means an overall attenuation of radiation of about 50 Db. is obtained.

In addition to its use in reducing radiation, the MSP41 amplifying stage also serves the purpose of preventing direct pick-up at vision intermediate frequencies. This is important, since the pass range of the I.F. channel includes part of the medium-wave broadcast band.

The R.F. stage provides a certain amount of gain for both sound and vision channels at a signal level sufficiently low to give negligible cross modulation.

Vision I.F. Amplifier Stages

Since the majority of the amplification of the vision channel is obtained at intermediate frequency, the design of the I.F. filters largely determines the picture quality, and the band width is included in the channel specification.

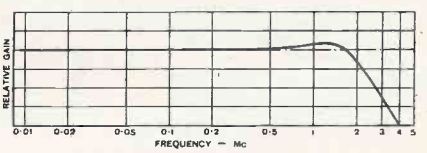


Fig. 4.—Picture frequency amplifier characteristic.

Design of Filter Unit

The design of a filter to cover a band width of 3.5 ms. with arithmetic mid-band frequency of only 3 mc., at first appears to present difficulties in application of normal band filter design data, due to the variation of effective values of the filter elements over wide frequency ranges.

It has been found in practice, however, that available data can in principle be applied to filters of this type, provided allowance is made for the distribution and effect of stray capacities.

The gain obtainable per stage with high impedance valves (e.g., MSP41), working with the relatively low loads necessitated by large band width is accurately given by

$$gZ_a$$

where g is the mutual conductance in amps./volt, and Z_a is the effective anode load vector.

SYNCHRONISING SIGNAL SEPARATOR

Signal Rectifier

Rectification of the L.F. signal is obtained by means of a double diode A748. Owing to the low filter terminating resistance necessitated by the broad band width, it is difficult to obtain linear rectification at low signal levels.

By the use of the A748, which is of especially low impedance, it is possible to reduce the initial curvature to a negligible value.

The output from the two rectifier valves is balanced, resulting in maximum rectification efficiency and removal of the carrier frequency component from the picture signal. The second harmonic (6 mc.) is well outside the required picture frequency band, and is entirely removed in the following picture frequency amplifying circuits.

Picture Frequency Amplifier

The output picture frequency voltage from the diode rectifier is insufficient to modulate the cathode-ray tube directly, and in the circuit shown would give a signal opposite in sign to that required, i.e., a negative picture.

An amplifier to supply the necessary modulator voltage has to meet the following requirements:—

(a) An output voltage of approximately 30 volts for picture signal, and 20 volts maximum for the synchronising signal (240 line system).

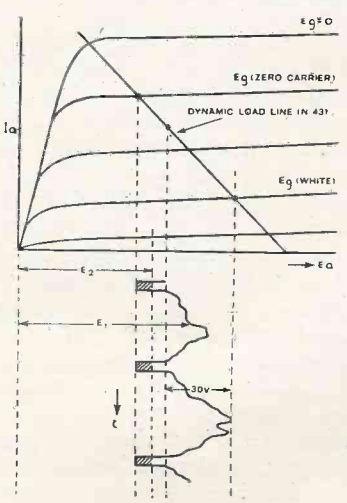
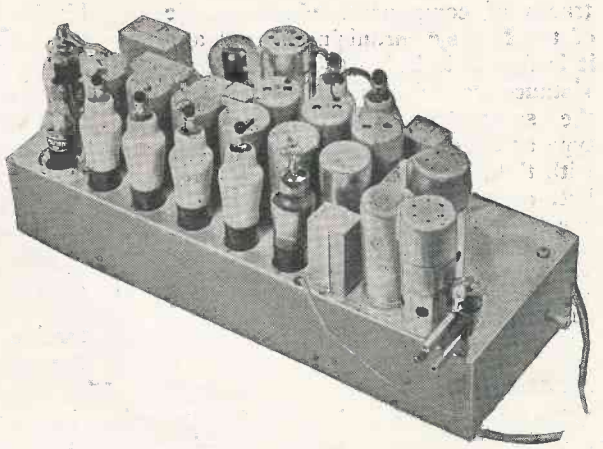


Fig. 5.—Operation of impulse starter.



The sound and vision chassis of the G.E.C. receiver showing aerial connection at the front and single tuning adjustment in the right foreground.

(b) A frequency and phase characteristic approximately linear up to 2 mc.

(c) Maintenance of the mean brightness level of the picture necessitating correct amplification at zero frequency.

(d) A small input capacity to avoid high-frequency loss on the input circuit.

Conditions a, b and d are met by the use of an N.43 high slope high frequency pentode, with compensated anode load (see Fig. 3). The resulting high frequency characteristic is shown in Fig. 4, and is arranged to be similar in high frequency loss to that produced in a single I.F. filter section.

The further requirement c has been met by the use of a D.C. amplifier circuit following the signal rectifier.

The cathode of the rectifier is therefore directly earthed and the output rectified voltage from the diode taken directly through a D.C. connection to the N.43 picture frequency amplifier grid (Fig. 3) so that the correct signal with its mean brightness is produced at this point.

The Synchronising Signal Separator

The synchronising signals appear as part of the combined signal available in the output circuit of the N.43 picture frequency amplifier. The voltage to be applied to the cathode-ray tube must contain these signals as they provide "blacker than black" suppression of the beam current during the flyback period. On the other hand, the time base control circuits must not have a voltage applied to them which is in any way characteristic of picture modulation. The synchronising signals must therefore be separated from the combined signal by a combination of amplitude and frequency discrimination.

Means are provided so that when the combined output voltage is below a certain critical level, a current is passed through a unilateral device, such as a diode, to apply an input to two different frequency selective circuits associated with their appropriate time bases. The arrangement is shown in Fig. 3. The operation of the circuit can be explained with reference to Fig. 5. The anode current of the N43 which corresponds to zero carrier is fixed, and the change of grid voltage E_g can only increase the value of anode voltage. The total output voltage is E_1 and it will be seen that if a bias voltage E_2 is provided in the anode circuit of the diode, then adjustment can be made so that current can only flow when E_1 is less than E_2 (i.e., for periods shown shaded in Fig. 5). As signals according to the two transmissions have different values of percentage synchronisation, it is found advisable to adjust E_2 to optimum by providing a switch S to be operated by the main receiver change-over switch.

Substantially rectangular current pulses pass through a network including the primary windings of two transformers T_1 and T_2. These transformers act as highly selective transmission circuits to supply specially shaped impulses, of the appropriate frequency range, to their associated time bases. The impulses are of such a form that the time bases are triggered in an extremely stable manner.

The low frequency transformer alone is not sufficient to remove all

THE DOUBLE TIME BASE

traces of components characteristic of the line synchronising signal and it is found desirable to include a resistance capacity network R_1C_1 in the secondary circuit. A similar type of circuit is used in conjunction with the high-frequency transformer, but, of course, with a smaller time constant, to reduce the possibility of high-frequency noise and picture components reaching the gasfilled relay.

The Time Base Unit

The time base unit provides the required frame and line scanning voltages for deflecting the electron beam over the screen of the cathode-ray tube. The electrostatic deflection type of cathode-ray tube had reached an advanced stage of development by the time the receiver was planned, and the choice of this type enabled the following specification to be drawn up for the double time bases:

(a) Peak to peak voltage of 800 volts between either the front or back deflecting plates to give a picture scan of 8 in. in the vertical direction or 10 in. in the horizontal direction.

(b) The scan distortion expressed in terms of change of spot velocity in either direction must not exceed 5 per cent.

(c) At any instant of time the mean voltage difference between either pair of deflecting plates and the final accelerator should be small.

(d) The flyback time of each time base must not exceed a limit set by the length of the picture black margin associated with each direction of scanning.

(e) When the picture is transmitted by the interlaced system, it is necessary that the frame and line timing circuits should be free from "crossfire" and dependent only on the incoming synchronising signals in order to maintain accurate interlacing.

(f) Means have to be employed in order to locate the picture information central with respect to the cathode-ray tube mask.

Fig. 6 shows the circuit of double time bases which meet all the above requirements. For reasons which follow later, it will be seen that the actual timing circuit is not coupled directly to the output.

The approximate sawtooth voltage generated by the timing circuit must be shaped and amplified considerably before application to the deflecting system of the cathode-ray tube. The amplifier comprises two MH4 valves in cascade, and its design must be such that the linearity of scan is well within the prescribed limits. As the voltage swings of both anodes are large, there is appreciable non-linearity of the output voltage of the stages taken separately. Condition (b) is much more important than condition (c), and the circuit is proportioned so that the voltage difference between the two anodes shows a linear rate of change, although it will be found that with this adjustment the second valve provides an appreciably greater voltage output than the first.

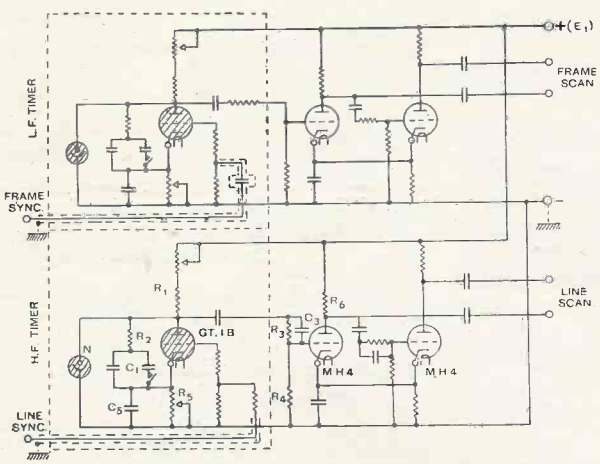
The deflecting plates of the cathode-ray tube have been designed to work effectively even with this departure from symmetry of the sawtooth voltage.

As the two time bases are similar in many respects the detailed description will be confined mainly to the high frequency case.

The timing circuit is shown within the dotted lines on the diagram, and it is here that the controlling sawtooth voltage waveform is produced by a relaxation oscillator employing a specially developed gasfilled relay now designated Osram G.T.I.B.

Although the required anode dissipation is quite low, the peak current to be handled is in some cases as high as 0.5 amp. if the flyback time is to be short enough. It is this peak current which partially dictates the form of the electrode system, and in the G.T.1.B. the distribution of ionisation is definitely controlled so that the effects of glass wall charges and random ionisation are avoided. The discharge always takes place along a definite path, and it is this feature which enables an exceedingly steady trigger action to be obtained. One consequence of using amplification after the oscillator is that the conditions within the relay are rendered less severe, and an excellent life is realised. An advantage of this type of timing circuit is that the relay is very sensitive to synchronising signals, making it possible to use a simple form of synchronising separator circuit.

It will be seen from Fig. 6 that the whole of the time base circuit is operated from a common H.T. supply



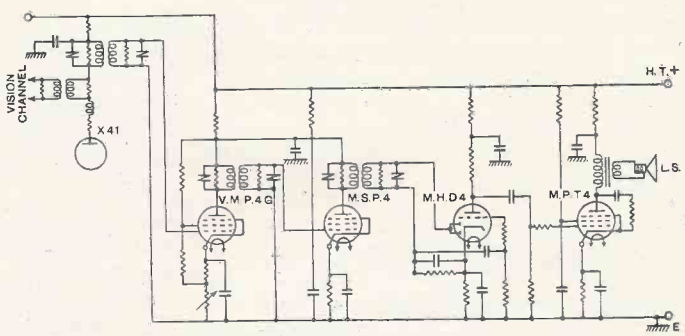


Fig. 6 (left).—Double time base circuit.
Fig. 7 (right).—Sound channel circuit.

POWER SUPPLY UNITS

which is actually one-half of the output of the voltage doubling rectifier circuit associated with the cathode-ray tube. The series charging circuit R_1C_1 is connected to the supply of about 1,100 volts. Condenser C_1 charges at an almost constant rate until a limit voltage is reached: at this point there is a rapid discharge through the gasfilled relay.

The two amplifier valves can be arranged to compensate each other

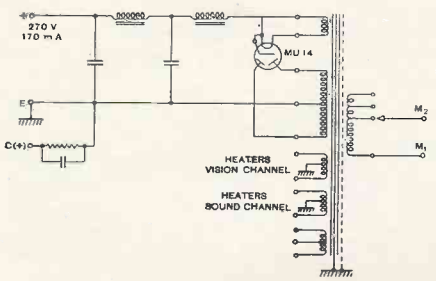


Fig. 8.—Power supply unit—anode and heater voltages.

for non-linearity, but by slight modification of this condition the small distortion can be included in this compensation to give an overall result of substantially linear rate of change of voltage between the deflector plates. If a voltage difference between plates of 800 volts is required to deflect the scanning spot across a picture side, the effect of unbalance of the two anode voltages can be reduced to a negligible amount by suitable design of deflecting plates.

Non-linearity introduces an apparent shift of the picture. A non-linear flyback has the same effect, but as there is less control over the shape of this part of the wave, it is preferable to avoid the disturbance by reducing the flyback time to a value consistent with good synchronisation.

It will be seen from Fig. 6 that the discharge of condenser C_1 is limited by a resistance R_2 in order to restrict the peak current conditions in the gasfilled relay.

Although the voltage across the relay can have a suitable waveform, it does not follow that the amplifier has an appropriate phase and frequency characteristic to give the required output, unless special means are employed. The earth capacity of the output leads and deflector plates appears in parallel with the anode loads and, in the case of the H.F. time base, has a large influence on flyback time.

The H.F. scan gives a flyback time of about 12 per cent. at 10,125 cycles per second, and 8 per cent. at 6,000 cycles per second. Both these values are covered by the transmitted H.F. black-out period, and are therefore satisfactory.

The flyback time for the L.F. scan is relatively very much faster, being about 1 per cent. of the scan time for both 25 and 50 cycles per second.

As the H.T. rectifier supplying the time bases is of the directly heated type, it is necessary to protect the discharge condensers and gasfilled relays from over-voltage during the heating-up period. For this purpose small indicator type neon lamps are connected from the anodes to earth to limit the peak voltage to about 180 volts.

Sound Channel

The circuit of the sound channel is shown in Fig. 7. The secondary of the separating filter in the anode circuit of the X41 frequency changer feeds the resulting 0.45 mc. carrier and side-bands to two I.F. amplifier stages.

The first valve has variable-mu characteristics, and is used to provide control of the output sound volume. The second stage is a straight I.F. amplifier of fixed gain. The second I.F. stage is followed by a normal double diode triode as detector and first low frequency amplifier.

Power Supplies

It was found most economical to provide high voltage supplies from two rectifier circuits using three rectifier valves, viz.: A single full wave, indirectly heated, M.U.14 rectifier to supply the combined sound and vision channel anode and screen currents; and a voltage doubler circuit using two U.17's to supply the time base voltage and the main cathode-ray tube voltages. The circuits of these are shown by Figs. 8 and 9.

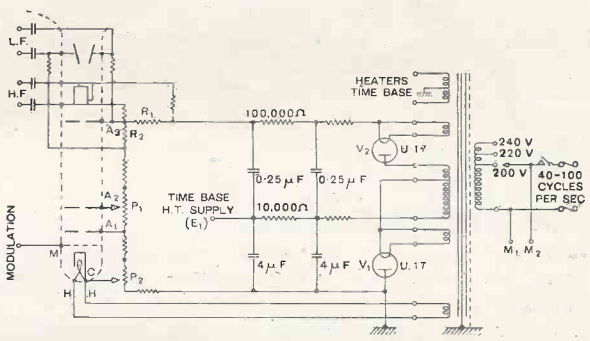
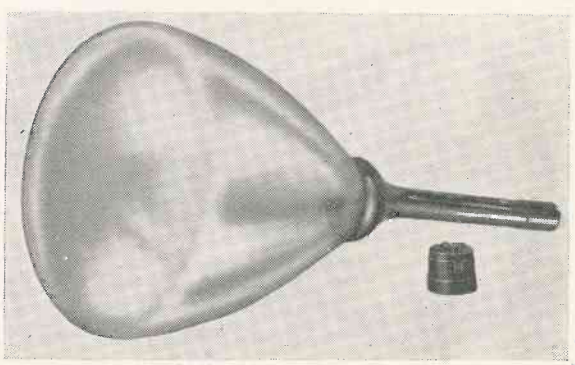


Fig. 9.—Power supply unit—high voltage circuit.

THE BAIRD CATHOVISOR TUBE

ON page 602 of last month's issue a photograph was shown of the Baird Cathovisor cathode-ray tube and it was stated in the caption that this was the 15-in. magnetically focused tube. Actually, the tube shown by the photograph was the 12-in. size and the description was therefore incorrect. The photograph reproduced here shows the 15-in. magnetically focused Cathovisor tube and it will be seen that the design differs from that which was shown last month.



EXPERIMENTAL MINIATURE TELEVISION.

A PICTURE ON A ONE-INCH TUBE

A picture has been received on the miniature television receiver using the circuit described below and a standard video receiver. The possibilities of miniature television are thus definitely established.

IN last month's article on miniature television, the details of the chassis and time base were given, and the circuit outlined.

As predicted, one or two modifications were necessary to enable the scanning frequency to reach the B.B.C. standard, and these are described below. In the original text* the type of transmission for which the time base was intended was not mentioned, but judging from the values of resistance and condenser the speed was very low, suggesting 25 pictures and 300 lines.

One snag which was considered in the original scheme for using a miniature 1 in. tube was the limitation imposed by the single deflector plate system. One of each pair of deflector plates is earthed to the anode of the tube internally, which prevents a changeover of the plates in the event of wrong scanning direction, and, unfortunately in the tube tested the connection to the horizontal plate gives a reversed picture. Whether the tubes issued by the R.C.A. are all standardised with regard to the internal plate connection remains to be seen, but users of the 1 in. tube will have to accept the reversal on the B.B.C. transmission. This, by the way, is not such a drawback as might appear, as the pictures are not affected and the only difficulty is in the titling. Apart from this defect, the picture obtained is surprisingly clear and the full-face studies were easily recognisable at a distance. A small lens was placed in front of the screen and gave a magnified image which could easily be seen.

The low intensity of the screen necessitated a hood being mounted over the tube, and the final mounting will have to allow for this. To sum up, however, there is no doubt that the miniature tube can be used to reproduce pictures, and its low cost and comparatively simple construction will commend it to many readers as an economical experimental unit. It should be particularly suitable for those to whom the high cost of a large tube equipment has prohibited any experimenting on the high definition system. It is hoped to continue this series of articles by describing a simple video receiver to use in conjunction with the tube, and to simplify the time-base still further.

In the meantime, the following modifications to the time-base circuit given last month will give the correct speeds for the 405 line transmission. The amended circuit diagram is given by Fig. 1 and so far as possible the components originally specified have been used.

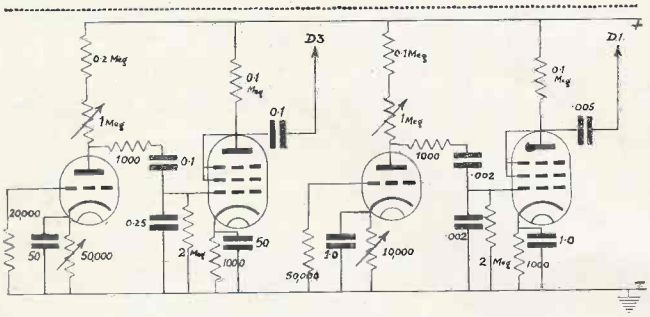
To increase the speed of the line scanning circuit the value of the series resistance will have to be reduced and it is now made up of a 1 meg. variable in conjunction with 0.1 meg. fixed.

The charging condenser is .002-mfd. and the series condenser (which acts as a potentiometer for the grid input to the valve) is .002 also. There will be no difficulty in finding suitable condensers from the experimenter's stock as they are only 350 volts working.

With certain thyratrons difficulty may be experienced in reaching a high enough speed even with lowered values of resistance, but the bias control will be found to vary sufficiently to give the final adjustment. The value given of 50,000 ohms variable is adequate, but the adjustment will be critical owing to the variation with a small movement of the rheostat, and it is recommended that a variable of 10,000 be used. This can be shunted with a 1.0 mfd. condenser, the 50-mfd. shown originally being unnecessary at the high speed.

The resistance of 20,000 ohms shown in the thyratron grid circuit may need increasing to 50,000 ohms, but this depends on the synchronising impulse and can be left till later.

With regard to the picture frequency circuit, the final values selected were 1 meg. variable and 200,000 ohms fixed instead of 2



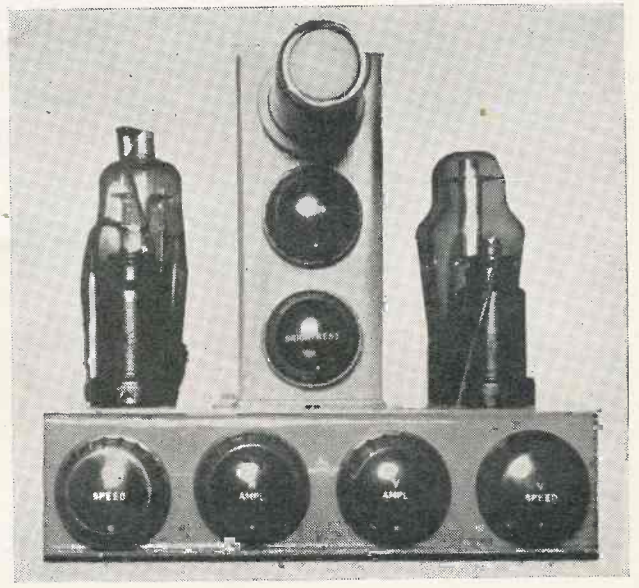


Fig. 1.—(Left) The modified circuit of the time base. (Right) Front view of the miniature cathode-ray receiver.

* "Television with Cathode Ray Tubes." A. Halloran.

megohms. The potentiometer condenser (0.5 mfd. originally) gave insufficient amplitude and was reduced to 0.25 mfd. The bias resistance was reduced by the connection of a 25,000-ohm parallel resistance, which gave a much smoother control of picture speed.

An important point which showed on testing was the insulation of the feed condenser to the plates. This is

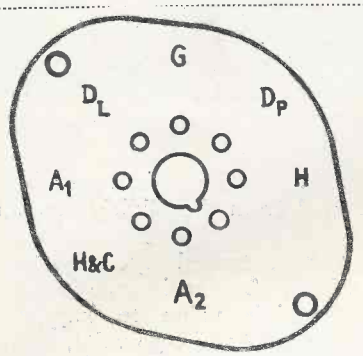


Fig. 2.—Rear view of tube socket showing connections to vertical (Dp) and horizontal (D1) deflector plates. Note the position of the key.

given as 0.1 mfd. for the picture frequency and if there is a slight leakage through it the picture will be displaced off the screen. It is desirable to use 1,000 volts working tubular condensers if available.

To obtain the picture right way up, the tube should be mounted in the bracket with the locating key downwards. The grid contact is then uppermost, and the deflector plates are wired as shown in the diagram of Fig. 2. Each plate must be connected to the anode by a 2-megohm leak, which can be of ½-watt rating or smaller. The slots in the bracket will allow the tube to be moved sufficiently to align the picture.

The drawing here, Fig. 3, shows the connections of the octal sockets for the 6K7 valve used as a triode.

To avoid interaction between the time bases, the condensers should be as near the edge of the chassis as possible, and leads going to each side of the time base should not run together.

After checking the wiring, leave the tube out of its socket and switch on the H.T. unit. The thyratrons should glow faintly and the note of the high speed scan should be audible as a faint whistle. If this is heard the time base is probably operating correctly.

Before trying the tube, switch off and make sure that the resistances at the back of the bracket are not touching the metal.

Turn the brilliance control as far over to the right as possible and switch on. After a short time, turn the control back until a green glow appears over the surface of the screen. If a black spot appears at the centre of the screen it is due to the charge described before* and can be removed by switching off and on again. If the lines are on the screen try the effect of altering the amplitude and speed of each scan. The amplitude under working conditions is sufficient to carry the lines right off the screen.

This is not a disadvantage, and gives in effect a larger picture than if the screen area was within the circle of the glass.

Although it is possible to check the picture frequency with a 50-cycle

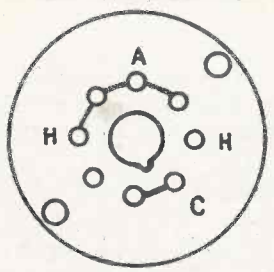


Fig. 3.—Under view of socket for 6K7 showing connections for use as a triode.

waveform, it is only possible to make final adjustments with the transmitter working. Under these conditions it will be found that the brilliance can be reduced and the focusing can be improved. If the line screen is focused without a picture it will appear very dim, but this improves immediately the modulation is applied.

Quality Reception On Six Wave Bands.

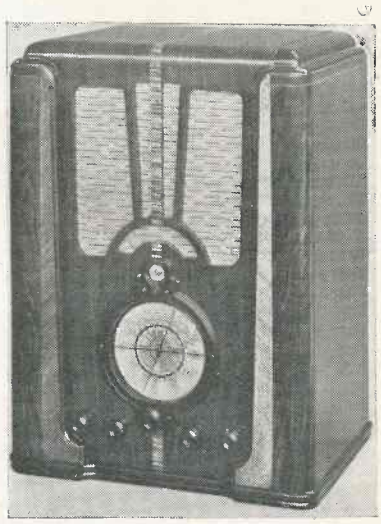
ONE of the new Pilot model 106 receivers has been undergoing tests in our laboratory and its performance has even surprised those who are accustomed to using multi-valve receivers of all kinds.

It is one of the first receivers of its kind built in this country which fulfils the needs of every type of listener.

The model 106 uses 10 valves in a particularly sensitive circuit. It is not, however, the large number of valves which call for special note. First in our estimation is the fact that all wavelengths between 4.5 and 2,200 metres are covered without a break with a high degree of sensitivity on all channels. So many of the multi-band receivers do not give a good account of themselves on the shorter wavebands.

Another important feature is the special tone control which allows the operator to adjust the percentage of bass response according to total volume output.

On all bands there is a stage of radio-frequency amplification so accounting for the complete suppression of image interference. Also owing to the generous amount of R.F. amplification available the noise level is very low so that good quality can be obtained from long distance short-wave stations.



A Headphone jack is also included for weak station reception.

In the output stage there are two high-gain triodes in push-pull that provide no less than 14 watts to a 10-inch loudspeaker that has been carefully matched up and fitted to avoid resonance.

Selectivity is more than sufficient to handle the congested conditions found at present on almost all wavebands, but this selectivity is not obtained at the expense of top note reproduction.

A six range dial is calibrated in wavelengths and station names, but unlike some dials which are so full up with names that stations are difficult to find, each band is illuminated separately as the appropriate band is switched into use.

For those who wish to know what sort of television programmes are being transmitted the sound transmission from Alexandra Palace can be received at great volume. At a distance of nearly 40 miles from London the volume from the television signals was very great.

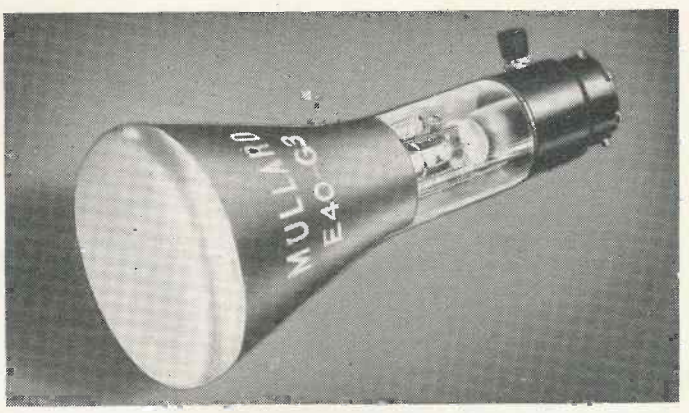
This 10 valve receiver in table form is priced at 25 gns. at which price it represents excellent value for money. For those who need a receiver for all world listening this Pilot model 106 appears to be highly satisfactory.

Full details can be obtained from the maker, Pilot Radio, Ltd., 87 Park Royal Road, London, N.W.10.

* See p. 523, Sept issue

THE MULLARD MINIATURE CATHODE-RAY TUBE

FOR OPERATION AT LOW VOLTAGES



Mullard cathode-ray tube E40-G3, screen diameter 7 cm.

THE Mullard Wireless Service Co., Ltd., have produced a cathode-ray tube of a particularly interesting design and with several novel features. This tube, designated the E40-G3, is primarily intended for oscillograph purposes, and it has the outstanding advantage

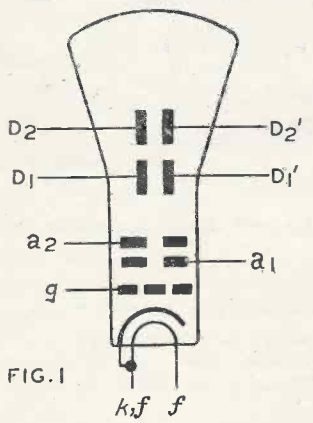


FIG. 1

g = grid a_1 = 1st anode
a_2 = 2nd anode
D1, D1' D2, D2' = deflecting plates.

that it can be operated at very low anode voltages of from 300 to a maximum of 800. The screen diameter is 7 centimetres, or roughly 3 in., and the overall length is approximately 16 centimetres. Despite the short length of beam, however, the tube has a very high degree of sensitivity.

The usual two pairs of deflecting plates are provided, but the design of the tube is such that electro-magnetic deflection can be applied if desired. The tube is of the high-vacuum type and can therefore be used for measuring very high frequencies.

As will be seen from the photograph the inner side of the bulb has a coating of graphite which collects secondary electrons from the surface of the screen, the graphite layer being in electrical connection with the second anode.

The diagram shows the electrode arrangement of the tube and it will be seen that the cathode is connected inside the tube to one side of the heater. The following are the technical data relating to this tube.

Technical Data

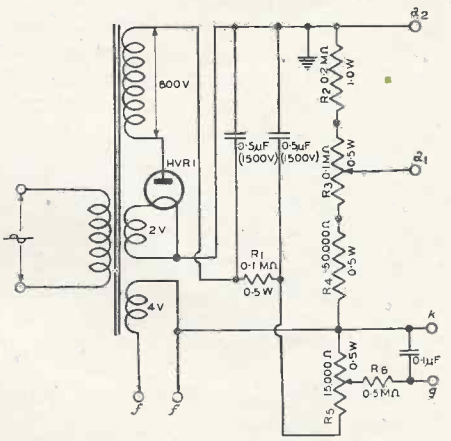
Heater voltage, 4.0 volts.
Heater current, 1.0 amp.
Second anode voltage, 500-800 volts.
First anode voltage, 140-200 volts.
Grid voltage, 0-25.0 volts.
Cathode internally connected to heater—
Deflection sensitivity of plates nearest cathode, 0.30-0.19 mm/V.
Deflection sensitivity of plates nearest screen, 0.20-0.12 mm/V.
Capacities.
Grid to all other electrodes, 6.7 $\mu\mu$F.
Between deflection plates nearest cathode, 2.9 $\mu\mu$F.
Between deflection plates nearest screen, 3.7 $\mu\mu$F.

The recommended circuit for the supply of high-tension to the E40-G3 tube is shown by the second diagram. The mains transformer has a high-tension winding of 800 volts r.m.s., current being fed to the tube by means of a half-wave rectifying valve, type HVR1, which is capable of supplying rectified current up to 5 milliamps., which is ample for the operation of the tube.

The necessary voltages between the cathode and anodes a_1 and a_2 and between the cathode and grid, are obtained by tapping from a potentiometer. R_3 is a variable potentiometer and supplies voltage for the first anode a_1. By adjusting the potentiometer the image can be focused to maximum sharpness and definition. Negative grid bias is obtained from the sliding contact of the potentiometer R_5; the spot brightness is controlled by varying this grid bias. The resistance is of sufficiently high value to supply the maximum bias of −30 volts, which is needed for suppressing the beam. This diagram also shows the load in watts of the various resistances employed and the operating voltages are indicated in brackets after the capacities of the smoothing condensers. R_6 and the condenser between k and g provide for the smoothing of the grid bias.

Sensitivity

Sensitivity is inversely proportional to the voltage between a_2 and the cathode. At the maximum permissible anode voltage of a_2 = 800 volts, sensitivity is at its minimum, being 0.19 and 0.12mm/V. respectively for plates D1 and D2, but the installation is then least susceptible to the disturbing influence of external fields. At a low anode voltage of 500 volts, sensitivity is respectively 0.30 and



H.T. supply circuit for the F40-G3.

(*Continued on page 674*)

RECENT TELEVISION DEVELOPMENTS

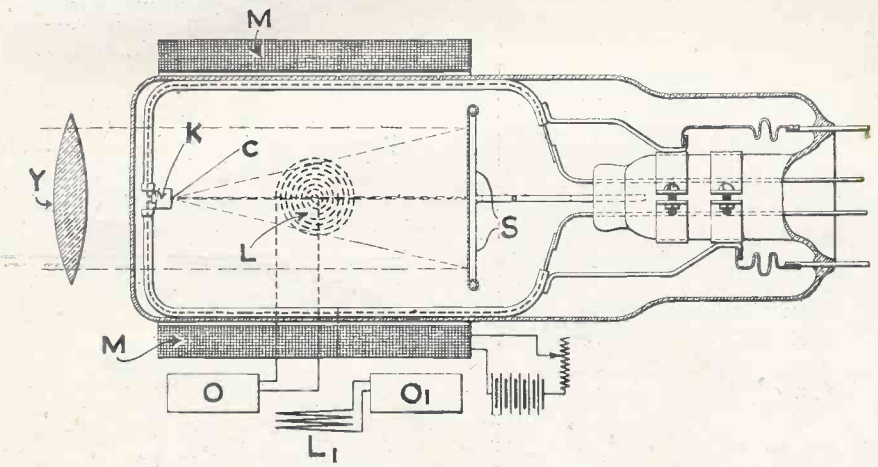
A RECORD OF PATENTS AND PROGRESS
Specially Compiled for this Journal

Patentees: Farnsworth Television Inc. :: Baird Television Ltd. and G. E. G. Graham :: H. G. Lubszynski :: E. Michaelis :: Scophony Ltd. and J. H. Jeffree :: Marconi's Wireless Telegraph Co. Ltd.

Projection Tubes

(Patent No. 468,795.)

INSTEAD of using a fluorescent screen, the picture is reproduced by the heating effect of an electron stream projected against a very thin screen of metal.



Projection tube. Patent No. 468,795.

As shown in the figure, a concentrated electron beam is projected from a cathode C against a thin metal screen S. The intensity of the beam is controlled by the signal voltages applied to the Wehnelt cylinder K, whilst the field from an external magnetic winding M keeps it concentrated into a thin pencil.

Scanning voltages are applied to a pair of deflecting coils L, L1 from saw-toothed oscillation generators O, O1.

The impact of the electron beam raises the screen S to varying degrees of incandescence, corresponding to the tone values of the orginal picture. The light so produced is projected back from the screen surface on to a lens Y which amplifies and focuses the picture on to an external viewing screen. Owing to the intense illumination of the screen S, the enlarged picture is of high brilliance.—*Farnsworth Television Inc.*

Stereoscopic Pictures

(Patent No. 468,837.)

In order to produce a stereoscopic effect in television, it is necessary to make separate scanning of the picture, simultaneously these being subsequently combined to give the effect of right-eye vision plus left-eye vision.

According to the invention the two separate scans are made by the ordinary and extraordinary rays produced when light is passed through a doubly-refracting substance such as a calcite crystal.

Each ray is used to scan the picture from a different angle, and the two rays are then passed on to two separate photo-electric cells. The output from both cells can be fed to a common transmission channel—or modulated on the same carrier-wave—by altering the frequency-band of one set of signals so that it does not overlap with the other.

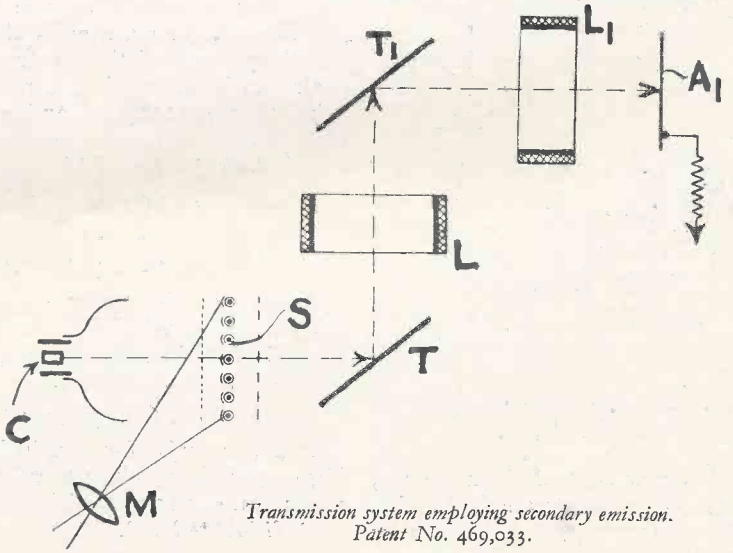
At the receiving end, a doubly-refracting crystal is similarly used to separate the two signals and project them simultaneously on to the viewing screen. The same arrangement can be used to produce two-colour television pictures.—*Baird Television, Ltd.*, and *G. E. G. Graham.*

Television Systems

(Patent No. 469,033.)

A cathode-ray tube, as used in television, is provided with electron-multiplier "targets" inserted between the photo-sensitive screen and the output electrode.

As shown in the drawing, the electron stream from the cathode C is swept over a permeable mosaic screen



Transmission system employing secondary emission. Patent No. 469,033.

S, and passes through on to an inclined target electrode T, where it produces secondary emission. The amplified stream is then caused, by focusing coils L, L1, to impact against another target T1, giving rise to further secondary emission, before finally reaching the output electrode A1.

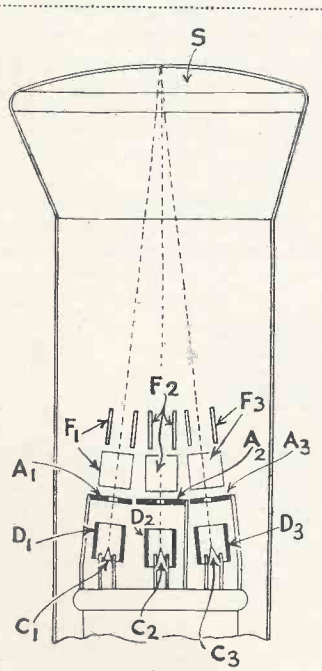
The picture to be televised is focused by a lens M on to the permeable mosaic screen S, which is made as an open grid of small photo-sensitive elements. The impact of the scanning beam controls the potential of each of the small cells and so regulates the strength of the emerging beam in accordance with the varying light-values of the original picture.—*H. G. Lubszynski.*

Cathode-ray Tubes

(Patent No. 469,127.)

In order to increase the intensity of the spot of light thrown on to the fluorescent screen, a cathode-ray tube is fitted with several different cathodes, all mounted on the same support, and arranged so that the separate electron streams are all brought to a focus at the same point on the screen.

As shown in the figure, three cathodes C1, C2, C3 are arranged in a plane perpendicular to the axis of the tube. Each has a separate Wehnelt cylinder or control electrode D1, D2, D3 and a separate anode A1, A2, A3. Each stream passes through its own pair of deflecting plates F1, F2, F3 and reaches the fluorescent screen S at the same point.



Cathode-ray tube with multiple cathodes. Patent No. 469,127.

Alternatively, the different streams may be merged, so that they pass through the aperture of a common anode, before reaching the deflecting plates, in which case only a single pair of deflecting plates will be required.—*E. Michaelis.*

Scanning Systems

(Patent No. 469,427.)

A ray of light is passed first through a combination of a spherical and cylindrical lenses, to produce a wedge-shaped beam, which is then directed on to a series of right-angled prisms which rotate the beam through 90°. The resulting flat-shaped beam is then passed through a light valve, which is subjected to mechanical vibrations of supersonic frequency. —*Scophony, Ltd.*, and *J. H. Jeffree.*

Electron Multipliers

(Patent No. 469,477.)

When an electrode is subjected to bombardment, it will emit secondary electrons, the number of which depends in part upon the material of the electrode, and in part upon the potential difference between it and the source of primary electrons. An emission of three or more secondary electrons for every impacting electron can readily be obtained from sensitised electrodes at potentials of 300 or 400 volts. If the primary stream is caused to strike against a number of sensitised electrodes in succession, it is possible in this way to obtain an amplification up to a million-fold in a single tube.

The invention is concerned with the electrode system of an electron multiplier of this kind, the various targets being so arranged that substantially none of the electrons miss their mark in passing through the tube, thus ensuring an optimum amplification factor.—*Marconi's Wireless Telegraph Co., Ltd.*

Summary of Other Television Patents

(Patent No. 468,808.)

Preserving the lower signal frequencies in a television receiver arranged for interlaced scanning.—*Radio-Akt. D. S. Loewe.*

(Patent No. 468,891.)

Rectifier unit for producing the high operating voltages required to run a cathode-ray television receiver. —*Radio-Akt. D. S. Loewe.*

(Patent No. 468,965.)

Electron focusing arrangement for causing the scanning beam in a cathode-ray tube to strike the screen vertically at all points on its surface. —*H. G. Lubszynski.*

(Patent No. 469,018.)

Method of producing mechanical vibrations of supersonic frequency by means of a piezo-electric crystal for use in a television light valve.—*Scophony, Ltd.*, and *J. H. Jeffree.*

(Patent No. 469,245.)

Matching the impedance of a television aerial to its feed-line over a wide band of signals.—*E. C. Cork.*

(Patent No. 469,394.)

Supplying operating voltages to the cathode-ray tube and time base circuits of a television receiver.—*The General Electric Co., Ltd.*, and *D. C. Espley.*

(Patent No. 469,404.)

Electron multiplier with secondary-emission electrodes formed of fine wire mesh inclined at different angles. —*W. E. Williams.*

"The Mullard Miniature Cathode-Ray Tube"

(*Continued from page* 670)

0.20 mm/V. for the plates D1 (near the cathode) and for plates D2 (near the screen).

When using a time-base unit the time-base voltage is usually applied to D2 and D2′—the plates farthest away from the cathode. The two plates D1 and D1′ are nearer to the cathode and hence possess greater sensitivity, and are less exposed to the damping effect of secondary emission from the screen, than the other parts. It is usually more advantageous, therefore, to use this pair of plates for carrying out a voltage measurement.

On the basis of the above sensitivity values of the tube, the voltage can be calculated which must be applied between the deflecting plates in order to deflect the light-spot from one side of the screen to the other side. For the plates D1 and D1′ (the pair near the cathode) this voltage amounts to 370 volts at an anode voltage of Va_2 = 800 volts, and to 230 volts at Va_2 = 500 volts. These values refer to a maximum voltage. It will be clear, therefore, that for normal operation, considerably lower voltages than those mentioned will be satisfactory.

The price of the tube is £3 10s. 0d.

TELEVISION AND SHORT-WAVE WORLD

NOVEMBER, 1937

Programme Pointers for Short-wave Listeners

By A. C. Weston

SHORT-WAVE programmes as far as Europe is concerned had a very bad set-back during the end of September and the early part of October owing to the extraordinary bad conditions which prevailed on practically all

Ozzie Nelson and Harriet Hilliard re-open the Bakers' Broadcast for the fifth year. This programme can be heard over NBC blue network each Sunday at 12.30 a.m. (NBC photo.)

commercial wavebands. Listeners with large receivers were able to hear stations fairly consistently, but fading and a high noise level prevented most programmes being of entertainment value.

A host of letters received from listeners indicate that in several parts of the country there was complete fade-out for several days at a time when nothing but European stations could be heard. However, this bad period now seems to be passing over and reception conditions are returning to normal. During November I anticipate that the

"Love and Learn," heard Mondays to Fridays at 5 p.m. over W3XAL, introduces Florence Freeman.

afternoon and early evening stations on 16 and 19 metres will be of particular interest, while the 31-metre band should be carefully watched after 9 p.m.

Although W2XAD is perhaps my most popular station, I have found that W2XAF, which relays the same programme during the overlapping period, very often provides a stronger signal, so this point should be borne in mind.

NBC station, W3XAL, on its 16 metre channel, is now becoming a true international broadcaster, for its programmes, when transmitted on a two-directional beam aerial, have been heard in such places as China, India, Afghanistan, Turkey, Palestine, Straits Settlement, Nigeria, Rhodesia, Somaliland, South Africa, Australia, and New Zealand.

W3XAL, which is on the air for sixteen hours a day, uses English, French, German, Spanish, Italian and Portuguese, and during the day carries the best of the NBC blue and red networks, so that listeners hear the pick of the programme transmitted by W2XAD, W2XAF and W8XK.

For this reason concentrate on

John Barrymore in streamlined versions of Shakespeare can be heard each Monday night over NBC blue network.

W3XAL during the next month and just see whether or not better and more consistent short-wave listening does not result. This station is on the air from 2 p.m. until 1 a.m. on a wavelength of 16.8 metres.

Most Sundays at 4.30 p.m. brings the Green Brothers Orchestra which is always well received owing to the fact that a directional beam aerial is in use. The most popular American short-wave broadcast comes on the air at 7 p.m. every Sunday, and is the well-known Magic Key, which differs in make-up each week.

Marion Talley, at 10 p.m. each Sunday is also another popular broadcaster, while a new item which is as yet unknown to the majority of European listeners, is Ernest Gill and his Orchestra at 11 p.m. every Sunday. There is no need to remind listeners about Jack Benny at midnight.

From Washington, at 11 p.m. most Mondays, is a relay for 30 minutes of the U.S. Army Band, and this is usually well received. The Barry

Jack Benny and Mary Livingston, with Kenny Baker and Don Wilson, who resume their broadcasts at midnight each Sunday over NBC red network.

McKinlay broadcast has been retimed and is now on the air at 5.30 p.m. on Tuesdays. The N.B.C. Music Guild, which during the course of the year covers all types of play, have 30 minutes at 7.30 p.m., also on Tuesdays. String Time, directed by Jack Meakin, has produced a huge quantity of fan mail from England, so proving the popularity of this broadcast. It is timed for 11 p.m. also on Tuesday evenings.

For those who are able to listen in the afternoon, hear the Honeymooners at 3 p.m. or Joe White at 5.45 on Wednesday. Continental Varieties, which

Internationally famous stage and screen star, Ina Claire, is now being featured with Osgood Perkins over NBC station W3XAL.

include Celia Branz, are a regular listing at 8.30 p,m. each Wednesday, while Harry Kogen and his Orchestra provide Dinner Music at 11 p.m.

"The Cossor Cathode-ray Tube Unit."

(*Continued from page 675*)

M is approximately 1,000 volts negative to the AN terminal and earth.

The beam trigger is operated electrically by connecting the EL terminal to any external circuit which produces a negative pulse, or conveniently to whichever terminal of the X or Y pairs whose potential is negative in operation. The beam switch is initially set so that the grid of the trigger valve is positive and the beam is off, the negative pulse driving the grid negative and turning the beam on. The time to reach full brilliancy is of the order of 20 micro-seconds, and owing to the time constant of the stopping condenser and resistance in the grid circuit, the beam is turned off automatically after approximately 0.25 second.

Fitted inside the mu-metal screen on opposite sides of the tube neck are a pair of deflecting coils. The deflectional sensitivity can be varied by connecting them in series or parallel as required or by shunting them externally. Alternative coils are available for higher or lower current ranges as required.

Short-wave Constructor Kits

A NEW booklet dealing with short-wave kit receivers of all kinds has just been published by the Peto-Scott Co., Ltd., of 77 City Road, London, E.C.1, and 62 High Holborn, London, W.C.1. Amongst the receivers illustrated is the Pilot Short-wave One, the parts for kit A costing £2 0s. 4d., and a similar model with greater selectivity and a more flexible input circuit. Both of these kits are ideal for beginners on short-waves.

Model 260, a two-valve receiver, costs £2 17s. 4d. for kit A, and is made up of a detector and low-frequency amplifier. The chassis is so arranged that additional valves can be added without the original fundamental circuit having to be altered.

In all these Pilot kit receivers a standard chassis is employed to make up to four valves, so that the beginner can build a one-valve set and when he has gained sufficient experience, increase to 2, 3 or 4 valves, as required.

A three-valve model using 6-pin coils is priced at £3 1s. 8d. for kit A, while the largest receiver in the range, a short-wave four, costs only £3 12s. 11d. With every kit a constructor's envelope is included free, including 16 wiring diagrams, eight theoretical drawings, calibration chart, and an up-to-date list of short-wave stations with wavelengths and frequencies.

"Aerials for Ultra-short Waves."

(*Continued from page 683*)

35 ft. The resistance R, which is of a non-inductive type, carefully insulated so that it is not affected by weather, should have a value of 400-ohms, or equal to the impedance of the feeder lines.

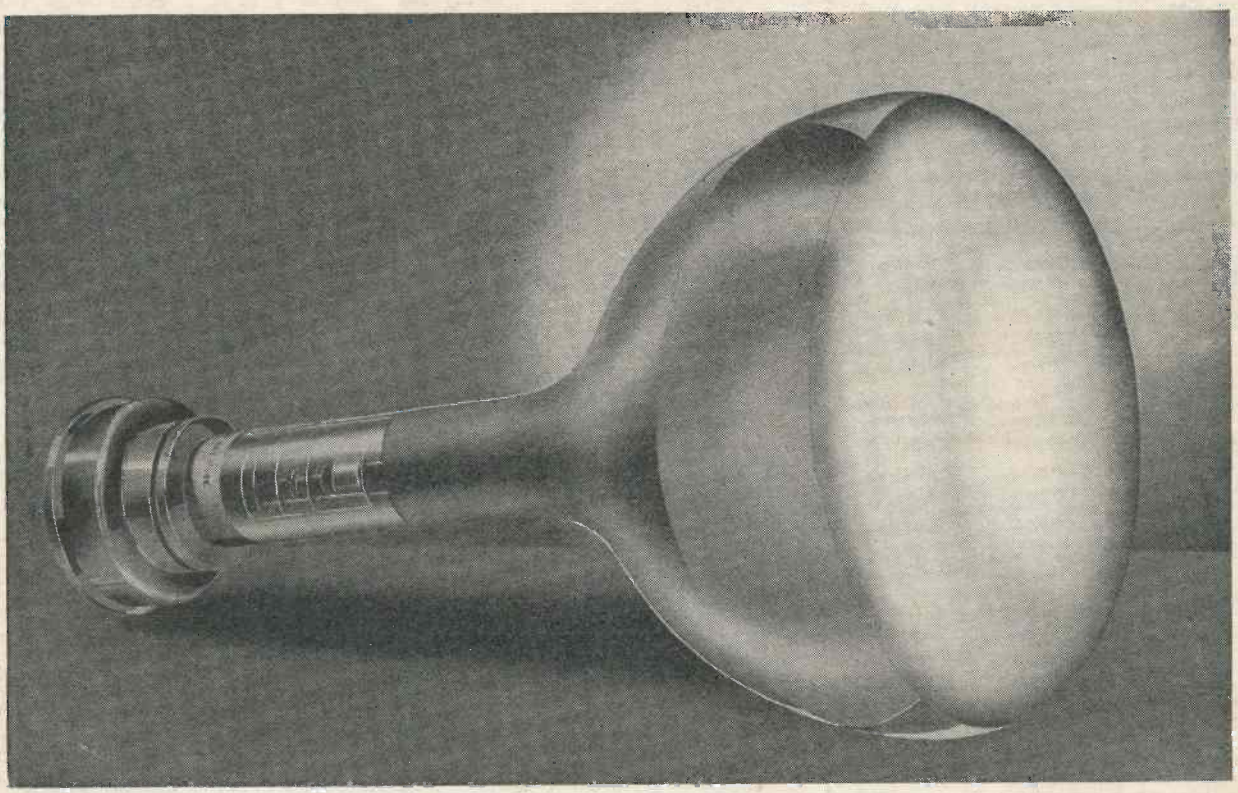
This type of aerial is also suitable for use up to 40-metres, over which wavelength its advantages and directional properties become less noticeable. Constructional data is shown in Fig. 12.

A highly directional aerial that is particularly suitable for 10-metre work is shown in Fig. 13, where there are two half-waves in phase, the entire array beginning and terminating in two quarter-wave sections. Without a reflector this aerial is bi-directional and has a pattern that is very much broadside and extremely concentrated. For wide coverage two aerials of this type would be needed and erected at right angles. The lengths of each section are given in Fig. 13 and can be calculated from the formula previously given for aerial lengths. The feeder lines are shown as 600-ohm, which are the most popular, can be of almost any impedance within the scope of the matching transformer.

The non-resonant line should be terminated in a coil of one or two turns, depending on the wavelength or the amount of coupling required, and looped over the grid coil in the receiver, as shown in Fig. 14. On 10 metres, however, it may be necessary greatly to increase the number of turns if the coils are of small diameter, but this can easily be checked by experiment.

An easy way of adjusting coupling is to have a small diameter coil inside the grid coil and to slide this in and out until optimum results are obtained. The coupling should then be fixed.

In this short article I have endeavoured to show some of the more suitable aerials for ultra-short wave reception, but the correct aerial for any particular purpose depends so much on location that the aerial finally chosen for any particular work cannot be definitely fixed without all the circumstances being known.



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