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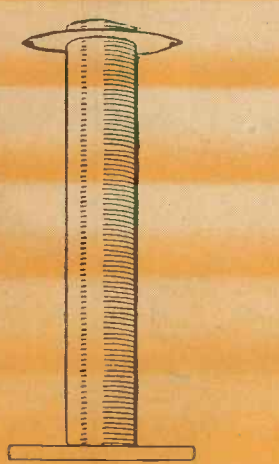
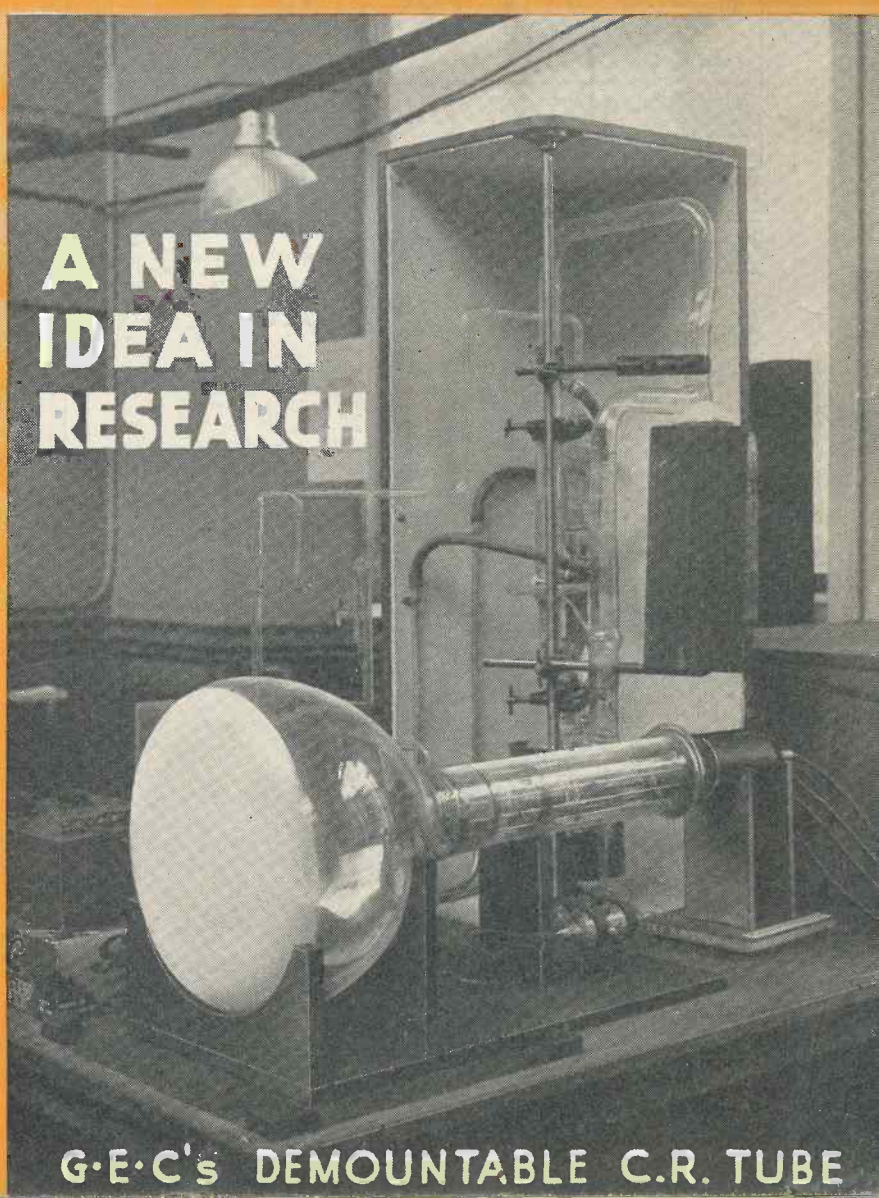


HOW THE CATHODE-RAY TUBE WORKS

SIMPLY EXPLAINED IN PICTURE

BROADCAST SHORT-WAVE THREE



No. 96 VOL. IX FEBRUARY, 1936.

TELEVISION and SHORT-WAVE WORLD

Special Features

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IMPORTANT

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COMMENT OF THE MONTH

George V.

WITH profound regret we place on record the death of George V, the King and Friend of English people throughout the world. All have learnt to know him as a man of broad mind and generous heart; as one who so ordered his life that in everything he did he strove to serve the interests of the countries and peoples over which he reigned; as, in short, the Father of His People. It fell to his lot to see the most amazing scientific development in the world's history. Ordered progress had in him a true friend, and we of TELEVISION AND SHORT-WAVE WORLD—its Editors, its Staff, and its Readers—have reason to mourn his passing.

George the King goes. Edward comes. The King is dead. Long live the King.

And the King who comes has a knowledge of men and things; an understanding, or an earnest desire to arrive at an understanding, of the world's problems; and much more than a nodding acquaintance with the scientific spirit of the age. It is highly probable that he is the only King alive who has spent many hours in watching a television demonstration and in enquiring into the whys and wherefores of the method and apparatus employed. He has spent the years of his youth and of his still early manhood in learning of his fellow men that he might the better rule them when his time came. He has already earned the confidence of the English people who, with respect and warm cordiality, bid him welcome to the Throne.

A New Service for our Readers.

THE reviews and summaries of the television patents which we publish each month by special permission of H.M. Stationery Office provide a concise and valuable record of progress and developments, and the many letters we receive regarding these indicate that they are very much appreciated by our readers. Equally, valuable sources of information showing the trend of development are the many authoritative articles which appear in the English, American and Continental technical journals. In very many cases these articles are isolated features which in all probability would not come to the notice of our readers, so it is our intention in future to publish abstracts of all those on television and allied subjects, together with full details of the origin. This, we hope, will enable readers to keep informed of the latest theory and practice. It should be noted that the length of the abstract will not necessarily be an indication of the quality of the article, and that the reviews are entirely unbiased and are issued for the sole purpose of giving our readers a résumé of current television literature. The first series appears in this issue.

HOW THE CATHODE-RAY TUBE WORKS

SIMPLY EXPLAINED IN PICTURE

A pictorial explanation of the construction and working of the Cathode-ray Tube, showing how it is used in the production of a television image.

On the right is a photograph of the electrode assembly of a cathode-ray tube and the diagrams which appear on this and the two following pages show the positions and functions of the various parts.

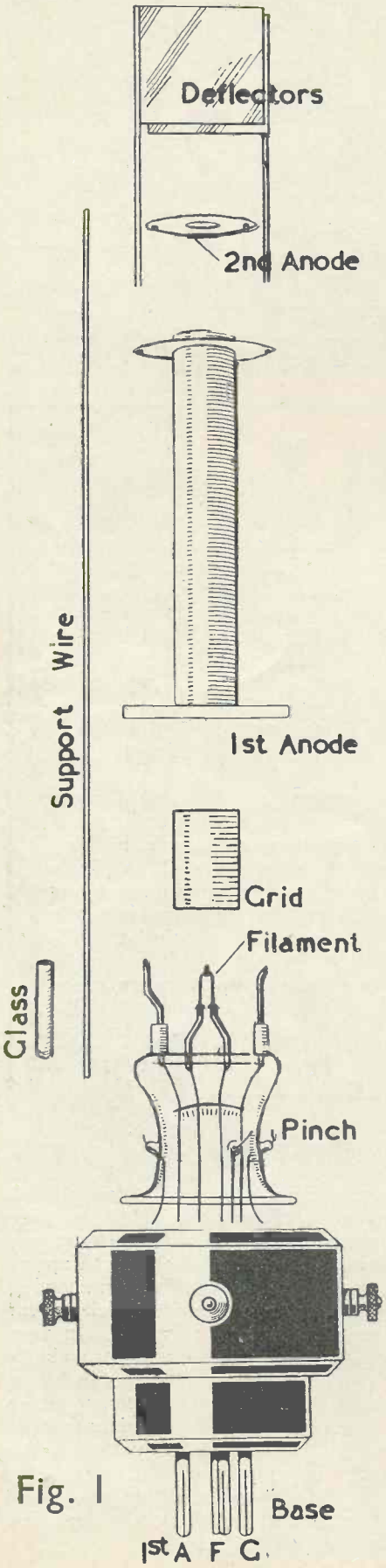


Fig. 1

FIG. 1.—The electrodes of the tube have been separated to show the assembly.

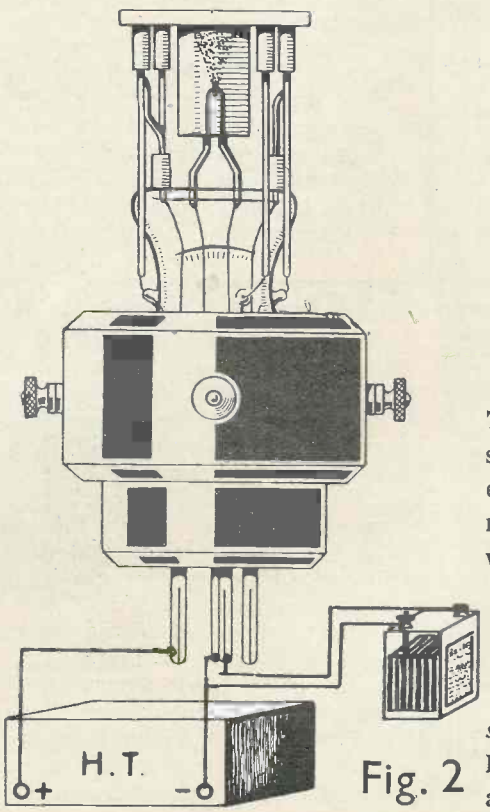
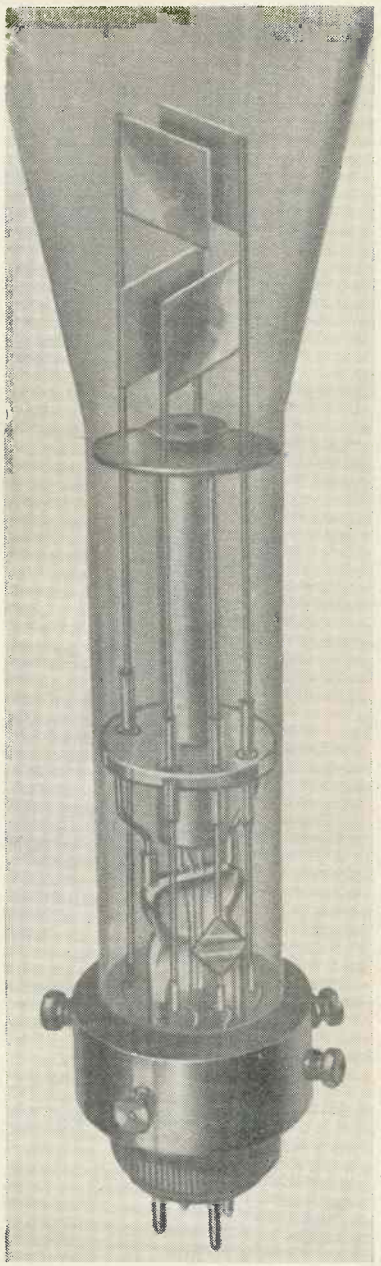


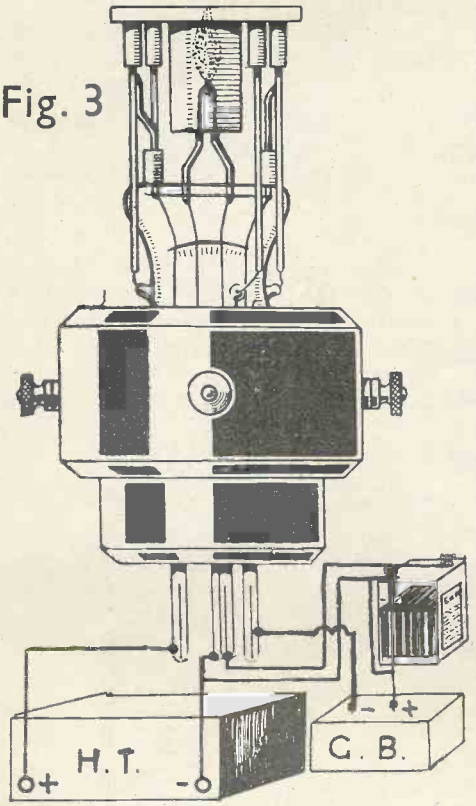
Fig. 2



This is an actual photograph of the electrode system of the Ediswan cathode-ray tube.

The *pinch* carries a filament, the source of electrons, a cylindrical electrode called the *grid*, from its resemblance to the grid of an ordinary valve, and the *first anode* which is a flat disc pierced with a small hole in its centre. The first anode is extended by the cylinder shown and at its end is mounted the *second anode*, a flat disc with a larger hole in its centre. Sometimes another anode is mounted above this one.

Fig. 3



Finally there are the deflector plates, two pairs of flat plates fixed above the second anode, the plates of each pair being parallel to each other. The two pairs are at right angles to each other. Only one pair of plates is shown in Fig. 1 for simplicity.

The electrodes are mounted on the support wires which are held rigidly in place by glass insulating sleeves and mica bushes. The supports are connected to the small wires round the side of the pinch, which pass through the glass and are joined to the terminals of the base.

FIG. 2.—When the filament is connected to an L.T. battery and a positive potential is connected to the first anode, electrons leave the filament and pass to the anode. Owing to their high speed some will pass through the hole in the anode, but the majority will flow to the metal and form an anode current as in the thermionic valve.

FIG. 3.—If a negative bias is applied to the grid or control electrode, it will have the effect of compressing the electron stream so that more electrons pass through the hole in the anode and very few remain on the metal. This makes the tube more efficient. If the grid bias is increased sufficiently the stream will be cut off altogether, and it is this property of the grid which is used in producing the black-and-white shades of the television picture.

FIG. 4.—Here the electrons have passed through the hole in the anode and are proceeding up the tube. As they pass up they tend to get further and further apart instead of remaining in a compact jet, and it is necessary to bring them back to a thin line to form a small spot on the

Fig. 4

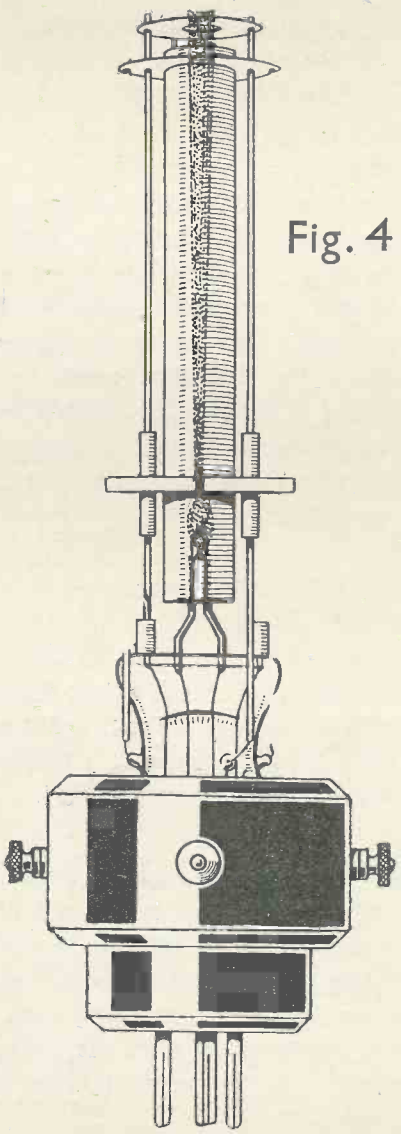
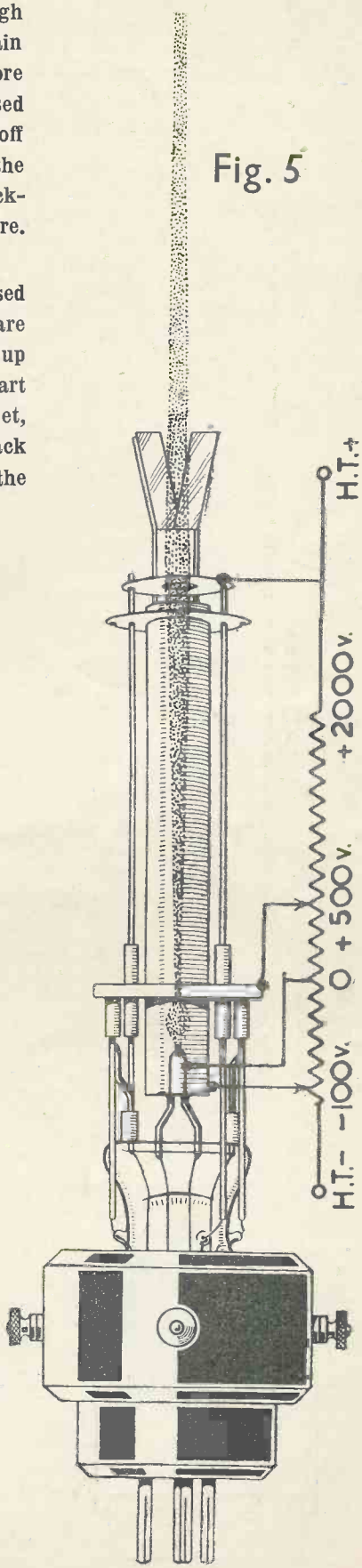


Fig. 5



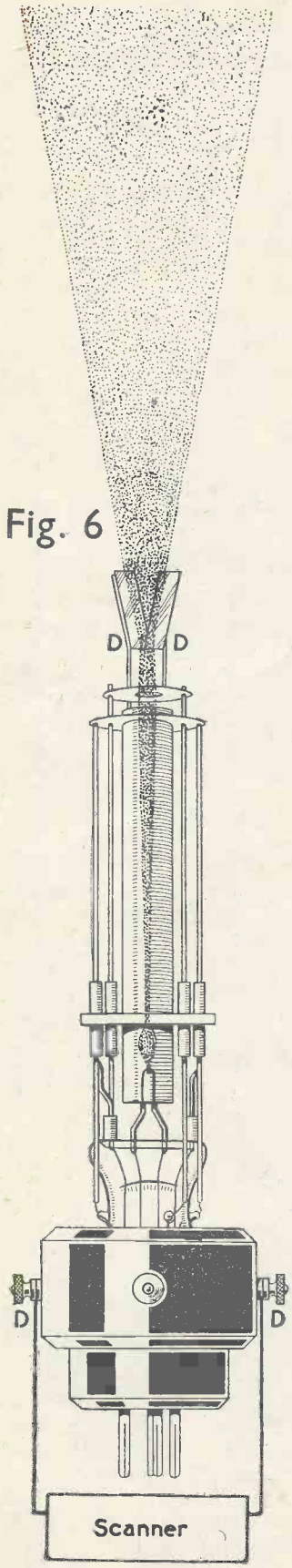


Fig. 6

end of the tube. This is done by applying a high potential to the *second anode*, which is seen at the end of the cylinder. The electric field between the second and first anodes compresses the electrons so that they are focused on the screen as in Fig. 5.

FIG. 5.—The H.T. potentials for focusing the beam are obtained from a chain of resistances connected across a high-tension supply. The tappings are shown at the side of the diagram, the grid being negative to the cathode and the anodes increasingly positive. The values will vary with each type of tube. In this diagram one pair of deflector plates is seen above the second anode, and if an alternating potential is applied to these plates the beam will be deflected as it passes through them.

FIG. 6.—A rapidly changing potential is applied to the deflector plates from the scanning circuit, and the beam is spread out as it passes through the plates DD. To produce a high-definition (240) line screen on the end of the tube the beam has to be moved across the screen in 1/6000 of a second. The scanner is designed to produce this deflection regularly and uniformly in one direction, while a similar circuit moves the beam in a direction at right angles to this at a rate of 25 times per second (25 pictures per second).

FIG. 7.—Here the beam is acted on by both pairs of deflector plates and is drawing the line screen on the end of the tube. The compound on the end of the tube fluoresces where the electrons strike it and a series of white lines are drawn as a framework on which the picture is reproduced.

The last stage is to apply the signal from the television receiver to the grid of the tube as the beam is swinging to and fro, and thus modulate the intensity of the lines as they are drawn. The black and white patches then form the picture if they occur in the same sequence as in the transmitter.

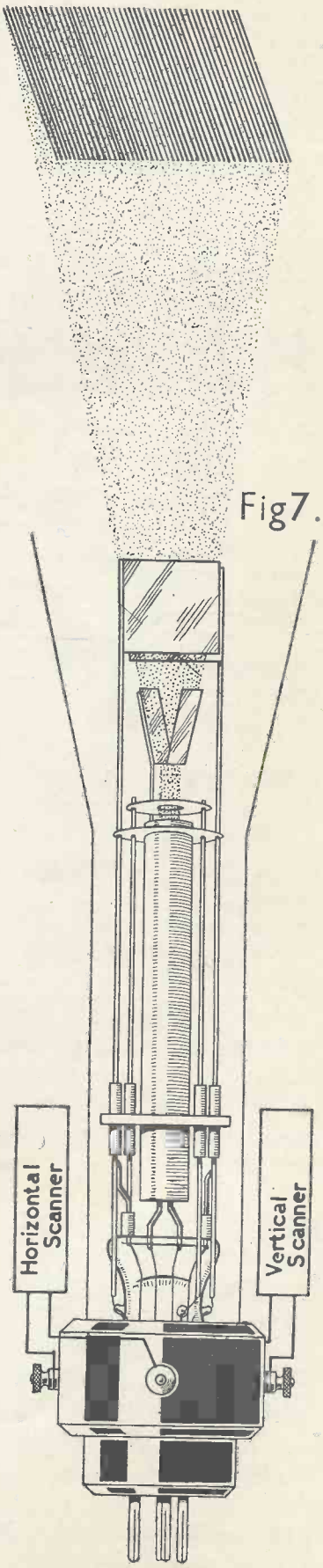


Fig7.

ELECTRONICS AT THE PHYSICAL SOCIETY'S EXHIBITION

THE 26th annual exhibition of the Physical Society at the Imperial College, which concluded on January 9, was, unlike previous years, confined to visitors who had received invitation tickets. This action on the part of the Council was probably dictated by the wish to avoid any tendency to commercialisation of the exhibition and to confine it to *bona fide* scientific workers, but it must have deprived many readers from seeing a representative collection of some of the finest British instruments and apparatus for research.

No research work in television or television apparatus was shown with the exception of the educational display described below, but there were many instruments to interest the radio enthusiast, of which we can only give a brief summary.

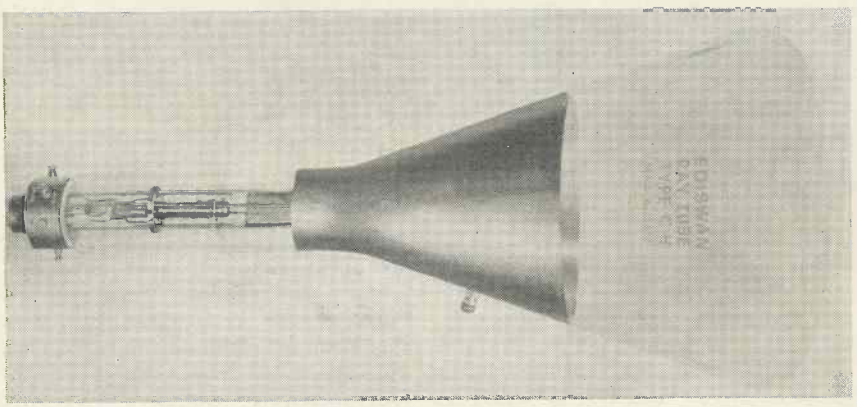


Fig. 1.—The Ediswan 10 in. tube for television, giving black-and-white pictures.

It is interesting to note the rapid development of cathode-ray tubes and apparatus as exemplified by the stands of the Cossor Co., Ediswan Co. and Standard Telephones. A number of large diameter high-vacuum tubes specially designed for television were shown, together with apparatus for research on wave-forms, frequency stabilisation, and internal combustion engines!

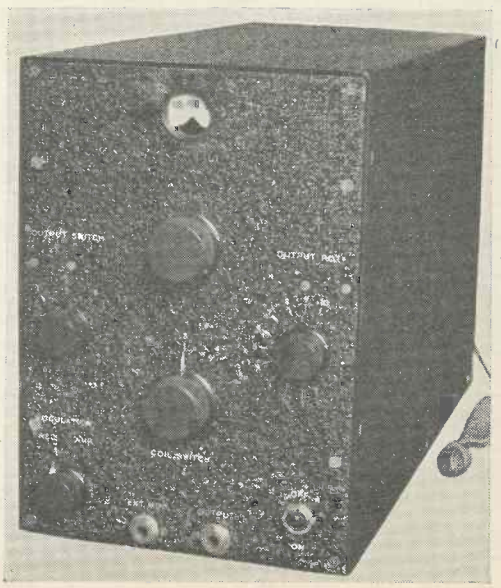
The 10-in. tube of the Ediswan Company is shown in Fig. 1. This is available at a list priec of £12 net and has a screen giving a creamy fluorescence for reproducing "black-and-white" pictures. The H.T. voltage required is approximately 3,500, and the cathode is indirectly heated from a 2 volt winding on the transformer.

Also on this stand were transmitting valves of 250 and 500 watts dissipation specially designed for short-wave working down to 5 metres, together with a new power amplifier, the ES.100, of 100 watts dissipation, in a hard glass bulb.

Another large cathode-ray tube with a 13-in. screen was seen on the Cossor Company's stand in company with an interesting range of complete cathode-ray tube equipments. Readers will remember that a portable equipment made by Cossor was on view at Olympia last year. The portable mains-operated unit shown in Fig. 2 has now been added to the range, and includes a valve ampli-

Fig. 2 (left).—Cossor mains operated oscillograph with self-contained valve amplifier.

Fig. 3 (right). — Oscillator for use in ganging I.F. stages in receivers.



fier to increase the sensitivity of the deflecting system. The time-base frequency covers 2 cycles per second to 300 kc. per second and waves of as high a frequency as 100 megacycles can be observed. The price complete is £75.

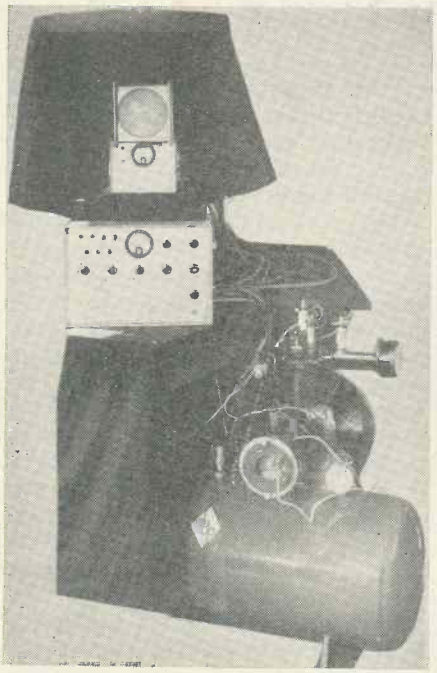


Fig. 4.—The oscillograph equipment used as an engine indicator (Messrs. Standard Telephones & Cables).

The same company were exhibiting a new form of " ganging " oscillator for use in conjunction with the oscillograph to determine the response curves of I.F. stages or overall receiver performance. The oscillator covers all the normal bands from 90 kc. to 20 mc. and the frequency can be varied over ± 15 kc in exact synchronism with the sweep voltage applied to the horizontal deflector plates. The oscillator can also be modulated externally or at 400 cycles from an internal source, and is thus useful as a signal generator (Fig. 3).

The cathode-ray tube has proved of the greatest use in mechanical engineering in showing the performance of internal combustion engines. The pressure variations in the cylinder are translated into electrical impulses either by a quartz crystal or by discs of resistance material which alter under compression. The pressure unit is made up in a convenient form and screwed into the cylinder head, leads being taken to the tube deflector plates. The horizontal movement of the beam is made proportional to the piston displacement and is obtained from a timing device connected to the engine shaft. The Cossor electronic engine indicator is sufficiently robust to enable it to be used for testing aircraft engines in flight.

A similar indicator equipment was being demonstrated by Standard Telephones on an air compressor (Fig. 4).

The tube can be seen at the top of the photograph, surrounded by a hood to shield it against glare, while below it is the control unit. The pressure units can be seen at the top of the cylinder head with wires leading to the equipment.

A different type of cathode-ray apparatus is that shown in Fig. 5, manufactured by Messrs. Tinsley. The tube is designed by M. Szegho and the principles of its operation were described in a recent paper before the Institution of Electrical Engineers* by the designer, Prof. Parker Smith, and Mr. Bradshaw. The cathode is " cold," i.e., does not operate at red heat, and the electron stream is produced by the application of a very high potential to the anode. The beam is focused by a magnetic coil. One of the advantages claimed for the tube is long life due to the special construction of the cathode. This is in the form of a sphere of aluminium which is loosely held and can be rotated by tapping the tube. When the surface of the cathode becomes damaged by the electron discharge it is a simple matter to present a new portion of the sphere to the anode. For fuller details the paper referred to below should be consulted.

Very interesting exhibits were found in the research section, where the Post Office had taken considerable space to demonstrate their new loud-speaking telephone. The microphone and receiving loudspeaker are mounted together as one unit, and speech is clearly audible although the

* Journal I.E.E. Vol. 76, p. 656, 1935.

Fig. 5.—Cold cathode oscillograph of special design made by Messrs. Tinsley.

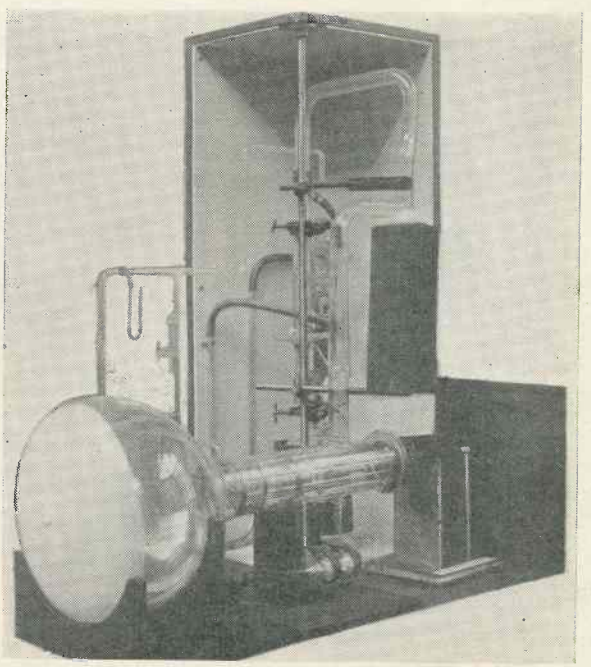


Fig. 6.—" Electron-Optica Bench " (G.E.C.) with vacuum pump for investigating cathode ray tube performance.

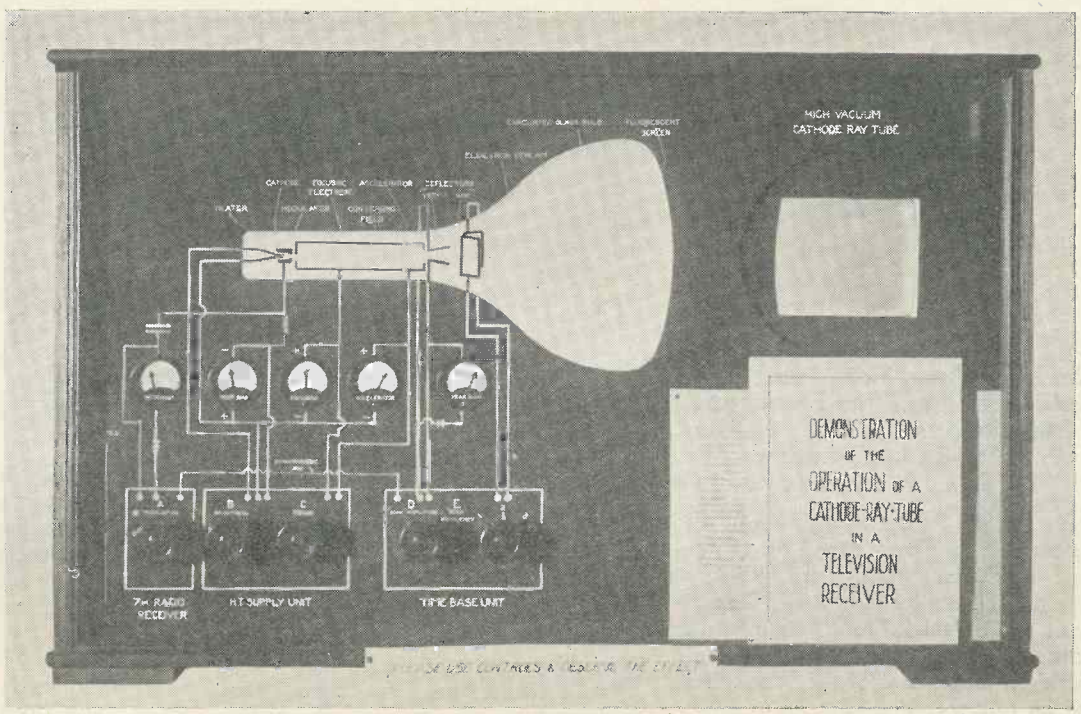


Fig. 7. — Television demonstration board made by the General Electric Co. to show the principles of cathode ray television.

speaker is standing some two feet away and lowering his voice.

The intricate apparatus which comprises the " talking clock " was also on view. It will be remembered that the " girl with the golden voice" spent many hours in recording the time for reproduction on demand by telephone subscribers. The sounds are recorded on a series of glass discs through which light is shone on the conventional photo-cell arrangement. One disc is devoted to the utterance of the hour, the next the even minutes, and finally seconds. The formula heard on the telephone is " At the third stroke it will be . . hours, . . minutes and . . seconds," followed by three pips.

In this section Messrs. Ferranti had an ingenious mechanical model to demonstrate the action of an amplifying valve circuit, and a model of a transmission line to show the various factors which affect the quality of transmitted speech,

The British Thomson-Houston Company in addition to showing the effect of fluorescent materials in mercury vapour discharge lamps had an improved stroboscopic lamp which gave remarkable results. The lamp illuminated three discs rotating at high speed on which were painted various patterns. The characteristics of the vapour lamp which illuminated them were such that they gave the impression of being absolutely stationary, and in one case it was possible to read faint pencil writing on the disc while it was running at several thousand r.p.m.

The General Electric Co. had two exhibits in the research section of interest to the television enthusiast. The first was an " electron-optical bench " which is shown in the photograph of Fig. 6. A cathode-ray tube with a ground glass joint at the lower end of the neck is attached to a mercury vapour pump which maintains a constant high vacuum. The electrodes of the tube are made adjustable and removable so that any combination or spacing can be tried. Twelve rods pass up the tube, making contact with the various electrodes and these are connected to terminals in the base of the tube. The apparatus was designed for investigation into electrode systems and for studying various fluorescent materials, and can be opened up, altered and repumped in the short time of 30 minutes.

The television demonstration board shown in Fig. 7 is another product of the Wembley Research Laboratory of the G.E.C. and is intended for educational work to show the principles of cathode-ray television reproduction. As the photograph shows a large section of a cathode-ray tube is outlined against a black board and the various circuits connected to it are shown diagrammatically by white lines. The controls on the front of the apparatus are arranged to operate a 12-in. tube of which the screen is seen at the right of the board. The behaviour of the real tube is illustrated by the working model, the various potentials being indicated by the meters shown below the tube.

A realistic imitation of the electron beam is produced in the sectional model and the changes effected by the controls can be seen simultaneously on both the real screen and the model. The following operations were illustrated:

Modulation, brightness, focus, picture size, picture and line frequency. It is hard to conceive a more effective demonstration that this working model and it is to be hoped that similar ones will be available for instructional work in the radio industry.

Space does not permit a detailed description of the remainder of the exhibits—the new Kodak " Pola " screen which eliminates glare from objects in front of a camera—precision variable condensers by Sullivan —apparatus for every kind of receiver test by E. K. Cole, and many others. It is hoped that many readers will have the opportunity of visiting this unique scientific exhibition next year and seeing for themselves the way in which British manufacturers keep in the front of the field of radio and engineering development.

Scannings and Reflections

By THE LOOKER

Justifying the Service

IN the course of a conversation with Sir Noel Ashbridge, the B.B.C.'s Chief Engineer, the other day, a most interesting point was raised. If a costly experimental service had to be justified by sales of television receivers, it is questionable whether, in the early months, the service could be maintained. Speaking in general terms, there are no receivers in the hands of the public capable of receiving high-definition television. The manufacturers are working more or less in secret at the moment and getting ready, but it is idle to pretend that there is any appreciable number of adequate receivers ready at this moment to receive broadcast television. Sir Noel told me, however, that in his opinion, the experimental service will be justified for some considerable time irrespective of sales. The service itself, if it is on the right lines, will create the demand for the receivers, and with the demand will soon come the supply. This is in the natural order of things; give the public something to look at, they will naturally want to see it and the means of seeing it will promptly come in the ordinary course of commerce.

The Question of Range

Sir Noel Ashbridge says that the range of London's television station can be safely put at 25 miles. Very safely indeed, I should say. But he points out that reception is certain to be patchy and there will be spots within the 25-mile range where reception will be poor and, just as surely, places well out of the 25 miles where reception will be good.

The Choice of System

As everybody knows, the introductory service will be worked by two systems—the Baird and Marconi-E.M.I.—operating in alternate weeks. But it does not follow that these are the only systems which the B.B.C. will try. The choice or change of system is entirely one for the Television Committee under whose general instruction the B.B.C. is working. In the course of conversation, Sir Noel Ashbridge made the point that if any new systems are developed it is probable that they will be tried out in the provinces, although as far as present intentions go it is not proposed to erect any provincial stations until the B.B.C. has had a full year's experience at the Alexandra Palace.

By the way, both of the initial systems of transmission will use the same sound transmitter and, of course, the same transmitting aerial. Work on the erection of the aerial-mast is just beginning. The internal alterations to the Alexandra Palace are all but complete and the first of the gear is about to be installed. I learn that Baird's are building their plant at the Crystal Palace, and Marconi-E.M.I. are building theirs at Hayes, Middlesex, and at the Marconi works, Chelmsford.

A Television Party

There was a television party at the London Press Club a couple of months or so ago, as readers of TELEVISION AND SHORT-WAVE WORLD will remember. Now I hear that Lady Selsden, whose husband is Chairman of the Television Committee, is proposing to give a private television party at a date to be chosen in the very early weeks of the experimental service.

"Make-up" for Televising

Mlle. Suzanne Bridoux, who was the first lady to be televised from the new Paris-P.T.T. television station, says that blondes and people with angular faces "go over" badly. Angular faces throw shadows which give the effect of side-whiskers, which reminds me that two or three years ago television had the trick of adding a moustache to people possessing a rather prominent nose. Mlle. Bridoux says that the technique of make-up has altered in the last two years; then, all she did was to accentuate the line of the lips and eyes with the same pencil—rouge—which, she says, caused the lips to show white when transmitted. After that, green eyes and lips were tried. Experimenting is still going on, but at the moment the popular make-up consists of violet lips, red eyelids, dark red complexion, eyes elongated outwards, dark eyebrows. Apparently, the cheeks are not touched-up with rouge.

"Visiogenic"

Mlle. Bridoux says that the most "visiogenic" face (the B.B.C. calls it the "photogenic" face) is round, with a dark complexion and dark eyes. "Television is capricious," says she, "and it is not always the most beautiful women who televise the best."

The Coming Programmes

Many statements have been published of the B.B.C.'s intentions with regard to the television programmes, but at the moment all programmes put forward are merely suggestions in which there is the element of guessing and it is quite certain that there will be considerable modification brought about by circumstances and experience. Obviously, there can be no thought of any standardised programme for the whole country until very considerable working experience has been obtained.

Renewal of German Service

On January 15 the German Broadcasting Company re-opened their regular high-definition television service in Berlin. Sight is broadcast on 6.772 metres and sound on 7.053 metres. Programmes consist of direct television of light entertainment by well-known artists and of excerpts from latest film releases together with actuality films. Definition is 180 lines and the number of frames per second remains at 25. The addition of direct television which permits of the transmission of head-and-shoulder pictures of one person or the two heads of two persons greatly enhances the entertainment value of the programme. The German Post-Office, which is now solely

MORE SCANNINGS . . . . . .

responsible for the entire technical side of the service, intend fitting a new type of photo-cell to the direct television apparatus within the next few weeks and this will permit of groups of up to three people being televised.

The opening programme, which lasted about an hour and a half, featured the well-known German "compère" and humorist Willi Schaeffers, Else Elster treated listeners to the latest popular songs whilst Carl de Vogt provided entertainment with songs which he accompanied himself on his lute. In contrast to the Paris television broadcasts, the direct television apparatus used does not require the thousands of candle-power of light. The person to be televised sits in a small, dark cabin, and only notices a slight flicker as the scanning ray passes over his head and shoulders.

Experimental

The authorities have publicly declared that the television service is *purely experimental,* but that they hope the public will make full use of the free facilities provided in eleven public televiewing rooms in various parts of the city to witness the programmes. These are broadcast daily from 8 p.m. to 9 p.m. and are repeated from 9 p.m. to 10 p.m. To accustom Berlin listeners to ultra-short-wave broadcasting ordinary sound programmes relayed from the Deutschlandsender are broadcast daily from 5 p.m. to 7.30 p.m. and from 10 p.m. to midnight. (Berlin local time).

Receivers are not available to the public at the present moment in view of the various technical improvements which it is hoped to realise in the course of the year. Higher definition is aimed at and the question of interlaced scanning is under consideration.

Foreigners Excluded from Viewing German Television

The Telefunken Company was able to complete the two new German high-definition television transmitters to take the place of those destroyed by the fire last August, in three months' time. On December 23 these were handed over by the German Post Office to the Ministry for Propaganda for operation by the Broadcasting Company. Foreign press representatives were excluded from those invited to witness the proceedings in some of the Berlin public televiewing rooms. The German Ministry of Posts stated that this was owing to reasons of German national defence.

The transmitters are situated at the foot of the Berlin-Witzleben radio tower and vision is broadcast on 6.772 metres, sound on 7.053 metres. The pictures are of 180-line definition with 25 frames per second. The power of the transmitter is the same as that of the old Witzleben installation, about 16 kW anode dissipation in the last stage.

The German Broadcasting Company's extended high-definition programme service was officially inaugurated on January 15, 1936. The Deputy Director of German Transmissions, Herr Boese, who is in charge of the programmes, has appointed a well-known Berlin actress as television announcer. Scenes scanned directly will be broadcast as well as films.

Film Interests Apprehensive

As I have already pointed out in earlier issues, the film interests are somewhat apprehensive regarding the effect of television on their industry —very prematurely, as I think—and they have arranged to restrict the broadcasting of feature films, but we understand there has been no actual contact between the B.B.C. and the interests concerned. The B.B.C. does not wish to televise long films, its present intention being to put over three-minute excerpts. But the possibility is borne in mind of the B.B.C. having to make its own arrangements for the production of suitable films should there be difficulty in obtaining these from the usual sources. The making of films for the special purpose of television would prove an extremely costly business. The estimate is from £1 to £2 per foot, and it is thought that to cover the field thoroughly the annual cost of specially produced films might approximate £120,000 per annum.

Will Television Borrow Much from the Films

I hear that D. H. Munro, the television production manager, is going to study film production at Shepherds Bush, and I am led to wonder if there is not a tendency to regard film production and television as being too similar. We must not forget that in television one has to present the programmes continuously while in film production a scene rarely lasts more than a minute or so, with colossal breaks in which all apparatus can be arranged.

Quality of Sound Broadcast

Sir Noel Ashbridge told me that the sound broadcast from the Alexandra Palace will be of better quality than the ordinary B.B.C. broadcast, but made the point that the *received* quality must be dependent upon the design of the receiver, and in the case of the ultra-short-waves, which will be employed in the Alexandra Palace transmission, this design raises some very difficult problems owing to the high frequencies involved.

Starting Date

The latest information bears out the statement made many months ago in TELEVISION AND SHORT-WAVE WORLD—and, by the way, made by TELEVISION AND SHORT-WAVE WORLD alone—that the new station will be in going order in March, when the first tests will be made. The B.B.C. expresses its opinion that the progress so far made indicates that this date will be kept. Provisionally, a test period of two months has been allowed for and there is every hope that the full service will be in operation not later than June.

In Sweden

Sweden, taking its systems and apparatus from the German Telefunken, is erecting a 12-kilowatt ultra-short-wave transmitter for television, and purely experimental transmissions are expected within the next few months.

In the U.S.A.

I learn from the American *Radio Craft* that National Broadcast Chain engineers have been dismantling the old television equipment in the tower of the Empire State Building, preparatory to installing new and modern equipment which will shortly be in operation. The plan calls for the manufacture of some 500 receivers of four different designs (giving 9 in. × 10 in. pictures) which will be placed in research outposts

and the homes of observers to facilitate a complete check on the system. It is expected that one of the four designs will be chosen for manufacturing purposes. The images will be sent out over a 15 kW transmitter on a wavelength of about 6 metres.

Viewing Rooms

The B.B.C.'s present intention is three transmission periods each day, namely, 3 p.m. to 4 p.m. in the afternoon, 6.15 p.m. to 7.15 p.m., and 9.30 p.m. to 10.30 p.m.—three hours in all, and the B.B.C. are inviting the big stores, newspapers, radio manufacturers, etc., to arrange viewing rooms each accommodating about 20 people, where the public can taste the quality of the new service. And the B.B.C. propose to adapt the programme accordingly by introducing as many topicalities as possible in their programme. It is hoped that at least 20 or 30 of these viewing rooms will be at the service of the London public.

The Photo-cell for Testing Oil

A new use for the photo-electric cell is the testing of oil that has been used in motor cars.

Oil in a crank case is subject to many sources of contamination, such as carbon, metallic particles, road grit and sludges from the breakdown of the oil itself. When this contamination reaches a certain point the oil should be drained and replaced. In the new device a sample of the oil is placed between two colour filters located a certain distance apart. A source of light illuminates this uniform section of oil, the amount of light that penetrates to reach the light-sensitive surface being read on a meter, and according to the reading, it is claimed, the conditions of the oil can be ascertained.

"Some Television Developments"

Under this title Mr. Geoffrey Parr, a member of the Edison Swan technical staff, and a well-known contributor to TELEVISION AND SHORT-WAVE WORLD, addressed the Midland Radio Luncheon Club at Birmingham recently. His address ranged generally over the subject of television, but in view of the special character of his audience had particular reference to servicing.

Dr. Zworykin Coming to London

Dr. V. K. Zworykin, inventor of the electron multiplier and television "electric eye," developed by the Radio Corporation of America with which the Marconi-E.M.I. is associated, has responded to a cabled invitation of the Institution of Electrical Engineers to lecture before the Wireless Section in London on February 5, states *Wireless World*. Dr. Zworykin had intended to deal with the applications of electrical and optical systems, but it is hoped that he will be induced to discuss his electron multiplier. This is his second visit to London.

Still 30-line in Australia

Many inquiries are being received by the trade from abroad for television apparatus, particularly transmitters of a simple type. Australia appears to be specially interested and one experimental station is in operation there. The system is a duplicate of the B.B.C. 30-line 12-pictures per second and the station is in the old Brisbane Observatory Tower and operates for an hour each day on 151 metres.

Secret Facsimile Transmission

A method of secret facsimile transmission for telephone lines and radio was announced last month by the famous French television pioneer—Edouard Belin. He has presented his invention to the French War Department and guarantees that messages, even though they are intercepted by wire tapping or radio reception, will be so garbled that they will be absolutely incomprehensible to the unauthorised receiver.

Physical Society's Exhibition

As usual this proved a most interesting event, although unfortunately no television was exhibited, but only cathode-ray tubes and associated equipment. As one interested in television I spent most of the time at the exhibit of Kodak's Pola Screen, a gelatine type of filter which obscures polarised light. Two sections of the screen can be used like a pair of Nicol prisms. Unfortunately, the Pola Screen appears to have arrived rather late for television unless there is a revival of the Kerr cell light valve. However, bear it in mind the next time you want to produce polarised light.

"Transmission for the Beginner"

(*Continued from page* 86).

serious experiments are to be undertaken. L3 should be a coil of the same dimensions as L2 but without the centre tap. It is tuned with a .00025-mfd. condenser and has a 20-ohm non-inductive resistance and a ½-amp. hot-wire meter in series across the coil. In this way R.F. can be measured just as if it were being sent out.

If the transmitter is to be used on 160 metres no alterations need be made except that L1, L2 and L3 have to be much larger and suitable for this waveband. As a guide, approximately 35-turns will be required on a former of about 2½-in. diameter. The four high-frequency chokes can be home-built without any difficulty. An article describing the construction of suitable chokes was published on page 212 of the April, 1935, issue. Suitable coils were described on page 611 of the October issue, while those who wish to save 15s. by making their own crystal holder will find just how to do this on page 488 of the August issue.

The use of P625 is suggested simply because it is such a stable valve and it is economical in use. However, it would not mean any alterations to use a smaller valve, such as the P240 type.

The amplifier for this transmitter is quite simple and follows conventional receiver practice. It consists of a carbon microphone with its own built-in transformer coupled to an HL/210 triode valve. This is R.C. coupled to a P215 used as a driver valve for a Cossor 240B amplifier. With this circuit more or less full modulation will be obtained with quite a reasonable current consumption. Before connecting the amplifier to the transmitter connect the loudspeaker across the points marked A and B and check for quality. If this is satisfactory then the points marked A and B should be connected as shown. Actually the output transformer has its secondary connected in series with the H.T. supply to the P625. Do not get confused and imagine that two transformers are necessary.

This transmitter is suitable for use from H.T. accumulators or large-capacity dry batteries, but of course those who have D.C. mains or an A.C. mains unit available can obtain even more satisfactory results. A maximum output of about 6 watts can be obtained which is ample for most experiments.

PHILIPS PHOTO-ELECTRIC CELLS

WITH NOTES ON CELL CHARACTERISTICS AND OPERATION

Philips' Vacuum Cell.

PHILIPS photo - cells are made in two main types —the vacuum and gas-filled. Both kinds consist of a glass envelope containing two electrodes. One of these, the cathode, is coated with a thin layer of metal (potassium, caesium etc.); this metallic coating emits electrons when light impinges upon it. Should the potential of one electrode be positive compared with that of the other, a flow of electrons will occur from the less positive electrode to the other—the anode.

The Vacuum Cell

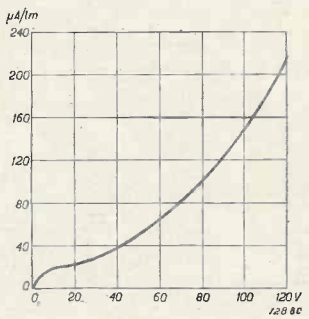
The anode current of the vacuum cell is dependent only on the intensity of the impinging light. The fact that the relation between anode current and the light—i.e., the sensitivity—is constant with anode potentials from 70 volts upwards, renders vacuum cells particularly suitable for accurate measurement and for use in photo-electric amplifiers.

The Gas-filled Cell

In a gas-filled cell, collisions occur between the gas particles and the electrons emitted by the cathode. As soon as the latter have attained a certain velocity, further electrons will be liberated from the gas-particles and will pass to the anode; each denuded gas particle, having become a positive ion, passes to the cathode.

The value of the anode voltage determines whether, after the first impact, the secondary electrons have sufficient velocity to atomise in their turn the gas particles, etc. The collisions increase in number as the anode voltages is raised and, at the same time, the number of ions having sufficient velocity to separate electrons from the cathode, on collision therewith, increases.

If this tertiary production of electrons is equal to the primary flow which produced the ions, a continuous electron-current, limited only by the resistance of the circuit, will ensue; a glow discharge will then occur in the cell, or, with small resistances, an arc discharge. These phenomena have a detrimental effect upon the photo-electric cell and, therefore, an anode-voltage which may not be exceeded is fixed for each gas-filled cell. In addition, a resistance of about .1 megohm is to be connected in order to afford protection against arc discharges. These actions, of course,



Curve showing sensitivity as a function of anode potential.

are common to all photo-cells of this type.

The diagram indicates to what a high degree the sensitivity of the gas-filled cell increases when the anode voltage is raised. A potential of 100 volts may safely be applied on the anode without having any detrimental effect on the life of the cell. A voltage of 120 is permissible when the lighting is faint (under .02 lumen). In order to facilitate adjustment it is advisable to make the anode voltage adjustable by means of a potentiometer. If the cell has been exposed to light for a considerable period its sensitivity may have decreased. Such decrease will be of a temporary nature, however, as the cell recovers entirely when placed in the dark.

It will be clear that the gas-filled cell exhibits much higher sensitivity than the vacuum cell if the loads are equal. For this reason it is suitable for purposes which call for large variations in photo-electric current, rather than a high degree of accuracy.

Philips' Gas-filled Cell.

The sensitivity of photo-electric cells is not identical over the whole range of the spectrum, but is always greatest in one particular wavelength band. When the cell has a potassium coated cathode it is especially sensitive to green light (5,400 A); with caesium coating it is chiefly sensitive to infra-red (7,000 A). It is, therefore, necessary to consider the colour of the light which will fall on the cathode when selecting the type of cell to be used. The sensitivity of the Philips photo-electric cell is based on a colour-temperature of 2,600° K.

The photo-electric cathode is able to follow light-fluctuations of almost any speed. The vacuum cell has a very small self-capacity and has therefore practically no inertia; the inertia of the gas-filled cell is somewhat greater, but it can efficiently follow fluctuations of 10^5 Hz.

Bulgin Anode Connectors.

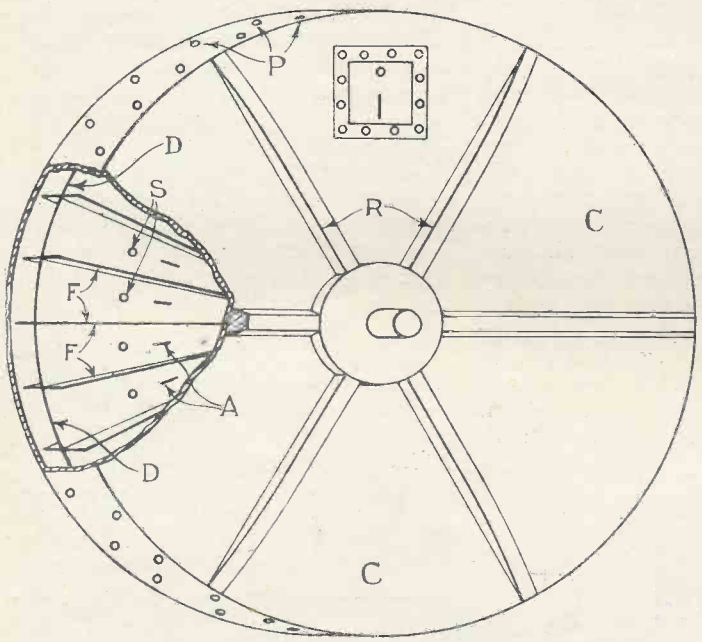
SEVERAL new anode connectors have been added to the already extensive Bulgin range of gadgets. Model P41 is a simple clip-on adaptor to which a wire can be clamped or soldered. It has been priced at twopence for three. A similar type of connector, but fitted with an insulated sleeve, costs 1d. and is designated the P43. A third model, fitted with a screw-head and called the P66, costs 3d.

Two further top connectors are available for plug-top valves, one with a shallow cap to prevent short-circuits through metal coating, and the second with a deep cap so an earth return can be made through the coating when required. They have been designated P64 and P65 respectively and cost 6d.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS
Specially Compiled for this Journal

Patentees:—J. D. Percy and Baird Television, Ltd. :: Cie de Compteurs :: Marconi's Wireless Telegraphy Co., Ltd., L. E. Q. Walker and W. E. Bonham :: Radio Akt. D. S. Loewe :: C. S. Agate :: A. C. Cosser, Ltd. :: Telefunken Co.



Casing for high-definition scanning disc. Patent No. 435,637.

Scanning Discs

(Patent No. 435,637.)

In high-definition work difficulty is experienced when driving a scanning-disc at speeds of the order of 6,000 revs. per minute owing to the effect of air-friction. It has already been proposed to overcome this difficulty by enclosing the disc inside an evacuated casing.

As an alternative method the scanning disc D is formed with radial fins F which force the air inside the casing C out through small apertures P formed in its periphery. The fins are so placed that they do not interfere with the passage of light through the spiral scanning holes S, or through the synchronising apertures A. The casing is strengthened by external ribs R.—(*J. D. Percy and Baird Television, Ltd.*)

Film Television

(Patent No. 435,749.)

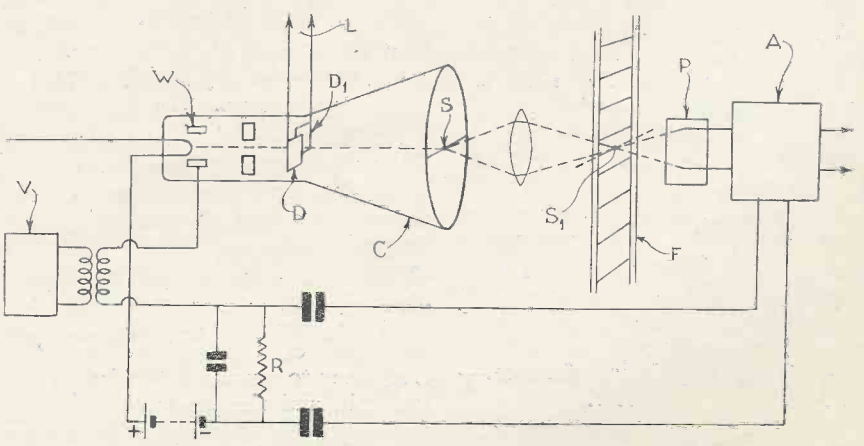
The film to be televised is scanned at high speed by the spot of light formed on the screen of a cathode-ray tube, and part of the resulting signal voltage is rectified and fed back to the control electrode of the tube, so that the brilliance of the scanning spot is automatically adapted to the transparency or tone-value of the particular part of the film being scanned.

As shown in the drawing, the spot of light S on the screen of the cathode-ray tube C is focused at S1 on the film F, which is continually fed forward at a constant rate. The resulting current produced in the P.E. cell P is amplified at A, and part of the rectified voltage is fed back, and applied through a resistance R to the control electrode W, where it automatically regulates the intensity of the spot S as the background tone-value of the film changes. A carrier-wave is superposed on the picture signals by applying high-frequency impulses to the electrode W from a valve generator V. Deflecting voltages are fed to the electrodes D.D1 from the leads L.—(*Cie des Compteurs.*)

Modulating Systems

(Patent No. 435,814.)

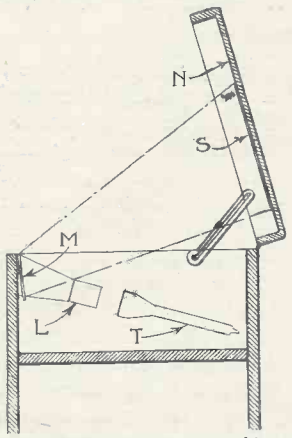
One method of modulation used in cathode-ray television is to cause the electron stream to traverse the fluorescent screen at constant speed and to regulate its intensity by the picture signals. Another method is to keep the stream at constant intensity, and



Method of televising films. Patent No. 435,749.

to apply the picture signals so as to increase or decrease the speed at which it passes over the surface of the fluorescent screen.

The method now put forward is to cause the area of the spot formed on the screen to vary in sympathy with the received signals, so that for dark signals the area is small, whilst for high-light signals it is large. The total intensity of the spot is kept constant at all times. The required result is secured by applying the picture signals so as to vary the voltage of the first anode and the screen in opposite directions, in accordance with a given formula.—(*Marconi's Wireless Telegraph Co., Ltd., L. E. Q. Walker, and W. E. Benham.*)



Arrangement of viewing screen in cabinet. Patent No. 436,301.

Simplified Synchronising

(Patent No. 436,142.)

Instead of producing the necessary synchronising voltages independently at each receiver, they are distributed from a central transmitter on a separate carrier-wave from that used to radiate the picture signals.

Oscillations of line and frame frequency are superposed on a single carrier-wave, and at the receiving end are rectified and passed through suitable filter-circuits to the control electrodes of the cathode-ray tube. The synchronising carrier wave is preferably not far removed in frequency from the picture-signal carrier. This helps to simplify the receiving circuits, and at the same time avoids the possibility of the two waves being subjected to different types of atmospheric interference.—(*Radio-Akt. D. S. Loewe.*)

Viewing Screens

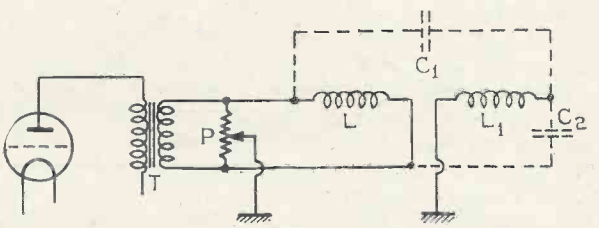
(Patent No. 436,301.)

In a television cabinet the cathode-ray tube T is arranged in a shallow compartment normally closed in by the lid N. During reception the lid is swung back to a practically-vertical position, as shown, and the picture appearing on the fluorescent screen is then focused by a lens L on to a mirror M, which reflects it forward to a sheet S mounted conveniently for observation on the inside of the lid. The sheet S consists of white or silver-coloured paper or cloth. The mirror M may be mounted on a drawer slide which can be moved out so as to increase the length of the light path between the tube T and the viewing screen.—(*C. S. Agate.*)

Preventing Halo Effects

(Patent No. 436,543.)

When the fluorescent light produced on the screen of a cathode-ray tube is viewed from outside, a considerable amount of internal reflection occurs at the air-glass boundary. The light so reflected may set up halo effects which tend to blur the clearness of the picture. In order to prevent this, the wall of the tube near the screen is made hollow, and the space is filled with a transparent fluid whose index of refraction is the same as that of glass, so that the critical angle of reflection is such that no light can be thrown back on to the fluorescent screen surface. Alternatively the fluorescent material is deposited on a thin mica sheet separated from the end of the tube by a small distance.—(*A. C. Cossor, Ltd.*)



Using magnetic deflecting coils for cathode beam. Patent No. 436,622.

Cathode-ray Receivers

(Patent No. 436,622.)

A difficulty which is not at first sight apparent will sometimes cause unsatisfactory performance in a cathode-ray tube of the kind using magnetic deflecting-coils. It is due to capacity coupling between the two pairs of coils, which, in spite of the coils being set at right angles, tends to cause currents of line-scanning frequency to pass into the frame-control coil, and vice versa.

To prevent this, the secondary winding of the transformer T feeding, say, the line-deflection coil shown at L is tapped at P to ground. The capacity coupling C1, C2 between the line-deflecting-coil L and the frame deflecting-coil L1 can then be balanced out by suitably adjusting the position of the tapping point P.—(*Telefunken Co.*)

Summary of Other Television Patents

(Patent No. 435,574.)

Increasing the ratio of signal strength to interference when amplifying photo-electric currents.—(*D. M. Johnstone* and *Baird Television, Ltd.*)

(Patent No. 435,623.)

Varying the characteristic relations between the modulating voltage and the electron current in a cathode-ray tube.—(*L. F. Broadway* and *W. F. Tedham.*)

(Patent No. 435,639.)

Compensating distortion due to the varying brightness of the spot on the fluorescent screen of a cathode-ray receiver.—(*General Electric Co., Ltd.*, and *D. C. Espley.*)

(Patent No. 435,815.)

Kerr-cell circuit in which high-frequency attentuation due to the capacity of the cell is eliminated.—(*Marconi's Wireless Telegraph Co., Ltd.*, and *E. F. Goodenough.*)

(Patent No. 436,160.)

Television system in which the light-source consists of the fluorescent effect produced by the electron stream of a cathode-ray tube.—(*C. Lorenz Akt.*)

(Patent No. 436,189.)

Cathode-ray tube in which the electrostatic deflecting-plates are made with bent-back ends in order to correct picture distortion.—(*Telefunken Co.*)

Patent No. 436,314.)

Electrode arrangement in a cathode-ray tube receiver designed to eliminate the so-called "white cross" effect on the fluorescent screen.—(*Fernseh Akt.*)

(Patent No. 436,650.)

Producing synchronising signals with a steep wave-front and interspersing them between the picture signals.—(*G. B. Banks* and *Baird Television, Ltd.*)

Photo-electric Cells

Appreciation

Our Readers' Views

Decline in Inventions

Five-metre Transmission

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

Photo-electric Cells

SIR,

With reference to the article on photo-electric cells which appeared on page 50 of your issue for January, 1936, we should like to call your attention to a statement which is made in the first column on this page concerning the sensitivity of the caesium type gas-filled photo-cells.

The emission of 15 microamps. per lumen is extremely low for a gas-filled cell, and for the type we manufacture, which is shown in the first illustration, the sensitivity at the working voltage under a gas magnification of 10 is at least 75 microamps. per lumen and may be three or four times this figure.

The statement, therefore, is rather misleading, particularly when referred to the gas-filled type of cell. Although the figure would be correct as an average one for a vacuum cell, we are now producing regularly vacuum cells which have a sensitivity of 25 to 35 microamps. per lumen, some going up to as high as 50.

THE GENERAL ELECTRIC CO., LTD.,
R. C. WALKER
(Osram Photo-cell Department).

Decline in Inventions in 1935

SIR,

We regret to have to report a decline in the number of patents applied for during the year 1935. It is estimated that approximately 36,100 applications for patents on inventions will have been filed by the end of 1935, as compared with 37,409 in 1934. Figures for several previous years are as follows:—36,117 in 1931, 37,052 in 1932, and 36,734 in 1933, the peak being 39,898 in 1929.

The number of patents applied for has by some people been regarded as an indication of the state of industry, but this is evidently not a sound view to take seeing that notwithstanding the continued improvement in trade during the present year, fewer patents have been applied for during this period.

During the present year we have found that activity persists in inventions relating to sensitising dyes used for photographic purposes, whilst in the radio industry there has been continued activity in connection with short-wave receiving sets and components, possibly in view of the prospect of commercial broadcast television. The effort which has been made by the authorities to secure greater road safety has been reflected in the many patent applications which have been taken out in respect of speed indicating devices, road signals, etc.

GEE & Co. (London, W.C.2).

Appreciation

SIR,

Allow me to congratulate you on your fine publication TELEVISION AND SHORT-WAVE WORLD.

I am a "new recruit" to your large number of subscribers, your November issue being, unfortunately, the first I have had the pleasure of reading. I have read almost every wireless and television book on the market, but find yours the best of all, as it is so instructive and easily understood by the non-technical wireless fans. I will be very proud to join your "Constructors' Circle" and to wear the membership badge. I have placed a regular order with my newsagent.

H. HASTINGS (London, S.E.)

Mr. Eustace Robb

SIR,

In the last few months we have heard a great deal about the B.B.C.'s plans for the new television studios, and have had intimate details about the private and public lives of the staff who are to direct the wonderful programmes which are promised to the public.

One name, however, seems to be conspicuous by its absence, and that is the name of Mr. Eustace Robb. Can it be that the B.B.C. have already forgotten the wonderful work which Mr. Robb did in organising practically single-handed, and often I believe in the face of opposition, the programmes which used to delight us in the old 30-line days? Surely it was not too much to expect that such pioneer work should have been rewarded by appointing Mr. Robb to a high position in the new personnel, but so far his name has not even been mentioned.

I do not know anything about the policy of the B.B.C., and it is quite possible that Mr. Robb has already declined the honours which the grateful Corporation have no doubt wished to thrust on him, but I think that the majority of your readers would join with me in paying a tribute to one who has been responsible for their entertainment in the past, and to assure him that his name will not be forgotten.

J. W. STEEVENS (Highgate).

Five-metre Transmission

SIR,

I cannot see how any amateurs could say that my report on the 2PB 5-metre transmission was inaccurate. It was accurate, and I would have them know that I have a written QSL from Mr. J. F. Stone, B.R.S. 2,038, of 91 Erskine Hill, N.W.11, to the effect that he heard my five-metre transmission on a one-valve super-regen. Please publish this as it confirms the Portsmouth-London contact. That 2PB was working without authority does not alter this Portsmouth five-metre record. I have the B.R.S. 2038 report before me now. He gave me QSA 4/5, T9, R4 with the remarks fb O.M.

On Tuesday, December 3, at 10 a.m., I asked if any 40-metre phone station which could listen on five-metres would co-operate. G2PB said if I would give him five minutes to rig up his 56-mc. superhet he would listen in. Meanwhile he said he would put on a record which he did. Then he came on and said he was ready. I then sent phone and one C.W. high note on 5.18 metres for ten minutes. He answered on 40 metres and described the transmission perfectly. On a subsequent second test he had a two-valve super-regen. put on without aerial and heard me O.K. I understood him to say that he used to operate in Devonport but was now in London. He said he was sorry he could not send on 56-mc. We carried on until after 11.30. Next morning B.R.S. 2,038 sent his report which verified the London contact. According to his talks and report 2PB is well versed in these matters. Please emphasise the B.R.S. 2,038 written verification—it

is important. My only fears are that this publicity will get some well-intentioned person into trouble. By the way, have you noticed that he has not been on since then? He announced himself as G2 Paris Brussels. I have my ideas on the location of 2PB and am following up. About 2PB not being allowed to work on 40; this can be met by saying that we are not allowed to work on 30--metres but there is nothing to stop us from dropping down to that to help someone we may hear calling, if we care to risk it!

ALBERT PARSONS (G6PU).
Municipal College, Portsmouth.

Television Kits for Home Construction.

APPRECIATING that a demand will shortly arise for units for high-definition television receivers, the Mervyn Sound & Vision Co., Ltd., have developed several of these in more or less complete form so that home-constructors will be able to purchase component parts or units of any part of the receiver. Included in the complete units are a 3,000-volt high-tension unit, a double time-base and a 7-valve vision receiver.

The high tension unit has an output of 3,000 volts and includes a winding for the tube heater for A.C. mains. It is complete in cadmium plated steel chassis including rectifier valve. This is completely assembled and ready for use, and the price is £6 os. od.

The double time-base is in kit form without valves and relays, but including cadmium plated steel chassis. The price of this is £6 10s. od. An H.T. and L.T. unit to operate the above can be supplied complete with thermal delay switch, etc., at an additional charge.

The vision receiver has seven valves, single dial control, and incorporates separate output for synchronising. This is completely assembled on a cadmium plated steel chassis, employing a triode heptode valve. The price of the complete receiver ready for operation is £16 10s. od.

In addition to the above the Mervyn Co. have developed two ordinary short-wave units. One of these is a converter adaptor for either mains or battery operation which is available in a metal case without valve at 42s. This is assembled ready for use. This unit employs a special coil and a switch is incorporated on the metal panel to provide the wave-band switching. The tuning condenser has brass vanes and the end plates are of a special low-loss high-frequency material. The reaction condenser has brass vanes and is fitted with a 9-1 slow motion drive. When used with an ordinary broadcast set having at least one H.F. valve stage (pretuned to 1,800 metres) it is an efficient self-oscillating converter and makes an ideal short-wave super heterodyne.

The second short-wave unit is an A.C. mains type triode heptode pre-selector amplifying converter covering 13-52 metres. The triode heptode pre-selector amplifying converter can be used with practically any type of receiver and is operated from the A.C. mains. It has its own filament transformer. High-tension is obtained from the broadcast set with which it is used in conjunction. It may be operated several feet away from the broadcast set. This is priced at 70s.

An illustrated list will be sent on request.

When to Listen for Short-wave Stations during FEBRUARY

By C. J. Greenaway—G2LC.

G.M.T.	3.5 mc.	7 mc.	14 mc.
0100	W1	SU; YI; ZB1	
0300	W3		
0400	W3, 4	W1, 3, 5	
0500	W1, 2, 3, 4	W1, 2, 3, 8	
0600	W1, 2, 3	W2, 3, 8	
0700	W1, 2, 3, 8	HC; SU; W2, 3, 4, 8; ZL	W9; ZL
0800	W1, 3	CN; FA8; HH; VK; VP4; W1, 2, 3, 4, 6, 8, 9; ZL	FA8; SU; YI; ZL
0900		VK; ZL	FA8; SU; YI; ZD; ZL
1000			FA8; SU; VK; VU; YI; ZB1; ZC6; ZD; ZL
1100			FA8; SU; VK; YI; ZB1; ZC6; ZD; ZL
1200			VK; VP2, 5, 6; W2
1300			FA8; SU; VE1, 2, 3; VK; VP5, 6; VS6; W1, 2, 3, 8, 9; YI
1400			VE2; VK; VP5; VQ4; VS8; VU; W2, 3, 8, 9; YI; ZD
1500		KA; VK; VS6	FA8; SU; PK; VE1, 2; VQ4; W2, 3, 8, 9; YI; ZD
1600		FA8; KA; VK; VS6, 7; VU; ZL	PK; VE2, 3; VQ3; W1, 8, 9; ZD
1700		VK; VS7; VU	VE1, 2; W1, 2, 3, 8, 9; ZD; ZS-U
1800		VK; VQ4; VS7; VU; YI; ZB1; ZC6; ZS-U	FA8; W1, 2, 3, 4, 8, 9; ZS-U
1900		SU; VK; VQ3, 4; VS7; VU; ZB1; ZD; ZE1; ZS-U	VE2; W1, 2, 8, 9
2000		FA8; SU; VK; VE1; VS7; VU; W1, 2; YI; ZB1; ZS-U	TI; VE2, 4, 5; W1, 2, 8, 9
2100		CN; FA8; SU; VE1; VK; VU; W1, 2, 8; YI; ZB1; ZC1; ZS-U	FA8; VE2, 4, 5; W1, 2, 3, 8
2200		FA8; SU; K4; VE1; VP5, 6; VQ4; W1, 2, 3, 4, 8, 9; YI; ZB1; ZE1; VU	VE2, 4, 5
2300		CM; FA8; K4; TI; VK; W1, 2, 3, 4, 8, 9; ZB1	
2400	W1	W1, 2, 3, 8	

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