THE SALIENT FACTS OF UP-TO-DATE TELEVISION

TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

and SHORT-WAVE WORLD

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PROJECTED PICTURES

Made possible by the new light relay: First published account.

SIR NOEL ASHBRIDGE

B.B.C. Chief Engineer on Television Development.

LARGE CATHODE-RAY PICTURES

A new combination of cathode-ray tube and light valve.

SHORT WAVES

Amateur Band Super

Full constructional details.

International DX Contest

NEW

SCOPHONY TRANSMITTER

240-LINE SOUND-ON-FILM

No. 99 VOL. IX

MAY, 1936.

TELEVISION

and SHORT-WAVE WORLD

Special Features

TELEVISION AND SHORT-WAVE WORLD

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IMPORTANT

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COMMENT OF THE MONTH

Mechanical Systems.

IT is no secret that when the recommendation of the Television Committee was made that 240 lines should be the minimum standard of definition, there was a certain amount of perturbation among those who had made mechanical methods the line of attack in the solution of the television problem. No experiments had been carried out with light modulation at the frequencies involved, and a number of experts contended that known methods would be quite inadequate and that no other solution appeared possible. A further bombshell was dropped when the Television Advisory Committee made known the intention of using two scanning standards. As Sir Noel Ashbridge, the B.B.C. Chief Engineer, has pointed out, the Committee itself felt that this procedure was undesirable, but that it was the only practicable way of giving two systems which were ready to be put into operation a fair test. A deputation waited on the Committee in the hope of getting this decision altered, for on the face of it, it seemed fatal to mechanical systems unless two different types of scanner were used alternatively for each type of transmission.

As the deputation failed to move the Committee in its decision there was nothing more to be done than to tackle the problem as such, and although very little, or nothing, has been heard of the lines of attack for the past few months, those interested in mechanical systems have not been idle. We are now able to announce that both the Scophony and Mihaly-Traub systems have been developed in such a manner that reception of high-definition television by mechanical methods is now entirely practicable.

Through the courtesy of Mr. S. Sargall, managing director of Scophony, Ltd., we are able in this issue to give our readers the first details of the new Scophony light control, which it is expected will make the projection of large pictures possible.

OUR COVER PHOTOGRAPH

The picture on the cover of this issue shows the Scophony 240-line sound-on-film television transmitter, using continuously moving film. A small arc lamp is used as the light source and the photo-cell is contained in a long screened tube projecting from the side of the amplifier. The amplifying gear consists of a complete vision amplifier with power supply and the sound-on-film amplifier. A non-synchronous playing turntable also forms part of the equipment and this can be seen on the left of the photograph.

THE SALIENT FACTS OF UP-TO-DATE TELEVISION

A Compendium of All the More Important Features of Modern Television.

THE cathode ray is an electron stream or beam. The term was coined by early experimenters before the electron arrived on the scene. In the early vacuum tubes the electrons produced used to give the effect of an invisible ray proceeding from the cathode, and the name "cathode ray" applied to this effect has stuck to the more modern tube.

Cathode is the name given to the source of electrons —heated metal. The attracting plate which is mounted a little distance away from the cathode is called the *anode*.

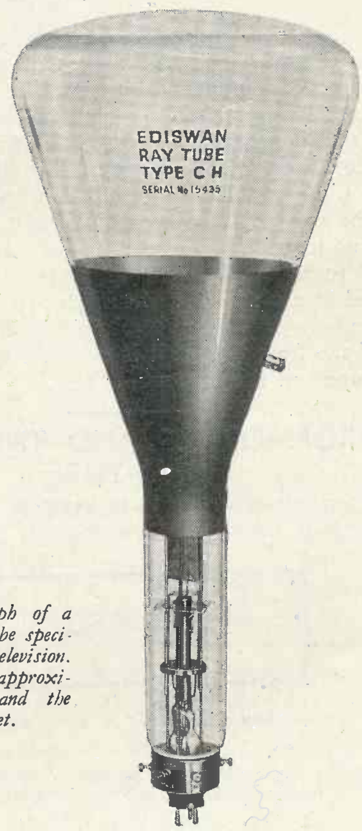
The speed with which the electrons fly to the anode is increased by increasing the attractive force of the anode, i.e., by applying a high *potential*.

CATHODE-RAY TERMS

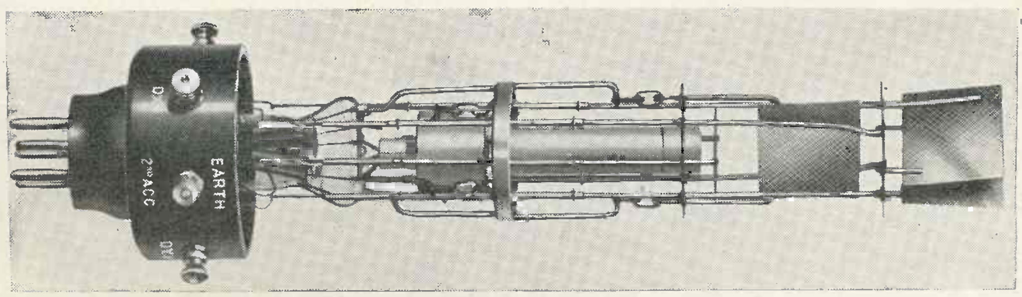
Confusion is sometimes caused by the use of different terms to describe the electrodes of the cathode-ray tube. Cathode for the electron emitting electrode is standard, but the anode is either called the anode or sometimes the "gun."

The control of the electron stream is obtained from the small cylinder which surrounds the cathode and is maintained at a negative or slightly positive potential. This is given a variety of names. It is called the Wehnelt cylinder or simply the cylinder, the shield, the control electrode, the modulating electrode, and so on.

There is need for an agreement as to the correct name for this electrode. Shield is probably the most general. Names such as control or modulating electrode are not good because in hard tubes two anodes are provided and some measure of control may be introduced on the first anode or gun.



This is a photograph of a typical cathode-ray tube specially manufactured for television. The screen diameter is approximately 10 inches and the total length 2 feet.



This is a picture of the electrode assembly of a modern cathode-ray tube; it shows in detail the component parts of the tube shown above.

THE CATHODE-RAY TUBE

There is a certain amount of similarity between the valve and the cathode-ray tube. Both are for the purpose of producing electrons, but in the latter they are required as a thin pencil, or beam, capable of being directed against the fluorescent screen at the end of the tube where their presence is made visible by causing the screen to fluoresce. On this account the place of the grid is taken by a cylinder which completely surrounds the cathode and which is negatively biased. The purpose of the negatively charged cylinder or "shield" as it is called is to compress the electron stream from the cathode and cause it to pass through a central hole in the anode.

By applying a potential to the shield the electrons can be made to form a "jet" of fine dimensions which will pass up the tube and produce a tiny fluorescent spot where they hit the screen. An increased anode voltage will naturally cause more electrons to pass through the hole and thus produce a brighter spot.

THE CATHODE-RAY TUBE

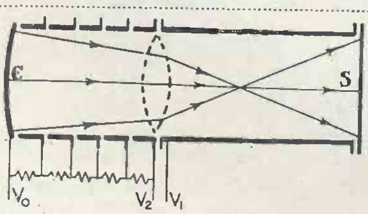
The electron " beam " thus produced behaves like a conductor carrying a current and therefore can be deflected by an electro-static or magnetic field in the neighbourhood. As the beam is a collection of negatively charged particles, it will be attracted by a positively charged plate, or repelled from a negatively charged one, and it is this method which is usually used for causing the beam to move and trace a pattern on the screen.

In the usual type of tube above the electrode structure are two pairs of parallel plates mounted at right angles to each other, and the beam passes between them on its way up the tube. As the beam passes between them it will be attracted by the positively charged one and repelled by the other.

If an alternating voltage is applied to one pair of plates the beam will be deflected first one way and then the other, conforming to the change of polarity on the plates. The spot will now appear as a line, since the eye will not be able to distinguish the rapid swinging to and fro of the beam. If the potential is applied to the other pair of plates the beam will be deflected in a plane at right angles to its original direction, and by applying a suitable value of potential to each of the four plates, it is possible to move the beam to any spot on the screen.

ELECTRON OPTICS AND THE CATHODE-RAY TUBE

Electron optics is the term given to the new science of control of the electron beam. It has a parallel in the optics of light, but instead of refractive materials being used the beam is influenced by electrostatic and magnetic fields.



A diagram of a simple electron lens system. Focusing of the electrons from the cathode C is accomplished by applying potentials V and they form an image on the screen S.

In modern hard vacuum cathode-ray tubes a concentrating device or electronic lens is used to obtain a sharp focus—such lenses may be either magnetic or electrostatic. The principle of these lenses makes use of the fact that electrons move at right angles to magnetic lines of force and along electrostatic lines of force. A simple magnetic lens consists of a coil of insulated wire wound round the neck of the C.R. tube. When a current flows through this coil the magnetic lines of force exert an inward pressure on the electrons focusing being carried out by varying the coil current.

The electrostatic lens operates on the following principle. There are two accelerating electrodes and the potential difference of about 1,500 volts between them together with their construction causes a converging field to be formed. The beam is brought to a focus by adjusting the potential of the first anode. Electronic lenses are exactly analogous to optical lenses and the same laws hold good for both types.

The spot on the fluorescent screen is an image of the active surface of the cathode and the relative sizes of image and object are dependent on the distances between cathode, lens and screen.

THE HARD CATHODE-RAY TUBE

Until comparatively recently cathode-ray tubes were what was termed soft—that is, a certain amount of gas was allowed to remain in the envelope. Nowadays the hard tube is universally used for television purposes. The high-vacuum tube overcomes many of the disadvantages of the gas-focused type, particularly " origin distortion " and loss of focus at high traversing speeds.

With the high-vacuum tube focusing is a function of the ratio between the first and second accelerator potentials and is independent of the negative cylinder potential. This means that the modulation of the intensity of the beam by a signal on the negative cylinder does not produce loss of focus on strong signals as was the case in the gas-focused tube. Origin distortion is the effect produced by the non-linear response of the beam to small deflecting potentials. This on a television line screen produces what is usually known as the " white cross."

THE FLUORESCENT SCREEN

The inner surface of the wide end of the cathode-ray tube is coated with a material that glows or " fluoresces " when electrons impinge upon it, thereby producing a bright spot of light. The material is usually bound on with pure waterglass.

Several different materials, and combinations of them, are used for the coating. The most active material for producing visual light is zinc silicate (in the form of the powdered mineral *willemite*). This glows a bright yellow-green, to which the human eye is most responsive. For oscillograph use, where the trace of the cathode-ray beam is to be photographed, calcium tungstate, which glows a bright blue colour, is better, since its light is about thirty times as active on a photographic plate as is that from zinc silicate. Cadmium tungstate may also be employed and mixtures of these substances are often used to produce a fluorescence fairly well suited for joint visual and photographic requirements.

The electronic impact energy varies as the square of the speed of the electrons, or, in other words, with the square of the voltage on the anode, so the fluorescent-spot brilliancy increases rapidly as this voltage is increased.

Deterioration of the active material with which the screen is coated will occur if the spot is too intense, due to intense bombardment resulting at the point of impact of the electron stream on the coating of the screen. The electron stream bombards the screen much as rapidly-fired machine-gun bullets would bombard a target, excepting that the machine-gun bullets would have a muzzle velocity of only about 2,000 miles per hour, whereas the electrons in an ordinary cathode-ray tube operated with 1,000 volts on the plate have a velocity of approximately 42 million miles per hour!

The beam should never be allowed to remain motionless, for, if this occurs, the full impact energy of the

ELECTRONIC SCANNERS

electrons will be concentrated at the focused spot on the screen, causing the fluorescent material to disintegrate. A black spot will be observed in the screen after this occurs.

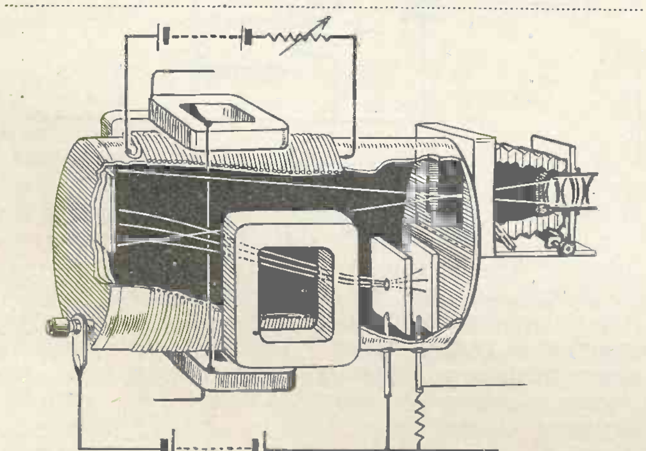
THE ELECTRON-IMAGE CAMERA

The broad working principle of the Farnsworth electron-image camera will be understood by reference to the diagram and the following explanation. The

A photograph of the Farnsworth electron-image camera.

diagram shows a cylindrically shaped vacuum tube, one end of which is coated on the interior surface with photo-electric material and is connected to the negative pole of a source of potential. Upon this coating, which is in the form of a diaphanous layer upon a translucent conducting backing, there is focused an optical image, by means of a lens, of the object or scene to be scanned.

At the other end of the tube there is an anode punctured with a small aperture Q, and electrons given off



Cut-away sketch showing the internal arrangement of the electron-image camera and its method of operation.

by the photo-electric material on the cathode are attracted to this anode under the influence of electrostatic acceleration.

Assuming that all the electrons are emitted from the cathode at right angles to its surface, these, under the influence of the electric field, will be accelerated in straight lines towards the anode and will preserve their relative density-configuration all the way to it. A fluorescent screen placed in the path of the electrons, or upon the anode, would light up with the same tone distribution as that existing in the original optical image.

As electrons come off *en bloc* they can be deflected, as shown, by suitably placed deflector plates or magnetic coils fed with scanning potentials in exactly the same way as the electron beam in a receiving cathode-ray tube.

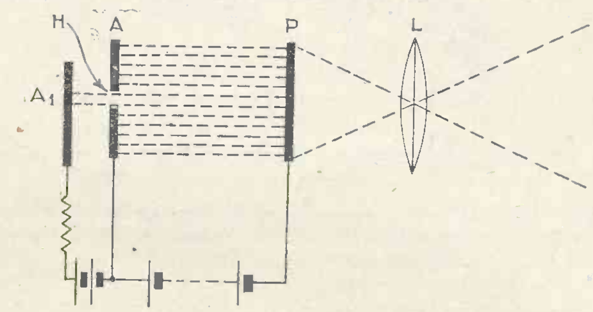


Diagram showing the operating principle of the Farnsworth dissector.

The electrons which would normally strike the anode at Q pass through the aperture, and can be collected on an additional electrode, behind the anode, to yield an electrical signal corresponding with an elemental area of the image. It will be apparent, therefore, that scanning is accomplished by movement of the electron image as a whole, and the electrons are collected only from that portion which is over the aperture at any given instant. The scanning motion is imparted to the electron-phalanx by Farnsworth, not with electrostatic deflector plates, but with magnetic coils in pairs on opposite sides of the tube.

THE ICONOSCOPE

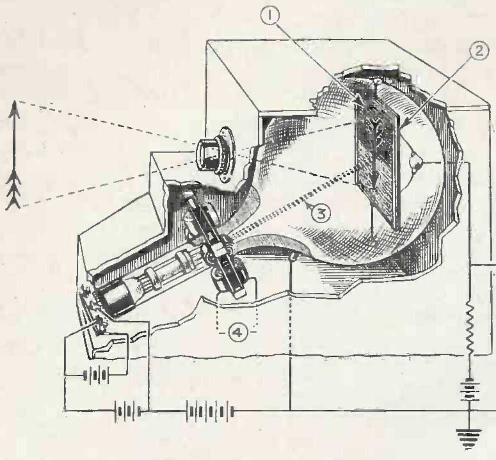
The Iconoscope is a special form of cathode-ray tube which is shown by the drawing. The glass envelope is of a somewhat different shape from the normal cathode-ray tube. The electron beam is produced by an " electron gun " system in a similar way to that of the ordinary cathode-ray tube. The novel feature is the square plate seen in the drawing. This consists of a metallic coating on one side of a sheet of mica. The other side of the mica sheet—the side exposed to the electron beam—is covered with a fine mosaic of minute particles of photo-electric material deposited on the mica.

The metal plate is in two parts, the actual photo-electric mosaic and the back metal plate, called the signal plate. The narrow neck of the tube and a part of the spherical bulb are metal-coated internally, this acting as a second anode for the electron beam which is directed on to the photo-electric mosaic in the usual manner..

Two local oscillators supply the energy to deflecting magnets which surround the neck of the tube. These can be seen in the drawing on the following page.

THE SCANNING CIRCUIT AND SCANNING

An image of the object to be transmitted is focused on the mosaic by a lens system, as shown in the diagram. The mosaic is, of course, systematically swept

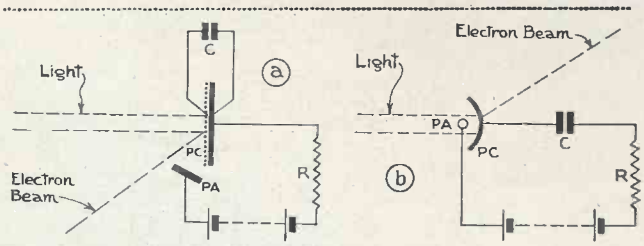


Sketch showing the general construction of the Iconoscope and its method of operation. The reference letters are: 1, Mosaic; 2, Signal plate; 3, Electron beam; 4, Deflecting coils.

by the electron beam under the influence of the framing and line-scanning " saw-tooth " currents applied by the coils.

The cross-section of the electron beam which scans the photo-cell plate must be held within very accurate limits. It must be equal in size to the area of one picture unit. The greater the number of elements into which the picture image is divided, the greater the definition of the received image.

The photo-electric elements of the mosaic are of microscopic size, it being estimated that there are some three million elements on the mica sheet. The scan-



Two diagrams explaining the principle upon which the Iconoscope functions. The second diagram makes the electrical action clear.

ning spot of the electron beam is thus large compared with each photo element, so that a large number of the elements is instantaneously under the influence of the beam. The mosaic itself is made up of minute silver globules each of which is photo-sensitised.

The second two diagrams will make clear the following explanation of the electrical action of the Iconoscope. The first diagram (a) shows the various parts in their actual physical relations. PC is the photo-electric cathode (mosaic) while PA is the metal coating of the tube which acts also as the anode of the photo-electric combination. The photo-electric material is insulated from the back metal plate by the mica sheet, but has a capacity to the metal plate which is shown by the condenser C.

The same elements are shown at *b* as a conventional photo-electric cell and condenser, in order to simplify the explanation. When light from the projected picture falls on the mosaic, each element of it (PC) emits electrons and charges the condenser. When the electron beam impinges on a photo-electric element that element *receives* electrons from the beam and discharges or partially discharges the condenser.

The discharge current will, of course, depend on the charge on the photo-electric condenser element and therefore on the light-intensity on that particular element. The charging and discharging currents into and out of the condenser are thus transformed into signal voltages across the resistance R and applied to the grid of the first amplifying valve. The Iconoscope, therefore, contains all the elements necessary for television scanning of a picture. Thus when a picture is focused on to the mosaic, the regions of light and shade are progressively scanned by the electron beam and varying currents (corresponding to these graduations of light and shade) are set up in the resistance R. In accordance with the normal arrangements of television these currents are amplified and used to modulate the carrier.

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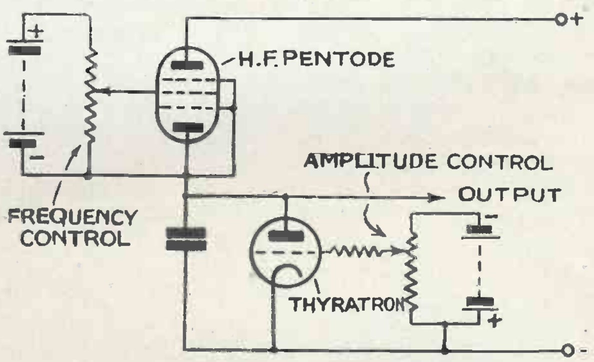
SCANNING CIRCUITS

To produce the horizontal scan on the fluorescent screen of the cathode-ray tube the electron beam is caused to move at a steady rate across the fluorescent



An example of a typical scanning circuit.

screen of the cathode-ray tube. Having completed the scan the beam is rapidly returned to the commencement of the next scan.

In order to carry out this operation a waveform of the " saw-tooth " type is required. The vertical traverse is carried out in a similar manner, but at a lower frequency. These saw-tooth waveforms are conveniently obtained by charging a condenser through a constant current device and rapidly discharging it through a valve or mercury relay such as the Thyratron. The first operation represents the scan and the second the return stroke of the scanning cycle.

The scanning waveforms may be applied to the electron beam electrostatically by means of deflecting plates within the tube, or electromagnetically by deflecting coils outside the tube. Both methods are in general use.

PHOTO-ELECTRIC CELLS

A typical scanning circuit is shown opposite in which an H.F. pentode is used as the constant-current device. When the condenser is charged to a given potential the Thyratron breaks down and a discharge takes place. The breakdown voltage depends on the negative bias applied to the grid of the Thyratron, and this bias controls the amplitude of the scan. Similarly the positive potential on the screen of the pentode controls the charging rate and hence the frequency of the circuit.

SCANNING SPOT SPEEDS

With a screen 6 ins. wide scanned by 240 lines 25 times per second, the spot travels 125 ft. per picture and 3,125 ft. per second, which is 2,130 miles per hour or about half as fast again as the muzzle velocities of a rifle bullet.

INTERLACED SCANNING

The method of interlacing which is to be used at the Alexandra Palace will be made clear from the diagram which represents the top and bottom portions on the scanned area with the distance between the lines very much enlarged.

The lines show the track of the scanning spot which moves under the influence of a regular downward motion (frame scan) with quick return and a regular left to right motion (line scan) with very quick return (not shown on drawing). The combination of these motions produce the slightly sloping scanning lines. Starting at A, not necessarily at the beginning of a line, the spot completes the line AB, returns to the left and traverses line CD, then EF and so on down the "dotted" lines on the drawing. At the bottom of the frame the spot travels along line GH and then starts at J and travels to K. At this point the return stroke of the frame motion begins and returns the spot to L at the top of the frame. A complete frame scan has now been made since leaving A, so that 202½ lines have been completed, and the point L is half a line away from A.

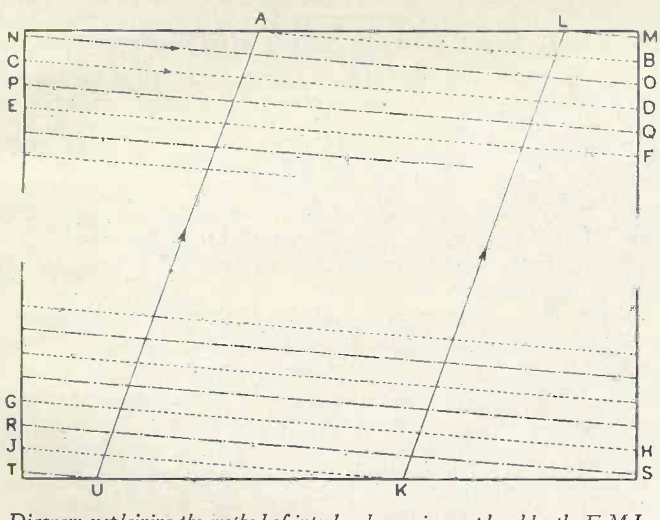


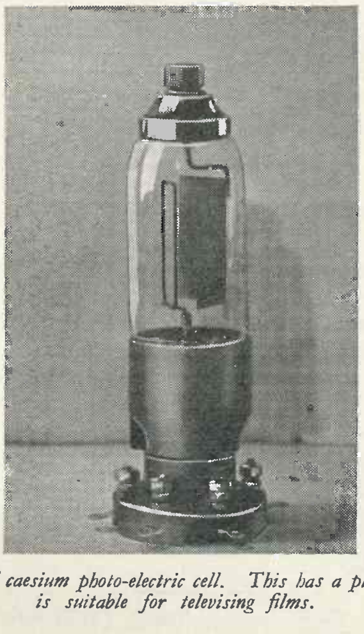
Diagram explaining the method of interlaced scanning employed by the E.M.I. system at the Alexandra Palace.

The downward frame motion now starts again causing the spot to travel along LM completing a single line motion JKLM. The spot then returns to the left and traces out line NO, which, due to L being half a line ahead of A, will lie between lines AB and CD. Similarly the next line PQ will lie halfway between CD and EF. The spot now traces down the chain dotted lines to RS and finally traces out TU, at which latter point the frame return causes the spot to rise again to the top. When the spot reaches the top it will have completed two frames, since leaving A, and, as two frames occupy the time of exactly 405 complete lines, the spot will return exactly to A, after which the cycle begins again.

It will be clear that the complete picture is scanned in two frames, but as each frame contains an integer number of lines, plus a half, the two frames will interlace. The system does not require the short return times shown for the line and frame scans, nor need the lines begin in the positions shown. Provided the line and frame traversals are regularly recurrent and have the correct frequency ratio (two frames = odd number of lines), an interlaced picture will be obtained.

THE ACTION OF THE PHOTO-ELECTRIC CELL

To understand the action of a photo-electric cell it is necessary to appreciate that electrons are minute particles of negative electricity, which, under certain influences, can be put in motion; the heated cathode of a valve, for example, will emit a cloud of electrons which can be made to travel to a neighbouring anode if attracted by a positive potential on the latter. A flow of electrons constitutes an electric current and the strength of the current will depend on the number of electrons moving at the same time.



A small type of caesium photo-electric cell. This has a plate cathode and is suitable for televising films.

SYNCHRONISING AND MODULATION

Heating a metal, as in the case of a wire filament in a valve, causes an emission of electrons, but heat is not the only force that will produce such an effect. A number of metals will respond in a similar way under the influence of light, the most important, in the order of their sensitivity, being caesium, rubidium, potassium, sodium. These materials are very active chemically in air and it is necessary to contain them in an evacuated glass tube. If a surface of one of these metals is deposited on the glass wall of the tube and a light is shone on to it, the number of electrons released per unit time at the photo-electric surface is directly proportional to the intensity of the incident light.

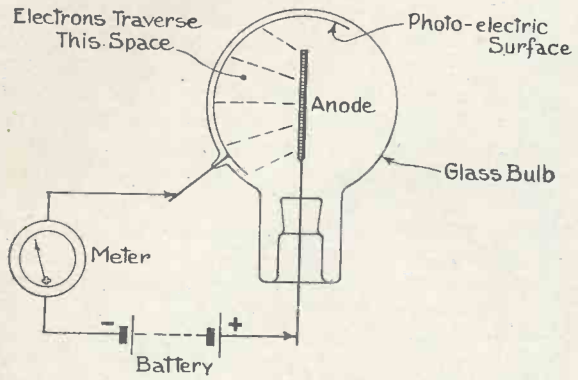


Diagram showing the elementary principle of the photo-electric cell.

If within the tube there is an anode (a small metal disc, rod or ring) to which a positive potential is applied. the negative side of the battery being similarly connected to the caesium surface, the electrons emitted when the light falls on the surface can be collected to the anode by virtue of its attractive positive charge. (The anode must be small or it would obstruct too much of the light.) Since a flow of electrons is an electric current we can produce a current proportional to the light, which is exactly what is required for television.

SELF-GENERATING PHOTO-CELLS

A layer of copper oxide on a copper disc acts as a tiny primary battery when light strikes its surface. The current generated is measured in micro-amperes but is sufficient to be extremely useful. The current output is directly proportional to the intensity of the light which strikes it and retains this property indefinitely. Its response to coloured light is another interesting characteristic. The response is almost exactly the same as that of the human eye. Thus a coloured light which seems bright to the eye seems bright to this type of photo-cell. This type of cell is the basis of the light-intensity meter and the transparency meter.

THE BEST VIEWING DISTANCE

The most suitable viewing distance for an image built up of a number of lines can be calculated from the formula: d = .00058d , where d = distance between dots, and d = viewing distance.

With a cathode-ray tube producing a picture 10 inches square with 240 scanning lines, the width of each line on a 10-inch screen would be 1/24th of an inch, and by applying the formula we get d =72 inches, or 6 feet, which is a viewing distance convenient for the average room. At this distance the definition will approximately equal that of the cinema screen viewed from an average seat.

SECONDARY EMISSION

An electron impacting on a conducting surface will, under certain suitable conditions, release a number of secondary electrons. The number of secondary electrons released by the impact depends on the velocity of the primary electron and on the physical and chemical nature of the surface. Under normal conditions the number of secondary electrons emitted is about two or three, and rarely exceeds ten. The secondary electrons are emitted in all directions and have low initial velocities.

Secondary emission depends largely on the physical and chemical properties of the surface of the material. All conductors contain a great number of free electrons which are able to move about in the metal. To enable an electron to leave the surface of a conductor work has to be done in overcoming the attraction between the metal and the electron, and this quantity is different for each substance.

LINE AND FRAME SYNCHRONISING

The cathode-ray tube requires two synchronising frequencies—line and frame. Mechanical systems need only one, the line frequency, because, being mechanically coupled, the picture or frame cannot help being in synchronism provided the lines are. The frame-frequency in mechanical systems is determined by the rate of rotation of the scanner, and so is the line-frequency which the number of mirrors on the drum automatically arranges.

With the cathode-ray tube we have two pairs of deflector plates, one pair for making the lines and the other for the frames. There is no mechanical or electrical coupling between them and it would be quite possible to have one pair working without the other. To make them provide a line screen it is necessary to apply separate frequencies to each pair and in order to ensure that these two frequencies are both of exactly the correct value each has to be controlled or synchronised by special impulses sent from the transmitting end along with the image signal.

Both transmitting systems used at the Alexandra Palace have provision for the two synchronising frequencies. In the case of the line frequency this is accomplished by sacrificing a certain percentage of each line.

D.C. MODULATION

D.C. modulation is the picture brightness component. In simple language it means that the average brightness of an image is transmitted, so that at the receiving end pictures having different average brightnesses at the studio end will not all appear the same. A convenient way of transmitting a component pro-

ULTRA-SHORT WAVE RECEPTION

portional to the average brightness, which, of course, varies continually from picture to picture, is to make the strength of the carrier current so proportional. When the modulation ceases the carrier drops to a low value, though not to zero,. A bright picture will send up the carrier strength more than a dull one, and if at the receiving end rectified carrier current is made to operate the biasing potential of the cathode-ray tube or other modulating device proper contrasts are secured.

MAGNIFYING THE IMAGE

Undoubtedly one of the greatest drawbacks of the cathode-ray system is the inability up to the present to produce large pictures. There is a limit to the size of tubes which it is practicable to produce and a screen diameter of about sixteen inches appears to represent the maximum. Reprojection and consequent enlargement of the image on the screen of the tube is possible, but it necessitates increasing the light value and using voltages of the order of 10,000. The life of the tube is also likely to be shortened by the use of such high voltages. Combinations of mechanical devices and the cathode-ray tube have also been suggested but no practical results have been obtained so far. A promising scheme is the introduction of a light valve into the tube and to use the cathode beam to " trigger " this, the actual light being provided by an exterior source.

THE ULTRA-SHORT WAVES

Owing to the extremely wide band of frequencies required to broadcast high-definition television it is quite essential to use the very short waves. Actually for the vision transmissions from the Alexandra Palace a wavelength of 6.67 metres will be used. These very short electromagnetic waves are almost optical in character; they travel in very nearly straight lines and are unable to follow the curvature of the earth's surface to any extent.

For this reason, no matter what power may be used, the range of an ultra-short wave transmitter is limited and depends on the height of the transmitting and receiving aerials and the nature of the intervening ground. Assuming the latter to be " flat," it will be apparent how the curvature of the earth's surface limits the range of a short-wave broadcasting system. If r is the radius of the earth (approximately 4,000 miles , h and h^1 the heights of transmitting and receiving aerials, and d and d^1 the horizon distance of transmitter and receiver respectively. It will be seen that

$$d^2 + r^2 = (r + h)^2$$

$$d^2 = 2rh + h^2, \text{ neglecting } h^2 \text{ we have}$$

$$d = \sqrt{2rh}$$

$$= \sqrt{8,000} \text{ miles.}$$

Similarly $d^1 = \sqrt{8,000^1}$ miles.

In the case of the Alexandra Palace transmitter, which has an effective aerial height of about 600 ft., it will be seen that this transmitter has a horizon of a little over 26 miles.

If the receiving aerial is elevated the range will be increased accordingly. It will be seen that a receiving aerial 25 ft. high has a horizon of 6.2 miles and could receive the Alexandra Palace transmissions up to a distance of 26 + 6.2 = 32.2 miles, assuming level ground between the two stations.

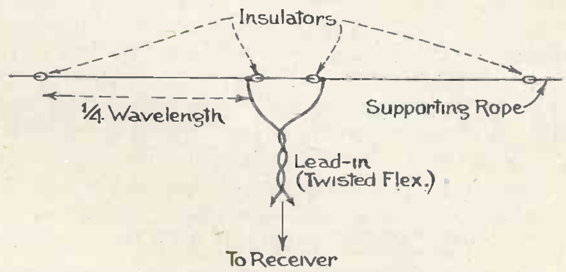
Actually the range is somewhat in excess of the figures given owing to the fact that these waves are not quite optical in character and do not have a sharply defined shadow. On the other hand, intervening high ground or buildings will reduce the range, and where the receiving aerial is in the shadow of a hill reception may be impossible.

TRANSMISSION CHANNELS

In television it is necessary to transmit three components (as compared with only one in ordinary sound broadcasting). These are vision signals which provide the tone values of the various parts of the picture; the synchronising signals which at the receiving end are used to reform the picture; and thirdly, the sound accompaniment. If the transmission is by radio then it is necessary to have two radio transmitters, two separate wavelengths for transmission and two radio receivers. If cable transmission is employed then two cables are necessary, one of which must be capable of carrying a sufficiently large range of frequencies without loss; the sound cable need be nothing more than an ordinary telephone line.

ULTRA-SHORT WAVE AERIALS

There are many types of ultra-short wave aerial, but from experiments that have been made a half-wave aerial of the di-pole type appears to be the most satisfactory. Usually a great increase in signal strength can be effected by elevating the di-pole, especially in congested areas. In this case the aerial may be connected to the receiver by means of an ordinary twisted flex of low resistance. It may be connected to the receiver by means of a single-turn coupling coil.



General scheme of half-wave di-pole aerial for ultra-short wave reception.

SOUND DELAY WITH INTERMEDIATE FILM

With the use of intermediate-film systems of transmission there is, of course, a time interval between an actual occurrence and its transmission due to the time taken for the film to pass through the developing, washing and fixing tanks. This time has variously been stated to be up to thirty seconds, but a minimum of eleven seconds has now been achieved. This time interval means that the sound must be delayed a corresponding amount so that sound and vision coincide at the time of transmission. The sound is delayed by recording upon a steel tape and placing the magnetic

ELECTRON MULTIPLIERS

pick-up at a point on the tape which represents a suitable amount of delay. The rate of travel of the tape is approximately 100 yards a minute, so it is an easy matter to calculate the correct position of the pick-up.

KEYSTONE EFFECT IN THE ICONOSCOPE

Due to the position of the scanning plate in the Iconoscope, if scanning is accomplished in the normal way a keystone effect is produced with consequent distortion. In order to correct this the beam is deflected by the scanning action in such a way that if the beam fell upon the plate at right angles it would produce a reversed keystone pattern; this, however, is cancelled out by the arrangement of the plate and the result is a rectangular area.

SCANNING CIRCUIT TROUBLES

The mercury vapour relays used in scanning circuits are occasionally liable to erratic performance since it is rather difficult to control the behaviour of a vapour-filled bulb. Temperature is liable to upset them, for instance, and it may happen that the speed of the time-base circuit alters slightly as the set is run.

To obviate this special relays have been developed with a filling of helium or argon gas instead of mercury vapour, and these are more reliable at high speeds of discharge. Even then an occasional " riccup " is met in the running of the relay which causes one or more lines to be shorter than the normal length.

If the effect is only momentary the picture will flicker, but a continuation will give a displacement of part of the picture as though a slice had been shifted out of alignment. A great deal of time and trouble has been spent in designing scanning circuits which shall be as reliable as possible, and some of these use ordinary hard valves which avoid the peculiarities of the gas-filled relay.

VELOCITY MODULATION

A system of television reproduction by a cathode-ray tube has been devised which is quite different from the conventional scanning systems. This is known as the " variable velocity " and is made possible by the property of the cathode-ray itself. Briefly, the principle is that the amount of light produced by the passage of the beam across the fluorescent screen depends on the rate at which it moves. The faster it moves, the less is the amount of illumination. By this means the modulation effect is obtained.

ELECTRON MULTIPLIERS

The theory upon which electron multipliers operate is comparatively simple, but the actual construction of these devices is a difficult problem. The few stray electrons which are present due to photo-electric effects are bombarded against a surface especially prepared to have the best possible secondary emitting properties. As a result of these original electrons striking this surface the emission of more electrons, than were in the original bombardment, results and this procedure is repeated many times until the desired "electron amplification " is reached.

Secondary-emission tubes may be used as amplifiers, oscillators, frequency multipliers, detectors, in short—wherever filament tubes are used to-day. A characteristic is the practically " noiseless " amplification.

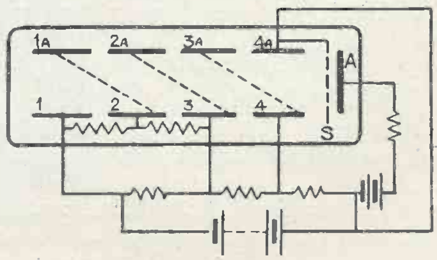


Diagram showing the operating principle of the electron multiplier.

ELECTRONIC LAWS

The two laws governing the velocity and direction of electrons as applied to electron tubes are:

(1) Electrons travel in straight lines in a uniform field. The velocity is not constant but there is a uniform acceleration.

(2) The velocity and the direction of electrons are changed when the beam passes from one field of electrical intensity to another and different field.

SENSITIVITY OF CATHODE-RAY TUBES

The distance moved by the beam on the screen for one volt of potential applied to the deflecting plates, varies inversely as the anode voltage.

For a given design of tube there is a formula from which the sensitivity can be found. This is usually given in the form Sensitivity = K/V, where K is the figure given by the makers of the tube and V is the anode voltage at which it is operated. Suppose K is 750, an average figure. Then at 1,500 volts the sensitivity is 750/1,500 or ½ mm. per volt of deflecting potential. At 3,000 volts the sensitivity will obviously be one-half of this or .25 mm. per volt.

THE SOUND OF A TELEVISION TRANSMISSION

The variations of the scan which produce the different tone values in a television image are at such a high frequency that they are above audible limits and therefore not heard. A high-pitched whistle is produced by the line synchronising frequency, which in the case of a 240-line picture is at the rate of 6,000 per second. Imposed on this there is a sort of burble which is due to the picture synchronising impulse with a frequency of 25 per second. This latter, in the case of the 405-line transmission, is a hum of the same tone value of A.C. mains hum. This is the frame frequency of 50 per second.

HIGH-FREQUENCY CABLES

Ordinary cables will not carry the high frequencies necessary for television transmission and therefore special cables have been designed which are capable of carrying high-frequency currents. In one, the outer conductor is formed of overlapping copper strips held in place with a binding of brass tape. The insulation consists of a cotton string wound spirally around the inner conductor, which is a solid copper wire. The outer conductor may be surrounded by a lead sheath, especially when used as an individual cable.

The other type has an outer conductor in the form of a lead sheath which surrounds the inner conductor, the latter being supported by hard rubber discs spaced at intervals along the inner wire. There is an optimum ratio of diameters which gives a minimum attenuation and, at high frequencies, is practically independent of frequency. The value of the optimum diameter ratio is about 3 to 6.

PHOTO-CELL TYPES

There are two main types of photo-cell—the vacuum and the gas-filled. The anode current of the vacuum cell is dependent only on the intensity of the impinging light. This characteristic renders vacuum cells particularly suitable for accurate measurement and for use in photo-electric amplifiers.

The gas-filled cell exhibits much higher sensitivity than the vacuum cell if the loads are equal.

Collisions occur between the gas particles and the electrons emitted by the cathode. As soon as the latter have attained a certain velocity, further electrons will be liberated from the gas-particles and will pass to the anode. This type of cell is suitable for purposes which call for large variations in photo-electric current, rather than a high degree of accuracy.

LUMINESCENT MATERIALS

Luminescent properties are exhibited in many natural and artificial substances when subjected to cathode-ray bombardment, though only a few are suitable for coating cathode-ray tube screens. The following are the principal substances employed—synthetic willemite, calcium tungstate, cadmium tungstate, zinc phosphate, zinc sulphide and zinc-cadmium sulphide. Very special precautions are necessary in the preparation of these materials if the best results are to be obtained and it is necessary for most of the luminescent substances to be in crystalline form. Some of them, as, for example, calcium tungstate and cadmium tungstate, display their maximum luminescence when perfectly pure. In the case of zinc sulphide and zinc-cadmium sulphide, zinc silicates, and zinc phosphates, very little luminescence is displayed unless an activator is present. The amount of the activator required is very small, generally about 1 in 10,000 to 1 in 100,000 parts by weight.

BRIGHTNESS OF SCANNING SPOT

The brightness of the scanning spot which is produced by a cathode-ray beam of high intensity is very great. In the case of a television transmitting tube with a scanning spot 0.3 mm. in diameter this has a candle-power of 1.2 and therefore its luminosity is 17 candles per mm^2. The intensity of illumination of the filament in a tungsten vacuum lamp is 1.25 candles per mm^2., and of the gas-filled lamp 5 to 13 candles per mm^2., according to the type and size of the lamp. The intrinsic illumination of the scanning spot is thus high though very much below that of the arc crater of a plain carbon arc, which is of the order of 170 candles per mm^2.

LARGE PICTURES WITH THE CATHODE-RAY TUBE

By L. S. Kaysie.

This article describes an ingenious combination of the cathode-ray tube and the Kerr cell with the object of making a large amount of modulated light available and the possibility of projecting large pictures without the aid of mechanical devices.

In spite of its many advantages as a television receiver, the cathode-ray tube is handicapped by the fact that the picture is projected on to a fluorescent screen, which at its best will only produce a relatively low level of light. It has not been found possible to magnify the fluorescent image to any substantial extent by optical means, and as the screen must be mounted inside the tube, the final size of the picture as seen by the eye is limited by the dimensions of the bulb.

This limitation is unfortunate, and various attempts have been made to overcome it. Inventors have, for instance, tried to find new compositions, capable of producing a more intense fluorescent effect. They have also suggested the use of X-rays to bombard the screen instead of electrons, and tried other methods of intensifying the light produced. But none of them appear to have proved successful in actual practice.

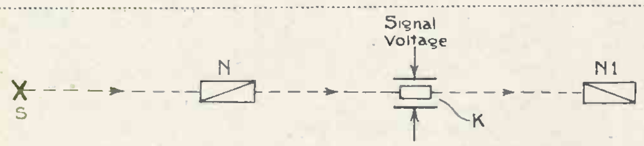


Fig. 1.—Diagram illustrating the action of a Kerr cell.

Light Control with Cathode-ray

An inventor named K. P. Pulvermacher has recently atttacked the problem on distinctly ingenious lines. He abolishes the fluorescent screen altogether, and in its place puts a light-sensitive relay, which under the action of the electron stream, controls the intensity of a powerful beam of light located outside the tube.

In order to explain the new arrangement, it will be necessary to recall the action of the well-known Kerr-cell type of light-valve. This depends upon the fact that certain substances, such as nitrobenzine, as well as various kinds of crystal, possess the property of rotating the plane of a polarised ray of light.

As shown, for instance, in Fig. 1, a

ray of light from a source S is passed through a Nicol prism N so that the emerging waves are "polarised." In other words, they are all oriented to vibrate in the same plane. They then pass through the "cell" K, and proceed, still vibrating in the same plane, until they meet the second Nicol prism N1. This is "crossed" relatively to the first Nicol, so that in the ordinary way it would extinguish the whole of the light.

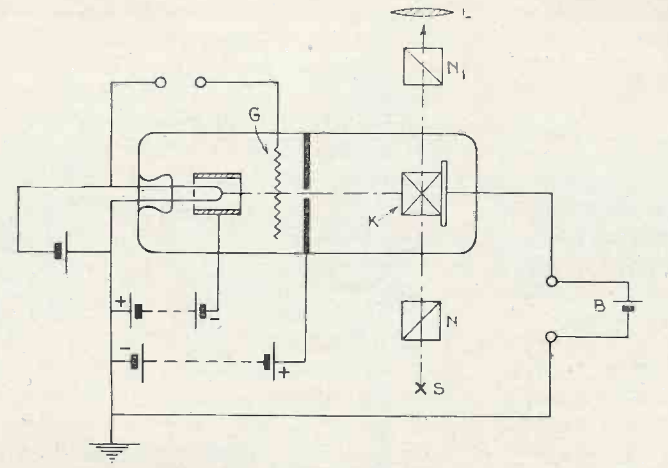


Fig. 2.—A Kerr cell inside a cathode-ray tube.

But when signal voltages are applied to the electrodes of the Kerr cell K, the plane of polarisation of the light passing through the cell is twisted to a certain extent, so that when the waves reach the second Nicol their passage is no longer completely barred. Actually the intensity of the light that succeeds in getting through the second Nicol depends directly upon the strength of the signal voltage applied to the sensitive cell K.

Suppose now that the light-sensitive cell K is mounted, as shown in Fig. 2, inside a cathode-ray tube, and that the two crossed Nicols N and N1 are placed outside the tube, so that they lie in the path of a powerful beam of light coming, say, from an arc lamp S.

It must be remembered that the electron stream from the cathode of the tube actually represents an electric charge in motion. If it is modulated in intensity by applying signal voltages to the control electrode G, then it will impart a varying charge to the face of the cell K on which it impacts. The opposite side of the cell is anchored, as shown, to a fixed biasing voltage B.

The arrangement is, in fact, on all fours with that shown in Fig. 1, and an observer at L will be able to see a ray of light which varies in intensity with the signal voltage.

So far, of course, the arrangement is not suitable for receiving television. But the inventor points out that various crystals, such as quartz, can be used to rotate the plane of a polarised ray of light. Further, it is possible to arrange a large number of "active" crystals on a transparent backing-plate so as to form a "mosaic" screen or surface. They could, for instance, be fused into a plate of lower melting-point, or deposited upon it from an emulsion. Each individual point of such a screen can then be regarded as a small Kerr cell capable of handling any light that may reach it.

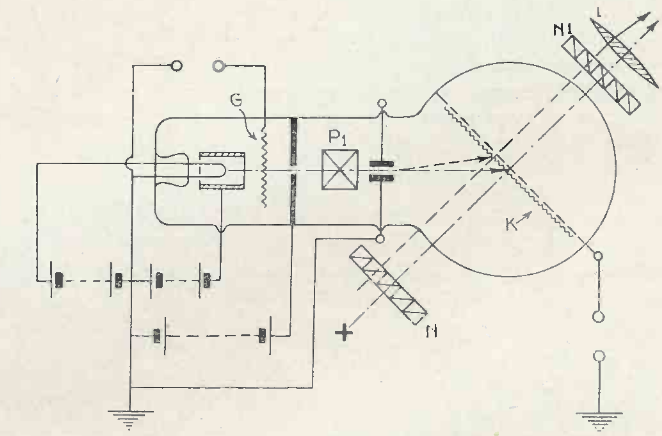


Fig. 3.—A multiple Kerr cell inside a cathode-ray tube. The screen consists of quartz crystals used to rotate the plane of a polarised ray of light. The Nicols are placed outside the tube.

Fig. 3 shows a screen K made in this manner and mounted in a cathode-ray tube for receiving television. The single crossed Nicols are of course replaced by a series of prisms as shown at N, N1 so as to give a wider angle of view, and the whole system is illuminated by a powerful source of light S located outside the tube.

In addition to the control grid G which receives the signals and varies the intensity of the electron stream, the cathode-ray tube is also provided with two pairs of scanning-electrodes P, P1, so that the modulated stream is swept from side to side and from top to bottom of the mosaic screen in the usual scanning motion.

At each point of its impact, the stream influences one or other of the individual crystal cells on the screen K, and causes it to rotate a part of the ray of polarised light from the sources to an extent which is controlled by the incoming signal voltage. The other cells of the screen are, for the moment, not affected by the stream, so that an observer at L only receives light from one point after another, as each small cell is "opened up" by the passage of the electron stream. Owing to the speed at which the scanning takes place, this is of course quite sufficient to produce the usual kinematographic effect of motion.

But instead of depending upon the relatively-feeble light of a fluorescent screen, the received picture is now built up of rays from an intense source of direct illumination. There will, of course, be certain losses in the Nicol prisms and the crystal screen, but the resulting image is stated to be sufficiently bright to admit of considerable enlargement by means of lenses. In addition, the operating voltages required are lower than usual so that the normal life of a cathode-ray tube is increased.

Scannings and Reflections

By THE LOOKER

Progress at the Alexandra Palace

IT is expected that a Press visit to the Palace will be arranged for about the third week of May; in the meantime admission is strictly forbidden. However, I managed to pay a visit recently—though how I got in I am not prepared to say—and here are the results of my observations of the progress already made—that is until approximately a week before these notes are published.

First of all the exterior. The aerial tower—that is the metal part which is being placed upon one of the existing Palace towers is about half way up. As a matter of fact progress with this appears to be quite rapid for all the constructional work has been carried out, and it is merely a matter of placing the parts in position, and riveting them together. I should imagine that a couple of weeks, that is somewhere about the middle of May, will see it completed.

The Concrete Apron

Another outside feature is what may be described as a concrete apron which is roughly semi-circular and about sixty feet by thirty feet. The object of this is the staging of outdoor demonstrations and in warm weather it is expected that it will be used by bands; it is so placed that the background is a pleasant vista of trees. The one other exterior feature of any note is a large roller shutter type of door to enable large properties and any other large objects which it is wished to demonstrate to be taken into the Palace.

Inside there is still a considerable amount of confusion and the only room which is absolutely finished is one of the projector rooms. Practically all the structural alterations have now been made and the studios are finished with the exception of decoration. Some of the apparatus is installed in the film studios, and so far as I could ascertain this was B.B.C. stuff, but as my visit was very unofficial I was unable to make sure. The Baird people have installed some of their apparatus, but there were few signs of E.M.I. gear and no one appeared to know when the rest of the gear was likely to arrive.

There was one other part completed which I omitted to mention, and this is the whole of the offices, which will be occupied by the administrative staff. The only thing lacking here is the actual furniture. The canteen is not finished though the boilers have been installed, and when I was there these were going in order to dry the place out. The theatre has not been touched—or rather that is not quite correct for when I was there cleaners were just commencing an onslaught on years of grime. It is not proposed to make any alterations to this for it has not really been decided to what use it will be put.

Discreet inquiries revealed that the hope of putting out test transmissions some time in June still prevails, though it is difficult to phophecy, at all events until the gear is in place.

Staff Appointments

I hear that it is practically certain that Cecil Lewis is to be given the appointment of Special Programme Director, and Moore O'Farrell will be the assistant producer at the Palace. Hyam Greenbaum is to be the Musical Director. These names were only given to me tentatively, but it is fairly certain that confirmation will soon be forthcoming. And then, of course, there are the lady announcers. The selection of these has been narrowed down to such an extent that we may say the appointments have been decided upon, but the names are for the present being kept a close secret.

Mr. Eustace Robb

Many of my readers will be wondering how it is that Mr. Eustace Robb, the Television Producer during the thirty-line days, has not come into the scheme of things. Mr. Robb, as most readers will know, did some most valuable work in showing what could be done even with limited facilities—and it may be said, in the face of a good deal of opposition, for television was ever the Cinderella at Broadcasting House. Well, as far as I can ascertain the B.B.C. and Mr. Robb could not come to any suitable arrangement, and he has therefore entirely severed his connection with the B.B.C. I understand that at present he is on the Continent, though whether for pleasure or business I do not know.

The Television Society Secretary

I am sorry to learn that Mr. W. G. W. Mitchell, B.Sc., one of the founders of the Television Society, has been compelled by ill-health and pressure of work to relinquish his honorary secretaryship of the Society. Its present flourishing condition (it has a membership of over 300 and is increasing weekly) is due in no small way to the enthusiasm of Mr. Mitchell and his colleagues. It is good to know that he is retaining his interest in the Society's Journal, which has a wide circulation.

The duties of Hon. Lecture Secretary are now being carried on by Mr. G. Parr, whose name will be familiar to readers as the author of articles in this journal on cathode-ray practice. His address is 68 Compton Road, N.21, and he will be pleased to send particulars of the Society's activities to intending members. Mr. J. J. Denton, of 25 Lisburne Road, Hampstead, is continuing his duties as General Secretary. Mr. Denton is equally well-known to audiences over the country as a fluent lecturer on television.

The Commercial Use of Television

Captain E. H. Robinson, speaking at the Television Society meeting the other night, gave it as his opinion that the future of television lies in

MORE SCANNINGS AND REFLECTIONS . . .

its commercial possibilities rather than the entertainment side. He had in mind the recent Berlin experiment of telephone and television, and he pictured the time when a television receiver will be included in every telephone installation. Apart from the telephone, television has other commercial possibilities which are not being overlooked. For instance, I know of two instances in which visual information of happenings some distance away is desirable, and experiments are being made to obtain this by television. Now comes the news that television will be employed for the control of the locks of the Moscow-Volga Canal in Russia. All these locks are to be centrally controlled and, if the report is correct, the operator will watch the approach of ships and their positions when in the locks and know exactly when to operate the controls.

Televising the Coronation

I have not been able to obtain any official confirmation of the reports that the Coronation will be broadcast by television next May, but it does seem a likely supposition that the televising of the procession rather than of the ceremony might well form the first important public television broadcast. Even in the state of present developments the televising of an outdoor event of this nature would be possible and we may be sure that before next May, as the result of experience and further developments, it will be quite practicable. I understand that Mr. Gerald Cock has already considered the scheme in some detail.

Who Leads?

Quite a keen sense of rivalry in the television race is becoming apparent between this country, Germany and the United States. America claims that the more recent major developments have all seen the light in that country and that the state of science there only needs putting upon a commercial basis to place America right ahead. Germany makes the claim that she has a service actually in being, and here—well, we may be a bit slow in getting things going, but it is contended that when we do get a start we shall certainly be the first country to have a real public service and to have placed television upon a commercial basis.

Television Parties

Many of us remember that in the early days of broadcasting, ownership of a receiver attracted quite a lot of visitors, and no doubt history will repeat itself in the case of television. Perhaps it will solve entertaining problems, until the novelty wears off. Even during the time of the thirty-line transmissions I was inundated with requests to "see television," often from almost total strangers, and as a rule for these late night transmissions there was quite a small crowd to witness them.

Edison Bell Television

In the June issue of last year the Edison Bell television receiver was described in TELEVISION AND SHORT-WAVE WORLD. Since that time the company has continued experiments with a view to further developments. The Edison Bell Company, it may not be generally known, was the first concern in this country to make sound records, which were of the old cylindrical type. Later they produced the disc type, and now they have concentrated on television. A new public company with a capital of £150,000 is in process of formation and it is expected that there will be an offer of shares to the public.

Football and Television

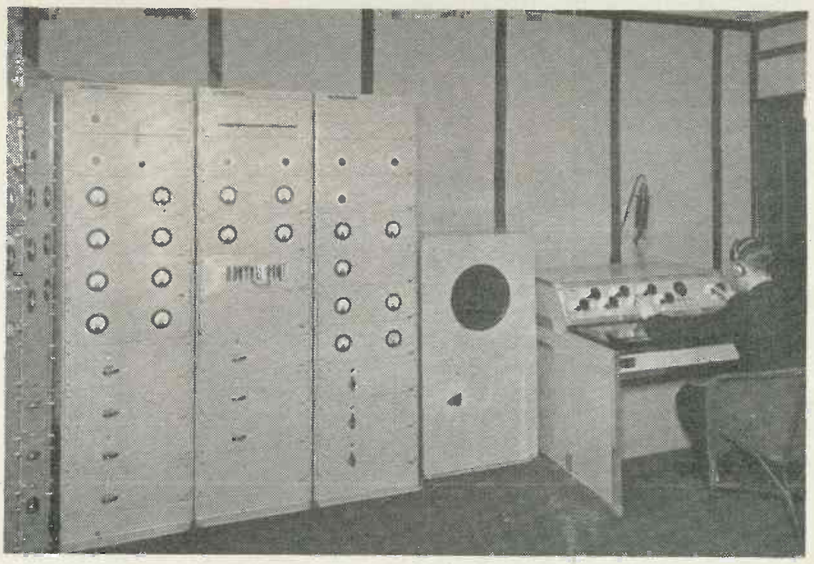
According to the daily press a feature of the new stand for the Arsenal Football Club, which is to be erected during the summer months at a cost of £100,000, will be a permanent broadcasting box and installation and a control tower for the installation of television equipment. The B.B.C. Television Director is not, I know, overlooking the possibilities of broadcasting football and other important sporting events, and it is fairly certain that they will be featured in the programmes at an early date.

Television and Schools

I see that television is being considered by education authorities as a new factor for the class room. Its possibilities in this direction are to be discussed at the conference of the National Association of Head Teachers to be held in Lincoln at Whitsuntide. The Association may be overlooking the fact that at present the range will be limited to the London area, but even with this limitation there is obviously plenty of scope and no doubt the B.B.C. would co-operate with educational films and demonstrations.

Televising the Olympic Games

Dr. Carl Diem, Secretary of the Organising Committee of the 1936 Olympic Games, recently announced that television transmitters were to be installed in the Berlin Stadium. This, of course, is not the first occasion in Germany when television has been employed for public events, in fact, the Germans are devoting a lot of attention to this side of television. The opening of the last Radio Exhibition was televised and no doubt other outdoor events would have followed had not the disastrous fire put an end to all activities in this direction for the time being.



The Baird control panels for the Alexandra Palace.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS
Specially Compiled for this Journal

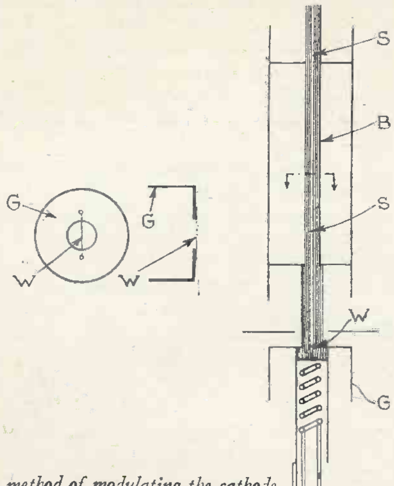
Patentees :—J. D. Riedel Haen A.-G. :: Marconi's Wireless Telegraph Co. Ltd. :: Radio Akt. D. S. Loewe :: C. O. Browne :: J. L. Baird and Baird Television Ltd.

Fluorescent Screens
(Patent No. 440,350.)

In order to minimise the "after-glow" effect which tends to blur definition, and, at the same time, to secure a natural or untinted light, the fluorescent screen of a cathode-ray tube is made of a mixture of zinc and cadmium sulphides. These are first thoroughly purified, and traces of silver and copper are then added in carefully calculated quantities in order to serve as "activating agents" which emphasise the effect of the electron beam. The mixture is finally crystallised by keeping it for one and a half hours at a temperature of 1,000° C.—(*J. D. Riedel-Haen A.-G.*)

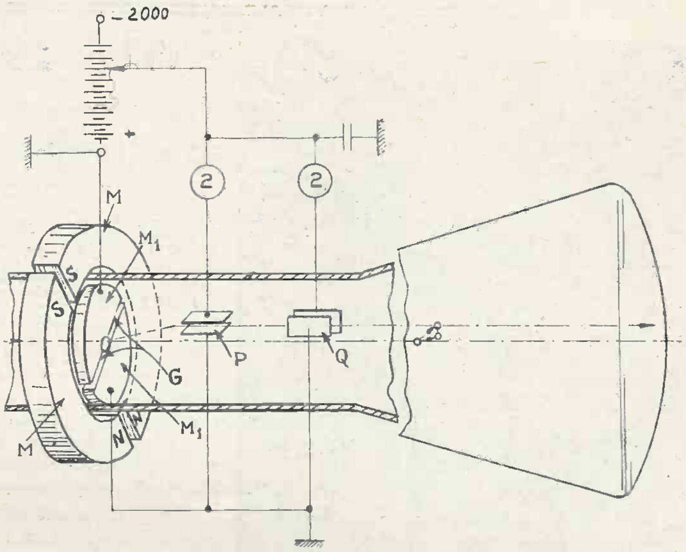
Modulating Systems
(Patent No. 440,390.)

In order to prevent the applied signal voltage from altering the effective size of the spot of light projected on to the fluorescent screen of a cathode-ray receiver—and so producing "streakiness"—the intensity of the beam is varied by altering the density of its centre, whilst leaving the outer diameter constant.



A method of modulating the cathode beam by altering the density at the centre. (Patent No. 440,390.)

The required result is obtained by applying the signal voltage to a thin wire W, stretched across the centre of the aperture in the control grid through which the beam passes after leaving the filament. The apparent size of the wire (i.e., the electric field surrounding it) alters with the applied signal voltage. This in turn cuts out a larger or smaller slice S from the centre of the beam B, and so varies the intensity of the light produced by it on the screen.—(*Marconi's Wireless Telegraph Co., Ltd.*)



A scheme for minimising the effects of stray magnetic fields on the cathode beam. Patent No. 440,560.

Controlling the Electron Stream
(Patent No. 440,560.)

The effect of stray fields from the magnets or windings used to concentrate or deflect the electron stream in a cathode-ray tube is minimised by arranging the magnetic system partly outside the tube and partly inside. As shown, two permanent half-ring magnets M are arranged outside the lower end of the tube, with their like poles adjoining, so that the field is concentrated around the gap. Inside are two similar pole-pieces M1, which are set as close to the glass and to the outer magnets M, as possible.

The inner magnets apply a field to the stream along the inclined gap G so as to deflect the electrons out of the straight and between the two pairs of scanning electrodes P, Q. This prevents the formation of the well-known "ionic cross," which tends to appear on the fluorescent screen, superposed over the picture. The inner pole-pieces may also be used in place of the usual anode, and may be given an electrostatic charge.—(*Radio Akt. D. S. Loewe.*)

Combined Sound and Picture Transmissions
(Patent No. 440,729.)

When televising from a "talkie" film, it is necessary to keep the film moving at the standard rate, since otherwise the reproduction from the sound track on the film will be distorted. But if the film is to be scanned by "interleaving," the usual practice is to transmit at the rate of 50 frames a second, which is just double the standard speed for the sound record. In addition each frame must contain an "odd" number of lines, say, $121\frac{1}{2}$ (or 243 for the pair), so as to ensure correct interlacing of the two frames on the screen.

The problem is solved by driving the film F from one synchronous motor M, and compounding the speeds of two other synchronous motors M1 and M2 through epicyclic gearing G. This enables the scanning drum D to be rotated at the required fractional rate.—(*C. O. Browne.*)

Magnetic Scanning Control

(Patent No. 440,810.)

It is usual to control the scanning movements of the electron beam in a cathode-ray tube electrostatically, that is, by applying saw-tooth voltages to both pairs of deflecting electrodes. Alternatively one can use magnetic fields of force for the same purpose. The latter are found to be quite satisfactory for the framing frequencies, which are relatively slow; but in the case of the more rapid line-scanning frequencies difficulties arise on account of eddy current losses in the magnetic system.

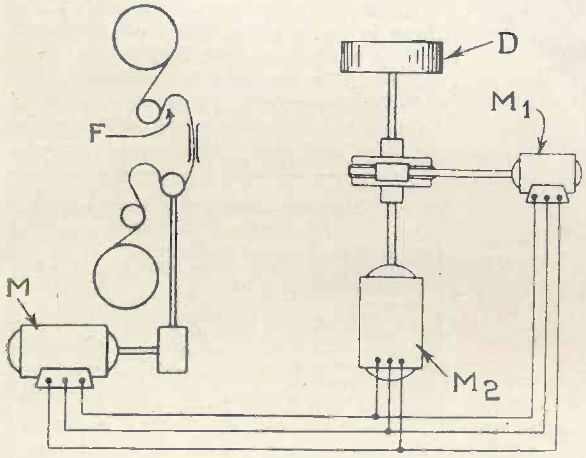
The diagram shows a magnetic circuit consisting of an outer core C set close to pole-pieces P, P1 located inside the cathode-ray tube. The controlling fields are produced by a winding W and an A.C. source S. According to the invention the core C is made of powdered iron mixed with an insulating binder, so as to reduce the eddy-current and hysteresis losses. At the same time the permeability is high, so that an intense control-field at high frequency is produced. The winding W and supply leads are screened at K and K1 to prevent stray fields from influencing the electron stream.—(*Radio Akt. D. S. Loewe.*)

Scanning Discs

(Patent No. 440,917.)

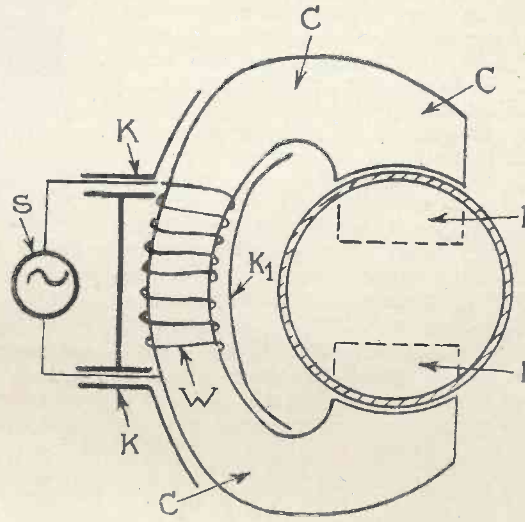
The ray of light thrown by a rotating disc across the viewing-screen is generally slightly curved, owing to the fact that it is produced by an aperture that is rotating around a fixed axis. This, in turn, causes the scanning-lines to become congested at one end of the screen whilst they spread out at the other end, thereby producing "gaps" which become particularly noticeable in the case of interlaced scanning. One suggested remedy is to make the scanning apertures of such a size that the lines are strictly parallel in the centre of the screen, though they inevitably overlap at each end. This is, at best, only a compromise.

According to the invention, the difficulty is overcome by making the disc apertures wedge-shaped in outline, instead of circular, so that as they intersect with the fixed aperture, the area of the resulting spot of light gradually increases from one end of the line to the other. This fills in the gaps and so produces a cinema film for television.—(*J. L. Baird* and *Baird Television, Ltd.*)



(*Left*) *Synchronising sound and vision with interlaced scanning systems. Patent No.* 440,729.

(*Right*) *An arrangement for producing the line scan of the cathode ray magnetically. Patent No.* 440,810.



Summary of Other Television Patents

(Patent No. 435,567.)

Interlocked scanning system for transmitting picture signals.—(*Marconi's Wireless Telegraph Co., Ltd.,* and *S. B. Smith.*)

(Patent No. 436,734.)

Amplifier which discriminates between the higher and lower frequencies so as to handle slow fluctuations without being subject to static interference.—(*A. D. Blumlein* and *C. O. Browne.*)

(Patent No. 440,386.)

Cathode-ray viewing-screen on which the picture is made visible by the heat produced by the bombardment of the electron stream.—(*J. L. Baird* and *Baird Television, Ltd.*)

(Patent No. 440,577.)

Lens system used for scanning a cinema film for television.—(*J. L. Baird* and *Baird Television, Ltd.*)

(Patent No. 440,818.)

Preparation of a fluorescent material which is practically free from after-glow.—(*L. A. Levy* and *D. W. West.*)

(Patent No. 441,410.)

Mirror scanning-drum designed to produce a continuous spiral track, suitable for use in "interleaved" scanning.—(*J. C. Wilson* and *Baird Television, Ltd.*)

(Patent No. 441,558.)

Making a sound and picture record of events to be subsequently reproduced by television.—(*C. P. Hall* and *H. Flynn.*)

(Patent No. 441,761.)

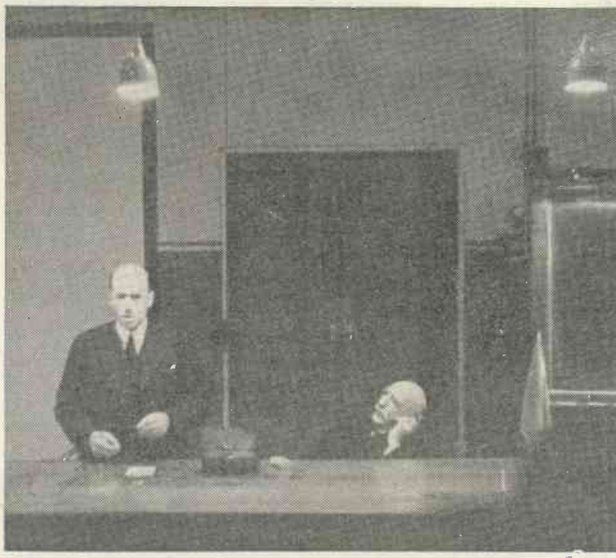
Television system in which synchronising impulses are transmitted on the same carrier wave as the picture signals, and are used to change the level of a positive bias applied to the receiver.—(*Radio-Akt D. S. Loewe.*)

(Patent No. 441,813.)

Fluorescent screens for cathode-ray tubes.—(*N. V. Philips, Gloeilampen-Fabrieken.*)

SIR NOEL ASHBRIDGE ON DEVELOPMENTS IN TELEVISION

An abstract of a lecture by the B.B.C.'s Chief Engineer at the Annual General Meeting of The Television Society on March 25th.



This photograph shows Sir Noel Ashbridge delivering his address before The Television Society. Sir Ambrose Fleming, who took the chair is seen on his left.

ON March 25, at the annual general meeting of the Television Society, Sir Noel Ashbridge gave an address on some aspects of the high-definition television system.

His remarks are reported in full in the Journal of the Television Society, which is being published at the end of this month, and the following is a resumé of some of the salient points of his talk.

In his opening remarks, Sir Noel regretted that he could not tell the audience much about the technical details of the station at present being built at the Alexandra Palace, nor could he make any comment on either of the two systems to be used there. As a member of the Advisory Committee on television he was necessarily impartial, and any discussion of technical details would be doing an injustice to one or other of the firms concerned.

"The primary object of the station," said Sir Noel, "was to provide a television service somewhere in England—obviously in London, because it stood the best chance of attracting the maximum number of subscribers. It was not intended to be an ordinary service—one would not normally begin a service of television with two sets of technical data for the conditions under which it would operate, nor would one use two different systems at the same station. It is desirable to explain what was intended in making these decisions. You will know, of course, that there were two firms who had developed television to a high degree of practicability. It was impossible for any person to say which of these two systems would actually prove the better when operated as a regular service and, as the two systems were different in many respects, it was desirable to obtain experience in operating both of them."

The Reason for Two Standards

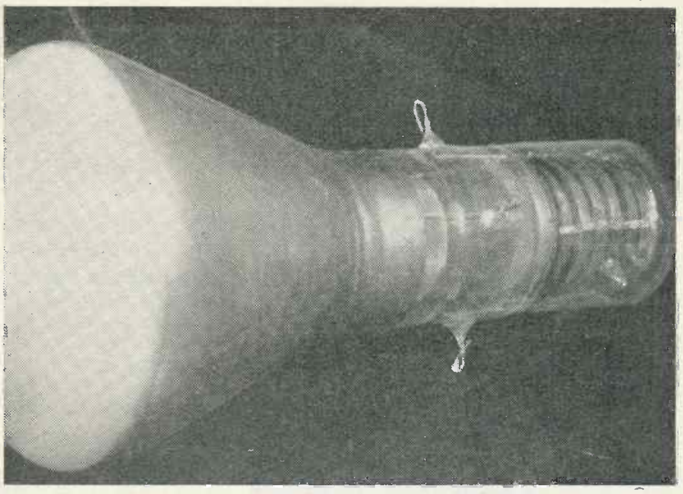
After dealing with the reasons which led to the choice of the site at the Alexandra Palace as the transmitter, the question of the number of lines and frames per second was discussed. He said "People have often wondered how the Committee ever came to adopt two different standards. It ought not to be necessary, but if two different systems are to be on trial, the designers of these systems must be allowed to a certain extent to choose the number of lines with which they scan their pictures. That is how it came about that in the end it was decided to use the two different sets of technical data.

"It is worth while considering for a moment the relative merits of, say, 240-line and 405-line pictures, and also the relative merits of a larger number of frames per second, or a smaller number. One may say, if it is possible to transmit a larger number of lines, why consider anything else? It might be argued that in the present state of the art you can do as much justice in the receiving of a picture of, say, 240 lines, as you can one of much higher definition, in that there are various factors which prevent taking full benefit from the higher number of lines. It might therefore be submitted that there is no object in using a higher number of lines, and it is true that this does not appear necessary until the standard of the art has advanced sufficiently to take advantage of all the benefits resulting from the higher definition. Whether this is the case or not I do not know, but it is one of the contentions in favour of the lower number of lines. Another contention is that higher definition may possibly mean a more expensive receiver, and that, of course, is obviously not a desirable thing. Television must eventually appeal to all classes, and not merely a few rich people.

"The new station at the Alexandra Palace has a section with an area comparable with that of Broadcasting House, but there is not the same accommodation, because there are not the same number of floors. A kind of minimum working accommodation is being provided, and for each system there are two large rooms about 70 ft. by 40 ft., in which there will be a separate transmitter for each system. This was necessary because the modulation systems to a large extent are bound up with the transmitter itself, and there is very little common to both.

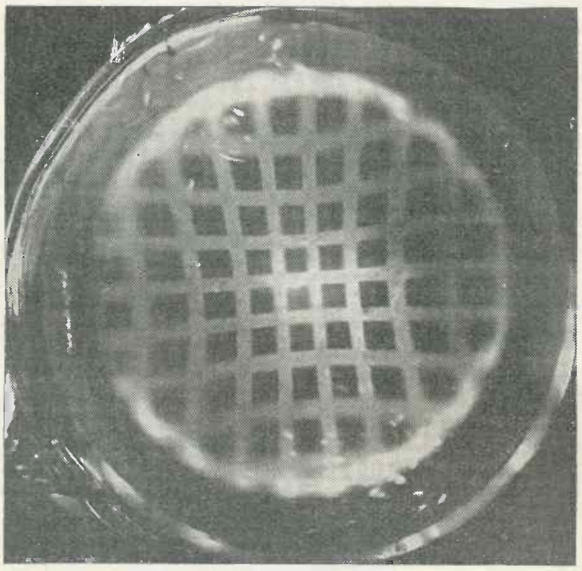
MORE ABOUT THE ELECTRON IMAGE TUBE

By George H. Eckhardt



The Zworykin electron-image tube.

WHILE the emergence of electronic television out of the laboratory stage is keenly awaited in the United States, the results of television research in fields other than the transmission and reproduction of scenes with the illusion of motion are already appearing. These results which promise to be exceedingly interesting and valuable may be regarded as byproducts of television research.



Showing image distortion in uncorrected tube. Comparison with picture showing corrected image tube indicates how focusing is accomplished.

Dr. V. K. Zworykin and Dr. George A. Morton, of the Radio Corporation of America Laboratories, recently exhibited an electron tube which enables man to see in the dark. This tube, exhibited at a meeting of the American Association for the Advancement of Science, in St. Louis, also offers great promise in the field of microscopy. Dr. Zworykin will be remembered as the inventor of the Iconoscope, the " heart " of the R.C.A. system of television.

The activity of photo-electric substances, especially caesium on a silver base, in the infra-red and ultraviolet zones, is well-known. It is also a well-known fact that not only visible light, but also infra-red and ultra-violet cause the emission of electrons from a photo-sensitive surface. Therefore, a properly prepared photo-sensitive surface is more sensitive to light than the human eye. This, roughly, is the basic principle behind these electron tubes.

A photo-senstive coating on one end of a tube con-

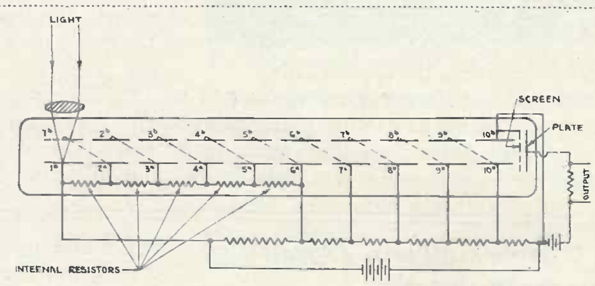
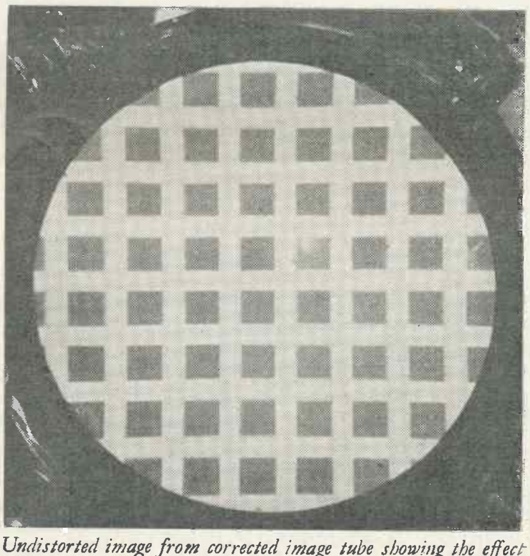
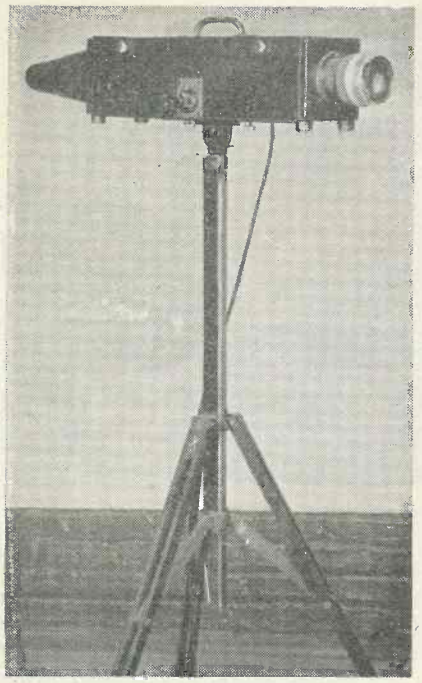


Diagram showing how potentials are applied to successive stages in the electron multiplier.

verted an optical image into electron emissions. These emissions, of course, were proportional to the amount of light falling upon each point. The electrons were



Undistorted image from corrected image tube showing the effect of electrostatic focusing.



A new electron telescope with which it is possible to see through fog by means of infra-red light.

" speeded " through the tube, and reproduced an enlarged picture when projected against a fluorescent screen at the far end of the tube. In short, the research men of R.C.A. produced a " television " pick-up and receiver, all in one tube.

One very striking experiment made by Dr. Zworykin was the focusing of motion pictures upon the "pick-up" end of the tube. These were reproduced in the " receiver " end. A filter which cut out all visible light, allowing only the passage of infra-red rays, was then placed in front of the motion-picture projector lens. It would seem to an observer that all light had been cut off by this filter. Yet the " receiver " end of the tube continued to reproduce the pictures with hardly any loss in clarity.

The electron images in this device are focused by electrostatic means. So similar does the focusing of the electron image by electrostatic means seem to optical focusing, that Dr. Zworykin speaks of " electrostatic lenses." Focusing of the image is accomplished by varying the " electrostatic lenses " by means of a potentiometer. To carry the analogy one step further, the tube has been corrected for various distortions as with the lens of a camera.

This device seems to promise great possibilities in the realm of microscopy. By means of it researches can be extended in minute living organisms, which are now observatble only by means of intense light or stains, that often kill the germs the study of which is being pursued.

This new device, sensitive to infra-red rays, reveals details of tissue and cell structure not readily viewed by visible light, the use of stains may be obviated, and the natural development of heretofore baffling cells brought within the field of human vision.

The device can also be used as an " electron telescope " for seeing through fogs and atmospheric haze, which seriously handicap visible light by reflection from water particles, but do not impose the same limitations upon infra-red rays.

Although the electron image tube will operate on visible light waves, its most promising fields of application are in studies where the infra-red and ultra-violet rays are used.

"A Complete Phone Transmitter for the Beginner"

(*Continued from page* 294.)

and enables the modulator to be fairly well matched to the transmitter. It certainly increases the percentage of modulation when the correct tapping has been determined. It will be noticed that no means of connecting the modulator to the transmitter has been shown in either circuit. Actually a 1-1 ratio output transformer is connected between the two units. The output from the modulator goes into one side of the transformer, and the output of the transformer plugs into the jack on the panel of the transmitter. This is putting the speech frequencies into the suppressor grid of the pentode. The earthy side of this transformer is then connected to bias, the correct voltage having been determined by experiment. A good average is 60 volts negative.

The mains rectifier in the speech amplifier section is of the half-wave type. The A.C. is fed into the anode of the valve D.C. being taken out from the cathode. On D.C. mains this valve acts as a passenger simply passing through the D.C. supply directly to the smoothing circuit.

The layout is not particularly important, but the position of the various components can be seen from Figs. 6 and 7. The smoothing choke, output choke, and inter-valve transformer are mounted on the base plate and then completely covered with metal box. A point to remember is that the heater wires to the three valves should be joined up separately. These wires should also be twisted as this will reduce the hum level.

In the original modulator no trace of hum could be detected, but it is essential to rotate the inter-valve transformer to a position where hum fades out. If this transformer is in the wrong position hum level is quite high.

Mounting

It is suggested that both the transmitter and modulator be mounted in a small wooden framework. If three racks are provided the bottom rack can house the mains unit. This can be of the standard broadcast type and is perfectly straightforward.

Reverting to the transmitter, by using a tapped-on aerial no coupling coils and tuning condensers will be required. We suggest an aerial having a total length of 66 ft. which can be tapped directly on to the tank coil. Assuming the transmitter to be adjusted to give maximum light with the loop lamp, which will automatically mean minimum current in the second m/a meter, tap on the aerial at the H.T. end. This will mean a readjustment of the P.A. tuning condenser. Keep on tapping down the coil and readjusting until a point is found where there is a sharp rise in anode current. This is the optimum position.

With the modulator connected via the 1-1 transformer and a pick-up across the input, the modulation will be denoted by a definite flicker in the light of the loop lamp. This light should increase in brilliance as the modulation is raised. An alternative method is to connect the hot wire meter in series with the aerial lead. This will give a reading of about .3 to .4 and 100 per cent. modulation is obtained when this current can be increased by 25 per cent. This is a very approximate figure.

APOLOGY

Owing to the demands that several special articles have made upon our space in this issue we regret that it has been necessary to hold over the third of the articles on Mechanical High-definition Film Transmission, Electron Optics and Transmitting for Beginners.

ARE THE EIFFEL TOWER TRANSMISSIONS A FAILURE?

A FRENCH CONTEMPORARY'S VIEWS

According to the *Haut Parler*, the Eiffel Tower television transmissions are a failure and this journal blames M. Mandel, the French Minister of Posts and Telegraphs for making an improper choice of the system to be used. It remarks that the performers are literally bathed in light and perspire and suffocate, whilst the method employed at P.T.T. is so costly that it constitutes a regrettable experiment from every point of view.

It appears that the Television Commission in April of last year suggested that Barthelemy and de France be asked to demonstrate their respective systems with a view to the inauguration of a television service. M. Mandel, ignoring this arrangement, excluded de France under the contention that he could not immediately transmit direct vision with 180 lines and yet he allowed another technician several months in which to achieve it.

The powerful projectors used at the P.T.T. studio make the heat almost unbearable.

Yet, it is contended, de France was surely one of the pioneers who ought to have been chosen on the basis of the chronological facts and the results obtained. The history of de France's television researches and achievements are given below.

August, 1931.—Official demonstration before MM. Herriot and Meyer (Mayor of Havre), 38 lines, mechanical system.

February, 1932.—Commencement of experimental transmissions at Radio-Normandy, 220 metres, 38 lines. Good reception at Havre.

June, 1932.—Attempts at transmission at Radio-Toulouse, 60 lines. Direct television and telecinema. Good reception at Havre.

November, 1932.—Establishment of the Research Laboratory at St. Cloud, near Paris. Demonstrations, 60 lines. Direct television. Reception on screen with crater lamps and Kerr cell. Telecinema, 90 lines.

February, 1933.—Telecinema demonstration, 90 lines, at the Lido in the Champ-Elysées, before well-known people of the cinematograph world.

May, 1932.—Transmission by wireless (175 metres). Telecinema, 90 lines and direct television, 60 lines. Reception in different parts of Paris.

July, 1933.—Reception with cathode-ray tube with high definition. First demonstrations, 120 lines.

January-March, 1934.—Public demonstrations of telecinema with high definition at the offices of the newspaper *Paris-Soir*.

April, 1934-April, 1935.—Production of a commercial receiver for 180 and 240 lines with 30-centimetre cathode-ray tube. Transmission by wireless on short waves and ultra-short waves, 180 lines.

Many research workers would have been discouraged on being confronted with the decision of the Minister for P.T.T., since transmission of pictures can only take place with the authorisation of the administration. The position of television is somewhat paradoxical because of the official support that is necessary.

The transmitter is in the base of the Eiffel Tower.

However, de France responded by beginning immediately on the design of a direct television scanner of 120 and then 180 lines. He was so successful and obtained such fine pictures that the construction of a private studio was decided upon.

One Kilowatt instead of Sixty

Here is the present position. It is known that the Paris-P.T.T. television studio is unique, in the strictest sense of the word: this is not a reference to quality, but an excuse.

To obtain "full-length" people, in spite of a slight increase in the area of the holes of the scanning disc which, regardless of all statements to the contrary, prevents achievement of a definition corresponding to 180 lines, the engineers of Paris-P.T.T. must shed floods of light on the performers with projectors consuming a total of 60 kilowatts!

It was necessary to install beneath the studio a refrigerating plant, the function of which is to cool overheated artists; studio performers compare the television studio of Paris-P.T.T. to a place of torments, and the fear is expressed that artists will suffer injuries to the sight. The method employed at P.T.T. is so costly that the construction of other television studios in France could not be faced, and yet it must be done. . .

The definition obtained, it is stated, is not of 180 lines in spite of the figure announced. Until quite recently there was no apparent difference between scanning with 60 lines and with 180 lines. The suppression of the former savours, moreover, of the exclusion of an undesirable witness.

De France, by mechanical devices, well-known in principle, but specially perfected, is able to obtain the same results as those of P.T.T., while using only one kilowatt instead of sixty.

By identical results with those of P.T.T. is meant full-length people on a two-metre screen; as regards the quality of the picture, it is very superior, since it is really a case of 180 lines.

Almost in Darkness

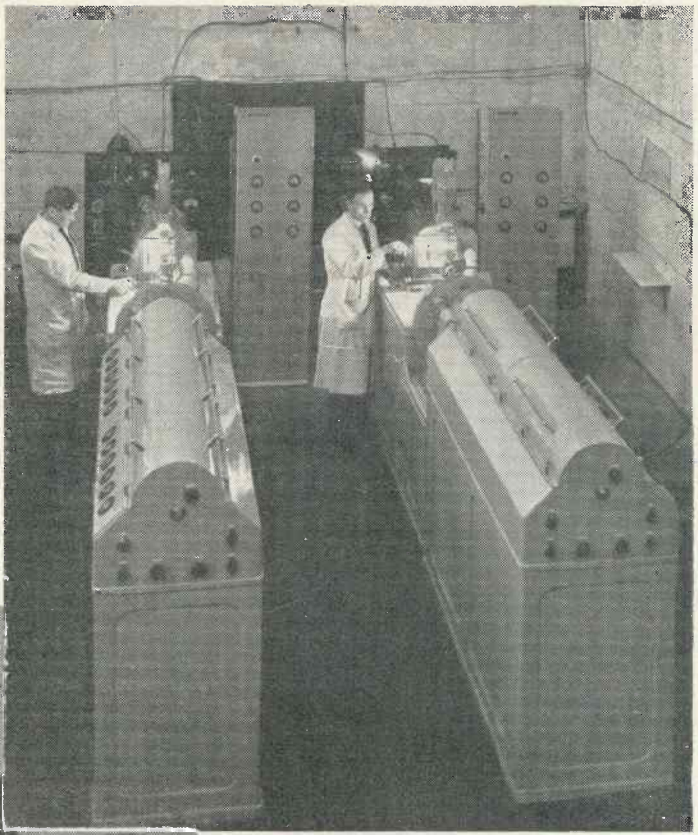
De France employs spot-light scanning and the studio is almost in darkness. The cost of the installation is very low, especially if consideration is given to the fact that air conditioning is not necessary. The pictures obtained are remarkably good and correspond exactly to what is called "180 lines." Without exaggeration, they are perfect in detail, perfectly stable and, what is more, pleasant to the eye.

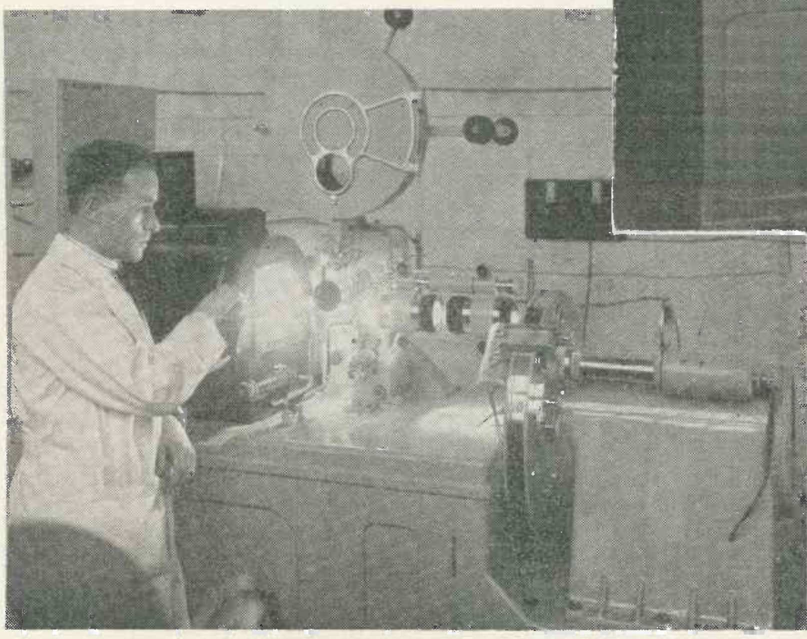
No claim is made for originality in the system, for well-known methods are employed. The excellent results, it is stated, are due to improvement in detail regarding which secrecy is being maintained.

What is M. Mandel going to do? Justice demands that he should allow the two systems to compete, as has been done in England and Germany; public opinion in France would not easily permit ostracism of one system in favour of another.

BAIRD APPARATUS FOR ALEXANDRA PALACE

The photographs show some of the Baird apparatus actually to be installed at the Alexandra Palace. This comprises two band Telecine scanners for transmitting talking films. Each consists of film projector mechanism, with arc and film gate, 240-line scanning disc running in vacuum, photo-electric cell and A & B amplifiers in the large consoles. Below the projector box contains automatically controlled vacuum and water cooler pumps. Below the amplifier is the all-mains supply unit and behind the switchboard are the controls and sound panel. The photograph below shows the transmitter in greater detail.





DIGESTS AND DATA

ABSTRACTS FROM AUTHORITATIVE CONTRIBUTIONS ON TELEVISION IN THE WORLD'S PRESS

SPECIALLY COMPILED FOR THIS JOURNAL

New Developments in Television Receivers. Electronics, Vol. 9, No. 2, Page 46.

A TELEVISION receiver is described manufactured by the Lorenz Company of Berlin. A schematic diagram of the receiver is given together with a photograph. In this receiver, regeneration is used for sound reception, the superheterodyne for vision; wavelength of about 6 metres.

The Periodic Emission of Light from a Discharge Tube Excited at High Frequency. By A. R. Fry, Physical Review, Vol. 49, No. 4, Page 305.

Describes investigations which were carried out in order to study the character of light emitted by a discharge tube containing air at low pressure, the tube being driven by a H.F. oscillator. A vacuum photo-electric cell operated with an alternating high-frequency driving potential was the receiver used. The results indicated that the light was fluctuating even when the driving frequency was as high as 10 mc. per second, and it was indicated that the average illumination lagged behind the driving potential, which for the higher frequencies was a considerable fraction of a cycle. This indicated that light emitted from the excited atoms persisted after excitation.

A New Superheterodyne Principle. Wireless Engineer, Vol. 13, No. 150, Page 117.

A superheterodyne receiver is described which involves novel features and which was described recently in a paper read by Mr. E. G. Beard before the Australian Institute of Radio Engineers. In the receiver, part of the received wave is used to produce the heterodyne oscillation which is then mixed with the remainder of the wave in the usual manner.

Fluctuation Noise in Vacuum Tubes which are not Temperature Limited. By F. C. Williams. Journal Inst. Electrical Engineers, Vol. 78, No. 471, Page 326.

Chiefly concerned with the question whether or not a fluctuation voltage component equal to that which would be produced by a metallic conductor of equal resistance and at the temperature of the cathode would be produced by the anode screen in a thermionic valve.

A Low-level Wattmeter. By A. L. Albert and H. P. Beckendorf, Electronics, Vol. 9, No. 3, Page 28.

An electrostatic communication wattmeter is described, suitable for the direct measurement of power at these levels. The wattmeter has been tested and found satisfactory up to 5,000 cycles, but it is stressed that it is suitable for use over a considerably wider range.

Voltage Measurements at Very High Frequencies. By E. C. S. Megaw, Wireless Engineer, Vol. 13, No. 151, Page 201.

Concluding part of the work on measurements of voltage at high frequencies, which was mentioned in the Digests for April. In it is made a comparison of a peak voltmeter and a thermal method of measurement. Also the calibration of other types of valve voltmeters against a peak voltmeter is dealt with.

R. F. Power Measurements. By G. F. Lampkin, Electronics, Vol. 9, No. 2, Page 30.

Describes how transmitter power may be measured within 10 per cent. by measuring peak grid driving voltage with a direct reading rectifier type R.F. voltmeter, or by the use of a rectifier type dummy load.

R. F. Resistance of Copper Wire. Electronics, Vol. 9, No. 2, Page 38.

The chart is given which was prepared in the laboratories of the Weston Electrical Instrument Corporation during an investigation of high-frequency measurements with the thermometer. This chart covers the frequency range from 500 kc. to 100 mc.

A New Tube for Use in Superheterodyne Frequency Conversion Systems. By C. F. Nesslage, E. W. Herold and W. A. Harris. Proc. Inst. Rad. Eng., Vol. 24, No. 2, Page 207.

It is pointed out that the major disadvantage of existing methods of frequency mixing is found in high-frequency operation with comparatively low intermediate frequencies, where serious coupling exists between oscillator and signal circuit in spite of electrostatic screening. A tube is described which is claimed to overcome these difficulties.

Ion Optics of Equal Coaxial Cylinders. By P. Kirkpatrick and J. G. Beckerley.

An empirical expression for the potential distribution along the axis of two equally spaced coaxial conducting cylinders has been found in terms of the radius and separation of the cylinders. The general empirical expression, combined with the theoretical lens equation of Hansen and Webster gives an algebraic formula for lenses of this type, directly relating object and image distance to readily measureable quantities.

An Unconventional Receiver for the Ultra-high Frequencies. Q. S. T. Vol. 20, No. 2. Page 21.

A description of an experimental receiver designed by Mr. F. W. Dunmore, of the National Bureau of Standards. This receiver includes four radio frequency amplifier stages and is designed for operation between 175 and 300 mc.

How The B.B.C. Regards Television

A considerable amount of space is devoted to television in the B.B.C. Annual, which was published recently. Many matters regarding the likely trend of development are discussed and as these appear in the B.B.C. official publication they may be taken to be representative of B.B.C. ideas. These, it will be noted, coincide to a very great extent with information that has already been given in recent issues of this journal.

THE television section of the Annual opens with a brief history of the B.B.C.'s association with television from the days of the commencement of the old thirty-line transmissions. Of these it says:—" Late in 1929 the B.B.C. undertook to radiate a regular but limited service of low-definition television, using a system which had been developed by the Baird Company. These transmissions emanated from the Baird studios. In 1932 a studio was equipped in Broadcasting House from which these transmissions were continued. This must not be confused with high-definition television—the number of lines per picture was only 30 and the number of pictures per second 12½. These transmissions, although regular, were in the nature of an experiment because the possibility of providing attractive programmes was questionable; on a 30-line basis, it was only possible to give a kind of impressionist reproduction with very little detail. At the same time the low number of complete pictures per second caused an unpleasant " flickering " effect.

In the meanwhile research was being carried out by the Baird Television Company, by Electric & Musical Industries, Ltd., and other firms, with the object of perfecting systems removing these serious defects.

The low-definition service was transmitted on an ordinary broadcasting wavelength (261 metres), this being possible only because of the small number of lines per picture and pictures per second. In order to increase the definition sufficiently it became necessary to use several times the number of lines per picture, and to reduce " flicker " the number of pictures per second had to be at least doubled. This necessitated a corresponding wider frequency band for transmission, so that an ordinary broadcast wavelength could no longer be used. However, by this time considerable progress was being made in the technique of transmission by ultra-short wavelengths, that is to say, those between, say, 5 and 10 metres, and on such wavelengths it is possible to transmit the wide band of frequencies necessary for this improved form of television, now usually called —rather vaguely—high-definition television.

Demonstrations were given to the B.B.C. by the two firms mentioned above, and it became obvious in 1933 that considerable progress was being made. It was not, however, clear exactly how a public service of this kind of television could be established, or even whether it was justified, particularly in view of the high cost to the broadcasting authority of producing programmes, and the high cost of receivers to the "viewing" public.

Accordingly the Postmaster-General appointed a committee to examine the whole situation, and to recommend whether or not a service should be established, and if so in what way.

This committee first met in May, 1934, and presented a report in January, 1935, which, very briefly, stated that research had reached such a stage that a regular service of high-definition television could be contemplated, and that there were two systems in this country which had reached a high standard of development, namely, that of the Baird Television Co., Ltd., and the Marconi-E.M.I. Television Co., Ltd., respectively. It recommended that a station should be established in London only to begin with, in order to examine, under service conditions, the relative merits of these two systems, at the same time providing a service for the public in the London region.

Shortly after the report was adopted the Postmaster-General appointed this Advisory Committee.

The committee began its work immediately, one of the first tasks being to choose a site for the London television station. Technically it is necessary for a station using ultra-short waves to be located on high ground, and this, of course, limited the choice of site considerably. Ultimately the Alexandra Palace was chosen.

It ultimately appeared to be desirable to allow each company to adopt for their system different technical data relating to the number of lines per picture and the picture frequency, in order that a true comparison of the merits of the two systems could be made.

Alexandra Palace

As already indicated, each system, besides using its own studio apparatus, will use its own transmitter, and there will be a third transmitter common to both for transmitting the accompanying sound. The wavelengths or frequencies to be used are 41.5 megacycles per second for sound (7.23 metres), and 45 megacycles per second for vision (6.67 metres approx.). The contracts were concluded about the end of August, 1935.

In the meanwhile extensive reconstruction has been carried out at the Alexandra Palace in order to provide the studio accommodation for each system, with the necessary dressing rooms, offices, and so on. At the same time a steel tower is being erected on the top of one of the four brick towers which already exist at each corner of the building. The height of the top of the mast above the ground is approximately 300 feet, and the ground itself is 306 feet above sea-level. Thus the aerial will be raised about 600 feet above sea-level, some 200 feet higher than the cross on St. Paul's Cathedral.

The transmission, while giving the first programme service of high-definition television, will be experimental to the extent of providing very valuable data on which to base future developments.

Programme Question

As to the programme side of the future service, experiments have been going on throughout the " low-definition " period in the intricate and difficult details of programme choice and presentation, details which at one end merge into the purely technical field and at the other in the broad questions of the artistic and social role to be played by television.

In the present and tentative phase it is possible to visualise the main characteristics of the programmes.

B.B.C. IDEAS ON THE FUTURE OF TELEVISION

Individual items will be short, to avoid fatigue and eye-strain, as considerable concentration will be necessary. Television cannot be a background to other occupations. A wide field of entertainment must be covered, but the more intimate cabaret type is more likely to be successful than the broader music hall material. News may at first have to be covered by commercial News Reel and Magazine films and by brief talks capable of illustration by film or other means. Serious musical activities and long and complicated dramatic productions must for some time remain a function of sound broadcasting only. There will be opportunities for topical and semi-topical programmes, and there should always be a demand for informative demonstrations of the latest achievements of industry and technology.

The Future

As to the future, it may be anticipated that as in the case of sound broadcasting, the curiosity value of the successful projection of pictures will soon pass. But it is hardly possible to imagine that television in its full development will not more profoundly affect both communications as such, entertainment, and, what is more important still, education in its wider sense.

Speculation, if it cannot at present harden into positive assertion, can at any rate take shape in questions. How far will *normal* programmes come to consist of both sound and visual elements? Will the listener of the future, for example, watch an orchestra playing throughout an entire concert, or will his listening to their music be merely reinforced by vision from time to time? Will talks be accompanied by continuous or by intermittent pictures, showing the speaker or documentary material illustrating his theme, or a combination of both? What will be the effect on speakers, if they have to consider the appearance which they are presenting to unseen audiences, as well as the effect of their voices upon them? Will listeners find difficulty in reconciling the discrepancy between the sound of a normal voice and the sight of a miniature portrait such as can alone be viewed on the television screens of the present day?

In sound broadcasting, experience has disclosed something like optimum lengths for different sorts of programme unit. Will television modify these? Will two tendencies emerge in programme presentation—one in which vision will be regarded as primary, one only relieved by a subordinated theme of sound; the other in which sound continues to predominate, with the occasional reinforcement of vision? It is at least easy to imagine that (to take two extreme examples) the former type would be most suitable for the report of a football match, the latter for a poetry reading. Between these two extremes, however, come all the nuances of variety, drama, light music, etc.

The coming of television already casts before it, in the shape of questions to be studied and answered by experiment, the shadow of a wide range of artistic and personal problems. They have merely to be suggested, by such examples as have been mentioned above, for it to become evident that their solutions, and the interaction of each partial solution with the rest, will for a long while tax the powers, no less than they will engage the interest, of all concerned.

This much, however, may be said at once, as it is of general application. More than ever, the listener who wishes to obtain reasonably full value from his set will be called upon to make and keep appointments with it; in other words to study the published programmes selectively, and to give an undivided attention to those items which he chooses for his entertainment or instruction. The habit of switching-on vaguely on the chance of finding a pleasant musical background to other activities would have to be modified. For topicalities of certain kinds, world events, and so on, film backed by explanatory descriptions will almost certainly be the originating medium for many years. The organisation of a world service of directly televised news is a formidable and, at present, quite impossible prospect, tempting as are the vistas it discloses of wider mutual understanding among the peoples. There will also be the vastly important problem of an Empire Service to consider.

There is nothing static about television; progress will be continuous; fundamental changes in method of operation are always possible. Apart from the necessity constantly to improve the quality of image reproduction, the problem of finance will probably be for long a source of anxiety. The more successful the service, and the more rapid the expansion, the greater will be the programme cost and the more pressing the demand for a continuously wider spread of service area.

It is certain that when the service shall have emerged from its experimental stages, the community as a whole will not take kindly to a system favouring a comparatively small portion of it. Civic pride will also be a factor of some importance. But the high cost of television makes complete Regional programmes as at present understood unlikely for many years, but local activities will eventually come into their own. The trend will probably be towards a main national programme interspersed with items dealing with regional activities, derived from regional sources. As things are at present, the area coverage of television programmes waits upon either a satisfactory solution of difficulties due to the limited range of ultra-short waves, or the installation of a network of special and costly co-axial cable.

Inventions with revolutionary implications have usually necessarily to encounter both inertia and direct opposition. There is widespread apprehension in certain quarters about the effect of television, though there is no reason to suppose that it will adversely affect any enterprise or interest that refuses to be static. Extravagant statements have, however, found their way into print and it will take time before the consequent fears and prejudices can be allayed. Optimistic prophecies of an entirely televisionary world can only add to difficulties already considerable and to general disappointment. Enthusiasm must be tempered by a cool and critical awareness of present limitations, and of the immense labours still required before television is comparable in technique and scope with sound broadcasting.

The Annual, which is profusely illustrated, will be useful to broadcast listeners as a book of reference, as it contains a wealth of information on B.B.C. activities. Its price is 2s. 6d.

Our Readers' Views

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

"Hush-Hush"

SIR,

It seems strange that the transmitting side of television is being discussed almost every day in almost all the technical journals dealing with such matters, and the general public or rather " the man-in-the-street " is being blamed for their " evidently lamentable " ignorance concerning television.

A little thought would perhaps tell those " know-alls " that the constant hush-hush and secrecy regarding any receivers for the television public is making the poor "man-in-the-street" think that there ain't such a thing as television.

Secondly, there is complaint regarding the series " Recent Ultra-short Wave Developments " (February and March issues). With due apologies to Mr. Microwave, I venture to state that this habit of trying to produce these mechanical analogies for explaining physical phenomena does very little for the student except being spectacularly obstructive to the freedom of mind he must possess to be able to argue his newly acquired knowledge into his intelligence. The analogies given here are very instructive and straightforward, but what do they signify?

Those concerned intimately with the investigation of the positive-grid or B-K type of oscillation or the magnetron (split-anode) oscillators are themselves at sea with the different possibilities for the mode of these oscillations, and what is done here is to push down the throat of the readers the already fixed notion of Mr. Microwave.

Considering the beginners it is perhaps a worse crime to gulp these biased opinions of one while they probably could otherwise with an open mind be instrumental in producing the correct explanation of these phenomena.

We should do well to remember that trying to explain by mechanical pictures the different electrical phenomena, reducing the laws of physics to the fundamental principles of dynamics is rather a fruitless task. Of course, if there is only one solution of the problem then it cannot be bought too dearly, but the case is rather different here.

It is only because one appreciates the standard of your journal and its importance in one's work that I send this note. I hope Mr. Microwave will see my point and if you can publish this note I shall be interested to read the opinion of the other readers of your paper.

P.K.C. (London, N.5).

"Lack of Control"

SIR,

My attention has been drawn to your reference to my remarks at the recent meeting of the Radio Industry Luncheon Club. The quotation from my speech is quite correct and my remarks are, I feel, quite justified.

If I may encroach upon your space, I would like to explain what was behind my remarks.

Firstly, it is generally recognised in the industry that the initial burst of publicity given to television on the

(*Continued on next page*)

appearance of the Television Report, had a definitely undesirable effect for some time on trade in ordinary radio equipment.

The trouble, as we all now realise was not that information should have been withheld from the public, but that the information given to the public should have been strictly correct. The radio industry had everything to gain and nothing to lose from the public's knowing the exact position on television development.

Unfortunately, however, the appearance of this Report did not appear to be anticipated by the industry and where the Press might have been warned of the injurious effects of loose statements on the future of television, they were actually left to place their own rather imaginative interpretation on the report, with the result referred to above. Even since then, certain responsible newspapers have printed entirely misleading stories in connection with television, but have always gone to considerable trouble to rectify the matter when their inaccuracies have been drawn to their attention.

This definitely proves the point that I was making at the time, that someone within an industry should be responsible for giving the Press correct facts relating to that industry and for anticipating any misconstructions which the Press may place upon events or reports around which they write.

G. J. FRESHWATER (London, W.1).

"Building a Cathode-Ray Exciter Unit"

(*Continued from page* 299).

to include a switch in the negative lead of the H.T. if the tube heater winding is used in order to allow the heater of the cathode-ray tube to come up to the proper temperature before the high-tension is applied. At the point X a fuse can be inserted according to load conditions.

When the unit is completed the tube can be tried out. First of all connect all the deflector plate terminals together and also twist the same wire round the anode pin of the tube base so that the deflector plates and anode are connected together; next switch on the rectifier valve, then the tube filament supply, and finally the tube H.T. A spot of light should now appear on the screen, but this must not be allowed to remain stationary for more than a few moments as otherwise the fluorescent screen will be damaged.

The D.C. peak output is 3,500 volts at 2 milliamps. All the components for this unit can be obtained from the Mervyn Sound and Vision Co., Ltd., 4 Holborn Place, London, W.C.1.

The Scanning Circuit for Beginners

(*Continued from page* 290).

of the condenser is not instantaneous, and the time occupied by the return is therefore deducted from the time taken to draw the last line. When pictures are being received this line (called the "flyback") will not be noticed as the synchronising signal will be dealt with in a later article.

The photograph of Fig. 6 shows a simple scanning circuit made up on the lines of Fig. 2. The various parts are labelled and the two charging condensers are then in the centre of the baseboard. Each relay is provided with a separate bias battery, although in practice these would be dispensed with. The terminals for connecting to the deflector plates are shown marked A_1, B_1, etc.

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