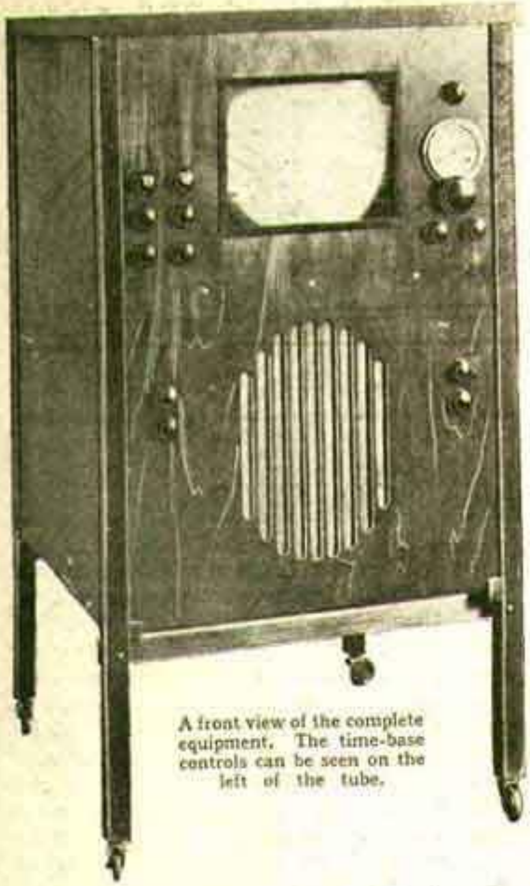


A front view of the complete equipment. The time-base controls can be seen on the left of the tube.

The Wireless World

Television

I.—FULL DETAILS OF THE VISION

FOLLOWING upon the theoretical articles which have been appearing in "The Wireless World," complete constructional details of a television receiver are being given in a new series of which this is the first. The vision receiver and its power unit, which also supplies LT for tube and time-base, is described here in detail.

A STRAIGHT set has been selected as the most suitable type of vision receiver for reasons which have been given in recent articles in *The Wireless World*. These reasons are briefly that it requires fewer valves, is simpler to construct and adjust, and, most important, is free from the serious interference problems of the superheterodyne.

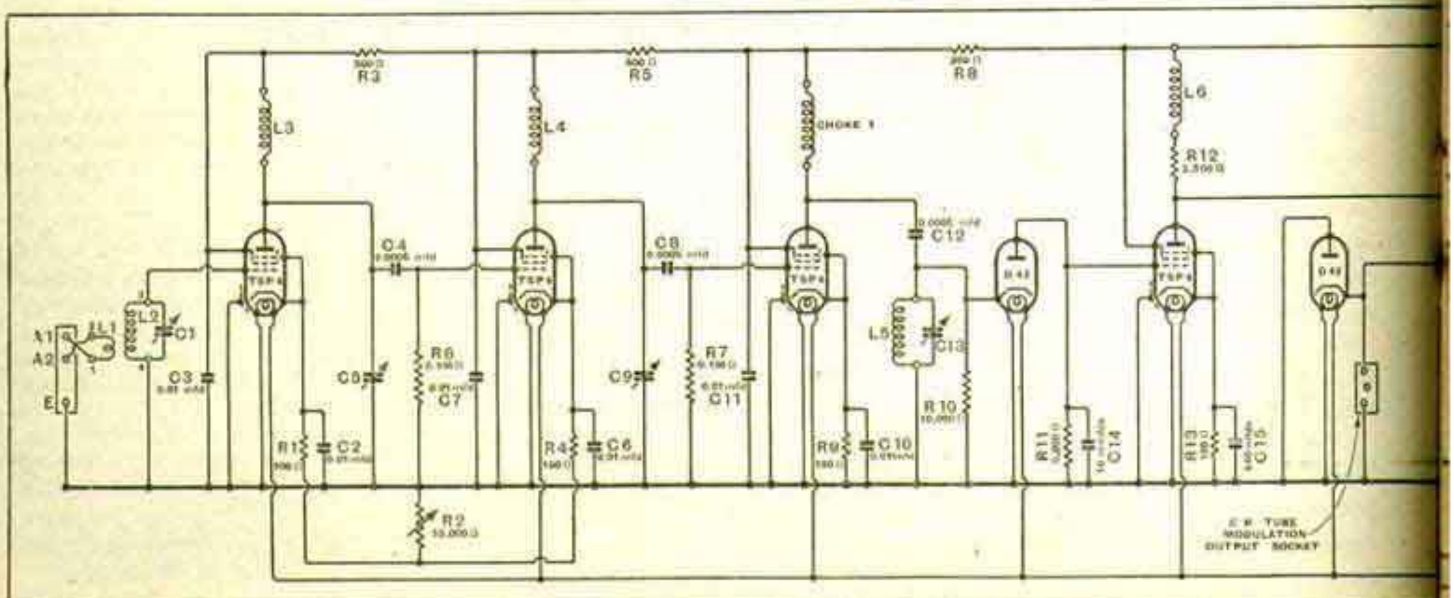
The circuit diagram of the receiver, which has been based upon many months of theoretical and practical research with many types of set, is shown in Fig. 1. It will be seen that three RF stages are used with a diode detector and one VF stage; the remaining two valves are a diode for restoring the DC component to the output signal and an RF pentode for sync separation.

For the RF stages pentodes of high mutual conductance have been selected, and they operate with the screens at the same steady potentials as the anodes. It is consequently possible to use common decoupling for screen and anode and so effect a saving in the number of components required. This decoupling is effected by the resistances and condensers R3 and C3, R5 and C7, and R8 and C11 for the first, second and third stages.

Single tuned circuits are used for the intervalve couplings and are suitably damped so that the requisite band-width can be secured. No artificial damping is employed in the case of the first three circuits, for the low input impedance of the pentodes at ultra-high frequencies is chiefly relied upon for damping. In the case of the first circuit L2 C1, damping is also imposed by the aerial circuit.

The second and third couplings are of the tuned anode type, the tuning coils being L3 and L4 tuned by the condensers C5 and C9. Because the input impedance of the diode detector is much higher than that of an RF pentode at very high

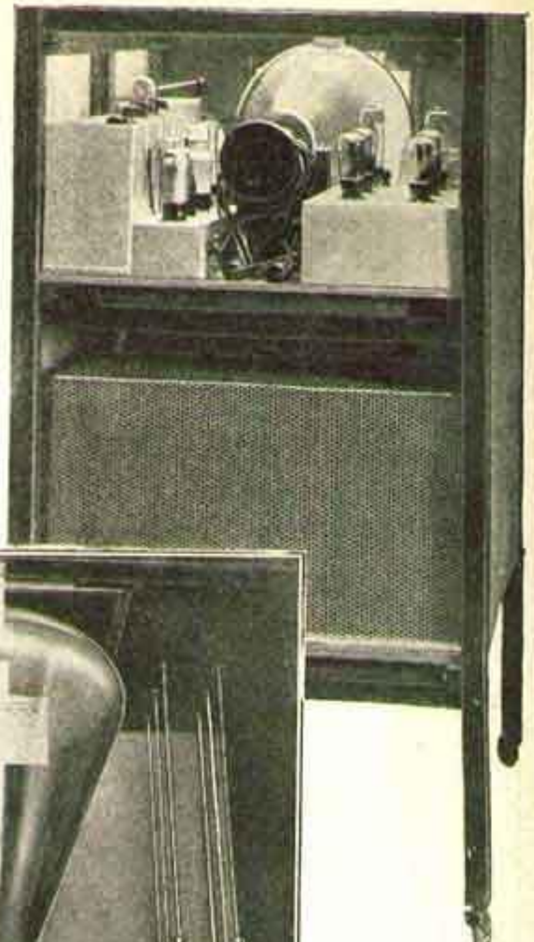
Fig. 1.—The complete circuit diagram of the vision receiver and amplitude filter is shown here. Three RF stages are used with a diode detector and one VF stage; the remaining valves are the DC restorer and the sync separator.



DESIGNED BY W. T. COCKING

Receiver

RECEIVER AND ITS CONSTRUCTION



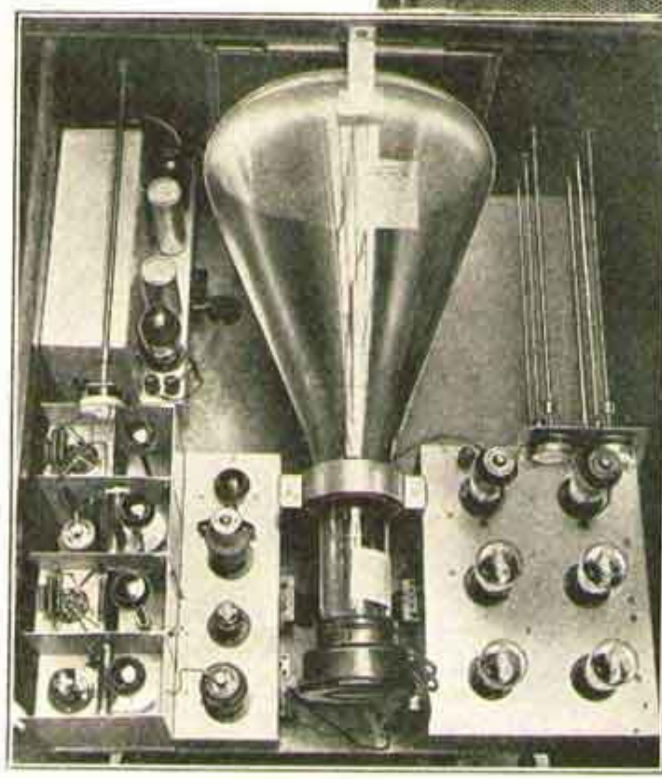
A rear view of the equipment with the back removed.

frequencies the fourth and last tuned circuit must be artificially damped by the resistance R10. This last RF coupling differs from the others in being of the tuned grid type; this is necessary because the detector must have an external path of low DC resistance apart from its load resistance R11.

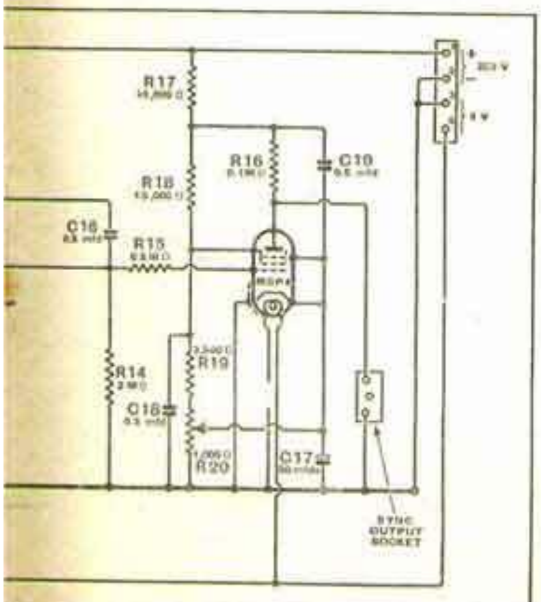
A choke feed with Ch1 and C12 is adopted for this circuit, therefore, and this last RF valve is operated with fixed bias provided by R9. The two early valves have initial bias provided by R1 and R4, but can be further biased for gain control by the variable resistance R2.

The Vision-Frequency Stage

The detector is a low impedance diode with a 5,000-ohm load resistance R11, and a 10μμF by-pass condenser C14. The output is applied directly to the grid of the VF amplifier, which is another RF pentode. Bias is obtained from the 100-ohm resistance R13 which is shunted by the 500-μF condenser C15. The full HT voltage is applied to the screen, no decoupling either of this or the anode circuit being necessary. The output coupling consists of the resistance R12



A view of the upper shelf showing the vision receiver and time-base to the left and right of the tube



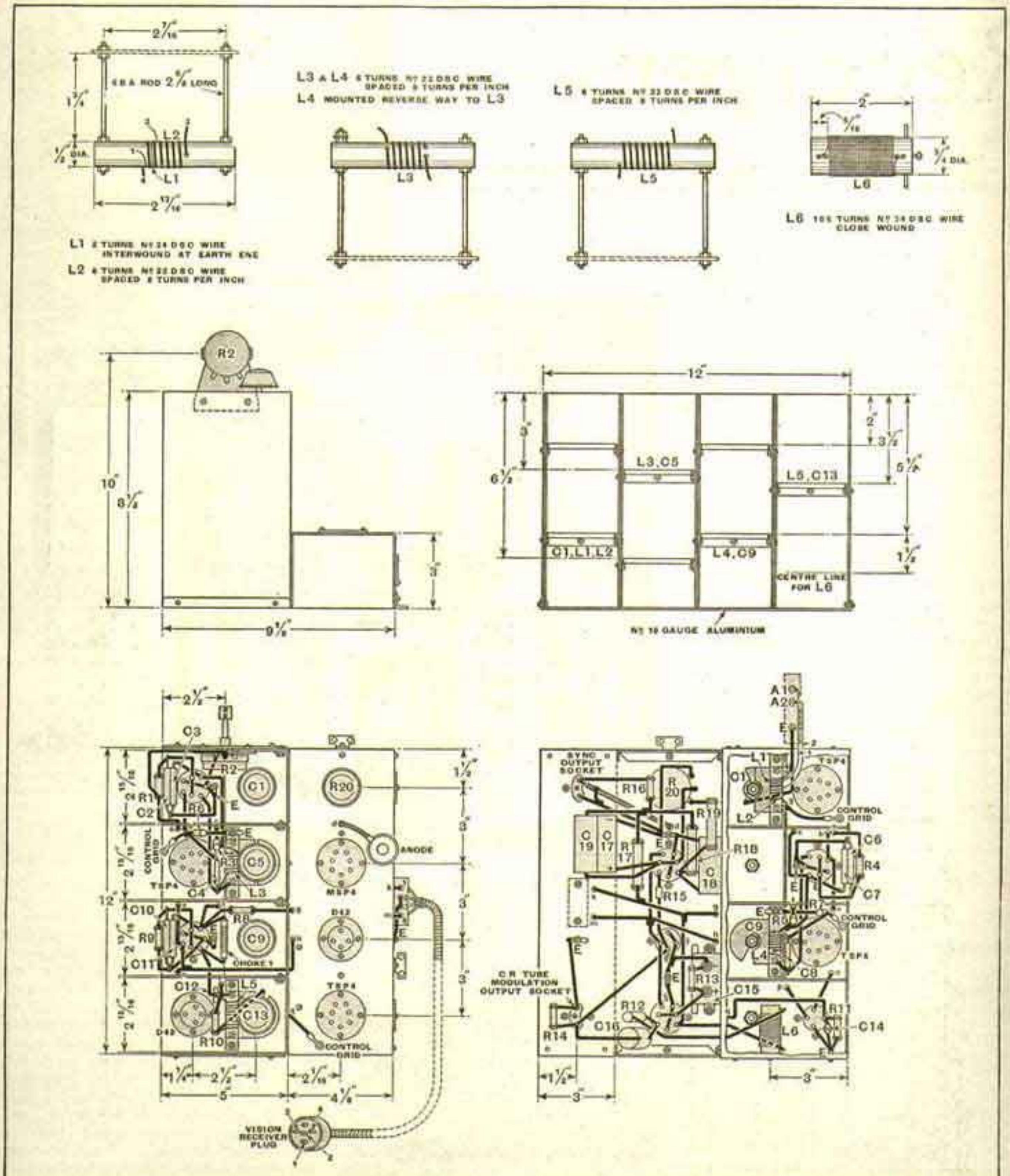
and the coil L6, and enables a response characteristic to be obtained which is flat within some 3 db. up to the extremely high frequency of 2.0 Mc/s, and this with a stage gain of about 20 times.

The vision signals developed across the coupling impedance are applied through C16 to the CR tube, the DC restorer, and the sync separator. The DC restoration, which is only rendered necessary by our having to include C16, is effected by the low impedance diode shunting R14. This resistance has a value of 2.0 MΩ, but it is shunted externally to the receiver by another resistance of the same value. This is done in order to safeguard the CR tube and prevent its being damaged should it be accidentally disconnected from the receiver. The effective load circuit of this diode thus has a value of 1.0 MΩ, not 2.0 MΩ.

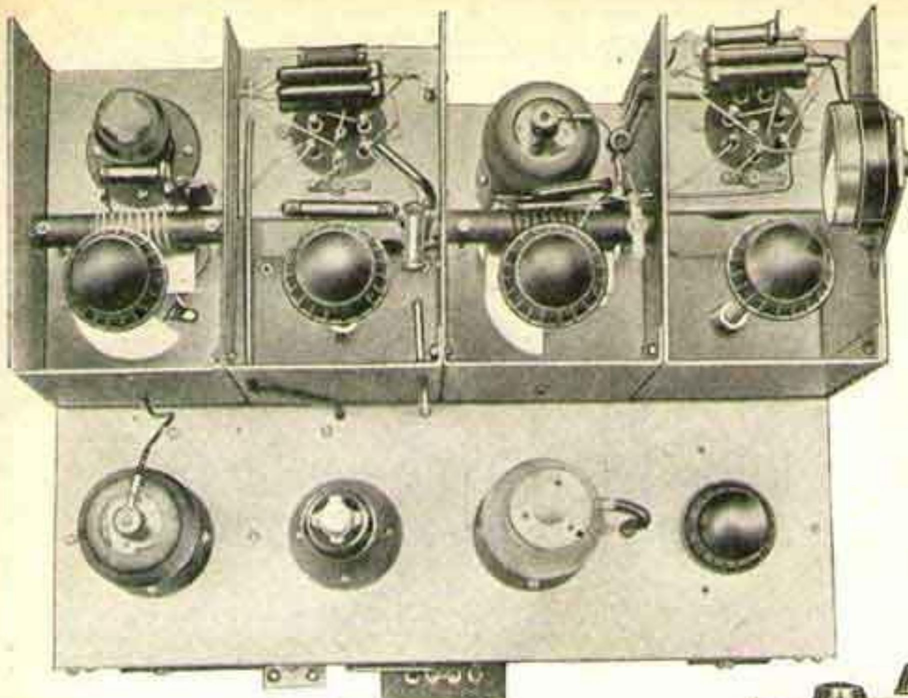
The volts developed across this circuit are also applied through R15 to the grid of the RF pentode, which functions as a sync separator. This valve is operated with some 40 volts screen, 140 volts anode, and −4 volts grid potentials. These voltages are obtained from the voltage divider comprising R17, R18, R19, and R20, and decoupling is effected by C17, C18, and C19. The resistance R20 is actually an adjustable potentiometer varying grid bias and anode voltage simultaneously in order to permit compensation being obtained for variations in components and valves. It is a pre-set, and not a panel, control.

Since there is only a single television transmitter variable tuning is unnecessary, and the four tuning condensers are accordingly regarded as pre-set controls, and are not brought out to the panel. The only panel control for the vision receiver is the gain control R2.

HOW THE COILS ARE MADE, DETAILS OF THE CHASSIS CONSTRUCTION, AND THE WIRING CONNECTIONS



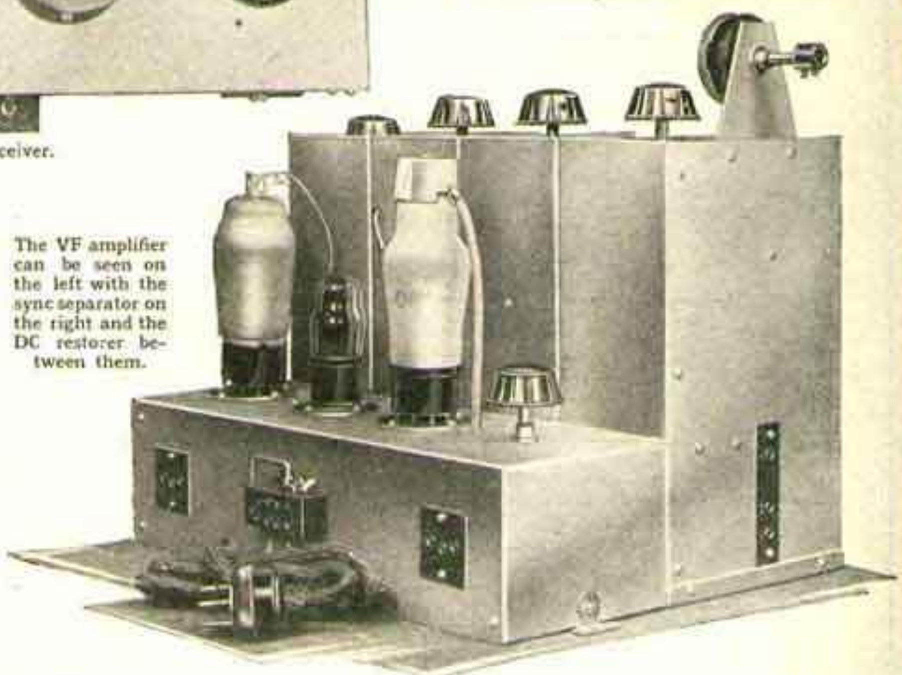
Complete constructional details of the receiver, together with wiring, are given in these drawings as well as coil winding data.



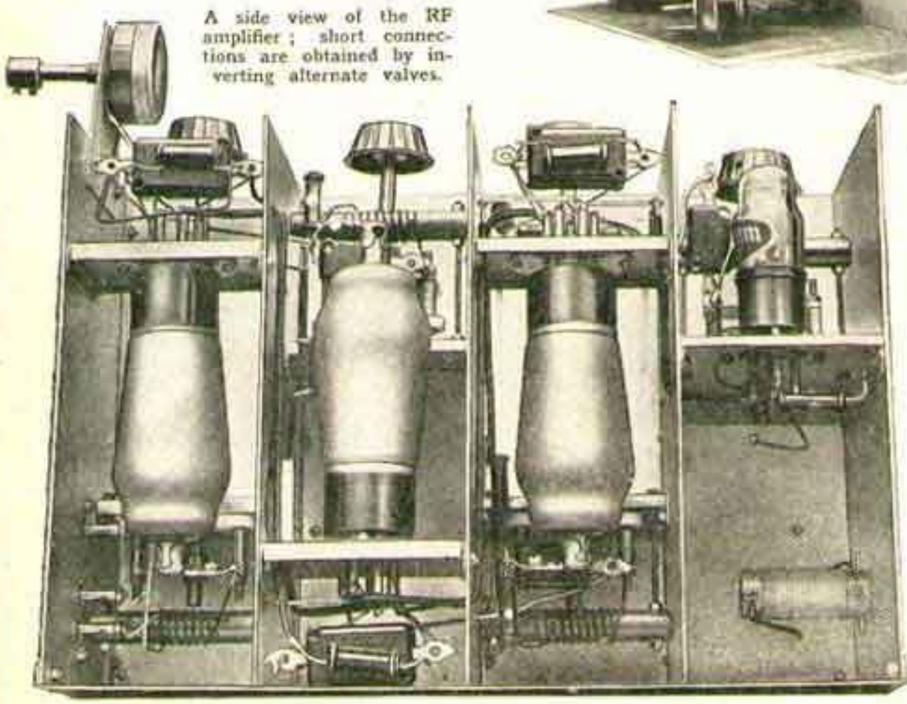
A plan view of the vision receiver.

The power unit is built as a separate unit, and its circuit diagram appears in Fig. 2. Not only does it supply HT and LT for the vision receiver, but it also supplies LT for the tube and time-base, and it also includes the delay-switch for the high-voltage unit. The mains transformer has windings rated at 2.0 volts 1.5 amps. for the CR tube heater, 4.0 volts 8.0 amps. for the vision receiver valve heaters, 4.0 volts 8.0 amps. for the time-base valve heaters, and 4.0 volts 2.5 amps. for the rectifier filament. This rectifier is a U12, and its anodes are supplied from the 350-0-350 volts winding. A single high-inductance smoothing choke in conjunction with two 8-μF. electrolytic condensers suffices for smoothing, and the output is about 250 volts at 75 mA.

Returning to the vision receiver, the components are in most cases standard in spite of the high operating frequency, for there is no point in using special low-loss types when it is essential for the circuits to be heavily damped in order to secure the necessary band-width. The tuning condensers are of the air-dielectric type, however, but this choice has been made not on the score of efficiency but in order to secure stability of tuning. From the point of view of efficiency the ordinary mica-dielectric type would be quite satisfactory and somewhat cheaper. Mica condensers, however, suffer from some inconstancy of capacity, for they are appreciably affected by temperature, vibration and humidity. Again for constancy, the coils are former wound.



The VF amplifier can be seen on the left with the sync separator on the right and the DC restorer between them.



A side view of the RF amplifier; short connections are obtained by inverting alternate valves.

The method of construction adopted is somewhat unorthodox, but combines a maximum of screening with a minimum of stray circuit capacity, and maintains the overall dimensions within reasonable limits. It is unnecessary to explain this in detail, for it will be abundantly clear from the photographs and drawings; it may be as well to say, however, that the chassis is in two pieces. One consists of the four compartments for the RF valves and detector, and the other of the side chassis carrying the VF stage and sync separator. This latter chassis has an extension which forms the base of the compartments. The compartments should consequently be completely wired before the two sections are screwed together. In most cases the wiring can be carried out with wire such as No. 22 tinned copper run in insulating sleeving. For the heater connections, however, No. 16 must be used on account of the heavy

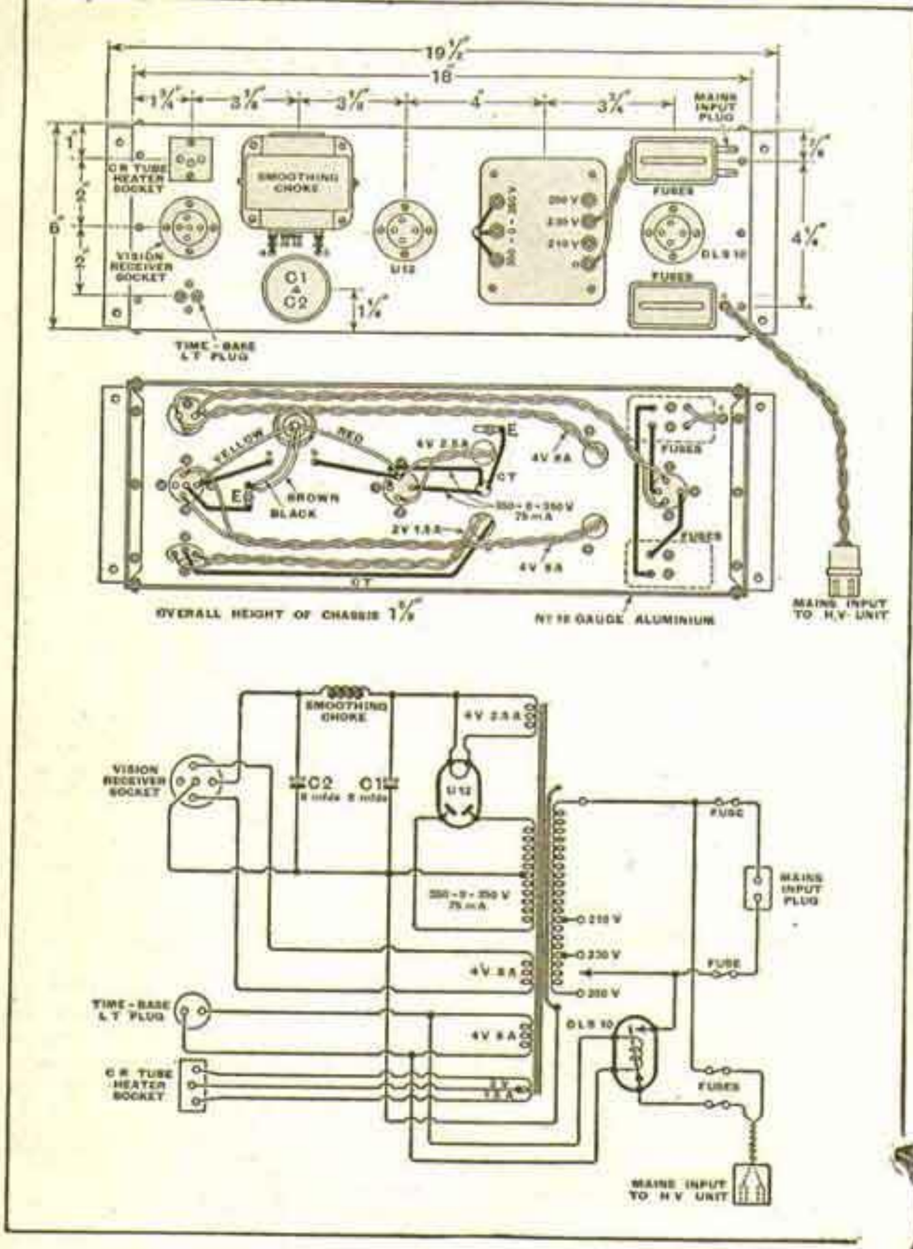


Fig. 2.—These drawings show the theoretical circuit, constructional details and practical wiring plan of the vision receiver power unit.

current, and this gauge is also convenient for a few other cases where especial rigidity is desirable.

When receiver and power unit have been completed they can with advantage be tested independently of the remainder of the equipment with the aid of a pair of phones or even a loud speaker. The phones or speaker transformer primary should be connected across R14, a condenser of 0.1μF. or more being interposed to prevent the DC load resistance of the diode becoming too low for safety.

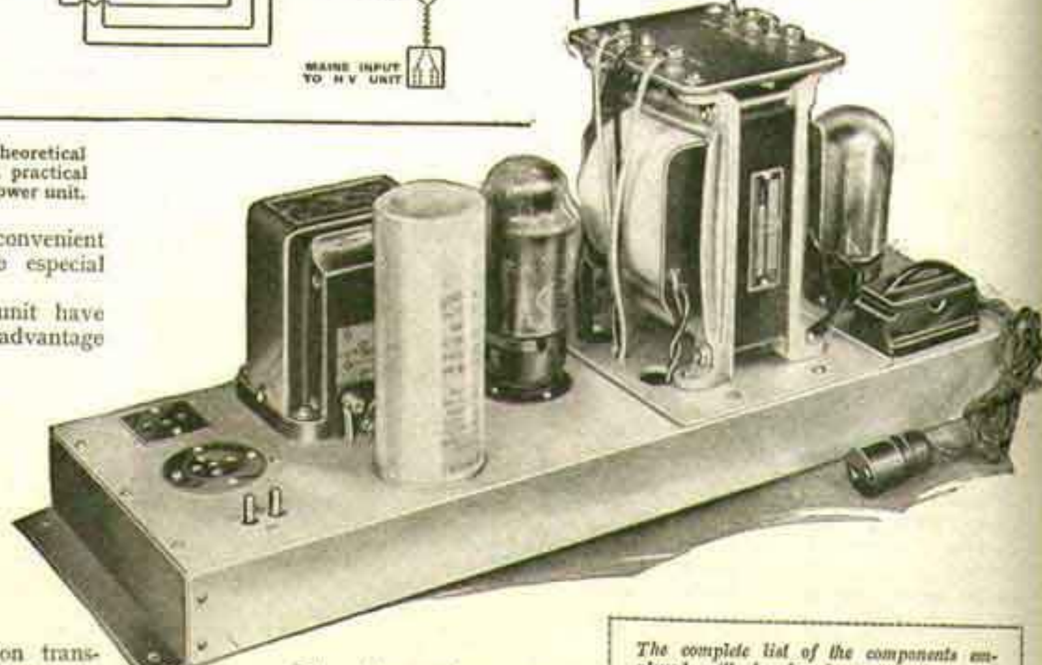
Choose a time when the vision transmitter is working, and with the gain control set somewhere near maximum tune in this signal by means of the four tuning condensers. Their optimum settings will be towards their minimum capacities. No difficulty should be experienced in finding the signal, for it is on a lower wavelength than the sound, and the characteristic signal of a vision transmitter is easily recognised, consisting chiefly of the frame synchronising pulses. If the phones are unusually good it may also be possible to hear the very high pitched note of the line synchronising pulses.

Testing the Receiver

It should readily be possible to obtain very loud phone signals, and such signals are about the strength necessary for operation of the CR tube. Provided that strong signals are obtained it is unnecessary to make any attempt at adjusting the circuits accurately, for this must be done for the best picture quality. In general, the circuits should not be all tuned accurately to the signal, but some of them staggered, notably the coupling to the detector. Naturally this can only be done with the tube connected and working so that the effect of the tuning on the picture quality can be observed.

At this stage, therefore, one should be content with determining that the receiver works properly in producing loud phone signals.

Before pictures can be obtained it is, of course, necessary to have a time-base and other associated equipment. Constructional details of the time-base will be given next week, while the high-voltage unit, tube assembly and sound equipment will be dealt with later in this series of articles. The operation and adjustment of the apparatus will be fully treated in the concluding instalment.



The vision receiver power unit contains the delay switch controlling the high-voltage unit.

The complete list of the components employed will be found on page 17; in many cases the use of suitable alternatives is permissible.

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FULL details were given last week of the vision receiver and its power unit and in this article the time-base is described. It is designed for a tube with electrostatic deflection and has balanced outputs, the saw-tooth oscillators being gas-filled triodes

II.—CONSTRUCTING THE DOUBLE TIME-BASE

SECOND in importance only to the receiver is the time-base which must provide suitable voltages for deflecting the beam in the cathode-ray tube and so permit the construction of the raster. The CR tube requires about 1,000 volts between its deflection plates to move the spot from one side of the screen to the other, and the wave form of the time-base output must rise steadily and linearly with time from zero to its maximum in nearly 1/50 second for frame scanning and 1/10,125th second for line scanning, and having reached its maximum value it must fall back to zero in as short a time as possible. The total time of each rise of voltage and its subsequent fall back to zero must be 1/50th second and 1/10,125th second for the frame and line scans respectively.

In general it is not possible to generate a true saw-tooth waveform with a voltage as great as 1,000 volts p-p directly. It is necessary to generate a lower voltage, and then to amplify it and in view of the type of waveform resistance coupled stages are practically essential. In spite of the saw-tooth wave of each scan being of constant "frequency," the amplifier must be capable of dealing with a wide band of frequencies if distortion is not to be introduced. Actually, to handle a perfect saw-tooth wave with an instantaneous fall from maximum to zero voltage, or "fly-back," the frequency response curve of the amplifier would have to be flat from the frequency of repetition of the wave to infinity, and there would also have to be zero phase distortion over this range.

Balanced Output

In practice, the fly-back time is finite and of the order of 5 per cent. of the scan time. When this is so the amplifier need be capable of dealing with frequencies from the fundamental time-base frequency to about ten or twenty times this value only. Since phase shift is important this implies a good frequency characteristic. The frame scanning amplifier must thus deal with frequencies of some 50 c/s to 500/1,000 c/s, and the line scanning amplifier with frequencies of about 10,000 c/s to 100,000/200,000 c/s.

Not only must the amplifier give a large output and handle a wide range of frequencies, but the output must be balanced to earth. With electrostatic deflection severe distortion of the shape of the picture occurs if this condition is not complied with; instead of a rectangular raster being obtained, unbalanced outputs result in a raster shaped like a trapezium. An unbalanced output is obtained when one of the two output terminals is maintained at earth potential, and the potential of the other varies above and below earth. With a balanced output neither output terminal is earthed, and at any instant the two output terminals are at equal and opposite potentials with respect to earth. The familiar push-pull amplifier is an example of a balanced amplifier, and a form of push-pull is actually employed in the time-base output circuits.

The complete time-base circuit appears in Fig. 2, and V4 is the frame scanning oscillator and is a gas-filled triode. The valve is initially non-conductive and the capacity formed by C11 and C12 in series charges through R17 and R18. The voltage across these condensers and hence the anode voltage of V4, consequently rises at a rate dependent upon the HT voltage and the value of R17. When the voltage rises to a certain value, dependent upon the grid bias of V4 and

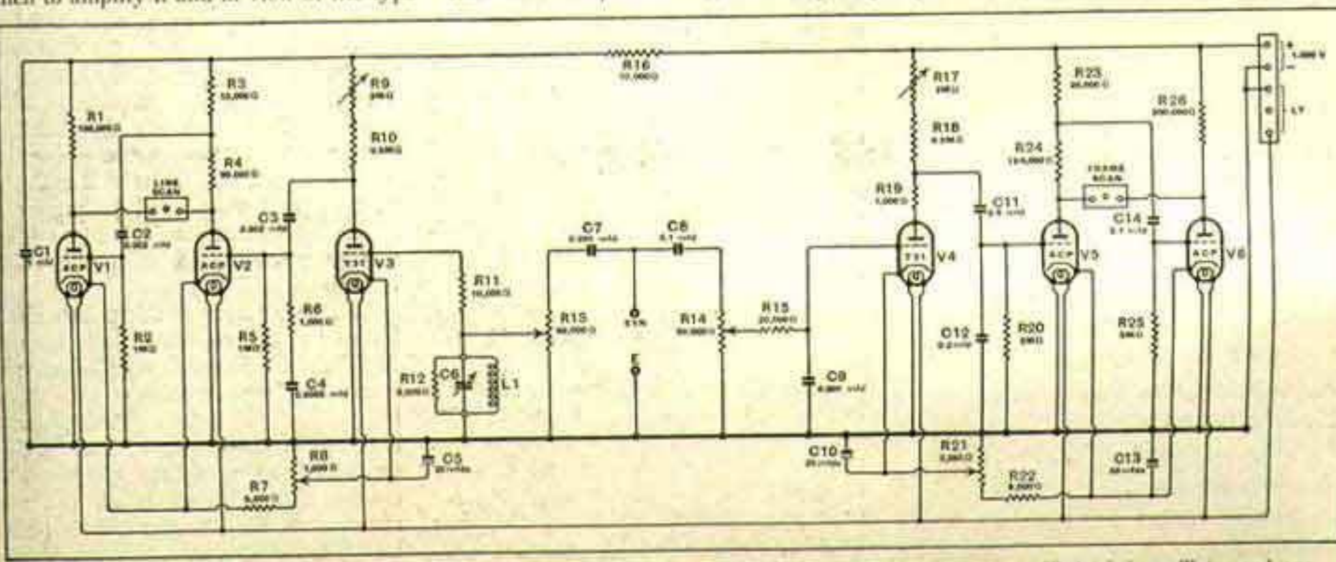


Fig. 2.—The complete circuit diagram of the time-bases is shown here. Each of the two consists of a gas-filled triode oscillator and one triode amplifier with a triode phase-reverser for balanced operation.

DESIGNED BY W. T. COCKING

Receiver

A view of the complete time-base. The gas-filled triodes are provided with insulated top-caps.

determined by the setting of R21, V4 becomes conductive and rapidly discharges the condensers. The resistance R19 is included merely to limit the discharge current to a safe value for the valve.

This is the action without synchronising. In practice, however, synchronising is essential, and the output of the sync separator in the vision receiver is applied to the terminals shown. The mixture of line and frame sync pulses flows through the two parallel circuits C8, R14 and C7, R13, and the desired amplitudes are taken off these potentiometers. A simple filter circuit comprising R15 and C9 is connected between R14 and the grid of V4, so that only the frame sync pulses are applied in any amplitude to the valve.

The Effect of the Sync Pulses

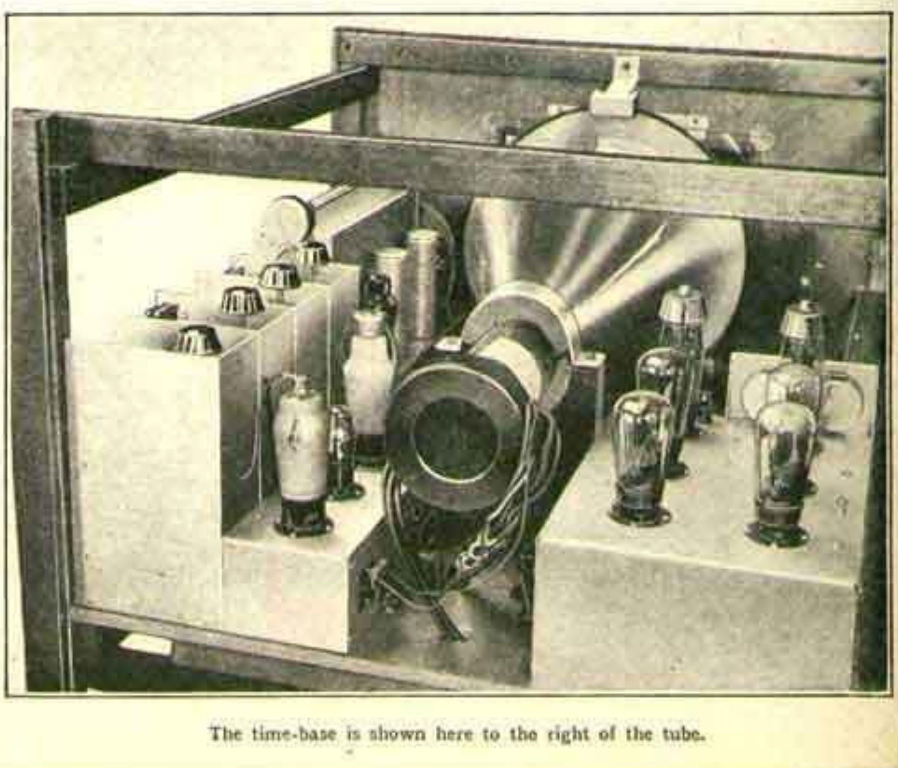
When in normal operation, the action is now as described above, but while the anode voltage of V4 is still rising, and before it has reached a high enough value to initiate the discharge in V4, the frame sync pulse arrives and drives the grid of V4 positive. This starts the discharge at a definite time. The net result is that the time of each discharge is determined by the frame sync pulses and the oscillator is maintained at the correct frequency. The varying voltage across C12 is applied to the triode amplifier V5 and about 500 volts p-p is developed across its anode resistances R23 and R24, and is applied to one deflecting plate of the CR tube. One-tenth of this voltage, that developed across R23 is applied to the grid of V6 through C14 with the result that a further 500 volts p-p is developed across the coupling resistance R26 and applied to the other vertical deflecting plate of the tube. Owing to the phase-reversal in this valve, its output is in opposite phase to that of V5, and so the balanced output is secured. The use of this additional valve V6 not only enables balanced operation to be obtained, but it also permits the required output being obtained with about one-half the HT voltage which would otherwise be necessary. Even so, an HT supply of some 1,000 volts is needed.

The two amplifier valves are biased by a common cathode resistance comprising R21 and R22. The cathode of the gas-filled triode V4 is returned to the slider on R21, and a portion of the bias of V5 and V6 is used also for V4.

The Filter Circuit

The line time-base is similar and comprises the gas-filled triode V3, the amplifier V2 and the phase-reverser V1. The resistance R6 is included in series with C4 to accelerate the fly-back speed, and a filter circuit is included in the grid circuit of V3. This assists in the sync separation and appreciably improves the line synchronising, especially when interference is present.

The filter comprises the resistances R11 and R12, and the tuned circuit L1, C6, and it is in reality a crude form of band-pass filter. The main filtering is accomplished by L1 and C6, the circuit being tuned to the line frequency of 10,125 c/s. The resistance R11 is included in order to ensure a fairly high resistance grid circuit for the gas-filled triode V3, since experience shows that if the DC resistance of the grid circuit is too low V3 operates irregu-



The time-base is shown here to the right of the tube.

The Wireless World Television Receiver—

larly. If the grid circuit resistance is not high enough there is an appreciable variation in the starting times of the lines, and a consequent reduction of the picture definition.

A very important point lies in the shunting resistance R12 to the tuned circuit. This must be of quite low value for a satisfactory performance, low enough, in fact, to make the tuned circuit non-oscillatory. If this resistance has too high a value the tuned circuit is oscillatory, which means that any sudden change in the voltage applied to it makes the circuit oscillate for a few cycles at its natural frequency. This natural frequency is slightly different from the normal resonance frequency determined by the inductance and capacity, for it is affected also by the circuit resistance. Now the sync pulses and also the grid current of V3 are of an ideal form for kicking L1, C6 into oscillation and such oscillation has a very detrimental effect upon the operation of the time-base.

Actually, L1 has an inductance of the order of 0.25 H and C6 is about 0.001 μF. In order to make the circuit non-oscillatory, R12 must not be greater than 2,500 ohms. With these values the filter functions very well indeed, and materially improves the stability of synchronisation.

This time-base does not need detailed explanation since it is essentially the same as the frame time-base, the differences being merely in the values of components necessitated by the much higher operating frequency. The unit as a whole consumes about 15/20mA. at 1,000 volts for HT and some 8 amperes at 4 volts for LT. The HT supply is taken from the high-voltage unit which will be described later, but the LT comes from the vision receiver power pack described last week.

Constructionally there is little to say about the time-base, for all components are assembled on the underside of the

THE LIST OF PARTS FOR THE TIME-BASE

Certain components of other makes but of similar characteristics may be used as alternatives to those given in the following list.

Fixed Condensers:
- 1 0.0005 mfd., mica **C4** — **Dubilier 690W**
- 2 0.001 mfd., mica **C7, C9** — **Dubilier 690W**
- 2 0.002 mfd., 5,000 volts DC test, **C2, C3** — **Dubilier 680**
- 1 0.1 mfd., 1,500 volts working, **C14** — **Dubilier 950A**
- 1 0.5 mfd., 1,500 volts working, **C11** — **Dubilier 950A**
- 1 1 mfd., 1,000 volts working, **C1** — **Dubilier 950A**
- 1 0.1 mfd., tubular, **C8** — **Dubilier 4523**
- 1 0.2 mfd., tubular, **C12** — **Dubilier 4425/S**
- 2 25 mfds., 25 volts, electrolytic, **C5, C10** — **Dubilier 3016**
- 1 50 mfds., 50 volts, electrolytic, **C13** — **Dubilier 3004**
- 1 Pre-set double 0.0009 mfds, **C6** — **Hunt's 3288**

Resistances:
- 1 2,500 ohms, ½ watt, **R12** — **Erie**
- 2 10,000 ohms, ½ watt, **R3, R11** — **Erie**
- 2 20,000 ohms, ½ watt, **R15, R23** — **Erie**
- 2 1 megohm, ½ watt, **R2, R5** — **Erie**
- 2 5 megohms, ½ watt, **R20, R25** — **Erie**
- 1 5,000 ohms, 1 watt, **R7** — **Erie**
- 1 8,000 ohms, 1 watt, **R22** — **Erie**
- 2 0.5 megohm, 1 watt, **R10, R18** — **Erie**
- 2 1,000 ohms, 2 watts, **R6, R19** — **Erie**
- 1 10,000 ohms, 3 watts, **R16** — **Erie**
- 1 90,000 ohms, 3 watts, **R4** — **Erie**
- 1 100,000 ohms, 3 watts, **R1** — **Erie**
- 1 180,000 ohms, 3 watts, **R24** — **Erie**
- 1 200,000 ohms, 3 watts, **R26** — **Erie**

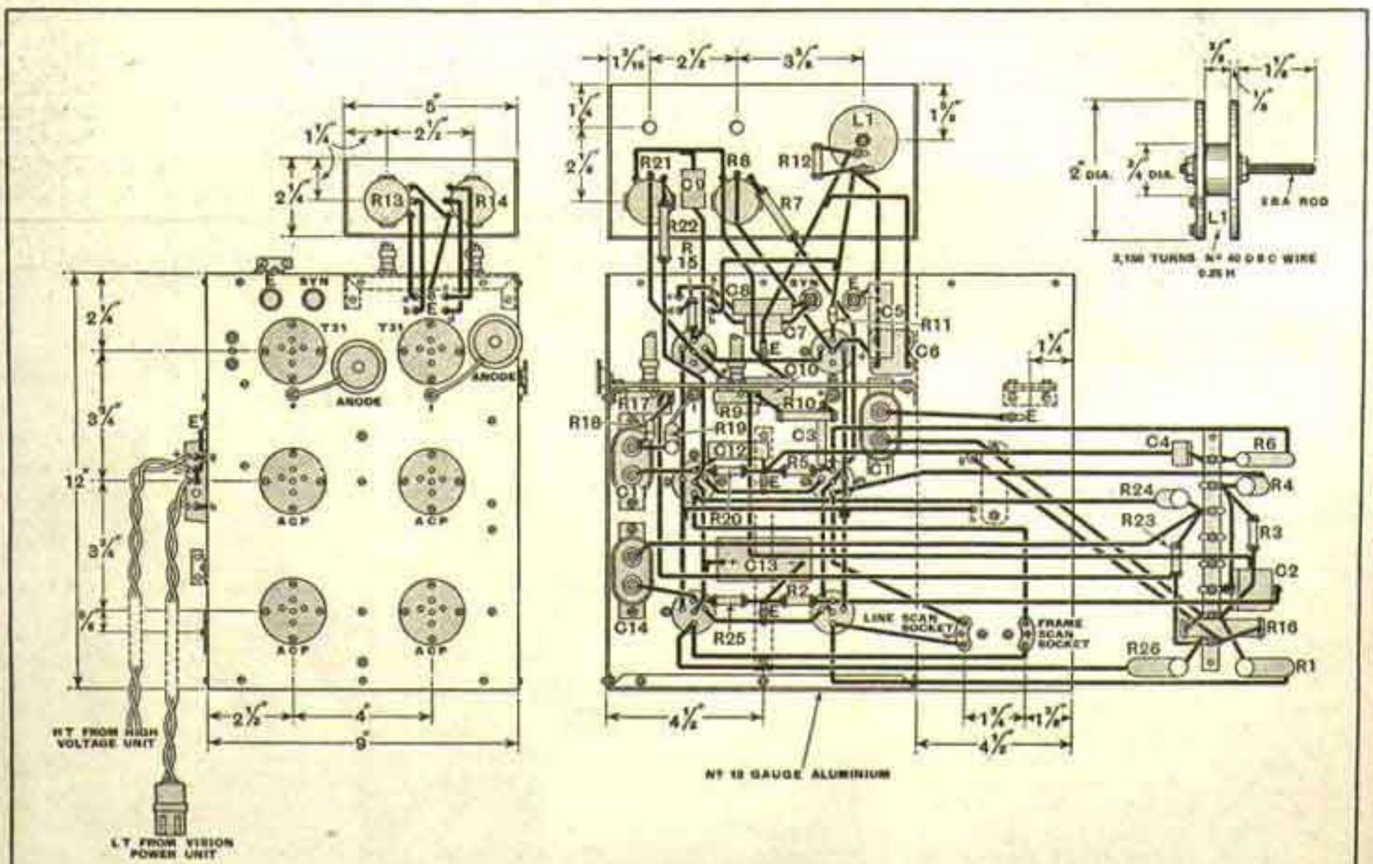
Potentiometers, non-graded:
- 1 1,000 ohms, wire-wound, **R8** — **Reliance "TW"**
- 1 2,000 ohms, wire-wound, **R21** — **Reliance "TW"**
- 2 50,000 ohms, **R13, R14** — **Reliance "SG"**
- 2 2 megohms, **R9, R17** — **Reliance "SG"**

6 Valve holders, 5-pin (7-pin type fixing) — **Clix Chassis Mounting Type.**
2 Extension control outfits — **Eddystone 1008**
4 Shaft couplings, ¼in. — **Bulgin**
2 Plugs and sockets, 3-pin — **Belling-Lee 1119**
2 Insulated valve top connectors — **Bulgin P92**
1 Connector, 5-way — **Bryce 5C4**
1 Choke 0.25 H — **B.T.S.**
2 Terminals, ebonite shrouded, Syn, E. — **Belling-Lee "B"**

Chassis — **Sound Sales**

Miscellaneous: — **Peto-Scott**
Paxolin bracket and strip, wire, systoflex, screws, etc.

Valves:
4 AC/P, 2 T31 — **Mazda**



Full constructional and wiring details of the time-base are given here.

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hassis and everything is quite straight-orward. Owing to the high voltage em-loyed, however, care must be taken to e that good insulation is obtained and picture in the horizontal and vertical directions respectively while R9 and R17 control the time-base frequencies. The remaining controls R13 and R14 enable the amplitudes of the line and frame synchronising pulses to be varied; only very occasional adjustment is needed, and if it were desired to reduce the number of panel controls they could be arranged as pre-set controls adjustable internally.

[*In the next instalment the design and construction of the high-voltage unit will be described in detail.*]

The Wireless World Television Receiver

III.—CONSTRUCTING THE HIGH-VOLTAGE SUPPLY UNIT AND THE SOUND POWER STAGE

DESIGNED BY W. T. COCKING

IN the preceding articles the vision receiver time-base, and the vision receiver power pack have been described, and the high-voltage unit, which supplies HT for both tube and time-base, must now be dealt with. The circuit diagram appears in Fig. 3 and the mains input voltage is derived from the vision receiver power pack in which the delay switch is included. The mains transformer has two secondaries rated at 4 volts 1 ampere, for the filaments of the two U17 valves, and a winding rated at 30 mA. at 1,750 volts.

The two rectifiers are connected in the voltage-doubler circuit with condensers C1 and C2 of 0.1 μF. and 1.0 μF. respectively. A current of some 20 mA. at 2,000 volts is withdrawn from the junction of these condensers and is used for operating the time-base. It is dropped to 1,000 volts by means of R2 and R3 which also provide smoothing in conjunction with C3 and C4.

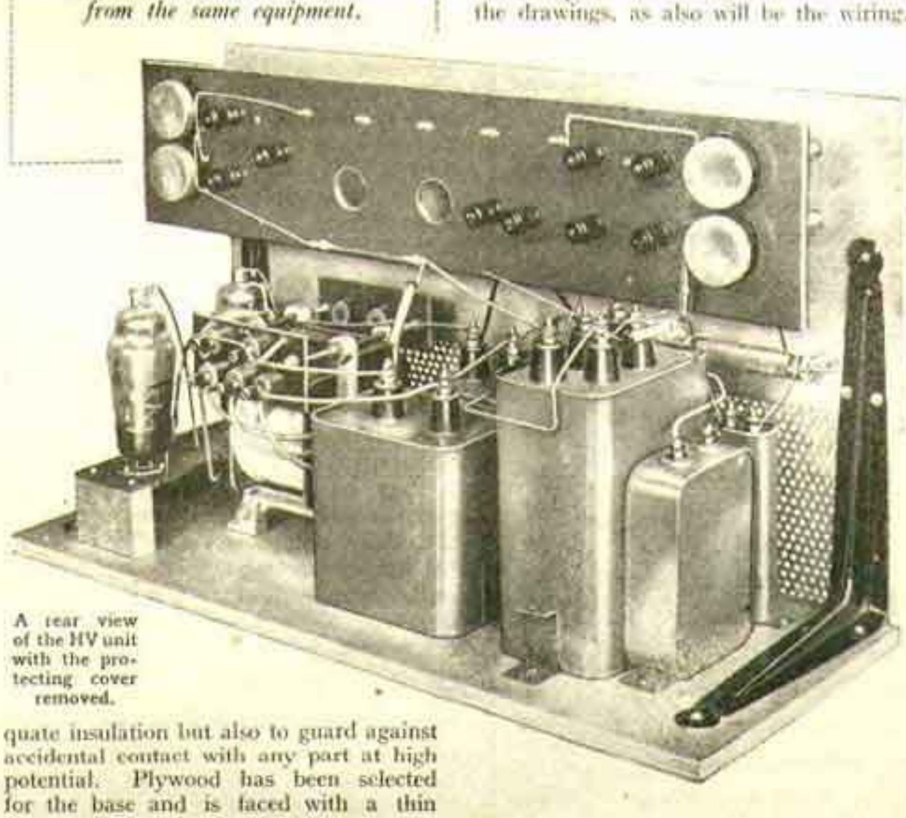
The voltage across C1 and C2 is about 4,500 volts and is used for the cathode-ray tube HT supply. The tube current consumption is very small, and the total current is substantially that consumed by the voltage divider—about 1 mA. Smoothing is effected by the resistance R1 and the following condensers. These condensers are connected across the tapping points of the voltage-divider, and so also tend to maintain the tube electrodes at cathode potential for alternating currents.

The two potentiometers R4 and R5 are termed the horizontal and vertical shift controls respectively, since they permit the picture to be moved sideways or up and down on the screen of the tube and so to be centred accurately. The potentiometer R9 enables the second anode voltage to be varied so that the light spot can be focused on the screen. These three controls are brought out to the panel for convenience, but as they only require occasional adjustment it would be quite permissible to make them internally adjustable. The fourth control on this unit is the brilliancy control; it is R13 and varies the grid bias of the tube.

Owing to the high voltages, special care has been taken in the design of this part of the equipment, not only to provide adequate insulation but also to guard against accidental contact with any part at high potential. Plywood has been selected for the base and is faced with a thin sheet of aluminium so that all components can be earthed by their contact with it. Before screwing down the condensers it is wise to scrape off the paint beneath the fixing flanges so that a good contact is ensured. Incidentally, in the case of the condensers C5, C6, C7, C8 and C9, which are all in a single container, the case is actually the connection to one side of C9 and it is accordingly fitted with an earthing screw.

The two valveholders are carried on a Paxolin strip supported above the base by wooden blocks in order that adequate insulation may be obtained. Similarly the fixed and variable resistances and the output terminals are mounted on another Paxolin panel. All this will be clear from the drawings, as also will be the wiring.

A CATHODE-RAY tube demands an HT supply of several thousand volts, but quite a small current is needed. Components must consequently be built to withstand much greater voltages than is usual in receiving equipment and the apparatus must be adequately protected. The peak voltages are reduced by using the voltage-doubler rectifier, and this is economical in permitting the time-base HT supply to be derived from the same equipment.



A rear view of the HV unit with the protecting cover removed.

CONSTRUCTIONAL DETAILS OF THE HIGH-VOLTAGE UNIT

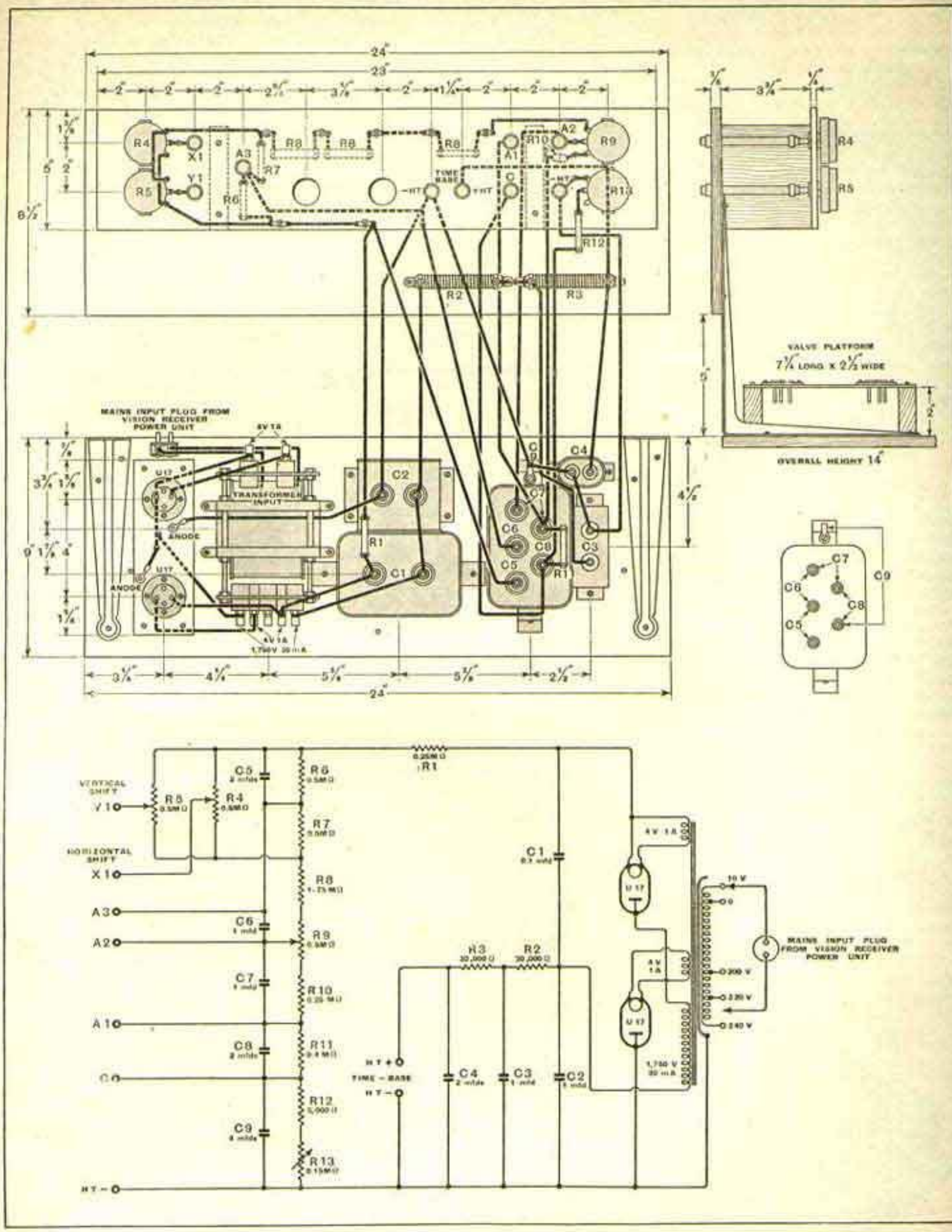


Fig. 3.—The theoretical circuit diagram is shown here as well as the practical wiring diagram.

"The Wireless World" Television Receiver—

No reliance can be placed on insulating sleeving at high voltages, of course, and every high-voltage wire should be spaced by half an inch or so from other wires or components. No. 18 or even 16 gauge wire stretched straight is the most convenient on account of its rigidity. Especial care must be taken in the construction and wiring of this unit. Although the variable resistances have "dead" spindles, no reliance is placed in their insulation, and insulating couplers are provided for the couplings to the extension control shafts. These couplers are of the type used in short-wave apparatus for the avoidance of hand-capacity effects and consist of a length of insulating tubing with a set-screw at each end. When connecting up remember to insert the extension shaft only far enough for the set-screw to grip properly. The couplers are hollow and it would be possible to push a shaft through so far that it could butt up against the end of the potentiometer spindle. To do this would completely defeat the end in view and would be asking for trouble.

Enclosing the HV Unit

A screen of perforated zinc covers the unit, and when it is in position it is impossible to come into contact with any high-voltage part. Although it is not essential to the working of the apparatus, it is a safety device the use of which is strongly recommended.

Suitably insulated wire must be used for the external connections to this unit. Ordinary good quality lighting flex can be used for the −HT and cathode leads; heavily insulated cable similar to motor-car ignition cable is adopted for the high-voltage connections.

Before passing on to the tube connections, inter-unit connections and cabinet, it may be as well to deal with the sound equipment. The receiver has already been dealt with in *The Wireless World*[1] under the title of The Ultra-Short-Wave Quality Receiver. It can be used with the Push-Pull Quality Amplifier if desired, and space has been left in the cabinet to accommodate it. Those who are not already in possession of this amplifier, however, will need an output stage and mains equipment, and a small unit has been designed for this purpose. The circuit diagram appears in Fig. 4, and it will be seen that a single PX4 output valve is employed with resistance coupling, while the mains equipment is of the simplest type. The output of such a valve is entirely adequate for television purposes, for experience shows that appreciably lower volume is needed than for ordinary broadcast reproduction. This is undoubtedly partly because one listens more attentively when one has vision as well as sound, but it is also due to the size of the picture. For optimum results, the picture size and sound volume must be correctly balanced.

The construction of the sound power unit is entirely straightforward and calls for no comment. When it is used, however, the Ultra-Short-Wave Quality Re-

[1] *The Wireless World*, April 23rd, 1937.

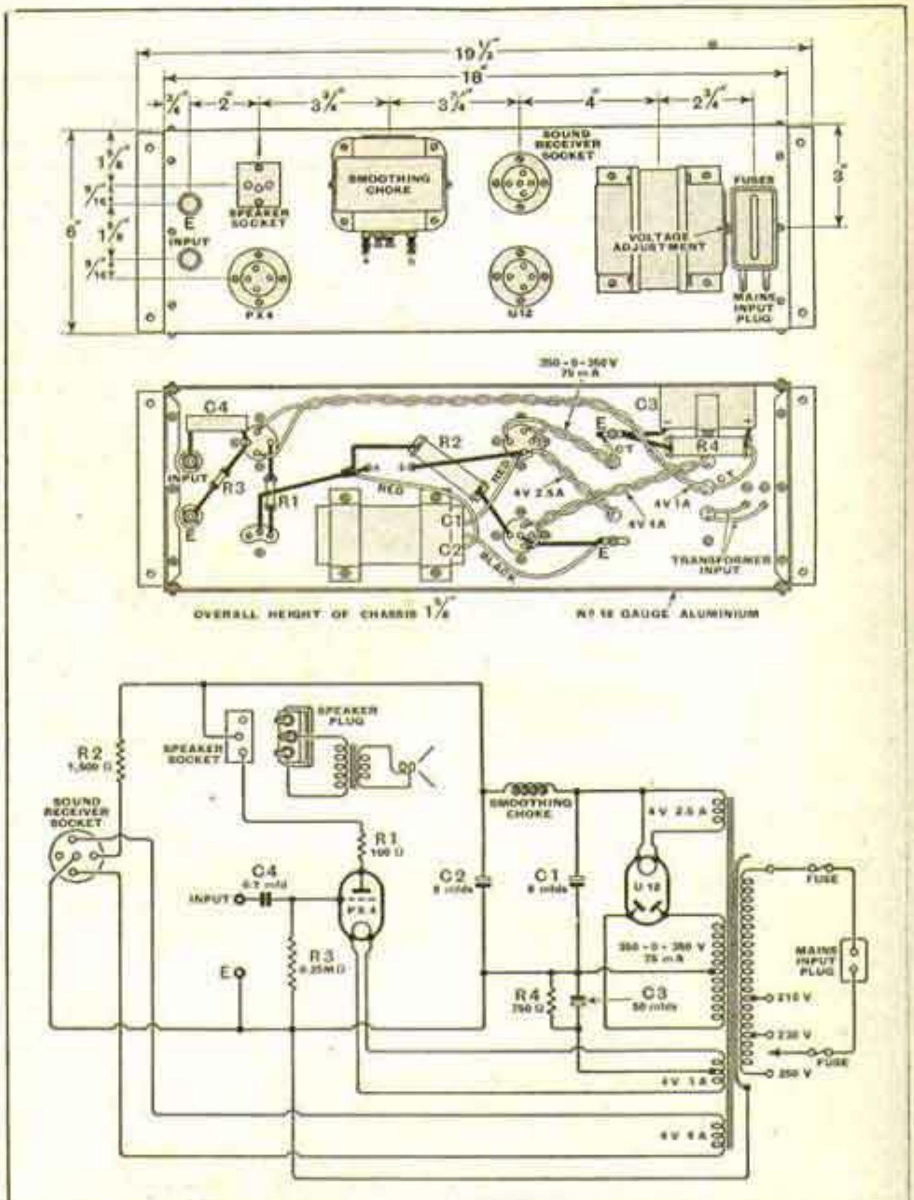
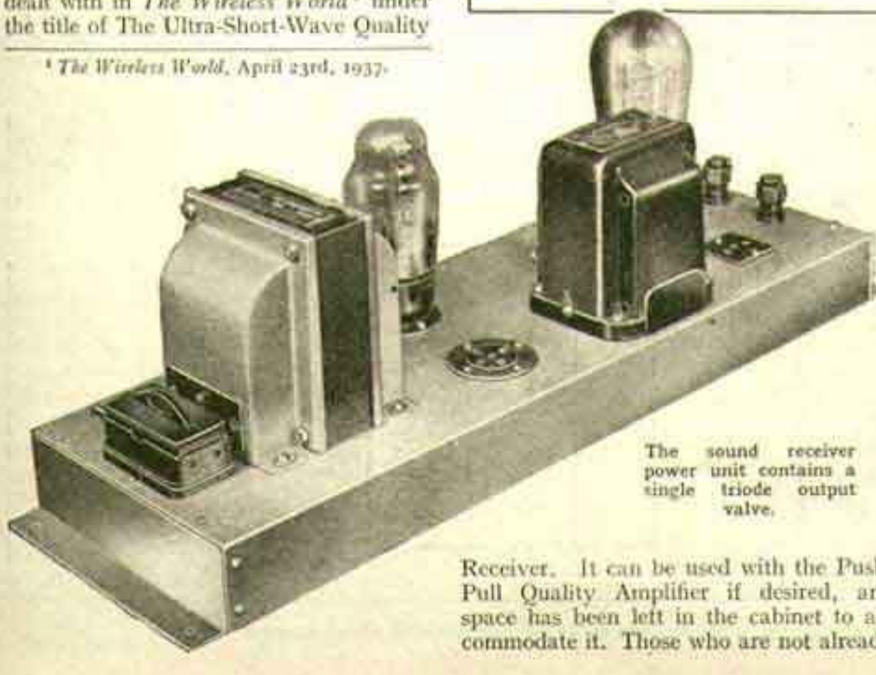


Fig. 4.—Full details are given here of a simple power unit for the sound receiver.



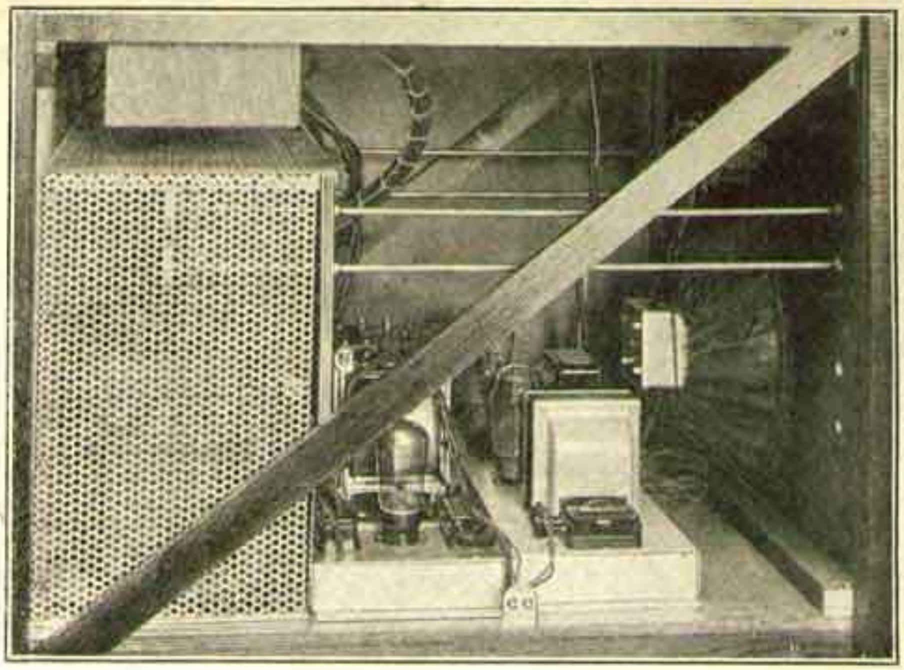
The sound receiver power unit contains a single triode output valve.

"The Wireless World" Television Receiver—
ceiver must be altered in one particular —the resistance R10 *in the receiver* must be short-circuited and only the "+Output" terminal employed. It is also important to use a metallised detector valve or to fit a valve screen over a plain detector; if this is not done the valve will pick up the scanning voltages by electrostatic induction from the tube since it is mounted immediately alongside its end.

A single 5-way cable in which four wires only are employed serves to convey power to the sound receiver, and a single screened lead carries the AF output to the power unit.

A permanent-magnet type loud speaker having very good characteristics has been selected and has proved very satisfactory. In this connection it must not be forgotten that the stray field of the magnet is important and may distort the picture. Excessive field will distort the rectangular picture into a trapezium. In order to avoid this effect the speaker has been carefully chosen and has been mounted as far as possible from the tube.

The assembly of the various units will be described next week.



A side view of the lower deck of the apparatus ; from left to right the units are the HV supply equipment, the vision receiver power pack, and the sound receiver power pack.

THE LIST OF PARTS USED

Certain components of other makes but of similar characteristics may be used as alternatives to those given in the following list.

HIGH-VOLTAGE UNIT

1 Mains transformer, Primary: 200-250 volts, 50 c/s; Secondaries: 1,750 volts 30 m/A., 4 volts 1 amp., 4 volts 1 amp. — **Sound Sales TEL/EHT**

Resistances:
- 1 5,000 ohms, ½ watt, **R12** — **Erie**
- 3 250,000 ohms, 1 watt, **R1, R8, R10** — **Erie**
- 1 400,000 ohms, 1 watt, **R11** — **Erie**
- 2 0.5 megohm, 1 watt, **R6, R7** — **Erie**
- 2 0.75 megohm, 2 watts, **R8** — **Erie**
- 2 30,000 ohms, 40 watts, **R2, R3** — **Bulgin PR39**

(R8 = 2 × 0.75MΩ + 1 × 0.25MΩ)

Resistances Variable, non-tapered.
- 1 150,000 ohms, **R13** — **Reliance "SG"**
- 3 0.5 megohm, **R4, R5, R9** — **Reliance "SG"**

Fixed Condensers:
- 1 0.1 mfd., 7,000 volts, oil-immersed, **C1** — **Dubilier 951**
- 1 1 mfd., 2,000 volts, oil-immersed, **C3** — **Dubilier 951B**
- 1 1 mfd., 3,000 volts, oil-immersed, **C2** — **Dubilier 951C**
- 1 2 mfds., 1,000 volts, oil-immersed, **C4** — **Dubilier 950A**
- 1 10 mfds. (multiple block), **C5, C6, C7, C8, C9** — **Dubilier BE526**

2 Valve holders 4-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**

2 Plug-top valve connectors. — **Belling-Lee 1175**

1 Mains connector, 2-way — **Bulgin P33**

9 Terminals, ebonite shrouded, HT+, HT−(2), A1, A2, A3, C, X, Y — **Belling-Lee "B"**

4 Extension control outfits — **Eddystone 1008**

Miscellaneous: — **Peto-Scott**
Paxolin sheet, baseboard, perforated zinc, wire, sistoflex, screws, etc.

Valves:
2 U17 — **Osram**

SOUND RECEIVER POWER PACK

1 Mains transformer, Primary: 200/250 volts, 50 c/s; Secondaries: 350-0-350 volts 75 m/A., 4 volts 2.5 amps., 4 volts 4 amps., 4 volts 1 amp., C.T. — **Bryce 5VT28**

1 Smoothing Choke — **Varley Dual DP11**

Fixed Condensers:
- 1 0.1 mfd., 350 volts, tubular, **C4** — **T.C.C. 250**
- 1 8+8 mfds., 450 volts, electrolytic, **C1, C2** — **T.C.C. 702H/3c**
- 1 50 mfds., 50 volts, electrolytic, **C3** — **Dubilier 3004**

Resistances:
- 1 100 ohms, ½ watt, **R1** — **Erie**
- 1 250,000 ohms, ½ watt, **R3** — **Erie**
- 1 750 ohms, 3 watts, **R4** — **Erie**
- 1 1,500 ohms, 3 watts, **R2** — **Erie**

2 Valve holders, 4-pin (without terminals), — **Clix Chassis Mounting Standard Type V1**

1 Valve holder, 5-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**

1 Fused mains input connector with 1 amp. fuses — **Belling-Lee 1114**

1 Plug and socket, 3-pin — **Belling-Lee 1119**

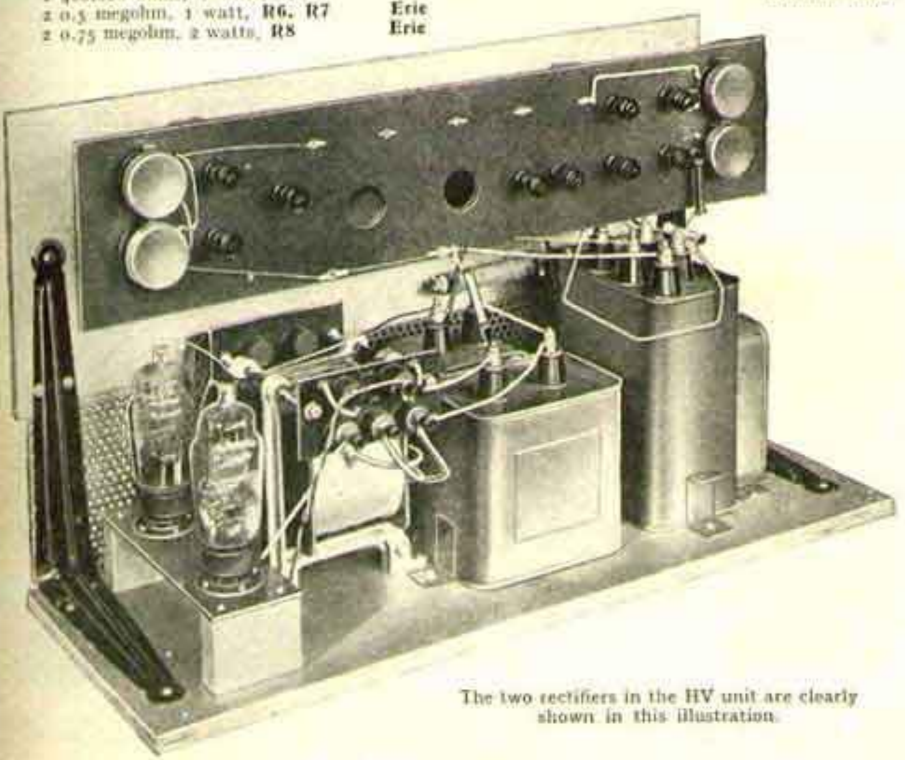
2 Terminals, ebonite shrouded, E, Input — **Belling-Lee "B"**

1 Loud speaker with transformer — **Goodman's WWT Auditorium**

Chassis — **Sound Sales**

Miscellaneous: — **Peto-Scott**
Wire, sistoflex, screws, etc.

Valves:
1 U12, 1 PX4 — **Osram**



The two rectifiers in the HV unit are clearly shown in this illustration.

The Wireless World Television

IV.—THE FRAMEWORK AND THE ASSEMBLY OF UNITS

DETAILS are given in this article of the method of assembly of the various units which comprise the television receiver, and the framework which houses them is described. The sound receiver is also briefly redescribed.

THE construction of the various units which comprise the sound and vision receivers has been dealt with in the preceding articles, and, before going on to discuss the operation and adjustment, their inter-connection and housing must be dealt with. Unless the equipment is operated in darkness some form of container is necessary in order to keep light from the back of the tube; it is, however, inconvenient to fit the units into a cabinet of normal design, for they would be inaccessible.

The method of housing adopted is one which enables all units to be got at readily and it consists really of a special form of cabinet construction. It consists of a framework made of the four corner posts suitably braced and carrying two shelves for the gear. These posts are grooved and sliding panels are used for the sides and front. The latter must be considered a fixture since the various control shafts pass through it, but the two sides and back can be slid out at a moment's notice. The details of the construction will be clear from the drawings and it will be noticed that small wheels in a swivel mounting are fitted to the legs. Naturally it is a matter of individual preference whether these are adopted or not, but they are recommended in view of the weight of the apparatus since they enable it to be readily moved.

A sheet of ¼-in. plate glass is fitted in the viewing window to protect the tube from accidental damage. In this connection, it must be remembered that a large cathode-ray tube is somewhat fragile and must be handled with care; it is electrically robust, but mechanically delicate and care must be taken to see that it is never knocked. Remember that the external air pressure is several tons; the glass is built to withstand this, but it is folly to increase the strain on it by rough handling.

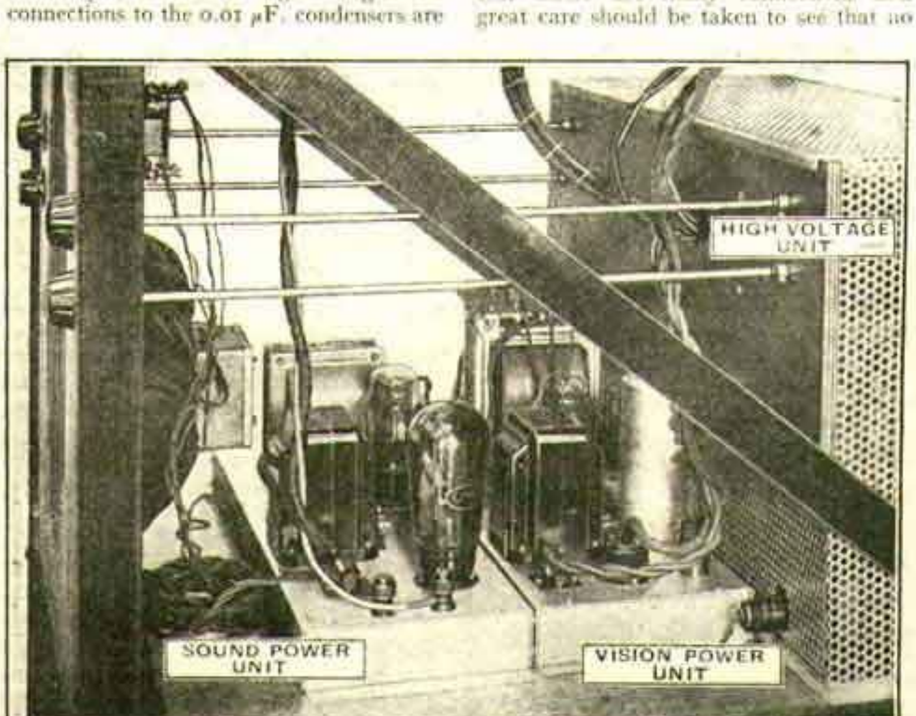
The Tube Mounting

The tube is supported at the front end on two small blocks of sponge rubber and at the other by a cradle, rubber cushioning again being adopted. The tube base fits on the end and is supported entirely by the tube.

The sound and vision receiver chassis are screwed on the right-hand side of the upper shelf and the time-base on the left-hand side at the rear. Between these and immediately beneath the tube base are mounted the two 0.01 mfd. high-voltage condensers for the line deflecting plates. The two 0.1 μF. condensers for the frame deflecting plates and the four 5-megohm resistances are contained in a small wooden box and screwed underneath the shelf under the time-base. These components are fitted in a box to guard against accidental contact with any of the connections for many of these are at high voltage. The connections to the 0.01 μF. condensers are necessarily made outside the box and the joins should consequently be carefully wrapped with rubber insulating tape, many layers being used.

The Connections to the Tube

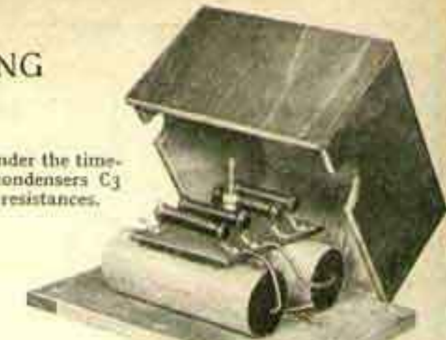
The theoretical circuit of the tube and its immediately associated equipment, which must be considered a part of the framework, is given in Fig. 5 and the practical wiring plan will be found among the other drawings which also show the way in which the various units are interconnected. There are many connections and great care should be taken to see that no



A side view of the lower shelf showing the power units.

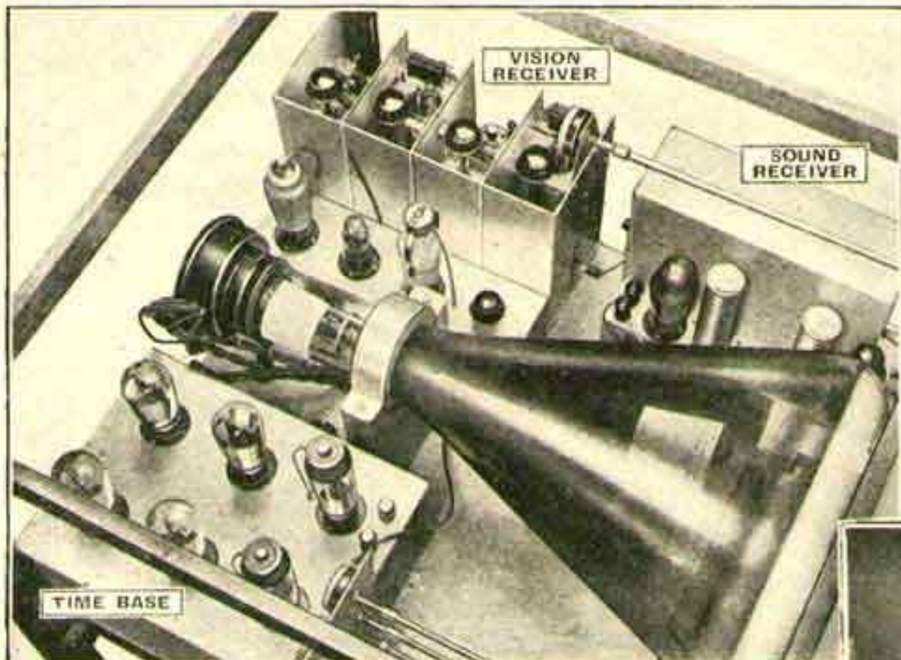
DESIGNED BY W. T. COCKING

Receiver



This box, mounted under the time-base, contains the condensers C3 and C4 and four resistances.

mistakes are made. The deflection plate connections may be a little confusing but no damage will result if an error is made. If the connections to the Y-plates are reversed the picture will appear upside down, while a reversal of the leads to the X-plates will reverse the picture from left to right. The remedy is obvious, but it should be pointed out that should such a misconnection occur, it can be put right either by reversing the leads on the tube socket or on the appropriate time-base plug.



The receivers, time-base, and tube are clearly shown in this illustration.

The Sound Receiver

The power units are all mounted on the lower shelf and the connections pass through holes in the upper shelf. Except in the case of the high-voltage unit, plug and socket connectors are used throughout. The AF connection between the sound receiver and its power unit is screened, as is also the lead between the vision receiver and time-base.

Although the sound receiver has been already described, the circuit diagram is repeated here for convenience of reference. It will be seen from Fig. 7 that a single RF valve is employed with a reacting grid detector. The two tuned circuits provide adequate selectivity to avoid interference from the vision signals and these tuning condensers are ganged together and operated by a single control knob. Following the detector, for which a metallised valve must be used, comes another triode. When the Push-Pull Quality Amplifier is employed this valve acts as a phase-splitter and gives little gain. When the smaller amplifier described last week is employed, however, the resistance R10 is short-circuited and the valve acts as an amplifier giving good gain and an output adequate to load a PX4-type valve.

It will be seen from the drawings that the two aerial coils of the sound and vision receivers are connected in series and joined to the aerial. The type of aerial used is of considerable importance, especially when the equipment is used at any great distance from the Alexandra Palace. In the writer's experience the best results are secured from a centre-fed half-wave dipole mounted vertically and with a reflector behind it. Details regarding various types of aerial were given in a recent issue of *The Wireless World*,[1] and from the data given there it is easy to obtain the dimensions and method of construction of a suitable type.

The Aerial System

Within two or three miles of the transmitter good results can be secured with almost any aerial, even the ordinary broadcast aerial. At greater distances a dipole is to be recommended, and at eight miles or more the addition of a reflector is strongly to be advised since it doubles the signal strength as well as greatly reducing interference which originates to the rear of the array.

This photograph shows the condensers C1 and C2 beneath the tube base.

Whatever aerial system is used it should be erected as high as possible and away from metalwork such as drain pipes and gutters. In particular, it should be kept away from any metalwork which is a multiple of a half-wave in length. A drain

[1] *The Wireless World*, May 28th, 1937.

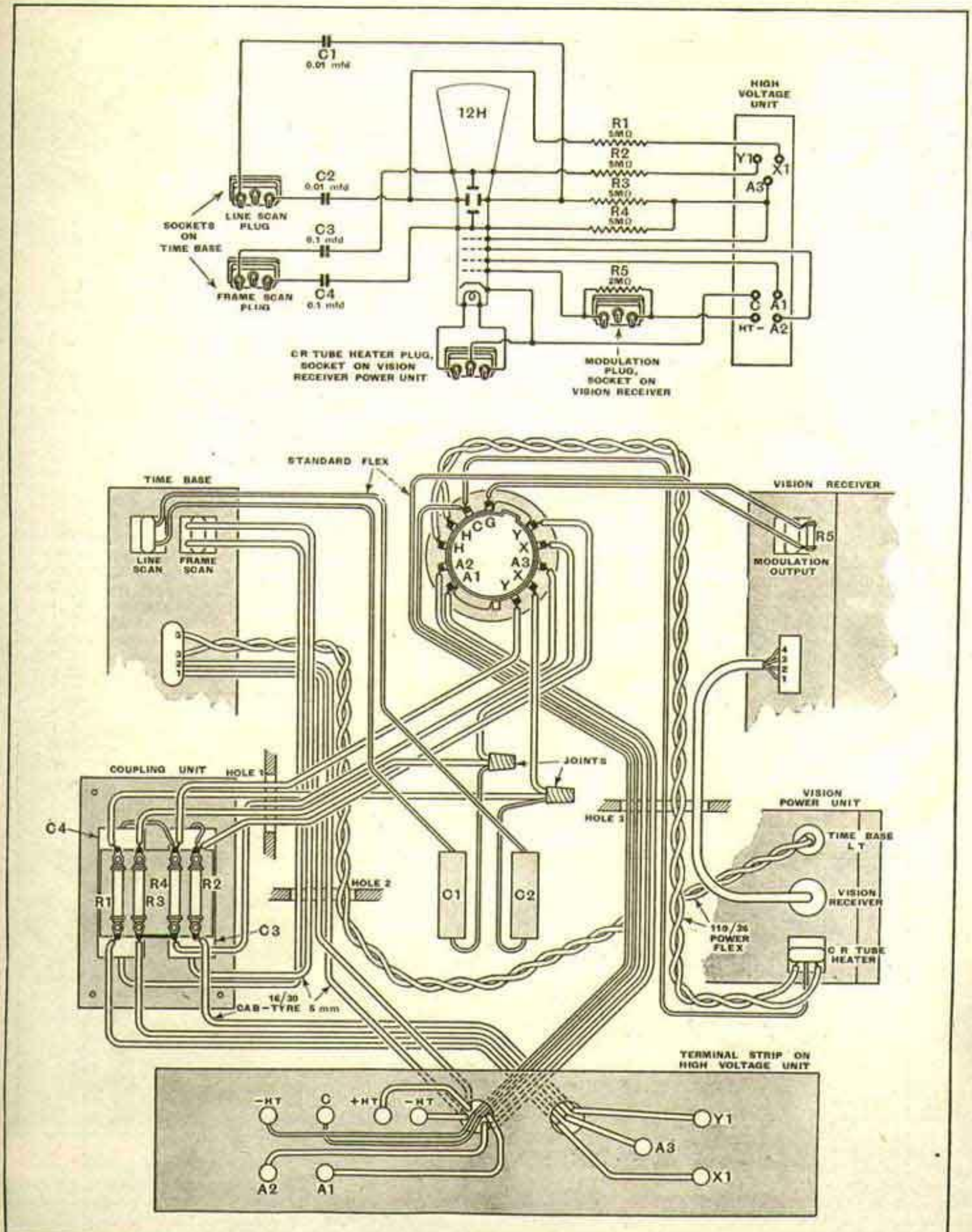


Fig. 5. Circuit diagram and practical wiring plan of the cathode-ray tube and connections to its associated units. The coupling unit should be wired before the high-voltage unit is inserted in the cabinet. On the opposite page, Fig. 6 shows suggested cabinet and layout; also wiring of terminal strips and inter-unit connectors.

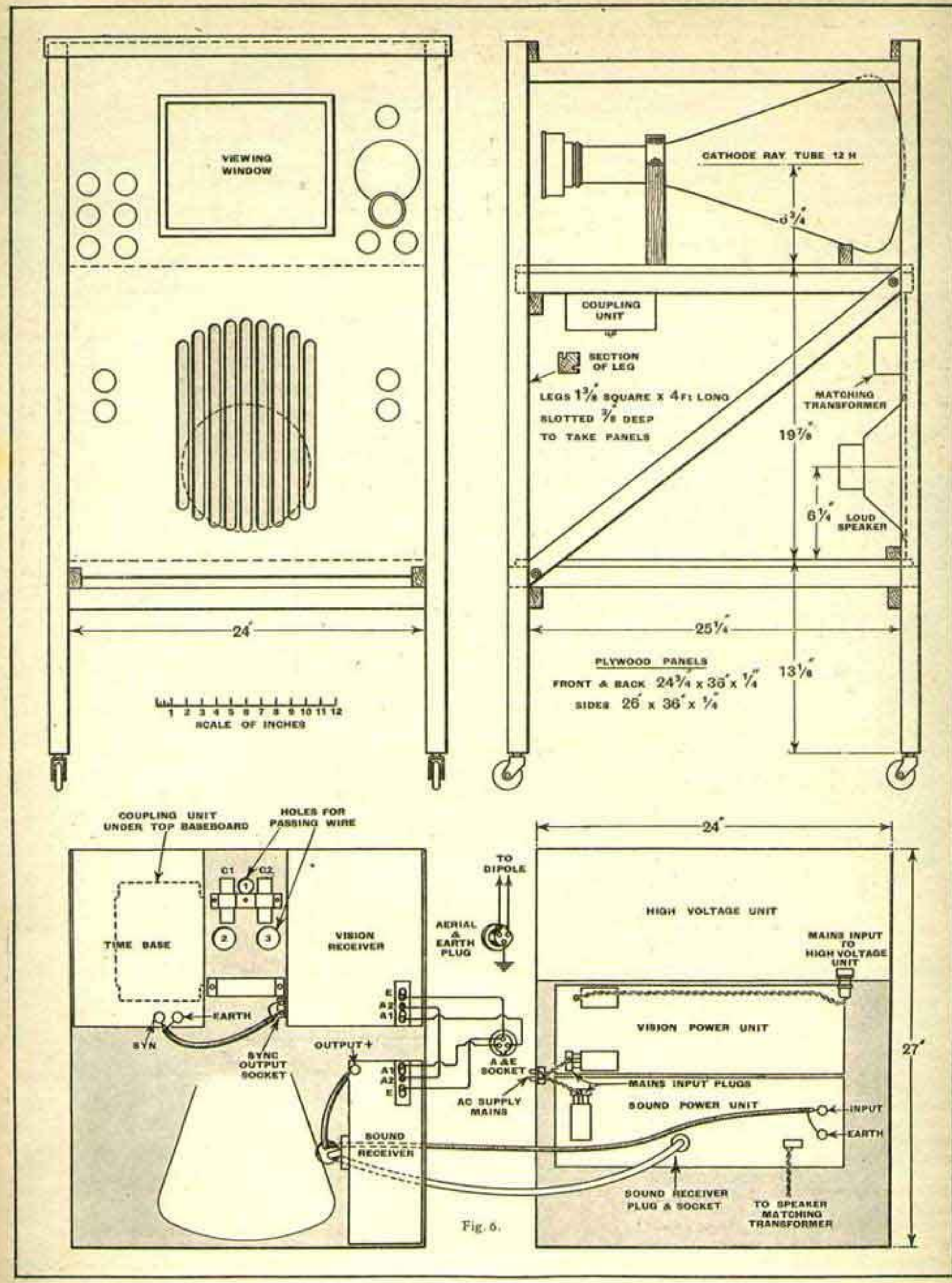

VIEWING WINDOW
24"
SCALE OF INCHES
1 2 3 4 5 6 7 8 9 10 11 12
CATHODE RAY TUBE 12 H
8¾"
COUPLING UNIT
SECTION OF LEG
LEGS 1⅜" SQUARE x 4 Ft LONG
SLOTTED ⅜" DEEP
TO TAKE PANELS
MATCHING TRANSFORMER
19⅞"
6¼"
LOUD SPEAKER
25¼"
PLYWOOD PANELS
FRONT & BACK 24¾ x 36" x ¼"
SIDES 26" x 36" x ¼"
13⅛"
COUPLING UNIT UNDER TOP BASEBOARD
HOLES FOR PASSING WIRE
C1
C2
1
2
3
TIME BASE
VISION RECEIVER
SYN
EARTH
SYNC OUTPUT SOCKET
OUTPUT +
E
A2
A1
A1
A2
E
SOUND RECEIVER
TO DIPOLE
AERIAL & EARTH PLUG
A & E SOCKET
AC SUPPLY MAINS
24"
27"
HIGH VOLTAGE UNIT
MAINS INPUT TO HIGH VOLTAGE UNIT
VISION POWER UNIT
MAINS INPUT PLUGS
SOUND POWER UNIT
INPUT
EARTH
SOUND RECEIVER PLUG & SOCKET
TO SPEAKER MATCHING TRANSFORMER

Fig. 6.

The Wireless World Television Receiver IV—

pipe of 11ft., 22ft., 33ft. in length will resonate at the wavelength of the vision signal and if it is close to the aerial, within 11ft. or so, it is likely greatly to reduce the efficiency.

Whether a reflector is used or not, the dipole must be joined to the receiver by a feeder of definite impedance (some 72 ohms). Special feeder cable in 60ft. lengths is available from Belling and Lee and is to be recommended. The loss in the feeder naturally increases with length but in any reasonable quantity is negligible. There is, consequently, no need to choose the aerial position for a short lead-in and it can be selected solely on its merits for reception. If the attainment of an extra five feet in aerial height involves an increase in feeder length of twenty feet or more by virtue of a different aerial position, the change will probably be well worth while.

The feeder itself consists of two wires embedded in insulating material and it is unlikely to pick up interference to any serious degree. It is "dead" to external objects and so does not need any special attention in the way of spacing from walls. It should, however, be run tidily and in such a way that it is not subjected to mechanical strain, otherwise a broken conductor will sooner or later interfere with reception.

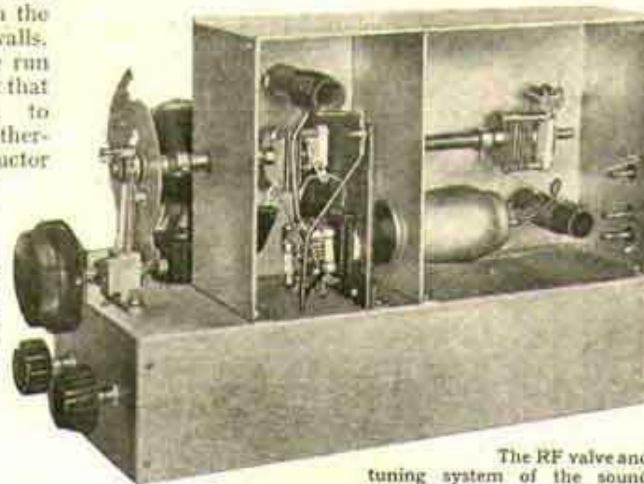
The operation of the equipment and the necessary initial adjustments will be described in next week's instalment.

LIST OF PARTS FOR FRAMEWORK AND ASSEMBLY OF UNITS

1 Cathode Ray tube — **Ediswan 12H**
1 Tube base (G.E.C. type) — **Bulgin CR10**
Fixed Condensers:
- 2 0.1 mfd., 5,000 volts, tubular, **C3, C4** — **Dubilier**
- 2 0.01 mfd., 5,000 volts, tubular, **C1, C2** — **Dubilier**

Resistances:
- 1 2 megohms, ½ watt, **R** — **Erie**
- 4 5 megohms, 2 watts **R1, R2, R3, R4** — **Erie**

11 Extension rods, ¼in., two 15¼in., five 14in., four 18¼in. — **Bulgin**
Miscellaneous: — **Peto-Scott**
- Wood, glass, screws, sistoflex, wire, etc.



The RF valve and tuning system of the sound receiver are clearly shown here.

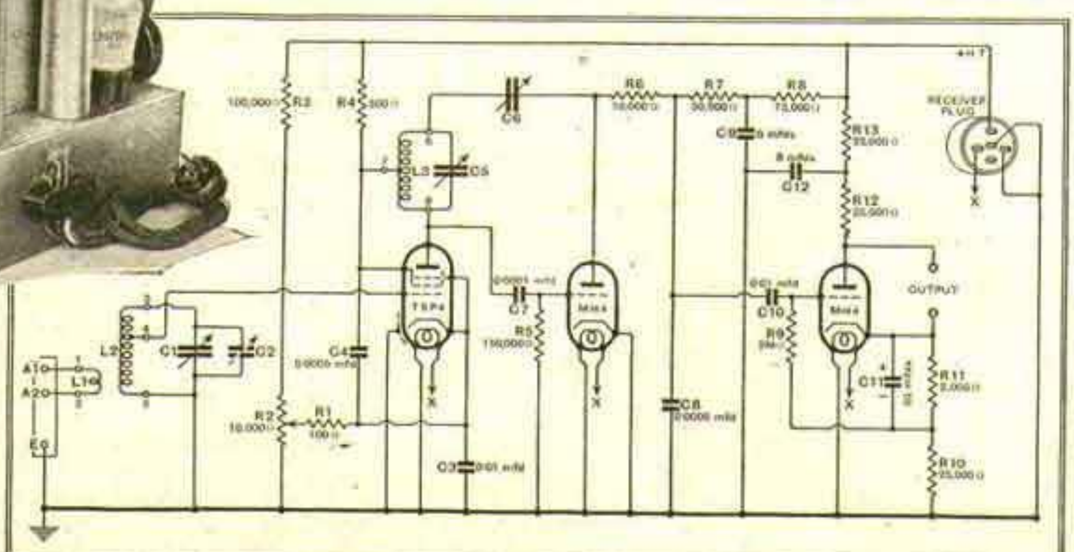
LIST OF PARTS USED FOR THE SOUND RECEIVER

Certain components of other makes but of similar characteristics may be used as alternatives to those given in the following list.

2 Variable condensers, 40 mmfds., **C1, C5** — **"Apex Economy" Webb's Radio** 14, Soho St., W.1.
1 Variable condenser, 15 mmfds., **C6** — **"Apex Economy" Webb's Radio**
1 Dial, dual ratio — **Eddystone 1070**
Condensers:
- 2 0.01 mfd., mica, **C3, C10** — **T.C.C. "M"**
- 1 0.0001 mfd., mica, **C7** — **T.C.C. "M"**
- 2 0.0005 mfd., mica, **C4, C8** — **T.C.C. "M"**
- 1 50 mfds., 12 volts, electrolytic, **C11** — **T.C.C. "FT"**
- 2 8 mfds., 460 volts peak, electrolytic, **C9, C12** — **T.C.C. 802**

1 Trimmer, C2 — **Bulgin SW95**
2 Coils
3 Extension control outfits — **Eddystone 1008**
1 Valve holder, 7-pin (without terminals) — **Clix Chassis Mounting SW Type V5**
1 Valve holder, 5-pin (without terminals) — **Clix Chassis Mounting SW Type V5**
1 Valve holder, 7-pin (without terminals) — **Clix Chassis Mounting SW Type V5**
1 Socket strip — **Clix "C"**
2 Terminals, ebonite shrouded, output +, — — **Belling-Lee "B"**
1 Group board, 10-way — **Bulgin C32**
1 Plug top valve connector — **Belling-Lee 1175**

The sound receiver, showing the detector and AF valves.



(Right) Fig. 7.—The complete circuit of the sound receiver is shown here for the Push-Pull Quality Amplifier. When used with the smaller power unit R10 should be short-circuited.

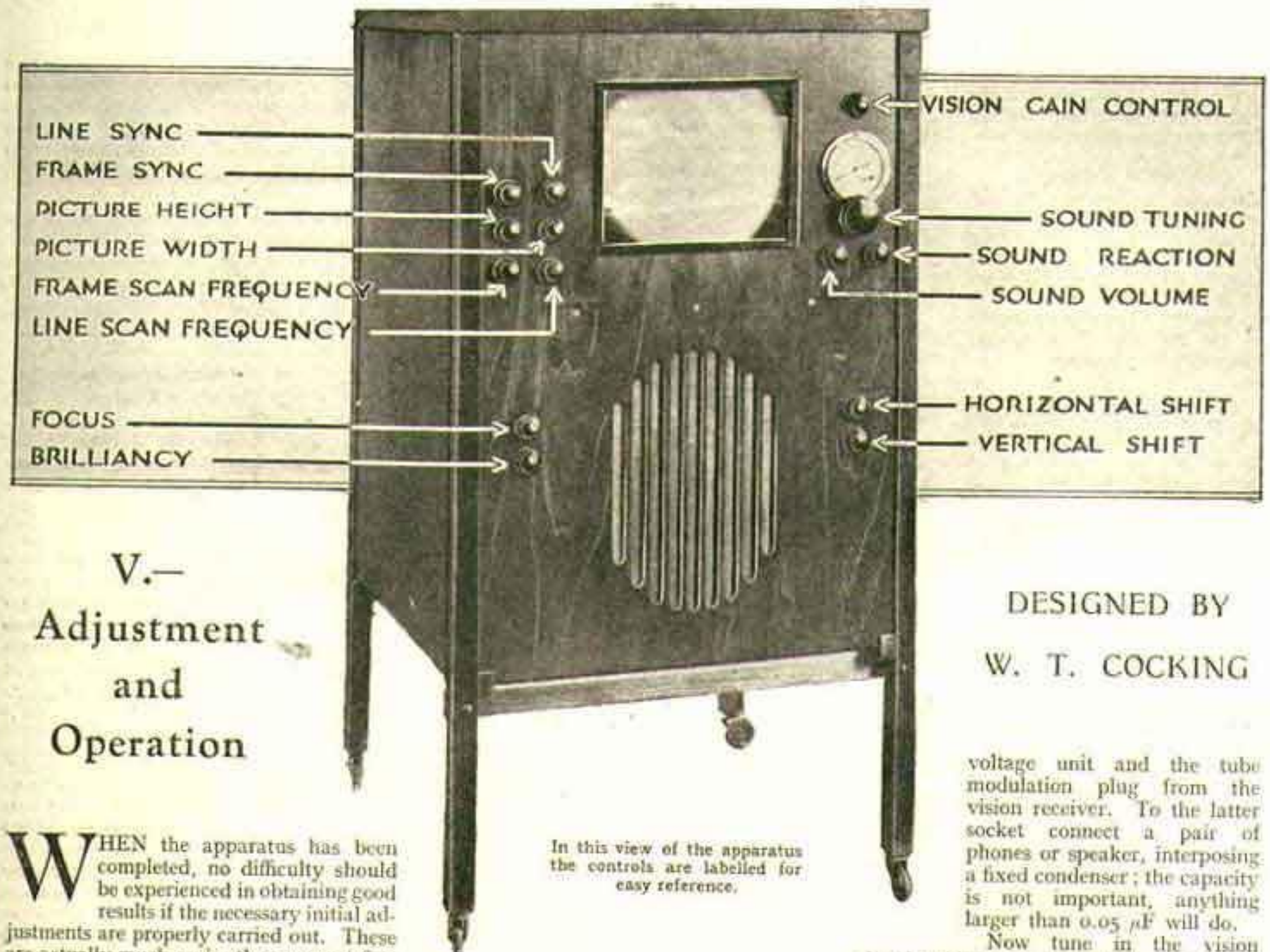
Resistances:
- 1 100 ohms, ½ watt, **R1** — **Dubilier F½**
- 1 500 ohms, ½ watt, **R4** — **Dubilier F½**
- 1 2,000 ohms, ½ watt, **R11** — **Dubilier F½**
- 1 10,000 ohms, ½ watt, **R6** — **Dubilier F½**
- 3 75,000 ohms, ½ watt, **R10, R12, R13** — **Dubilier F½**
- 1 50,000 ohms, ½ watt, **R7** — **Dubilier F½**
- 1 75,000 ohms, ½ watt, **R8** — **Dubilier F½**
- 1 150,000 ohms, ½ watt, **R5** — **Dubilier F½**
- 1 2 megohms, ½ watt, **R9** — **Dubilier F½**
- 1 100,000 ohms, 2 watts, **R3** — **Dubilier F2**

1 Potentiometer, 10,000 ohms, wire-wound, **R2** — **Haynes Radio**

1 Connector, 5-way — **Bryce**
1 Cable, 5-way, with twin 70/36 leads and 5-pin plug — **Goltone**
Chassis — **B.T.S.**
Miscellaneous: — **Peto-Scott**
- 2 Lengths Systoflex, 1 oz. No. 18 tinned copper wire, aluminium for brackets, etc. Screws: 48 6BA ½in. R/hd.; 2 4BA ½in. R/hd.; 2 6BA 1in. R/hd.; all with nuts and washers.

Valves:
- 1 TSP4, metallised — **Mullard**
- 1 MH4, plain — **Osram**
- 1 MH4, metallised — **Osram**

The Wireless World Television



In this view of the apparatus the controls are labelled for easy reference.

V.—Adjustment and Operation

DESIGNED BY
W. T. COCKING

WHEN the apparatus has been completed, no difficulty should be experienced in obtaining good results if the necessary initial adjustments are properly carried out. These are actually much easier than may at first appear, and any apparent complexity is due largely to their unfamiliarity. The adjustments will consequently be described in some considerable detail.

Except at the shortest distances from Alexandra Palace a resonant aerial should be used and at any considerable distance a centre-fed half-wave aerial with reflector is strongly recommended. Not only does this type give greater signal strength, but it is directional and will in consequence often reduce interference.

A good earth is essential, not for reception, but for safety. If the equipment is not properly earthed, the screens and metal work generally can become charged to quite a high voltage. It is wise, therefore, not only to install a good earth, but to arrange it so that it cannot easily become disconnected.

The sound and vision receivers are entirely separate and can consequently be tested separately. Test the sound receiver first; this may be done by pulling out the mains plug on the vision receiver power pack. For precise details regarding initial adjustments to the sound receiver, the constructor is referred to the article in which this set appeared.[1] The tuning control, reaction and sound volume control are the only controls which affect it, and it should readily be possible to tune in the sound transmissions at good volume. In the original receiver the dial setting was about 14 and the vision signal could be heard near zero.

Tuning the Vision Receiver

Turning now to the vision side, all adjustments can be carried out by watching the effect on the tube, but it is generally more convenient to tune the receiver first with the aid of a pair of phones or even a loud speaker. To do this remove the mains plug from the high-voltage unit and the tube modulation plug from the vision receiver. To the latter socket connect a pair of phones or speaker, interposing a fixed condenser; the capacity is not important, anything larger than 0.05 μF will do.

Now tune in the vision signal, adjusting each of the four trimmers for maximum response. In general the first three trimmers will be near their minimum capacity, and the last about one-third in. It should be possible to obtain very loud phone signals, or rather weak loud speaker signals, from the sync pulses, and until these are obtained there is little use in proceeding further.

There should be no difficulty in obtaining such signals, and the HV unit can now be switched on. Before doing so, make sure that the tube and all valves in the time-base are alight. The heaters can all be clearly seen except in the case of the T31 valves. With these it may be necessary to remove the top-caps for inspection.

Before switching on, make sure that the brilliancy control is turned fully anti-clockwise, the focusing control and the six controls on the left-hand side of the window are set about half-way round their travels.

Then push the mains plug on the HV

[1] *The Wireless World*, April 23rd, 1937

Receiver

FULL constructional details of the television equipment have appeared in the earlier articles in this series and it now remains to describe the adjustments necessary for the attainment of a good performance. It will be seen that these adjustments are by no means complex and are, in fact, easier than those needed by many modern broadcast sets.

unit. This will function immediately for the delay switch in the vision receiver power unit will have been closed for some time since it has been in operation during the testing of the vision receiver.

Turn the gain control right down and then slowly turn up the brilliancy control. An illuminated rectangle should appear on the end of the tube. Leave the control set at moderate brilliancy so that the rectangle is clearly visible. Then centre the raster with the panel opening by the two shift controls on the right of the speaker fret.

The Time-base Controls

The next step is to adjust the raster to approximately the right size. This is done by the centre pair of knobs to the left of the window; the left-hand knob controls the picture height and the right hand the picture width. These should be adjusted so that the raster is about the size of the window. Now focus the spot on the screen by means of the upper of the two knobs on the left of the speaker fret. Adjust this slowly for maximum sharpness of the horizontal lines which build up the raster. It is essential to turn this knob slowly for there is a small time lag between its movement and a change on the tube. At this stage the lines are unlikely to be steady for there is as yet no sync being applied.

The next step is to apply the signal by turning up the vision gain control until black and white marks appear on the picture. Then turn the sync separator bias control (R20 on the vision receiver) fully anti-clockwise and then back about one-quarter of its travel.

Set the frame sync amplitude control (top left-hand knob) fully anti-clockwise, and slowly turn the frame frequency control. A horizontal black line will be observed moving vertically across the tube, but as the frame frequency control is turned its speed of movement will vary. If it increases, turn the knob the other way. The speed will then slow down and a point will be found at which the black line stops. When it does, turn up the frame sync amplitude control about half-way. The black line will now probably be moving across the screen in a jumpy manner; readjust the frame frequency control, and a point will be found at which it will lock in at the top of the raster and become invisible. The setting of the frame frequency control is not critical with a good amplitude of sync pulse, and may be varied appreciably without visible effect.

The line must now be adjusted and this is best done by turning the line sync amplitude control fully clockwise and turning the line frequency control. As this is rotated the various black marks on the picture will change and at some points become lines which swing round through the vertical. At one point, the picture will suddenly appear with a black edge on the right-hand side which will lock in on the extreme right. The setting of the line frequency control is more critical than that of the frame, but is not unduly so. In fact, the setting of no control is nearly as critical as the tuning of an ordinary broadcast set!

The picture should now be steady and recognisable, but will probably be of the wrong shape, for the size of the picture depends not only on the settings of the height and width controls, but also upon the frequency controls. If the picture is not wide enough, turn the picture width control clockwise, at the same time turning the line frequency control in the same direction so that the sync is not upset. Then adjust the height by simultaneously turning the height and frame frequency controls in the same direction.

Final Adjustments

Now inspect the picture closely. It will probably be found that the lines are wandering slightly up and down, and this can be corrected by more careful setting of the frame frequency control. The next step is to adjust the focus precisely for maximum sharpness of the lines and this is now easily done for the lines are perfectly steady and not wandering.

Turn down the gain control so that the picture disappears and turn down the brilliancy so that the raster just disappears. Then turn up the gain control so that a very faint picture appears. This will probably be unsteady, so adjust the sync separator control for maximum stability. On turning up the gain control farther a good steady picture should be obtained, but it may be a bit fuzzy for the tuning has not yet been properly adjusted. This is the next step and should be carried out with a fairly bright picture.

The tuned circuits should, after the preliminary tuning, be all in resonance with one another, and although this condition gives the greater sensitivity it does not give the best picture. The circuits must be mistuned slightly for the best results, and this condition must be found experimentally, since the precise settings will vary with different receivers. In the original model the best results were obtained with the first and third circuits tuned to resonance, the second trimmer set at zero, and the last with somewhat more capacity than the optimum for signal strength. As these circuits are varied the gain control should be altered simultaneously so that the picture brilliancy remains constant.

At certain settings of the controls it will be found that on the right-hand edge (viewing the tube from the front) of a black object there appears a band of white or on the edge of a white object a band of black. This indicates that the circuits are so tuned that frequency distortion is occurring.

During the adjustment of the circuits, settings will probably be found at which interference from the sound occurs, and these must naturally be avoided. The interference manifests itself as a horizontal dark shadow across the picture which varies with the sound modulation; it may also affect the sync. On the tuning signal a regular wobble of the lines, so that while "B.B.C." is moving sideways to the left, "Tuning Signal" is moving to the right, is a definite indication of interference from the sound signal. When such interference is not due to the vision receiver being incorrectly tuned, it will be found that the cause is misadjustment of the aerial circuit trimmer on the sound receiver.

When satisfied with the picture definition it is only necessary to adjust the contrast. This is done by varying the brilliancy and vision gain controls for the best results. In general, an increase in brilliancy will give better detail in dark parts of the picture, but may be accompanied by a loss of detail in light parts. The two controls should thus be adjusted for the best effect.

Precautions

These adjustments are, of course, carried out when initially setting up the receiver, and in normal use only the gain controls and brilliancy need attention. Before switching off always turn the brilliancy control fully anti-clockwise and before switching on always make sure that it is in this position. If this is not done there is a risk of the screen being burnt, for the time-base HT voltage falls more rapidly than the tube voltage when switching off. If the brilliancy control is not turned down, therefore, the raster collapses and leaves a bright spot in the centre of the tube.

When switching on, do not turn up the brilliancy control until the delay switch closes. This will usually be audible as a clatter in the speaker; if it is not heard, allow two minutes before turning up the control. After switching off, do not

The Wireless World Television Receiver—V—
switch on again within five minutes, otherwise the delay switch may not have opened, and will not afford any protection to the condensers.

The best results are naturally secured when the equipment is operated in a dark room, but complete darkness is by no means essential. At night good results are obtainable with ordinary room lighting, and in the afternoon it is normally necessary only to draw the curtains in the room. The most important point is to prevent so far as possible light from falling on the end of the tube, and in general the receiver is consequently best placed with its back to the window.

In darkness, the brilliancy obtainable is amply sufficient, and, indeed, it is usually necessary to work with less than full brilliancy to avoid dazzle. Some people

REFERENCE TO EARLIER INSTALMENTS

July 2nd	-	The Vision Units
July 9th	-	The Time Base
July 16th	-	The Mains Units
July 23rd	-	Framework and Assembly—The Sound Receiver

A model of the complete receiver will be shown on "The Wireless World" stand during the Olympia Radio Show.

It will normally be found that the synchronising holds the time-bases in step over long periods without adjustment. The stability of operation, however, is affected in some degree by temperature, and there may be a slight drift during the first quarter of an hour or so after the gear is switched on. For a short time, therefore, occasional readjustment of the line frequency control may prove necessary.

Radio Amateur Call Book

THE summer edition, 1937, of the *Radio Amateur Call Book Magazine* is now available and can be obtained from F. L. Postlethwaite, 41, Kinfauns Road, Goodmayes, Ilford, Essex. The price is 6s. post free.

In addition to the call signs of amateur stations throughout the world, there is much information of value to the short-wave listener. For example, there is a list of commercial stations that transmit weather and press news on the short waves, and another of stations operating regularly in proximity to the amateur bands which can be used for the purpose of frequency calibration.

Wireless World, July 1937