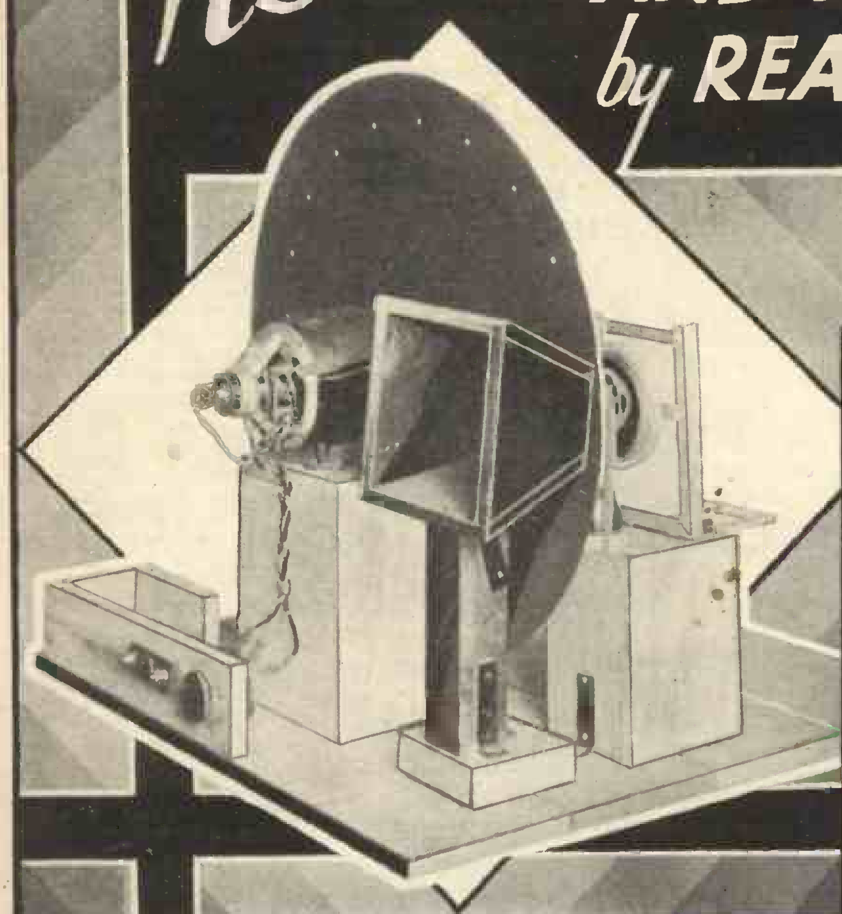
TELEVISION for BEGINNERS A NEW SERIES By BARTON CHAPPLE

PRACTICAL TELEVISION

6D

Visors DESIGNED AND MADE by READERS



CONTENTS.

MARCH, 1935.

GEORGE NEWNES LTD. LONDON

PRACTICAL TELEVISION

Editor: F. J. CAMM

Vol. I MARCH, 1935 No. 7

CONTENTS

SUBSCRIPTION RATES:
Inland and Abroad 7s. 6d. per annum
Canada .. .. 7s. per annum

Registered at the G.P.O. for transmission by Canadian Magazine Post.

Editorial and Advertisement Offices: "Practical Television," George Newnes, Ltd., Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 7760. Telegrams: Newnes, Rand, London.

The Editor will be pleased to consider articles suitable for publication in PRACTICAL TELEVISION. *Such articles should be written on one side of the paper only, contain the name and address of the sender, and preferably be typewritten. Whilst the Editor does not hold himself responsible for manuscript, drawings or photographs, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL TELEVISION, *Geo. Newnes, Ltd., 8-11 Southampton Street, Strand, W.C.2.*

TELEVIEWS

Television Programmes This Year!

THE highly satisfactory report of the Television Committee, summarised on other pages of this issue, confirms to an almost remarkable degree our own analyses and forecasts as given in recent issues of this journal. We advocated high-definition transmission of 180 lines *or more*, the cathode-ray system, the introduction of a network of television transmitting stations, the use of sound-on-film for the early transmissions, the pooling of patents, the continuation of the 30-line system, the erection of the first station in London as a preliminary test of the selected systems, delayed television, and stated that satisfactory television could not be obtained from any purely mechanical system.

"P.T." Correct in Every Particular!

Our forecasts were not wrong in any one particular, and it is indeed satisfactory to know that, almost alone of the technical and daily Press, we so accurately anticipated the trend of events in the new science. Whilst the Press were stating the reverse, last month we unequivocally stated that television would without doubt arrive this year. The daily papers, and even responsible people in the radio industry, stated only a few days before publication of the Report that television was many years distant! We now know that it has reached such a state of perfection that a station is to be erected and in operation this year, and that others will follow as a result of the experience gained. Home constructors will be in the enviable position of being the first to enjoy the programmes, and for but a fraction of the cost of the commercial vision receivers, which will doubtless be on sale at this year's Radiolympia.

A New Industry Created

The Report virtually creates a new industry; it settles the rumours, speculations and uncertainties, and will act as a terrific fillip to the radio industry. As we put it in our first issue—the missing link is forged! The Report is an historic document, and worthy of the extended space we have accorded it. The Committee has thoughtfully made sensible recommendations as to the future—notably that an Advisory Committee should be appointed to advise the B.B.C., who will be the Authority to operate television, and are to be indemnified on the patent question. It suggests that the difficulty of serving the whole country with vision programmes can eventually be surmounted by a relay service, that there should not be any increase in the listener's licence fee, that the Baird and E.M.I. companies be given equal opportunities of supplying apparatus for the operation of their systems (both of which must be suitable for standard receiving apparatus), and that licences for the manufacture of television receiving apparatus be granted to responsible firms forthwith.

Price

The price of receiving apparatus, it states, should not be unreasonable. Early models will, of course, be expensive (£50 at least), but when production catches up with demand this should be considerably reduced, one is promised at £30. The home constructor awaits the production of a reasonably priced cathode-ray tube and associated time-base equipment. The important thing is that television is here!

SIMPLE TELEVISION RECEIVER SUGGESTIONS

Because of its inherent simplicity and cheapness the disc Television Receiver provides a useful introduction to the subject for readers who are making a start on Television reception

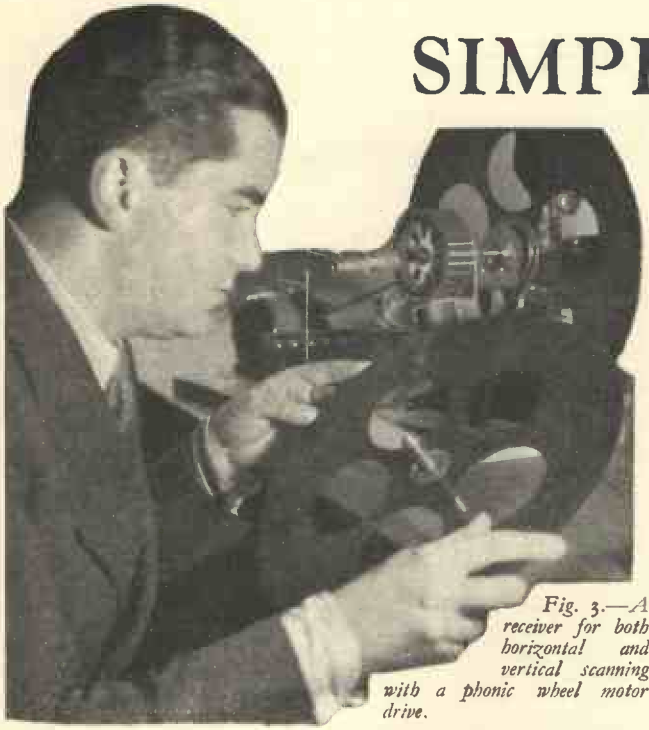


Fig. 3.—A receiver for both horizontal and vertical scanning with a phonic wheel motor drive.

THE essential components required to enable one to look in are merely a motor, disc, resistance control, neon lamp and magnifying lens. In the case of the first-named, quite successful results have been obtained by using fan motors (rewound to give the correct speed or attached to the disc shaft by a belt drive), sewing machine motors, Klaxon horn motors, etc. While it is admitted that the best results can only be expected when a specially-designed motor similar to those advertised in this journal is used, do not delay your initial work if a cheap second-hand motor is available. The same remarks apply to the other items of the equipment, and these few notes and suggestions are compiled for the purpose of showing how the simple but complete receiver designs can vary to suit individual taste or ingenuity.

The First Machine

The design shown in Fig. 1 has quite a good professional finish. Here the driving motor is completely encased and supported on an inverted V-form of metal stand. The disc has the usual blackened rim, but has not been lightened by having sectors cut away as is the usual practice. On the right and behind the disc is a flat-plate neon lamp, and the correct height for this has been obtained by mounting it, together with the bayonet holder, on a right-angled metal bracket.

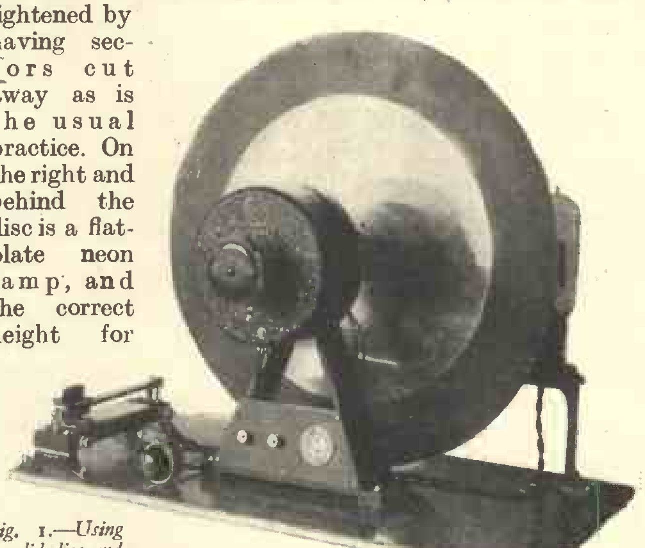


Fig. 1.—Using a solid disc and encasing the motor. A push-button brake is incorporated in the large knob.

The motor derives its power from the mains, the long sliding resistance on the left acting as a coarse speed control, while the small rheostat serves as a fine speed regulator. Even with this device (and in the absence of some form of automatic synchronising) it is often difficult to maintain the disc at its synchronous speed of 750 revolutions per minute. A further refinement has therefore been added by the constructor of the machine illustrated, this being a push button in the centre of the large knob in front of the motor casing. By periodically pressing the finger against this button a braking effect is applied to the end of the motor shaft, and with properly-timed pressures any tendency for the image to hunt or slip away can be corrected after one has acquired a little practice in the operation. No magnifying lens has been included, so the image area size is exactly that built up by the disc holes, which in the case of a 20 in. diameter disc is about $1\frac{3}{4}$ in. high and $\frac{3}{4}$ in. wide.

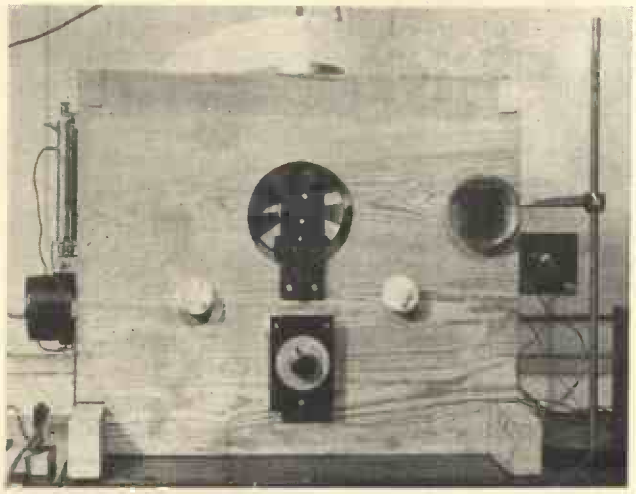


Fig. 2.—A receiver built up on very experimental lines and having a stroboscopic speed check

Another Arrangement

The arrangement shown in Fig. 2 is of a somewhat different character to that just described. A vertical wooden panel, with two thick crosspieces at the bottom, almost completely screens the disc, motor and lamp. On the right-hand edge of the panel is a rheostat for the purpose of controlling the luminosity of the neon lamp fed from an external source of voltage. This is always advantageous, for it enables the user to conserve current when desired, and bring his images to the degree of

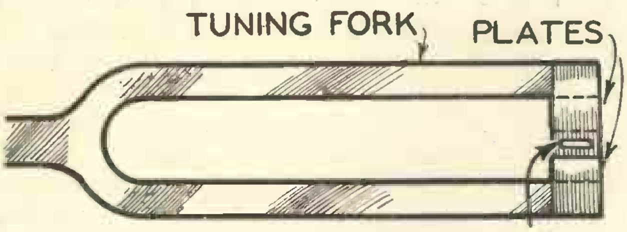


Fig. 4.—A tuning fork, with two small plates attached as shown, is used for observing when the motor and disc are running at their correct speed.

brilliance which is so often governed by the number of people who want to look in at one time. The magnifying lens is of the reading type, being held in a clamp on a vertical metal rod. In this way the correct focusing position can be found very easily, while different size lenses or combinations of lenses can be tried at will to find that which suits conditions best.

The white knob below and to the left of the magnifying lens is for switching the neon lamp on and off, while its "neighbour" on the left is the motor switch. On the left-hand edge of the panel is the coarse motor-speed resistance, the centre rheostat and dial acting as the fine motor-resistance control. In the centre of the panel a circular hole has been cut out to render the stroboscope visible. The rectangle ebonite mask conceals a small neon lamp lit from the 50-cycle A.C. mains, the observer adjusting both coarse and fine resistances until the black-and-white sectors give the optical illusionary effect of appearing quite stationary.

Ingenious Speed Observation

Another form of assembly which has several points of interest to the home constructor is shown in Fig. 5. Here, again, a mains motor is used to drive the scanning disc, but the motor is a very small fractional horse-power one, while to cut down the mains voltage to the value required to rotate the armature at its correct speed, a lamp having a blackened glass bulb is placed in series with the mains feed. In addition to this is the usual variable resistance, while on the right of the baseboard is the single lens and mount, together with a control for varying the current through the neon lamp.

The most interesting feature, however, is the stroboscopic arrangement for observing when the motor and disc are running at their correct speed. Instead of the more usual sectored disc being observed with neon lamp flashes superimposed upon it, a tuning fork having slotted vanes at the ends of its prongs is employed. A fork of this nature is shown in Fig. 4. Two small and thin plates are attached to the fork, these plates having a single slot in each, so that when the fork is stationary the two slots coincide exactly.

If, now, a pattern is drawn on a small disc (cardboard or metal) which is secured to the end of the disc shaft, true synchronous speed will occur when the pattern, as observed through the vibrating slots, appears to be stationary. As in all stroboscopic methods, there is a definite relation between the disc speed, fork frequency, and the marks drawn on the chart. This is expressed as a very simple formula—namely :—

$$\text{Disc Revolutions per second} = \frac{\text{Fork Frequency}}{\text{Number of Marks}}$$

If the tuning fork which is used has a musical frequency which will not enable an exact number of marks to be calculated for the disc, then its frequency can be altered slightly by sliding on the fork—a movable weight. The position of this weight should be found by experiment, bearing in mind that the nearer the weight is to the ends of the fork legs the slower the vibration or lower the note pitch. For example, if a fork of middle C frequency is used, that is 256, then if this is reduced to 250 by the small weight, using the formula just given, the number of marks on the stroboscopic disc will be 20 for a speed of 750 revolutions per minute, which of course is the speed of the B.B.C. transmissions.

A Universal Receiver

Knowing that there are occasional low-definition television transmissions from the Continent using horizontal scanning, some experimenters have built up a single receiver capable of producing images from the English or Continental stations. An example of this is shown in Fig. 3. In the illustration this disc has been lightened by cutting out 5 circular blanks, while a small neon lamp and stroboscopic card positioned as shown serve to give speed indication.

The motor is not a standard one, being a phonic wheel type. The amplified pulsations derived from a time-controlled local oscillator or from the synchronising pulses included in the picture signal are fed to a 2-pole field. This drives a large toothed wheel, somewhat like the cogwheel of a standard magnetic synchroniser and is capable of giving extremely good results when properly designed.

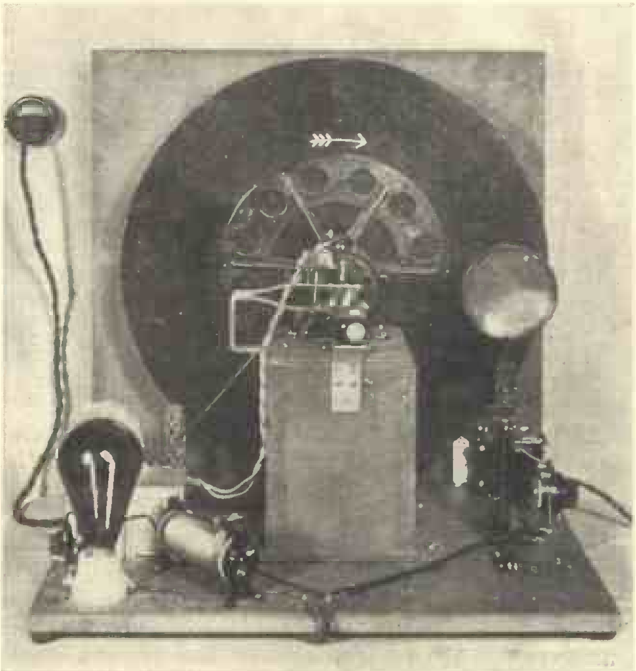


Fig. 5.—The outstanding feature of this design is the tuning fork for speed observation.

VISORS DESIGNED AND MADE BY READERS

The Visors described on this page and made by readers incorporate a number of novel features that may prove helpful to other readers desirous of making their own Visors.

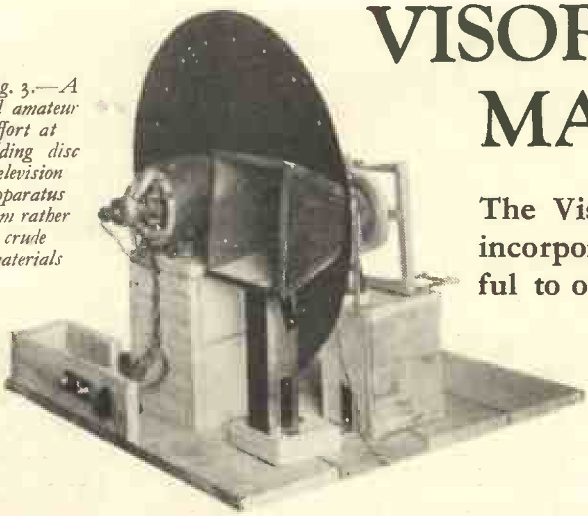


Fig. 3.—A good amateur effort at building disc television apparatus from rather crude materials

THE image, as it is built up by rotating the spiral of holes in the disc before the modulated neon glow of the lamp, is limited in its size by the dimensions of the disc. For example, with a disc having an external diameter of 20 in., the actual image area size will be found to be $1\frac{3}{4}$ in. high and just over $\frac{3}{4}$-in. wide. For most practical purposes, this is too small to watch for any length of time, without eye strain, so a lens or pair of lenses must be mounted before the image so as to enlarge it optically.

Do not attempt to magnify the image too much, or with the present 30-line transmission it will lose definition. A limit of four to five times will, as a general rule, be found ample. Suitable lenses may be obtained from our advertisers.

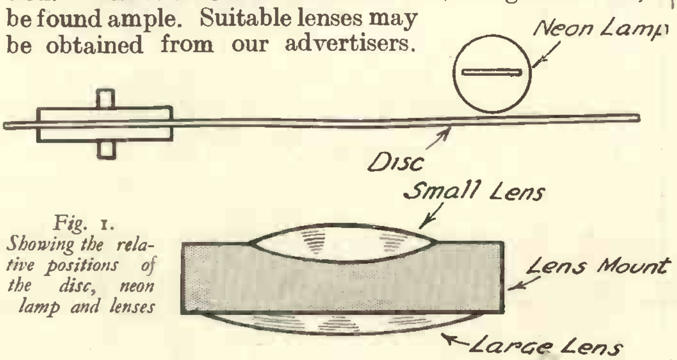


Fig. 1. Showing the relative positions of the disc, neon lamp and lenses

An ordinary reading glass will serve, but usually a combination of two lenses will be productive of better results. One very good combination is a 6 in. diameter single-convex and one 4 in. double-convex with focal lengths of 17 in. and $11\frac{1}{2}$ in. respectively. These should be clipped or fixed to a mount, 1 in. apart, with the smaller or double-convex lens nearer the disc, and the larger or single-convex lens farther from the disc. This is shown in Fig. 1, and the exact distance of the mount from the disc itself can be ascertained by observation, but about $2\frac{1}{2}$ in. will be found to be the approximate distance.

Assembling the Components

The assembly of the various components is quite a straightforward matter, and should present no difficulty to the reader. Of course, the layout may be varied according to the taste of the constructor, but in every case one or two points must be observed. First of all, screw the motor to a wooden mount so that when the disc is placed on the shaft, it will clear the table or bench on which the mount is resting. One example of this is shown in Fig. 2. The neon lamp must be fitted in the usual type of bayonet-type holder at the back and on the right of the disc, so that the centre of the neon glow area is on the same horizontal line as the motor shaft, and coincides with No. 15 hole in the disc. This precaution will ensure that the whole light area will be scanned by the disc apertures as they rotate. Care should be taken to mount the disc the right way round on the motor shaft — that is, when facing the front, the spiral of holes should progress towards the centre in a clockwise direction. Then, if the motor is made to rotate in an anti-clockwise direction, the scanning mov ment will be as the B.B.C. standard—namely, hole movement bottom to top and strip movement right to left.

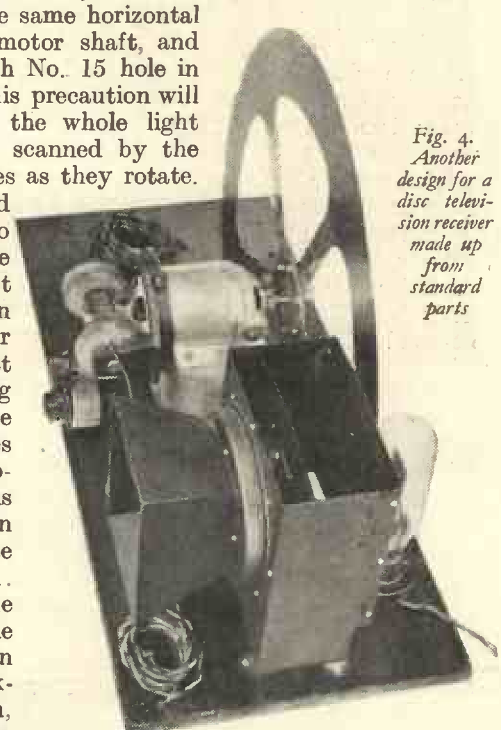


Fig. 4. Another design for a disc television receiver made up from standard parts

We shall illustrate and describe, in later articles, Visors made and designed by our readers. Will you send us a description of yours?

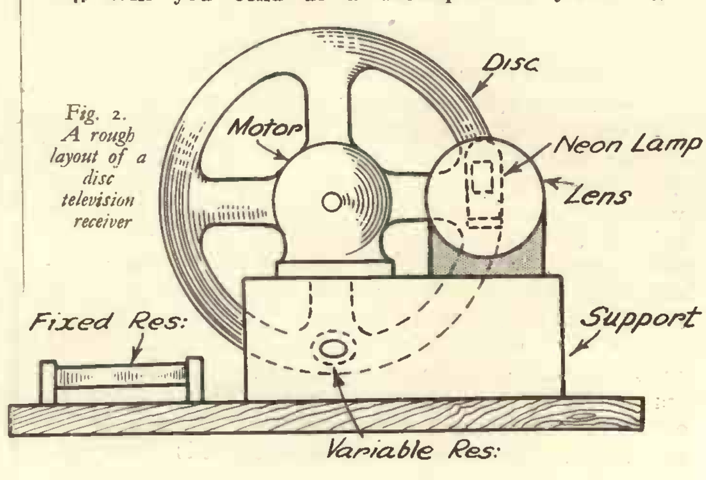


Fig. 2. A rough layout of a disc television receiver

TELEVISION FOR ALL.—1

By H. J. BARTON CHAPPLE, B.Sc.

A New Series describing the Principles of Television Transmissions and Reception in the simplest possible language

Fig. 1.—The arc lamp and rotating-disc mechanism of the Baird high-definition light-spot scanner

Fig. 2.—Using the Baird intermediate-film high-definition scanner to televise an open-air scene of horses at jumping practice.

IN spite of numerous articles which have been written on the subject of television, coupled with a few published books, there is still a marked ignorance among the general public as to what it means or how it works. Then, again, a measure of confusion has arisen because of misleading statements made in the daily Press within the last few months concerning the relation of radio and television.

Now that the Television Committee have made known their long-awaited report concerning the recommendations for the inauguration of a television service, which it is felt will sustain public interest, it is opportune to explain the principles of television transmission and reception in the simplest possible language. In this way, readers of this journal can familiarise themselves with what is admittedly quite a new technique and one which promises to extend considerably the measure of home entertainment.

Television Summarised

First of all, then, television may be described as the transmission of scenes or objects (at rest or in motion) to any distance as an electrical signal, using as the medium for transmission either a wire or radio link, and their reproduction at the receiving point as images built up in a transitory visible form having the appearance of pictures of varying light intensity. At first sight this may read a trifle complicated, but shorn of technicalities one can regard it as a means of watching what is happening at a distance just as if we were eye-witnesses on the spot, but employing electrical and optical methods of communication. It is not some wonderful form of telescope such as can be used for optically extending the normal vision limits of the eye, or anything which will destroy privacy.

At one end, in the chain of events, must be a specially-designed piece of television transmitting apparatus, the form taken by this apparatus depending upon the nature of the subject it is desired to transmit. This apparatus has the property of converting or translating the "scene at which it looks" into an electrical signal by methods which will be described later.

The signal, a continuously-varying one, somewhat similar in character to that generated at the output end of, say, a broadcasting studio, is then occasionally transmitted along cables to the receiving end, but more generally radiated into space by modulating—that is, altering the amplitude of the electron-magnetic carrier wave of the radio transmitting station.

At the Receiving End

To obtain intelligible results at any point within the range of these "wireless waves," it is necessary to have a radio receiver and amplifier to detect and increase in amplitude, that is, make stronger, the signals picked up by the aerial. From the radio receiver these signals are now fed to a television receiver constructed in one form or another. Here, owing to the nature and properties of the equipment included in the receiver, the signals are reconverted from their electrical form, which is invisible but audible in 'phones or a loud-speaker, to a visible form on a large or small screen so that the eye is stimulated and able to recognise the pictures quite clearly.

In some cases this process of sight transmission is instantaneous as when direct television methods are employed, while in others there is a slight delay (only a matter of seconds, however) between the time of the action taking place at the transmitting end and its final reproduction as a picture at the receiving end.

A Common Condition

It will perhaps simplify the whole process of television if attention is now turned to a condition which is common to every form of television, irrespective of system. This may perhaps be understood best if for a moment we consider nature's own television system, a system which has been copied in a crude manner but never equalled for the quality of its reproduction. I refer to the eye or normal sight of every able-bodied individual.

Here we have direct vision pure and simple, and to all intents and purposes we can view any scene as a whole, confining that scene to quite a narrow compass or embracing a wide vista, if, say, we stood at the top of a hill and viewed the countryside spread out below. Now how can the eye " see " in the broadest sense of the term ? Apparently we observe the scene as a whole, but strictly speaking, what happens is that the object or scene, whether stationary or moving, reflects light (obviously our eyes are useless in complete darkness and only operate when light, either dim or brilliant, illuminates the scene).

Neglecting for a moment any question of colour differences, as this does not enter into our description for we are only concerned with monochromatic television, this light reflected from the scene observed is focused by a " lens " in the eye on to what is known as the retina. This is shown in the diagrammatic eye section of Fig. 3, and the light variations stimulate nerve cells connected to the brain. The retina cells are what is termed light sensitive, and although finite in size, are extremely minute, since there are millions of them on each retina surface.

Granular Structure

The perception of the scene under observation has, however, been brought about by this granular breaking up of the scene into infinitesimal light values, and in every television process a similar " breaking down " of the scene's light values has to be made before it can be transmitted as a signal.

Section by section, not as a series of pulses, however, but as a continuously varying effect, in a predetermined and ordered sequence, every picture or image has to be " explored " in order to interpret its relative light value. This is known as the process of *scanning*, and when one or more individuals are scanned they can be conscious of the process or have no knowledge of it taking place, according as to which of several scanning methods is employed. As an example of conscious scanning, reference can be made to Fig. 1, which shows a section of what is known as the light spot scanner. As will be shown later a high-powered arc lamp, together with a rapidly rotating disc perforated with a series of small apertures, produces a tiny spot of light visible to the eye, which moves over your features and so produces a television signal.

In Fig. 2 is illustrated the Baird intermediate film television scanner located in its own camera room, while through the open window is shown an exterior scene of horses preparing to jump over a gate, with the Crystal Palace building in the background. The scene within the compass of the camera lens is photographed on a film, and after a developing and fixing process lasting only thirty seconds, this is televised as a film negative. In this case the scanning operation is not a visible effect to the person being televised, as we shall see later.

An Ordered Effect

Reverting now to this important problem of scanning and bearing in mind the question of eye stimulus by light effects of a granular character, it is necessary to see how television apparatus can be made to carry out a similar operation. The relative brilliancy of each grain in the scene has to be transmitted, and it should be obvious, therefore, that the finer the grain into which the scene is dissected, the better will be the detail in the final image watched.

This will be appreciated if the reader takes any photograph, say one of the illustrations accompanying this article, and cuts it up into vertical or horizontal strips, each of the same width. With thirty strips, the detail is rather coarse unless the photograph is, say, just the head and shoulders of an individual. This corresponds to the conditions of the present low-definition television service, and will show the method is really only fitted to the presentation of " close-ups " if detail is required.

Dividing the same illustration up into 240 strips, however, will give a grain equal to that which is recommended by the Television Committee for the first high-

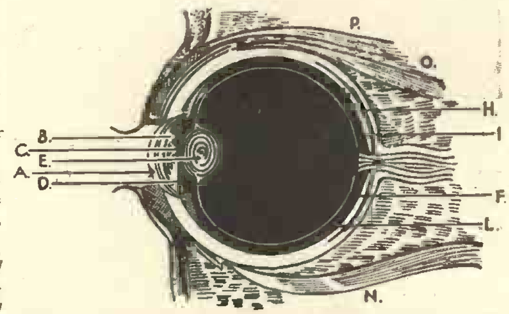


Fig. 3.—A representation of nature's television system:—the eye. (P,O,N) muscles of eyeball. (A) cornea, which closes the front of the anterior chamber (B), which is filled with aqueous humour, and the back wall of which is formed by the curtain of the iris (D). In the middle of the back wall is the opening of the pupil (C), through which is seen the lens (E). Behind the lens is the posterior chamber (L), filled with vitreous humour. Entering the eye from behind is the optic nerve, which is distributed to the retina. The posterior wall of the eye shows from within outwards the image-forming retina, the dark choroid with blood vessels (I), and the firm, protective sclerotic (H)

definition television service—technically known as 240 line scanning—and if we imagine each thin strip divided into equal square elements for comparison purposes, it is apparent that a picture built up in this way has quite a wealth of detail.

One Method

How, then, can this process of scanning be effected by electrical, mechanical or optical means, or better still by a combination of all three ? Perhaps the simplest to assimilate is that known as the light spot method, due originally to the invention of Mr. J. L. Baird. The scene or object, whether large or small, is scanned by a single square spot of light in ordered sequence. If the area to be transmitted is a large one, then the spot of light for a given degree of television definition will be much larger than would be the case for the televising of a small scene or object with the same degree of definition. With television it is not a case of dissecting the picture into so many lines per inch, but into so many lines for the whole scene.

(To be continued.)

ANTI-PHASE TELEVISION SIGNALS

This Article Deals with Phase Changes, and Their Effects on the Television Signals

FROM questions which readers continue to ask, it would appear that considerable confusion still exists on the question of phase changes, and their effects on the television signal or the image seen in the receiver. The greatest difficulty concerns the anti-phase effect, or, what is more generally termed technically, "a phase displacement of 180 deg." Various reasons have from time to time been given for this, but the simple explanation which follows should help to clarify the situation.

Light Changes at the Transmitting End

To grasp the essentials it is necessary, first of all, to consider briefly what happens when the television signal is generated at the transmitting end. In the case of the transmission of a talking film, the individual pictures of that film are projected by means of a brilliant light source and lens system on to a small area near the edge of the disc, so that the minute apertures in the disc can pass across the pictures as the disc revolves at high speed. Depending on the degree of opacity of each section of the picture, varying degrees of light will pass right through the disc to the other side. That is to say, the sections of the picture which we term bright will allow a relatively large amount of light to pass through, while the dark sections will reduce this to a small quantity with corresponding quantities for the intermediary shades.

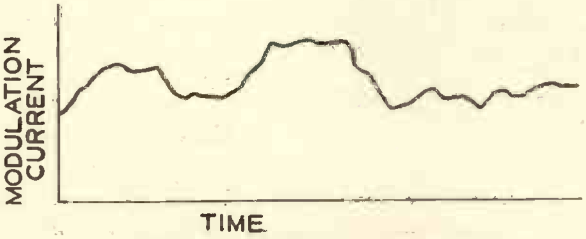


Fig. 1.—Illustrating simply the modulating current produced by a television signal

The photo-electric cell on to which this continuously varying light is focused will, in consequence, convert the high lights to a strong electrical signal, and the dark portions to a signal of low intensity.

A similar state of affairs, as far as the television signal is concerned, exists in the case of a light spot transmitter. Here a minute spot of light of constant intensity passes over the object or scene to be televised so that it explores the whole area. At any one instant, therefore, a certain proportion of the light on the minute area of illumination will be *reflected* and so influence one or more photo-electric cells arranged in convenient positions round the scene or object. A bright or highly reflective (relatively speaking) surface will give a correspondingly high signal from the cells, whereas a dull or poorly reflective surface will produce a much fainter signal, and so on for intermediate shades.

In both types of scanners mentioned, therefore, there is a very distinct and proportional relation between the degree of light and shade in the initial signal televised, and the corresponding signal generated by the photo-electric cell, whose function is to convert the light variations to electrical variations.

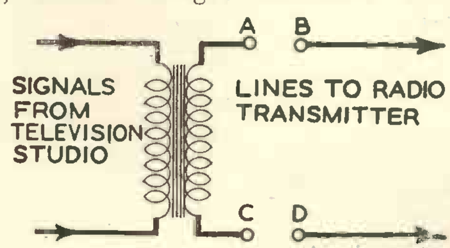
Inversion

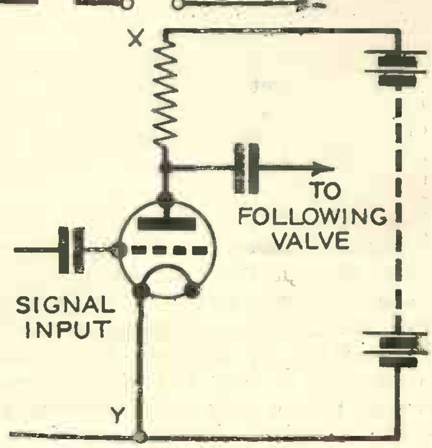
The effect of this is to give a continuously varying signal, or what is better termed a modulating current, which can, for the purposes of explanation, be shown as a simple undulatory curve as in Fig. 1. The rises and falls will correspond with the light and dark portions of the picture respectively, and as there is present the generated proportionality, it is essential to maintain this throughout the chain of events which occurs before the televised scene is watched as an image in the receiver. The penultimate stage must, however, not only maintain the variation proportions of Fig. 1, but the current direction must be the same.

If a reversal occurs through some effect, then a negative picture will result provided the inversion is complete (generally referred to as a 180 deg. phase displacement). Taking the case of a simple neon lamp disc receiver by way of an example, the effect just stated would give the correct current modulating amplitudes to the lamp, but it would glow darkly for the televised high lights and brightly for the dull sections of the picture. This gives the same result as an ordinary camera plate from which a photographic contact print is being made, and it is therefore essential to know how this reversal of phase can occur and what steps can be taken to counteract it.

Transformer Reversal

Consider, then, first of all, the case of a low-frequency transformer. There is no direct electrical connection between the primary and secondary windings, but when an alternating voltage and current is applied to the primary, similar voltage alternations are induced





Figs. 2 and 3 (above). Applying the television to lines via an output transformer and (right) the elements of an R.C. coupled stage to show phase reversed effects.

magnetically in the secondary. These are larger or smaller in magnitude, according as to whether the number of turns of wire in the secondary winding exceed or are less than those of the primary, and currents will flow through the secondary winding if the circuit in which it forms a part is closed electrically.

The television signal modulation applied to the primary winding being alternating in character, means that at any one instant one end of the winding is at a higher potential than the other end, and vice-versa at another instant. Similar effects are induced in the secondary winding. If, for instance, the line from the studio to the radio transmitter is connected to the secondary, as in Fig. 2, that is, A to B and C to D, then the line will have applied to it one type of signal. It will be obvious, however, that if the engineer makes his line connections to the secondary so that A is joined to D and C to B, then the signal will be completely reversed in phase or direction. Here, then, is one way in which signal direction can be reversed, and incidentally it provides the user of any radio set connected to a television receiver with a method for counteracting negative pictures if a low frequency transformer is included in his amplifier. Just reverse the connections to *either* the primary or the secondary windings and matters will be rectified.

The Case of R.C. Coupling

If we turn to a resistance capacity coupled low frequency amplifier (the method which incidentally is by far the best for all television reception work), the voltage and current changes can be traced quite readily. Fig. 3 shows the elementary connections for a single valve stage, and assuming for a moment that the television signal passing through the set at one particular instant causes a positive potential to be applied to the valve grid, then our knowledge of valve working tells us that the plate current through the anode resistance will increase also.

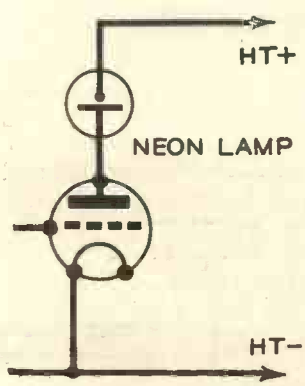


Fig. 4.—Inserting the Neon lamp directly in the valve anode circuit

The drop of voltage across this anode impedance will therefore increase, and as the total voltage applied between X and Y remains constant, there is a drop of potential between the valve anode and Y, which is the earth point. Similar reasoning shows that a decrease in the potential applied to the grid causes an increase in the potential difference between valve anode and earth. Hence the voltage changes between valve anode and earth are exactly the reverse of those applied between grid and earth. But it is the voltage changes between anode and earth which are passed to the grid of the valve in the following stage, and it is therefore quite plain to see how each stage in a resistance capacity coupled amplifier brings about a complete phase reversal.

Neon Lamp Connections

Having dealt with anti-phase effects "inside" the low-frequency amplifier, the next point that arises is in connection with the methods of joining the source of light modulation to the output valve. Taking the common case of a Neon lamp connected directly in the valve anode circuit as in Fig. 4, then an increase in grid volts will cause an increase in current flowing through the lamp, and in consequence an increase in brightness. A decrease in grid volts brings about the opposite effect, so that if the number of preceding amplifier stages is correct the light intensity of the lamp will follow exactly the picture signal undulations.

When the static conditions of the output valve are such that there is insufficient current passing through the Neon lamp to make it glow at its correct mean value, and also in those cases where it is desired to vary the current through the Neon lamp, then the connections shown in Fig. 5 apply. From the electrical point of view this is the same as Fig. 4, that is, increase in applied grid volts causes an increase in Neon lamp current and vice-versa.

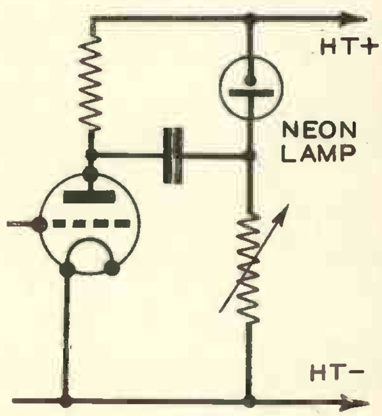


Fig. 5 (Left).—Another method of connecting the Neon lamp in circuit

As far as the Neon lamp and variable resistance are concerned, however, they can be interchanged as in Fig. 6 without in any way upsetting efficiency. Now the lamp is to all intents and purposes joined between anode and earth, the whole scheme being really the same as an R.C. coupled stage. Here the Neon lamp voltage (and hence the current) variations are anti-phase to the grid variations, and, in consequence, the arrangement shown is a particularly convenient and simple one for counteracting a negative image when it is impossible to bring about the change in the low frequency amplifier itself.

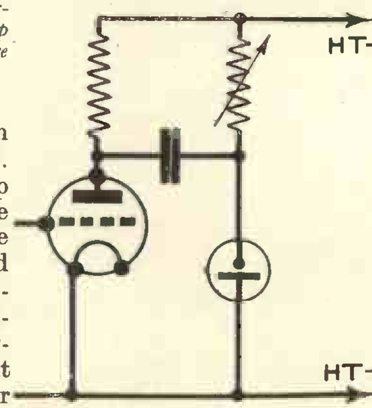
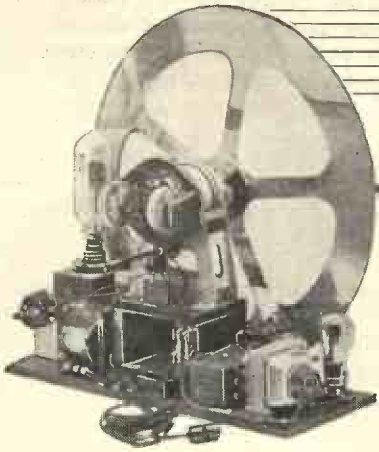


Fig. 6 (Right).—Interchanging the Neon lamp and variable resistance to reverse the phase

In conclusion, it is as well to remind readers that antiphase effects occur as a result of the method of rectification employed in the radio receiver. In the case of grid leak and condenser rectification, the average anode current in the detector valve decreases, but with anode bend rectification the average anode current increases. At this stage in the set, therefore, another convenient method of effecting a 180 degrees phase change presents itself when the ideas just propounded are inconvenient. Furthermore, bear in mind that with the present B.B.C. low definition television service an anode bend rectifier followed by an odd number of R.C. coupled stages gives a positive image when the Neon lamp is connected directly in the anode circuit of the output valve.



Telenews

Topical Reflections from The Radio Screen. Pars about Persons and Programmes.

Large-Screen Television

ACCORDING to messages which have been received from the United States, U. A. Sanabria, who is well known for his television experiments and demonstrations with large scale pictures, is stated to have constructed, at very considerable cost, a 150-line television apparatus which is capable of projecting an image on to a screen some 12 ft. in size. The important problem of the high-intensity light source which is used at the receiving end is said to have been solved by using a carbon dioxide arc.

Television and Finance

IT is stated that a television firm is endeavouring to secure the whole-hearted interest of a film company in the development of its systems with a view to the film company making a financial investment to the tune of £200,000. So far the efforts have been in vain, but the suggested co-operation leaves little doubt that instead of the cinema and television interests working in opposition to one another, they will be closely related when the latter becomes fully commercialised.

Amateur Television Broadcasts

IT is learned that Mr. H. Bailey, of Denton, who ran a television display throughout the summer at Blackpool, is concluding arrangements for experimental transmissions of television signals within a 20-mile radius of Manchester. It is proposed to transmit 30-line images on a wavelength of 10 metres and these can be picked up with an adaptor attached to the usual radio and television set. Mr. Bailey was granted an experimental television transmitting licence in June last and the station's call sign is G2UF.

A Controversial Point

CONSIDERABLE satisfaction exists in all radio circles as to the splendid recommendations which have been made by the television committee on one of the most vital questions it has been called upon to solve. This deals with the measure of State control which will be exercised in the future over television. While there are advantages for both private enterprise and State control it must not be forgotten that the present advanced stage of television has been brought about by individual and company enterprise without the slightest Government support in money or kind. Credit and financial consideration are therefore to be given to this matter and the recommendations have been received with satisfaction.

A Scottish Television Effort

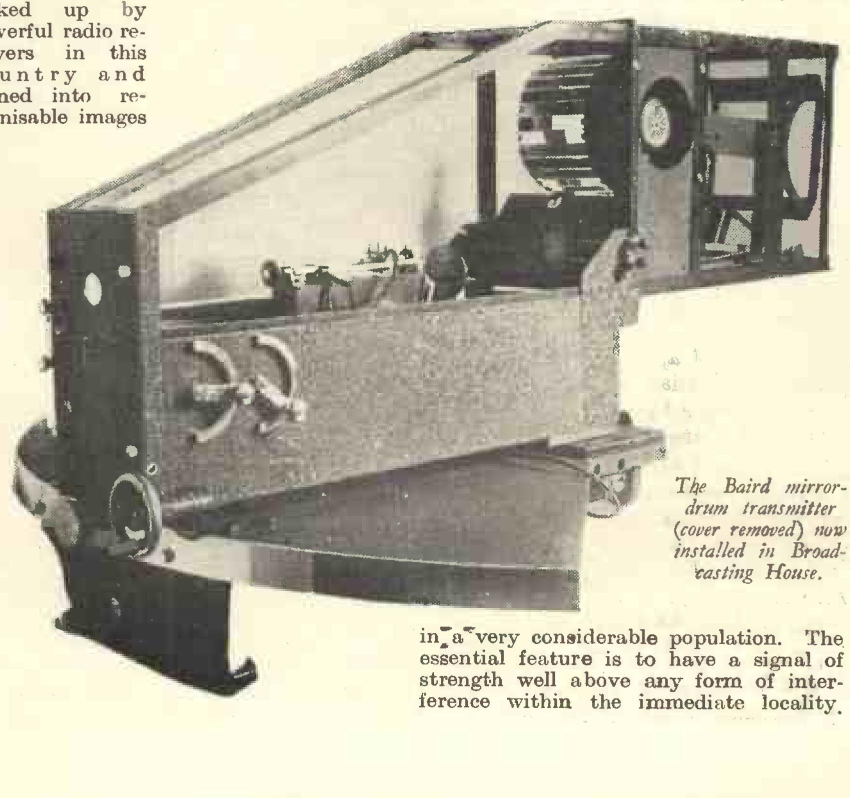
EVERY week news is published concerning some new system of television which promises to revolutionise all that has happened before. The latest one hails from Scotland, where a Glasgow University student is stated to be working on a scheme whereby the continuous strip-scanning method will be replaced by one embodying *complete* and instantaneous transmission and reception. While admitting that "Why do we scan?" is an oft-repeated question, no one, so far, has come forward with any practical idea for abolishing every form of exploration in order to secure an intelligible television signal.

Television in Russia

THE Soviet have shown keen interest in television for some time now, and have conducted a number of experiments. Indeed, the signals which they have radiated from their high-powered stations have from time to time been picked up by powerful radio receivers in this country and turned into recognisable images by the television apparatus attached thereto. It is now learnt that in Moscow they are radiating the television signals in a form which is called "Telechronique" or, in other words, specially prepared talking films which give images similar to a newspaper. News radiated in this way cannot fail to have a very wide appeal and would stimulate interest very rapidly if adopted in this country.

Forecasting!

FOR the first few weeks of this year the newspapers were full of their special forecasts as to what 1935 would bring in the way of radio and television developments. In the case of the latter, the authors of the articles made very long shots in the dark, especially when they attempted to deal with the deliberations of the Television Committee which has conducted its investigations with such commendable secrecy. The only true facts which emerged were based on tests carried out by the experimental transmitter located at the Crystal Palace, the ultra-short radio aerial of which is positioned right at the top of the South Tower. It is stated that the area over which signals of sufficient strength can be received are within a circle of about 25 miles radius, which, of course, takes in a very considerable population. The essential feature is to have a signal of strength well above any form of interference within the immediate locality.



The Baird mirror-drum transmitter (cover removed) now installed in Broadcasting House.

The worst interference on these ultra-short wavelengths comes from the ignition systems of motor cars, so it is not too much to expect that car manufacturers may soon be persuaded to fit suppressors as part of their standard equipment.

The Stage, Films and Television

WHEN Sir Oswald Stoll spoke at a recent annual meeting, he laid particular emphasis on the question of television. He was quite emphatic that practical commercial television was inevitable, but did not regard this as a death knell to those forms of entertainment in which he is particularly interested. On the other hand, he very forcibly implied that this coming television meant eminent advances in the entertainment world, advances which involved the preservation of and co-operation with the stage. Against this can be taken the views of the film industry, which seems to regard television as a spectre of trouble. They felt it rather keenly when no representative of film work was co-opted to assist the Committee in its work, claiming that as talking films would form quite a considerable proportion of any television service, it was essential that their expert film knowledge should have been used.

Television and Hitler

FOLLOWING the news that the proposed scheme to install public television telephones in Germany has been postponed because of the high cost involved, a substitute has been mooted. This is to the effect that a television receiver is to be located in the Reich Chancellery in Berlin for the purpose of connecting Hitler's residence with the Storm Troops headquarters at Munich. A number of preliminary tests have already been conducted by experts from the Post Office, special programmes having been radiated from Witzleben, where the ultra-short wave radio transmitter is installed.

New Television Company

IT is inevitable that the promise of television should have special significance to all radio firms who regard it as an additional market. This has meant that many of the companies have taken steps to carry out a number of investigations in laboratories staffed by young engineers familiarising themselves with the new technique associated with the science. Now comes the news that a new company, called Catheon, Ltd., has been registered, with Messrs. Stanley, Ellis and Robinson as directors. The name chosen may be taken to be indicative of the line of research proposed, namely, cathode-ray tubes, although it is stated that the company has been formed with the object of being in readiness to take advantage of any television developments or activities that may materialise. It will also segregate the television research work from the other activities of Pye Radio.

An "Electric Eye" Television Camera

DISC or mirror-drum methods of scanning are not used in the newly-evolved Baird television camera, which is entirely self-contained, and as portable as a professional cinematograph camera. It can be used for either indoor or outdoor work and requires no special lighting arrangements. An image is obtained by a normal camera lens on a photo-electric plate and electrons are given off in exact relation to the tones of the picture. These electrons pass in parallel lines to the front of the camera, being drawn by a ring anode, and influenced by a magnetic field causing horizontal and vertical deflections of such a nature that scanning occurs before a stationary hole. Electrical impulses of varying intensities in exact relation with the light and shade of the picture, as in more familiar types of television transmission, are thus received, and after amplification reach the control room. The pictures are built up at the rate of 25 complete pictures per minute.

When the first high-definition television broadcasts begin in the autumn the cost of sets for receiving both sound and vision will be between £50 and £80, but within two years they will probably be as cheap as £25.

A Film Star's Opinion

WHEN asked the other day what were his reactions to television, Eddie Cantor, the well-known film comedian, who has been spending a holiday in this country, stated that he felt it would in no way affect adversely either the theatre or the cinema. No matter how perfect may be the entertainment provided in the comfort of one's own home by radio, television, home ciné, gramophone, etc., it will always lack the appeal imparted by the atmosphere of a collected audience, was the film star's opinion. This feeling is being shared by many of the leading executives connected with the entertainment industry, although it must be admitted that their first reactions to the proposal of "pictures in the home" was one of fear.

Ultra Shorts and Long Distances

ALTHOUGH it is admitted quite generally that good signal strength range on the ultra-short wavelengths is limited to an area depending primarily on the contour of the country and the relative height of the transmitting aerial, this only holds good when the aerial is designed to give equal electro-magnetic wave radiation in all directions. Quite a number of experiments have been recently carried out both in this country and abroad in connection with directional aerials both at the transmitting and receiving ends, and these have produced quite astounding results. Ranges up to 150 miles have been claimed and demonstrated, but the beam or angle of spread of the signal is quite small, so that while this scheme is admirable for establishing communication over a narrow sector of a circle, it must not be confused with the more general requirement of strong signals in all directions, irrespective of the relative positions of transmitter and receiver.

The Fernseh A.G. Light Spot Scanning Transmitter for 180 lines, 25 images per second, and 40,000 points, as delivered to the German Post Office.

Licence Fees

WE are pleased to learn from the Television Committee's Report that there is no likelihood of the Post Office varying the present ten-shilling wireless licence fee when the first high definition television service comes into operation. This will naturally be welcomed by all, and to meet the cost involved in producing the television programmes it is planned that a definite proportion of the licence money will be allocated, any further sums being available in the form of a Treasury grant.

Cathode-Ray Tube Coating

THE new and specialised technique which is now being developed in connection with cathode-ray tube manufacture and use is intensely interesting. Coupled with this is the fact that at the moment it seems highly probable that these electron image devices will serve as the medium for producing the initial high-definition television pictures. Any special feature in connection with them, therefore, should be studied by readers so that when the appropriate time comes they will at least be familiar with the devices, if only from a theoretical standpoint.

With ordinary thermionic valves it is not possible to see the electrode assembly with most types, owing to the silvered appearance of the inside of the glass envelope resulting from the process known as "gettering." If a cathode-ray tube is examined a similar opacity will be observed, but for an entirely different reason. It is quite a common procedure in C.R. tube manufacture, the internal coating of the glass walls extending from the narrow neck of the tube at the base, right up to the bell-shaped mouth at the far end to the edge of the screen of fluorescent material. This coating is actually a conducting layer being brought into play frequently in connection with the focusing on to the screen of the stream of electrons emitted from the incandescent cathode.

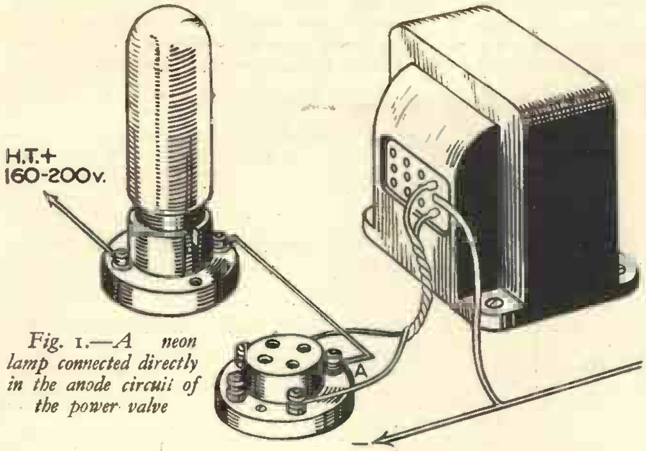


Fig. 1.—A neon lamp connected directly in the anode circuit of the power valve

OBTAINING BRILLIANT PICTURES

This article deals with different types of light sources, and how to obtain maximum modulation

ONE of the greatest problems in television reception at the moment is that of obtaining sufficient illumination to produce, after scanning, a reasonably brilliant picture.

There are in popular use several different types of light sources, and it is proposed here to give some information concerning their correct operation, with ways and means of getting maximum modulation.

The best-known and easiest lamp to use is, of course, the neon. The most obvious way to use a neon lamp is to connect it directly in the anode circuit of the power valve (Fig. 1), apply 160 to 200 volts H.T., and under these conditions the lamp will pass approximately between 17 to 25 milliamps.

This method of operation, however, is by no means the best. It is well known that to obtain maximum transference of power from the anode circuit of a valve to associated apparatus, a correct impedance matching must be obtained. The correct load for the majority of output valves lies between 3,000 to 9,000 ohms (excluding pentodes). The neon lamp has nothing like this impedance under working conditions, and consequently the maximum voltage will not be built up across the lamp when the valve is fully loaded. This gives rise to distortion.

A Remedy for Distortion

To remedy this, a step-down output transformer is used having a ratio of between 2 and 3 to 1 (depending on the output valve) and connected in circuit as shown in Fig. 2. Although a step-down transformer is used, greater voltage swing will be obtained with a minimum of distortion.

However, the brilliancy of a neon lamp is limited after a certain voltage is passed, but lamps having a mixture of gases can now be obtained, chief of which is the mercury neon lamp. These give a bluish-white light of remarkable intensity, though unfortunately they have certain drawbacks. They are, however, not of a serious nature.

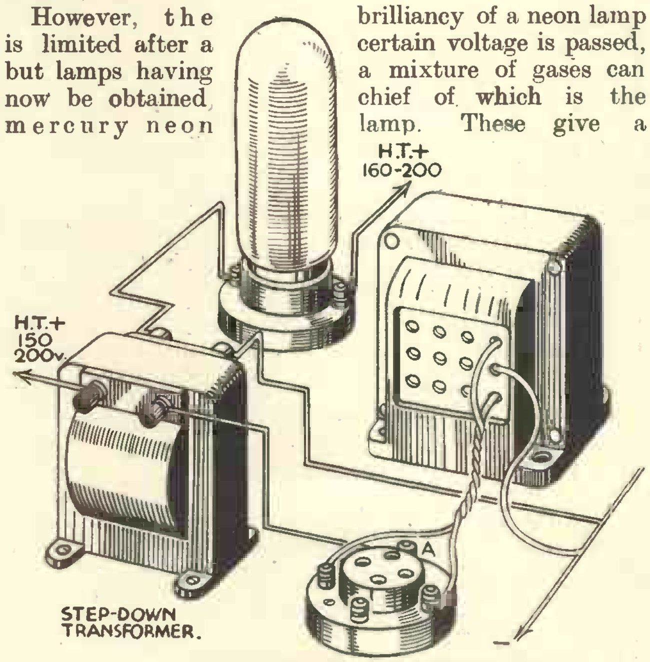


Fig. 2.—Although a step-down output transformer is used, greater voltage swing will be obtained with a minimum of distortion.

The mercury neon-type lamp, which is 4 in. in length, consists of small diameter thin glass tube with an electrode at either end. A small quantity of mercury may also be seen when the lamp is not in operation.

The frequency response of these lamps is not so good as that of pure neon when used on a definition of over 60-line scanning, but for 30-line it is ample at all times.

Contrary to the neon, best results are obtained with a mercury neon lamp when connected directly in the output circuit of a P.X.25 type valve. A minimum voltage of 500 should be applied, as very nearly a 200-volt drop takes place in the lamp. The output valve should deliver at the very least 4 watts undistorted output.

(Continued on page 168)

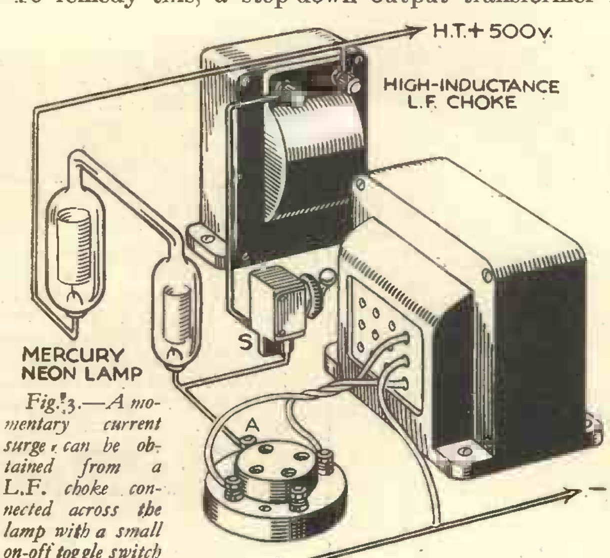


Fig. 3.—A momentary current surge can be obtained from a L.F. choke connected across the lamp with a small on-off toggle switch connected in series

DAYLIGHT T

THEN AND NOW

It is generally conceded that one of the most popular fo events either of local or national importance. The same with the new television service towards the end of this y to compare the results obtained in this connection a fe day appara

Fig. 3.—The large mirror-drum scanner and driving motor used in connection with three-zone outdoor television.

THE very first recorded demonstration of daylight television was given by Baird in June, 1928, and Sir Ambrose Fleming, when shown the apparatus under working conditions, declared it a very striking advance. For studio work it had been the usual practice to use spotlight or floodlight methods, the latter necessitating the scene or object being "bathed" in intense light from floodlights, while the former produced signals through the agency of a rapidly exploring square spot of light. The original scheme of daylight transmission much resembled early floodlight methods, the scene or object lit by daylight or the sun's rays being projected on to a disc as a small picture. Using a 30-apertured disc with the holes arranged in the familiar spiral formation, it was found, on rotating the disc, that the picture (made up from light and shade variations) allowed varying quantities of light to pass through each hole as it travelled in a pre-determined path across the picture. This small but continuously varying quantity of light was focused on to a single photo-electric cell, where it was converted into an equivalent voltage variation. The resultant signal, after amplification (when transferred to the receiving end by wire or radio), was then made to modulate the standard neon lamp light source of an ordinary disc-model television receiver.

While establishing the principles of a daylight system of television transmission, the results were rather crude for a variety of reasons. Foremost amongst these was the lack of intrinsic brilliancy in the picture projected on to the disc for the initial scanning operation, and the inefficiency of the photo-electric cells available at that time.

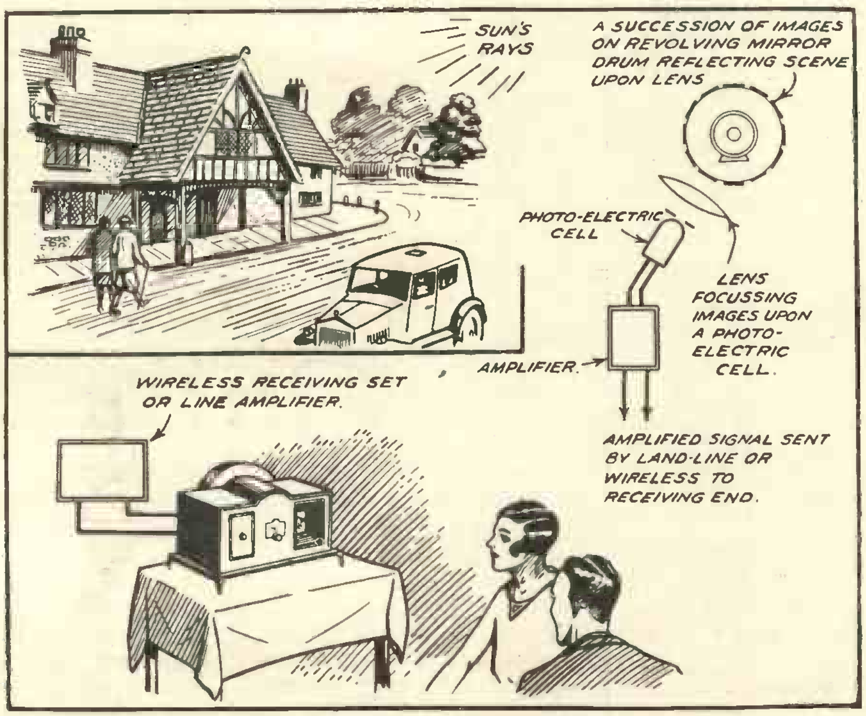


Fig. 1.—Pictorially representing early efforts at televising outdoor scenes.

A Step Forward

A period of nearly three years elapsed before any notable improvement took place, but in May, 1931, everyday street scenes were televised, still using, however, 30-line scanning with its corresponding limitation in detail. The arrangement is indicated pictorially in Fig. 1. Housed in a trailer van was a mirror drum about 2 ft. in diameter, and this was revolved at 750 revolutions per minute by a constant-speed motor. Around the drum periphery were fixed 30 rectangular mirrors, each mirror being inclined at a slightly different angle with reference to its immediate neighbour

An image of the scene being transmitted was formed on each mirror, since the back of the trailer was open and exposed. Immediately below and slightly in front of the drum was a lens which focused the scene from the mirrors on to a mask in which was located a small aperture. As the drum revolves it will be obvious that owing to the differing inclinations of each mirror, adjacent strips of the same scene are passed in turn across the aperture, giving the effect of dissecting the picture into 30 separate strips. The result of this form of scanning was to allow light variations (corresponding to the scene being observed) to be passed right through the small aperture, where they "fell" upon a single photo-

Fig. 4.—A side view of used at the Metropole Cinem

ELEVISION:

By H. J. BARTON CHAPPLE,
Wh.Sch., B.Sc. (Hons.), etc.

rms of radio listening is outside broadcasts of thing is sure to happen when we are furnished ear, and it is therefore particularly interesting v years ago with those obtained from present- us.

electric cell. A conversion to equivalent voltage variations was produced by the cell and associated amplifier, and these signals were transferred by land line or radio to the television receivers (still disc models in this particular case) to be observed as images in the apparatus.

A "Panning" Mirror

The success attending these experiments encouraged a somewhat more ambitious undertaking, for this same trailer van was moved to Epsom, and being positioned against the racecourse rails, a praiseworthy attempt at televising the finish of the famous Derby race was made. Under the course were laid P.O. telephone lines and the amplified signals travelled to a control room at Long Acre, where they were again amplified and transferred to Brookman's Park, to be radiated as a television signal on the London National wavelength.

the triple Kerr-cell receiver a for showing the Derby race]

With a microphone and commentator at the Epsom course, the accompanying sound made the broadcast complete, and in addition to the horses flashing by the winning-post at the end, the parade of the horses and jockeys prior to the start was also watched. Since the drum scanner and van were fixed in position the effect of "panning" to secure a change of vista was brought about by a mirror fixed to the side of the trailer opening. It was the pictures of the course and horses (reflected from this large mirror as it moved through a small arc) which were focused on to the small mirrors of the revolving drum for scanning purposes. Occasionally telegraphic interference from nearby Post Office lines obliterated the images, but the tiny horses were there and the experiment was regarded as a step forward in the progress of the science.

The Following Year

An experiment of somewhat more spectacular character was attempted in connection with the Derby race of the following year. This is shown pictorially in Fig. 2. A similar revolving mirror drum housed in a trailer caravan positioned opposite the Epsom Grand Stand was employed. A section of the van interior, together with the large drum and driving motor, are seen in Fig. 3, the weird patterns on the inner face of the drum being for the purpose of stroboscopic speed observation. Instead of the resultant daylight pictures on the individual mirrors being focused on to a mask with a single aperture, however, three apertures were employed. The total picture was therefore divided into three adjacent zones, each zone being dissected into 30 strips. Three photo-electric cells with their amplifiers were in use (see Fig. 2), the triple television signals thus generated being sent along Post Office cables to a control room at Long Acre, where they were relayed to the receiver on the

Fig. 5.—The mobile van containing the Fernseh A.G. intermediate film camera and associated apparatus.

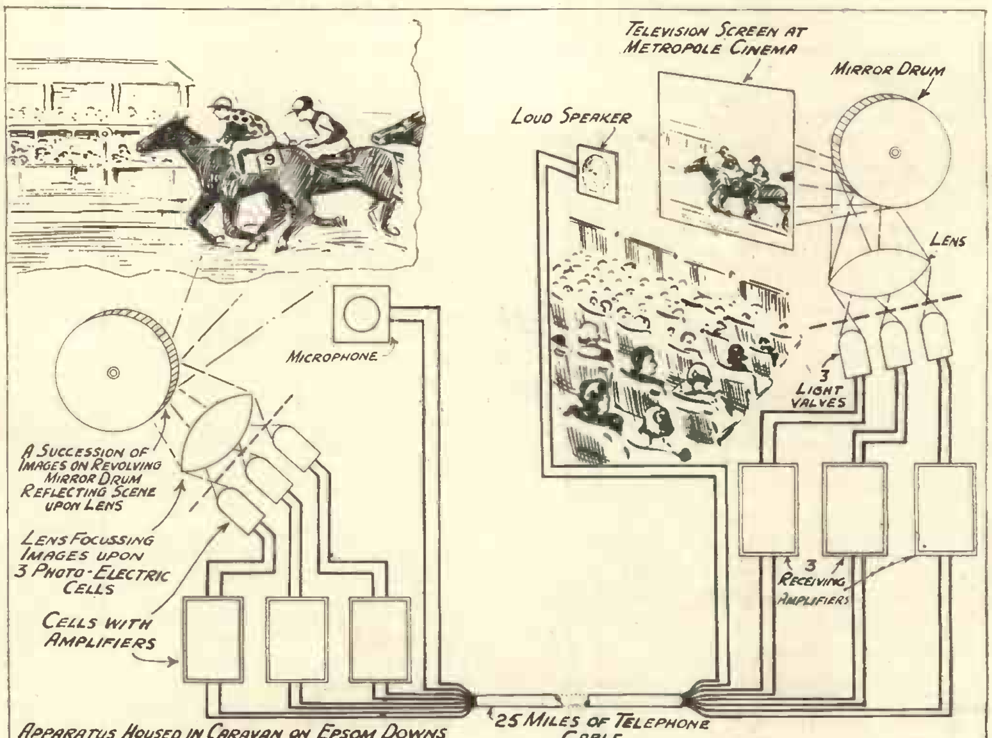


Fig. 2.—Showing how the Derby was televised by three zones and shown on a large screen at a London cinema.

stage of the Metropole Cinema, Victoria. The complete apparatus comprising the television receiver (except for the screen) is seen in Fig. 4. Three arc lamps were employed to provide three constant and intrinsically brilliant light beams. One beam was focused direct on to a large revolving mirror drum geometrically similar to and maintained revolving at the same speed as the transmitter drum at Epsom, while the other two beams set on opposite sides and at right angles to the centre beam had their light path bent through 90 degrees by means of two small mirrors. The three beams therefore met the drum mirror surfaces and were then reflected from them on to a large plate glass mirror (see Fig. 4) set at an angle of 45 deg., so that as the drum revolved they could be observed as three parallel and vertical strips of light projected on to a translucent screen facing the theatre.

Light Modulation

The separate incoming television signals were each taken to large Kerr cell and Nicol prism combinations, one in each light beam, so that the light from the arc lamps could be modulated and so build up a 3-zone picture 9 ft. wide and 7 ft. high. The resultant images, when properly framed and phased zone-to-zone, gave a very brilliant and quite distinct picture of the Derby race, horse parade and finish, at the instant the events were happening on the Downs. This new Baird development was shown to an overcrowded house on Derby day, and in addition the centre zone was broadcast by the B.B.C. on the London National wavelength, so that anyone in possession of a television receiver was able to participate in the thrills of a televised Derby.

Bearing in mind the enormous difficulties which had to be overcome, the occasion was something in the nature of an historic achievement, for although the pictures flickered owing to the 12½ per second scanning speed, the horses, jockeys and cheering crowd in the Grand Stand at the back were clearly discernible by everyone present on that day. A commentator seated on the roof of the trailer van provided the accompanying sound so that the illusion of instantaneous sound and vision was complete.

Present-Day Schemes

Subsequent to this work in 1932, enormous strides have been made in all branches of television, not the least of which is the intermediate film process. This is readily adaptable to all outdoor televising, the scheme being quite ingenious in its conception. The scene to be transmitted is photographically recorded on a special film by means of an intermittent camera. After this the negative is run through sectionalised tanks which first of all develop, then fix and finally wash the film, as shown in the simple sketch (Fig. 6). Two alternatives then present themselves, one being to scan the film wet with a rapidly rotating disc, or else dry the film before it is scanned. In either case, the measure of delay between the actual filming of the scene by the camera and its disintegration into a television signal for instantaneous reception on a television receiver is only a matter of seconds. This small delay is quite a negligible factor, and to all intents and purposes the system is identical with real television by the direct method. In the scanning process the method is similar to that for the televising of ordinary talking films. The disc has a circle (not a spiral) of minute apertures, and the individual film pictures are projected on to the disc as they pass in front of a focused source of light. Light variations therefore pass through the disc holes, the usual conversion to voltage variations being effected by the standard photo-electric cell method. The arrangement has the advantage that the event photographed is stored in celluloid form for any subsequent purpose to be used as required.

In Germany the Fernseh A.G. have built a complete intermediate film equipment into a mobile van. This is shown in Fig. 5, being designed to move to any point where a scene is to be televised, such as a public speaker, racing, sports, etc. The camera film spool is seen very clearly on the top of the van, and after the pictures have been taken they pass through the roof to the van interior for the processing and scanning. The mobility and convenience of such an arrangement in conjunction with high definition pictures make this method of televising outdoor (and of course, indoor) scenes one of great promise and value.

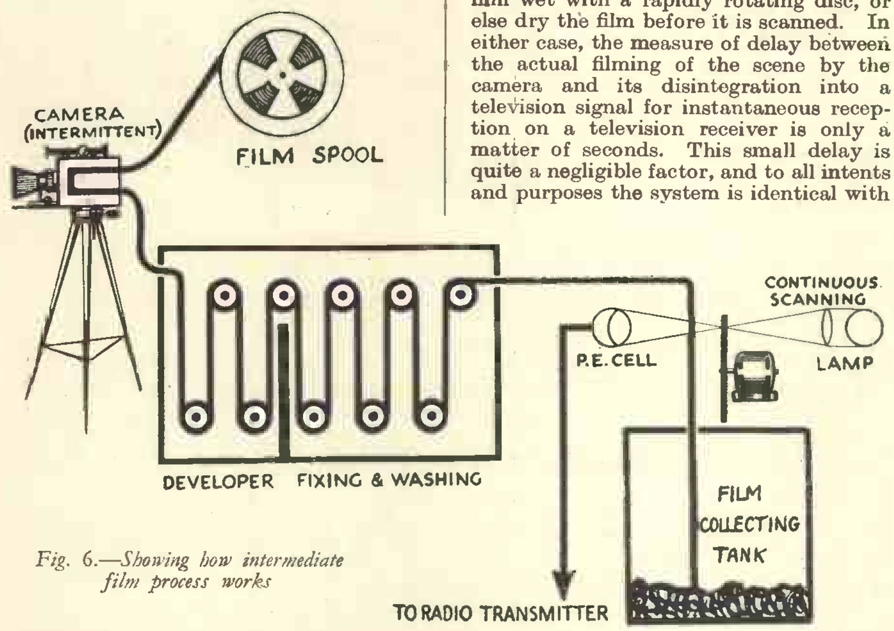


Fig. 6.—Showing how intermediate film process works

SUMMARISED REPORT OF THE TELEVISION COMMITTEE

We publish below, by kind permission of the Controller of H.M. Stationery Office, the important Clauses embodied in the Report. This momentous document spells the birth of a new industry and we have accorded space to it for the convenience and future reference of our readers. Television is here, and the first Station will be erected in London within the next few months. A total of ten Stations will be erected throughout the country. A Booklet giving the Report in full is obtainable for 6d. from H. M. Stationery Office, Adastral House, Kingsway, London, W.C.2.

WE have inspected, in some cases upon several occasions, all the different television systems belonging to firms who were prepared to provide demonstrations. Of the systems under development in this country, the most distinctive are those of the Baird, Cossor, Marconi-E.M.I. and Scophony Companies.

Further, we despatched a delegation headed by the Chairman, to investigate and report upon progress in television research in the United States, and a delegation headed by Mr. O. F. Brown, to Germany for a similar purpose. We have also been furnished with information regarding the position in certain other countries.

American Systems

In America, our delegation visited and inspected many of the chief centres of television experimental research, as well as the plant and laboratories of the principal Broadcasting, Telephone and Telegraph Authorities. They had also the advantage of consultation in Washington with the Federal Communications Commission. To all of these Corporations and Authorities we desire to make the fullest and most sincere acknowledgment of the kindness and courtesy extended to the delegation, who were given every possible opportunity for the fullest examination of methods and plant, and the frankest interchange of opinion.

German Systems

In Germany, our delegation made a similar inspection of the television experimental installations belonging to the Reichspost and also of those of several private firms in Berlin, and they had many profitable discussions with officials of the Reichspost and others regarding various aspects of Television. As in America, so also in Germany, every facility was accorded to our delegation in their investigations, for which we likewise desire to express our sincere appreciation.

Sound on Film

Considerable experimental development has taken place upon a technique whereby the scene to be televised is first photographed on ordinary cinematograph film which, after being developed, is scanned by light transmitted through it. This system can be used to provide a method of delayed television where direct scanning by a mechanical device would be difficult or impossible. In order to reduce the period of delay, equipment has now been produced in which the cinematograph camera is associated with the film scanner, and the film, after exposure, is immediately developed, fixed, washed and partially dried. (*This system has been described in earlier issues of "Practical Television."*—ED.) It then passes through the scanner, and after further drying is stored for future use if required.

The direct scanning of open-air scenes and studio subjects without abnormally powerful illuminating devices has also been made possible by the use of cathode rays in combination with photo-sensitive surfaces or minute photo-electric cells. For instance, in one such device which is being developed in America, Germany and this country, the image to be televised is focussed by means of lenses on to a photo-electric mosaic contained in a cathode-ray tube.

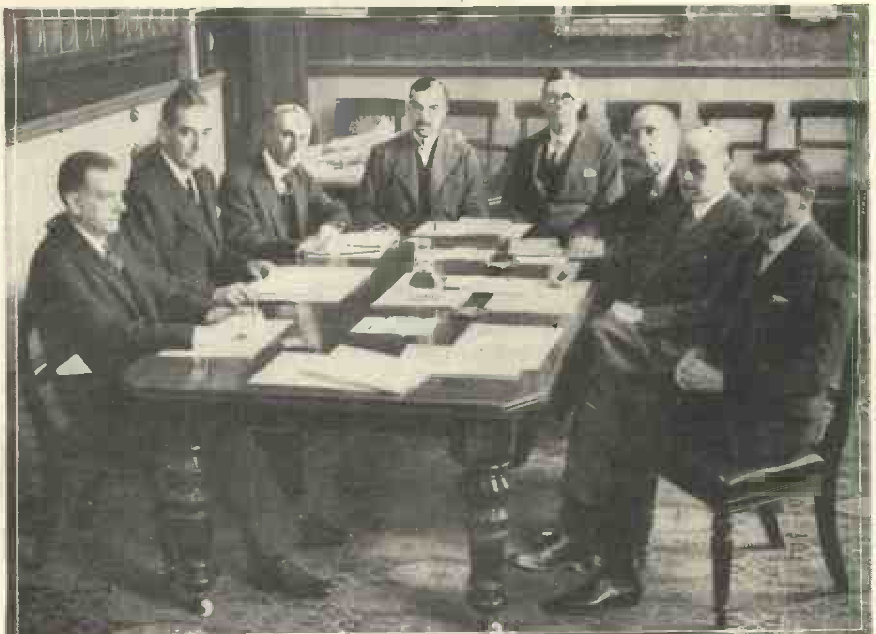
Our observations lead us to the opinion that this system of "direct pick-up" has already attained a considerable degree of effectiveness, and we should say that satisfactory reproduction of outdoor moving scenes can now be attained by this method in conditions of light, etc., approximating to those under which satisfactory cinematograph pictures can be taken, provided that the recording apparatus can be located reasonably close to and at a moderately constant distance from the scene to be televised. **We should regard it as probable that satisfactory reproduction could, even at this stage of development, be obtained of such scenes as a procession, a lawn-tennis match, or the actual finish of a horse race, though the transmission of a view of the whole course of a race, a cricket match, or a football match, would present much greater difficulty.**

Low-Definition Television

In the case of these transmissions, the size of the elements (elementary areas) composing the picture is such as to admit of transmission being effected in a series of thirty lines per picture, and each picture is repeated 12½ times per second.

Any pictures built up with a structure of the order of thirty lines are, however, comparatively coarse in texture. Little detail can be given, and generally speaking the pictures are only fitted for the presentation of "close-ups"—*e.g.*, the head and shoulders of a speaker—and the quality of reproduction leaves much

THE TELEVISION COMMITTEE



The Television Committee, whose findings are issued in the Report and summarised on this page. Left to right: Sir John Cadman, The Rt. Hon. Lord Selsdon (chairman), F. W. Phillips, J. Varley Roberts (secretary), O. F. Brown, Vice-Admiral Sir Charles Carpendale, Noel Ashbridge, and Col. A. S. Angwin.

to be desired. Moreover, any frequency of the order of 12½ pictures per second gives rise to a large amount of "flicker."

Whilst low definition television has been the path along which the infant steps of the art have naturally tended, and while this form of television doubtless still affords scientific interest to wireless experimenters, and may even possess some entertainment value for a limited number of others, we are satisfied that a service of this type would fail to secure the sustained interest of the public generally. **We do not, therefore, favour the adoption of any low definition system of television for a regular public service. The question of the temporary continuance of the present low definition transmissions pending the institution of a public television service of a more satisfactory type is dealt with later.**

High Definition Television

With a view to extending the application of television to a wider field and thereby increasing its utility and entertainment value, much attention has been given in recent years to the problem of obtaining better definition and reduced "flicker" in the received pictures.

The degree of definition it is essential to obtain is necessarily a matter of opinion, but the evidence received and our own observations lead us to the conclusion that it should be not less than 240 lines per picture, with a minimum picture frequency of 25 per second. The standard which has been used extensively for experimental work is 180 lines, but we should prefer the figure of 240, and we do not exclude the possible use of an even higher order of definition and a frequency of 50 pictures per second.

For the reception of high definition pictures the cathode ray tube is now usually employed. The cathode ray tube receiver involves no moving parts, and the picture is presented as a fluorescence at the end of the tube.

The size of the picture produced naturally depends upon the size of the cathode ray tube. At present the most usual size gives a picture of about 8 in. by 6 in., although good results have been seen with larger tubes. The apparent size can, of course, be increased by viewing the tube through a suitable fixed magnifying device, though with a corresponding loss of definition. Experimental work is proceeding with a view to the projection of pictures on a screen of much larger dimensions, but this is still in an early stage of development.

We are impressed with the quality of the results obtained by certain of these systems, and whilst much undoubtedly remains to be done in order to render the results satisfactory in all respects, we feel that a standard has now been reached which justifies the first steps being taken towards the early establishment of a public television service of the high definition type in this country.

As regards the existing low definition broadcasts, these no doubt possess a certain value to those interested in television as an art, and possibly, but to a very minor extent, to those interested in it only as an entertainment. We feel that it would be undesirable to deprive these "pioneer lookers" of their present facilities until at least a proportion of them have the opportunity of receiving a high definition service. On the other hand, the maintenance of these low definition broadcasts involves not only some expense, but also possibly considerable practical difficulties. We can only, therefore, recommend **that the existing low definition broadcasts be maintained, if practicable, for the present; and that the selection of the moment for their discontinuance be left for consideration by the Advisory Committee,** with the observation that, if practicable so to maintain these broadcasts, they might reasonably be discontinued as soon as the first station of a high definition service is working.

Sound and Vision Broadcasting

In our opinion there will be little, if any, scope for television broadcasts unaccompanied by sound. Television is, however, a natural adjunct to sound broadcasting, and its use will make it possible for the eye as well as the ear of the listener to be reached. Associated with sound, it will greatly enhance the interest of certain of the existing types of broadcast, and will also render practicable the production of other types in which interest is more dependent upon sight than upon sound.

The time may come when a sound broadcasting service entirely unaccompanied by television will be almost as rare as the silent cinema film is to-day. We think, however, that in general sound will always be the more important factor in broadcasting. Consequently the promotion of television must not be allowed to prevent the continued development of sound broadcasting.

No doubt the evolution of television will gradually demonstrate the possibility of its application for many purposes other than those of entertainment and illustrative information. Its uses for purposes of advertisement are obvious, were such deemed desirable. We can conceive, moreover, its potential application—as distinct from existing practice in picture transmission—to public telegraphic and telephonic services, to the transmission of lists of prices, or of facsimile signatures or documents, and to its use by the police and the forces of the Crown, or as an aid to navigation.

Television Operating Authority

Holding the view which we do of the close relationship which must exist between sound and television broadcasting, we cannot do otherwise than conclude that the Authority which is responsible for the former—at present the British Broadcasting Corporation—should also be entrusted with the latter. We therefore recommend accordingly; and we have received an assurance that the Corporation is prepared fully to accept this additional responsibility and to enter wholeheartedly into the development of television in conformity with the best interests of the licence-paying public.

Advisory Committee

Whilst we think that the British Broadcasting Corporation should exercise control of the actual operation of the television service to the same extent and subject to the same broad principles as in the case of sound broadcasting, we recommend that the initiation and early development of this service should be planned and guided by an Advisory Committee appointed by the Postmaster-General, on which the Post Office, the Department of Scientific and Industrial Research and the British Broadcasting Corporation should be represented, together with such other members as may be considered desirable. We recommend that this Committee should be appointed forthwith for a period of, say, five years.

Use of Ultra-Short Waves for Television and their Effective Range

As previously mentioned, the transmission of high definition television is practicable only with ultra-short waves, and a wide band of frequencies is necessary. Fortunately, there should be no difficulty, at present at all events, in assigning suitable wavelengths in the spectrum—between 3 and 10 metres—for public television in this country, although in allocating such wavelengths regard must, of course, be paid to the claims of other services. The recent experimental work has been conducted upon wavelengths around 7 metres.

Technically, it is desirable that the transmitting stations should be situated at elevated points, and that the masts should be as high as practicable, consistent with any restrictions which may be deemed necessary by the Government. The mast at present in use in Berlin is about 430 ft. high, and the question of employing masts of greater height is under discussion in Germany.

Provision of Television Service

We nevertheless envisage the ultimate establishment of a general television service in this country, and in this connection we contemplate the possibility of television broadcasts being relayed by land line or by wireless from one or more main transmitting stations to sub-stations in different parts of the country. We should observe that recent developments in cable technique render it possible for the first time to transmit, over considerable distances, frequencies such as are required for high definition television.

Start of Service

We have come to the conclusion that a start could best be made with a service of high definition television by the establishment of such a service in London. It seems probable that the London area can be covered by one transmitting station and that two systems of television can be operated from that station. On this assumption, we suggest that a start be made in such a manner as to provide an extended trial of two systems, under strictly comparable conditions, by installing them side by side at a station in London where they should be used alternately—and not simultaneously—for a public service.

There are two systems of high definition television—owned by Baird Television, Ltd., and Marconi-E.M.I. Television Company, Ltd., respectively—which are in a relatively advanced stage of development, and have indeed been operated experimentally over wireless channels for some time past with satisfactory results. We recommend that the Baird Company be given an opportunity to supply the necessary apparatus for the operation of its system at the London station, and that the Marconi-E.M.I. Company be given a similar opportunity in respect of apparatus for the operation of its system also at that station. Besides any other conditions imposed, acceptance of offers should be subject in each case to the following conditions precedent :—

(*a*) The price demanded should not, in the opinion of the Advisory Committee, be unreasonable.

(*b*) The British Broadcasting Corporation to be indemnified against any claim for infringement of patents.

(*c*) The company to undertake to grant a licence to any responsible manufacturer to use its existing patents or any patents hereafter held by it, for the manufacture of television receiving sets in this country on payment of royalty.

(*d*) The terms of a standard form of such licence to be agreed upon by the company with the Radio Manufacturers' Association, or, in default of agreement, to be settled in accordance with the provisions of the Arbitration Acts, 1889 to 1934, or any statutory modification thereof, either by a single arbiter agreed upon by the Company and the Radio Manufacturers' Association, or failing such agreement, by two arbiters—each of the parties nominating one—and an umpire nominated by the Postmaster-General.

(*e*) The Company to agree to allow the introduction into its apparatus at the station of devices other than those claimed to be covered under its own patents, in the event of such introduction being recommended by the Advisory Committee.

(*f*) Transmissions from both sets of apparatus should be capable of reception by the same type of receiver without complicated or expensive adjustment.

(*g*) The definition should not be inferior to a standard of 240 lines and 25 pictures per second.

(*h*) The general design of the apparatus should be such as to satisfy the Advisory Committee, and when it has been installed, tests should be given to the satisfaction of the Committee.

Programmes

It is scarcely within our province to make detailed recommendations on the subject of television programmes. To what extent those programmes should consist of direct transmissions of studio or outdoor scenes, or televised reproductions of films, must be determined largely by experience, technical progress and public support, as well as by financial considerations. No doubt the televising of sporting and other public events will have a wide appeal, and will add considerably to the attractiveness of the service. We regard such transmissions as a desirable part of a public television service, and it is essential that the British Broadcasting Corporation should have complete freedom for the televising of such scenes, with appropriate sound accompaniment, at any time of the day.

With regard to the duration of television programmes, we do not consider that it will be necessary at the outset to provide programmes for many hours a day. An hour's transmission in the morning or afternoon which will give facilities for trade demonstrations and, say, two hours in the evening, will probably suffice. As regards the future, the British Broadcasting Corporation and the Advisory Committee will doubtless be guided by experience and by financial considerations.

Finance

We estimate that the cost of providing the London station, including all running and maintenance expenses, programme costs and amortisation charges (calculated on the basis of a comparatively rapid obsolescence), for the period up to December 31, 1936, will be £180,000. For obvious reasons, we refrain from specifying here the details upon which this estimate is built, but these are available to you in the confidential section of the Report. Lest, however, too hasty conclusions be drawn from this figure, we add the following observations. It must not be assumed that an accurate estimate of the cost of a number of stations can be reached by the simple process of multiplication. By far the largest factor in the above figure is the programme cost. On the one hand, if the service is a success, the cost of programmes will certainly rise materially, just as the cost of sound programmes has risen. We have not budgeted during this early stage for a programme comparable in duration, variety, or quality, with existing sound programmes, although the service should be amply adequate to provide interest and entertainment for the public, as well as opportunity for daily demonstrations by retailers of sets. On the other hand, if and when a number of stations start working, it is contemplated that one programme may be relayed simultaneously to all stations . . . . . . and that only a small portion of the daily output will consist in each case of topical items of local interest. In the case, therefore, of each additional station, the amount to be added to other charges in respect of programme costs will be merely fractional.

We have carefully considered the question of providing the necessary funds. Roughly speaking, the means suggested to us for so doing may be classified under two heads : (*a*) Selling time for advertisements, and (*b*) Licence revenue.

Advertisements may take two forms : they may be either (i) direct advertisements for which time is bought by the advertiser, such as, for instance, a dress show by Messrs. Blank ; or (ii) the acceptance, as a gift, of programmes provided by an advertiser and coupled with the intimation of his name, in accordance with a standard formula, such as, for instance, "This programme comes to you through the generosity of Messrs. Dot & Dash," the latter system being usually known as that of "sponsored programmes." As regards direct advertisements, this proposal has been frequently examined in past years. In relation to sound broadcasting it was discussed and rejected by the Sykes Committee on Broadcasting in 1923. We do not differ from that Committee's view, and accordingly do not recommend this course. As regards "sponsored programmes," for which the Broadcasting authority neither makes nor receives payment, the Sykes Committee saw no objection to their admission ; and they are now specifically allowed under the British Broadcasting Corporation's Licence, although the Corporation has, in fact, only admitted them on rare occasions. We see no reason why the provision concerning sponsored programmes in the existing Licence should not be applied also to the television service ; and we think it would be legitimate, especially during the experimental period of the service, were the Corporation to take advantage of the permission to accept such programmes.

In attempting to provide funds from licence revenue there appear to be four possible courses :—

(1) The raising of the fee for the general broadcast listener's licence.

(2) The issue of a special television-looker's licence.

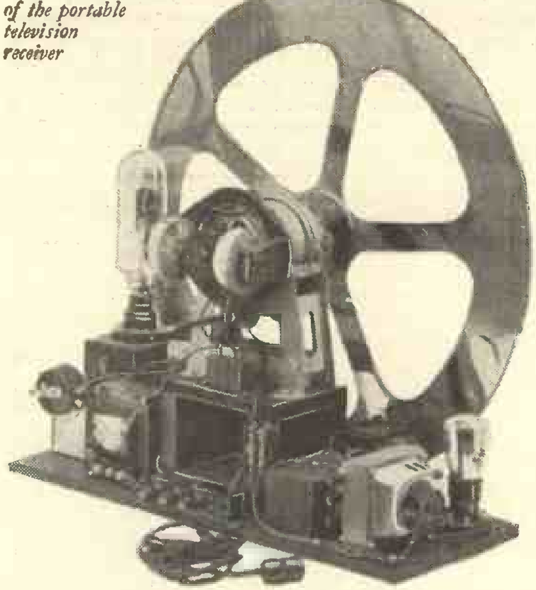
(3) The imposition of a licence upon retailers.

(4) The retention of the existing listener's licence at 10s. and the contribution from that licence revenue of the necessary funds during the experimental period.

Of these courses, the first has the merit of certainty and simplicity. It is arguable whether an additional charge would seriously diminish the number of existing listeners, or even materially abate the normal rate of growth. It would provide a definite and substantial fund to start and maintain a television service. Moreover, if the view which we have already expressed as to the future development of television in association with sound broadcasting be well founded, then there is considerable logical justification for treating it as an indispensable adjunct to sound broadcasting, and accordingly laying any increased consequent charge upon the broadcast licence. We, however, see no adequate answer to the inevitable complaint from country listeners, "Why should we pay an increased charge for a service which only London or some other centres can receive ?"—nor even to the further complaint within such areas as are actually served, "Why should we people with restricted means pay this increased charge for a service which we cannot receive, because the necessary apparatus is at present so dear that it is only within reach of the well-off ?" We do not, therefore, recommend the adoption of this course.

The second course, the issue of a special licence, has also considerable logical justification. It provides a means whereby those who use—and can afford the apparatus necessary to use—this service may contribute towards the cost of it.

(*Continued on page* 172)



A rear view of the portable television receiver

FURTHER CONSTRUCTIONAL DETAILS FOR—

BUILDING A PORTABLE TELEVISION RECEIVER

This month we deal with the construction of the Cabinet and also give details for operating the Portable Television Receiver described on page 136 of last month's issue

THE appearance and dimensions of the cabinet for the portable television receiver are shown in Fig. 7 (shown last month). It has *internal* dimensions of 20½ in. × 20½ in. × 8⅝ in., is made of ½ in. wood and has a detachable back. The back is detachable, having one hole drilled to allow the synchronising framing shaft to pass through, and also a rectangular section cut away at the bottom to allow access to the three terminals and give the mains lead free passage.

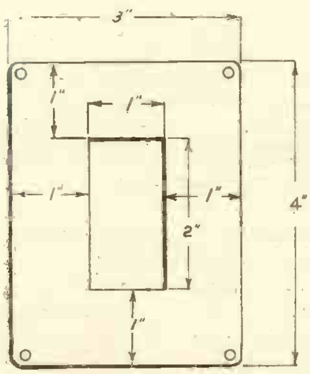


Fig. 9.—The aluminium mask should be cut to the dimensions shown

At the front, on the right, an aperture (midway between top and bottom) is cut out 2½ in. wide by 3 in. deep so that its centre coincides with the centre of the neon lamp plate. Below this is a hole to take the bush of the extension rod and to enable an easy control of the variable-resistance to be effected from outside. When the aperture and hole have been made, slide the whole apparatus into the cabinet from the back. See that the disc boss does not touch the back of the cabinet front, and then once more connect the plug to the mains socket and switch on. As the disc gathers speed, it will flap a little and foul the cabinet front, but this is quite normal and as soon as it is revolving at speed it will run quite flat, without touching the cabinet. The strips of light area of the neon lamp will now be observed through the disc holes, and it becomes necessary to mask off the cabinet aperture with a *blackened* aluminium plate, 1/16 in. thick, cut to the dimensions shown in Fig. 9. Position this over the aperture while the apparatus is running so that the hole in the mask just exposes the glowing light area, and then attach it to the cabinet front by means of four screws.

Enlarging the Image

The television image observed through the rectangular hole in this mask will be the true size as traced out by the disc holes, that is, approximately 2 in. × 1 in. For certain experimental purposes this is sufficient, but on many other occasions when it is desired to sit down and watch the programme provided by the B.B.C. transmissions, lens magnification must be resorted to.

Details of a simple outfit for this purpose are shown in Fig. 10. First of all obtain two lenses, one a 4-in. diameter double-convex of 11.5 in. focal length, and a second of 6-in. diameter, single-convex, having a 17 in. focal length. Now make up the wooden structure shown in Fig. 10. When the hole centre has been marked off, scribe off with dividers or compasses on one side, two holes of 3¾-in. and 4-in. diameter respectively. On the other side two similar concentric circles should be drawn of 5½-in. and 6-in. diameters respectively. Cut out the inner circle of 3¾ in. with a fretsaw, and then with a spokeshave chamfer off sufficient wood so that there is a bevel between the 3¾ in. diameter hole at the back and the 5½-in. diameter circle at the front.

Place the large lens central with the 6 in. diameter circle so that its flat face touches the wood, and hold it firmly in position with three small brass clips, as shown in Fig. 10. Turn the structure over and mount the smaller lens in place, that is, central with the hole, and fix it securely with three small clips. This can now

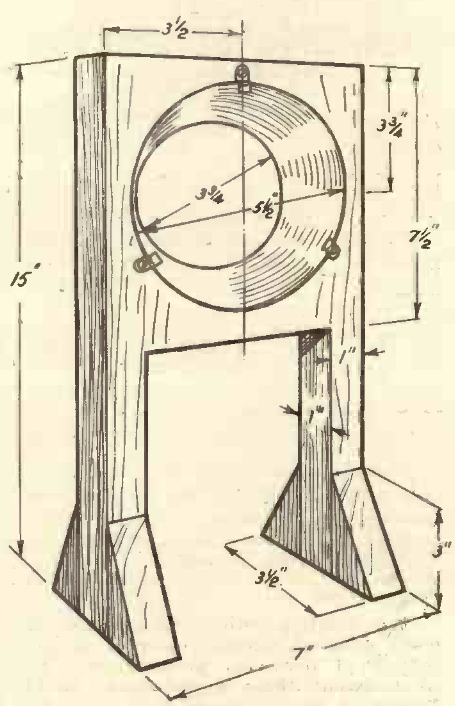


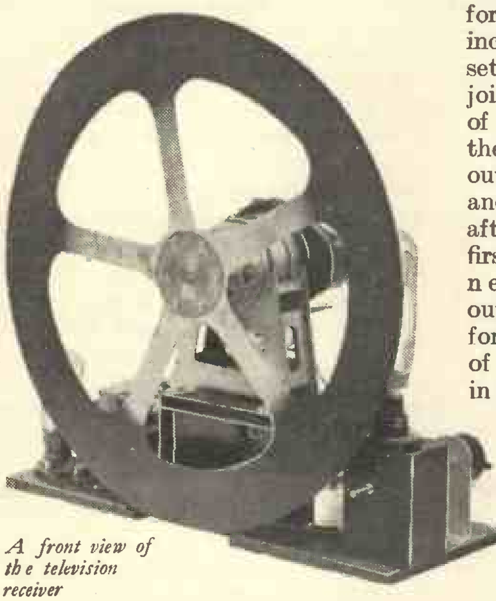
Fig. 10.—The lens mount. Note the bevelled hole

be painted black and when in use stands in front of the cabinet mask, and in this way considerably magnifies the image. As the cabinet has rubber feet at the bottom, the height of the lens centres just corresponds with that of the aperture centre.

To house the assembly when not in use, make two U-shaped clips and fix these to the inside of one cabinet side, on the right facing back preferably, to accommodate the feet of the lens stand. Then screw a short length of wood 1 in. thick to the inside top of the cabinet, nearly flush with the top end of the lens frame, and add two clips to hold it in place, with the feet resting in the U-clips.

Operation

Having dealt very fully with the constructional details, it is necessary now to say a few words about operation. The portable television receiver is joined to the radio receiver through the pair of input terminals and earth terminal. Join the former direct to the normal loudspeaker terminal if there is not a *step down* output transformer already included in the set. If there is, join the pair of terminals to the plate of the output valve and H.T. + after having first disconnected the output transformer primary of the set. As in most sets to-day, the type of output is direct- or choke-feed, with the transformer included with the loudspeaker, and therefore, this latter course will seldom be necessary.



A front view of the television receiver

Having connected the earth terminal to an earth point on the set, switch on the television receiver five or ten minutes before the television transmission is due to start to allow the motor to warm up and run steadily. Assuming the London National station which broadcasts the television programme has been previously tuned in on the set, then as soon as the transmission begins, some form of image, very probably distorted to start with, will be seen in the right-hand cabinet aperture.

A series of black lines will be noticed sweeping upwards or downwards, depending on whether the motor is running too fast or too slow, the correct speed being 750 revolutions per minute. The variable motor resistance must be adjusted carefully until the lines lie horizontal it being noted that if this does not happen, then another tap on the tubular fixed resistance must be tried.

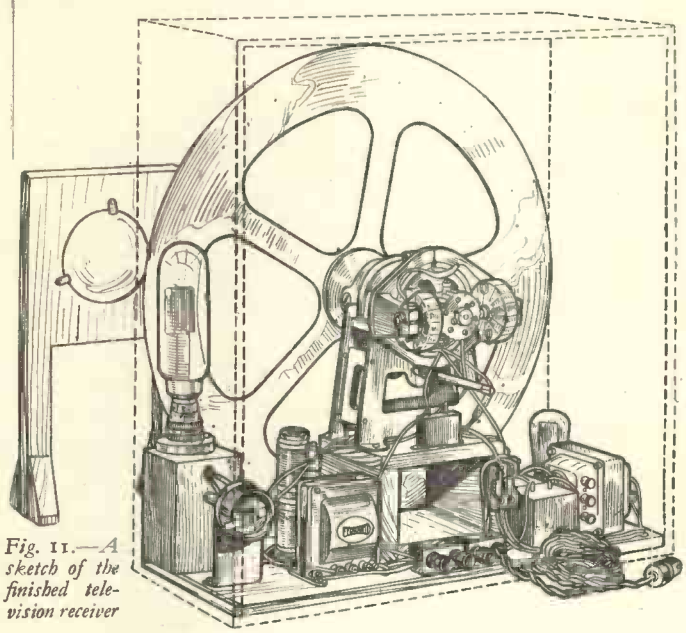


Fig. 11.—A sketch of the finished television receiver

When this state of affairs is reached, the synchronising equipment will come into action and maintain the image steady. If, however, the condition of synchronism is brought about with two sections of the image lying side by side, then increase the motor speed slightly until the images move slowly upwards and drift to the left. Let this go on until the double picture resolves itself into a single one, and then quickly bring back the speed of the motor to normal again. This is called phasing the image.

OBTAINING BRILLIANT PICTURES—(*Continued from page* 159)

A Current Surge

One of the aforementioned drawbacks of the mercury type lamp is the difficulty of striking it, and therefore some sort of momentary surge is necessary, which may be obtained by switching on and off the H.T. voltage, or, better still, from a low-frequency choke connected across the lamp with a small on-off toggle switch connected in series (Fig. 3).

The choke should of course be one with a fairly high inductance, the " back-kick " given by the choke when switched momentarily in to circuit will start the discharge.

Incidentally the normal current passed by a neon mercury lamp at 500 volts is about 50 milliamps, and it is unwise greatly to exceed this figure, as the life of the lamp will be considerably decreased.

Very recently there has appeared on the market a lamp similar in characteristics to the neon and capable of being worked at reasonably low voltages, for which, it is claimed, gives a white light.

Undoubtedly when considerably more experimental work has been done in combining various gases, it should be possible to produce a lamp giving a brilliant white light and having all the advantages of the neon.

The direct viewing of a black-and-white image would be a very great improvement, particularly on low-definition television, where the present black and orange of the neon is apt to become very tiring to the eyes.

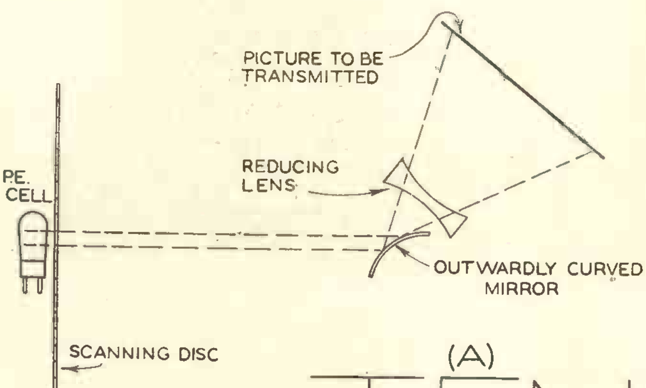
HIGH-DEFINITION WITH A DISC RECEIVER

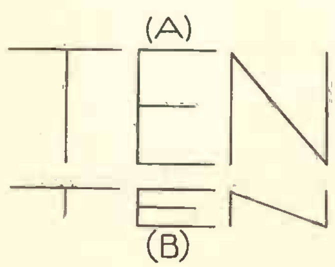
Television programmes will be transmitted on high-definition of at least 180 lines. This article makes useful suggestions for adapting a disc machine

IF television is to become as great an entertainment feature as is radio to-day, then it is obvious that only high-definition pictures must be transmitted.

The disc receiver is easily and deservedly the most popular type of television receiver in use to-day for reception of the 30-line transmissions given by the B.B.C., but it is practically useless for high-definition pictures, owing to the very small size of the received image.

To illustrate this statement, if we wish to receive a 30-line transmission, it is necessary to use a scanning disc





Figs. 1 and 2 (above).—Here the picture to be transmitted is reduced in size by the bi-concave lens, and then reduced or compressed in height but not in width by the outwardly-curved mirror. (Right).—An example of the effect that the curved mirror has upon the picture to be transmitted.

that has 30 holes punched around its periphery, and the distance between each scanning hole and its predecessor is exactly the length of the received picture.

Now to receive a 180-line transmission, we must use a scanning disc that has 180 holes punched in its periphery, which means that unless we make the scanning disc much larger, the received picture will be but one-sixth the length of the 30-line picture, owing to the scanning holes being so much nearer to each other.

Cathode-Ray Tube Receivers

The only alternative is to use a cathode-ray tube receiver, but if television is to become as popular as is radio, the television receiver must be cheap, simple and easily controlled, and the cathode-ray tube receiver, however good in performance, at present fulfils none of these requirements.

The mirror-drum receiver is, of course, quite useless for high-definition picture reception.

However, what seems to be a solution to the problem of devising a cheap and easy-to-control receiver for high-definition pictures has recently been invented by a Lancashire radio engineer.

It is a modification of a disc receiver, and one of the best features of the design is that the ordinary 30-line disc receiver could quite easily be adapted to this design.

At the Transmitting End

Now if you study Fig. 1 you will see that the picture to be transmitted is reduced in size by the bi-concave lens, and then reduced or compressed in height, but not in width, by the outwardly-curved mirror.

As an example of the effect that the curved mirror has upon the picture to be transmitted, turn to Fig. 2.

(A) in the illustration shows the picture before compression; and (B) shows what it looks like after compression.

The angles at which the rays of light strike off the curved mirrors in Figs. 1 and 3 are absolutely correct, and has been proved by both practice and theory.

The compressed image is now scanned by the 180-line scanning disc in the usual way, although of course, an even higher definition scanning disc could be used instead.

Now to return to the receiver. You will see in Fig. 3 that when the picture is first received it is still in the shortened or compressed form, but by the aid of the curved mirror it is stretched out to its original form.

Have you ever stood in front of one of those trick mirrors that make you appear either excessively short or tall ?

Well, the curved mirrors used in the transmitter and receiver work exactly on that principle.

One of the finest features of this system is that, although it enables the disc receiver to receive high definition pictures, it does not prevent the cathode-ray tube receiver from doing so, for as long as it is fitted with a correcting curved mirror it can do so just as well as the disc receiver.

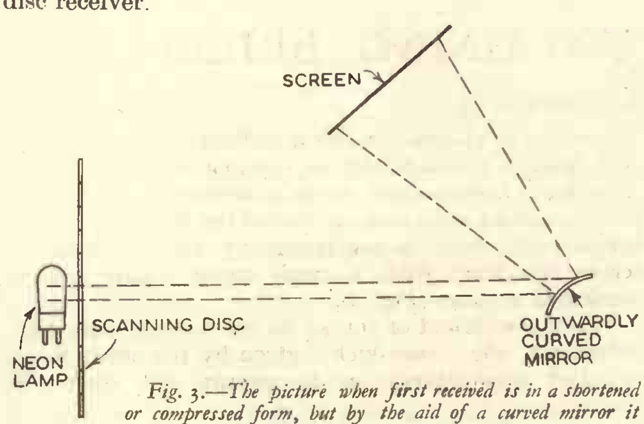


Fig. 3.—The picture when first received is in a shortened or compressed form, but by the aid of a curved mirror it is stretched out to its original form.

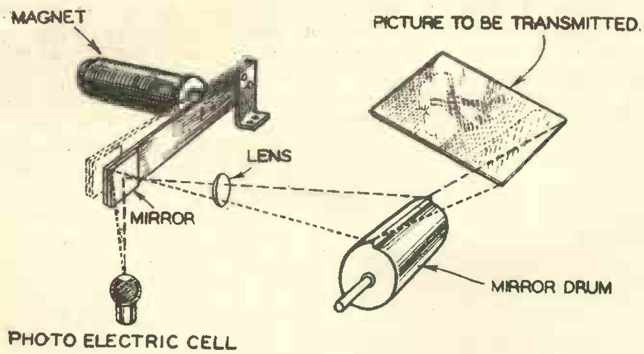


Fig. 1.—Showing the transmitting scanner diagramatically.

A NOVEL SCANNING SYSTEM

A combination of the vibrating mirror and mirror-drum systems

SOMETHING really new in television scanning systems has recently been invented by a Lancashire radio engineer. It is a combination of the vibrating mirror and mirror-drum systems, and can employ anything from 20 to 300 lines in the scanning of a picture.

In Fig. 1 the transmitting scanner is shown diagrammatically, and presuming that a 180-line picture is to be transmitted 16 times per second, a 2,880-cycle alternating current is fed into the coil of the electro-magnet, which then vibrates the steel strip, and the tiny mirror fastened to it at exactly that frequency. The mirror drum is now rotated at 16 revolutions per second, and thus the picture to be transmitted is scanned as in Fig. 2.

The Vibrating Mirror

It must be understood that as the mirror drum revolves it keeps reflecting different strips of the picture on the vibrating mirror, which then breaks it up into tiny spots of light and shade.

Thus, when the mirror drum is in the position shown in the illustration, the bottom strip of the picture is being scanned, but when it has made one complete revolution the top strip is scanned.

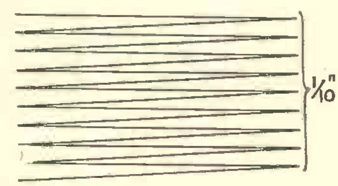
Now if we imagine that the photo-electric cell in Fig. 1 is a neon lamp, and that the picture to be transmitted is a ground glass screen, the transmitter immediately becomes a receiver.

An Important Feature

One of the chief features of this type of receiver is that it can reproduce any transmission, providing the transmitter employs this scanning system (no matter how many lines are used or how many pictures per second are given), simply by varying the mirror drum speed and the frequency of the alternating current fed into the magnet coil.

This type of receiver greatly resembles a cathode-ray tube receiver, in its ability to reproduce both high- and low-definition pictures by the turning of a knob, but, of course, it is much simpler, and would be far less costly, than a cathode-ray tube receiver.

Fig. 2.—Showing how the picture is scanned.



The alternating current fed into the magnet coil is generated by an oscillating valve, and provided that the magnet is placed close to the fixed end of the steel strip, a small movement of the opposite strip will cause a much larger movement of the mirror fastened to the end of it. Thus the mirror will be able to scan the length of the mirror drum quite easily, especially if there is a short distance between the mirror and the mirror drum.

E.M.I. TELEVISION ANNOUNCEMENT

ELECTRIC & MUSICAL INDUSTRIES, LTD., express very great satisfaction with the report of the Television Committee (extracts from which appear in these pages), which states that television broadcasting will be started in Great Britain. They expect that during the course of years television will become a very large industry in this country.

They assume, of course, that the B.B.C., who are to control this new development, will take the necessary steps in the shortest possible time to start the broadcasting of high-definition television.

As and when the B.B.C. begin broadcasting high-definition television, Electric & Musical Industries will be ready to market television receiving sets. They consider it too early to state at the present time what the price of these sets will be, but it is believed that the price mentioned in the Committee's report of £50 to £80 will be more or less correct.

It must be clear to everyone that in the early stages of this industry, as is true of any other new industry, the first years of working will be very largely experimental, and it will take some time before television is developed on a large commercial scale.

They quite agree with the Committee's report that radio sound broadcasting will still, for many a year to come, dominate the B.B.C. programmes. Moreover, they do not believe that television will in any way interfere with the developments in radio sound broadcasting with its ever-increasing entertainment value. Therefore their company, as well as all other manufacturers in the radio industry, are going right ahead with the development of the manufacture and sale of radio sets for sound.

A B C of Television

A Dictionary of definitions of the more important Television Terms.

(*Continued from page* 148 *February issue*)

CALCIUM TUNGSTATE.—Chemical formula: $CaWO_4$. A calcium salt of tungstic acid. Used in the preparation of fluorescent screens for cathode ray and other tubes. Under cathode-ray excitation it fluoresces with a bluish colour.

CALORIFIC RAYS.—The rays of the spectrum which give rise to heating effects. The infra-red rays.

Photo-electric (and also selenium) cells can be made so that they are specially sensitive to these heat rays. Upon the working of these cells is based the process of Noctovision, which see. From the Latin, *calor*, heat.

CAMERA TRANSMITTER.—Name given to various types of television transmitters by means of which the scene or view to be televised is focused directly on to a scanning device by means of a camera lens, natural lighting thus being employed for the transmission.

CANADA BALSAM.—A greenish-yellow resinous fluid obtained from certain North American fir trees. It hardens into a clear transparent solid which, dissolved in certain solvents, such as benzene or chloroform, is extensively used for cementing together the various components of lenses and other optical devices employed in television working. Its precise composition is unknown.

CANAL RAYS.—In the earlier forms of electric vacuum tubes it was observed by Goldstein that if, in place of a solid cathode or negative electrode, which emitted a stream of cathode rays, a perforated cathode was provided in the tube, a stream of rays was emitted from each perforation in the cathode, these rays proceeding in a direction *opposite* to that of the cathode rays.

Such rays, which were termed "canal rays," are streams of positively-charged particles. They produce characteristic luminous and electrical effects, but up to the time of writing, they have not been applied by inventors to schemes of television working.

CARLEY'S INSTRUMENT.—A crude form of television apparatus invented in 1880. Its transmitter consisted of a mosaic of small selenium cells, each cell being connected by a wire to a miniature electric bulb mounted in a corresponding mosaic of bulbs on the receiver. An outline image projected upon the transmitter was crudely reproduced upon the receiving mosaic, the electric bulbs varying in illumination intensity according to the amount of selenium cell resistance included in their circuits, this latter, of course, being controlled by the light falling upon the "active surface" of the transmitter.

The instrument, like the others of its period, was hopelessly impracticable.

CANDLE-POWER.—The unit of light for photometric work. It is the light given out by a spermaceti candle burning 120 grains per hour, the height of the flame being 45 mm., the flame being well shielded from draughts.

The following table indicates the candle-power of some well-known sources of illumination:—

	Candle-power
Bright sunlight	50,000–60,000
Arc lamp..	250–6,000
Electric filament lamp. (Household type) ..	10–120
Lime-light	100–600
Magnesium ribbon ..	100–200
Incandescent gas-mantle	40–60
Gas flame (Batswing burner)..	8–16
Oil lamp (flat wick type)	6–10
Light of full moon ..	1/500th aprox. (varies)

CASE CELL.—See *Thalofide Cell.*

CASELLI'S APPARATUS. — See *Pantelegraph.*

CATHODE.—Used in connection with photo-cell construction, this term refers to the negative electrode of the cell upon which the light-sensitive surface is formed and from which a stream of electrons is emitted by the action of light. See *Anode*.

CATHODE RAYS.—Name given to a stream of electrons which are emitted from the cathode, or negative electrode, of an electric discharge tube exhausted to a high degree of vacuum. They were first discovered by Sir William Crookes.

In 1899 Sir J. J. Thomson showed that the cathode rays were quite independent of the nature of the cathode used for their generation, and that they were, in fact, nothing more nor less than a stream of negative electrons travelling with a high velocity. It is upon this electron stream in a cathode ray tube of special design that many of the modern cathode-ray systems of television are based.

CATHODE-RAY TUBE. — A tube which consists essentially of a negative filament or cathode which is treated with an electron-emitting substance. Near the cathode is an anode, or "gun" as it is sometimes termed, consisting of a circular plate perforated with a central aperture. This is maintained at a high positive potential. As a result, the electrons which are emitted from the heated filament or cathode are violently attracted to the anode. Some of them pass right through the hole in the centre of the anode, and thereafter travel in the form of a beam outwards from the anode (being on their way controlled as regards direction by passage between two pairs of "deflector plates") until they reach the flattened end of the tube, where, by impinging upon a screen of specially-prepared fluorescent material, they manifest their presence visibly by causing the fluorescent material to glow strongly.

The cathode-ray tube is being used increasingly in some television systems. Previously it was employed for the examination of the wave-forms of alternating currents. Hence its other name, the "Cathode Ray Oscillograph."

CELL AMPLIFICATION.—A term used in connection with photo-electric cells of the gas-filled type to denote the ratio of the current which leaves the cathode of the cell under the influence of light to the current present at the positively-charged anode.

For an explanation of this difference in current intensity, see *Gas-Filled Cell*.

CHALCOPYRITE.—Another mineralogical name for *Copper Pyrites*, which see.

CHANCE GLASS.—Popular name sometimes given to small sheets of intenso blue glass which are opaque to ordinary light, but which pass ultra-violet rays quite freely. This glass, which is manufactured by Messrs. Chance Brothers, is often used as a light-filter in ultra-violet ray experiments.

CHEMICAL RAYS.—Name sometimes applied to ultra-violet rays on account of their photo-chemical action.

CHEMI-LUMINESCENCE.—A term referring to the generation of light by chemical action.

CHOPPER WHEEL.—A perforated or slotted wheel which, by revolving between a source of light and a light-sensitive cell, breaks up the continuous light beam into "pulses," which, impinging on the light-sensitive cell, give rise to a pulsating or fluctuating current. Synonym: *Light Chopper*.

CHOROID.—Anatomical term denoting the second layer or coat of the eyeball. It is composed for the most part of a network of veins and capillaries. See *Sclerotic*.

CHROMATIC ABERRATION.—An optical term referring to the inability of a lens to focus light rays of different colours on the same plane. The defect is sometimes known, also, as *chromatism*.

Lenses suffering from the defect of chromatic aberration give blurred images. Hence, for optical work, televisionary or otherwise, the lenses used must be suitably corrected for this defect.

From the Greek, *chroma*, colour.

CHROMATISM. — See *Chromatic aberration.*

CILIARY MUSCLES.—Small hair-like muscles which, acting upon the crystalline lens of the eye, vary the formation of the latter as regards curvature and depth, and thus enable an image to be focused clearly upon the retina at the back of the eye.

From the Latin, *cilium*, an eyelash—in reference to the extreme fineness of the muscles concerned.

CIRCLE OF LEAST CONFUSION.—A term which is used to denote the maximum diameter of the minute discs or points of light forming a projected image which is focused sharply. This diameter, in a sharply focused image, is not more than 1/100th of an inch. Television images, of course, at the present time, do not approach this degree of sharpness.

CLAUSTHALITE.—A metallic looking mineral, similar to Galena in appearance. It contains selenium in the form of lead selenide, and was at one time the source of selenium.

Named after Clausthal, a town near the Hartz mountains of Germany, where the mineral was first discovered.

CLOSE SCANNING.—Synonymous with "Fine Scanning," which see.

COARSE SCANNING.—The coarse scanning of an image occurs when the light-spot is of relatively large diameter, and when it covers the image in a comparatively small number of lines or sweeps. See *Fine Scanning.*

CODE PICTURE SYSTEM.—A crude method of transmitting pictures by wire or wireless, the picture to be transmitted being split up beforehand into a large number of small patches or areas, the degree of blackness of each patch being indicated by a previously arranged code letter which is telegraphed in the usual manner. After reception, the various transmitted letters corresponding to the different patches in the picture are decoded and subsequently pieced together and assembled into a rough reproduction of the original picture.

The method is an ingenious one, but it is entirely without practical possibilities, despite the fact that coded pictures of this nature have been transmitted across the Atlantic.

COGGED-WHEEL SYNCHRONISER.—See *Toothed-Wheel Synchroniser.*

COLLOIDAL.—Literally, "glue-like." The name given to materials such as glue, starch, albumin, etc., and to certain mineral substances which, when "dissolved" in water or some other solvent, do not pass through a porous membrane.

It can be shown that such "colloids" are not really dissolved in the water, but that they are, in fact, "suspended" or floating in the water in the form of extremely fine particles which do not settle. Such "suspensions" are often termed "colloidal solutions."

Many colloidal solutions of metals and their compounds have very interesting properties, including that of light-sensitivity, whereby they alter in electrical properties on exposure to light rays.

From the Greek, *kolla*, glue.

COLLOIDAL CELLS.—Name usually applied to certain types of light-sensitive cells which contain "colloidal solutions" of various compositions.

COLORIMETER.—An instrument used for comparing colour standards. It is employed, in one of its many forms, in connection with the preparation of colour-filters for colour television experiments and, also, for many other purposes.

COLOUR.—Colour is essentially due to the subtraction of some of the component rays of white light. If, for instance, we direct a beam of white light through a sheet of blue glass, the glass will absorb from the light beam all its constituent colours except blue. Consequently only blue light passes. If, however, a beam of red light is directed upon a piece of blue glass, no light will pass at all, for the blue rays (the only rays which the bluo glass passes) are absent from the red light.

In the same way, a ray of daylight falling upon the surface of a blue object will have all its constituent colours absorbed except blue. The object, therefore, will reflect back only blue rays, thus creating to itself a blue appearance. See *Spectrum.*

COLOUR-FILTER.—A coloured medium, usually comprising a sheet of dyed gelatine cemented between glass, which, when placed in the path of light rays, filters out unwanted rays, allowing to pass only rays of one colour or wavelength band. A green colour-filter, for instance, filters out all light-rays except those of a narrow band of wave-lengths which constitute green light.

Colour-filters are also known as "light-filters." They are employed in all systems of colour television.

COLOUR TELEVISION.—Systems of television in which the picture or image is obtained in an approximation to its natural colours. In the Baird experimental system of colour television, a triple scanning disc is used. This disc contains three spiral series of holes, the series of holes being provided with red, blue and green colour-filters respectively. By means of this arrangement, the picture is triply scanned.

(To be continued)

REPORT OF THE TELEVISION COMMITTEE

(Continued from page 166)

We must, however, repeat at this juncture, that we are concerned with the means necessary to start this service—to try it out and to set it on its feet—and not with its permanent financing as part of the British Broadcasting Corporation's general system. **From the former point of view the proposal, however logically justifiable, has the fatal practical defect that, if the licence fee is placed high enough even toe begin to cover the cost, it will strangle the growth of the infant service—while, if it is placed low enough to encourage growth, the revenue must for some time be purely derisory as a contribution towards the cost.** We do not, therefore, recommend that at the start of the service there should be any extra licence, but we think that the question should be reviewed when it is seen to what extent the use of the service has taken hold, and when the costs of further extensions of it can be more accurately estimated.

Wireless Exchanges (Radio Relays)

We have considered the question, which has been raised in evidence, of the relaying of public television broadcast programmes by Wireless Exchanges. We see no reason why such a practice, if technically feasible, should not be allowed under the same conditions as are applicable in the case of sound broadcast programmes.

Private Experiments and Research

We hope that encouragement will continue to be given to all useful forms of experiment and research in television by firms or private persons. It is true that much experimental work can be done by transmission from one room to another by wire without recourse to a radio link. In certain cases, however, the use of such a link is necessary; and we trust that . . . adequate facilities for experimental work will continue to be given.

T 3 See p. 162

Printed in Gt. Britain by THE AVENUE PRESS, 55-57 Drury Lane, W.C.2, for the Proprietors, GEO. NEWNES, LTD., 8-11 Southampton St., Strand, London, W.C.2. Sole Agents for Australia and New Zealand: GORDON & GOTCH, LTD. Sole Agents for South Africa: CENTRAL NEWS AGENCY, LTD.