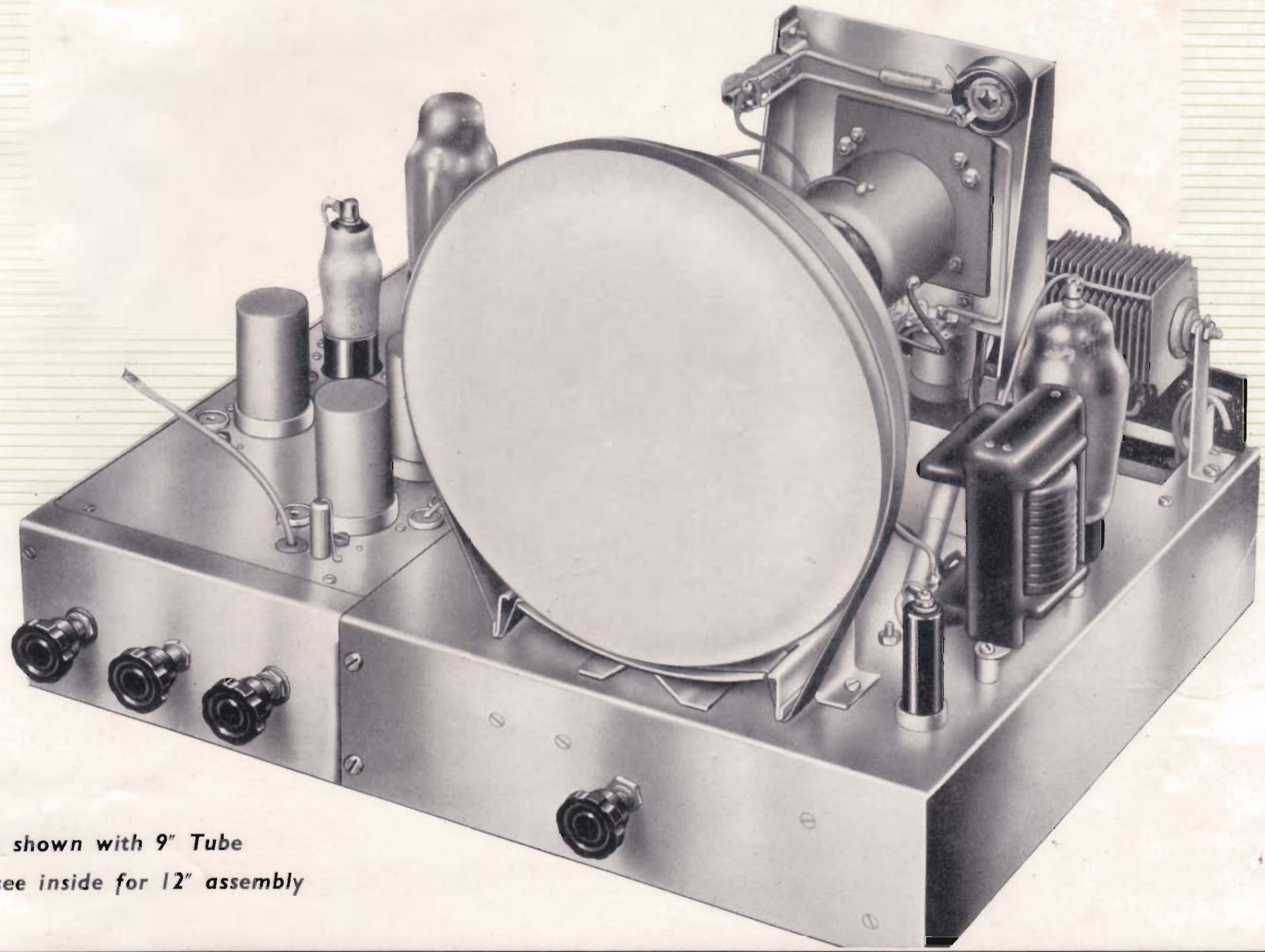
Building and operating the 'VIEW MASTER'

BY W. I. FLACK

Fellow of the Television Society



Set shown with 9" Tube — see inside for 12" assembly

TELEVISION FOR THE HOME CONSTRUCTOR

NOW AS SIMPLE AS A.B.C.

★ These untouched photographs, taken on a "View Master" show excerpts from a B.B.C. Alexandra Palace production "Cabaret Cruise." When it is remembered that the only light source available was the emission at the end of the C.R. tube, these excellent pictures prove that "View Master" owners can confidently look forward to a quality of reproduction that is unsurpassed for brilliance and wealth of detail.

THE MAGIC WINDOW

by **ERNEST R. GILBERT**

●

SPONSORED by nine of the leading radio component manufacturers and brilliantly designed by a highly qualified Television Engineer, the "View Master" achieves a standard of performance that places this great receiver in a class by itself. Its rock-steady picture and its superb definition—even in areas where reception is notoriously difficult—mark a noteworthy advance in Television engineering.

IT is half-past eight. More than half a million people will draw up their chairs and settle down to enjoy — as through a magic window — entertainment so vivid and real, so bewildering in its variety, that but a generation ago it would have been dismissed as some fantastic Wellsian dream.

Nothing — not even the impact of Broadcasting or the Sound Film — has stirred the imagination of the public so deeply as Television. Its growth since the re-opening of Alexandra Palace has been phenomenal. The reason is unmistakable — Television is today accepted as the ultimate in home entertainment. It *is* the theatre, the music hall, the ballet, the cinema and the concert platform. It is all these, marvellously re-created for your enjoyment, within the privacy and comfort of your own home.

Nor does this complete its tremendous achievements. With equal facility the all-seeing eye of the B.B.C. Television camera covers the race-course, the cricket field, the football pitch, the running track, the tennis court, the boxing ring — with a clarity of definition and wealth of detail that savours of the miraculous.

So today it can truly be said that Television has arrived. But what of tomorrow ? Who dares to forecast the shape of things to come — the developments that our scientists have in store for us ? Certainly quite soon there will be few areas in Britain outside the B.B.C. transmission network. Nor should we be straying too far into the realms of fantasy by imagining that we shall be able to see great events taking place, at the very moment of their happening, a thousand miles distant.

History, they say, has a habit of repeating itself. Certainly there is a remarkable parallel between radio and television. Each was profoundly influenced by a war. For so often out of military necessity have come great scientific achievements.

After the first World War came Broadcasting, soon to be followed by a tremendous surge of popularity in favour of home-built wireless sets. For many of these home constructors, the satisfaction and thrill of being able to say " I built it and it works " was the great incentive.

Today the wheel has turned full circle. During the last twelve months many Television Sets have been built by amateurs, and others who received their technical training whilst serving with the Royal Navy, the Army, and the R.A.F. For every one, however, who possesses the requisite skill to do this there are thousands who — equally eager — are handicapped by lack of practical information.

To such men this publication will make an instant appeal. For not only does it explain in simple language how Television works, but for the first time the man-in-the-street is given the fullest details of a super-reliable high-fidelity Television Receiver of the very latest type that has been specially planned for home assembly.

● The peak performance of the "View Master" owes much to the technical resourses and laboratory assistance so freely placed at the disposal of its designer by the following component manufacturers : Belling & Lee, Bulgin, Colvern, Ediswan, Morganite Resistors, T.C.C., Wearite, Westinghouse, Whiteley Electrical. The designer also wishes to express his appreciation of the help and co-operation given by the following valve manufacturers : Cossor, Ferranti, G.E.C., Mazda, Mullard.

'VIEW MASTER'

A great new Television Set that anyone can build at home

IN designing a Television Receiver suitable for the home constructor three problems must be solved before wide-spread popularity can be achieved. Firstly, its standard of performance must be high—certainly not inferior to any commercially built receiver of comparable type. Secondly, its assembly must be within the ability of the average man able to read a wiring diagram and use a soldering iron. And lastly, because it must provide reliable all-the-year-round entertainment for the whole family, it must be really simple to operate.

In other words, the home constructor wants a Television Set embodying all the latest technical developments—that, when finished, will be a credit to his workmanship and skill—that he will be proud to own.

How closely the View Master fulfils all these considerations will be apparent when the reader has studied the illustrations and read about its many advanced features of design. When housed in its handsome polished cabinet, the View Master is indistinguishable from the most expensive factory-built receiver. Its performance is so outstanding that even under normal room lighting a brilliant picture with maximum definition is easily obtained.

Operation is simplicity itself—even a child can use the View Master. It is fitted with three main controls together with a separate on/off switch. One control varies the picture contrast, a second controls its brilliance whilst the third acts as a volume control for sound.

The use of an independent on/off mains switch permits the Receiver to be switched on or off without disturbing the adjustment of either of the two picture controls or the volume control.

In view of the fact that operating voltages in any television receiver are often very substantially higher than in an ordinary radio set, special safety precautions have been incorporated in the design of the View Master.

To reduce the overall cost, weight and size, the View Master has been designed partially on A.C./D.C. lines. That is to say, a transformer is employed for feeding the heaters of the valves and Cathode Ray Tube, but the H.T. supply is taken direct from the mains through a metal rectifier.

It was felt that a completely A.C./D.C. type of receiver would be an unnecessary risk since the principle involves high voltages in the heater chain. The compromise adopted virtually eliminates any possible danger by ensuring that whenever the chassis is inadvertently operated at mains potential, a neon indicator bulb lights up as a warning device. Immediately the A.C. mains plug is withdrawn and reversed the light is extinguished. This proves that the chassis is now reconnected on the neutral side of the supply with the chassis at earth potential, and rendered safe for any adjustments or lining up that may be necessary.

The View Master is built in two sections, the smaller containing the vision receiver, the sync. separator and sound receiver, whilst the main chassis contains the two time bases, the H.T. supply, the E.H.T. supply and the Cathode Ray Tube assembly. The vision receiver consists of three R.F. stages, together with a high gain video amplifier which is directly coupled to the Cathode Ray Tube. One diode of a double diode valve is for rectification of the video signal, the other diode acting as the sync. separator.

The receiver may be aligned directly on the aerial, using the Cathode Ray Tube as an indicator, the use of a signal generator or oscillator not being essential.

The sensitivity and range of the View Master are extremely good. Its sensitivity may be increased still further when required by the alteration in value of a few resistors. The time bases are Thyratron operated, followed by high efficiency amplifiers which give ample scan and linearity, E.H.T. being obtained from the line flyback.

The Cathode Ray Tube, which may be one of four makes, has an E.H.T. of 6,000 to 7,000 volts on it, sufficient to give a bright and sharp picture for viewing in a normally-lighted room or even in daylight.

Finally, the View Master can be assembled either as a Table Model or as the handsome Console shown on the opposite page. And it can use either a 9″ or 12″ C.R. Tube without the slightest alteration to the circuit or change in components. The stage-by-stage wiring instructions ensure that its assembly can be carried out by any one with complete confidence.

To assist the beginner in Television, the first chapter is devoted to an explanation of the methods by which a picture is transmitted. This is followed by an outline of the functions of the various parts of a television receiver, which will enable the novice more easily to understand the succeeding chapters.

W. I. FLACK
FELLOW OF THE TELEVISION SOCIETY
Chief Engineer (Television), The Telegraph Condenser Co., Ltd.

The View Master is a Television Receiver you'll be proud to own. Here it is shown as a magnificent Console giving a twelve-inch picture of remarkable quality. On pages 27 and 28 detailed instructions are given for assembling the 'double decker' chassis.

How Television Works

IN THE FOLLOWING CHAPTER, intended mainly for the beginner to Television, it is hoped to give some idea of how a television receiver works and how it is capable of reproducing a picture, whether still or moving, at a distance. It must, however, be realised that television is a subject so vast and so much a part of the science of electricity, magnetism and optics, that only the briefest outline can be given. It will, however, enable the beginner to get some idea as to how his receiver functions and will perhaps, enable him to appreciate more fully its complexity.

To begin then, television is the art of reproducing a picture — instantaneously, and at a distance. The key to the method by which this is achieved is in what is known as "scanning." Scanning consists of examining, in detail, the picture or shape which it is intended to reproduce, the method following a distinct pattern.

SCANNING A PICTURE

An analogy to scanning, would be in reading a page in a book. A page is divided into a series of lines, each line again being divided into individual letters forming words. If, therefore, it is desired to understand the intelligence contained on the page, it is not sufficient merely to glance at it. It is necessary to commence at the top left-hand corner, noting each letter and word, continuing the process line by line, from left to right, until the bottom of the page is reached. Obviously then, the more words there are on the page the greater is the amount of information which may be conveyed to the reader. Furthermore, the more words there are on the page, then the smaller must be the print.

Similarly, in television the picture is divided into lines, each line again being sub-divided into elements. In the present-day system of television, so as to ensure a high order of definition, the picture is divided into 405 horizontal lines, each line being considered equivalent to approximately 500 elements. This gives a total of 500 × 405, or in round figures 200,000 elements in a complete picture. (Fig. 1).

To give the effect of action and movement in the picture, as on a cinema screen, it is further necessary to repeat the picture at such a rate, that, with the aid of that characteristic of the eye, known as retentivity, a flickerless visual impression of a moving picture is obtained.

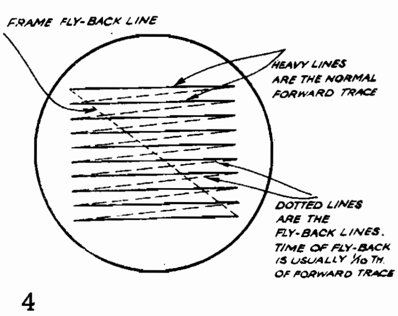


Fig. 1.

Scanning as it appears on the end of a Cathode Ray Tube. Direction of scanning is left to right and top to bottom.

To obtain continuous movement the complete picture should be repeated 25 times a second, giving the total number of elements appearing on the screen per second as 200,000 × 25 = 5,000,000.

The amplifier and radio equipment concerned with transmission and reception of television must therefore be capable of handling 5,000,000 elements per second.

Since however, radio amplifiers deal with alternating current waveforms which are "sinusoidal," that is, are composed of "sine" waves, and as a "sine" wave has two points of maximum amplitude and two of minimum amplitude (see Fig. 2) in each cycle, the figure of 5,000,000 may be halved. Therefore the amplifier need only be capable of handling 2,500,000 cycles per second, or, as it is more usually stated, the equipment must have a band width of 2·5 Mc/s.

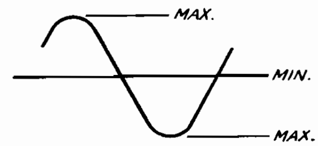
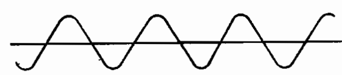


Fig. 2.
One cycle of a "sine" wave showing two points of maximum amplitude and two of minimum amplitude.

Section of a line containing eight elements.



Four "sine" waves showing eight points of maximum amplitude which coincide with the eight elements in the line above.

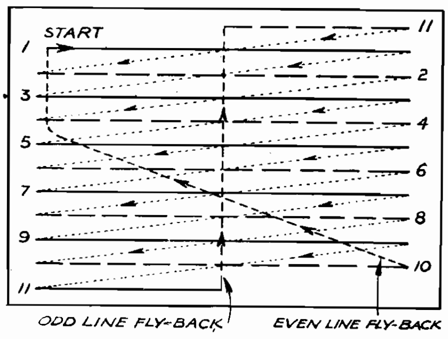
WHAT "INTERLACING" MEANS

There is yet one further feature to be considered. This is the prevention of flicker. Flicker, if at all apparent, would soon become irritating and would lead to eye-strain and tiredness. It is prevented by increasing the rate at which the picture is shown from 25 per second to 50 per second. Just doubling the picture frequency would, however, have the effect of doubling the number of picture elements per second and, of course, the band width—which instead of being 2·5 Mc/s. would then become 5Mc/s. This is undesirable, for reasons which will be apparent later, and in order to retain the 2·5Mc/s. band width and yet double the picture frequency a modified system of scanning known as "interlacing" is used. (Fig. 3).

Interlacing is carried out by scanning only half the number of lines at a time, the alternate and even numbered lines being scanned in succession. That is, lines 1, 3, 5, 7, 9, etc., would be scanned first, then lines 2, 4, 6, 8, 10, etc. In this way the picture repetition

Fig. 3.
Diagram indicating Interlacing. This raster consists of 11 full scanning lines. The odd numbered lines (shown solid) are scanned first, followed by the even numbered lines (shown broken).*

** A raster is the oblong of light formed on the end of a C.R. Tube when scanned by the electron beam.*



frequency can be raised from 25 per second to 50 per second without an increase in band width. With interlacing on the B.B.C. 405-line system, 202½ lines are scanned in each picture, there being 50 pictures a second. The total number of elements per second is therefore the same as in scanning the whole 405 lines in sequence at the rate of 25 pictures per second, but flicker is eliminated due to the higher repetition frequency.

THE TRANSMISSION END

At the transmitter, scanning is carried out in the studio camera, the scene under transmission being focussed by a lens on to a mosaic consisting of thousands of photo-electric cells, each smaller than the size of a pin's head. The action of light on a photo-electric cell is to cause it to emit electrons. Similarly, a photo-electric mosaic emits electrons from its surface in proportion to the brightness of the light falling on it,—a bright part of the picture, such as the sky, causing a large emission, whilst dark parts have a correspondingly smaller emission.

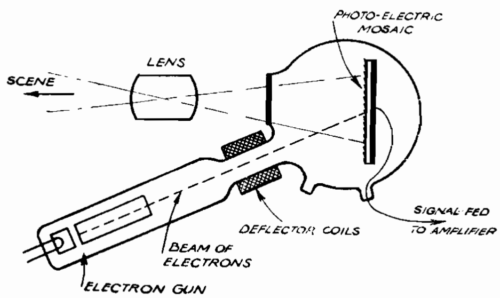


Fig. 4. Cross-section of electron camera (Emitron). This type has been used by the B.B.C. since 1936.

Mounted facing the mosaic is an electrode system, very much like that of a normal cathode ray tube, from which a beam of electrons is directed on to the mosaic. This beam of electrons is moved in a horizontal and vertical direction to scan the photo-electric mosaic and supply the individual cells of the mosaic with such quantities of electrons as are lost through emission when it is exposed to a scene. A current is thereby caused to flow in an external circuit, which is proportional to the light of the scene at the instant of scanning. (Fig. 4.)

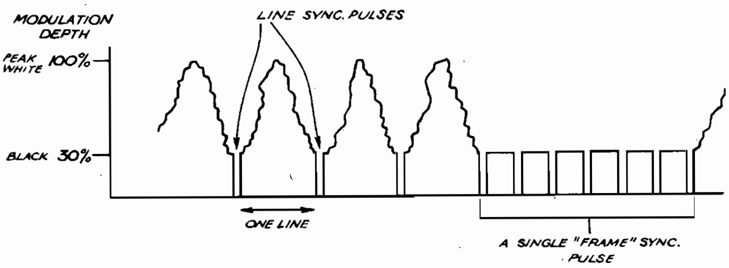


Fig. 5. Video waveform showing line and frame synchronising pulses. This waveform does not conform strictly to B.B.C. standards, but is sufficiently accurate to serve for illustration.

After the studio camera has scanned and converted the varying light values of the scene into equivalent electrical voltages or currents, they are amplified and have added or superimposed further voltages with the object of synchronising the receiver with the transmitter.

Synchronising is essential to the correct functioning of a television receiver, as, without it, it would be impossible to re-assemble the picture elements into their correct order.

In order to synchronise, a separate pulse is sent at the end of each line, and a further one of different shape and duration at the end of each picture or frame. A suitable circuit at the receiver is arranged to separate these synchronising pulses from the picture signal, and also to separate the line synchronising pulses from the frame synchronising pulses. (Fig. 5).

After the addition of the synchronising pulses to the camera picture signals, the combined signal is further amplified and is arranged to control, or more technically, modulate, the radio transmitter.

A separate transmitter, controlled by the studio microphone, deals with sound, which is handled quite independently of the vision channel. The sound and vision transmitting aerials are, however, both mounted on the same mast. (Fig. 6).

Two systems of transmission are in use at the present time, that at Alexandra Palace being known as double side band transmission and which is similar to normal broadcast practice, whilst the system at Sutton Coldfield is known as single side band transmission and differs by having one side band (*i.e.*, the response on one side of

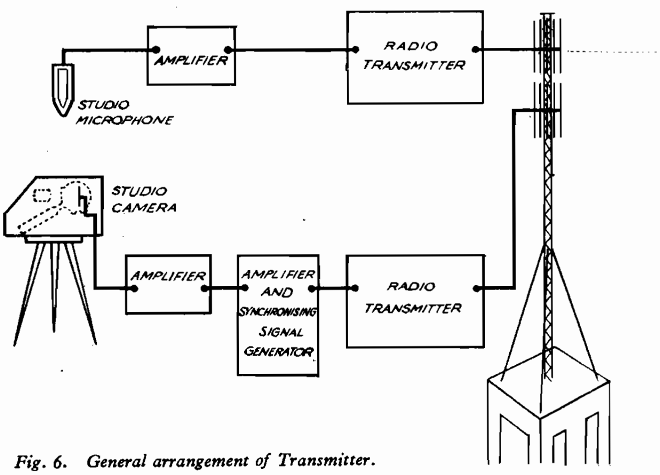


Fig. 6. General arrangement of Transmitter.

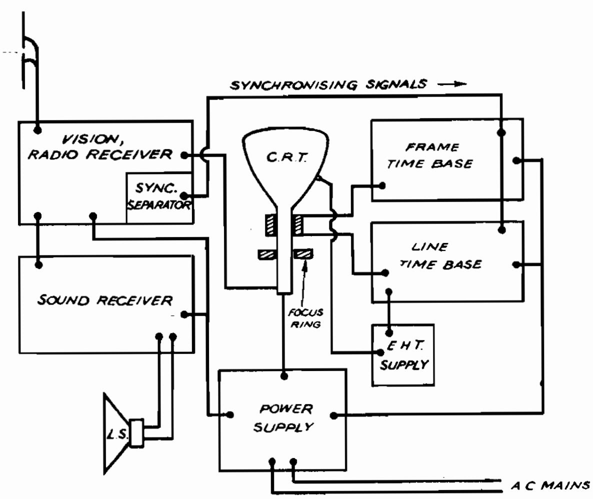
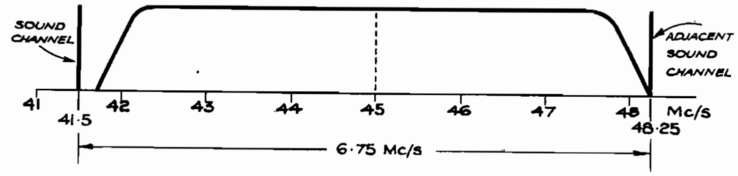


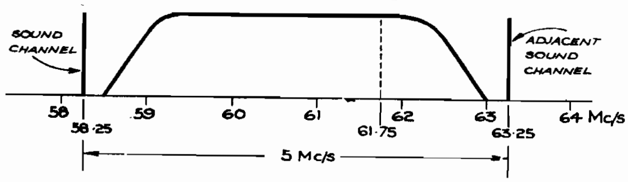
Fig. 7. Block schematic of Receiver.

Fig. 8

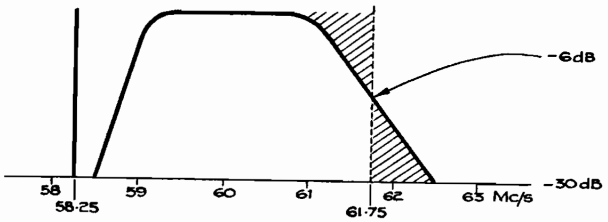
Alexandra Palace: Double Side Band Transmission



Sutton Coldfield: Single Side Band Transmission



Frequency response characteristic of single side band receiver for Sutton Coldfield



It should be noted that the energy contained in the lower triangle, from 61.75 Mc/s. to 62.5 Mc/s., is added to the section from 61 Mc/s. to 61.75 Mc/s., thereby giving an even response from 59 Mc/s. to 61.75 Mc/s.

the carrier) partially suppressed. There is no deterioration in the quality or definition of the picture when making use of the single side band principle, since in effect all the information required to produce a picture is contained in each side band and either may therefore be used on its own.

The frequency response characteristics of double and single side band transmissions are shown in the diagram, Fig. 8, where it will be noted that the single side band transmitter takes up less space in that part of the frequency spectrum allocated to television transmissions and therefore permits more transmitters to work in a given space.

A single side band receiver may be used for either single side band or double side band transmissions but a double side band receiver can be used only for double side band transmission. A recommended frequency response curve for a single side band receiver for use with Sutton Coldfield transmitter is also shown in Fig. 8.

RECEPTION IN THE HOME

The Television Receiver comprises several sections or units, each of which has to perform a particular function. These are as follows :—

Television Receiver Section.	*Function.*
(*a*) The Cathode Ray Tube.	For producing a picture on the fluorescent screen.
(*b*) The Vision Channel Radio Receiver.	To receive and amplify the transmitted signal.
(*c*) The Synchronising Separator.	To separate the synchronising pulses from the picture signal.
(*d*) The Time Bases.	To cause the electron beam in the cathode ray tube to be deflected in a horizontal and vertical direction so as to scan the face of the tube.
(*e*) The High Voltage Supply.	To supply the voltage for the cathode ray tube.
(*f*) The Focussing Device.	To focus the picture so that it is sharp.
(*g*) The Sound Channel Radio Receiver.	To receive and amplify the accompanying sound signal.
(*h*) The Power Supply.	To supply power for operating all of the above units.

These units are shown combined in Fig. 7, and incorporated in a practical receiver (actually the View Master) in Fig. 11.

Before enlarging upon the functions of the individual working units, it is necessary to deal first with the cathode ray tube, since the operation of the complete receiver is directed towards controlling the tube and thereby producing a picture.

(a) The Cathode Ray Tube.

A cathode ray tube may be considered very much like a valve, but with the difference that the electrons emitted from the cathode are directed and focussed into a beam which is arranged to strike the screen and thereby produce a spot of light. The intensity of the spot of light may be controlled by variation of voltage on the modulating electrode (which may be the grid or the cathode), the variation in voltage controlling the quantity of electrons in the beam. To scan the screen of the tube, the spot must be deflected both vertically and horizontally. Deflection is accomplished by subjecting the beam either to an electro-static or electro-magnetic field, dependent upon the type of tube. (Fig. 9).

At the present day, the vast majority of cathode ray tubes are electro-magnetic, and deflection is achieved by mounting suitable coils around the neck of the tube, through which current is fed by the time bases. Further notes on the cathode ray tube appear later in this chapter.

(b) The Vision Channel Radio Receiver.

The first of the units in the receiver proper is the Vision Channel Radio Receiver. This is connected direct to the aerial and amplifies the signal until it is of such a value as to be suitable for controlling the cathode ray tube.

The receiver must conform to certain rigid standards so as to reproduce a picture with the definition and full range of tone values which is required of it. The defini-

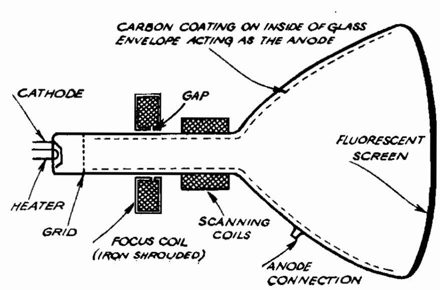


Fig. 9. Cross-section of an Electro-Magnetic Cathode Ray Tube.

tion or sharpness of the picture is affected by the band width of the receiver. Band width is a measure of its capacity to amplify all the elements composing the picture.

It has already been shown that for the present B.B.C. transmissions, the band width required must be not less than 2·5Mc/s. This figure of 2·5Mc/s. must be considered the absolute minimum for high quality reproduction as, actually, a further improvement in definition is attainable by increasing the band-width. Conversely, by reducing the band-width, definition suffers and the resulting picture is poor.

(c) The Synchronising Separator.

The Vision Receiver, besides controlling the cathode ray tube, also feeds the signal to the synchronising separator, so that the sync. pulses, which form part of the transmitted wave form, may be separated and used for controlling the time bases. The sync. separator circuits also have to differentiate between the line and the frame synchronising pulses so that they may be fed to the respective time bases.

(d) The Time Bases.

The Time Bases are those sections of the receiver which control the movement of the spot on the screen of the cathode ray tube. When synchronised, the line time base works at a frequency of 10,125 c.p.s., deflecting the spot in a horizontal direction, whilst the frame time base, which operates at only 50 c.p.s., deflects the spot

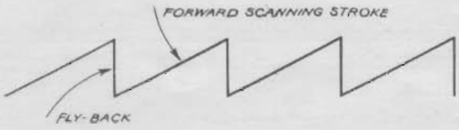


Fig. 10.
Saw-tooth wave-form developed in time base.

in a vertical direction. The time bases, in fact, cause the screen to be scanned in a manner already described on page 4. The time bases consist of saw-tooth generators, that is circuits in which the output voltage rises steadily to some given point and then falls rapidly, the cycle being repeated continuously. (Fig. 10). The saw-tooth voltages are then fed to amplifiers which feed the deflecting coils.

(e) The High Voltage Supply (E.H.T.).

The cathode ray tube screen fluoresces when the beam of electrons emitted from the electron gun strikes it. The brightness of the screen depends on the velocity with which the electrons strike it and the quantity of electrons in the beam. The more electrons there are in the beam, the larger is its cross-section as well as the size of the resultant spot appearing on the screen. If the spot, however, becomes too large in diameter, definition is impaired, particularly in the bright parts of the picture.

To maintain an electron beam of small cross-section the voltage applied to the anode of the cathode ray tube must be as high as possible, provided the maximum rating for a particular cathode ray tube is not exceeded, an improvement being brought about by an increase in

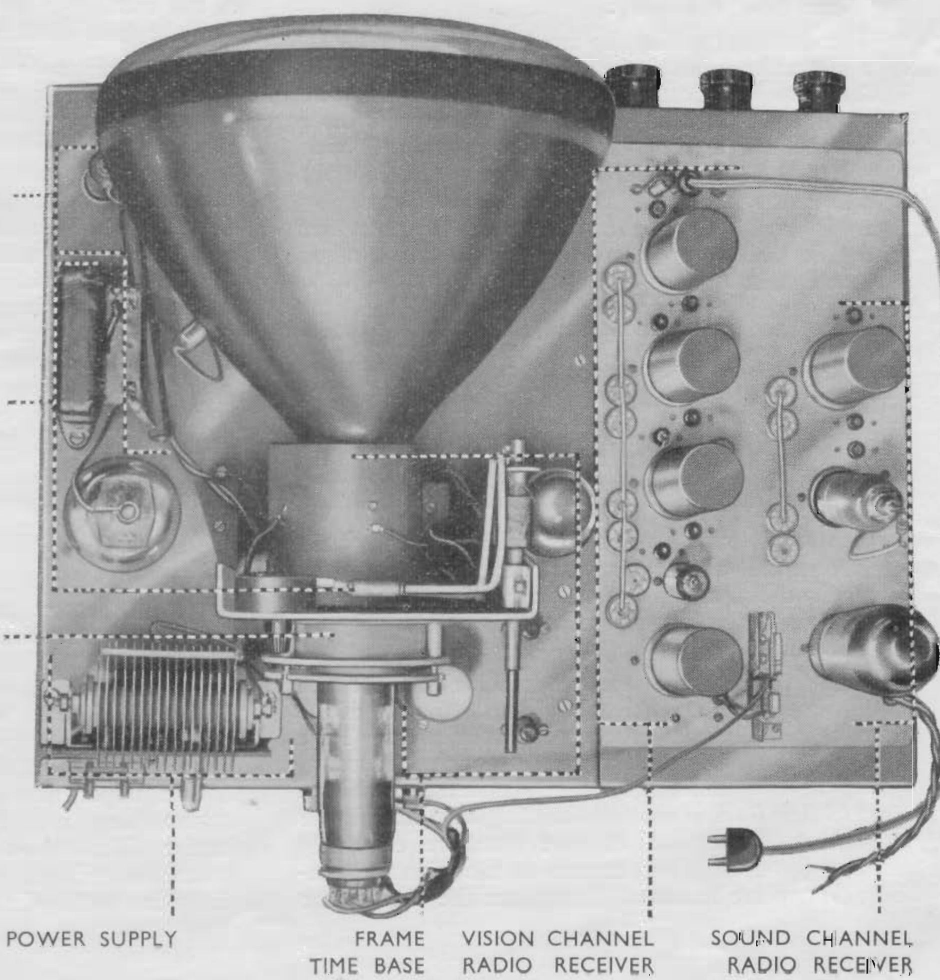


Fig. 11.
Top view of completed View Master. (Table model with 9" Tube).

the velocity of the electrons with an increase in voltage, there being fewer electrons in the beam for a given screen brightness.

For example, a few years ago the voltage applied to a 9″ cathode ray tube was usually in the region of 4000V. Development in cathode ray tube design has enabled this value gradually to be increased to around 6000V. and in some cases even 7000V., whilst for 12″ tubes voltages are usually 6000 to 7000V.

(f) Focussing.

The high voltage on a tube is not sufficient alone to give a sharp picture, as the beam of electrons is divergent and requires focussing.

Focussing is effected by subjecting the beam to a radial magnetic field, which must be adjustable for optimum sharpness. An electro-magnet, consisting of a coil carrying direct current, or a permanent magnet, which takes no power, may be used. The choice usually depends on the design of the receiver and its economics.

(g) The Sound Receiver.

To reproduce sound, a receiver similar to a normal broadcast type may be used, the main difference being in the radio frequency or wave length at which the signal is received. An average type of sound receiver may have two radio frequency amplifying stages followed by a double diode detector and perhaps a triode audio amplifier driving a high efficiency pentode in the output stage.

(h) The Power Supply.

The D.C. voltage may be around 350V. on an A.C. type of receiver, but only 220 to 240V. on an A.C./D.C. type. Rectification of the H.T. supply may be either by a valve or a metal rectifier. The latter is more robust and, with a particular design, is capable of giving a greater D.C. output voltage for a given A.C. input voltage than a valve. Heater supplies on A.C. working receivers are always derived from a transformer, but with A.C./D.C. types are connected in series and taken direct to mains.

The View Master—Vision/Sound Chassis

THE VISION AND SOUND UNITS, which are both built on the small sub-chassis, are exceptional in their simplicity of layout and ease of construction, particularly so if their sensitivity and freedom from instability are considered.

The stability of the receivers together with the ease of construction is almost entirely due to the use of the special T.C.C. Mica decoupling condensers, Type CM30. These are essentially feed-through condensers, or, as they are sometimes termed, condenser bushings. Due to their form of construction they have virtually no measurable inductance and are therefore extremely efficient for decoupling purposes at television frequencies. They are mounted directly on the chassis, the earthy end becoming integral with the chassis, whilst they also act as terminals for the intervalve wiring. Furthermore, in the case of the heater circuits, they enable the wiring to be run above the chassis. The H.F. valves are Mullard EF50s, or Cossor 63SPTs, which in conjunction with the feed through condensers, enable the wiring to be kept short and direct. See Fig 12.

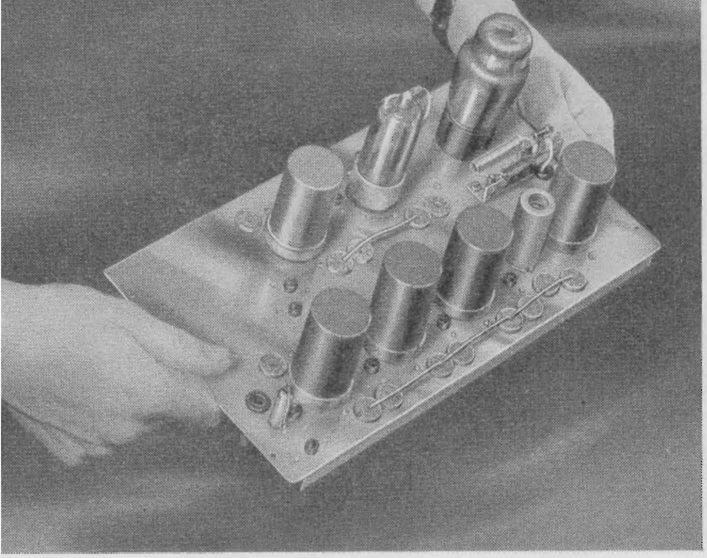
The chassis is made of 24 s.w.g. tin plate, this material being extremely easy to work, not only from the point of view of cutting, drilling and bending but it is also exceptionally easy to solder. The latter point is very important as so many soldered connections have to be made direct to the chassis. There are no screening boxes separating the R.F. stages but instead, screens are mounted across each of the R.F. valveholders, after the intervalve wiring has been completed.

Design Features of the Vision Receiver

DEALING WITH the vision channel first, it will be remembered that in the chapter for beginners, it was stated that the vision receiver is that part of the complete television equipment which is responsible for the definition or sharpness of the picture, for the contrast and gradation of the picture and finally, for the sensitivity and range of the receiver. To a great extent, the maximum sensitivity of the receiver for a given number of valves is closely linked to the definition which it is intended the receiver should be capable of resolving. It will, of course, be realised that the overall sensitivity of any receiver is dependent on the number of valves and the gain of each valve. Definition, however, is dependent on the band width of the receiver, whilst the gain of any valve and consequently of the complete receiver, is also dependent on the band width, gain being inversely proportional to band width.

Also in the chapter for beginners, the difference between single and double side band transmissions was dealt with, the Sutton Coldfield transmitter operating on a single side band with its carrier at a frequency of 61·75 Mc/s. A vision receiver for use with the Sutton Coldfield transmitter must conform closely to the frequency characteristic shown in Fig. 8. Due to its asymmetric form and the close proximity of the accompanying sound transmission to the higher modulation frequencies, filter circuits are employed to ensure adequate rejection of the accompanying sound transmission.

Sound interference causes dark horizontal bands to move vertically across the screen, these dark bands coinciding with loud passages of speech or music. In the worst cases, the synchronising may also be affected causing the picture to tear or slip. To ensure complete freedom from sound interference, two inductively coupled high 'Q' rejection filters are employed which together are capable of giving an attenuation ratio of over 30d.b. A difficulty which may arise when using sound rejection filters is that, with adequate rejection of the sound transmission, there may be appreciable attenuation of the upper modulation frequencies of the vision transmission, *i.e.*, 2·5—2·75Mc/s. from the vision carrier. This must be prevented since excessive attenuation of these side bands will result in a loss of definition in the picture.



The 'heart' of the View Master—a photograph of the Sound/Vision chassis completely assembled and with valves in position.

A further point which has to be considered in view of the fact that more transmitters are envisaged by the B.B.C., is that it is necessary to ensure that there will be no interference from these at some future date. Two further filters are therefore employed to reject signals which might be received from adjacent transmissions, one of these being tuned to the adjacent sound carrier frequency at 63·25Mc/s., whilst the other is tuned to the adjacent vision carrier frequency of 56·75Mc/s. There is therefore a total of four filters. Whilst it is true that two of these filters are not essential at present, and could be omitted, they have been incorporated to ensure freedom from interference in the future.

The R.F. section of the vision receiver has three transformer coupled valves, the first of these being common to both vision and sound. The advantages of having the first stage common to both channels are :

(*a*) A more efficient aerial coupling may be employed.

(*b*) A valve is saved in the sound receiver.

(*c*) The vision gain control, also controls the sound channel thereby preventing overloading of the sound output valve when a receiver is used in an area of high signal strength.

(*d*) The sound receiver may be fed from a sound rejection filter in the vision circuit.

Following the three R.F. stages is a double diode valve, one diode being the video detector, whilst the second acts as the sync. separator. The latter has a negative picture signal (positive sync.) applied to its anode by a self-biasing circuit so that it only conducts on sync. pulses, positive going separated pulses being developed across a load resistor in the cathode.

Turning to the last valve in the vision section, this is the video stage which must have an even response and freedom from phase distortion at all frequencies from zero to 3 Mc/s. As the sync. separator requires a negative picture signal, it is convenient to arrange for the cathode of the cathode ray tube to be modulated rather than its grid. Under these conditions the video amplifier has to be biased close to a point approaching anode current cut-off, whilst the detector, which is directly coupled, drives the grid positive. This is quite a convenient arrangement, but with self-bias, does suffer from a loss in gain due to the feed back developed in the cathode circuit. The reason for this will be apparent from the following :—

The gain of a pentode valve (ignoring cathode feed back) is given by :

Gain $= gR$
Where g = Mutual conductance in ma./V.
Where R = Anode load in kΩ.

An EF50 with a g of 6·5 ma./V. and a load resistor of 5kΩ can have a maximum gain of 32·5. Working under conditions where the cathode of the cathode ray tube is modulated, it would probably need a negative bias of 3V. and would require a cathode resistor to obtain this bias of around 390Ω. The figure of 32·5 for the maximum possible gain must therefore be corrected by the feed back factor, which is $\frac{1}{1 + gRc.}$

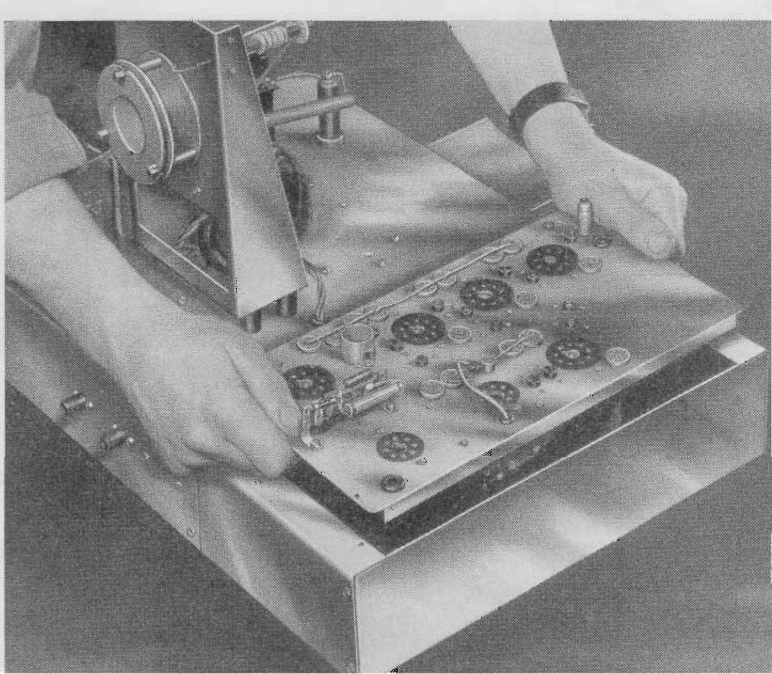
where Rc = cathode resistor.

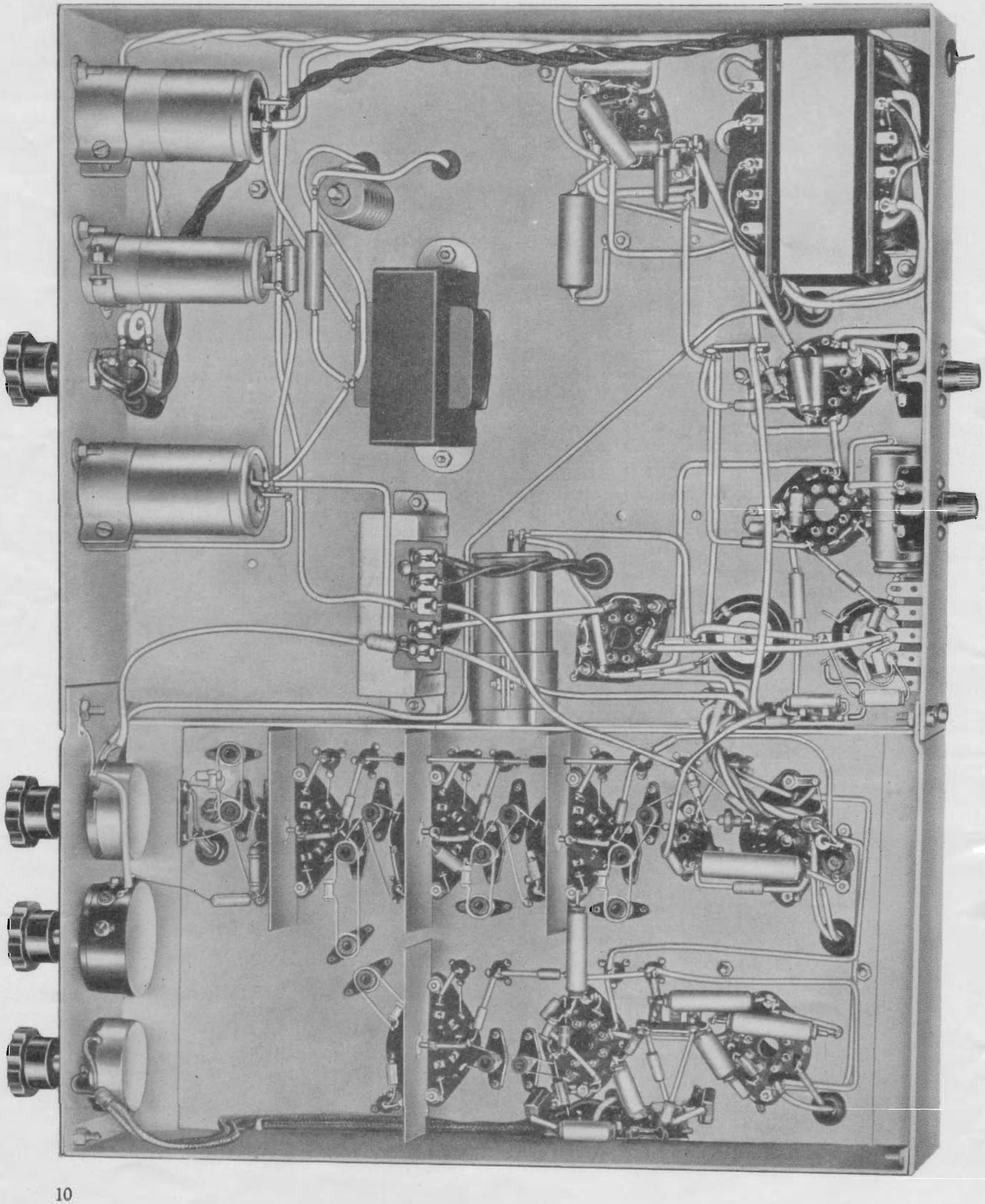
Evaluating the feed back factor for the conditions stated above, will give $\frac{1}{1 + (6{\cdot}5 \times {\cdot}39)} = \frac{1}{3{\cdot}5}$ approx.

The gain then becoming $\frac{32{\cdot}5}{3{\cdot}5}$ = nearly 9·3.

It will be seen then, that due to the cathode resistor, the gain of the video stage has fallen from a possible 32·5 to 9·5. In the View Master, so as to obtain the maximum gain from the video valve, the method of biasing which has been adopted is somewhat unusual, as there is no loss of gain due to feed back, the cathode of the video stage being taken direct to earth, and negative bias is applied to the grid of the valve. The negative bias is obtained by connecting a resistor in the negative H.T. lead, the total H.T. supply current of approximately 200mA. passing through the resistor, thereby producing a voltage drop. Unfortunately, not only is a D.C. voltage developed across this resistor, but it also has superimposed a 50c/s. voltage due to the hum or ripple in the H.T. supply. It is necessary for this 50c/s. voltage to be completely eliminated, otherwise it

Mating the assembled Sound/Vision unit with the main Power Pack and Time Base chassis (Stage 7). This is the side-by-side arrangement for a Table Model with 12" tube.





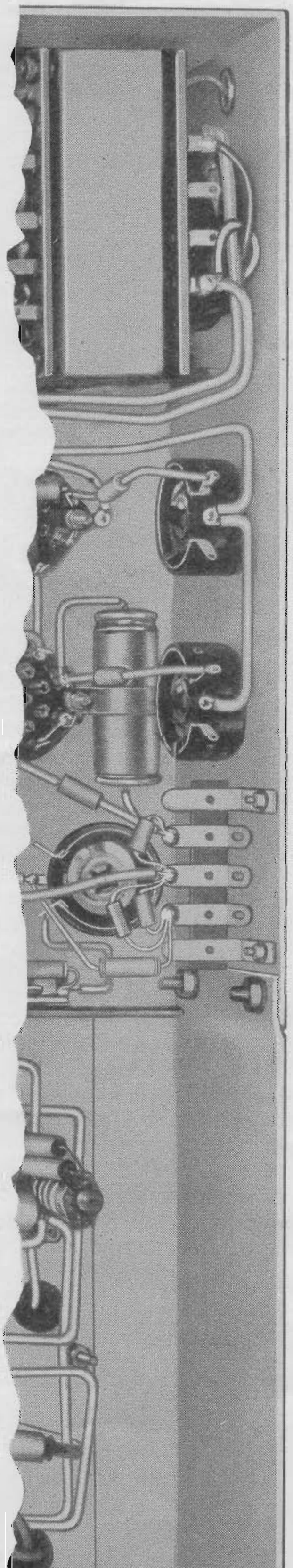


Fig. 12

UNDERSIDE VIEW OF COMPLETE "VIEW MASTER"

This photograph shows the remarkable simplicity of wiring below the chassis and the correct position of components, but is not intended as a guide to wiring.

would be fed to the grid of the video valve. This would result in a ripple appearing on the picture in the shape of a dark horizontal band ; there would also be some distortion of the verticals due to the 50c/s. voltage in the line time base ; interlacing too, could be affected.

To overcome the effect of this 50c/s. ripple voltage, a high capacity condenser is connected directly across the voltage dropping resistor. This condenser has a capacity of $2{,}500\mu$F. and is sufficient to prevent any sign of hum being visible in the picture, either as modulation or in the time bases. Though it would be more effective to split this condenser into two sections, separated by a resistance or choke, and connected as in the standard type of smoothing circuit, the method would be unsuitable as it would affect the D.C. amplification of the stage.

Analysis of Vision Circuit

Analysing the vision receiver in greater detail, it will be noted that the signal is fed from the aerial by a 72Ω feeder to the first H.F. transformer L101/102. The primary is insulated from the secondary by two thicknesses of insulating paper, the centre tap being earthed through a condenser C1, whilst a resistor R1 is also connected to this point to ensure freedom from electrostatic charges on the aerial. This method of coupling the aerial to the receiver is necessary to ensure freedom from shock or damage to the receiver in the event of the receiver chassis being live and any part of the aerial or feeder shorting to earth.

The secondary L102 of the first H.F. transformer is tuned to 59·25Mc/s. and has closely coupled to it the first rejection filter L109, C101, this filter being tuned to the adjacent vision carrier frequency of 56·75Mc/s. Gain control of the receiver as well as contrast of the picture is effected by variation of bias on V1. To ensure a constant impedance and capacitance when adjusting the gain of V1, a 33Ω resistor R8 is connected in series with the cathode so that negative feed back is developed, this having the effect of maintaining the input impedance and capacitance constant over the controlled change of bias. In this way the frequency response characteristic of the receiver and therefore the picture quality is maintained constant within the range of the gain control.

L103 is in the anode circuit of V1 and is closely coupled to L104 through a $1\frac{1}{2}$ turn coupling coil which is in series with the top end of L104. In this way maximum signal is transferred and a wide band width is maintained. Also closely coupled to L103 through a small coupling coil is the second rejection filter comprising L110 and C102, the tuning coil L110 being adjusted so as to obtain maximum attenuation at the accompanying sound carrier frequency of 58·25Mc/s. L110 is also closely coupled to L113, the input circuit of the sound receiver, so that any voltage developed across it is transferred and feeds the sound receiver.

V1 anode is decoupled by two resistors R6 and R7 and two 500pF. feed through condensers, thus ensuring maximum stability. V2 is very similar to V1 with the exception that the bias on the valve is fixed. The primary L105 of the intervalve transformer coupling V2 and V3, is damped by a $22\text{k}\Omega$ resistor R101 to assist in obtaining the correct frequency response. L106, the secondary of this transformer, is closely coupled to

L105 as is the third rejector circuit L111, C103, which is also tuned to the accompanying sound frequency.

To maintain the response between 61 and 61·75Mc/s. the gain of those circuits tuned to this frequency has to be fairly high and to assist in this, damping on L106 must be very much less than is possible with a straight forward R.F. stage using a standard EF50 valve. Fortunately it is possible to increase the input impedance by again resorting to negative feed back. A 22Ω resistor R102 not bypassed by a condenser is connected in series with the cathode of V3 raising the input impedance. In this way, the gain at the frequency to which L106 is tuned is increased, with respect to the rest of the frequency band, whilst the adjacent selectivity is also improved.

V3 anode is coupled to the diode detector V4 through an inductively coupled H.F. transformer, though in this case, the coupling coil in series with L108 is connected at the earthy end. The last filter L112, C104, is tuned to 63·25Mc/s., the adjacent sound carrier frequency. This last filter is intended not only to prevent interference from the adjacent sound channel, but is also useful in adjusting the response at the vision carrier to its correct level (6d.b. down, see also Fig. 8). Further details on adjusting these filters are given in the instructions on alignment.

V4 is a double diode valve and has one diode connected as the video detector whilst the second diode is the sync. separator. The top of L108, the secondary of the last intervalve transformer, is connected direct to the detector diode anode, the earthy end of the winding being taken to chassis through a 500pF. condenser C16, the detector cathode load resistor R19 and by-pass condenser C15 being returned to this same point. This method of connection is necessary because of the bias circuit which has been developed so as to obtain maximum gain from the video stage V5.

The cathode of the diode, from which positive going video signals are taken to the grid of V5, has in series with it a correction choke of 250μH., so as to boost the response of the receiver in the region of $2\frac{1}{2}$–3Mc/s. The load resistor R19 has a value of 5·6kΩ, whilst the cathode by-pass condenser has a value of 10pF. R19 also acts as the grid leak of V5, the negative bias to V5 being taken to the earthy end of R19.

The anode load of V5, the video amplifier, is split into two sections, R22 being connected to HT+ whilst R23 and R24 in series are taken to earth. The resistance of R22 is 6kΩ, obtained by connecting two 12kΩ resistors in parallel, whilst in the lower section, R23 has a value of 5·6kΩ and R24 of 27kΩ. From the point of view of a load resistor on the valve, the two sections are in parallel, giving an actual value of a little over 5kΩ with a gain of slightly over 30.

Included in the top section of the load resistor is a tunable correction choke, L10, which gives a rise in response of approximately 6d.b. at around 2.75Mc/s. When adjusting the receiver finally on a signal, this tuned choke is set for maximum response at 2.5 to 3Mc/s. The object in splitting the lower section of the load resistor into two parts R23 and R24 is two-fold. In the first place it is undesirable to have the cathode of the cathode ray tube at too high a positive potential. With a tetrode tube such as the Mullard MW22–14C, there would not be a sufficient difference in volts between the cathode and A1, thus causing a large spot size. Secondly, by feeding the sync. separator direct from the anode of the video stage and the cathode ray tube from the lower tapping, the ratio of sync. signal to video is increased. This ensures better locking of the time bases.

A further useful feature of this arrangement is that, by connecting a small capacity across R23, the video response fed to the cathode ray tube is further boosted in the region of 2–3Mc/s. This additional H.F. response is obtained at the expense of the sync. separator feed, though it is not sufficient to upset it, or cause pulling on whites. It does, however, give a very appreciable improvement in definition and is well worth while from every point of view.

Finally, to ensure a picture reasonably clean and free from interference, an extremely simple spot suppression circuit has been developed (Fig. 14). This consists of a Westinghouse WX3 metal rectifier MR5 in series with a 0·1μF. condenser, the combination being connected between the anode of V5 and H.T. positive, the cathode end of the rectifier being connected to the anode of V5.

The mode of operation of the suppression circuit is as follows. The rectifier together with the condenser, operates as does a peak voltmeter, the condenser charging through the reverse resistance of the rectifier to a potential approximately equivalent to peak white. On the arrival of a noise pulse exceeding peak white, which is of course in a negative direction, the rectifier conducts through its forward resistance. Under these conditions the signal at the anode of V5 is attenuated, as there is then connected across the anode load a

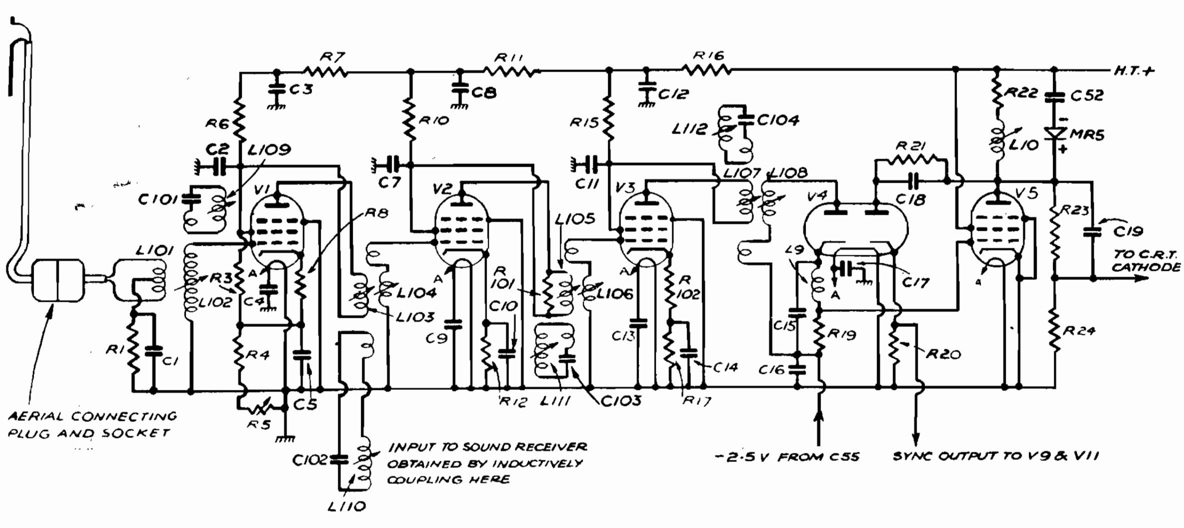


Fig. 13
Circuit of Vision Receiver

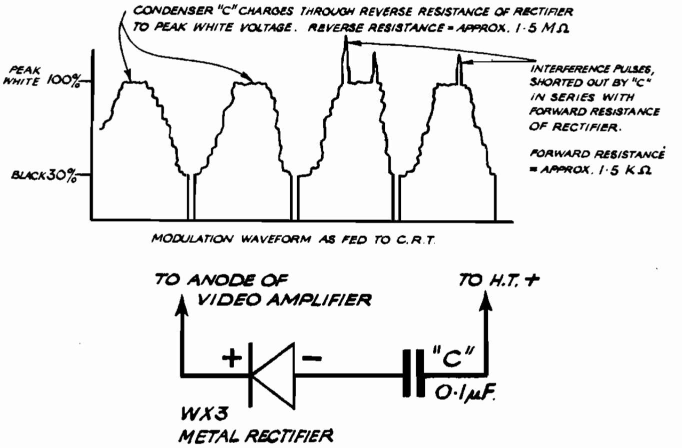


Fig. 14 Diagrams of Vision Interference Limiter

relatively low resistance in series with a condenser. An interference pulse instead of appearing as a large white blob on the screen is consequently reduced in size with an accompanying reduction in nuisance value. Unfortunately, in common with all automatic spot suppression circuits, there is some degrading of the picture due to clipping of peak whites. There is also some small deterioration due to the capacity of the rectifier which is about 8pF. being thrown across the output of the video stage. Where, therefore, the receiver is used in an area of high signal strength or where there is little interference, the limiter may with advantage be omitted.

It should be noted that C52 may be connected to either H.T. positive or earth and will function equally effectively, but by connecting it to H.T. positive, the charging current when first switching on the receiver will flow through MR5 in a forward direction. There is therefore little chance of damage occurring to the rectifier.

Reverting to the sync. separator diode V4, the video signal with positive sync. pulses is fed via R21 and C18 in parallel, to the diode anode. The time constant of R21, C18, is such as to bias off the diode so that it conducts only on the sync. pulses. The positive pulses developed across the cathode resistor R20 are taken to the time bases through their respective feed circuits.

Design Features of the View Master Sound Unit

THE SOUND CHANNEL has three valves. The first is an EF50 or 63SPT acting as an R.F. amplifier, this being followed by a double diode triode for rectification and L.F. amplification. Finally, there is an output pentode to feed the special television type loudspeaker.

The signal input to the sound channel is developed across a circuit consisting of a tuning coil L113 and condenser C20, L113 being inductively coupled to L110 by being mounted in close proximity to it. This method of extracting the sound signal from the vision receiver has advantages, as it enables the sound rejector circuit of the vision receiver to be tuned for minimum sound interference in the vision channel, whilst the input circuit to the sound receiver may be tuned for maximum sound signal.

So as to improve the effectiveness of the rejection filter and therefore its selectivity, the input impedance of V6 is increased by developing negative feed back in the cathode circuit, as has also been done on V3, a 22Ω resistor being connected in series with the normal bias resistor, the latter being by-passed by a 500pF. condenser. The anode of V6 is taken to the primary of an inductively coupled transformer the secondary of which feeds one diode of the double diode triode valve, V7. Optimum coupling of the two sections of this transformer is arranged by mounting the two coils at a specified distance apart. The secondary L115 of the transformer is connected to diode anode, and has its earthy end taken to a 100kΩ load resistor R30, by-passed by a 47pF. condenser C27, both of which are returned to the cathode of V7.

The audio signal is taken from the top of R30 via a 5·6kΩ resistor R28. A 100pF. condenser C25 is connected to earth from this point so as to by-pass any R.F. voltage. The value of this condenser has been made somewhat low so as to ensure an audio response capable of handling ignition interference pulses with the minimum of distortion, thereby ensuring more effective pulse interference suppression from the succeeding circuits. The audio signal is taken to the top of the volume control R29 through a 0·02μF. condenser C26.

A 220Ω grid stopper is mounted close to the grid of V7 to prevent parasitic oscillation.

Due to the high gain of V7 it is necessary to have an extra stage of decoupling in the anode. This consists of a 1μF. electrolytic condenser C32, and a 100kΩ resistor R33. The audio signal from the anode of V7, is taken to a Westinghouse metal rectifier Type WX6 (MR1) which functions as an interference limiter. A diode valve such as a Mullard EA50, or Mazda 6D1, could, of course, also be used but would not be as convenient.

It should be explained that this type of limiter is only suitable for ignition type interference where the pulse width is very narrow — of the order of ½–20μs. Other forms of interference are in no way reduced by this circuit.

To understand more clearly the method by which it operates, it is proposed that the positive end of the metal rectifier be called the cathode and the negative end the anode, as these are the equivalent electrodes in a diode which could perform the same function. A positive potential is applied to the anode by having a 2·2MΩ resistor R36, connected to the H.T. line, thereby making the rectifier conduct. The potential difference across the rectifier itself is very small due to the voltage drop across R36. On the arrival of a positive going

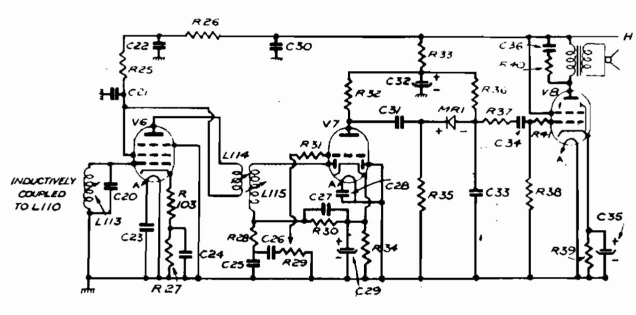


Fig. 15 Circuit of Sound Receiver

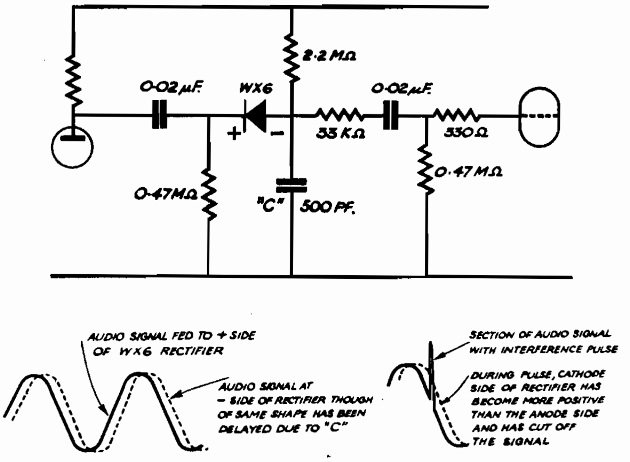


Fig. 16 Circuit and section of audio waveform to show method by which narrow interference pulses are eliminated.

audio signal at the cathode of the rectifier, the cathode goes more positive, the anode consequently also goes more positive and in fact, closely follows the cathode potential, rising and falling exactly as the audio signal. It can be fairly assumed that whatever audio signal appears on the cathode will appear at the anode and no appreciable distortion will occur as long as the rectifier is conducting. (See also Fig. 16).

It will further be noted that a 500pF. condenser C33 is connected between anode and earth, becoming charged to the mean potential of the anode. The charge on the condenser is therefore varying in sympathy with the audio signal. When however, a pulse of interference appears at the anode, the time constant of the combination is such that the potential of the anode cannot change rapidly, making the cathode positive with respect to anode, and causing the rectifier to become non-conducting and so cut off for the duration of the pulse. In this way narrow steep-sided pulses of interference, similar to car ignition interference, are practically eliminated, whilst the audio signal is not affected in any way. It is true that there is some very slight reduction in the H.F. response, but this is not serious as there is ample compensation in the following stage.

V8 is a normal L.F. amplifier feeding a special television type loudspeaker. The reason for the use of the special type of loudspeaker is to prevent distortion of the raster, and for this it is essential that there should be no stray magnetic fields close to the tube. In the past the loudspeaker has been one of the more serious problems, as there has always been a very considerable stray magnetic field around the magnet, whether permanent or electro-magnetic types. With the loudspeaker specified there is no appreciable external magnetic field and no distortion of the raster occurs, even though the loudspeaker may be within a few inches of the cathode ray tube.

Across the primary of the output transformer is connected a resistance/condenser combination to prevent accentuation of the high frequency response.

The View Master Main Chassis

(containing Time Bases and Power Supplies)

THE MAIN CHASSIS, upon which is mounted the cathode ray tube, also carries the line and frame time bases, the power supply to give 6·3V. at 7 amps, and 280V. at 200 mA. H.T., also the E.H.T. supply for the C.R. Tube derived from the line flyback.

Dealing with the time bases first, it will be noted that Thyratron saw-tooth generators followed by high efficiency amplifiers are employed. It was considered that Thyratrons were the most suitable type of time base generators for the average home constructor, as with them it is so very easy to obtain suitable scanning voltages of good linearity. Synchronising, too, is readily achieved with the economical sync. separator previously described. The Thyratrons specified are Mazda 6K25's manufactured by Ediswan and are, with the exception of the heater voltage, in all respects similar to the well known T41's which have a very high reputation for stability and reliability.

Line Time Base

The sync. pulse to the line Thyratron is fed through a differentiating circuit to ensure a steep sided pulse for triggering. Frequency adjustment of the Thyratron is by variation of cathode bias, a part of the cathode resistor being made variable.

The anode charging condenser is returned direct to the cathode, which is not by-passed by a condenser. The anode charging resistor has a fixed value, line amplitude being controlled, not by variation of the Thyratron anode charging circuit as is frequently done, but by a variable inductor in the line transformer output circuit. The line amplifier is a Mazda 6P28. This is a beam power tetrode, having a 20W. maximum anode dissipation.

The line time base amplifier is designed for maximum economy and is operated under very efficient conditions, the total power consumption being around 20W. whereas for a similar deflecting power a straight brute force circuit would require approximately 32W. The high efficiency of the circuit is brought about by the use of a diode rectifier frequently referred to as an efficiency diode. The way in which the circuit functions is by arranging that the amplifier valve is cut off, not only during the flyback period, but also for an appreciable part of the forward trace. During this period, deflection power is obtained from the diode circuit, which has utilised much of the magnetic energy in the line transformer and scanning coils, caused by the oscillation which occurs immediately following the flyback, and is normally dissipated in a shunt damping resistor.

At the same time, the diode sets up a bias voltage of about 40V. which is added to the H.T. supply of the line amplifier. In a particular amplifier, there was an increase of 38V. making the H.T. supply fed to the line valve 323V. as against 285V. available from the power supply. This increase in anode voltage gives a very appreciable increase in scanning power.

This high efficiency circuit makes it possible to over-scan a 9″ tube with 6500V. on its anode yet with power taken by the line amplifier of only 22W.

The efficiency diode actually used is a specially developed metal rectifier, connected in series with the secondary of the line transformer and the H.T. feed to the line amplifier valve. The rectified voltage developed by the diode is therefore in series with the H.T. supply and, being additive, contributes to the supply. Deflection power is therefore increased in proportion.

The primary of the line transformer is overwound to act as an auto-transformer so as to step up the already high peak flyback voltage to a maximum of 7kV. for rectification as E.H.T. for the tube supply. Rectification is carried out with the aid of a Westinghouse 36.EHT.100 rectifier. If preferred, a Mullard EY51 valve rectifier may be used, in which case a further small secondary winding supplies current for the directly heated cathode.

The small drawing of the Line Transformer on Stage 6 shows the three tags to which the EY51 should be connected.

The regulation of the E.H.T. supply is better than 5%. It is actually best when using the metal rectifier, as with this type a rise in voltage is prevented above a certain figure, dependent on the type of rectifier.

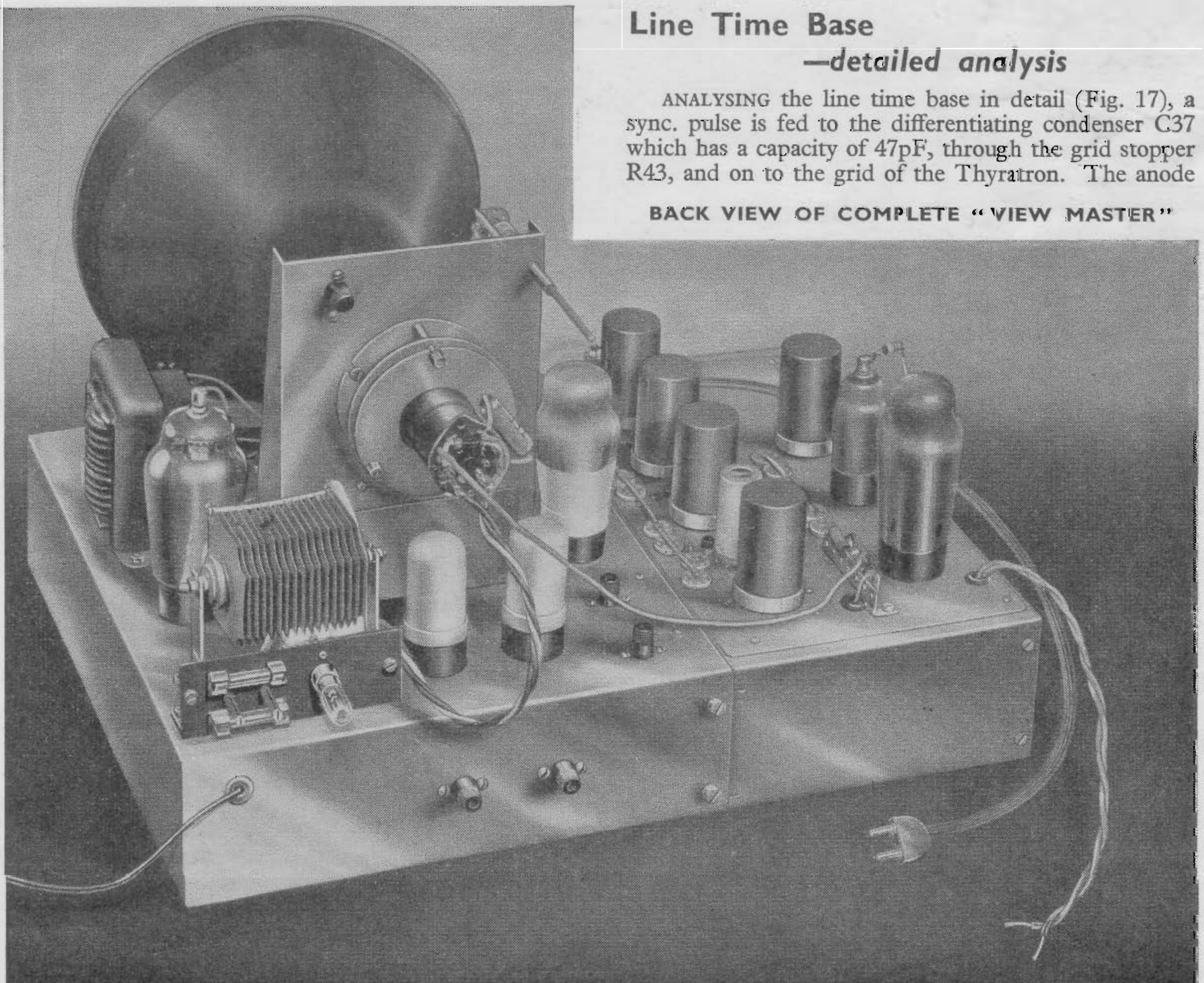
In addition, when using an EY51 rectifier, there is a rise in E.H.T. of about 500V. To prevent this a small condenser C.44 (220pF. T.C.C. Type No. S.C.T.3.) is connected across the scanning coils and is wired across the tags YZ on the terminal strip on the rear C.R.T. support.

The line transformer is an open core type. Amongst the many advantages of this form of construction is the fact that it enables the transformer to run cooler, since ventilation is naturally more effective.

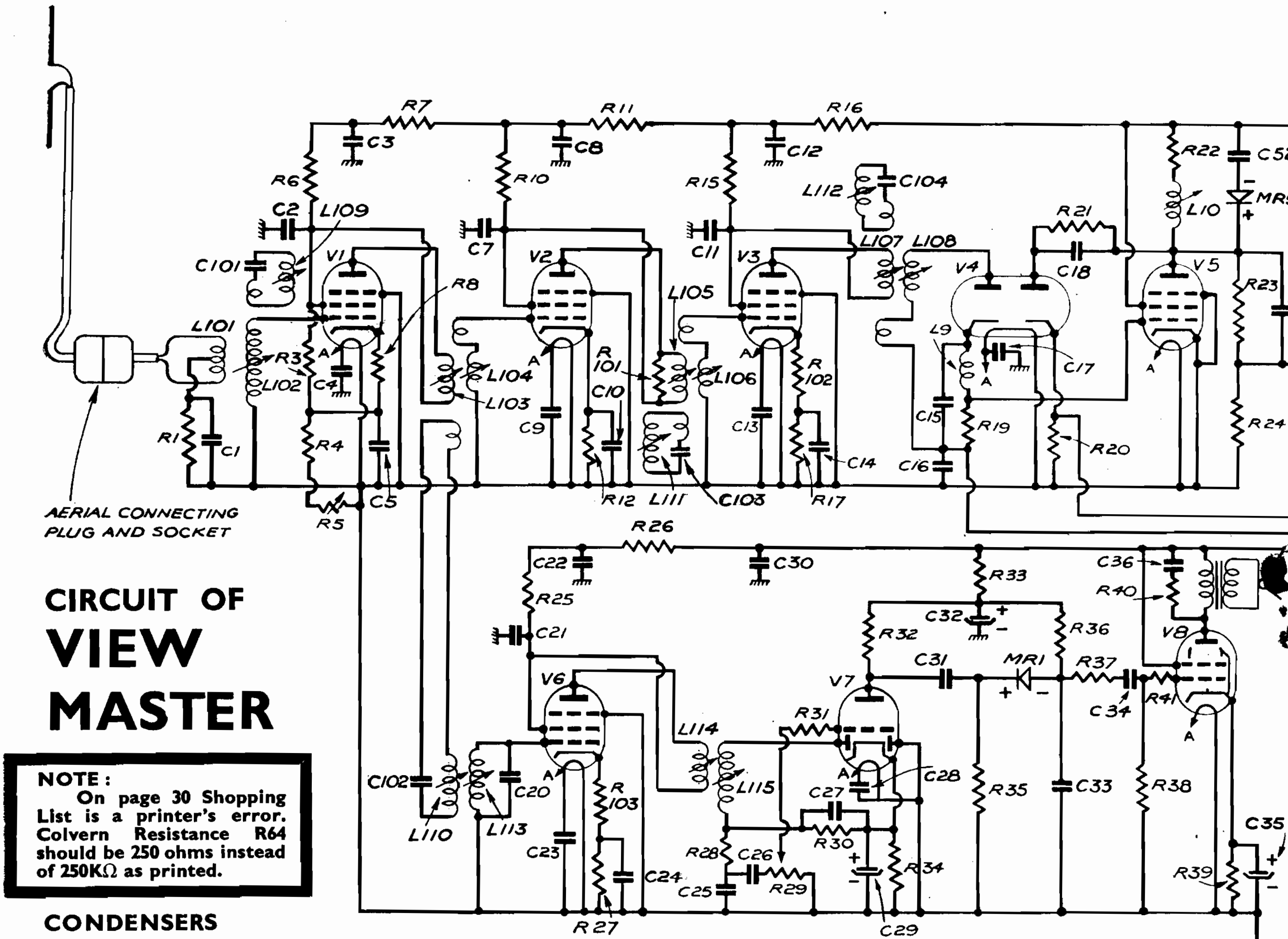
The scanning coils are wound with Lumex wire and enable a relatively thick wire to be used with very little insulating material between coils, yet without fear of damage or breakdown, thereby increasing the efficiency of the coils. A mumetal band is wound around the coil assembly to increase the flux across the deflecting field.

Line Time Base
—*detailed analysis*

ANALYSING the line time base in detail (Fig. 17), a sync. pulse is fed to the differentiating condenser C37 which has a capacity of 47pF, through the grid stopper R43, and on to the grid of the Thyratron. The anode



BACK VIEW OF COMPLETE "VIEW MASTER"



CIRCUIT OF

VIEW MASTER

> **NOTE:**
> **On page 30 Shopping List is a printer's error. Colvern Resistance R64 should be 250 ohms instead of 250KΩ as printed.**

● *Note that certain C. and R. numbers are deliberately omitted from the tables of Condensers and Resistors. These values were previously used in the London version and are not now required.*

CONDENSERS

NO.	CAPACITANCE	NO.	CAPACITANCE
1	0·001 μF.	32	1 μF.
2	500pF.	33	500pF.
3	,,	34	0·02 μF.
4	,,	35	20 μF.
5	,,	36	0·005 μF.
7	,,	37	47pF.
8	,,	38	0·005 μF.
9	,,	39	0·01 μF.
10	,,	40	0·1 μF.
11	,,	41	0·1 μF.
12	,,	42	2 μF.
13	,,	43	0·01 μF.
14	,,	44	(See Page 15)
15	10pF.	45	0·001 μF.
16	500pF.	46	0·002 μF.
17	,,	47	0·01 μF.
18	0·1 μF.	48	0·25 μF.
19	300pF.	49	0·015 μF.
20	10pF.	50	0·001 μF.
21	500pF.	51	250 μF.
22	,,	52	0·1 μF.
23	,,	53	100 μF.
24	,,	54	,,
25	0·0001 μF.	55	2500 μF.
26	0·02 μF.	56	0·025 μF.
27	47pF.	101	40pF.
28	500pF.	102	40pF.
29	20 μF.	103	40pF.
30	500pF.	104	40pF.
31	0·02 μF.		

VALVES

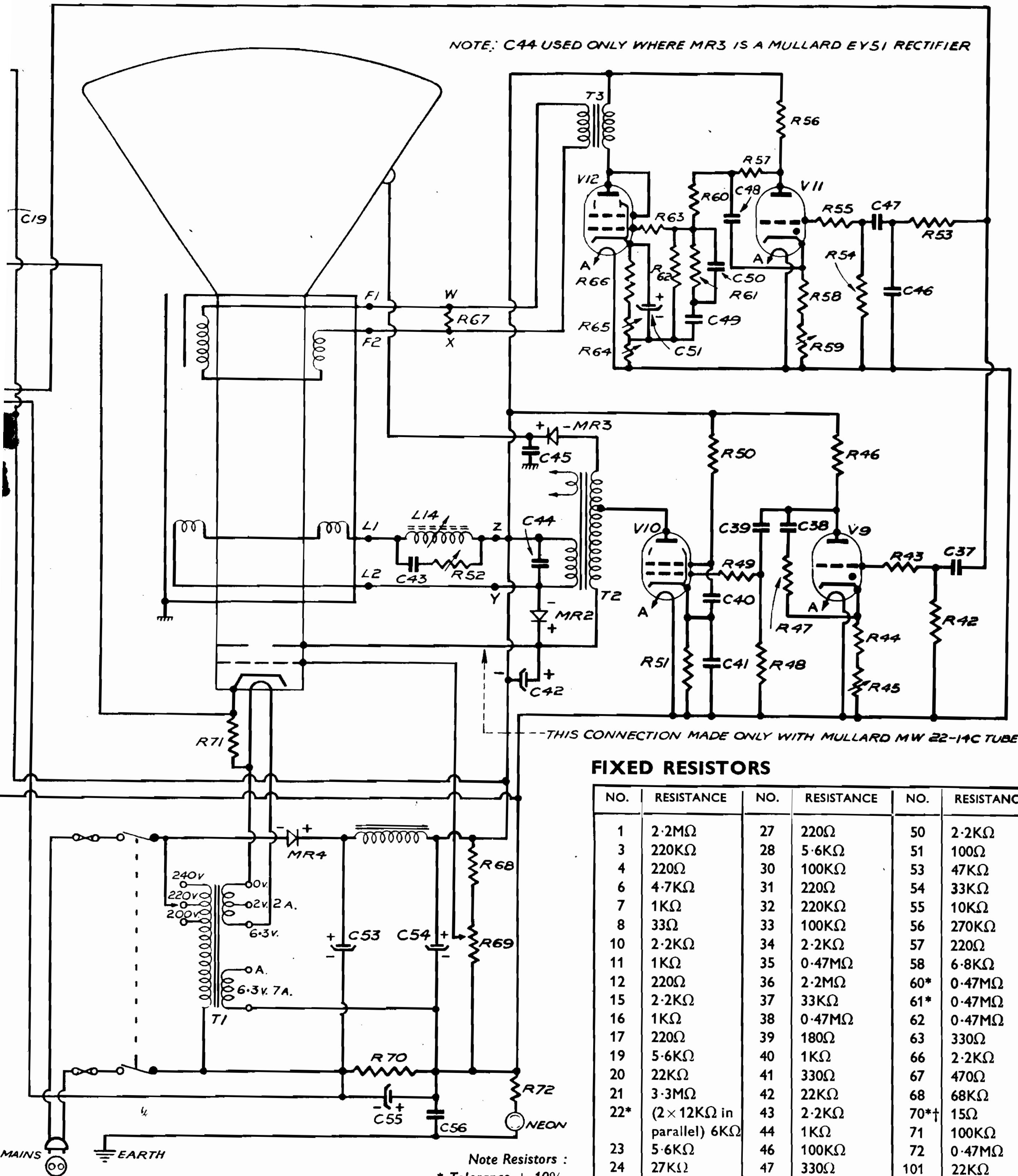
NO.	MAKER	TYPE
1	Mullard or Cossor	EF50 63SPT
2	Mullard or Cossor	EF50 63SPT
3	Mullard or Cossor	EF50 63SPT
4	Mullard or Mazda or Osram or Cossor	EB91 6D2 D77 6AL5
5	Mullard or Cossor	EF50 63SPT
6	Mullard or Cossor	EF50 63SPT
7	Mullard or Osram or Cossor	EBC33 DH63 OM4
8	Mullard or Osram or Mazda	EL33 KT61 6P25
9	Mazda	6K25
10	Mazda	6P28
11	Mazda	6K25
12	Mazda or Osram	6P25 KT61

INDUCTANCES

NO.	DESCRIPTION
101	Aerial Coil
102	V1 Grid Coil
103	V1 Anode Coil
104	V2 Grid Coil
105	V2 Anode Coil
106	V3 Grid Coil
107	V3 Anode Coil
108	V4 Anode Coil
109	Aerial Filter Coil
110	V1 Anode Filter Coil
111	V2 Anode Filter Coil
112	V3 Anode Filter Coil
113	V6 Grid Coil
114	V6 Anode Coil
115	V7 Input Coil
9	250 μH Choke
10	3Mc/s Boost Choke
14	Width Control

METAL RECTIFIERS

NO.	MAKER	TYPE
MR1	Westinghouse	WX6
MR2	Westinghouse	14–D–36
MR3	Westinghouse	36 EHT 100
MR4	Westinghouse	14–A–86
MR5	Westinghouse	WX3



Note Resistors :
** Tolerance ± 10%.*
† 2 × 33 Ω in parallel may be used.

FIXED RESISTORS

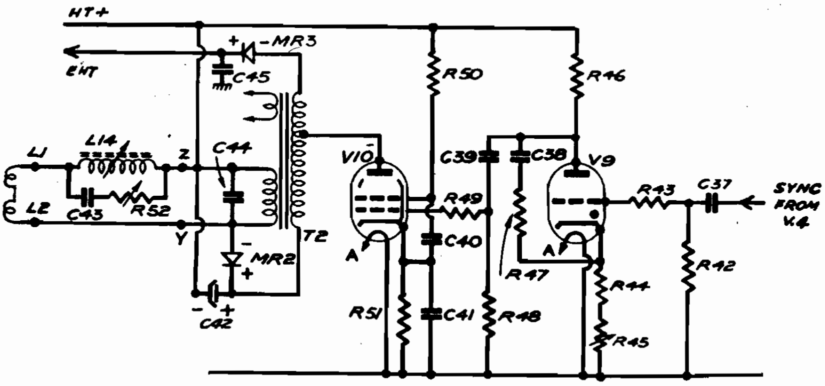
NO.	RESISTANCE	NO.	RESISTANCE	NO.	RESISTANCE
1	2·2MΩ	27	220Ω	50	2·2KΩ
3	220KΩ	28	5·6KΩ	51	100Ω
4	220Ω	30	100KΩ	53	47KΩ
6	4·7KΩ	31	220Ω	54	33KΩ
7	1KΩ	32	220KΩ	55	10KΩ
8	33Ω	33	100KΩ	56	270KΩ
10	2·2KΩ	34	2·2KΩ	57	220Ω
11	1KΩ	35	0·47MΩ	58	6·8KΩ
12	220Ω	36	2·2MΩ	60*	0·47MΩ
15	2·2KΩ	37	33KΩ	61*	0·47MΩ
16	1KΩ	38	0·47MΩ	62	0·47MΩ
17	220Ω	39	180Ω	63	330Ω
19	5·6KΩ	40	1KΩ	66	2·2KΩ
20	22KΩ	41	330Ω	67	470Ω
21	3·3MΩ	42	22KΩ	68	68KΩ
22*	(2×12KΩ in	43	2·2KΩ	70*†	15Ω
	parallel) 6KΩ	44	1KΩ	71	100KΩ
23	5·6KΩ	46	100KΩ	72	0·47MΩ
24	27KΩ	47	330Ω	101	22KΩ
25	4·7KΩ	48	0·47MΩ	102	22Ω
26	1KΩ	49	330Ω	103	22Ω

CATHODE RAY TUBES

MAKER	9″	12″	BASE	HEATER VOLTS
Ferranti	—	T12/46	I.O.	6
G.E.C.	6504	—	I.O.	6
Mazda	CRM92	CRM121	M.O	2
Mullard	MW22-14C	MW31-14C	B8G	6

VARIABLE RESISTANCES

5	5KΩ Colvern CLR4089/22	59	10KΩ Colvern CLR901
29	250KΩ Morganite	64	250Ω Colvern CLR901
45	2·5KΩ Colvern CLR901	65	5KΩ Colvern CLR901
52	2KΩ Colvern CLR901	69	100KΩ Morganite



NOTE: C44 USED ONLY WHERE MR3 IS A MULLARD EY51 RECTIFIER

Fig. 17. Circuit of Line Time Base.

charging resistor R46, has a value of 100kΩ. and the condenser C38, a capacity of 0·005μF. A resistance of 330Ω, R47, is connected in series with C38 to give the correct wave form for feeding to the line amplifier. The lower end of the charging circuit is connected direct to the cathode to give a fast flyback. R45, the variable portion of the Thyratron cathode resistor, acts as the frequency control.

The saw-tooth wave form developed across C38 is fed to the grid of the line amplifier valve via the coupling condenser C39, whilst a 330Ω. grid stopper is connected close to the grid of this valve. The cathode bias resistor on the line amplifier valve, V10, has a value of 100Ω. and is by-passed by a 0·1μF. condenser. To keep the screen dissipation within its rating, a 2·2kΩ. screen feed resistor is used and is decoupled to cathode by a 0·1μF. condenser.

The anode of the 6P28, which is at the top of the valve, is taken to a tapping on the primary of the line transformer. The top end of this winding develops the high voltage for rectification for the E.H.T. supply. The lower end of the primary winding is taken to the junction of C42 and the metal rectifier efficiency diode MR2. The other end of the rectifier is connected to one side of the secondary of the line transformer, the other side of which is taken direct to H.T. In this way it will be readily seen that the H.T. supply is fed to V10 via the scanning coils and rectifier, which has developed a positive bias across condenser C42.

The line amplitude or width control is connected in series with the scanning coils. It is a small coil with an inductance variable between 0·5 and 2·5mH. by movement of an iron dust core. Adjustment of inductance, and therefore series impedance, controls the scanning current. Across the width control is connected a variable resistor R52 in series with condenser C43. Adjustment of R52 controls the linearity at the extreme left of the raster.

The high potential end of the primary of the line transformer is taken direct to the E.H.T. rectifier MR3, the other end of the rectifier going to the smoothing condenser C45 which has a capacity of 0·001μF., and to the anode of the cathode ray tube.

The rectifier, being light in weight and convenient in shape, is soldered in position directly between the transformer and the condenser. It therefore presents no problems regarding insulation.

Frame Time Base

THE FRAME sync. pulses are fed to the Thyratron, V11, through an integrating circuit which, though having few components, does give a good interlace if adjusted correctly and if the wiring is carried out in a neat manner so as to prevent coupling with the line time base.

Integrating circuits have been used for a large number of years where reliability and economy are important features and although interlacing may not be up to the standard of a more complex interlace filter requiring additional valves and components, results are considered to be satisfactory.

The frame Thyratron, as in the line time base, is a 6K25, frequency being controlled by variation of cathode voltage. The saw-tooth voltage from the anode of the Thyratron is taken to the frame amplifier via a correction circuit to compensate for the deficiencies of the frame output transformer. This correction circuit, in combination with the frame linearity control which acts by varying the bias of the frame output valve and therefore shifts the working characteristic of the valve, ensures a linear frame scan.

The frame amplifier is a Mazda 6P25 connected as a triode. The output of the Thyratron is D.C. connected to the frame amplifier grid, there being no condenser in series.

To compensate for the positive D.C. voltage which appears on the grid of the frame amplifier, the cathode is raised by some 50V, the linearity control varying the bias by a few volts either side of this figure. Frame amplitude or height is controlled by a variable resistor in the cathode of the amplifier valve. This resistor is not by-passed and therefore develops negative feedback.

The frame output transformer, which has an inductance of around 60H. is connected directly in series with the anode of the 6P25.

Some idea as to the efficiency which may be obtained from the output stage may be gathered from the fact that the total current of the amplifier valve is only 14mA, yet with this current a 9″ cathode ray tube may be fully scanned with 7kV. on its anode.

Analysis of Circuit

EXAMINING the frame time base in detail (Fig. 18), it will be seen that sync. pulses are fed to the grid of the Thyratron by the integrating circuit consisting of R53 47kΩ. and C46 0·002μF. There is a grid stopper,

Fig. 18. Circuit of Frame Time Base.

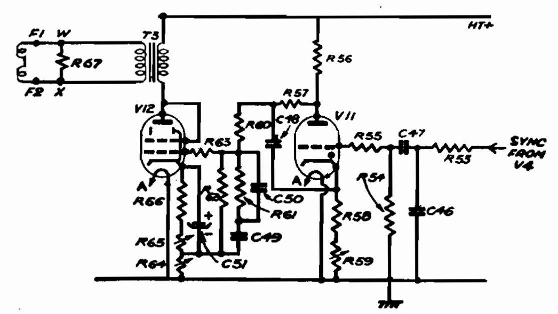
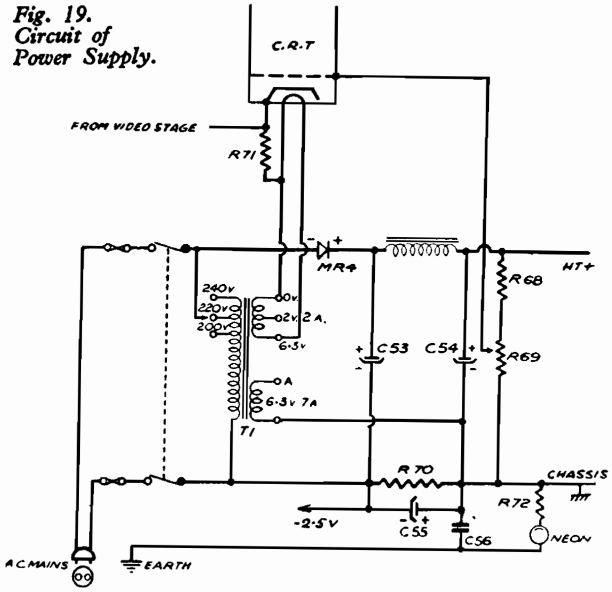


Fig. 19.
Circuit of Power Supply.



R55 of 10kΩ. with a grid leak R54 of 33kΩ. The anode charging circuit consists of a resistor R56 270kΩ. and condenser C48 0·25μF. the latter being returned direct to cathode. A 220Ω. resistor R57 is connected in series with C48 to limit the Thyratron discharge current and so prevent damage to the valve. The frequency control R59 has a value of 10kΩ. and has in series with it a fixed resistor, R.58, of 6·8kΩ.

The waveform correction circuit consists of two 0·47MΩ. resistors, R60 and R61, in series with a 0·015μF. condenser C49, and a 0·001μF. condenser connected across R61, the combination being connected across the frame Thyratron output. The grid of the amplifier valve V12 is taken to the junction of R60 and R61. Connected between the bias control R65 and earth is a 250Ω. variable resistor R64. Negative feed back is developed across this resistor and by varying its value, amplitude is smoothly controlled. In series with R64 are the two bias control resistors, R65 and R66, by-passed by a 250μF. electrolytic condenser C51. R65 is made variable and, as has previously been explained, varies the bias applied to V12, shifting the working point along the anode current curve and acting as a linearity control.

The frame scanning coils, which are connected directly to the secondary of the frame output transformer, have across them a resistor of 470Ω. (R67), with the object of preventing coupling with the line scanning coils.

When coupling is present, the line scan at the left of the raster is modulated vertically, causing horizontal line to appear wavy.

Power Supply and Cathode Ray Tube

IT HAS PREVIOUSLY been mentioned in the Introduction that the heater supply for the valves and cathode ray tube is taken from a mains transformer, whilst the H.T. supply is obtained directly from the mains through a suitable rectifier. This method, whilst being economical and simple, is also reliable and robust, but calls for certain precautions to be taken, more particularly if the receiver has to be adjusted and the chassis handled by the home constructor.

The reasons for this will be obvious when it is realised that one side of the mains is invariably earthed. At the same time, the chassis of the View Master must also be connected to one side of the mains. If the mains input is connected in such a way that the chassis is at earth potential, all is well. If, however, the polarity should be reversed, then the chassis would be 200-250V above earth, dependent on the actual mains voltage. Under working conditions this would have no adverse effect whatsoever on the functioning of the receiver, as demonstrated by the millions of A.C./D.C. receivers in use.

Special safety feature

In a Television receiver built by the home constructor it is necessary for certain adjustments to be carried out and it would be most inconvenient and, indeed, dangerous, if this had to be done with the chassis at mains potential. To obviate this and to give warning that the chassis is above earth, a simple indicating device has been adopted consisting of a miniature neon lamp with resistor in series. These are connected between the chassis and a lead taken direct to an earth point. It will readily be seen that if the chassis is at earth potential the neon lamp will not light, whereas if the chassis is at mains potential it will light, since the full mains voltage will appear across it.

The earth lead to the neon lamp must be well insulated from the chassis to prevent short circuiting the mains in the event of an incorrect connection. As the receiver will function satisfactorily even if connected with the chassis at mains potential, a special A.C. working condenser is connected between the chassis and the earth lead so that the receiver is always earthed so far as signal frequencies are concerned.

It should be quite clearly understood that the object of fitting this neon indicator is to give warning to the constructor or experimentor if the chassis is live, in which case the mains plug must be reversed to enable adjustments to be carried out with safety. It has no other function to perform in the working of the television receiver (Fig. 19).

The mains rectifier is a special Westinghouse type capable of withstanding the very heavy surges which occur during the switching-on period. The necessity for using this type of rectifier will be readily understood when it is realised that to obtain a D.C. output greater than the R.M.S. input to the rectifier, the reservoir condenser has to have a very large capacity. In this case it is actually 100μF. (C53). This large capacity draws an extremely heavy charging current when the receiver is first switched on and a metal rectifier is the only type which is capable of supplying this heavy surge without damage.

A smoothing choke with an inductance of 2H. is followed by a further 100μF. electrolytic smoothing condenser, C54, which ensures a D.C. supply free from hum. Between the negative ends of C53 and C54 (the reservoir and smoothing condensers respectively), are connected R70 15Ω. and C55 2,500μF. across which is developed the 2·5 volt negative bias for the video stage

V5. From the diagram it will be apparent that the chassis, though considered at earth potential if the neon lamp does not light, will in fact be 2·5V. positive with respect to earth. This is a further point calling for insulation between chassis and earth, since if there should be a direct connection between chassis and earth the 2·5V. bias voltage will be shorted-out and V5 will be over-run, giving a flat picture, lacking in contrast. C53 and C55 must, of course, be insulated from the chassis by having insulating tape, Empire cloth or P.V.C. sleeving wound around the can before fixing by the mounting clip.

Across the H.T. supply is connected the brightness control for the cathode ray tube, consisting of a potentiometer R69 and fixed resistor R68. The slider of R69 is taken to the grid of the cathode ray tube and varies the grid voltage between approximately 100-140 volts. The cathode is also connected through a 0·1MΩ. resistor R71 to its heater so as to prevent a high voltage developing between heater and cathode, thereby causing a breakdown.

The primary of the transformer supplying the heater volts is tapped for voltages between 200-240. This is necessary to ensure that the valve and cathode ray tube heaters are neither over-run nor under-run. The receiver itself can function at any voltage between 200 and 250, though the picture is naturally better at the higher input voltage.

Focussing the picture is accomplished by means of a permanent magnet focussing ring, which once set up does not require further adjustment.

The advantages of using permanent magnet focussing over electro-magnetic focussing are many. A current drain of 30-40mA. is saved. There is no shift in focussing due to heating up of the focus coil, which can cause an increase in resistance and a reduction in the current, necessitating frequent re-adjustments. There is one control less, as once focussing has been adjusted by setting the gap correctly, it requires no further re-adjustment.

Centring the picture, too, has been incorporated in the specified focus ring, the picture being shifted by altering the gap between the two components of the focus ring, with the three separate adjusting screws fixed 120° apart.

Focussing is normally done by adjusting the three screws evenly, so that the gap is slowly opened, thereby increasing the flux, whilst the picture is made to shift by varying the width of the gap along its diameter.

Two types of focus ring are specified, one for use with a tetrode cathode ray tube such as a Mullard MW22-14C, whilst the other is for triode tubes such as Mazda CRM91 and G.E.C. 6504. These latter types require a considerably stronger magnetic field.

Further notes on focussing will be found in the chapter dealing with operating the receiver, on page 23.

How to set up and align the View Master

THE RECEIVER has been designed so that it is possible for alignment to be done directly on the aerial, using the loudspeaker and cathode ray tube respectively as indicators, though in view of the more complex circuits necessitated by single side band reception, a signal generator or oscillator could with advantage be used.

The method of aligning using the transmitted television signal will be described first, whilst the alternative method using a signal generator will be dealt with further on. The sound receiver will normally be aligned first so that one of the rejector circuits will be approximately correct.

With the aerial and loudspeaker connected and the receiver switched on, with brightness control turned down, adjust the iron dust cores of the tuning coils to the following positions. Screw in fully cores L109, L110, L111. Unscrew completely core L112. Adjust all other cores level with the top of the moulded formers. It is just possible that when adjusting the dust cores in the sound receiver, a point will be reached where the television sound signal is audible. Should this occur, then tune circuits L115, L114, L113, L110 and L102 for maximum signal. If however, no signal is received during the initial adjustments to the cores, then each of the tuned circuits must have its core screwed in one turn at a time, the procedure being repeated until a signal is heard in the loudspeaker. As soon as there is some response from the loudspeaker each tuned circuit may be adjusted for maximum output. This completes the sound receiver tuning for the present, final adjustments being carried out after the vision receiver has been completely aligned.

Turning now to the vision receiver, it will be realised that when adjusting for best definition, some standards must be adhered to, otherwise the definition or the resolving power cannot be specified. The alignment of the vision receiver using the cathode ray tube as indicator must therefore be carried out during the transmission of the B.B.C. Test Card C, which is usually transmitted between 10 a.m. and 11 a.m. on week days. This Test Card has on it several blocks of vertical black lines of varying thickness and spacing, the narrowest lines representing a band width of 3Mc/s. and the widest lines a band width of 1Mc/s. By aligning the receiver on this pattern it should be possible to resolve those lines representing a band width of 2·5Mc/s. whilst with care, even this may be improved on.

Continuing the alignment procedure, leave cores L108, L107, L106 and L104 level with the top of the moulded formers whilst L105 and L103, which have also been adjusted to this same point, should now be screwed in by two complete turns. The brightness control on the cathode ray tube may now be turned up so that a raster is visible. Gain control should be advanced towards maximum gain and if a signal is being received, a jumble of constantly moving black and grey lines will be visible on the tube. This is the picture modulation which at this stage is not yet synchronised.

Adjustment of the line and frame time base frequency controls at the back of the receiver, may cause the picture to lock into synchronism though it may not yet be of very good quality. If after initial adjustment of the dust cores there is still no sign of any modulation on the tube even though the gain control is turned to maximum, it will be necessary to adjust each tuned circuit throughout its complete range of movement, until a point is reached when modulation does appear. Once modulation has appeared on the end of the tube, it only remains for each of the cores to be adjusted for maximum signal.

To obtain the best definition, it is necessary for the vision receiver to have a response which is flat from 59·25Mc/s. to 61Mc/s. whilst at the carrier frequency of 61·75Mc/s. it should be 6d.b. down. There must also be adequate attenuation at the accompanying and adjacent sound carrier frequencies. To obtain the correct response from the receiver, it is necessary to follow closely the procedure outlined below, since at this stage, though there may be a strong signal at the receiver, the picture will probably be lacking in definition whilst it is also possible that there may be severe interference from the sound channel. At this point too, the focus ring should be adjusted for correct focus. Details of this adjustment are given on Page 23.

L108, L107, L106 and L104 are each adjusted for maximum signal, that is maximum brightness on the tube. As each of the tuned circuits is adjusted, it will be necessary to reduce the gain of the receiver by turning down the gain control R5 to prevent the video stage V5 or perhaps the cathode ray tube from overloading, giving an overall white appearance to the screen completely lacking in detail. The filter circuit L112, C104 is then adjusted for minimum signal on the tube, after which the dust core is unscrewed by $1\frac{1}{2}$ turns. L108 and L107 are then re-adjusted, since setting the filter circuit may have shifted the frequency response to some small extent.

L105, L103 and L102 are now adjusted for maximum signal after which they are screwed in by one complete turn, so as to bring the resonant frequency close to 59·25Mc/s. The filter circuit L111, C103 should also be adjusted screwing in the iron dust core to a point where minimum interference from the accompanying sound signal is obtained.

Repeat all the above adjustments as a check that the filters have not caused any shift; finally L109 must be adjusted for minimum sound signal and then the dust core must be screwed in further by about one complete turn, until the sound signal is back to its original volume; the frequency to which this filter is then tuned will be approximately 56·75Mc/s.

The receiver will now be fairly closely adjusted to the final position. The following information will, however, be of assistance in obtaining the best possible results.

Generally speaking, the definition of a receiver is affected by the high frequency response of the receiver, whereas the low frequency response affects the general background level. Tuned circuits L102, L103 and L105 are those controlling the high frequency response and therefore the definition and sharpness of the picture. As the sound carrier is close to this end of the vision transmission, the sound rejection filters coupled to V2 and V3 anodes will also have some effect on the H.F. response. Excessive attenuation of the sound frequency or incorrect adjustment of these filters, will attenuate the upper side bands of the vision transmission. If then it should be considered that the picture is not sharp or will not resolve the 2·5Mc/s. bars in Test Card C, or the clock face background of the tuning signal, the three tuned circuits mentioned previously may be re-adjusted, whilst the coupling coils for the accompanying sound rejectors may be raised slightly towards the top of the formers away from coils L103, L105, so as to reduce the coupling and therefore the attenuation of the upper side bands, the best balance between picture resolution and sound interference rejection being the aim.

Tuned circuits L104, L106, L107 and L108 are those affecting the low frequency response of the receiver, whilst the filter circuit tuned to adjacent sound L112, C104, will also have some effect on the response, since again if attenuation is too severe the vision channel is affected. It is important that the low frequency response should be correctly balanced both in amplitude and phase with respect to the video spectrum, otherwise the quality of the picture will suffer, notwithstanding that the definition will otherwise be good.

Generally, it may be assumed that amplitude or phase distortion of the low frequency response will cause shading or streaking of the background, particularly following black objects. In the worst cases, streaking may cause a smudge to appear right across the picture. If the low frequency response should not be considered satisfactory, judicious adjustment of L104, L106 and L107 and L108, and more particularly the latter pair, together with Filter L112, may be carried out until these defects are removed. The picture should now be capable of resolving the 2·5Mc/s. lines whilst the background should be free from shading. L10 can finally be adjusted for maximum output or contrast on the 2·5Mc/s. lines or if the 3Mc/s. lines are visible, for maximum output at this frequency. All the iron dust cores must then be locked in position by dropping a small spot of molten wax on them, taking care that they are not shifted in doing so. At the same time, seal in position with "Durofix" cement all coupling turns on each of the coils. It is obviously advisable to this after the receiver has been aligned, rather than during assembly at Stage 2.

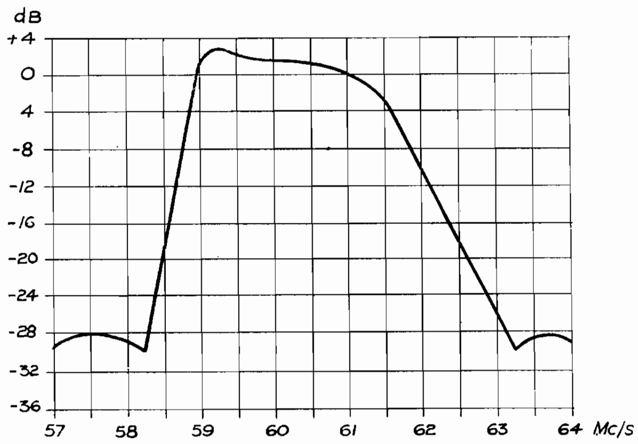


Fig. 20. Frequency Response Curve of Vision Receiver.

An alternative method, using a Signal Generator.

IF THE SIGNAL GENERATOR to be used has a calibrated voltage output, it would be an advantage to use an output meter so as to enable an accurate response curve to be obtained, and also to measure the sensitivity of the receiver. If the generator output voltage is not calibrated, the cathode ray tube may itself be used as the indicator, noting on the screen, the brightness and contrast due to the modulation, whilst if an unmodulated source is to be used a 500μA. meter may be inserted between C16 and the lower end of R19, or a voltmeter may be connected between the anode of V5 and earth.

Having connected a suitable meter or other indicator to the vision receiver and a loudspeaker to the sound receiver, and having made certain that all other connections are correct, the receiver may be switched on. All iron dust cores should be adjusted level with the top of the bakelite formers except those in L109, L110 and L111 which should be screwed in fully and L112 which must be screwed out fully. A signal generator may then be connected to the grid of V6, as the sound receiver will be aligned first so as to ensure that the first sound rejector circuit is approximately correct. The aligning procedure is as follows :

Connect generator to grid of V6.	Tune L114, L115 for maximum sound output at 58·25Mc/s.
Connect generator to grid of V1.	Tune L113, L110, L103 for maximum sound output at 58·25Mc/s.
Connect generator to grid of V3.	Tune L108 for maximum output at 61·75Mc/s. Tune L107 for maximum output at 61Mc/s. Tune L112 for minimum output at 63·25Mc/s.
Connect generator to grid of V2.	Tune L106 for maximum output at 61·75Mc/s. Tune L105 for maximum output at 59·25Mc/s. Tune L111 for minimum output at 58·25Mc/s.
Connect generator to grid of V1.	Tune L104 for maximum output at 61Mc/s. Tune L103 for maximum output at 59·25Mc/s. Tune L110 for minimum output at 58·25Mc/s.
Connect generator to aerial input.	Tune L102 for maximum output at 59·25Mc/s. Tune L109 for minimum output at 56·25Mc/s. Tune L113 for maximum sound output at 58·25Mc/s.

Repeat all above but with the signal generator connected to aerial input only. L10, must of course, be tuned on a signal.

A response curve of the vision receiver may now be taken and should conform closely to the curve of Fig. 20. The sensitivity, for an output of 15v. peak to peak measured at the anode of V5, should be around 350μV. If necessary, slight re-adjustments may be made so as to obtain the correct response. Should the rejector circuits be coupled too tightly to the tuned circuits, attenuation at the unwanted frequency will be greater than is necessary, with the possible result that the response of the vision channel will be affected. Great care must therefore be taken to ensure that the coupling coils are set correctly on the moulded formers, so that attenuation of the sound signal is sufficient but not excessive.

If the frequency response and sensitivity are considered to be satisfactory, the iron dust cores may be locked in position by dropping a small spot of wax on them, taking care not to shift the tuning whilst doing so.

Increasing sensitivity for "Fringe Area" reception.

For fringe areas or where conditions are difficult, some increase in gain may be achieved by making the following changes :—

Reduce R4 to 150Ω.
Reduce R12 to 180Ω.
Reduce R17 to 150Ω.
Reduce R27 to 150Ω.

Tuning and alignment will be no different in any way, whether done directly on an aerial or with the aid of a signal generator.

Definition should not be appreciably affected, though tuning will be somewhat sharper. The range of the receiver will, however, be improved, the increase in gain being most appreciated in the fringe areas.

Operating the View Master

HAVING COMPLETED the View Master, preparations can now be made for receiving a picture. First of all, install a suitable aerial system—the information given on page 25 will help you to choose the most efficient for your location. The View Master is connected to the aerial by Belling & Lee L336 twin feeder cable. The actual connection is by a Bulgin plug and socket—the plug is permanently connected to the set itself and its socket to the free end of the twin feeder. Don't forget to allow a reasonable length of twin feeder to permit the View Master being moved around the room if necessary.

It is assumed that at each stage of its assembly you have carefully checked all the wiring of the Receiver. A further check over will do no harm. Make sure for example, that the H.T. line and the heater supply are not miswired so as to cause a short circuit. Clear any pieces of loose solder and wire which could cause similar trouble.

A mains lead and an earth may now be connected at the receiver only, making certain that the mains are taken to the correct tapping on the primary of the heater transformer. The valves and cathode ray tube, fuses and neon lamp may also be fitted, taking particular care in handling the double diode valve V4, as it is so very easy to damage the pins and glass seals around the pins if undue force is exerted in fitting the valve into its socket.

Should it be found difficult to insert, then the V4 sockets must be opened out slightly with a scriber or needle of appropriate size.

Care is also necessary in fitting the plastic supporting band around the cathode ray tube.

The earth lead should be taken to an earth point, preferably a water pipe. The brightness control should be turned to minimum and the mains switch in the off position.

The receiver may now be connected to mains and switched on. If the neon lamp should light, then the mains plug must be reversed. Adjustments to the receiver must only be carried out when the polarity of the mains is such that the neon lamp does not light. If on first switching-on it is found that the neon does not light it is strongly advised that the functioning of the circuit be checked by reversing the mains lead, not forgetting finally to connect it the correct way round.

At this stage it is again emphasised that the neon lamp is fitted solely as an indicator of mains polarity for safety purposes and it should therefore be treated as such. Apart from this purpose, it performs no other function in the receiver.

Having now switched-on, a minute or so should be allowed to elapse, after which the brightness control may be turned up slowly, until a raster is visible.

At this stage the raster, though bright, will be out of focus. The next step must then be to adjust the permanent magnet focus ring for optimum focus, taking care not to shift the picture off the screen or cut off the corners in doing so.

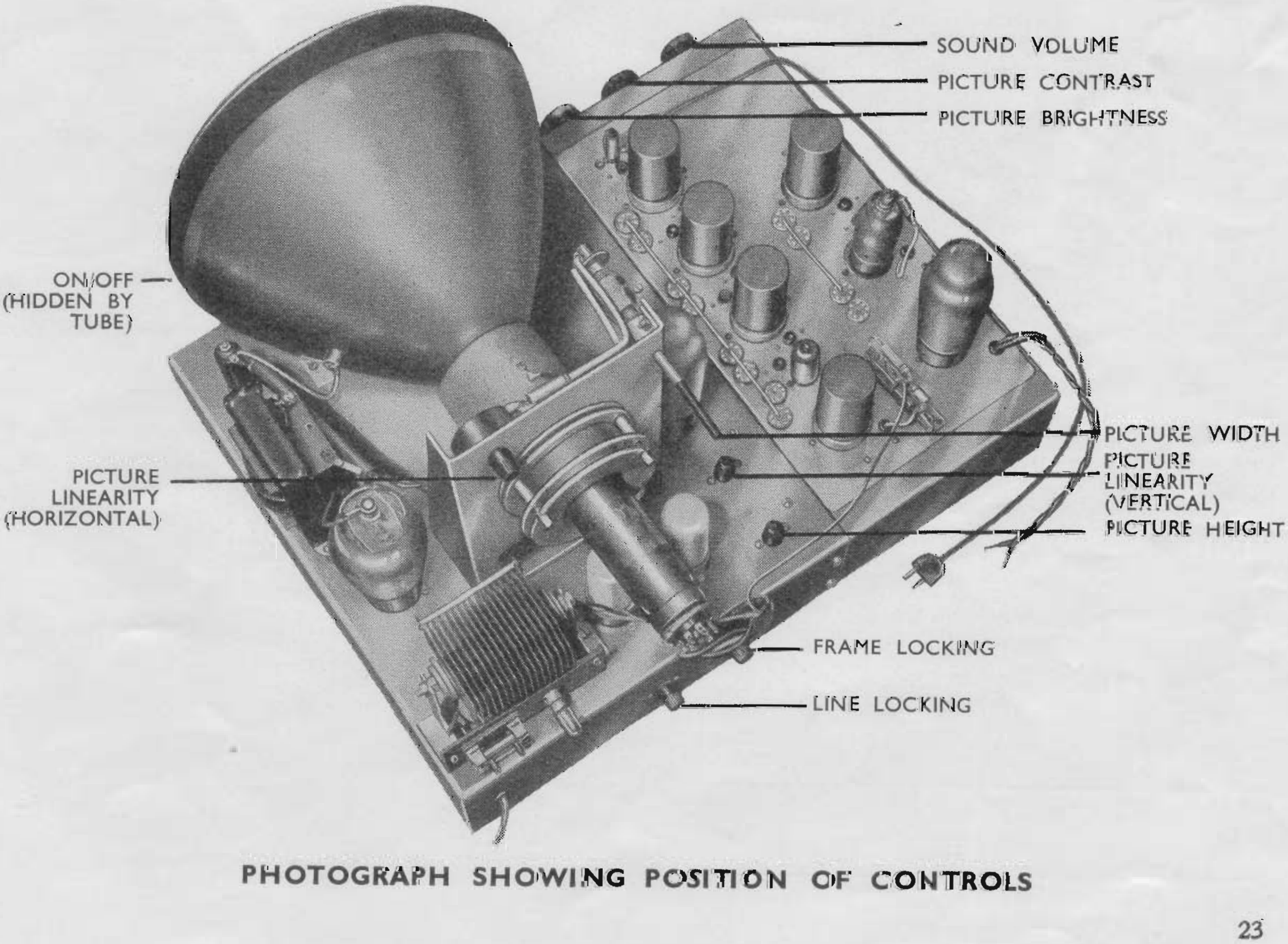
The focus ring will normally be received with the gap open. In this position the magnetic field is at maximum. To adjust the gap for correct focussing the three adjusting screws must therefore be screwed up.

It is recommended that the three adjusting screws be screwed a half-turn at a time working in strict rotation in a clockwise direction.

As the screws are done up so the gap in the magnet is closed and the magnetic flux reduced until a point is reached when the raster is correctly focussed. If, during focussing, the picture has moved slightly off centre, it is an easy matter to re-centre it by slight re-adjustment of the screws, the correct screws and direction of adjustment being found by trial and error.

If no obvious faults are visible, after having obtained a satisfactory raster which is correctly focussed, the vision and sound receivers may be aligned, following closely the instructions given on page 20.

If in doubt as to whether the receiver is functioning correctly, voltage and current measurements may be carried out and compared with the figures given on



PHOTOGRAPH SHOWING POSITION OF CONTROLS

this page. If the faults are more obvious, guidance may be obtained from the list of possible faults, together with causes, given on pages 31 and 32.

After making all the necessary adjustments to ensure a brilliant and sharply focussed picture, the View Master can be fitted into its cabinet. A suitable one for the purpose, fitted with a glass-protected aperture and a rubber mask to frame the picture, is made by Whiteley Electrical Radio Co. Ltd. and can be obtained from any wireless dealer stocking View Master components.

Under no circumstances should the View Master be used in the home without the protection of a cabinet. This elementary precaution applies to any mains-operated equipment — a television receiver is no exception.

But apart from the common sense safeguard against electric shock, do not overlook the risk of damage to the Cathode Ray Tube. Remember that every Cathode Ray Tube functions under a very high vacuum. Although extremely robust, the fact remains that it is made of glass.

If, therefore, the end of the tube is accidentally hit — as for example by the handle of a carpet sweeper or vacuum cleaner — it would probably explode (or more correctly implode). Should this happen anyone in its immediate vicinity would almost certainly be injured by particles of flying glass. It is strongly recommended therefore, that the special container in which the Cathode Ray Tube is bought should be carefully retained. Always remove the Cathode Ray Tube and place it in this container whenever the View Master is removed from its cabinet.

'VIEW MASTER' MEASUREMENT DATA

For the benefit of those who wish to check the correct functioning of each stage in the receiver, the following tables have been compiled. A certain degree of latitude (say 10%) is permissible, though allowance must also be made for different A.C. input voltage.

Mains Supply ... 240v. ... 50 Cycles

Instrument ... Avo ... Model 7

VOLTAGES

	Point	*Voltage Reading*	*Avo Range*
V1	K	1·9 to 5·0	10
	G2	188	400
V2	K	2·0	10
	G2	214	400
V3	K	1·8	10
	G2	233	400
V5	K	0	
	G2	285	400
	A	180	400
V6	K	2·1	10
	G2	218	400
V7	K	1·2	10
	+ end C32	185	1000
	A	63	1000
V8	K	6·5	10
	G2	285	400
V9	K	5·0	100
	A	62	400
V10	K	7·7	10
	G2	238	400
	Boost point	323	400
	Boost volts across C42	38	100
	A	Do not touch	—
V11	K	5·6	100
	A	62	1000
V12	K	52	100
	Across C51	48	100
	A & G2	263	400
Power Supply	Choke input	289	400
	Choke output	285	400
	Fixed bias for V5	— 2·6	10
C.R.T.	K	152	1000
	G	130	1000
	A1	320	1000
	A	6·3 KV	—(Electrostatic meter)

CURRENT

Total H T Current = 200 mA

V1	Ia + Is = 1·2 to 7·8 mA according to setting of contrast.
V2	Ia + Is = 9·2 mA
V3	Ia + Is = 7·8 mA
V5	Ia = 15·5 mA, Is = 4·9 mA } with signal
V6	Ia + Is = 9·9 mA
V7	Ia = 0·7 mA
V8	Ik = 42·5 mA
V9	Ia = 2·4 mA
V10	Ik = 80 mA
V11	Ia = 0·8 mA
V12	Ik = 14 mA

● *Note : Since V4 deals only with signal voltages, no measurements are possible with an Avo meter.*

Some hints on your Aerial Installation

IF YOU LIVE almost within sight of the giant mast at Sutton Coldfield you will be able to obtain a perfect picture on your View Master with the simplest of indoor aerials. In fact a short length of twin feeder cable will probably do the trick—a more efficient and elaborate aerial system might even be an embarrassment.

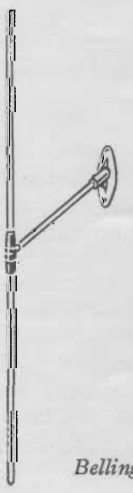
But as your distance from the transmitter increases other phenomena, such as interference, absorption and echo effects, will be experienced. The behaviour of the very short wavelengths used for T.V. transmissions is very different from those used for ordinary sound broadcasting. With the latter, a few feet of wire around the picture rail may be quite adequate to enable programmes to be received from transmitters thousands of miles away.

At the very high frequencies used for television the effective range of a station is controlled by two main factors: the height of its transmitting aerial above sea level and its k.w. output. That is why it is often said that the range of a T.V. station is its optical range. For, as you know, these ultra-short waves travel horizontally, unlike those used for broadcasting which are reflected by the Heaviside layer to rebound earthwards vast distances from the transmitter.

Sutton Coldfield has the highest mast and the greatest output of any Television Station in the world —its range, therefore, is considerably greater than any other. But even so the gradual attenuation of the signal as it leaves the transmitter makes the careful choice of a suitable receiving aerial a matter of considerable importance if good clear pictures free from interference are to be enjoyed.

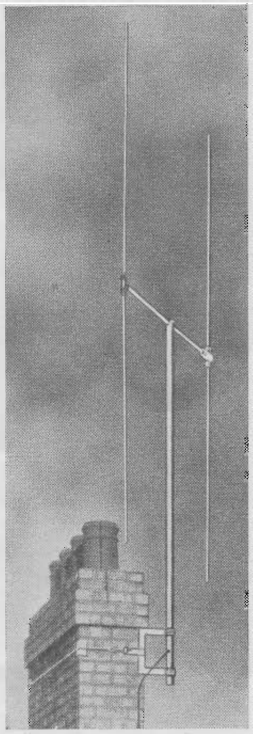
Experience has shown that there is often a wide variation in the field strength of the television signal in heavily built-up areas. In fact it is by no means uncommon to obtain variations as great as 10 to 1 from street to street. Thus a simple dipole may provide a good picture in one part of a town and be useless half a mile away.

Basically the simplest form of efficient T/V. aerial is the half-wave dipole illustrated here. This consists of two $\frac{1}{4}$-wave elements insulated from each other and mounted vertically on a common axis with connections to the receiver taken from the innermost tips.



Belling-Lee Half-wave Dipole

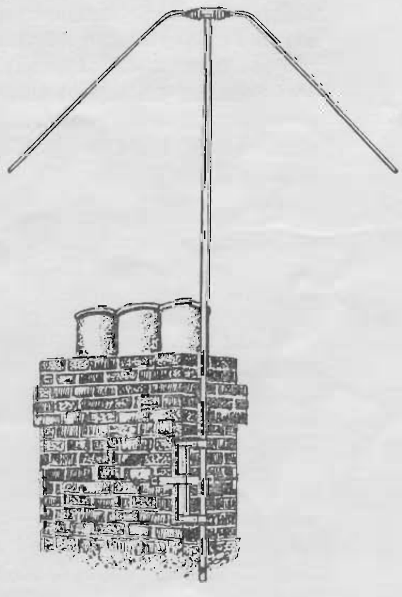
The dipole, however, suffers from one serious disadvantage. It is non-directional, so that in addition to receiving the T/V. transmission it will also pick up interference from all directions. To overcome this in areas where interference is prevalent it is usual to install the familiar H-type aerial. In effect this is a dipole with a half wavelength reflector spaced from $\frac{1}{8}$ to $\frac{1}{4}$ wavelength behind it. Such an aerial, apart from providing nearly twice the signal input as compared with the dipole, gives a low response over a fairly wide angle at the rear. The H-type aerial is deservedly popular because it increases signal strength and at the same time reduces general interference.



Belling-Lee H-Type Aerial

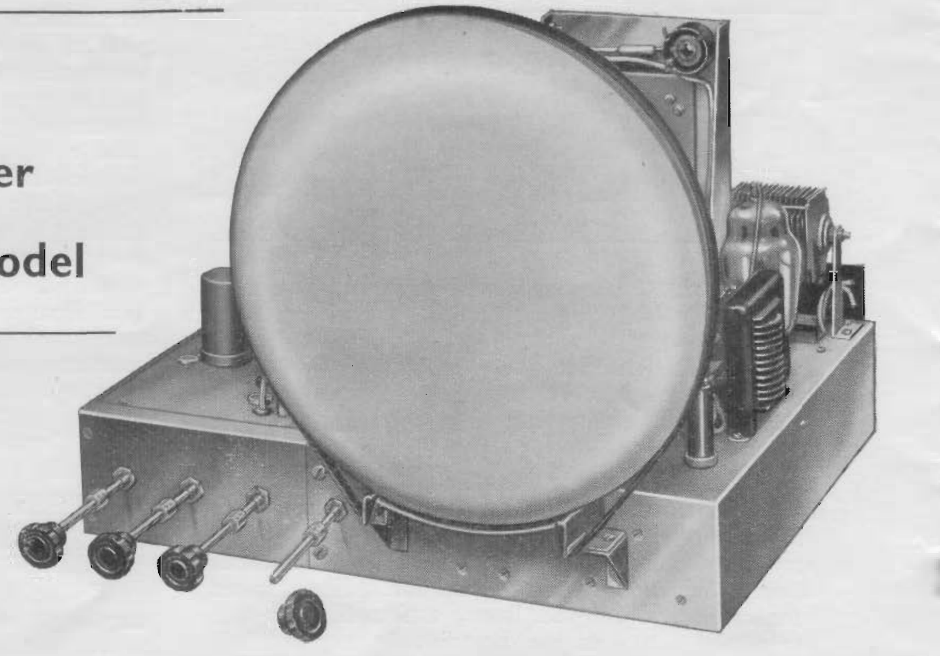
Belling & Lee Ltd. are the largest makers of Television Aerials and have carried out a great deal of research work on the problems involved. Space is inadequate to describe all their various types such as the V-dipole with two very sharp minima at right angles to the maximum signal position, or the multi-element array which, erected on a high mast, permits high quality pictures being obtained well outside the normal Sutton Coldfield service area or where particularly virulent interference from behind makes television useless. But mention must be made of the various types of Belling-Lee indoor aerials that have been specially developed for Sutton Coldfield. These are the Viewflex (17/6), the Doorod (26/6) and the Veerod. The latter is a new directional type which often proves successful in removing troublesome interference from passing cars and other vehicles. It can be installed either in the attic (25/-) or mounted on the chimney stack (70/-).

Of the many types of outdoor aerials made by Belling & Lee Ltd., the two most in demand are the dipole for fixing to an external wall (35/-) or the H-type available in several forms, with a 9ft. mast for mounting on a chimney stack, from 70/-. Finally, there is the Twinrod which has been designed for window mounting and costs 29/-. Your Wireless Dealer will be able to advise you which of these types will give you the best results according to your location.



Belling-Lee V Dipole Aerial

Building the View Master as a 12" Table Model



STANDARD 'VIEW MASTER' CHASSIS WITH 12" TUBE

BECAUSE it is possible to use either a 9-inch or a 12-inch C.R. Tube without the slightest alteration in the circuit or making any change in the components, there will be many who will prefer the larger Tube.

How much larger will be the picture area with the bigger Tube can be judged from the following comparison : when using a 9" Tube the effective viewing area is $7\frac{1}{2}" \times 6"$ or about 45 square inches—if a 12" Tube is used, the dimensions are increased to $10" \times 8"$ or 80 square inches. In other words, for the small extra outlay £3 (plus the additional purchase tax) the picture area is almost doubled. It can be claimed, therefore, that the choice of a 12" Tube for the View Master is fully justified.

Now to use a 12" Tube a somewhat larger cabinet will be required as a Table Model. Not only is the glass bulb larger in diameter but the overall length of the Tube is greater. Both of these problems, however, can be easily overcome by modifying the mounting arrangements.

First of all make up two little angle brackets to the shape and dimensions given on page 29. Bolt these brackets to the underside of the front Tube support, which should be opened out slightly to receive the larger Tube. As can be seen from the various photographs, when a 12" Tube is used the front support is not mounted on top of the chassis but in front of it. It will be necessary, therefore, to drill two additional holes on the front edge of the chassis (to take 2 B.A. bolts and nuts).

The correct position for the front bracket is found by placing its two corners in line with the top of the chassis and equidistant from the $\frac{1}{2}"$ hole for the on/off switch.

After mounting the support in position it will be necessary to drill a new hole for the switch. This should be 4" to the left—there is ample room to do this.

It will be necessary to raise the rear Tube support be approximately $\frac{3}{4}"$. This can be easily done by inserting spacing washers—or short lengths of tube—between the feet of the bracket and the top of the chassis. If you choose to make your own Tube supports (page 29), add $\frac{3}{4}"$ to the height of the rear support, making it $9\frac{1}{16}"$ high, instead of $8\frac{5}{16}"$

The neck of a 12" Tube is the same diameter as that of a 9" so that no difficulty will be experienced in fitting the larger Tube. It will be found that the overhang at the rear of the chassis is quite negligible.

To secure the front of the Tube to its support an endless rubber band will be required. This can be easily made from a length of cycle tubing by cutting a strip 1" wide and cementing the ends together with rubber solution. When fitting it see that the strip is passed through the slot first and then between the glass bulb and its aluminium support before passing through the other slot. By this method not only is the Tube rigidly held in position but its glass envelope is insulated from and cushioned on the supporting bracket.

As we have said, the front of the Tube now extends beyond the chassis so that in all probability it will be necessary to extend the four control shafts. This, however, can be done very easily by using Bulgin couplings and pieces of $\frac{1}{4}"$ dia. brass rod cut to the required length. It is advisable, of course, not to do this until you have obtained your cabinet and checked its internal dimensions.

Table model cabinets for the View Master are made by Whiteley Electrical Radio Co. Ltd., Mansfield, Notts., and by James Tallon & Sons Ltd., Rugby, and can be obtained through your local radio retailer. Both makes of cabinet are fitted with a glass-protected aperture specially devised to protect the end of the Tube against accidental damage. If a rubber mask is not supplied with the cabinet it can, of course, be obtained separately from your dealer. A rubber mask is necessary for two reasons. Firstly it "frames" the picture by giving it the correct proportions. Secondly it cushions the end of the Tube against the wood-work of the cabinet and ensures greater rigidity.

Building the View Master as a 12" Console

THE VIEW MASTER is so outstanding a Television Receiver that there will be many who will wish to house it in a cabinet worthy of its performance. For these there can be no better design than a vertical Console. Such a cabinet takes up little floor space, it ensures that the Tube is at the correct height above floor level, it is a permanent investment and a piece of furniture that will grace any room.

The Tallon Cabinet illustrated on page 3 is extremely well made and has the added advantage that it reaches your radio dealer soundly packed in a carton ready for home assembly. Because all the parts are machined and jig-fitted, actual assembly should not take more than half an hour or so. The cabinet is fully veneered in walnut and the final finish is highly polished. The special packing employed eliminates all risks of damage through handling or transit.

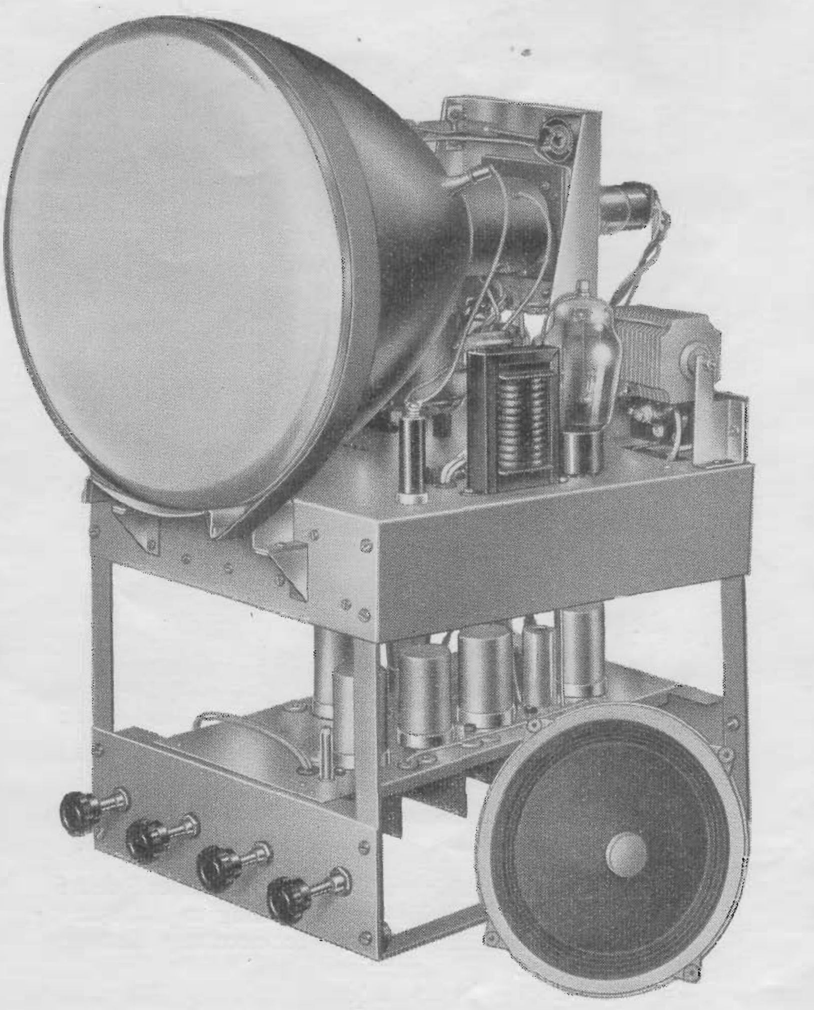
To fit the Tallon Console cabinet, your View Master must be assembled as a "double decker," and the photographs show how simply this can be carried out.

The first four stages of assembly remain unaltered, but at Stage 5 instead of attaching the three-sided supporting bracket WB/101 to carry the Sound/Vision chassis, this is omitted entirely.

For the first time: a fine Console cabinet professionally finished in real walnut veneer that can be assembled with a screwdriver in less than an hour—and fits into a carton this size.

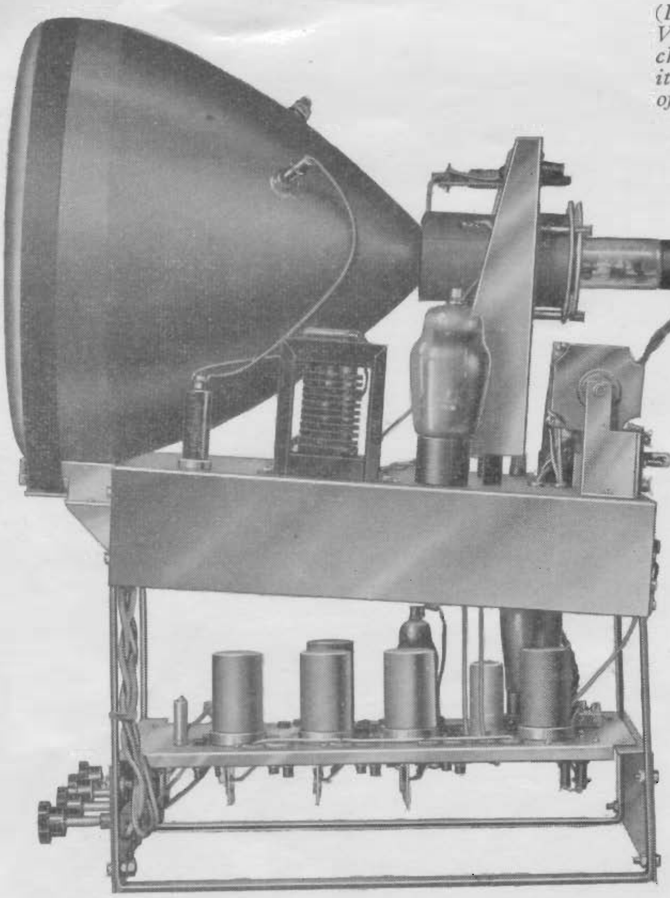
Instead, before mounting the components on the Power Pack and Time Base chassis, it will be necessary to make and fit a pair of U-shaped supports. These, when mounted to the underside of the chassis provide a cradle on which the lower deck, carrying the Sound/Vision chassis, and the controls can be mounted. And by making the rear legs 1" shorter than the front the C.R. Tube can be slightly tilted to provide a better viewing angle.

To make these supports take two lengths of $\frac{3}{4}$" heavy brass strip $33\frac{3}{8}$" long. Mark off $10\frac{1}{2}$" from one end and bend at right angles. Mark off $9\frac{1}{2}$" from the opposite end and also bend at right angles. The distance between these two angles should now be $13\frac{3}{8}$". At a point 3" from each end slightly bend the strips backwards, say 5°, from front to rear. Now, using 2 B.A. bolts and nuts, attach these two U-strips to the inside of the main chassis before mounting any of the components. It may be necessary to shorten the right hand rear support to avoid fouling the rubber grommet carrying the earth lead, but otherwise assembly is quite straightforward.

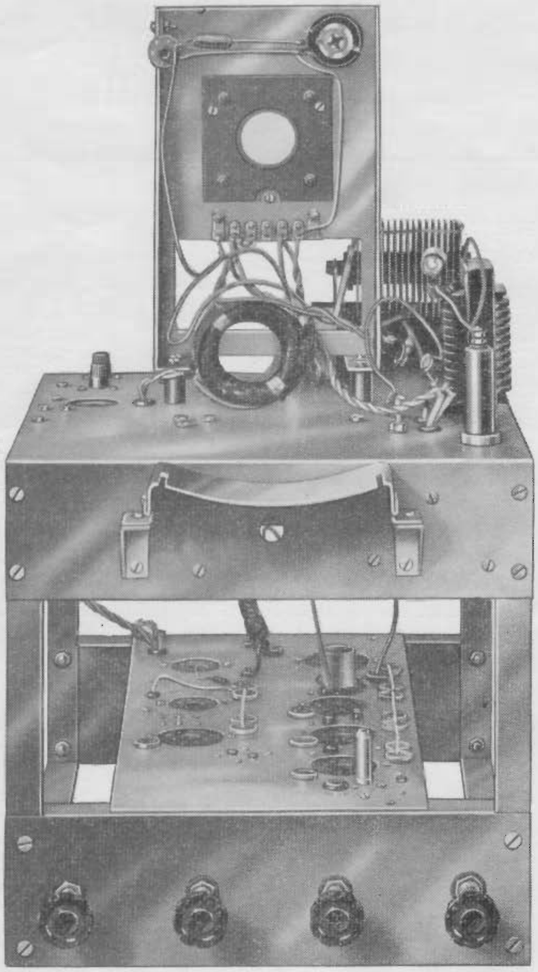


Here you see the View Master assembled as a "double decker" with 12" C.R.T. in position. When fitted into Tallon Console cabinet (see page 3) the Whiteley Loudspeaker is independently mounted below the chassis.

Now make and fit the two vertical metal panels, on the turned-back edges of which is mounted the Sound/Vision chassis. These two panels (cut from 20 s.w.g. aluminium sheet) are both the same size, each being $10\frac{3}{4}$" by $3\frac{1}{4}$" with a folded portion $1\frac{1}{4}$" wide bent at right angles and cut short at each end to clear vertical supports. As will be seen from the photographs the two panels are each attached to the brass supporting strips at the base with 2 B.A. bolts and nuts. In addition the front panel is drilled with four holes at intervals of $2\frac{3}{4}$" between centres to receive the Volume, Brightness and Contrast Controls ($\frac{3}{8}$" diameter) and the on/off switch ($\frac{1}{2}$" diameter).



(Left) This impressive photograph of the View Master assembled as a two-deck chassis shows what a fine engineering job it is. Note the extreme accessibility of all valves and components.



(Below) This view with the C.R.T. removed shows the positioning of the curved front support. Note also how the rear support is raised ¾″ by means of four distance pieces cut from tube.

Now the assembly work detailed on Stages 5 and 6 can be proceeded with—not forgetting to make any minor modifications as may be necessary through " double deck " construction.

At Stage 7, when the Sound/Vision chassis is to be mounted and connected up, no difficulty should be experienced in making the connections. The sync. output lead from R20 (Pin 1 V4), however, should be as short and direct as possible. This can be achieved by drilling a hole in the chassis near V4, fitting a rubber grommet, and passing the wire through it to the tag nearest to V9 on the 3-way terminal strip on the main chassis. Similarly, in order to avoid hum pick up and capacity-to-earth the lead between the junction of R23 and R24 on the Sound/Vision chassis and the C.R. Tube cathode pin on its base should not be bunched with the remaining base leads. Here again, let it be short and direct.

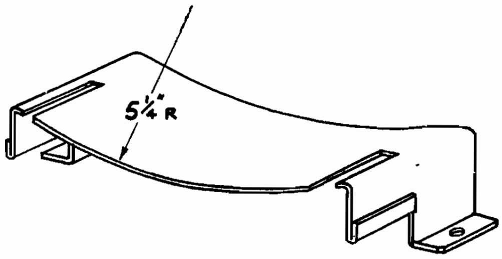
The leads from the upper deck to the control panel can be bunched together for neatness and taped to one of the front vertical supports.

The rigid construction of the View Master when assembled as a 'double decker' enables it to be turned on its side for connecting up the two chassis, and also for trimming the coils.

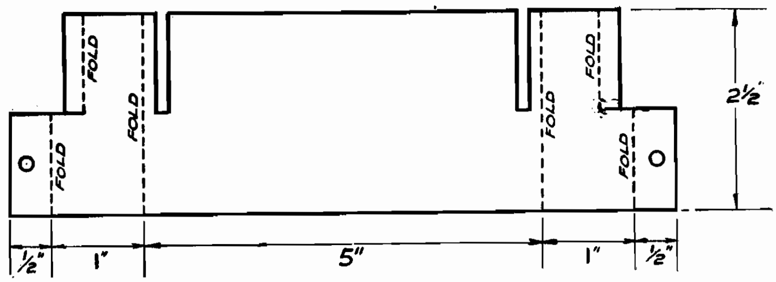
When the Receiver has been finally completed the twelve valves and the C.R. tube should be fitted. You will, of course, check the correct type of valve for each stage and when inserting V4 into its socket see that its pins are not bent. This valve can easily become damaged through careless handling.

Two kinds of rubber mask are available. One type fits closely around the end of the tube, whilst the other is fixed to the inside of the cabinet. If the former type is used it should be fitted before the C.R. tube is inserted into the Receiver. The rear lower edge of the mask will then rest on the curved front support. The whole assembly can then be robustly held in position by means of a 1″ endless rubber band which can be cemented up from a strip of cycle tube as described on page 29.

It will be noted that when the receiver in its double deck form is ready to be aligned, its coil cores, being slotted at each end, can be adjusted either from below or above the chassis.



FRONT BRACKET



How to make the C.R. Tube Supports

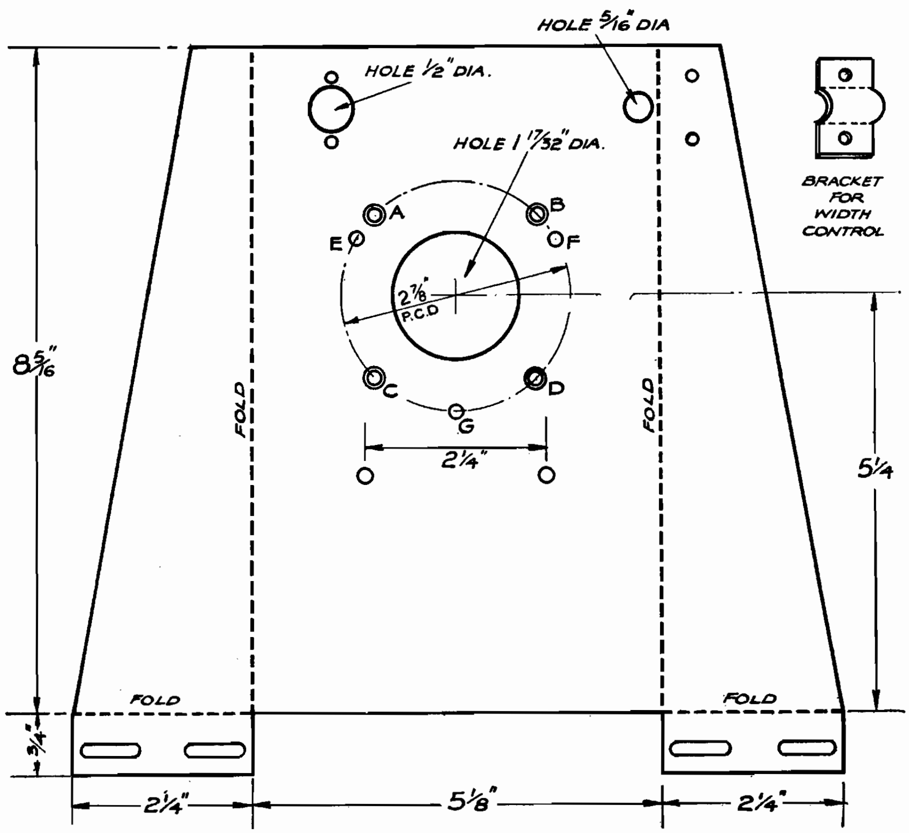
FOR THOSE who prefer to make the C.R. Tube brackets, this drawing gives all essential dimensions. Begin with the large rear support. First, create a drilling and cutting template on stout paper taking off the measurements given. Then, using rubber solution (to avoid stretch) mount this on a sheet of 18 s.w.g. aluminium. With a file tang, mark out the shape and the centres of all holes for drilling. Scribe guide lines for the four folds. The base is slotted to permit the use of alternative makes of C.R. Tubes of different lengths.

Its large centre hole can be cut with an expanding bit or carefully filed to shape. Now take a piece of stout bakelite, $3\frac{1}{8}''$ square. At its centre, cut a hole of identical size. Bolt the bakelite and aluminium together at A.B.C.D. (using 4 B.A. **brass** bolts and nuts) with the two large holes in alignment.

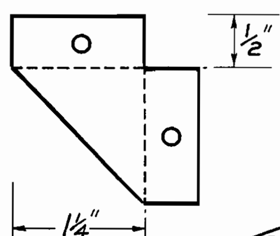
Remove the bakelite, complete the drilling of the remaining holes in the aluminium including the three marked E.F.G. for the Focus Magnet and finally bend to shape. Out of a small piece of aluminium cut, shape and fit the little half-round bracket which holds the Width Control in position. Now take a piece of stout felt about $3\frac{1}{8}''$ square and at its centre, cut a round hole $1\frac{1}{8}''$ dia. Sandwich this felt between the bakelite and the aluminium bracket with its hole accurately centred. Bolt bakelite and aluminium together, forming a protecting pad to surround the neck of the C.R. Tube and hold it securely in position. Note that before the Focus Magnet can be fitted the three holes E.F.G. must be extended through the felt and bakelite.

Prepare templates and follow the same procedure for the front bracket. See that it is curved to a radius slightly greater than $5\frac{1}{4}''$.

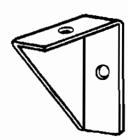
The tube itself is secured to the front bracket by means of an endless rubber band 1″ wide passed through the two slots provided. This can be cut and cemented from a length of cycle tube.

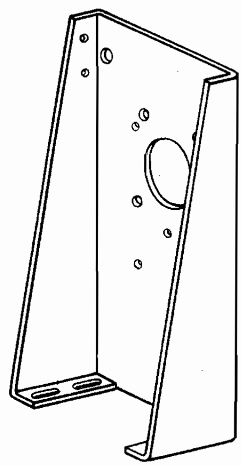


BRACKET FOR WIDTH CONTROL



Above is the small angle bracket (2 required) for mounting the front tube support to front of chassis when 12″ C.R. Tube is used.





Your Shopping List

for the

VIEW MASTER

STAGE 1

Sound/Vision Chassis, Whiteley Type W.B/200, complete with 8 valve holders, rubber insulating bushes, screens and screws	1 2 6
3 Bulgin Terminal Strips :	
1 3-way Type T17, 1 ditto Type T19 and 1 7-way Type T25	1 7½
19 T.C.C. Capacitors* :	
16 Micadiscs (500 pF) Type CM30	1 4 0
1 Metalmite (·001 mfd) Type CP119W	2 2
1 Ceramic Tube (10 pF) Type SCT1	2 6
1 Ceramic Tube (47 pF) Type SCT1	1 9
23 Morganite resistors, Type T (20% tol.) :— 2 4·7kΩ, 4 1kΩ, 1 33Ω, 1 22kΩ, 3 2·2kΩ, 2 5·6kΩ, 2 100kΩ, 1 220kΩ, 1 2·2MΩ, 1 180Ω, 1 330Ω, (10% tol.), 2 ·47MΩ, 2 22Ω	8 7½
TOTAL	£3 3 2

*** 59 Standard T.C.C. Condensers with mounting clips (grouping VMB—Midlands) are available at an inclusive price of £7.**

STAGE 2

10 Wearite Tuning Coils	1 0 0
4 Wearite Filter Coils	8 0
1 Wearite R.F. Choke, Type L9	2 0
1 Ediswan Boost Choke, Type 72006	5 0
4 T.C.C. Capacitors ; (40 pF) Type SCT1	7 0
TOTAL	£2 2 0

STAGE 3

5 Westinghouse Rectifiers	3 2 6
14 T.C.C. Capacitors* :	
4 Micadiscs (500 pF) Type CM30	6 0
1 Moulded Mica (0·0001 mfd) Type CM20N	1 9
1 Moulded Mica (500 pF) Type CM20N	1 6
1 Ceramic Tube (10 pF) Type SCT1	2 6
1 Metalmite (0·1 mfd) Type CP36H	2 4
3 Metalmite (0·02 mfd) Type CP33N	5 3
1 Picopack (1 mfd) Type CE30N	2 6
2 Picopacks (20 mfd) Type CE30B	5 0
10 Morganite Resistors : Type T (20% tol.) 4 220Ω, 1 2·2MΩ, 1 220kΩ, 1 3·3MΩ, 1 33kΩ, 1 22kΩ, Type R (10% tol.), 2 12kΩ	4 6
TOTAL	£4 13 10

STAGE 4

1 Bulgin 7-way Terminal Strip T24	10½
1 Bulgin Plug and Socket Type P420/421	2 6
1 Bulgin Valve Top Connector Type P96	1½
2 ft. Belling & Lee Twin Feeder Cable Type L336	5
1 T.C.C. Moulded Mica Capacitor (300 pF) Type CM20N	1 2
1 T.C.C. Metalmite Capacitor (0·1 mfd) Type CP36H	2 4
3 Morganite Resistors : 5·6kΩ Type T, 27kΩ Type R, 220Ω Type T	1 3
TOTAL	8 8

STAGE 5

Power Pack/Time Base chassis, Whiteley WB/102, complete with 4 valve holders, rubber insulating bushes	1 2 6
Supporting Bracket, Whiteley WB/101, complete with all attaching bolts and nuts	5 0
Ediswan, or Whiteley, Frame Transformer	18 6
Main Choke, Whiteley Type WB/104	12 6
Heater transformer, Whiteley Type WB/103	1 15 0
4 Colvern Variable Resistors Type CLR901 (2·5kΩ, 5kΩ, 10kΩ, 250kΩ) 1 ditto, Type CLR4089/22 (5kΩ)	16 6
2 Morganite Variable Resistances Type Q (100kΩ, 250kΩ)	9 0
1 Bulgin On/Off Switch Type Q257/1	4 3
2 Bulgin 3-way Terminal Strips, Type T19 1 5-way ditto, Type T22, 1 7-way ditto, Type T25	2 0
10 T.C.C. Capacitors* :	
1 Ceramic tube (47 pF) Type SCT1	1 9
1 Metalmite (0·1 mfd) Type CP37N (with P.V.C. sleeving)	2 3
1 Metalmite (0·1 mfd) Type CP36H	2 4
1 Metalmite (0·01 mfd) Type CP33S	1 10
1 Metalpack (0·25 mfd) Type CP48N	2 8
1 Lectropack (250 mfd) Type CE10DA (with P.V.C. sleeving)	10 0
2 Lectropacks (100 mfd) Type CE10LE (with P.V.C. sleeving)	1 8 0
1 Lectropack (2,500 mfd) Type CE25AA (with P.V.C. sleeving)	6 9
1 Buffer type (0·025 mfd) Type 647	2 0
5 Mounting Clips for Electrolytics	1 4
10 Morganite Resistors : Type T (20% tol.) 2 330Ω, 2 2·2kΩ, 1 22kΩ, 1 33kΩ, 1 10kΩ, 1 220Ω, (10% tol.), 1 ·47MΩ, Type R, 1 100Ω	3 10½
TOTAL	£9 8 0½

STAGE 6

Ediswan, Type 72007 front and rear C.R. Tube Supports	14 0
Ediswan, Type 72003 Scanning Coil	1 5 6
Ediswan, Type 72004 Focus Ring	19 6
Ediswan, Type 72002 Width Control	8 9
Ediswan, Type 72000 Line Transformer	1 1 3
Belling & Lee Connector Unit, Type L707	7 6
Fuses for above	1 0
G.E.C. Neon Lamp Type G	2 9
Bulgin 7-way Terminal Strip Type T25	10½

2 Bulgin Valve Top Connectors P96 & P41		3
Colvern Variable Resistance Type CLR901	2	9
3 T.C.C. Capacitors✱ :		
1 Metalmite (0·01 mfd) Type CP33S	1	10
1 Cathodray (0·001 mfd) Type CP55QO	4	6
3 Morganite Resistors :		
470Ω Type T, 100k Type T, ·47MΩ (10% tol.) Type T	1	3
TOTAL £5	11	8½

STAGE 7

1 Stentorian Speaker Unit Type WB/105	1	7	6
7 T.C.C. Capacitors✱ :			
2 Metalmites (0·005 mfd) Type CP32S		3	8
1 Metalmite (0·01 mfd) Type CP33S		1	10
1 Metalmite (0·002 mfd) Type CP30S		1	9
1 Metalmite (0·015 mfd) Type CP33N		2	0
1 Moulded Mica (0·001 mfd) Type CM20N		1	9
1 Picopack (2 mfd) Type CE30G		2	6
13 Morganite Resistors : Type T (20% tol.) 2 1kΩ, 1 100kΩ, 1 330Ω, 1 47kΩ, 1 270kΩ, 1 6·8kΩ, 1 68kΩ. (10% tol.), 3 ·47MΩ. Type R, 1 15Ω, 1 2·2kΩ.		5	7½
TOTAL	£2	6	7½

Also Cabinet to choice.
9″ or 12″ C.R. Tube & 12 Valves as listed (pages 16-17.)

One man's opinion of the View Master

Of the many letters of appreciation already received, the following—reproduced by permission—is typical :

MAIDENHEAD, BERKS.
28th December, 1949.

I feel I must write and tell you my experiences with the " View Master " which I completed about a fortnight ago.

May I congratulate you on producing a really great set, the results from which have exceeded my expectations, and which are fully equal to the photographs in front of the View Master book.

I built my View Master exactly as specified. I am glad I did, but in any case I did not think it right to depart in any detail in my first effort at it. When I say that I had a picture within five minutes of first switching on, and further, that every control responded correctly exactly in accordance with your instructions, you can imagine I was impressed. As you say, it is very easy to line up. I have since had it lined on a signal generator—with results surprising to the friend who kindly did this.

Then, too, the parts as supplied by the various makers are quite first class. Again, I have found no fault in any of the working drawings or circuits. In fact it is obvious that a very great deal of work has been done to ensure correctness in every possible detail.

As you say, it is something which I am proud to own and to demonstrate to my friends. The View Master gives the best results I have so far seen in Television—and as you will see, I am 25 miles from Alexandra Palace.

REGINALD H. THURLOW.

Trouble Spotting

A HANDY GUIDE TO COMMON TELEVISION FAULTS

Below, grouped in convenient tabular form for reference, is a list of possible faults and alongside each is the correct diagnosis. This information should be read in conjunction with the table of voltages and currents on page 24. On the inside back cover are a series of photographs of typical faults that can be easily corrected by adjustment of the appropriate control. The numbers in brackets refer to these pictures.

VISION RECEIVER

No picture	V1, V2, V3, V4, V5 faulty. Heater wire disconnected to one of above valves. H.T. disconnected to valves—R6, 7, 10, 11, 15, or 16 Dis. L9 disconnected. R68 too high in resistance.
No Picture or Sound	V1 faulty. L101 short circuited. R6 or R7 disconnected. R4, R5 or R8 disconnected. L102 disconnected or shorting.
Weak Signal	Tuned circuits incorrectly aligned. Coupling coils loose or incorrectly wound. R101 wrong value (low resistance). Aerial disconnected from one side of L101 R19 or R22 too low in value.
Poor definition (9)	Tuned circuits incorrectly aligned, more particularly L102, L103, L105. R19, R22 wrong value. (Too high resistance). C19 disconnected. C52 shorting. MR5 faulty.
Picture " flat "—lack of detail in highlights	V5, overloaded due to gain control being turned up too high. Overloading due to receiver being located close to transmitter. (This needs an aerial attenuator).
Picture "flat"—V5 becoming excessively hot	No bias on V5, C55 shorted out or R70 too low in value.
Picture streaky (9)	Tuned circuits incorrectly aligned giving poor L.F. response. Circuits L104, L106, L107, L108 may require re-adjustment. C52 or MR5 faulty.

Receiver unstable.	Tuned circuits incorrectly aligned. (not staggered). Spigot of V1, V2 or V3 valve holder not earthed. V1, V2, V3, cross screens not soldered correctly. Feed-through condensers not soldered to chassis, or centre connection badly soldered.

SOUND RECEIVER

No sound	V6, V7, or V8 faulty. L113, L114, L115, disconnected or shorting. H.T. disconnected to V6, V7 or V8. (R25, R26, R32, R33 disconnected). MR1 disconnected. C26, C31, C34 disconnected. C25, C33 shorting.
Weak Sound	Tuned circuits L113, L114, L115 incorrectly aligned. R30, R32 too low in value.
Vision interference on sound	Tuned circuits incorrectly aligned, particularly L110.
Distorted sound	R34 wrong value. MR1 faulty. R36 wrong value.
50 c/s interference in background	R33 too low resistance. C32 low capacity or disconnected.
Excessive high note cut	C25 too high in capacity. C33 too high in capacity. C36 too high in capacity.
Ignition interference limiter not effective	MR1 shorting or faulty. R36 low resistance. C33 low capacity or disconnected. C25 too high capacity.

SYNCHRONISING CIRCUITS

No sync.	V4 faulty. C18 disconnected. R21 disconnected or too low in value. R20 disconnected or too low in value.
Weak Sync. (7)	R20 low resistance. Poor L.F. response from vision receiver. Tuned circuits L104, L106, L107, L108 require re-adjustment.
No line sync.	C37 low capacity or disconnected. R53, low resistance.
Weak line sync.	C37 low capacity. R42 low resistance.
No frame sync.	C47, R53 or R55 disconnected. C46 shorting.
Weak frame sync.	R53 high resistance. C46 capacity incorrect.

LINE TIME BASE

No raster or E.H.T.	No H.T. on V9 or V10. V9 or V10 faulty. C38, R46 or R47 disconnected. R44 or R45 disconnected. MR2 reversed.
Raster out of focus, low E.H.T.	V9 working at wrong frequency. C38, R44 wrong value.
Very large scan, E.H.T. low, lack of brightness	Connections reversed to secondary of line transformer.
Small scan, low E.H.T.	MR2 faulty. C42 reversed.
Small distorted scan	C42 disconnected. C38 very low capacity. R46 very low resistance.
Large scan distorted at left	C38 low capacity. R46 low resistance.
Non-linear scan (1) (4)	C42 low capacity. R52 incorrectly adjusted. C43 disconnected.
Picture reversed left to right	Connections to line scanning coil reversed.
Time base satisfactory but low E.H.T.	MR3 faulty or wrong type. C45 disconnected. C44 connected when using Westinghouse 36EHT100 as MR3. Line transformer faulty.
Time base satisfactory but no E.H.T.	MR3 faulty. C45 shorting. Line transformer disconnected.

FRAME TIME BASE

No frame scan	V11 or V12 faulty. No H.T. to V11 or V12. C48 shorting. R56 disconnected. R58 too high resistance. R56, R60, R57 disconnected.
Will not sync. at correct frequency	C48, R56, R58 wrong value.
Small amplitude	R56, C48 too high in value. R60, R61 incorrect value.
Small scan—non-linear	C51 low capacity or disconnected.
Amplitude too large with non-linear scan	R66 short or wrong value. R65 incorrectly adjusted. C49 disconnected or very low capacity.
Cramping at picture top (5)	C50 disconnected or too high in capacity. R65 incorrectly adjusted. C49 wrong value. *NOTE.* C49 sets the ratio of the top ⅓rd of the raster to the bottom ⅓rd of the raster. Increasing the capacity of C49 will open out the top and close up the bottom, reducing C49 will have the opposite effect.
Cramping at bottom (11)	C51 low capacity. C49 wrong capacity (*see above*).

POWER SUPPLY

No H.T.	MR4 faulty. Smoothing Choke disconnected. C53, C54 shorting. R70 disconnected and C55 disconnected.
Low H.T.	C53 disconnected or low capacity. MR4 faulty.
Hum on raster	C54 or C55 low capacity or disconnected.
Heater volts too high	Mains connected to wrong tapping on heater transformer.
Fuses keep blowing	Short across H.T. supply. C53, C54 faulty. MR4 shorting to chassis. C56 shorting. Earth lead shorting to chassis.
Neon lamp will not light	Neon faulty. R72 disconnected. Neon holder faulty. Break in earth lead or bad earth connection.
Neon lamp dim	Neon faulty. R72 too high in value. Poor earth connection.

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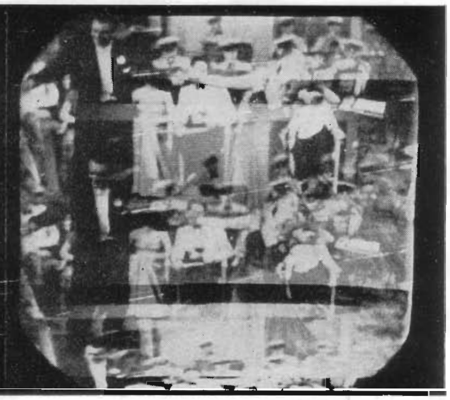
1. Left edge of picture cramped, circle slightly oval
Correct by re-setting R.52—further adjustment of L.14 may be necessary.

2. Picture weak, lacks contrast, line sync slipping, frame fly-back lines visible
Increase "Contrast," reduce "Brilliance."

3. Picture out of focus
Re-adjust three screws on p.m. focus ring to open (or close) gap.

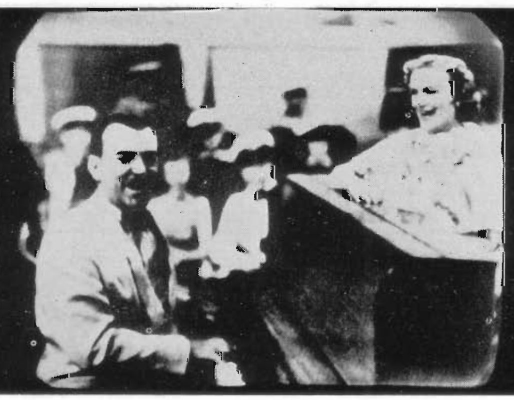
4. Bright line at left of picture
Caused by incorrect linearity setting. Re-adjust R.52, this may necessitate further adjustment of L.14

5. Picture distortion—expanded below, cramped above
Re-adjust frame linearity control (R.65).



6. Multiple Horizontal Picture
Frame Time Base out of sync. Correct by re-adjusting frame lock (R.59).

7. Picture bends over at top
Due to weak sync. signal or incorrect time constants in sync. circuits. See facing page.



8. Excessive Contrast
Soot-and-whitewash easily corrected by adjusting "Brilliance" and "Contrast."

9. Loss of definition, with some streaking
Due to poor response from vision receiver. See facing page.

10. Picture incorrectly proportioned
Re-adjust width control (L.14).

11. Picture distortion—cramped below, expanded above
Re-adjust frame linearity control (R.65).

12. Multiple Vertical Picture
Line time base not synchronised. Re-set line lock (R.45).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