

NEW TELEVISION SERVICE: WHEN IT WILL START

TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

and **SHORT-WAVE WORLD**

MONTHLY 1/-

OCTOBER, 1935.

No. 92. Vol. VIII.

BERNARD JONES PUBLICATIONS LTD.,
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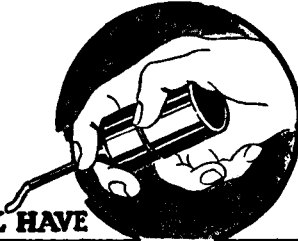


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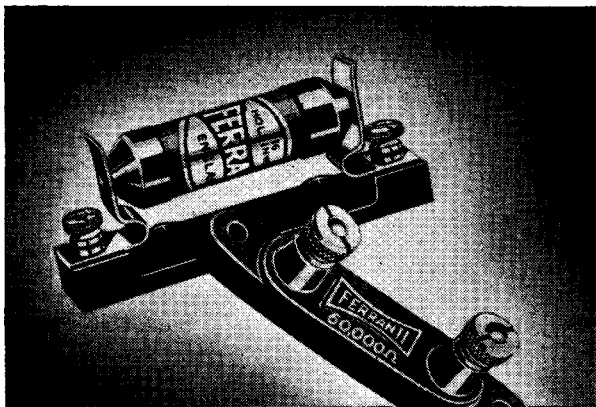


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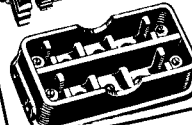
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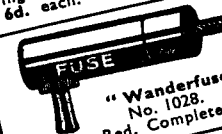
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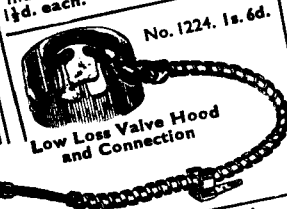
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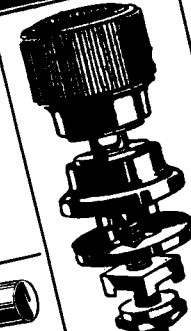
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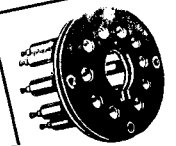
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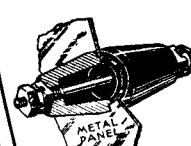
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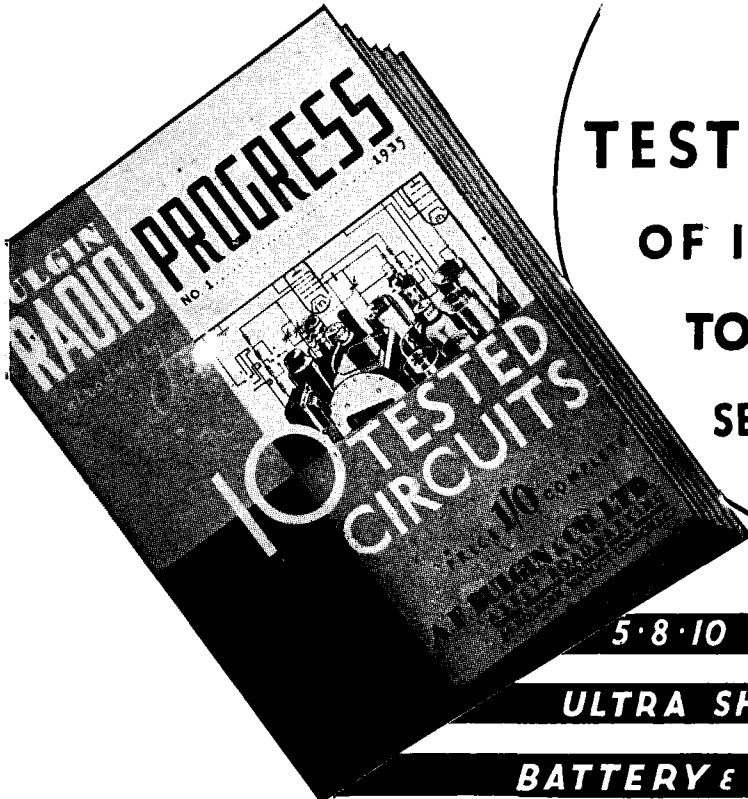
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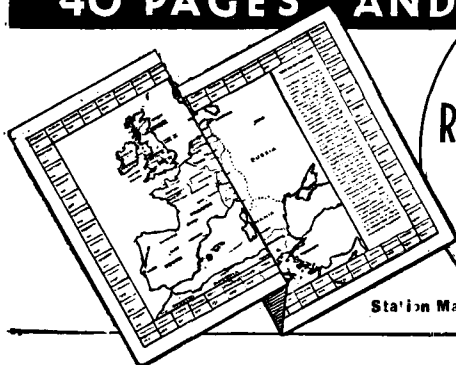
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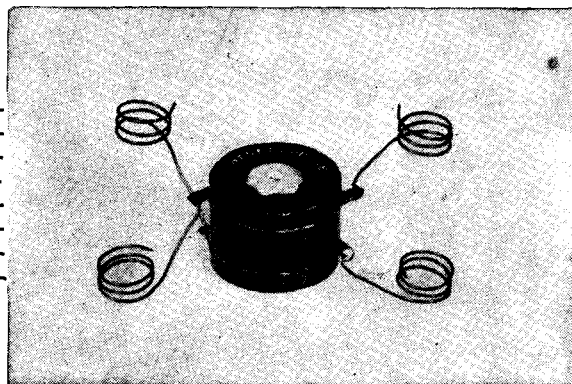
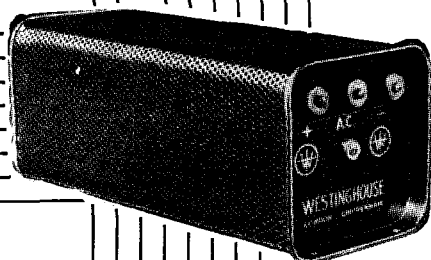
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TELEVISION

and SHORT-WAVE WORLD

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TELEVISION AND SHORT-WAVE WORLD

Proprietors :

BERNARD JONES PUBLICATIONS, LTD.

Editor-in-Chief :

BERNARD E. JONES.

Editor :

H. CORBISHLEY.

Editorial, Advertising and Publishing Offices :

Chansitor House, 38, Chancery Lane, London, W.C.2.

Telephones : Holborn 6158, 6159

Telegrams : Beejapee, Holb., London.

Subscription Rates : Post paid to any part of the world—3 months, 3/6; 6 months, 6/9; 12 months, 13/6.

Published Monthly—1/- net.

(Last Wednesday in every month for following month).

Contributions are invited and will be promptly considered. Correspondence should be addressed according to its nature, to the Editor, the Advertisement Manager, or the Publisher, "Television and Short-wave World," Chansitor House, Chancery Lane, London, W.C.2.

IMPORTANT

"Television and Short-wave World" is registered at the General Post Office, London, for transmission to Canada and Newfoundland by Magazine Post.

COMMENT OF THE MONTH

A Fine Record.

ON other pages in this issue we present a survey of the development of the engineering side of 30-line television. No one who reads this can fail to appreciate what astonishing progress has been made, even within the limitations of what is now regarded as an elementary system. If such development is possible within a comparatively short time along an obviously restricted line, it augurs well for the progress that is likely to be made by the new service when it comes into being. It would not be fitting to let the 30-line service terminate without a word of praise for the B.B.C. staff who have been responsible for it. Only those who have been constantly in touch with the executive in the television studio and control room at Broadcasting House are aware of the unbounded enthusiasm of both producer and engineers. A new technique had to be developed which necessitated the closest collaboration between both sections and a thoroughness has been observed in rehearsals and presentation which to the average observer would appear to be thrown away. We could hazard a guess that there has been a lower percentage of adverse criticisms of the television broadcasts by those who made use of them than there has been in any other department of broadcasting.

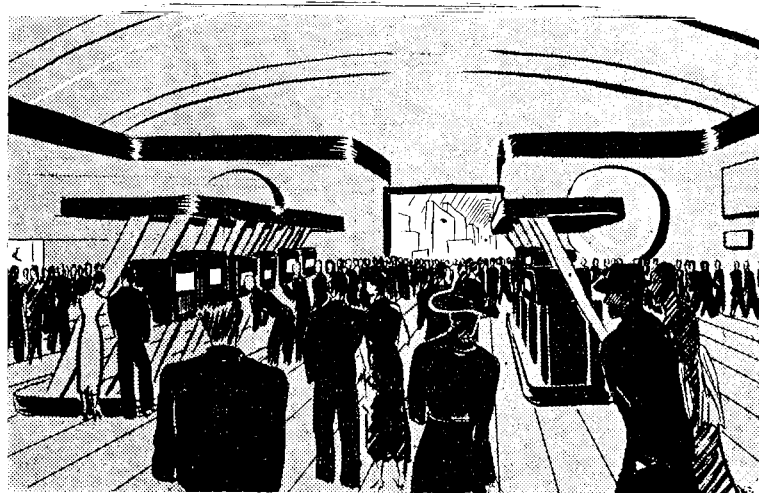
It is regrettable that the decision should have been made to close down these transmissions at this time of the year, but the B.B.C. has never encouraged participation. The lateness of the times of transmission and the refusal to give any indication of the likely duration of the transmissions have kept all but the keenest experimenters away from television. It was only after a hard fight by the Baird Co. and this journal that the B.B.C. decided to recognise the claims of television and on two occasions since when the termination of the service was practically determined we have been able to secure an eleventh hour reversal of the decision by the production of proof of the large amount of interest that prevailed.

German Standards and German Policy

IT was generally assumed that a definite standard of 180 lines and 25 pictures per second had been adopted in Germany and that there would be intensive development, for a considerable time at least, with the perfection of this standard as the objective. It appears, however, from more recent information, that the Germans are aiming at a much higher ideal, for receivers were shown at the Berlin Exhibition with greatly increased definition. Present policy appears to be the education of the public in tele-

vision and the preparation of the way for a service in the near future, and to this end demonstrations are being given in various parts within the area of reception. The close co-operation between the Broadcasting Company, the Post Office authorities and the manufacturers appears to indicate that in the near future a television counterpart of the "people's" broadcast receiver will be placed on the market, which, if not within the purchasing power of all the German people, will nevertheless have a very large sale.

This year even more prominence than usual was given to television exhibits at the Berlin Radio Exhibition. The exhibi-



bits occupied a large hall to themselves, and the floor space available was more than twice that of last year.

TELEVISION PROGRESS IN GERMANY

A detailed account of the exhibits at the Berlin Radio Exhibition

By Our Own Correspondent

A NEW departure was made in the arrangement of the exhibits, in as much as the six research firms, the Post Office and the Broadcasting Co., had their stands arranged on all four sides of the hall, whilst the centre of the hall was occupied by the so-called "Television Street."

"Television Street" was arranged by the German Broadcasting Co., which exhibited commercial home-receivers of all the six different companies. These receivers have been bought by the Broadcasting Co., from the various concerns.

The Demonstrations

In all, twenty working receivers were shown in the "street," ten on each side. All these sets were showing reception from the Berlin 180-line, 25 pictures per second, transmission. This exhibit was very cleverly arranged in such a way that the public could see the relative simplicity of television reception, for it was possible to walk round the back of the stand where, in each case, there were only two connections to the receiver, namely (1) to the mains supply, (2) to a small $\frac{1}{4}$ -wave aerial which was placed on a kind of roof directly on top of the receiver. Each receiver had its own separate aerial.

Demonstrations by these sets were given for seven hours a day.

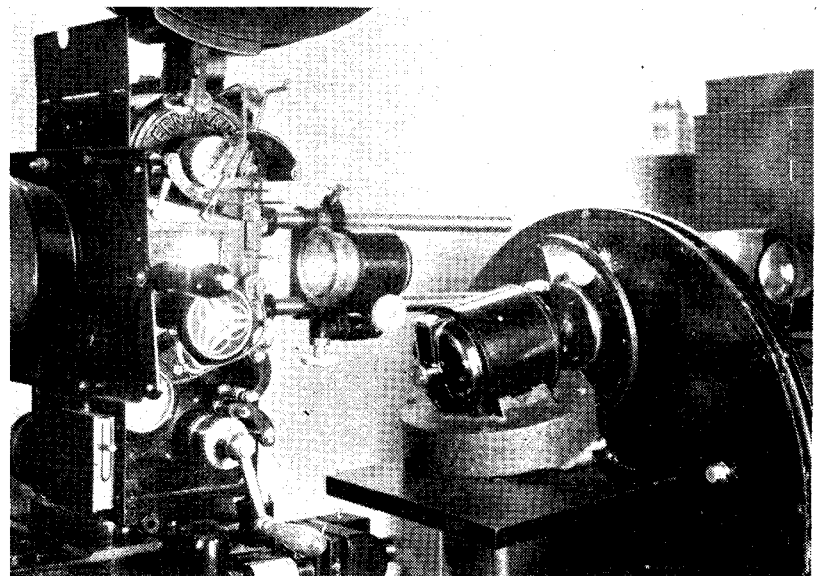
The results in most cases were very pleasing, as regards detail, although

the flicker of many receivers was rather tiring to the eyes.

It should, however, be remarked that certain makes of receivers showed rather inconsistent results throughout their range of models, i.e., out of five receivers possible two would give good results, while

The Makes of Receivers

The six firms represented in the "Television Street" were Fernseh A.G., Telefunken, Loewe, TeKaDe, Lorenz and, as a newcomer, C. H. F. Müller, which, of course, is the Ger-



TeKaDe transmitter for interlaced scanning.

the other three would show relatively poor pictures. This, however, appeared to be more due to the fact that the receivers in the "Television Street" were handled by engineers not used to adjusting cathode-ray receivers.

man valve firm of Philips, Eindhoven.

From an engineering point of view the research exhibits on the stands of the various firms were of particular interest, as here the firms were not tied down to a standard but were at

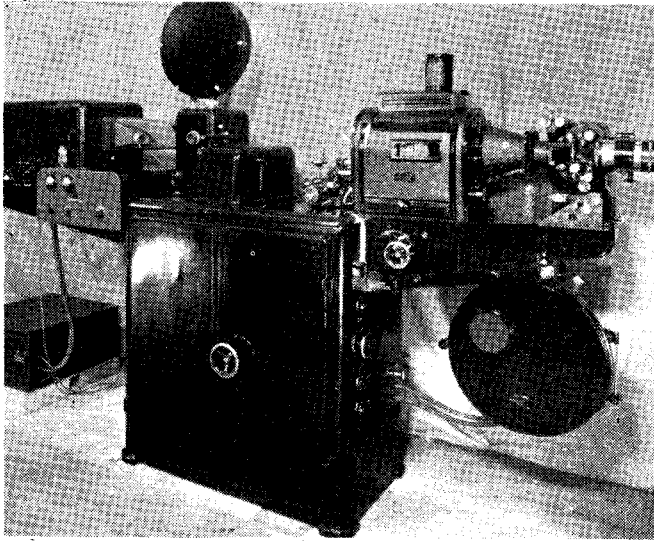
liberty to show what pictures and what definition they liked, in addition to the standard 180-line receiver. Each firm here showed its particular fancy, some showing interlaced scanning, others increased definition, others bigger pictures with lower definition and so on.

Simple Control

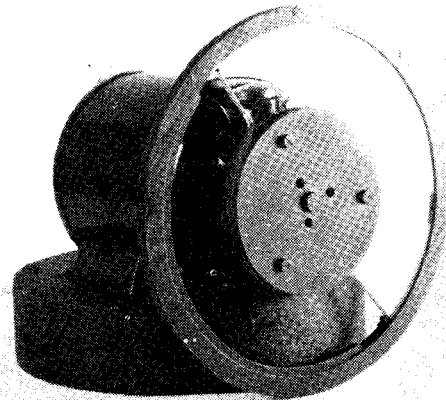
Furthermore, on this stand was a display of complete 180-line receivers similar to those in the "Television Street." These receivers have a picture-size of 19 cms. x 23 cms., and

Another Fernseh A.G. product was shown on the stand of the German Broadcasting Co., and this was the new and improved intermediate-film projection receiver. This receiver differs from previous models in several respects.

Firstly, a hard cathode-ray tube is



(Left). Fernseh new intermediate film projector.
(Below). Cut away glass disc of the TeKaDe interlaced transmitter.



320-line Pictures

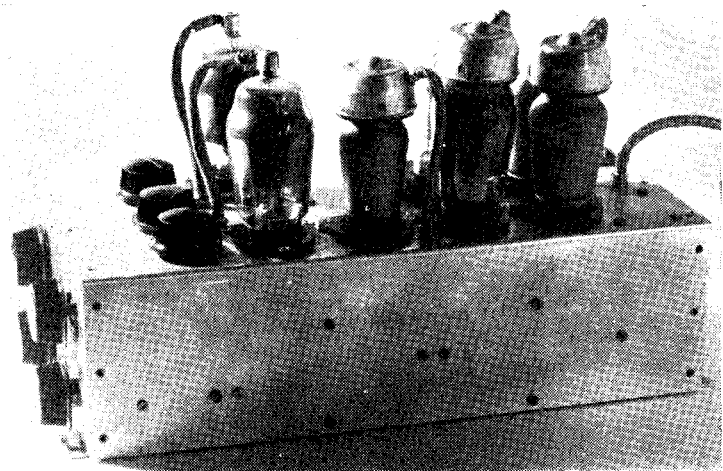
Undoubtedly the most impressive picture at the show was a 320-line image of the Fernseh A.G. This is the first time that such high definition has been shown in public, and I can hardly speak too highly of the superb picture-quality shown on this receiver. The picture had a size of almost 10 ins. x 12 ins., and was of sepia colour. The modulation and high-frequency reproduction were excellent. The only factors which, to some slight degree, marred the beauty of this picture were the rather high order of flicker, a rather pronounced red afterglow of considerable duration, and slight distortion due to the rather strong bulge of the very big tube.

An Outstanding Exhibit

In spite of these slight defects, this particular effort to my mind, was one of the outstanding features of this year's exhibition. This 320-line picture is particularly interesting, inasmuch as a mechanically-operated film transmitter was used, namely, an ordinary scanning disc. The disc contains 80 holes and runs at 6,000 r.p.m., and the construction of this transmitter must be described as a triumph of television engineering.

show a very nice sepia picture. There are only two controls in the front, while there is a small concealed panel of "fit and forget" controls on the side of the receiver. The handling of this receiver, as of all the other television receivers at the show, is particularly simple, the practice being always to tune into the sound programme, whereupon the picture will automatically appear correctly

used as the receiver's medium instead of the old scanning disc and Kerr cell combination. Secondly, the continuously re-emulsified film has been abandoned in favour of new stock. The film, after it has been processed and projected, is collected on a spool and can be used on other occasions; or the film can be sent back to the works and have a fresh emulsion put on. This is possible as the film is

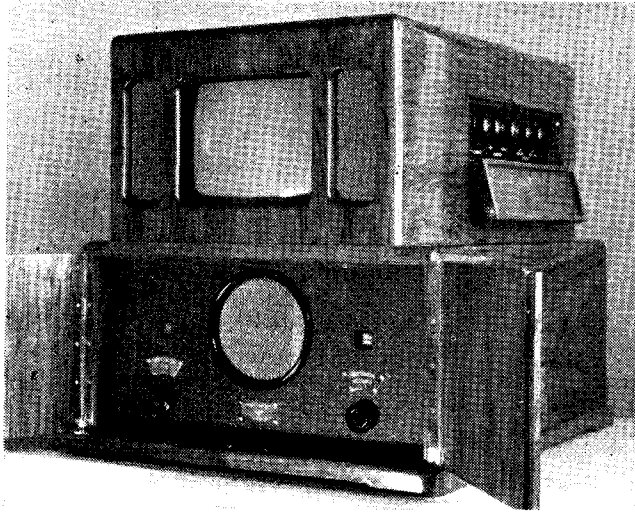


Hard valve time base of Telefunken receiver.

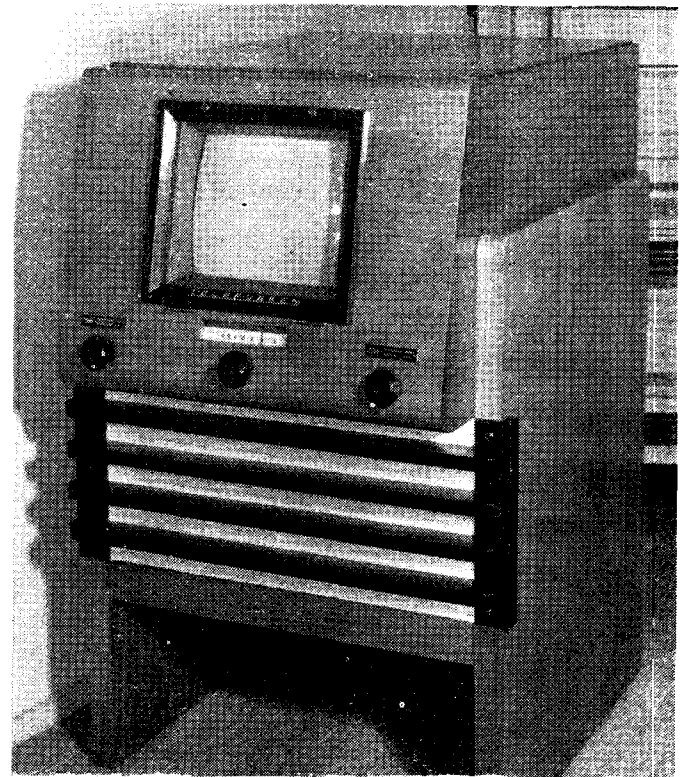
tuned. After that, a small touch of the brightness and contrast controls and the receiver is ready for a couple of hours' entertainment. The synchronising controls do not have to be touched.

only used a few times and is therefore in no way scratched.

The results shown on this intermediate film projector are still disappointing, and the improvement from year to year is only very small. The



(Above). Fernseh cathode ray home receiver.



(Right). Telefunken home receiver, front view.

difficulties associated with this process appear to be so great that many experts express great doubt whether this system can ever be perfected.

Interlacing

Another stand of particular interest was that of Loewe. They showed 180-line pictures with interlaced scanning. The reception of these interlaced pictures, however, was shown on their standard receiver as they have been so designed that they will show either straight or interlaced scanning on either 180 or 240 lines.

The pictures were extremely bright and entirely free from overall flicker, and were undoubtedly the best 180-line pictures in the show.

The Loewe receiver, which was illustrated on pages 500 and 501 in last month's issue of TELEVISION AND SHORT-WAVE WORLD, is undoubtedly the most advanced of the commercial types of receivers. It is the most compact and appears to have the lowest number of valves. The anode voltage is only 2,000 and thyratrons are used in the time base. The images were almost black and white with a slight bluish tint.

Telefunken, in addition to their standard 180-line receiver, also showed an interlaced picture of excellent quality.

The transmitter in this case used a lens disc in preference to the perforated type which is generally used. Both the Loewe and the Telefunken interlaced pictures are of particular interest to us from several points of view.

Firstly, they are proof of the fact that interlacing, even with cathode-ray receivers, can be done perfectly simply using an even number of lines, and secondly, that although in-

terlacing gets rid of overall flicker, the viewing distance must be increased beyond the viewing distance for a sequentially scanned 180-line picture.

In other words, the introduction of interlacing in a picture is definitely detrimental to its definition.

The standard 180-line receiver of Telefunken is another beautiful example of German television engineering. The picture-size appeared to be somewhat bigger than on most receivers

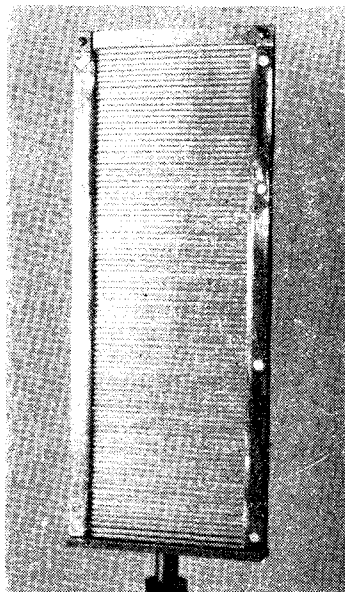
whilst the colour was definitely black and white. The external design is interesting, inasmuch as the picture-screen slopes backwards about 10° . This has purposely been so designed to avoid distortion, and to show an equally good picture sitting or standing in front of the receiver.

The set contains eighteen valves in all and uses hard valves in the time-base. The voltage of the tube is 5,000 and magnetic deflection is used in both directions. The receiver contains five chassis, one being the mixing unit and vision I.F. amplifier. The second unit is the sound I.F. amplifier and output stage. The third unit is the hard valve time-base. Furthermore there are two eliminator units, one for high and one for medium tension.

Telefunken also showed a slightly smaller version of this receiver giving a smaller picture. This receiver does not contain any provision for sound reproduction. The intention is that an ordinary broadcast receiver tuned to 300 metres is used as the I.F. amplifier for ultra-short wave sound reception. The actual aerial tuning on sound is, however, done in the mixer stage of the television receiver.

The Lamp Screen

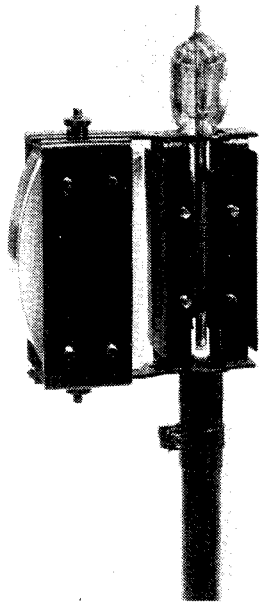
Another exhibit of particular importance was shown on the Telefun-



Tekade Optical Raster.

OCTOBER, 1935

ken stand, this being Professor Karolus's 10,000 element lamp screen. The transmitter used in conjunction with this was of a floodlight type and members of the public were allowed to sit in it in order to be televised. Pictures on the lamp screen appeared in a size of 2 metres \times 2 metres. The brightness was nothing short of terrific, definitely more than that of an ordinary cinema picture,



TeKaDe Kerr Cell unit.

and yet the image was entirely free from flicker. Of course, 50 pictures per second were transmitted. The image signals passed over 100 separate cables, one communication channel for each line. The definition, although only 100 lines were used, was extremely good. The mechanism associated with this lamp screen may appear to many people to be too complicated for practical work.

But Professor Karolus has succeeded in simplifying this to a great extent, and the importance of this experiment is that this particular line of research is capable of enormous development.

There appears to be no reason why a lamp screen of five, six or seven hundred lines could not be successfully constructed.

Tekade showed several mirror-screw receivers. Some were complete 180-line receivers working from the Berlin ultra-short-wave transmission, others were large 90-line screws working from their own film transmitter.

The 90-line mirror-screw pictures showed remarkable definition, and

many experts guessed these images were composed of 180, 240 and in one case, 400 lines. These pictures afforded, once again, an opportunity of seeing the superior reproduction that can be obtained on mechanical-optical receivers for a given number of lines.

All receivers this year used a sealed Kerr cell as light valve.

Mechanical Interlacing

On one occasion 90-line interlaced scanning with overlapping lines was also demonstrated. For this purpose Dr. Okolicsanyi, of Tekade, has involved a special system of transmission which can be seen in one of the photographs. This consists of the addition of a semi-circular glass disc placed to rotate at an angle in front of the scanning disc itself. When the beam passes through that half of the disc which contains the glass plate it is deflected by the amount of one line, and thus interlacing is achieved.

The Tekade 180-line receiver also gave very good definition, but the viewing angle of these screws was rather restricted.

Manfred von Ardenne's tubes were used in the Lorenz receiver. These picture were also black and white and particularly bright. The receiver is said to be capable of picking up very much higher definition than 180 lines. In fact, the band width of most of the commercial 180-line receivers is designed to accommodate a changeover from 180 to 240 lines.

The newcomer to television is C. F. H. Müller, of Hamburg (Philips group). This firm showed a complete 180-line receiver working from the 7-metre transmission. The results were frankly rather disappointing. The pictures were bright green and the detail left room for considerable improvement.

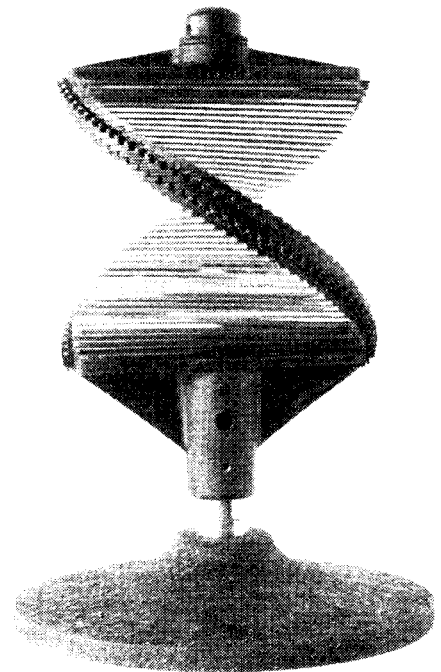
The receiver seemed to be bristling with valves. On one occasion I counted at least 30. The cathode-ray tube used contains an interesting innovation as ceramic insulation is used in the base and in the internal construction.

The German Post Office, on their stand, also showed 180-line reception. A further exhibit was what probably must have been one of the biggest cathode-ray tubes that has ever been shown. It had a screen diameter of about 18 ins. Two-way television

with 90-line definition was also in operation on this stand. The transmitters were discs and the receivers were of the cathode-ray type.

The stand contained also an historical exhibit of television development during the last seven years, and test films with various definitions were shown.

The general position of television in Germany appears to be this. The firms are encouraged to produce commercial types of receivers in small quantities which, however, are not allowed to be sold to the general public. These receivers are bought by the Broadcasting Co., Post Office and Propaganda Ministry and they are



The Tekade Mirror Screw for Interlaced Scanning.

distributed to the various looking-in rooms and television engineers for purposes of reception tests.

The purpose of the transmission appears to be, firstly, to give the industry a constant television signal on which to compare their results, and secondly, to educate the public about television. It appears that we may expect an alteration of the transmitting standard in Germany before television is launched commercially.

In contrast to this country, every possible encouragement is given to the television industry, and indirect subsidies are granted by the authorities.

WHAT THE TELEVISION PROGRAMMES WILL BE LIKE

By Capt. West, M.A., B.Sc., Technical Director of Baird Television Ltd.

The following is an abstract of a paper read before the Engineering Section of the British Association on September 6th, 1935.

IT is rather early to talk about the types of programmes which are most suitable for television purposes for reception in the home.

We must bear in mind that the home screen is comparatively small in size and this, therefore, implies a limitation to the size of scene which can be usefully transmitted, however well-defined it may be. A picture-size about a foot or 18 ins. square is best observed at a distance of about 8 ft.,

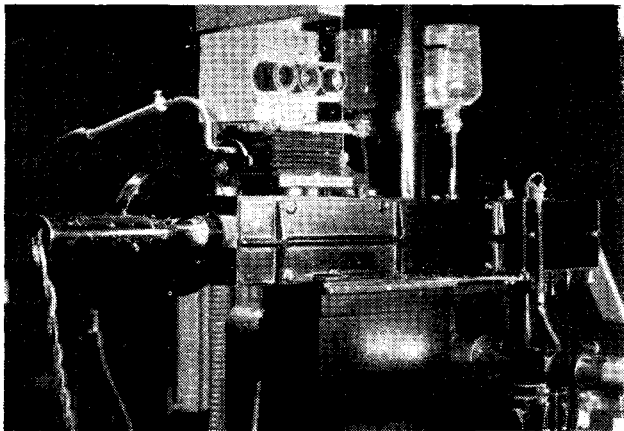
shows. I am referring, of course, in these cases to programmes specially compiled for television transmission. At the same time, of course, topical items, mostly exteriors of the horse-racing type, or interiors such as boxing contests will be extremely popular and will be, in fact are even now, within the bounds of technical possibility.

Larger effects will probably be best transmitted by means of talking films,

getting personality into the home by means of television will be so great that the public will insist on seeing artists and events direct rather than by means of talking films.

New Technique

It must be remembered that the provision of television programmes has still to go through rather an experimental period and, from a technical point of view, television itself is definitely not so much an extension of broadcasting, but a combination of talking picture and broadcasting technique, the former being predominant. The preparation of a programme will have to follow much more the preparation of a theatrical production, because artists will not be able to read their plays from a book as in broadcasting, and they will not be able to ask for another or many other "takes" as is common in talking pictures, where the various "takes" are seen at the end of each day's work, and the best chosen, to be used for making up the complete picture. Thus it may be that television will produce not only an entirely new technique for artistic production, but also a new type of artist.

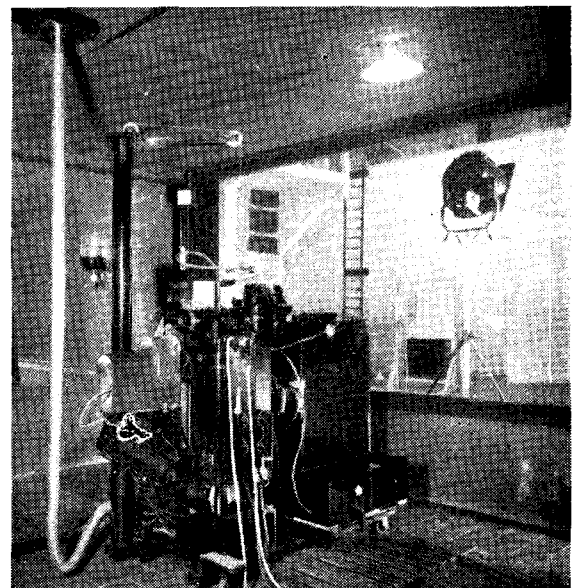


A close-up view of part of the photographic equipment of the I.F. machine showing also the sound recorder on the left.

and in practice the maximum number of observers would probably work out at about a dozen. Usually it is found that close-ups of head and shoulders and three-quarter views of two or three people are preferred, and that pictures containing more than six people at full length do not sustain interest, unless they have some particular topical value.

In the case of television of solo artists, or plays having not more than three or four characters, the closer one can get to the subject the better, because it is found that being able to see clearly such things as the movement of lips and the expression of the eyes is very important in getting an idea over to the home audience. Thus it may be that some of the most telling items in television may consist of addresses by well-known personalities in close-up or semi close-up, interviews, lectures illustrated by models and drawings, solo artists and entertainers, and possibly items such as solo dances may be preferred to the more grand conceptions of big stage

but it is difficult to say now the proportion of programme time which will be taken up by the transmission of films. It may be that the effect of



An interesting view of the intermediate film equipment housed in the Baird television laboratories at the Crystal Palace.

The Short-wave Beginner's Page

The Programme Value of an All-wave Receiver

Many amateurs do not realise the amount of programmes available via short-waves, while ordinary broadcast listeners are frankly sceptical of anyone ever hearing anything other than morse with a short-wave receiver. Here are some details of just a few of the best world's programmes.

ALL-WAVE receivers, which made their debut this year, have been introduced owing to the consistent demand from broadcast listeners. It is admitted that very few people realise just what is to be heard below 100 metres, but many have visions of American and Australian programmes, to quote just one example, at all hours of the day.

While this is in a way correct, many of our readers will be very disappointed if they hope to be able to obtain the same number of programmes via short waves and with the same ease as they can normal medium-wave programmes. Although a modern short-wave receiver is no more difficult to tune than a family receiver, the only point is that whereas a broadcast set will provide a programme of some sort or other for 24 hours a day, a short-wave receiver is far more moody, and will only provide a programme if the right waveband is coupled with the correct time of day.

200 Regular Programmes

Over 200 stations in various parts of the world are transmitting regular programmes below 100 metres, and the amateur who knows how to handle his short-wave set can obtain a very high percentage of these programmes. The broadcast listener and the would-be short-wave fan generally become disappointed when he is not able to hear long-distance stations at the first attempt.

We ask all of those readers just for a little while to believe that these long-distance programmes are obtainable. We are going to endeavour to give a

rough idea of what can be heard with almost any type of short-wave receiver provided everything is considered in its proper order.

There is no need to go into the technicalities of the whys and wherefores of short-wave reception just to prove our point, but remember these few rules of thumb. Disregarding the local continental stations and concentrating more on programmes from the American continent, bear in mind that when both the transmitter and the receiver are in daylight the wavelength used is bound to be a short one. When one or the other points are in darkness use an intermediate wavelength, while when both of the points are in darkness actually the best time to listen, then use a fairly high wavelength of about 50 metres.

Let us explain more fully these variations in wavelength. The lowest wavelength commercial broadcaster is Pittsburgh, on 13.93 metres, which can only be heard on average apparatus during summer months when broad daylight covers both England and America, so that this station only transmits between 1 and 3 p.m. The first station which is really heard with any degree of regularity is Bound-brook with a call sign of W₃XAL, which transmits on a wavelength of 16.87 metres from 2 until 3.5 p.m. and 8 until 9 p.m. Excellent programmes are really obtainable from

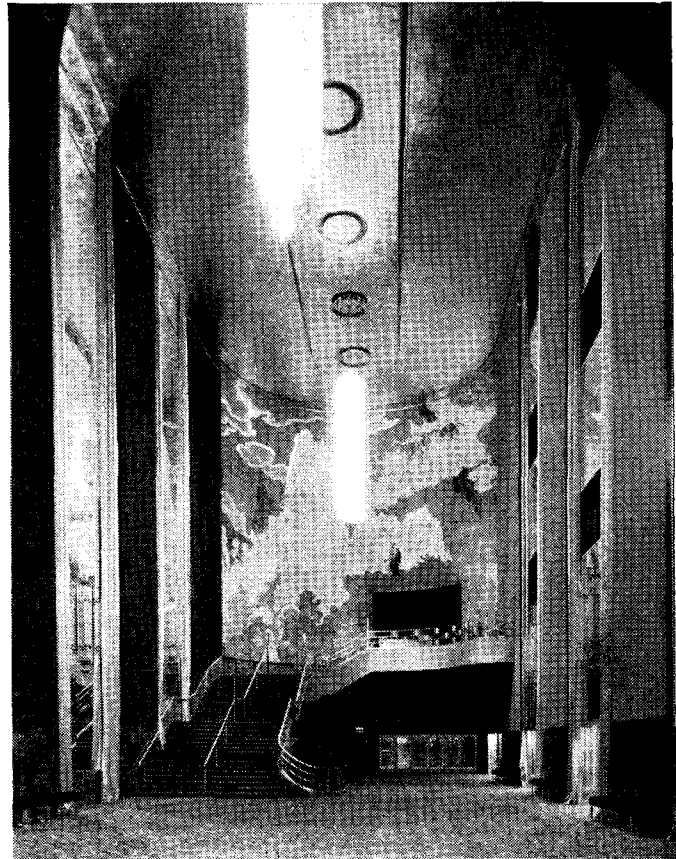
this station. During October, for example, there is the official news reeler giving a summary of world news, several excellent dance bands, a relay of light opera and a Marimba band.

The powerful Philips station, Eindhoven, send out transmissions for their nationals in Dutch East Indies. These programmes are well worth hearing, and even the simplest receiver will bring them in on Tuesday mornings from 9 to 12 a.m. and Wednesday afternoons from 3 to 4 p.m.

Zeesen World-wide Broadcasts

Those who have heard Zeesen cannot help being intrigued by the way the Germans put over their world-wide broadcast. Special programmes are sent out for different continents. They inquire after your health, wonder if your receiver is working satisfactorily, and most sincerely hope that the programmes transmitted meet with approval.

Colonial readers comment very enthusiastically on these programmes, and compare them with the rather dry way in which the normal broadcast programmes are put over. The most interesting time, or should we say the most convenient time, for the average person, is during the early evening. Unfortunately this coincides with the period when



This is the Grand Foyer of the Radio City Music Hall. Listen to the mammoth organ from here.

short-wave reception is not so good. Do not for a moment get the idea that the reception will be bad; just the reverse. But conditions will not be so good as experienced on 16 or 50 metres at the proper times.

Stations which transmit in the evening are Zeesen, Parede (Portugal), Lisbon, Moscow, Radio Colonial, in Paris, Wayne (New Jersey), Rome, Boston, Winnipeg, Caracas Venezuela, Madrid, Sydney, Philadelphia, Jeloy in Norway, Rio, Havana Cuba, and numerous others. You will notice that all these stations during the evening use a wavelength of 24 and 34 metres, so it is not much use tuning on the bottom of the band or at the top end.

The Fifty-metre Band

If you don't mind being up a little late, the most productive time with any short-wave set is after 10 or 11 p.m. The stations heard earlier in the evening will still be available, but on totally different wavelengths, so that most evenings the following stations will be on the air. Riobamba, Valencia Venezuela, Bound-brook, New Jersey, Santa Domingo, Parede, Lisbon, Winnipeg, Pittsburg, Wayne, New Jersey,

Chicago, Johannesburg, Bowmanville, Nairobi, Cincinnati, all using wavelengths between 40 and 50 metres, most of them nearer 50. That is just a very small selection of what will actually be on the air.

With the increasing congestion on short-wave bands an S.W. receiver can often be very useful to provide programmes from local stations. We have noticed during the past few weeks that Rome, for example, broadcasts *complete* operas from the Scala Theatre in Milan, via their 25 metre transmitter, whereas only small sections from the opera are broadcast on medium waves. The same remarks apply to Berlin, who broadcast through their short-wave transmitters at Zeesen. As these programmes have a world-wide audience, they are infinitely better than their normal medium-wave programmes.

Even assuming that the S.W. programmes are only equal to our own, there is a considerable interest in picking up a station two or three thousand miles away. On an ordinary broadcast set strong transmission means that the station is not very far away, while a weak one means that it is probably some distant European. With a short-wave set the same remarks do not apply. It

is quite difficult to receive the short-wave Daventry stations, whereas the West Coast Americans come in at very good strength.

Reception at 5,000 Miles

This point can never actually be realised by newcomers to short-waves, but it must be taken for granted that distance means absolutely nothing and it is simpler to receive stations over 5,000 miles away on a short-wave set than it is to hear some of the smaller continental stations on medium waves. If at first results seem poor it is probably only due to lack of experience. Get into the habit of switching on the short-wave section of your receiver at all odd times of the day, making a note of whether or not stations can be heard. After a time a whole heap of valuable data will be obtained so that the exact times will be known when stations can be heard. A short-wave receiver is a continual source of interest, for, unlike the broadcast set, one never knows from where the next programme will come.

Always bear in mind that there are 200 stations broadcasting regularly, and a good percentage of these can be received on quite a simple apparatus.

Programmes from South America

By F. H. Beane

COLOMBIA is rapidly becoming famous for its number of active short-wave stations, many of which are well received in this country with simple gear. As in U.S.A. the authorities in Colombia have organised radio and divided the country into five districts. Every station uses the prefix HJ followed by the number of its district, the letters AB and a final distinguishing letter.

The first district provides the famous HJ1ABB, in Barranquilla, known as "La Voz de Barranquilla," which operates daily from 22.30 to 04.00 B.S.T.

This station frequently carries out tests with W2XAF on Mondays just before midnight, when English is used. It may be identified by a 3-note gong and the call "Aqui estacion HJ1ABB, Barranquilla, en Colombia, South America."

In the same city a station on 49.65 metres, HJ1ABG, "Enisora Atlantico," is on the air daily from midnight to 04.00 B.S.T. To facilitate identification a four-note gong signal is used at fifteen-minute intervals together with the call "Enisora Atlantico."

To the West, in Cartagena, there are two transmitters: one HJ1ABE and the other HJ1ABD. The former is on 49.05 metres with a power of 150 watts and can be heard from 01.30 to 03.00 B.S.T. daily.

HJ1ABD, using the title "Ondas de la Heroica," transmits daily from 01.30 to 03.00 B.S.T., on a wavelength of 41.2 metres, with the low power of 50 watts. Though subject to much interference from the 40-metre amateur band this station has been well received in England with a 3-valve receiver. Reports sent to "Ondas de la Heroica" at Box 252 are verified by a neat QSL card, which is well worth getting.

HJ2ABA, located at Tunja, operates on 48.6 metres from 01.00 to 04.00 B.S.T., using the call "Ecas de Boyaca."

HJ2ABC, "La Voz de Cucuta," on 50.9 metres, has a daily schedule from midnight to 03.30 B.S.T., and is owned by P. Sanchez, C., but situated in Cucuta.

Further south in the third district are several transmitters, the principal being HJ3ABH, HJ3ABD and HJ3ABF. HJ3ABD, "La Voz de la Victor," verifies with a very nice QSL card upon which the power is given as 250 watts, and wavelength as 49.9 metres, although actually they use a wavelength of 50.3 metres, close to the dial reading of HVJ. The schedule is from 01.00 to 04.00 B.S.T. daily. HJ3ABD (40.5 metres) can easily be identified by its frequent reference to "Colombia Broadcasting," and sometimes by its use of cuckoo calls. Hours of transmission are from about 01.00 to 05.00

B.S.T., and the address, Alford's Radio Service, Box 509 Bogota.

Station HJ3ABE on 48.62 metres, known as "La Voz de Bogota," relays medium-wave HJ3ABE from midnight to 05.00 B.S.T.

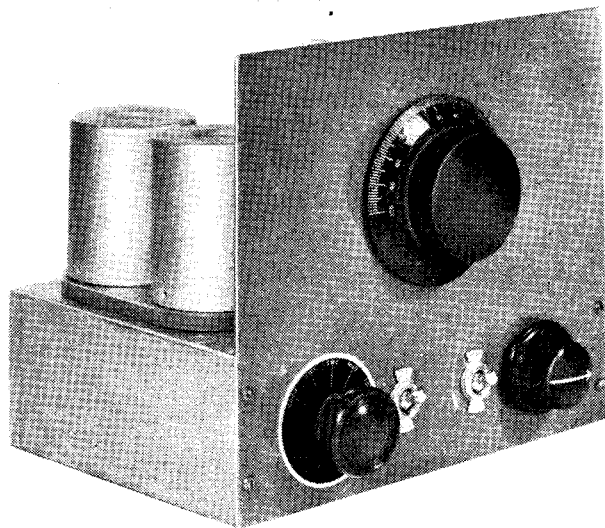
The fourth district which provides many of the strongest Colombian signals heard in this country, includes HJ4ABB, HJ4ABL, HJ4ABE and the new HJ4ABA. Many readers are probably familiar with HJ4ABB, "Radio Manizales," which normally operates in the 40-metre amateur band from about 22.00 to 01.00 B.S.T. irregularly. Recently, however, they are said to have deserted their 42-metre channel for one in the 49-metre band.

This station, which is comparatively high-powered (500 watts) is situated at P.O. Box 175, in Manizales, and announces as "Radio Manizales." HJ4ABL, "La Voz de Accidente," is also located in Manizales and usually operates on about 49.15 metres from 23.30 to 01.30 B.S.T. daily and until 05.30 B.S.T. on Sundays.

The latest addition to the fourth district is the new HJ4ABA, also in Medellin. Unlike the majority of the Colombians, however, it is not in the 49-metre band, but on 25.62 metres, just above FYA.

It may be heard from 00.30 to 04.30 B.S.T. usually working with amateur phone stations in the U.S.A. Though they use only 100 watts power, HJ4ABA is frequently heard in England.

The chief station in the fifth district is HJ5ABD, "La Poz del Valle," in the city of Cali.



Single dial control and a wavelength calibrated switch are but two of the important features.

Now that all-wave coils are available, there is no reason why constructors should not build all-wave receivers. This is the first of a series of sets we have designed.

NEWCOMERS to short-waves do not appear to like the idea of having a receiver that will not tune above 100 metres. It seems that most constructors do like to be able to tune in Luxembourg and other stations of a similar type when conditions on short-waves are not too good.

Of course, although it is a simple matter to hook up another receiver, this is usually far too much trouble, particularly when a common aerial, loud-speaker and power supply have to be used.

Until just recently, only the knowledgeable experimenter could build a multi-wave receiver, for it meant home-constructed coils. Fortunately, that problem has now been overcome by the introduction of commercially-built all-wave coils of an efficient type. We have in mind the new Bulgín C53 unit which, although it is designed for use in super-het circuits, can be modified for use as a conventional tuner with Reinertz reaction.

16 Metres and Medium and Long Waves

As the beginner generally starts off with a one-valve set, we have anticipated his requirements and designed a receiver which tunes from 16 metres on short-waves and includes in addition the medium- and long-wave bands. So as to give maximum amplification and volume, we have used a two-in-one valve—a Marconi-Osram B21—which combines the functions of a detector valve and low-frequency amplifier.

Consequently the receiver, although it is really supposed to be a one-valver, works a loud-speaker quite nicely on a fair number of stations. This is a

great advantage, for several British stations in addition to half a dozen Continentals can always be heard at loud-speaker strength, while it is quite a simple matter to plug in headphones for short-wave listening.

The seasoned short-wave man or the transmitter will probably consider it beneath his dignity to build such a simple receiver, but this little set has many points in its favour. It can be used to check conditions on the various wave-bands without coil-changing, while a quick change over from band to band can be made with the minimum

12 STAR FEATURES

- One double valve**
- Two stages—detector and amplifier.**
- Four wavebands 16-33, 27-110, 200-570, 1200-2200 metres.**
- Five-continent reception.**
- Loud-speaker volume.**
- Three S.W. amateur bands.**
- Five S.W. commercial bands.**
- One coil for all wavelengths.**
- Calibrated wavechange switch.**
- Simple construction.**
- Easy short-wave tuning.**
- Small H.T. battery.**

of trouble. Also it is ideal as a phone monitor for a good gauge of quality can be obtained, while as it is battery-operated no modulation hum is introduced.

Actually the circuit is quite conventional, merely a leaky grid triode detector, R.C. coupled to another triode L.F. amplifier. In practice there are several points which do not at first

meet the eye. The coil consists of seven distinct windings, four in the grid section and three for reaction. To obtain the correct wave-band coverage, a .0005 mfd. tuning condenser must be used. We consider that this would make short-wave tuning difficult, so we have used a .00025 mfd. condenser with a .00025 mfd. parallel condenser. The idea of this is that the main tuning condenser can be used on short-waves, while the additional capacity can be switched into circuit should the tuning range not be quite sufficient.

In practice with the .00025 mfd. tuning condenser the wavelengths are 16-33, 27-85, 200-440 and 1,200-1,750 metres. With the additional capacity in circuit the second short-wave band can be increased to 110 metres, medium waves to 570 metres and long waves to well over 2,000 metres, all very satisfactory.

The H.F. choke, normally in the anode circuit of the detector presented a little difficulty for we could not find one without certain peaks unless the price was fairly high. However, a simple solution presented itself, for a 10,000-ohm resistance proved entirely satisfactory.

Cheap and Simple Construction

Again, to save expense, we have omitted the conventional low-frequency transformer and simply R.C. coupled the detector to the power valve. This gives quite a reasonable gain, or rather quite sufficient for our needs. Another feature is automatic bias for the power valve so eliminating the bias battery. This enables the number of leads to be cut down to four, two for the high-tension and two for low-tension so the

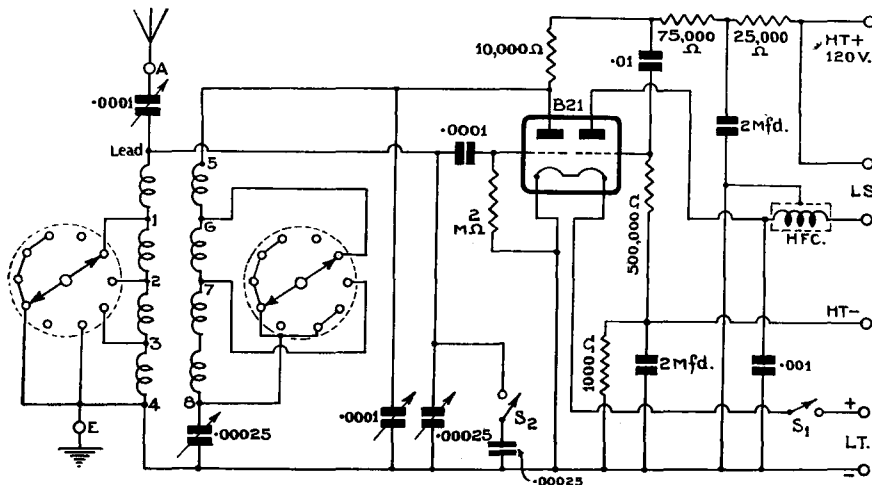
The Beginner's All-waver for World listening

**1 Coil
Double Valve**

2 Stages

**4 Wave Bands, 16-2000
Metres**

Battery Operated



Although only one valve it is a complete two valve receiver, with detector and low-frequency amplifier.

the centre of the back lip of the chassis for the four battery wires.

There is not any need to mention the method of wiring for it is quite straightforward, but it is necessary to use a soldering iron as in addition to many of the components having wired ends, we do feel that soldered connections are a distinct advantage on short waves.

For headphone operation, 75 volts H.T. will be ample, but to obtain maximum amplification and good loud-speaker quality on medium waves, use 120 volts. The anode to earth by-pass condenser, which is pre-set, should be adjusted to give smooth reaction, while the pre-set condenser in series with the aerial should be adjusted to give level oscillation on the short-wave bands and sufficient selectivity on broadcast bands.

For an aerial anything between 35 and 50 feet will be ample. But it should be erected so that the lead-in wire is well away from any surrounding objects and is quite taut, otherwise the short-wave stations will be inclined to fade.

receiver can be coupled up in a very short space of time.

Construction should not present any difficulties. The all-wave coil, which is in two sections mounted on one base, is provided with numbered tags, while the switching consists of two rotary switches on one spindle. On the top of the chassis are mounted the coil unit, aerial series condenser, anode to earth by-pass condenser, the H.F. choke in the phone lead and seven-pin valve holder. On the panel are mounted the tuning condenser, rotary wave-change switch, reaction condenser, on-off switch and a switch to bring into circuit the additional tuning capacity. When constructing the receiver make a special point of completely finishing the assembly and wiring with the exception of the two type 50 condensers. These must be put in last of all.

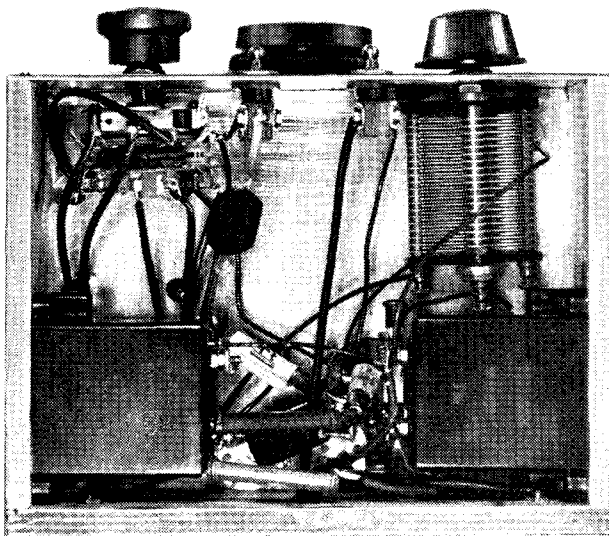
At the back of the chassis, four Clix insulated sockets must be mounted, two

LIST OF COMPONENTS

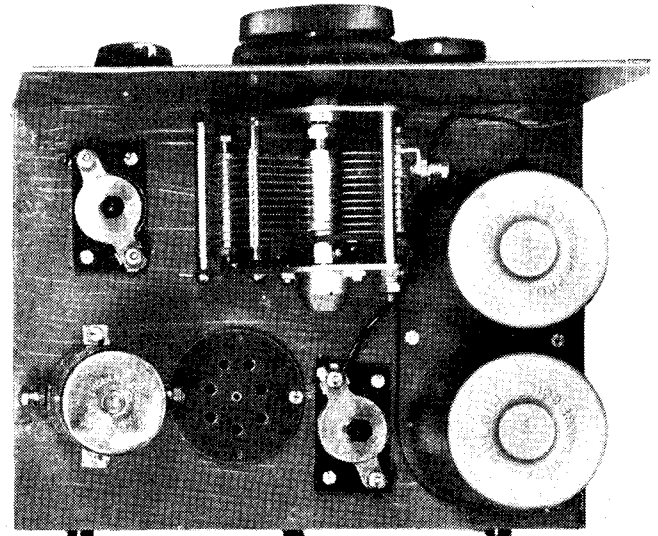
- CHASSIS AND PANEL.**
1—special aluminium to specification (Peto-Scott).
- CHOKE—HIGH FREQUENCY.**
1—S.W. screened type 982 (Eddystone).
- COIL UNIT.**
1—special all-wave type C53 (Bulgin).
- CONDENSERS FIXED.**
2—2-mfd. type 50 (T.C.C.).
1—.01-mfd. type M (T.C.C.).
1—.0001-mfd. type M (T.C.C.).
1—.00025-mfd. type M (T.C.C.).
2—.001-mfd. type M (T.C.C.).
- CONDENSERS, VARIABLE.**
1—.00025 type Midget (J.B.).
1—.00025-mfd. type C (Polar).
2—.0001-mfd. type preset (J.B.).
- HOLDER, VALVE.**
1—7-pin chassis type without terminals (Clix).
- PLUGS, TERMINALS, ETC.**
4—insulated sockets No. 11 (Clix).
- 2—Spade terminals No. 2 marked L.T. pos. L.T. neg. (Clix).
- 2—Wander plugs No. 14 marked H.T. pos., H.T. neg. (Clix).
- RESISTANCES FIXED.**
1—25,000 ohm type 1 watt (Erie).
1—75,000 ohm type 1 watt (Erie).
1—10,000 ohm type 1 watt (Erie).
1—500,000 ohm type 1 watt (Erie).
1—2 meg-ohm type 1 watt (Erie).
1—1,000 ohm type 1 watt (Erie).
- SUNDRIES.**
1—coil quickwire (Bulgin).
24 6 B. A. nuts, bolts and washers (Peto-Scott).
- SWITCH.**
1—rotary type S122 (Bulgin)
2—S80 (Bulgin).
- VALVE.**
1—B21 (Marconi-Osram).
- LOUD-SPEAKER.**
1—type Stentorian Baby (W.B.).

are for the loud-speaker or headphones, the remaining two for aerial and earth. Do not forget to drill a large hole in

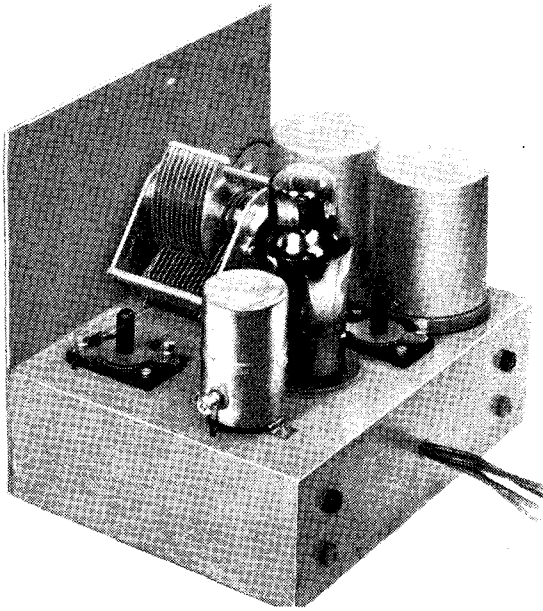
This receiver will bring in programmes on the commercial 16, 19, 25, 31 and 49 metre bands from America,



Construction is simple, but do not mount the 2-mfd. condensers until wiring is almost completed.



Baseboard layout is very symmetrical and easy to wire.



This photograph gives a very good idea of the general appearance of the receiver.

Europe and Australia on a 31-metre band, while amateurs crowd the 20, 40 and 80-metre bands.

We feel this receiver will be ideal for the beginner who wants a simple set to gain experience of short-wave listening and to hear some of the numerous short-wave amateur stations which are radiating almost continuously.

A full-scale wiring blue-print, showing point to point wiring of this set can be obtained from the Blue-print Department, "Television and Short-wave World," 38, Chancery Lane, London, W.C.2. Price 1s.

A B.B.C. Day in Parliament

We are given to understand that the Ullswater Committee, which is about to report on the B.B.C.'s charter, will recommend that one day in each year be set aside in Parliament for a debate on broadcasting. If the recommendation is accepted it follows that some member of the Government will have to assume responsibility for the B.B.C. We welcome the suggestion and believe that if such a debate had taken place in quite recent months some of the delay in the establishment of a television service would most certainly have been obviated.

Progress at Alexandra Palace

The mast to be erected on the South West Tower at Alexandra Palace is being designed to support two aerials, one for vision and one for sound.

ANTI-TELEVISION PROPAGANDA

By Richard O'Connor

Mr. O'Connor is a well-known newspaper man of New York City and is at present in this country on holiday.

ON reading the pamphlet based upon statements made to the Press by the R.M.A. in a series of conferences at which delegates from the Council met editorial executives of all the leading London and provincial papers one is led to think that the P.M.G.'s Committee has erred in all respects.

At the outset the pamphlet states: "At the transmitting end expensive ultra-short wave gear has to be erected, tested and got working on a new technique." This is admitted, but how does it affect the public? The technical staff of the transmitting firms have proved themselves capable of doing their job.

World-wide Interest

Whilst on this point it is well to remember that applications for apparatus and inquiries concerning conditions from all over the Empire, especially Australia and from every European country have been received by firms interested in the manufacture of both transmitting and receiving sets.

The pamphlet goes on to state that

the proposed programme will be available for a limited area. Granted, but when wireless first started the area covered by the station was approximately 30 miles, and yet to-day it is possible to hold 2-way wireless telephonic conversation with Africa by simply lifting up the receiver of a telephone! We can look for the same progress in television.

It is difficult to understand the allegation of the R.M.A. that the television receiver will probably use up to 25 valves. It will be of interest to know what basis the Association has for this statement, when the experts of to-day find it only necessary to have a considerably smaller number of valves. It is not unreasonable to expect that as time advances the number of valves will be reduced, and not increased. And it is difficult to understand the Association's statement that the number of valves in a television set has any definite bearing on its cost.

The statement continues "The approximate price of a television set is between £60 and £70, as stated in the Television Committee's Report." How does this coincide with the pub-

AS AN AMERICAN SEES IT

lic statement made by manufacturers of television receivers that the price will be approximately £30 to £35?

"There is at present no large commercial manufacture of cathode-ray tubes, and supplies must therefore be limited for some time." A statement like this, from an Association of the R.M.A.'s standing is difficult to understand. It is admitted that there is not at present any large-scale commercial manufacture of the tubes, but I have been informed, officially, by two manufacturers in this country that they will be in a position to supply the market in November. Surely the R.M.A. does not expect any manufacturer to produce an article for which there is no public demand?

The R.M.A. or any other group of interested parties cannot stop progress and their efforts in trying to muzzle the Press and issuing misleading propaganda will be of little avail.

As an objection to television the Association states that the viewer will have to sit in a semi-darkened room and concentrate his vision for two hours. This is not an unreasonable way to be entertained. Cinema goers find a considerable amount of entertainment doing this very thing.

Transmitting for the Amateur

Many amateurs who perhaps have A.A. licences or are B.R.S. listeners will be interested in this article, a first of a series on the construction of simple transmitting apparatus. We want to stress most definitely that no experiments of any kind must be carried out without a permit from the G.P.O.

TO transmit messages over quite long distances is not as difficult as one might at first imagine, and, providing the correct circuit is used, the expense need not be too prohibitive. Valve makers are now introducing transmitting valves of low power types which amateurs can use to advantage. A 2-valve transmitter can be built quite easily to give almost world-wide range on CW without having to build high-

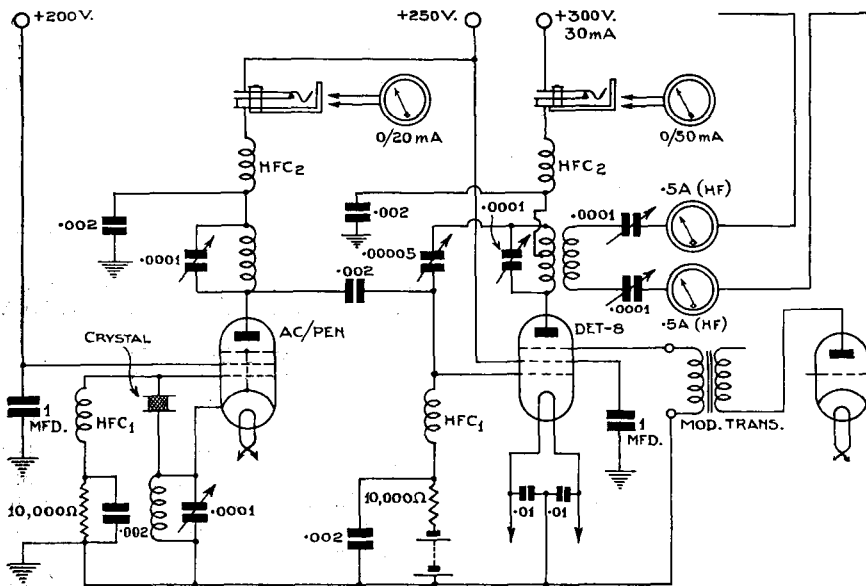
anode of the oscillator which is capacity-coupled on to the grid of the Det-8 pentode operating as a neutralised power amplifier. Assuming that the transmitter is for operation on the 40-metre band a crystal should be obtained that will oscillate within the allotted amateur band. In such circumstances the cathode of the A.C. Pen. can be joined to earth, so short-circuiting the cathode-tuned circuit. The anode of the A.C. Pen. is

fashion in three sections. Chokes marked HFC₁ are standard short-wave chokes, preferably of the screened variety.

Although a certain amount of bias is obtained automatically for the Det-8 auxiliary battery bias is recommended.

In normal circumstances as the valve is biased back to twice cut-off value a fairly high voltage will be required. During our experiments we used an additional 70-volt bias in this circuit. If the transmitter is used with an artificial aerial consisting of resistance, inductance and capacity the radiation meter will read about .7 to .8 of an amp RF, but if coupled to a conventional 66 ft. zepp the current in each feeder averages .4a. RF. High tension can be obtained from a small 300-volt power pack, while two filament windings are suggested, one giving 4 volts 1a. for the crystal oscillator and the other giving 4 volts 2a. for the P.A. We will give operating details and suggested circuit for a modulator in the next issue, but in the interim any amateurs requiring information on this Det-8 should write to us for it. We have no doubt that the Det-8 valve will prove very popular in low power transmitters in view of its many virtues, while next year's field day will probably find a lot of them in general use.

A variation on the C.O. circuit is shown in Fig. 2 where a type-59 pentode is used as a crystal oscillator. Providing the amateur has some efficient means of frequency measurement, this circuit



This simple arrangement can be operated on any waveband with either an elevated or artificial aerial.

voltage power packs with the accompanying expensive components.

We have in mind the new Marconi-Osram valve Det-8, which is actually the standard PT25 hardened up and modified for transmitting purposes. This valve, with a maximum anode dissipation of 25 watts, is the nearest English valve to the American pentodes we have so far tried.

Simple Circuit

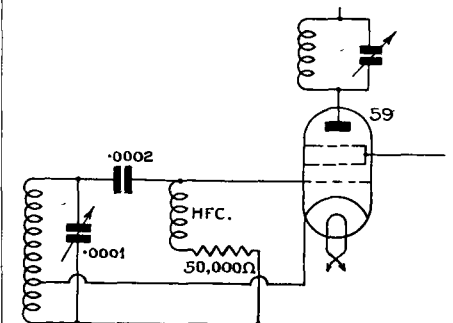
A suggested circuit for the beginner is shown in Fig. 1. It is quite straightforward, inasmuch as an I.D.H. pentode is used as the crystal oscillator. The crystal, which should be ground to the required frequency, is in the grid-cathode circuit, while the valve obtains bias automatically by means of grid current across a 10,000 ohms resistance. In the cathode of the CO is a tuned circuit which consists of a coil parallel tuned by a .0001 standard condenser tuned to the frequency required.

A similar tuned circuit is in the

then tuned to 40 metres as is the anode coil in the Det-8 circuit.

The apparatus can be used on 20 metres by using a 40-metre crystal, a 40-metre tuned cathode circuit, a 20-metre oscillator anode circuit and a 20-metre Det-8 anode circuit. Some amateurs reverse this procedure and have a 20-metre tuned cathode circuit as well as a 20-metre C.O. anode circuit. This is a matter for experiment.

By using suppressor grid modulation there is no need for a large speech amplifier and modulator. 1 watt of audio in the grid of the Det-8 will provide 100 per cent. modulation of a 20-watt carrier, so that a 10-watt carrier will probably be modulated from the output of any of the larger battery-operated pentodes. There is little we need say about the construction of the transmitter, for, owing to the low voltage used all of the components are of the standard broadcast type. The H.F. choke marked HFC₂ can be wound on ½-inch diameter glass test tubes and consist of approximately 200 turns 26-gauge enamel copper wire wound solenoid

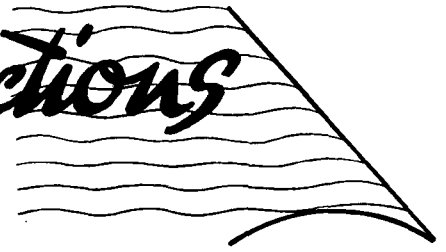


Providing a master wave meter is available this electron coupled circuit is very useful. The valve is of American design.

has much in its favour. The cathode return is made through a tap on the grid coil, and, in actual practice, the frequency stability of this arrangement is of a very high order. In addition to the fact that no crystal is required the operator is able to vary the frequency of the transmitter so as to move out of the way of QRM if the occasion arises

Scannings and Reflections

By THE LOOKER



Addis-Ababa

LISTENERS on 38 metres can hear a Post Office station testing from Addis-Ababa at the time of writing, a station that can well be heard with the all-wave receiver described in this issue.

The Third Layer

We have the Heavyside and the Appleton layers and technicians are now disposed to think that there is still another. They base their conception on the consistent way in which the German 7-metre television transmissions are heard in New York.

The American Angle

The European situation is reviewed by Lowell Thomas, an American journalist, in a special news bulletin sent out from Pittsburgh on 25 metres at 11.10 p.m. each evening. Listen to him and see how the world looks at us.

A Popular Demonstration

Congratulations to Bentalls, the Kingston-on-Thames store, for staging a most attractive demonstration of television under the care of our old contributor, Mr. J. H. Reyner (see another page of this issue). A home-movie film and some other film pictures are being transmitted by line and an independent witness assures us that the quality is very good indeed.

The New Television Studio

There is an idea that although transmission of the high-definition television will take place from Alexandra Palace, the south wing of which has been leased for television for the period of 21 years, the actual studio will be at Broadcasting House as be-

fore. This, however, is not the case. A special studio for the purpose is now being built at the Alexandra Palace and will be in advance of anything hitherto attempted. We assume that the open-air possibilities of the Palace will not be overlooked in providing the television programme.

Interference

The Post Office engineers are more and more alive to the fact that the increased sale of domestic electrical appliances such as refrigerators, vacuum cleaners, etc., will make their

The Virtuous Visor

"I have visors for you all," Shakespeare proclaims, "a virtuous visor." Old-style or new-style? Pre-September 15 or post-January 1936, 1937 or 1938? From the request elsewhere in his writings, "Show me the chink to blink through with mine eye," we gather that Shakespeare had in mind a type of televisior now completely out-of-date even though it did "amaze indeed the very faculties of eyes and ears."

What Radiolympia Missed

Two or three years ago, the production month by month of new components and the introduction of new circuits kept the wireless public alive, and the visitor at the Radio Exhibition was a man of keen, inquiring mind, with scores of questions to ask and a curiosity that was quite insatiable. This

year, ninety per cent. of the visitors found little to attract them except the B.B.C. Variety Concert, which they attended in their thousands. The Exhibition evidently *needed* something. What was it?

Berlin Had It

Whatever London missed the Exhibition at Berlin had it. The attendance was enormous, remarkable interest being taken in the television exhibits and demonstrations. Unfortunately, the even course of the Exhibition was upset by a fire which destroyed two of the halls—not the one containing the television exhibits—and utterly destroyed the short-wave transmitting plant. The real difference from the public's point of view between the two shows was just this: There was television at the

NEW TELEVISION SERVICE WHEN IT WILL START

We understand that the Baird and E.M.I. companies have received from the B.B.C. definite contracts under which they will each supply a transmitter for Alexandra Palace, London, N., the complete plant to be ready in each case for erection early next January. The authorities will not say when transmissions will begin, but we have every reason to believe that

**A HIGH-DEFINITION EXPERIMENTAL
TELEVISION SERVICE WILL BE IN
OPERATION BY THE FIRST WEEK
OF NEXT MARCH.**

job of cutting out interference to radio much more difficult. They are suggesting legislation governing the manufacture of all apparatus which, in operation, is likely to interfere with radio. Interference makes a curious mess of a television picture.

Skin Trouble

High-frequency waves affect the skin and cause trouble. Waves of 2½ metres and under should be treated with particular care even though the apparatus is quite simple

No Speaker

"Was your visor made without a tongue" is Shakespeare's way (in *Love's Labour Lost*) of asking whether somebody's television receiver was adapted for sound reception.

MORE SCANNINGS

Berlin show; there was none at Olympia.

Radio Trade's Attitude

The radio manufacturers, according to the press, are full of work, their factories are being extended, their men working overtime. We must admit that their lack of enthusiasm for television comes from a fear that a television service will seriously interfere with the sale of their sets. So "mum" is their favourite word; they have nothing to say about television; didn't allow any television apparatus to be shown at their National Exhibition; and they give every excuse for supposing that behind the scenes they have done their best to put the brake on. At a meeting of the Essex and East London Branch of the Wireless Retailers' Association, the chairman, Mr. L. Wilde, said that he did not think that the threat of television was interfering with dealers' sales. He had never yet spoken to anybody who could bring him proof that he had lost a sale because of television.

Canute

Nothing can stop progress. No ban by manufacturers can come between the people and an immense development for which the people have been waiting for years. It is the story of our old friend, King Canute, over again. Nobody can stop television coming. The most anybody can do is to delay it, and then only for a short time. Instead of delaying it, the radio manufacturers should be encouraging it and preparing the way.

Poor Old 30-line

Why did the 30-line transmission stop on September 11? Television workers everywhere have been disappointed that the service should not have been continued until the new high-definition service is ready to start. We fail to see what advantage there can be in leaving the public without a television programme of any kind for the remainder of the year. Lydia Sokolova, the well-known dancer, was the last artist to figure in the 30-line régime.

A Formal Protest

The Council of the Television Society at a meeting held on September 9 decided to make a formal protest to the B.B.C. regarding the ces-

sation of the 30-line transmissions and to suggest that the present apparatus should be transferred to Midland Regional station. The value of these transmissions for experimental purposes and the desirability of allowing people living in the north to obtain an insight into television was stressed.

Television Questions and Answers

The Radio Manufacturers' Association have issued to the radio trade a pamphlet containing questions and answers on the subject of television. A wireless trade paper says that any public issue of the pamphlet "would only serve to re-awaken interest which, fortunately, seems now to have died down." It speaks of renewed interest as possibly causing "another television scare." It is very difficult to understand the radio trade in this matter. Surely, the Television Committee was not promoting a "scare" when in its Report it stated definitely that high-definition television has reached such a standard as to justify steps being taken to establish a public television service. Neither was the Government when it appointed the Advisory Committee to be responsible for all the preliminaries in bringing a television service into being.

Electronic Scanning

Many television engineers believe that the plant now being built for the Alexandra Palace may possibly be out-of-date by the Spring of 1937, by which time the electronic methods of scanning will have demonstrated beyond question their superiority over existing methods.

The Committee's Function

Technically, the Advisory Committee's duties are limited to advising on such matters as specification of plant, location of the sites of transmitters, number of programme hours per day, the establishment of the essentially technical data such as number of lines per picture, number of pictures transmitted per second, etc., etc., any patent difficulties that may arise, and any problems in connection with the proposed service which may be referred to it by the Post Office or the B.B.C. In practice, it is adhering closely to the above definition of its duties. In any question affecting rival interests, firstly the B.B.C. and,

secondly, the Post Office, try to effect a settlement, failing which the Committee is called upon to act as referee or chairman. Unfortunately, as it seems to us, there is nobody to tell the Television Committee to get on with the job when somebody or other has succeeded in giving occasion for delay.

Price of Television Sets

It is expected, if all goes well, that the prices of television sets will see a 25 per cent. reduction next year and within two or three years will be reasonably competitive with those of ordinary broadcast receivers. It will need the large-scale manufacture of cathode-ray tubes to make a big alteration in price. At the moment, the 8 in. x 14 in. tube is likely to cost about £10.

Double Scanning

We need to remind ourselves that Baird was using a double-scanning system as far back as 1925, although evidently, in the years that immediately followed, Baird was by no means certain that the method had advantages. We are inclined to think that the matter will not be settled until the experimental service has been in operation for some time. While it undoubtedly reduces "flicker," it introduces a new trouble, "shimmer," which, speaking in very general terms, is caused by the alternate lines of the picture being, as it were "dropped in," instead of the picture being built up in orderly fashion line after line.

America

America has no television service yet, but during the last ten years fortunes have been spent in television research and there are some fine experimental pictures to be seen there.

240 and 405

It was at first thought that considerable difficulty would be occasioned by the Advisory Committee's decision to allow of the Baird and E.M.I. transmissions being at 240 and 405 lines per picture respectively. An official test recently carried out, we understand, demonstrated that receivers can readily accommodate the two different definitions, but there is still the fact that the necessity of providing for two definitions must lead to undesirable complexity. Had both

AND MORE REFLECTIONS

transmissions been on the same definition, a set could be manufactured to "stay put"; its controls could be reduced to the minimum—just a matter of providing for altered brilliancy and so forth—whereas with the two definitions the set must have at least two extra control knobs.

Another Outline

The practical guide to television, which is one of the chief features of this issue, is actually an up-to-date outline of television as we shall see it in a few months' time. The subject is attacked from a fresh angle.

Short-wave Programme Value

Short-wave listeners intent on programme value are turning to all-wave sets. Component manufacturers are closely watching this tendency and we ourselves, in the easily-built all-waver for world listening described in this issue, are taking advantage of new components which the trade has had the enterprise to produce. Both coil and double valve are special.

The Final Programme

I missed Eustace Robb during the final programme. The producer was taking his first real holiday in three years and the transmission was in the care of Mr. D. R. Campbell and Miss Peacock. Jean Bartlett, who before marriage used to act as assistant producer, was present with her husband, Mr. Bridgewater, and other engineers had brought their wives as guests to watch the demise of the 30-line programmes.

Ten minutes before the curtain, when the artists were already in costume and make up waiting for their cue, the telephone bell rang. It was Eustace Robb calling from Lausanne to wish the party luck. No other touch was needed, and guests were visibly affected as the announcer read "Some of us who have followed the television programmes for the past three years will feel somewhat sad that we are looking at the last programme on 30-line television to-night. We present a programme of some of the valiant little band of artists who have helped to popularise the new art, which is full of such fascination and scope."

Television has always attracted first-class talent to the studio, and a distinguished company had assembled for the last transmission.

Cyril Smith, classical accompanist

since the earliest days of television, opened with a piano solo. Then Morgan Davies appeared in a slashed doublet costume to sing an operatic aria. He was followed by Algeranoff in a Japanese dance with some striking lighting effects. Daisy Kennedy played violin solos in a semi-distant shot and Olive Groves, who always makes a most attractive picture, gave some English songs.

It fell to Lydia Sokolova to end the programme. The great ballerina had flung herself to the floor in a climax to the Bacchanale when the light of the scanner was dimmed for the last time.

"And that, ladies and gentlemen, is the end of the last television programme on thirty lines, so may we say Good-bye." It was the announcer speaking in even tones.

Sokolova was assisted to her feet; the first phase of the new service was over; and we departed for a toast to the future.

Working Overtime

The Italian short-wave station in Rome on 25 metres is working overtime during the evening, transmitting in several languages comments on the Abyssinian affair.

The 30-line Gear

Engineers started to dismantle the television gear in Portland Place as soon as the last programme ended and it was a depressing task to remove piece by piece the apparatus which they had so recently assembled.

Within a few days the control room and dressing rooms will be in use as offices and only the studio will remain as artists knew it.

The vision equipment, it is understood, will be offered to the South Kensington Museum where it is expected that a permanent home will be found for it. Microphones and amplifiers for sound remain and the studio, which has excellent acoustics,

will be used for rehearsals and occasional transmission of ordinary broadcast programmes. The new offices will accommodate additional television staff, so a link with the past is maintained.

A Problem in High-definition Production

Technically it will be a simple matter to maintain a balance between the two high-definition systems on trial at the Alexandra Palace. As the apparatus of the Baird and E.M.I. companies will be used independently each will have an equal chance.

Programmatically the task will be more delicate as the looker is bound to be influenced by the artistic merit of the respective programmes.

At first films are certain to occupy most of the transmission time and it would be wise to insist on an equal proportion of film to actuality in the programmes of each system. It should be possible to arrange programmes over a period so that films having roughly the same appeal are broadcast by each system. In the case of live material it will be more difficult, but the B.B.C. can be trusted to be scrupulously fair.

Consider, for example, a big sporting event. Which system will be chosen to televise the Derby next year? There will be many knotty problems such as this.

Outside events will test the relative merits of the electric eye of E.M.I. and Baird's electron camera. Lookers are bound to compare results and it will be important that they should base their judgment on events of equal interest and suitability for transmission.

Overseas Interest

The B.B.C. is already being asked by listeners overseas whether an Empire television service will be provided. There are no plans. Signals will not travel far enough on the ultra-short waves.

Broadcasters in the Dominions are watching developments in this country. Keen as they may be to start a service the cost is prohibitive and there are signs that they are ready to let Britain show the way. Denmark, the country with the highest percentage of listeners to population, is watching us too. The B.B.C. should prepare for visitors when the new London station is working.

An order placed with your
newsagent will ensure regular
delivery of TELEVISION
AND SHORT-WAVE
WORLD

Measuring the Power Output of an Oscillator

By S. K. Lewer—G6LJ

EVEN if it is not directly useful, it is often interesting to know the amount of radio-frequency power which is generated by an oscillator. Closely associated with the power is the efficiency of the generator. These questions of output and of efficiency are always likely to occur in any experimental work in which an oscillation generator is used. Unfortunately, it does not seem to be generally realised how simple and easy it is to make the necessary measurements. There are various methods, some of them requiring costly apparatus, but there is at least one inexpensive method which is sufficiently accurate and reliable for all measurements in which the amateur is likely to be interested. Such a method will be described here.

A Simple Oscillator

Consider as a typical oscillator, a 5-metre set using perhaps an LS5 with 400 volts anode supply. If the generation of oscillations is prevented, say, by short-circuiting the anode inductance, the anode current will be at some high value, say, 50 mA. When the set is allowed to generate oscillations, the anode current is found to be much lower, perhaps 15 mA, assuming that no-load circuit or aerial is coupled to the oscillator. If, however, a tuned circuit is coupled up to the oscillator, the anode current will be found to rise to a maximum when the coupled tuned circuit is adjusted to resonance. The valve is then taking more power from the H.T. supply, and is generating more radio-frequency power, and this extra power is being dissipated in the coupled tuned circuit (in the form of heat and increased radiated energy of radio-frequency).

Incidentally, this illustrates the principle of the absorption wavemeter, which relies for its operation on the withdrawal of energy from an oscillator when the measuring and the measured circuits are in resonance.

Returning to our example of the 5-metre oscillator, the greater the energy absorbed by the coupled circuit, the greater is the anode current in the valve. If we now include a lamp (of the ordinary tungsten filament variety) in the coupled tuned circuit, the lamp will light at resonance, and the amount of light from it will give an indication of the amount of radio-frequency power in that circuit. There is obviously no possibility of confusion with power from the D.C. supply, as it is in an inductively coupled circuit. It would be

possible to develop this as a method for power measurement, but it has a disadvantage in that the measuring device must be accurately adjusted to resonate with the oscillator. It is evident that where the frequency of the oscillator is likely to vary, such a

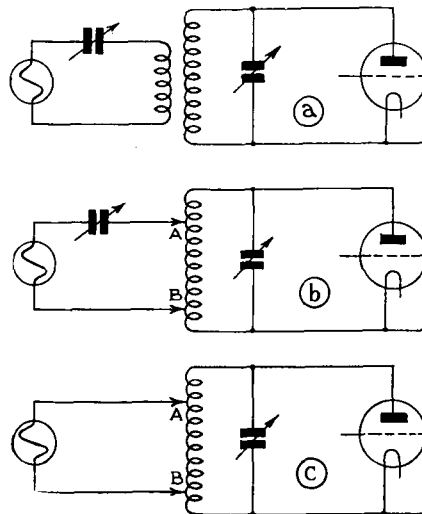


Fig. 1.—These circuits are almost self-explanatory for they show how the tapping points can be arranged

method would present serious difficulties. Variations in the degree of coupling would introduce errors in the scale of calibration.

Fortunately, a simplification can be made which has three advantages:—

- (1) The system is aperiodic—no tuning required;
- (2) the coupling is very easily fixed;
- (3) less apparatus is used—only a lamp is required.

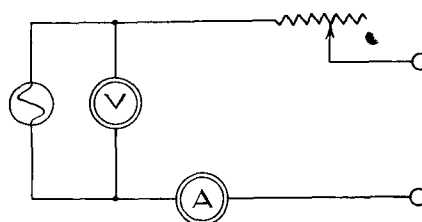


Fig. 2.—This is the simple measuring circuit referred to. Adjustments are made by altering the value of the resistance.

The lamp, instead of being connected in a coupled circuit, can be directly connected across a portion of the tuning inductance of the oscillator. The lamp behaves effectively as a resistance, and therefore it is untuned; this leaves only the tuned circuit of the oscillator, and the possibility of detuning disap-

pears. The degree of coupling is determined by the proportion of the inductance across which the lamp is connected.

Fig. 1 is more or less self-explanatory in indicating the steps by which this simplification has been made. As the tapping points A and B are moved farther apart, the anode current of the valve will increase and the brightness of the lamp will also increase.

Now let us consider the method of measurement. When an aerial or any other load is connected or coupled to an oscillator, the anode current rises, owing to the increased power absorbed from the oscillator. Suppose the anode current rises to 40 mA when the aerial or load circuit is coupled up to the oscillator. If we remove the load circuit, and connect the lamp across a portion of the inductance as in Fig. 1c, adjusting the positions of the tapping points until the anode current is again at 40 mA, then there will be as much power absorbed in the lamp as was absorbed in the aerial or load circuit. A lamp of suitable wattage must, of course, be chosen.

Method of Measurement

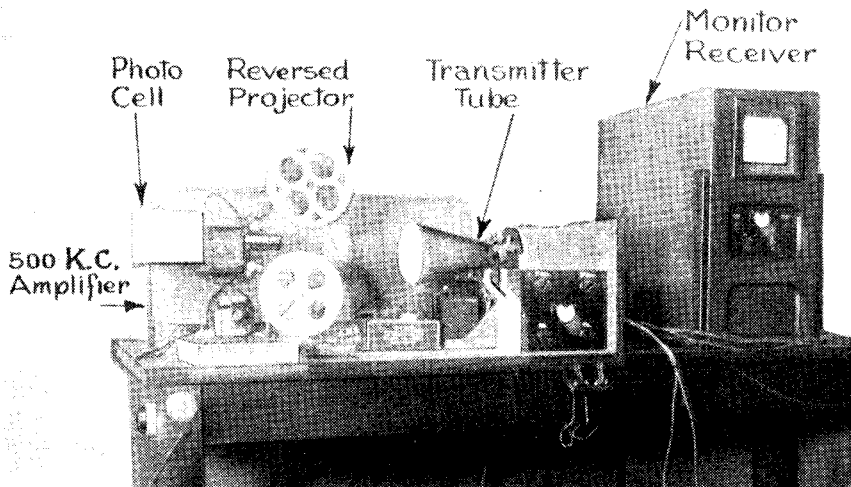
It is quite a simple matter to make a close estimate of the power in the lamp by comparison of its brightness when supplied first with radio-frequency current and then with a measured current which may be either D.C. or A.C. (D.C. is preferable as it is generally easier to obtain accurate instruments for D.C. than for A.C.). All that is needed is a rheostat, a voltmeter, an ammeter, and a suitable voltage supply. See Fig. 2. The rheostat is adjusted until the lamp brightness is the same as is obtained when it is connected to the oscillator. The product of the ammeter and voltmeter readings will then give the wattage in the lamp.

The lamp may be quickly transferred from one circuit to another if a fairly rough measurement is all that is required, but where greater accuracy is needed, more care must be taken in estimating the brightness of the lamp. Two lamps of identical rating should be taken, one connected to the oscillator inductance, and the other connected to the measuring circuit of Fig. 2. It will be an advantage to choose the wattage rating of the lamps so that the power which it is required to measure, the filaments will not be at white heat. If the power output is expected to be about 5 watts, a suitable size of lamp would be a 12-watt automobile lamp.

A 120-LINE CATHODE-RAY TRANSMITTER

By J. H. Reyner, B.Sc., A.M.I.E.E.

A description of the Transmitter recently demonstrated at Bentalls', Kingston-on-Thames. This transmitter will also be on view at the Annual Exhibition of the Kettering



Radio and Physical Society on September 26th-28th. The design embodies many unique features which are fully described in this article.

The film transmitter in use at the 120-line demonstrations at Bentalls', Ltd., Kingston.

FOLLOWING the successful results achieved with the 30-line transmitter discussed some time ago in these pages, it was decided to attempt higher-definition transmission. As before, film was used to provide the subject matter, since for experimental purposes this has the immense advantage that any one shot can be examined again and again and the effect of minor improvements in the various parts of the apparatus can be examined at will.

The question of the scanning was the most important one and after some consideration it was decided to use a cathode-ray tube for this purpose. This has three main advantages. In the first place the number of lines can be altered at will by a simple adjustment of the time-base.

Secondly, during the early stages it is possible to avoid the difficulties of synchronism by running the transmitter and receiver tubes from the same time-base. The rest of the chain remains undisturbed so that all the problems arising from amplification, modulation, etc., can still be studied without any difficulty. True television can still be transmitted at a later stage when the earlier difficulties have been overcome.

The third advantage is that of cost, for any mechanical system suitable for a large number of lines requires considerable accuracy of construction and consequently the expense is heavy. A 90-hole scanning disc itself costs about twice as much as a 6,000-volt transmitter tube.

The disadvantage of the cathode-ray system is the limitation of light. With a disc or mirror-drum arrangement one can increase the illumination and thereby generate a signal in the photo-cell which is definitely well above the noise level. With the cathode-ray tube the light is limited and considerable attention has to be paid to this point, and although in the transmitter in question background noise does not interfere with the pic-

cathode-ray system is that it is not possible to transmit actual objects, except in silhouette, but for the present purposes this was not required.

Transmitter Tube

The next step was the choice of a suitable transmitting tube. The ordinary cathode-ray tube is nothing like brilliant enough. The early experiments used a Cossor soft J tube having 3,000 volts on the anode. The type J screen used by the Cossor

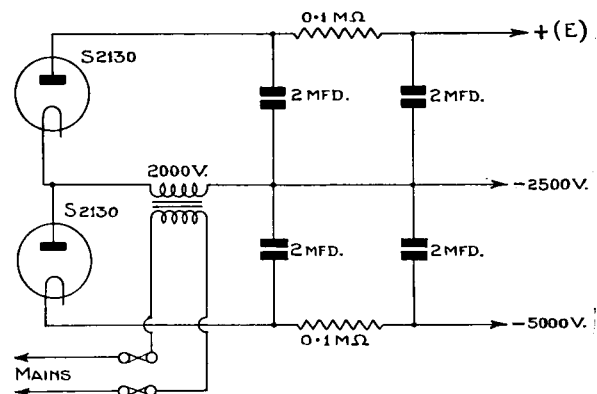


Fig. 1.—The circuit of the 5000-volt eliminator used with the Cathode-ray transmitter.

ture at all, the image on the screen in the early stages consisted largely of noise with a faintly discernible pattern of picture behind!

A further disadvantage of the

people is particularly suitable for this class of work. The wavelength of the light emitted is good from a photo-cell point of view, and the screen has no appreciable afterglow

POWER SUPPLY FOR A CATHODE-RAY TRANSMITTER

which is a most important consideration.

Afterglow gives the effect of top loss and has therefore to be compensated for in the amplifier. Since this can only be done at the expense of decreased average amplification, the overall gain has to be increased and with it the noise comes up, to counteract which the brilliance of the spot must be increased if possible. Conse-

ter for it was found that the insulation between secondary and primary had to be very large indeed. This insulation, of course, has to withstand the full D.C. voltage plus the peak inverse A.C. voltage, which in the present instance amounts to roughly 12,000 volts! In the end a voltage-doubler circuit was used, as shown in Fig. 1. This limits the maximum stress on the insulation to about 6,000

Magnetic Deflection

This particular type of transmitter tube is provided with magnetic deflection for the picture-scan direction, this being done owing to difficulties of insulation. The third gun and the deflector plates are brought out through the sides of the tube, thereby keeping them well away from the



These are two untouched photographs of transmissions received by the apparatus described in this article. Owing to the difficulty of photographing and the fact that the images have movement these pictures do not do justice to the results obtained.



quently, the use of a screen without afterglow is directly equivalent to an increase in the brilliance and L. H. Bedford has estimated that this may amount to as much as eight times in a 120-line transmitter.

The soft tube, however, was unsatisfactory although it did give tolerable pictures. The main troubles were a loss of focus of the spot at high brilliancies, and, of course, the knowledge that the life of the tube under these conditions of heavy bombardment would not be very long. The Cossor people, however, have developed a somewhat similar tube, but having a vacuum instead of a gas filling. The usual Cossor electron lens is employed having three guns in addition to the shield and with this a very fine focus can be obtained. At full brilliancies the focus still tends to be lost but it is considerably better than can be obtained with a soft tube. Since the electron velocity in a hard tube, however, is not as high as in a soft one, it is necessary to increase the anode potential and 5,000 to 6,000 volts was required.

Power Supply

The production of an eliminator to deliver this voltage was no easy mat-

ter for it was found that the insulation between secondary and primary had to be very large indeed. This insulation, of course, has to withstand the full D.C. voltage plus the peak inverse A.C. voltage, which in the present instance amounts to roughly 12,000 volts! In the end a voltage-doubler circuit was used, as shown in Fig. 1. This limits the maximum stress on the insulation to about 6,000

volts which is a more reasonable figure. The voltage doubler circuit also enables condensers of lower working voltage to be used. A condenser with a working voltage of 5,000 costs very considerably more than twice as much as two condensers of 2,500 volts working. With the arrangement shown 2,500-volt condensers could be used throughout, and actually T.C.C. jelly-impregnated type 141B condensers were used. Resistance smoothing is incorporated, and the arrangement has the advantage that a centre tap is automatically provided. This is very convenient for operating the receiving tubes, which only need 2,500 volts H.T.

filament and shield which are 5,000 volts different in potential.

The technique of magnetic deflection is not familiar in this country although it is used considerably in America. There are, however, various ways of achieving the desired result, one of the simplest being to feed the voltage generated in an ordinary time-base on to the grid of an amplifying valve and to connect the coils in the anode circuit of the valve as shown in Fig. 2.

Some arrangement must be included to balance out the steady current flowing through the coils as otherwise this will cause a permanent deflection. This can conveniently be done by connecting a re-

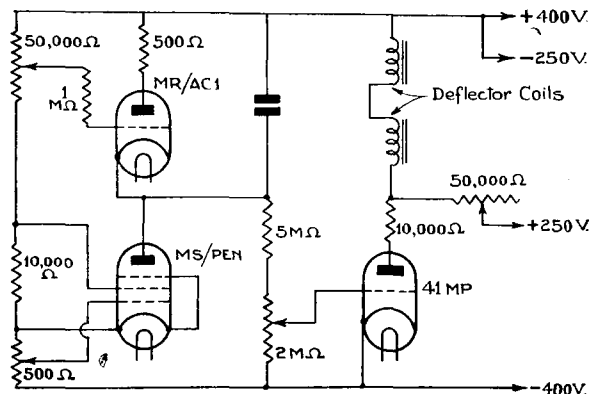


Fig. 2. On account of difficulties of insulation magnetic deflection was used and this diagram shows the circuit.

AMPLIFIER FOR 120-LINE TRANSMITTER

versed battery feeding the coils through a suitable high resistance, and the adjustment of this balancing current also serves to shift the position of the raster on the screen.

The voltage to the horizontal (high-frequency) deflecting plates was obtained from a standard time-base, the shift in this direction being controlled by a potentiometer applying a steady voltage in the usual manner.

This raster was focused down on to a film and for this purpose a small hand-driven Ensign projector was purchased and in place of the lamp-house a photo-cell was located.

The Amplifier

A 7-stage amplifier was used after the photo-cell, divided up as follows. The first stage was incorporated in the same casing as the photo-cell itself so that the connecting leads were extremely short, thereby avoiding capacity loss. The whole was screened to avoid the pick-up of mains hum and stray noise, while this particular stage was battery-driven. An A.C. S₂/Pen. valve was used, resistance-coupled to the succeeding stage.

Next followed a 4-stage unit, mains-operated and having separate H.T. supply for each pair of stages. This was necessary because of the unusually good low-frequency response and the provision of separate power units was cheaper than elaborate decoupling. The first two stages were normal amplifiers built in accordance with the principles already quoted in my articles on high-definition reception, namely, the use of small anode resistances, screened valves to reduce Miller effect and careful layout to minimise stray capacities to the utmost.

The third stage is a top corrector giving a gain at 300 kilocycles some fifty times greater than that at one kilocycle while the fourth valve is a normal amplifier, inserted to bring the phase right.

Finally, there is a 2-stage power amplifier unit constructed on the same general principles and having its own power unit, but since in this case it is necessary to deliver an appreciable voltage output, power valves are used with very low anode resistances, the final stage resistance being only 1,000 ohms. The valves used in this stage were DN₄₁—the Osram double-diode output pentode. This type of valve was used because it happens to

have the grid at the top, thereby reducing the anode-grid capacity quite appreciably. The diodes on the valve were not actually used in the amplification.

This amplifier gave a level response, with a constant input, up to frequencies of a little over 300 kilocycles. In other words the top loss introduced by the inevitable capacity association with the photo-cell circuits is satisfactorily compensated for up to frequencies of this order, and this is adequate for 120-150 lines. With a fairly bright picture at the input end an average voltage of about 5 volts is developed at the output which is found to be more than sufficient to modulate the receiving tube.

Ediswan receiving tubes are employed, the AH type with 8-in. black and white screens being most favoured. The deflector plates of these tubes are supplied with scanning voltages in the normal way from suitable time-bases, several tubes being run off the one time-base quite satisfactorily.

Transmitting Moving Film

The transmission of moving film was a matter requiring a little thought. The method used in the earlier 30-line transmitter was to arrange the scanning spot to move over the same line while the picture was moved slowly past the scanning disc at a continuous and uniform rate. Theoretically the same procedure can be used with the cathode-ray arrangement, but in practice it is not permissible to scan a continuous line in exactly the same place with a very high intensity spot. If this is done the screen is damaged, an actual burn appearing which causes the fluorescent material to lose its sensitivity.

Even with the movement of the spot distributed over an appreciable area to form a raster it will be found that the screen shows a discolouration after a time if the raster is always kept in the same place, so that if the whole of this light is concentrated into one line it will be clear that rapid deterioration of the screen will ensue.

A further disadvantage of this form of operation is that still pictures cannot be shown. The film must be moving in order to produce the necessary picture-scan. It was decided, therefore, to build up a perfectly nor-

mal raster on the transmitter tube and to arrange to pull through the film in an intermittent manner as usual. Now the time of the pull-through is roughly one-tenth of the stationary time and it will be clear therefore that while the picture is stationary it would be scanned by the moving spot in the ordinary way. Just before the end of the scan, however, the picture will start to move so that the last few lines will scan a rapidly moving frame of the film.

In practice this is what happens and a funny blurred horizontal streak appears across the picture. If the time-base, however, is synchronised with the projector this streak can be made to appear at the top or bottom of the picture and can quite easily be masked off at the transmitting end. In other words the scanning lines at the extreme top or bottom of the raster on the transmitting tube are prevented from passing through the film at all and therefore the film is not scanned during the period in which it is moving. The introduction of a suitable contact on the projector mechanism enables the necessary synchronism to be maintained.

In the particular instance a small voltage was fed via this contact on to the grid of the picture-frequency time-base tube which was therefore actually tripped each time by the projector and all that was necessary was to arrange that the speed of charging the time-base condenser was approximately correct.

This method requires a steady drive for successful operation and for this reason an induction motor was used operating direct from the A.C. mains, an arrangement which proved quite successful in practice.

With this equipment surprisingly good pictures could be obtained, despite the limitation of the number of lines to 120. Two photographs are reproduced herewith, one showing a close-up and the other a long shot. The detail of the figures in this latter shot is necessarily somewhat poor, but if the shot is viewed from a little distance away and allowance is made for the fact that normally these figures will be moving (and the difficulties of photographing) it will be appreciated that quite a wealth of action can be introduced into the picture. Three or four characters can appear on the screen at the same time quite satisfactorily and they can be distinguished quite clearly.

A Simple A.C. Meter

Here are some details of an output meter for gauging the signal strength of any station. This meter will overcome the trouble in giving an accurate indication of R strengths.

IN our issue of last month we gave a brief account of the manner of using an output meter. From the name on the instrument, which like so many other marks seen on wireless technical apparatus, is of English origin and denotes a measurer of volume emission, it is obviously intended for the measurement of a receiver's emitted volume when a known alternating voltage is impressed on the inflow terminals of

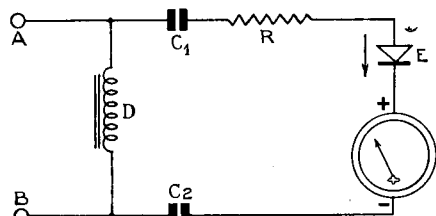


Fig. 1.—The meter is of the Westinghouse instrument type while details of the L.F. choke are given in the text.

the said receiver. The electric effect is estimated in watt units. When the voltage and the current are in phase, as is always the case with D.C., the formula for the effect in question is:

$$W = E.I,$$

where W is the effect in watts, E the voltage in volts, and I the current in amperes. With the aid of Ohm's Law, which is $RI = E$, R being the resistance in ohms, the right-hand side of the first equation can be re-written:—

$$W = E.I = R.I^2 = E^2/R.$$

It will thus be seen that if we measure the current by means of a known resistance or the voltage impressed on it, the effect emitted in the resistance can be calculated.

How it Functions

The method of functioning of the output meter can best be understood by referring to the diagram, Fig. 1, which represents the simplest form for the output meter. The choke coil D, which should have an inductance of 30-henries with a load of about 30 milliamperes, is switched into the output circuit of the receiver. So through the choke flows the constant anode current of the valve and any A.C. impulses, which cannot pass through the choke coil, find a ready path through the two blocking-condensers C_1 and C_2 . If we suppose that, at a given moment, the A.C. is positive in C_1 and negative in C_2 , the current will therefore flow from C_1 through the resistance R and then through the rectifier E which only al-

lows current to pass through in the direction of the arrow while it creates a high resistance for current in the contrary direction. If a milliammeter is switched into circuit it will swing outward. Next moment, the current is passing in the opposite direction, but the rectifier offers a high impedance. It will be readily understood that, when the current is allowed to pass in the one direction, it is possible to measure the current that goes through the known resistance R, with the aid of a D.C. milliammeter. The effect resulting from the A.C. is precisely what we measure in R. Take, for example, a case where the current passing through R, which may be 5,000 ohms, is measured as 10 milliamperes, then we have:

$$W = R.I^2 = 5,000.0,01^2 = 0.5 \text{ watt.}$$

The rectifier employed is, as a rule, a dry one such as the WX6 and this type is not liable to serious measurement errors within the frequency-range 50-10,000 cycles. Fig. 1 shows a rectifier which functions on the principle of single rectification while in Fig. 2 is shown a diagram corresponding to that most frequently employed in good tone-frequency measuring instruments and which makes use of double rectification.

We explain in Fig. 2 also the output circuit for the terminals A and B of the receiver; the constant anode-current goes through the choke D and A.C.

ings, and only after the scale has been carefully set off is the loudspeaker entirely removed.

As before a resistance R_2 of 10,000-ohms is included in the A.C. circuit. This represents a value that may be suitably employed both for triodes and pentodes. If the output meter is employed to measure the output from a receiver, then this resistance, which may be regarded as the valve's external load-impedance, may be of exactly the same value as the valve impedance.

Rectifiers

We come now to the single rectifiers that are combined to act as a double rectifier according to a method known as the Graeth coupling. The single rectifier-valve is indicated by the arrow, which also shows the direction when through-flowing current is possible. We may suppose that at a definite moment, C_1 is positive and C_2 negative, in which case the current will flow in the direction indicated by the arrows and the current in the milliammeter proceeds also in the direction shown from + to -. When the A.C. has, next moment, changed in potential, the current will pass from C_2 to C_1 by way of the two other rectifier-valves but steadily in the same direction through the milliammeter. The difference in quality between the two output meters

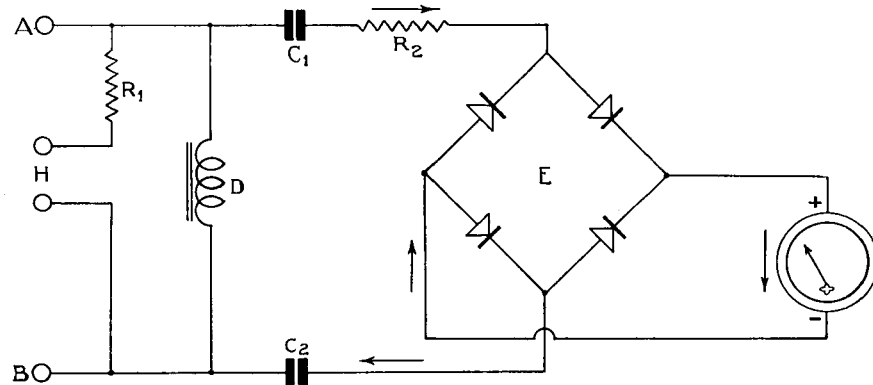


Fig. 2.—This bridge rectifier arrangement can consist of a dual rectifier or simple units connected as shown.

through the two block-condensers C_1 and C_2 each of 2 mfd. (1,500 volt test). In order further to obtain an adequate control with the signals through the loudspeaker, the output-meter is regulated by two loudspeaker clamps H connected together in such a manner that the loudspeaker is shunted over A-B through a resistance R, of 100,000 ohms. In this way the attachment of the loudspeaker is, on the one hand, prevented from altering the measurement read-

is illustrated in Figs. 1 and 2 inasmuch as, in the case first named, the milliammeter makes a current impulse every 1/f second, whereas the double-rectifier yields a current impulse every 1/2f second. If small effects have to be measured, it is necessary to employ a comparatively sensitive instrument and where there is not adequate damping in the movement, the needle may vibrate somewhat and obviously with the normal impulses per second.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS *Specially Compiled for this Journal*

Patentees:— *Marconi's Wireless Telegraph Co. Ltd., H. M. Dowsett and L. E. Q. Walker W. H. Bullimore, L. H. Bedford and A. C. Cossor Ltd. :: Marconi's Wireless Telegraph Co., Ltd. :: J. L. Baird and Baird Television Ltd. :: Radio Akt. D. S. Loewe and K. Schlesinger. :: Radio-Akt. D. S. Loewe.*

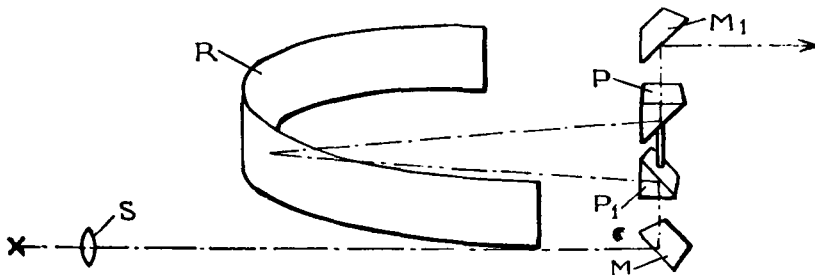
Mirror Scanners

(Patent No. 429,690.)

Relates to a scanning system in which reflectors P, P₁ are rotated at the centre of a stationary mirror-ring R. Light from a source S is first

reflected from a fixed mirror M on to the lower element P₁ of the revolving system, which transmits the ray on to the inner surface of the ring R. From here it is reflected back to the upper element P of the rotating system, and then out *via* a second fixed mirror M₁ to the object to be scanned.

quency, but rich in harmonics. The resulting "difference" frequencies are then passed through a "square-law" detector which yields a comparatively narrow band of frequencies for transmission through the and is coated on its concave surface. A second electrode C₁ is arranged radially, as shown, and acts as a secondary cathode. It is surrounded by a grid-like winding G which carries a high-positive potential and acts as an accelerating electrode, causing the electrons given off by the action of light on the electrode C to impinge on the electrode C₁ with considerable force. This gives rise to the emission of secondary electrons, and so amplifies the original current. The grid windings are carried by rods R, R₁.—(*Marconi's Wireless Telegraph Co., Ltd.*)



Mirror scanning system. Patent No. 429,690.

reflected from a fixed mirror M on to the lower element P₁ of the revolving system, which transmits the ray on to the inner surface of the ring R. From here it is reflected back to the upper element P of the rotating system, and then out *via* a second fixed mirror M₁ to the object to be scanned.

ether. At the receiving end, the incoming signals are again heterodyned to restore the original frequencies.—(*Marconi's Wireless Telegraph Co., Ltd., H. M. Dowsett and L. E. Q. Walker.*)

Velocity-modulated Scanning

(Patent No. 430,179.)

The invention consists in so arranging the various parts that the stationary mirror M always presents the same angle to the incoming ray of light, whilst the other stationary mirror M₁ does the same to the emerging ray of light.—(*Marconi's Wireless Telegraph Co., Ltd., H. M. Dowsett and L. E. Q. Walker.*)

In order to prevent variations in the light-content of the transmitted picture from affecting the desired constant frequency of transmission, the charging-valve used to produce the line-scanning potentials is of the pentode type, with a high resistance in the screen-grid circuit. This holds the screen-grid and anode current at a steady mean value, and so prevents the average or mean frequency of line-scanning from fluctuating with the signal voltages, when velocity modulation is used.—(*W. H. Bullimore, L. H. Bedford and A. C. Cossor, Ltd.*)

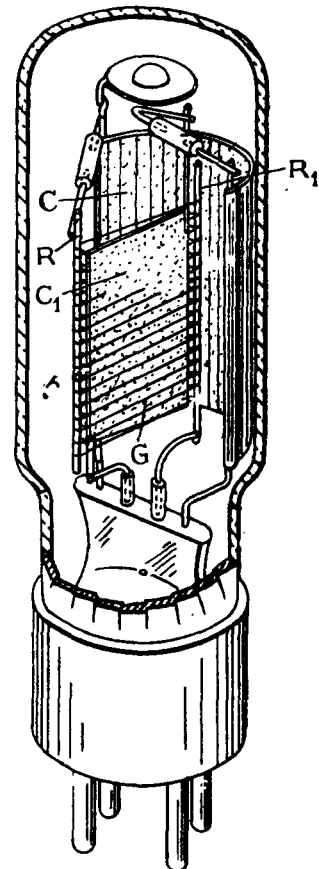


Photo-electric cell construction. Patent No. 429,726.

Reducing Frequency Spread

(Patent No. 430,161.)

A method of reducing the width of the frequency band normally required to transmit television signals is based on the assumption that the essential signals are not uniformly distributed, but are concentrated in and around bands coincident with the line-scanning frequencies, including harmonics of these frequencies.

The picture-signals are accordingly first heterodyned with a frequency near that of the line-scanning fre-

Photo-electric Cells

(Patent No. 429,726.)

The P.E. cell is arranged to act as a direct amplifier of the photo-electric current. The light-sensitive electrode C is of semi-cylindrical form,

Mechanical Scanning
(Patent No. 430,570.)

It is sometimes advantageous in disc, mirror, and similar scanning systems to throw the scanning-beam over more than one hole or mirror at

the ether. At the receiving end the arrangement illustrated in the figure is used to "double" each picture before it is thrown on the projection screen.

As shown, the incoming signals

torted pictures.—(*Radio Akt. D. S. Loewe.*)

(Patent No. 429,516.)

Photographic method of preparing scanning-discs for use in television.—(*F. Plew and E. H. Wright.*)

(Patent No. 429,832.)

Synchronising a television receiver by signals submodulated on the carrier-wave used for transmitting a sound programme.—(*T. M. C. Lance, D. M. Johnstone, and Baird Television, Ltd.*)

(Patent No. 430,262.)

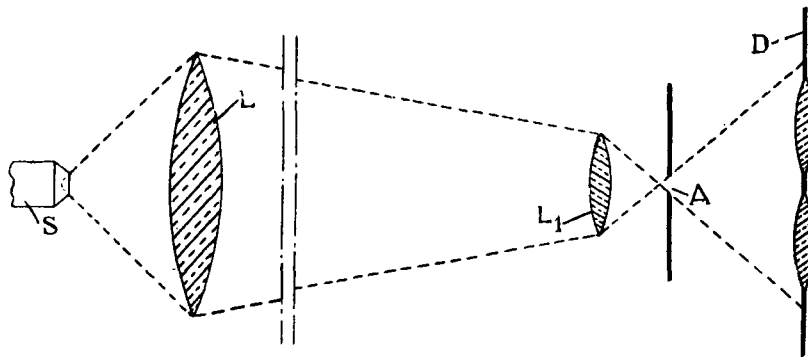
Short-wave aerial with coupling to a transmission line.—(*T. M. C. Lance, D. W. Pugh, and Baird Television, Ltd.*)

(Patent No. 430,463.)

Transmitting a short-wave carrier, modulated with a saw-toothed frequency, as an addition to the picture-modulated carrier.—(*Telefunken Co.*)

(Patent No. 430,534.)

Correcting picture-distortion by specially shaping the electrodes of a cathode-ray tube.—(*General Electric Co., Ltd., and L. C. Jesty.*)



A mechanical scanning system. Patent No. 430,570.

a time. With this object in view, two lenses L, L₁ are interposed between the diaphragm aperture A and the arc-lamp or other source of light S. The lens L₁ is of short focal-length and is placed close to the aperture, so as to enlarge the emerging beam of light sufficiently to cover two of the lenses in the scanning-disc D, as shown.—(*J. L. Baird and Baird Television, Ltd.*)

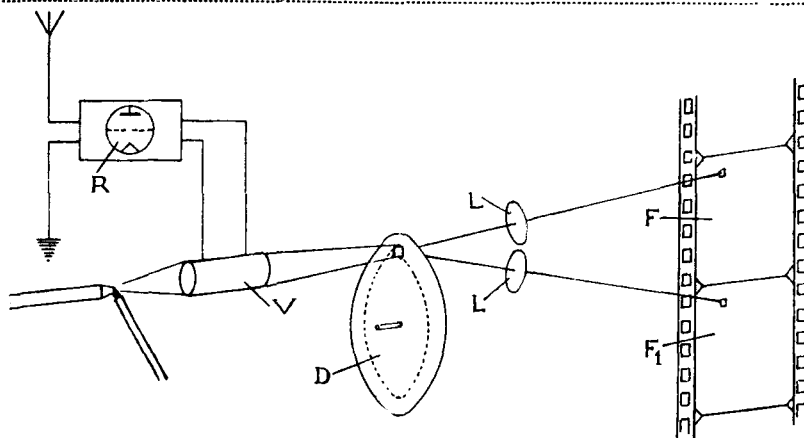
are applied from the receiver R to a light valve V, and the modulated ray is then passed through a scanning disc D. It is next focused by lenses L, L₁ on to the two adjacent frames F, F₁ of a cinema film, which is advanced two frames at a time by the usual Maltese-cross movement. After the film has been developed, it is projected on to the viewing-screen at normal speed, i.e., so as to give 25

Cathode-ray Tubes
(Patent No. 430,650.)

There is a tendency for the marginal fields of force from the two pairs of scanning-electrodes in a cathode-ray receiver to exercise a disturbing influence on each other, and so cause distortion of the picture. The inventors have discovered that this is caused, in part, by the spacing of the two pairs of electrodes along the main axis of the tube, and in part by the spacing between the associated plates of each pair of plates. The connections necessary to avoid this effect are set out in the specification. In addition the two plates of one pair of plates are made to incline slightly towards each other.—(*Radio Akt. D. S. Loewe and K. Schlesinger.*)

Reducing Ether "Spread"
(Patent No. 430,900.)

It is usual in high-definition television to transmit each complete picture at the rate of 25 per second. This rate is necessary to avoid flicker, but is higher than is necessary to maintain the effect of smooth motion. The invention is accordingly based on the idea of transmitting only 12½ pictures per second, so as to cut down the frequency-band occupied in



Scanning system to reduce ether spread. Patent No. 430,900.

pictures per second, free from flicker.—(*J. L. Baird and Baird Television, Ltd.*)

(Patent No. 430,569.)

Improvements in mirror-drum and like scanning systems.—(*J. L. Baird and Baird Television, Ltd.*)

(Patent No. 430,809.)

Fluorescent screen having a foundation of conducting-gauze for a cathode-ray tube.—(*Fernseh Akt.*)

Patent No. 430,940.)

Television receiver on which a "mosaic" of moving elements form the light-and-shade units.—(*W. W. Triggs.*)

Summary of Other Television Patents

(Patent No. 429,427.)

Method of producing relaxation oscillations which result in undis-

Owing to the demands upon our space in this issue we have been obliged to hold over the third instalment of the series of articles entitled "The Design of Television Amplifiers."

OCTOBER, 1935

TELEVISION FACTS FOR THE PUBLIC

The Radio Manufacturers' Association issues to its members some answers to customers' queries.

THE R.M.A. has issued a pamphlet in "question-and-answer" form for the guidance of the radio trade generally in replying to questions which are being frequently asked by the public, and we avail ourselves with pleasure of the Association's courteous permission to reproduce the pamphlet in our pages.

Do we endorse it? We have not much to find fault with in the literal wording of the replies, but we feel that the R.M.A. in approaching the subject from a very special angle has consciously or unconsciously introduced into the replies a certain amount of "colour."

We can all sympathise with the R.M.A.'s desire that the coming of a television service will not prove a hindrance to the business of its members in disposing of the goods they have manufactured for sale.

It is undoubtedly true that when the Television Committee's Report

was published in January last many of the popular papers completely lost their heads and gave their readers the idea that a television service would be with them in a few weeks and by that time the ordinary broadcast receiver would be obsolete. There followed, it is alleged, a serious drop in the sales of receivers, and quite naturally, but not necessarily correctly, the radio manufacturers regarded the falling away as a direct result of the ill-informed enthusiasm occasioned by the popular Press. Accordingly the radio manufacturers as a body hardened their hearts against television, and even at times, we think, shut their eyes and ears to the facts of the position. The R.M.A. has never troubled to deny the report that it exerted pressure upon the Press to "go slow" upon the subject of television and even to attempt to reverse the impression, already created in the public's mind, by eating its own words.

It is obvious that the R.M.A. in preparing its questions and answers has adopted a conservative point of view, and whilst endeavouring to provide the public with some useful information it has at the same time tried to give the impression that a television service is not a thing of the immediate future but rather something that will come one of these days when a long series of experiments shall have been pursued to its end. We criticise not so much the R.M.A.'s answers as the tone of those answers, and it is for this reason that we, whose point of view—quite as honest and informed—happens to be rather different from that of the R.M.A., here attempt to provide some alternative replies.

It will be understood that we reproduce the question and answer *precisely* as given in the R.M.A. pamphlet and that in the parallel column we offer our own alternative reply.

Is it true that television is here and that, very shortly, we shall all be seeing as well as hearing the radio programmes?

Television has been "here" for years, and it has been possible to see as well as hear B.B.C. programmes for some considerable time past. Experimentation is now being taken a definite but limited stage further.

What is all this talk about regular television broadcasts?

An official inquiry has been held into the problems with which the ultimate development of television is surrounded and recommendations made as to the lines of its possible progress.

What are those recommendations and in what direction will television develop?

It has been decided that there shall be an experimental period during which two comparative television systems shall be tried out on broadcast televised programmes.

Anybody in Greater London who will buy a television receiver will be seeing as well as hearing in about six months' time.

As to "all," everybody is not yet hearing the ordinary broadcast programme.

It is no longer "talk." The B.B.C., acting under the advice of a committee appointed by the Government, will have a double transmitting station in operation early next year. The station is now being built.

The recommendations are those of the Television Committee contained in a report presented by the Postmaster-General to Parliament last January. They cover the establishment of a service in London and later the provision of additional stations until a network of stations is gradually built up. The transmitting plant for the first station is now in course of construction.

How long is that experimental period to be?

There is no definite time limit fixed, but the Committee that has been appointed by the Government to survey the progress made has a statutory life of five years and the experimental period is fixed at two years.

What will be done during that period?

First of all a station, to transmit the new form of televised programmes, will be opened in the London area. *It is expected to serve an area within a radius of 25 miles.*

When will that first station commence public transmissions?

According to a recent announcement by the Postmaster-General, who is responsible to the Government for the development of television, the work of manufacture and installation of the transmitting equipment required for the first station, in London, is expected to be finished in

The R.M.A.'s reply is endorsed, but what is the implication of this question and answer? That, after the experimental period, television will be discarded? This is simply not conceivable.

Nobody yet knows the area which the Alexandra Palace station will cover. 25 miles from Alexandra Palace would reach Gravesend on the east, nearly to Maidenhead on the west, to Redhill on the south, and miles beyond Hatfield on the north, so that even such a limited range would cover Greater London. But Baird's Crystal Palace installation has an effective range of 40 miles.

The R.M.A.'s reply is full and complete.

about six months; the first test transmissions will, it is anticipated, not be made until the early part of 1936; and these will be followed by a regular public service as soon as practicable. It has been made abundantly clear that the transmitters for centres of population outside London will be erected only after a certain amount of experience is gained with the London service. *The first of this series will possibly begin to operate towards the end of 1936.*

When will the whole of the country be served by television transmitters?

That is a possibility that has not been envisaged by the authorities. The furthest that the Committee has gone is to estimate that *in time there may be ten stations operating to serve about half the population of the country.*

When the new station commences to operate will it cost much to receive the programmes?

Both the Committee and the manufacturers declare that the cost of a television receiver will be somewhere about 60 guineas. A television receiver will employ a device known as a cathode-ray tube or possibly an equivalent mechanical system and 15 or more valves. Together with their associated equipment these valves have a fairly definite bearing on the cost of an instrument, and it is fairly obvious that *if a television receiver requires up to five times as many valves as the popular-priced radio receiver its price will be proportionately greater.*

Would there be any other expenses involved?

Only installation and maintenance costs. It is obvious that as many more valves than are employed in a sound-broadcasting receiver will be required in a television receiver, the valve-replacement costs will be correspondingly higher. Incidental circuits to these valves will require and receive the greatest care in manufacture, but will, of course, require the same proportionate degree of maintenance as sound-broadcasting receivers. There will also

The Television Committee envisaged a "network of stations" and in the ordinary course of progress these stations will give complete coverage. We will not forget how many years it took to obtain national coverage with ordinary broadcasting.

The cost of receiving the programmes will be the cost of buying a receiver and running it. A receiver is likely to cost about 60 guineas during 1936 and very much less in the years immediately following.

The R.M.A.'s answer rather emphasises the cost of valve replacement but otherwise is not open to criticism. The cost of running will be slightly more than that of a high-power radio receiver, but what does that amount to? There is no reason to expect any undue cost of valve replacement.

be the cost of replacing cathode-ray tubes when necessary.

Will the B.B.C. broadcast television programmes regularly?

It has been decided that at first television programmes with accompanying sound will be broadcast for a short period each day on two ultra-short wavelengths. This will be entirely separate from the sound broadcasting service on medium waves.

What will the owner of a television receiver have to do in order to enjoy the televised programmes?

Unlike sound-broadcasting, which can be simultaneously enjoyed as a pleasant background to other occupations, television will demand that the viewer must not engage his vision and attention in other directions. In order to obtain the best results it will be found advisable to use a semi-darkened room and concentrate on a small picture area probably.

A regular television programme is the definite intention.

More or less what the owner of a broadcast receiver does now. He will look at the television picture just as he would look at a home movie picture, but with the added advantage that he will be listening to an accompanying sound programme. To use both sight and hearing at the same time is natural to everybody. It is true that to get the best illumination the room will have to be darkened, or some part of it arranged to be in the shadow.

Is the B.B.C. making arrangements to extend television operations?

The immediate future plans of the B.B.C. are mainly concerned with sound-broadcasting. They are, at the present moment, planning the erection of four new stations of the present type—that is, with transmitting gear for long- and medium-wave broadcasting only, whereas television must be broadcast on the ultra-short waves.

Will the television experimental transmissions be received with the aid of the present radio receivers?

The present type of "popular" radio receivers only cover the medium and long waves and, as such, are useless for receiving on the ultra-short waves which television will occupy. It will be impossible to receive even the "sound" part of television programmes on such instruments, but they will be essential for receiving all the B.B.C. and foreign sound-broadcasts as at present. *A normal sound-broadcasting receiver, such as those in popular use today, will be required to receive the sound transmissions which will occupy the*

We must assume it soon will be doing so, as in due course it will be instructed to proceed with the establishment of a network of television stations.

The R.M.A.'s reply properly points out that a separate television receiver will be necessary. Not until the conclusion of an experimental period of unknown length will it be desirable to incorporate in one receiver provision for receiving sound broadcasting on medium- and long-wavelengths and the sound and vision broadcasting on low-wavelengths.

(Continued at foot of next page)

30-line TELEVISION IN HISTORY

—A Record of Engineering Development

In view of the cessation of the 30-line transmissions, this article is specially valuable as a record of the astonishing development that has taken place since these commenced. It is the only complete survey yet published.

THE last day of September, 1929, was a red letter day in television history, for at eleven o'clock on that morning the inaugural programme of an experimental television service was broadcast from the Baird Company's Studio at 133 Long Acre. This was made possible by the co-operation of the B.B.C. via

—still photographs, girls from the staff, the engineers—almost anything or anyone sufficed for those early experiments, except for the first few occasions when some well-known persons were alternately seen and heard. Professor Andrade and Mr. Baird both appeared in the inaugural programme.

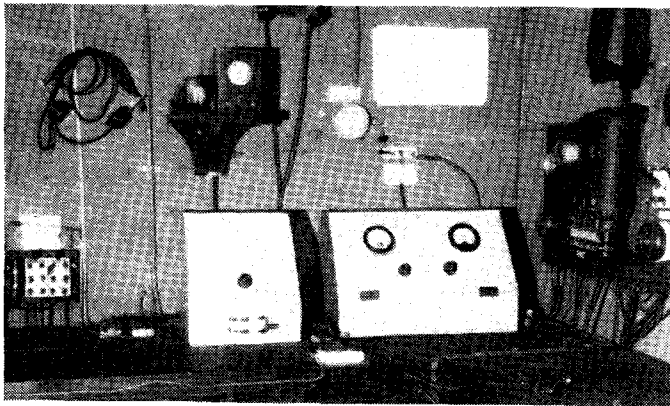
were wired in parallel and connected to an amplifier just on the other side of the partition wall. This amplifier consisted of five stages of L610 valves with special resonant circuits in two of the anode circuits, to give correction for aperture attenuation.* After passing through a small additional amplifier and a "line-corrector" the signal was put on to the Savoy Hill line.

At first the programmes were on five successive mornings each week, but it was not long before two night transmissions were added, at midnight on Tuesdays and Fridays, for the benefit of amateur lookers who could not avail themselves of the morning broadcasts. These midnight transmissions will always be remembered by at least two of the engineers, for one of them had to walk some four miles to complete his journey home, and another slept on a camp bed in the airless studio. But that is a digression, and this is meant to be a technical survey.

It must have been early in 1930 that the new Regional transmitter at Brookman's Park was opened and the television images were noticeably improved on being sent from there instead of from Selfridge's. The London National transmitter was soon completed and on March 31, 1930, simultaneous vision and sound

(Continued on page 617).

* The Television Transmitter, by T. H. Bridgewater, "The Wireless World," Sept. 3rd. 1930.



Part of the Baird control room as it was on the occasion of the first 30-line broadcast.

whose control room at Savoy Hill the picture was carried by wire to their transmitter situated on the roof of Selfridge's. The programme consisted of vision and sound, but not both simultaneously, for only one transmitter was then available. It was usual to make verbal announcements at the beginning and end and to devote the rest of the half hour to television.

Without accompanying sound only the simplest subjects could be shown

The studio was small—roughly 15 feet square—and every artist had to appear sitting down as the scanning beam was low. The beam originated in a 1,000-watt lamp projected through a Nipkow disc driven by a 12-volt D.C. motor. It came through a small hole, about 12 ins. by 6 ins. in the partition separating the studio from the adjacent control room. There was one bank of four small photo-electric cells (C.M.G.8 type) immediately over the hole. They

"Television Facts for the Public"—(Continued from preceding page).

greater part of the B.B.C. day and also those from abroad.

Is it possible that we shall all wake up one morning to learn that a scientific secret has been discovered which will change the entire television situation overnight?

It must be remembered that television is not a new invention but is a development of radio. There has been no fundamental change in the conception of radio during the past quarter-century, but during that time there has been a gradual and normal improvement in technique.

Not very likely. But who knows? We don't. There is quite a lot of waking up to be expected in the future.

Of such is television—one of the expected developments of radio. Television will, therefore, follow the course fashioned by radio—a gradual and steady development along well-defined technical lines.

Is there, then, any justification for expecting that television will take the place of radio in public favour?

Television cannot in any way be regarded as an alternative to sound-broadcasting, *but in course of time it will become a supplementary adjunct thereto.*

No. Television is the natural complement to the broadcasting of sound and not in any sense a rival. Our eyes are friends not enemies of our ears

Simple Signal Generators

By Robert Cockerill, B.Sc.

SIGNAL generators and simple test oscillators should form part of every amateur's equipment. This type of apparatus can be used to line up receivers, check wave-lengths of stations heard and as a monitor in the case of a transmitting station.

First of all, before going into the various circuits which can be used,

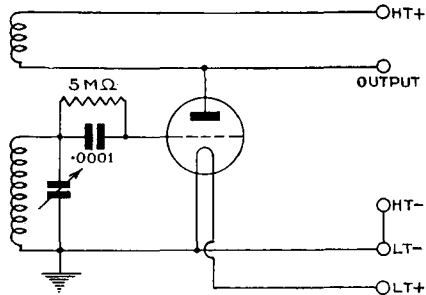


Fig. 1.—This is the simplest type of signal generator. Use a valve of the HL2 type.

here are a few details about the fundamental principles of a signal generator. Some of our new short-wave fans are hazy as to the functioning of an oscillator. Actually an oscillator is simply a valve so connected that it oscillates at a controlled frequency or wave-length. The control is largely governed by the inductance and capacity constituting the tuned circuit generally in the grid of the valve. The object of the oscillation is to obtain a signal at any required frequency to be fed into a radio receiver so that it can be lined up to the frequency of the oscillator. In this way any receiver can

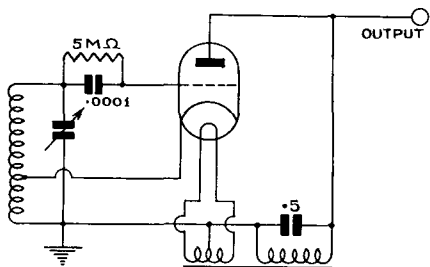


Fig. 2.—Greater frequency stability is obtained by having a cathode tap in this way. The R.F. output is modulated at 50 cycles.

be calibrated. If required the signal can be modulated to simplify this checking.

From this very rough outline it will be realised that frequency control is very important. If errors are to be avoided and accuracy of calibration maintained, any given dial reading must always represent the same frequency or frequencies. To obtain this

the circuit must first of all be designed to give complete frequency stability.

The Best Generator Circuit

From my experiments I have come to the conclusion that the only oscillator which is satisfactory in this respect, excepting arrangements of the crystal variety, is the electron-coupled arrangement. For this reason the best circuit is the one indicated in Fig. 4, but we will come to that later. Fig. 1 shows the simplest type of oscillator which, nevertheless, operates quite effectively. It uses a triode valve of the H-L 210 type, while the H.T. supply need not exceed 45 to 60 volts. Oscillations are obtained by feed back from the anode circuit, and the output is taken from the actual anode of the valve. Incidentally A.C. on the heater will introduce a very simple modulation at 50 cycles.

The main disadvantage of this circuit is that the frequency will vary unless the voltages applied are kept absolutely constant, so that unless a milliampere-meter is included in the anode circuit frequency can never remain entirely constant.

A tuning coil which, with a short-wave condenser is tuned to the wave-band required is necessary for this circuit, but the buffer condenser in the anode circuit must have a small capacity and can be similar to the 60 mmfds. Bulgin type S.W.90. As an alternative couple about 3 in. of wire around the anode lead to the valve as this will give approximately the same capacity and will in most cases prove entirely satisfactory.

Most amateurs will prefer an A.C. operated arrangement which will prove far more stable owing to the fact that the heater voltage is not likely to vary. Fig. 2 shows the circuit which is slightly different owing to the fact that the cathode is taken to a tap toward the earthy end of the coil. Both anode and

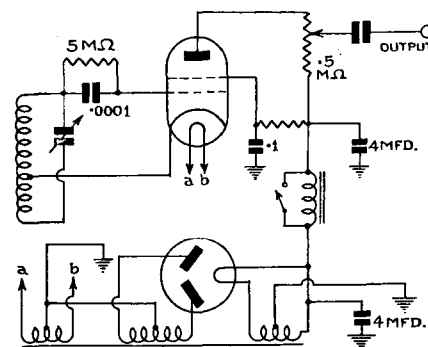


Fig. 5.—If the unit is all-mains operated calibrations should not vary. Here is the circuit.

filament voltages are obtained from an A.C. transformer with the result that the R.F. output from the oscillator is actually modulated by the 50 cycles hum from the mains. The idea of this is to make the signal audible without going to the trouble of complicated modulating system. If modulation is not required a small 36 volt H.T.

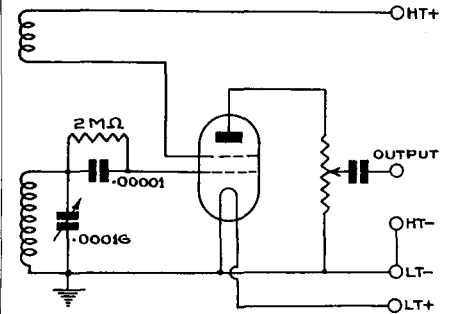


Fig. 3.—An attenuator is almost essential. This is the simplest method.

battery should be used instead of the A.C. transformer. An attenuator so that the output and the oscillator can be controlled is an idea that should be more generally used. Fig. 3 shows this arrangement which actually is quite conventional with the exception that the anode goes to H.T.—

Oscillators can always be adapted so as to perform two functions, that of frequency metering and as a monitor for phone and C.W. transmissions. By placing a pair of headphones in the anode circuit the oscillator is then

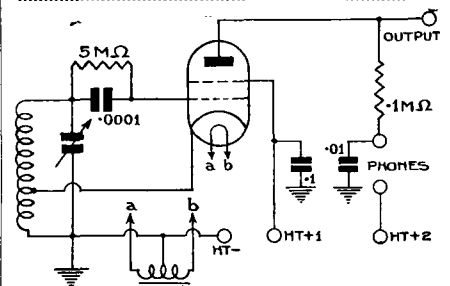


Fig. 4.—The most stable oscillator is of the electron coupled type. Constructional details of a unit such as this were given in the September issue.

actually an oscillating single valve receiver. Provided it is completely screened in the metal can the strong signals from a nearby transmitter will not cause grid choking. The circuit as shown will give a pure output, that is, it will not have any A.C. modulation on it. This is most important, otherwise every station carrier would be accom-

(Continued at foot of page 590.)

THE A B C OF THE CATHODE-RAY TUBE—VII

By G. Parr

THE stage, or rather, the screen is now set for the picture to be shown. Fig. 1 shows what the screen looks like before anything happens, and, as a matter of fact, this is an actual photograph of the end of the tube. The line screen has been expanded a bit so that the build-up can be seen clearly—in practice the spot would be blurred so that there is not such an obvious gap between the lines.

The definition is roughly 30-line, and you can estimate the enor-

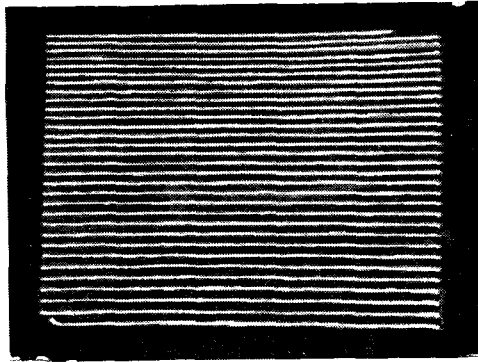


Fig. 1.—The raster or television screen.

Provided that these variations are occurring in the correct order and place on the screen, a television picture will be built up which will be a replica of the scene transmitted.

“Correct order and place”—how are these arranged? It goes without saying that the scanning lines must be produced at the same speed as the moving spot in the transmitting studio and that they must be of the correct proportion. Here is a point in which the cathode-ray system differs from the

GETTING A PICTURE

mous improvement that 240 lines will produce by imagining seven lines packed in the space between the ones shown. Notice the bit missing in the top line. The beam, instead of completing the line is using that amount of time to return to its original position at the other end of the screen, and if you look closely you can see where it slides in to start the lowest line at the left-hand corner.

The return stroke of the beam is invisible, although it moves across the line screen itself, owing to the great difference in speed between the normal scanning movement and the return movement. In high-definition pictures the return stroke is more visible and steps have to be taken to push it off the screen and make the beam come round the back way, so to speak.

How the Picture is Built Up

Now, while the beam is drawing the lines we have to make the picture build up in step with the scanned scene at the studio. First, disconnect the shield circuit of the tube, but not while it is working. If the negative bias were taken off while the full accelerator potential is on the tube it would be rather like unscrewing a water tap with the full main pressure behind it—a great deal of damage would be done! No, switch off, and then connect a resistance in series with the shield terminal, taking the output leads from the set to the ends of the resistance.

The cathode-ray tube is then connected like an output valve, the signal being applied to the equivalent of the grid. Instead of varying the anode current as in the case of the valve, we are varying the beam current, and with it, the intensity of the spot on the end of the tube. So each time that the incoming television makes the shield more negative the beam is cut off and a black patch appears on the screen (black by contrast with the lighter parts, of course). Conversely, each time we decrease the shield potential the beam current increases and the spot brightens up. So the incoming television signal is turned into light and dark variations on the screen, all ranges of tone being produced by varying the strength of signal.

mechanical scanning disc or drum. In the mechanical system, since the number of mirrors or holes is fixed, if the disc rotates at the correct speed, the correct number of lines will automatically be drawn, so many per complete revolution.

In the cathode-ray system the number of lines in the picture is controlled by the relative vertical and horizontal speeds of the beam, which can be varied at will and independently of each other. For example, suppose the value of the charging condenser in the vertical scanning circuit is set to give one line in $1/360$ th second, and the horizontal scanning speed is such that the beam returns at the end of $1/12$ th second. We shall get 30 lines all right, but they won't be the right 30 lines! Our picture is changing too fast and the line is being drawn too slowly, and as a result the light and dark patches made by the modulating signal will all be in the wrong place. The cathode-ray television screen, therefore, requires more “setting up” than a mechanical scanner, but once the correct proportion is obtained it is easier to keep it in step.

Keeping the Picture in Step

This is done by applying the synchronising signal to the valve which discharges the condenser, forcing it to do its job at the end of every $1/375$ th second. If the

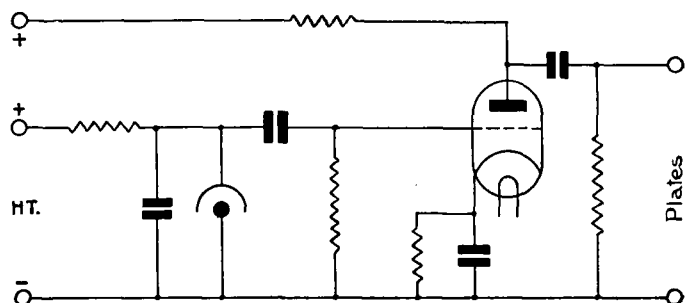


Fig. 2.—An elementary scanning circuit for producing the line screen on the tube

condenser is set so that it is discharging at the end of every $1/370$ th second instead of the correct time, along

DISTORTION IN CATHODE-RAY IMAGES

comes the synchronising signal and discharges it whether it likes it or not. The timing of the lines is thus controlled by the signal from the transmitter. In high-definition television, where the synchronising is of even greater importance, the condenser discharge is not only forced to occur at the end of every line, but at the completion of every "frame" as well.* In the 30-line system it was not necessary to synchronise both

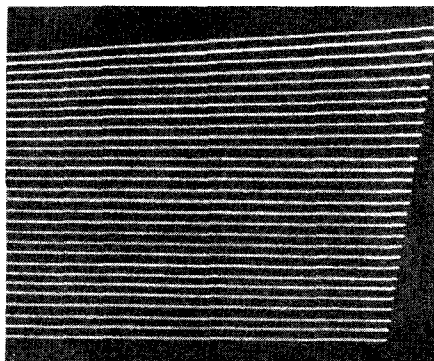


Fig. 3.—Distorted rectangle caused by unbalanced deflection potentials in a cathode-ray tube.

picture and line movements, since one could be actuated from the other with sufficient accuracy to keep the picture steady. If you wish to go into more details of the synchronising of scanning circuits, refer to J. H. Reyner's article in the issue of March, 1934, which gives a diagram of the action of the synchronising impulse.

Additions to the Scanning Circuit

The circuit of Fig. 2, which is reproduced from last month's article gives only the bare bones of the scanning arrangement, and several little extra gadgets are added before the whole is complete. In the first place, we have assumed that the beam will always occupy the centre of the screen, but this is seldom true in practice. Due to slight variations in the mounting of the deflector plates, or more commonly, to external "stray fields," the beam may tend to wander to one side or the other and will have to be brought back. For this purpose we return one of the deflector plates to a poten-

* The frame is one complete picture produced by the scanning lines.

tiometer slider, connecting the potentiometer across the H.T. supply to the scanning circuit.

This enables us to apply a small D.C. potential to one plate which will push the beam about on the screen irrespective of the scanning impulse applied from the condenser. These potentiometers, one for each pair of plates, are called the "shift pots." (Potentiometers is such a long word!)

A second improvement in the scanning circuit which is very necessary in high-definition working is to provide a means of balancing the deflecting voltage applied to the plates.

In the circuit shown, the potential of one plate varies from nearly zero to full H.T. value with respect to the accelerator. This, in high-vacuum tubes gives rise to a peculiar distortion of the picture, as though the edge of the line screen were pulled down at one corner. It is usually called the "trapezium effect," since the shape of the picture is more trapezium-shaped than rectangular (Fig. 3). A better shape is obtained by feeding the potential on to the plates from a push-pull circuit, similar to that used in amplifiers, the centre point of the valve circuit being connected to the accelerator (Fig. 4). This ensures that the change of potential on the deflector plates is electrically symmetrical with respect to the accelerator, and removes the distortion mentioned. In the next and concluding article we will clear up odd points, and discuss the various snags which can occur if the cathode-ray tube is not working nicely.

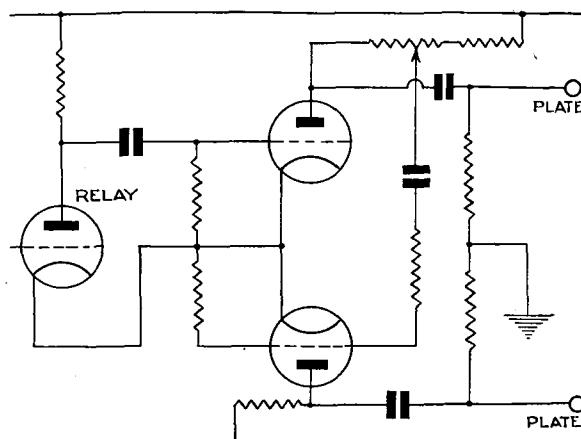


Fig. 4.—A push-pull stage added to the scanning circuit relay to give balanced voltage on the deflector plates.

"Simple Signal Generators"

(Continued from page 588)

panied by a ripple giving a false idea of the transmission quality.

This circuit uses electron-coupling which, as previously mentioned, is the most effective arrangement. The screen of the valve is actually the anode in this circuit, while the output of the oscillator section is coupled through the valves electron stream to the usual anode. Frequency stability with this circuit is particularly good.

To obtain complete stability and to be quite sure that the voltage applied will remain sensibly constant most amateurs prefer an all A.C. arrangement. This is shown in Fig. 5, again an electron-coupled oscillator which has its own power supply all contained in a metal box. The smoothing condensers should be of the type supplied in a cardboard container otherwise the cylindrical condensers will have to be mounted. The screen of the pentode—an A.C. Pen. obtains its voltage from the main

H.T. supply through a series resistance of 25,000-ohms. A low-frequency choke in the same lead will provide modulation, but this should be connected across the make-and-break switch so that this can be cut out of the circuit when not required.

As regards coils, in Figs. 1 and 3 standard four-pin short-wave coils can be used but for the electron-coupled circuits as shown in Figs. 2, 4 and 5 special tapped coils must be obtained from Eddystone.

WAVEFORM IN TELEVISION SIGNALS

UNTIL comparatively recently it was assumed that the television image was similar to a newspaper illustration—that is built up of an immense number of dots of differ-

Such a waveform is built up of a whole series of simple harmonic vibrations. There is the fundamental frequency of 2,000 cycles a second and harmonics having frequencies 3,

to a frequency of 38,000.

But there is yet another factor to be taken into account. Consider the scanning of a simple object by means of a scanning disc. The sides

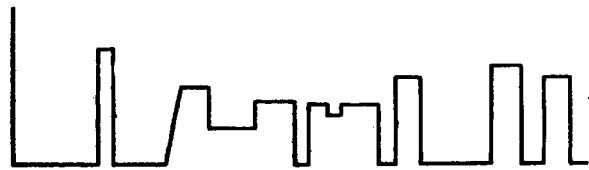
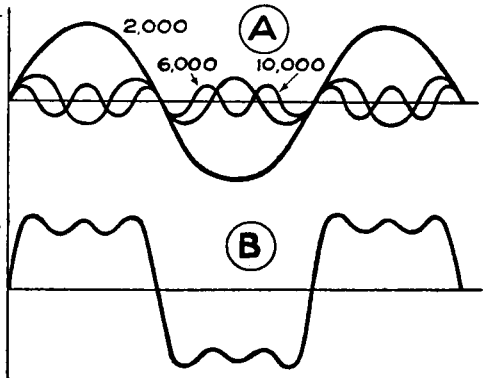


Fig. 1 (left).—Variations of intensity in one scanning line of a face.

Fig. 4 (right).—The addition of three frequencies produces a roughly square wave form, the highest frequency is only 10,000 cycles per second.



ent intensity. It has since been shown, however, that this idea is fallacious. This will be understood if we consider what happens at a television transmitter. The process of scanning splits the person or scene being televised into a number of vertical strips, and the changes of intensity along each strip are impressed on a photo-electric cell. The kinds of variations of intensity which fall on the cell are shown in Fig. 1, in which the strip scanned is a vertical section cut from a photograph of a woman's face. The intensity curve consists of some five very rough rectangles of different lengths and heights. The height is a measure of the actual intensity falling on the cell, and the length a measure of the time for which it falls. Since in the transmission of 30-line television signals 375 strips are scanned every second, then on this basis of five rectangles per strip there would be only $5 \times 375 = 1,875$ impulses transmitted every second.

A rectangular waveform of the type found in Fig. 1 contains not only

5, 7, 9 . . . times the fundamental. That is, a square waveform of 2,000 cycles contains in addition frequencies 6,000, 10,000, 14,000, and upwards.

Suppose we combine just the first two of these components. They have frequencies 2,000 and 6,000, and are

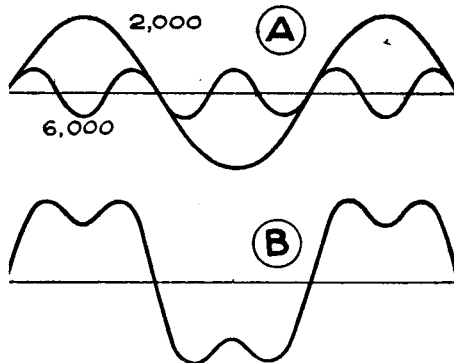


Fig. 3.—The addition of two waves with frequencies of 2,000 and 6,000 cycles per second.

shown together in Fig. 3A. The result of their addition is shown in Fig. 3B, and already we can see a roughly square waveform appearing.

of the "rectangular" impulses falling on the photo-electric cell at the transmitter are not so steep and square as those shown in Fig. 1. Imagine a slot passing over a simple picture consisting of a single white band, as in Fig. 6. When the slot is at A, no light falls on the photo-electric cell, and none will fall until the edge marked "2" reaches the boundary of the white band.

As the slot passes over the boundary, the intensity will gradually increase until at B it is half its final value. Only when edge "1" reaches the boundary will the maximum amount of light pass into the cell. The same thing happens at the next boundary between white and black, so that although the curve of intensity of the original subject is square, as in

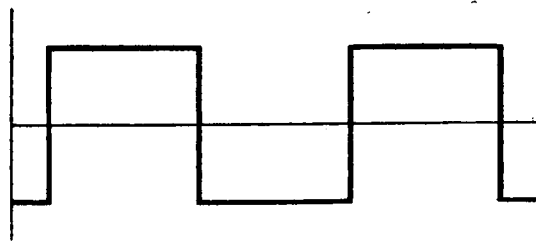
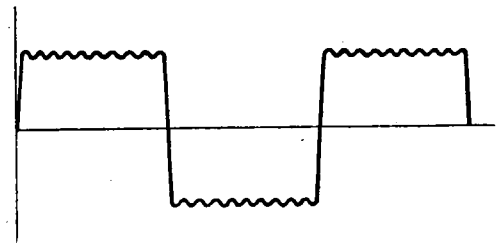


Fig. 2 (left).—A wave of square formation.

Fig. 5 (right).—A waveform such as this would necessitate a frequency of 38,000 cycles per second.



its fundamental frequency, but also a large number of harmonics having frequencies many times greater than the fundamental.

A square waveform which it will be assumed has a frequency of 2,000 cycles a second is shown by Fig. 2.

An addition of three components having frequencies 2,000, 6,000, and 10,000, as in Fig. 4, improves matters, but it requires as many as ten times to give the substantially square waveform of Fig. 5.

The tenth component corresponds

Fig. 7A, the response curve the photo-electric cell gradually builds up is horizontal and falls again as in B.

We have already seen (Fig. 5) that for a more-or-less exact reproduction of the steep sides of a square wave-

(Continued on page 624).

DE TO THE NEW TELEVISION

at published of television principles as they will be the joint work of various authorities and is written standable by non-technical readers.

produced the modern cinema, which is very closely allied to television. Both depend on a peculiarity of the human eye to make their functions acceptable. Without the phenomenon of "persistence of vision" both cinematography and television would fail to register their effects. From a severely optical point of view the human eye is, as an instrument of vision, defective, and the televisior and the cinema camera play on this defect.

A luminous object within an observer's field of vision produces an image on the retina, which is the eye's sensitive

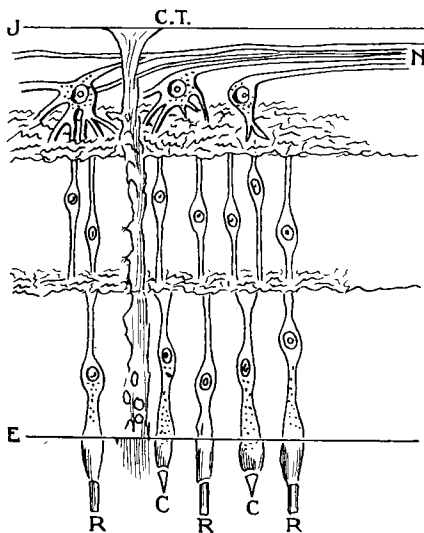


Fig. 3.—Transverse section of retina, greatly magnified.

photographic plate. If objects present themselves to the eyes in too rapid succession the images on the retina are blurred and overlap, because each image is retained on the retina for about one-fortieth of a second before it fades. Sir Malcolm Campbell, travelling at three hundred miles per hour would not get a good view of the objects he drove past.

Thus, the cinema, which actually presents to the sight successive photographs of moving objects, each slightly different from the preceding one, achieves its effect by showing twenty-four of these photographs twice per second, and thus makes use of the eyes' optical "deficiency," for the eye is the ultimate "receiver" of all systems, including television, devised to produce images artificially. Similarly, television also presents a rapid succession of images of still or actually moving objects, according to an elaborate scanning system which is simply described in the following pages.

The cinema has caused something like a peaceful revolution in the last thirty years. A form of entertainment and education has been brought within the reach of every small town, of almost every village, in the world, and not its least important development has been the recent extension of its news programmes.

And what of television in the future? Along both these lines already explored and exploited by the cinema it can

progress to an extent that at present seems immeasurable. It will, no doubt, as at present in Germany, co-operate with the cinema by televising films, taking them to smaller and remoter audiences than they have ever reached before. But the real value and fascination of television must always be its actuality. It is when it reproduces on the screen of the receiver, not a photograph, however "moving," but the image of the actual person or scene which is immediately before the apparatus at the transmitting end, that television is vital and convincing.

In commerce, not only as an extension of the radio industry, but in its own field as an advertising medium, it will become immensely important. To the remotest of homes it will take, in time, the means of lightening work and enlivening leisure; it will carry immediate and living images of the world outside the little local radius. Unlike the cinema, its news can be as red hot as the time signals.

The Whys and Wherefores of Scanning—Part I.

When one looks at any scene, one sees it by the amount of light which different objects in the scene reflect. Take Fig. 1a for example, a head of a girl. We recognise the

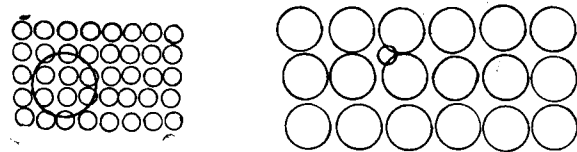


Fig. 4.—Cones of the eye and a fullstop. Left-hand drawing large circle represents fullstop much larger than cones. Fullstop clearly seen. Right hand drawing, small circle represents fullstop much smaller than cones. Fullstop invisible.

white of the eye, from the black pupil, as practically the maximum and minimum of light reflected from this scene, while most of the tone is about 45 out of a possible 100 units reflected. Now any part of any scene is recorded by our sense of sight by having an image (by "image" we mean the optical figure of any object produced by rays of light) formed in our eye. Now the eye—the final judge of all

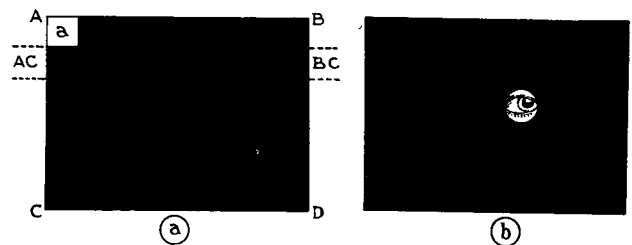


Fig. 5.—Diagram explaining relation of persistence of vision effect and scanning.

optical work—is definitely limited in the smallness of things which it can record. This limitation, while certainly having disadvantages, is probably outweighed by the advantages.

THE EYE AS A MOSAIC SCREEN

One advantage, for example, of the eye's incapability of seeing small things is that in looking at Fig. 1a from the usual reading distance, one is not aware that the picture is composed of a very large quantity of black and white spots, while it may be considered on the other hand a disadvantage that the average eye could not read the type in which this paper is printed if viewed from a distance of more than four feet. In passing it may be mentioned that it has been

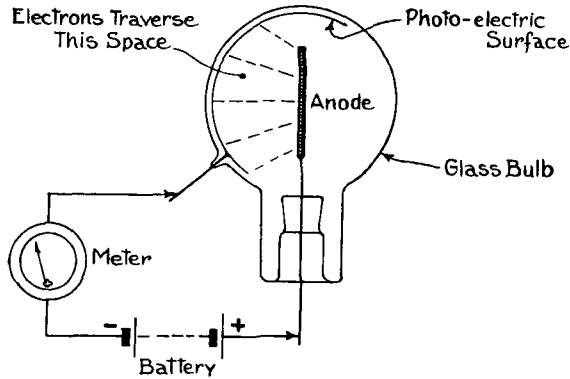


Fig. 6.—Diagram showing the principle of the photo-electric cell.

found by many investigators that the average eye can just distinguish two small objects placed one centimetre apart when viewed at a distance of 77 metres.

Let us now examine why the eye fails to detect objects

Fig. 3 shows a transverse section of the retina (greatly magnified) which is a transparent membrane, lining the interior of the eye. It consists of two layers of connective tissue J and E bound together by transverse tissue CT. Nerves, N, from the main optic nerve finally terminate on small elongated bodies RR and CC, called rods and cones; these are tightly packed together, not unlike the hairs of a brush. It is on the tips of these cones and rods that the image of a scene falls and for two small neighbouring objects to be distinguished the images must fall on separate cones, which are from .002 to .006 millimetre diameter.

Put into diagram form, should a black spot representing a full-stop in this paper fall on the tips of the cones in your eyes, as in Fig. 4, the large circle representing the full-stop, the little ones the cones, you will see the full-stop clearly. But suppose the paper be held so far from the eye as to reduce the image of the full-stop to some value relatively smaller than the cones, apart from the fact that our full-stop may miss falling on a cone altogether, if it does it will be so diluted by its white surroundings as not to register on the particular cone on which it falls.

From what has been said, it will be realised that the eye sees by breaking up the image formed inside it into definite areas and of different intensities according to the amount of light reflected from the original scene. Thus any scene is, as far as vision is concerned, composed of a large number of positioned elements of various intensities of light, all of which are operating on the brain simultaneously.

Early television pioneers suggested that a mosaic screen of some photo-electric material should be made and the resulting current caused to operate a mosaic screen of lamps

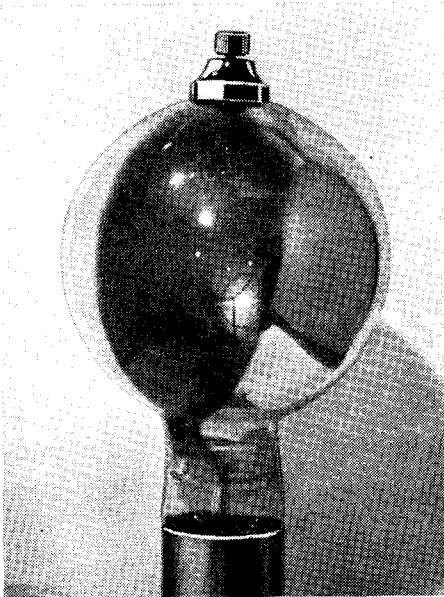


Fig. 7a.—An early type of photo-electric cell having a potassium surface (used in the Baird studios in 1928).



Fig. 7b.—A caesium photo-electric cell of the "plate-cathode" type, suitable for televising films. Commercially produced for talkies.

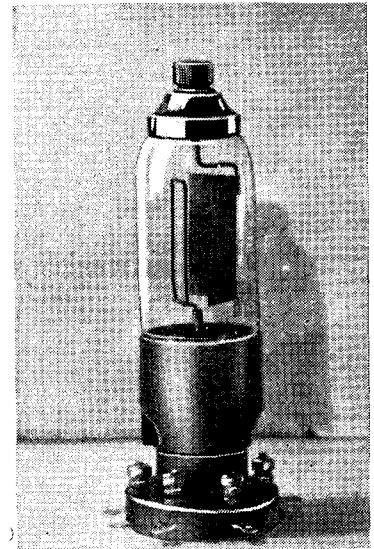


Fig. 7c.—A recent "Oxford" cell, caesium surface specially designed for television; used for spotlight scanning of studio subjects.

smaller than a certain size. The eye, Fig. 2, consists very briefly of a crystalline lens, which produces an image of the object being looked at on the retina. It is at the retina that the light vibrations are changed to what we term sight and it is the physical structure of the retina which is the limiting factor as to the smallness of what the eye can see.

at the receiving end. But as such a device would require one wire per element of the mosaic, the idea is not really possible in practice, especially as for anything like reasonable definition some 120,000 points would be required. Hence at an early stage of television development it was obvious that a scene for practical purposes must be transmitted by a small

SEEING BY ELECTRICITY

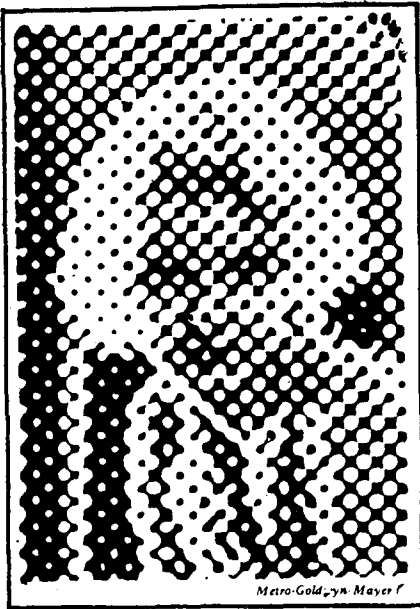


Fig. 8.—An interesting study in definition. If this picture is viewed at an ordinary distance it is almost meaningless; viewed at a distance of six feet or so the characteristics are quite clear.

Metro-Goldwyn-Mayer

number of lines, or channels, and for radio transmission—one channel appears essential.

Luckily the eye has a property of what is known as persistence of vision, that is to say once light has stimulated the eye the stimulus does not instantly cease upon the light being cut off, but takes from one-eighth to one-tenth of a second to entirely subside, the actual time of persistence being less when the eye is exposed to bright light.

Readers can easily prove the time period of persistence of vision by cutting out a disc of black paper on which is stuck one small white spot, somewhere near the edge. If this is revolved slowly at less than one-eighth of a second the spot will clearly be seen, but on speeding up the rotation the white spot dissolves into a white circular streak. Obviously if one moves the white spot by some tortuous route, which eventually ends up at the starting point within the time limit of the persistence of vision, and then repeatedly repeats its journey over the same route, the area covered will appear white so long as the white spot keeps in motion.

Repeating the idea, let us suppose that the black area, ABCD, Fig. 5a is traversed by a smaller white area, such as a starting at the A corner travelling across to B, appearing round the back of the black area at AC across to BC and so on till it has covered the whole area, crossing back diagonally to the A corner from corner D to repeat the process, say twenty-five times a second, our eye would only record a white area not a black one. Thus our eyes would have recorded an optical illusion that we were looking at a white area instead of a black one with a white spot occupying only a relatively small area, and furthermore actually not present on the black area for 50 per cent. of the time if the spot is moving at uniform speed.

Photo-electric Cells

Everyone knows that the vital link between sound and electricity is the microphone. In the microphone are generated currents proportional at any instant to the pressure of the sound wave which strikes it. Telephony and broadcasting are only possible with the microphone because they are both essentially electrical methods of communication.

Consequently the sound must first be converted from one form of energy to another. Since television has also to be conveyed by electrical means of communication there must be some junction where the light from the scene to be transmitted is converted into an equivalent electrical form. This essential link is the "photo-electric cell." Although the photo-electric cell was invented before the thermionic valve, the co-operation of the latter was needed before television could become a reality—unlike the telephone which became possible almost as soon as the microphone was devised.

What is known as the photo-electric effect, that is to say the response of an electric current to light, was first noticed by Heinrich Hertz in 1887, although he himself did not attempt to explain or make use of the phenomenon. In 1890 Elster and Geitel produced in a crude form the forerunner of the modern photo-electric cell.

To explain the action of a photo-electric cell, we will assume that the reader knows that electrons are minute particles of negative electricity, which, under certain influences, can be put in motion; that the heated cathode of a valve, for example, will emit a cloud of electrons which can be made to travel to a neighbouring anode if attracted by a positive potential on the latter. A flow of electrons constitutes an electric current and the strength of the current will depend on the number of electrons moving at the same time. Heating a metal, as in the case of a wire filament in a valve, causes an emission of electrons but heat is not the only force that will produce such an effect. A number of metals will respond in a similar way under the influence of light, the most important, in the order of their sensitivity, being caesium, rubidium, potassium, sodium.

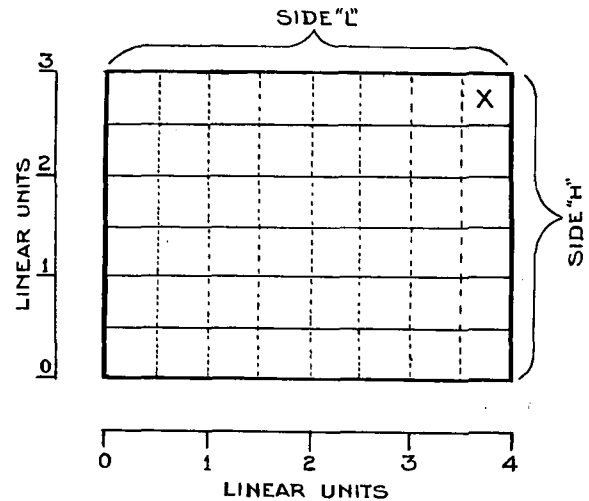


Fig. 9.—Television Picture Constants.

Picture Ratio : $\frac{\text{LENGTH}}{\text{HEIGHT}}$ which in figures equals $\frac{L}{H} = \frac{4}{3} = 1.3$

Scanning :

Horizontal, when scanning area \times travels across picture.

Vertical, when scanning area \times travels up or down picture.

Number of lines = Diameter of round scanning area or one side of square area divided into side "L" if vertical scanning and side "H" if horizontal.

Number of Picture Elements = Lines squared by picture ratio aspect

Horizontal scanning in above = $6^2 \times \frac{4}{3} = 48$ elements.

Vertical scanning in above = $8^2 \times \frac{3}{4} = 48$ elements.

All these materials are very active in the presence of air, and form oxides and hydroxides which render them comparatively useless for photo-electric purposes. It is therefore

HOW AN IMAGE IS SCANNED

necessary to contain them in an evacuated glass tube (see Fig. 6). In this and many other respects the photo-electric cell bears a great resemblance to the valve. If a surface of one of these metals is deposited on the glass wall of the tube and a light is shone on it, the number of electrons released per unit time at the photo-electric surface is directly proportional to the intensity of the incident light. The preceding sentence constitutes the first law of photo-electricity.

is an electric current we can produce a current proportional to the light, which is exactly what is required for television.

Photo-electric cells in commercial form suitable for television generally consist of some form of evacuated glass container with the cathode, that is to say the photo-sensitive part, as a coating either on the inner wall of the cell or on a metal plate supported inside. The anode is usually a ring or grid situated near the cathode. Caesium, the most sensitive photo-electric metal, is most commonly used, and is deposited as a very thin film on another film of caesium oxide which in turn has been formed on a surface of silver. The size of the cell will vary considerably according to the use to which it is to be put. For example, when scanning a film, as described in the next section, a cell having a cathode area of only a few square inches will be sufficient while spotlight scanning in a studio requires a large cell to collect as much light as possible, and sizes such as 12 by 4 inches are employed. Some typical examples of commercial cells are illustrated in Fig. 7.

When speaking of light we have not mentioned any particular colours. If we had a variety of different coloured lights to play on to the photo-electric cell by way of experi-

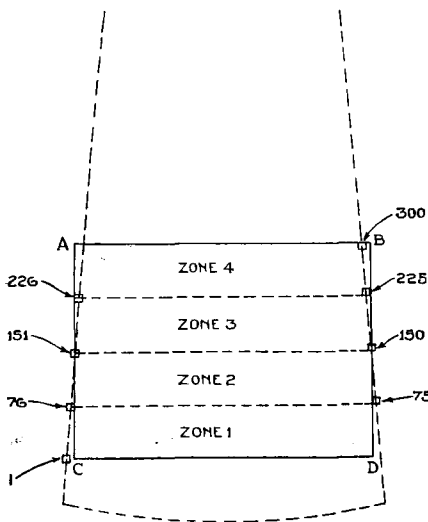


Fig. 10a.—A, B, C, D represents the area to be scanned. 8 apertures are shown, the first of four sets of spirals and the last; they are numbered assuming a 300 line picture. If the disc were to revolve once all the zones would be scanned simultaneously, which would require four channels, if, however, some shutter or mask is applied which only allows one zone at a time to be in operation the disc will have to revolve four times to scan the area.

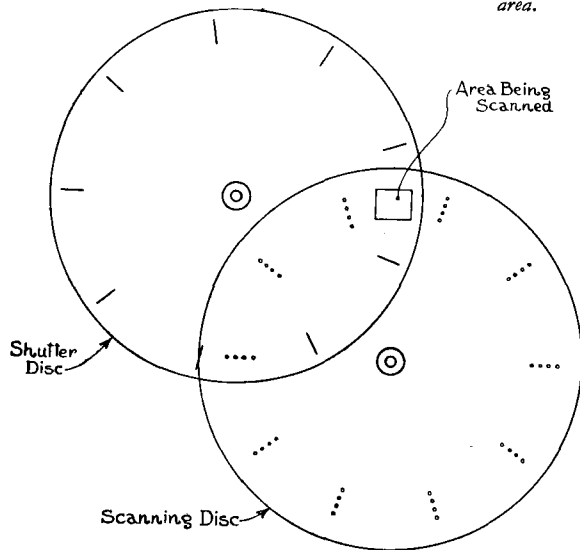


Fig. 10b.—Various devices can be used for masking; one method employs slits in another disc, running at such a speed that one slit moves through the angle between it and its neighbour once for every four revolutions, the slits are not much wider than one scanning line. Diagram shows 40-line disc for ease in drawing.

If now, within the tube, we place an anode, which can be a small metal disc, rod or ring, to which by wire through the glass we apply a positive potential, the negative side of the battery being similarly connected to the caesium surface, the electrons emitted when the light falls on the surface can be collected to the anode by virtue of its attractive positive charge. (The anode must be small or it would obstruct too much of the light.) Since a flow of electrons

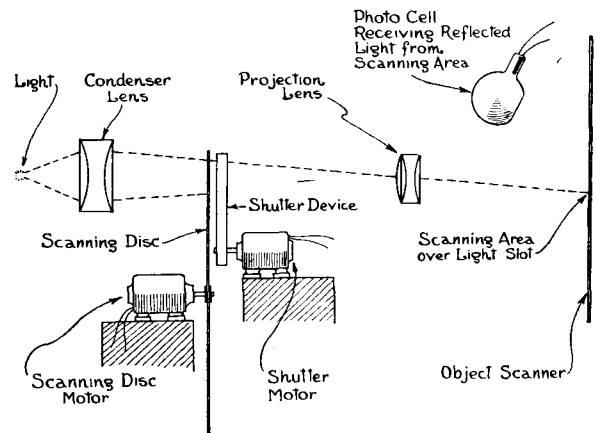


Fig. 10c.—The general arrangement of a disc transmitter.

ment, we should find that many more electrons, i.e., more current, would flow for a red light than for any other. This shows that a caesium photo-electric cell is most sensitive to red light. Ordinary white light is composed of several different colours blended together. The experiment with red light shows that when a photo-electric cell is exposed to white light, it is the red component of it which has the strongest effect in liberating electrons. (The reader will probably know that photographic plates are generally more sensitive to some particular colour than to others. In the early days of photography it used to be violet; now the tendency is towards increased red sensitivity.)

What the red sensitivity of caesium cells means in practice is, first, that the light used for illuminating television subjects must contain a good portion of red. This requirement is easily met as both arc and incandescent lamps are rich in red rays. Secondly, since red objects will influence the cell more than others, the "tone value," when reproduced on a black and white screen will not necessarily be correct, and, for example, a lady's rouged lips would appear almost white! This and other discrepancies have to be overcome by using other colours, such as blue, to give the effect of red.

THE BASIC PRINCIPLES OF SCANNING

Before leaving the subject of photo-electric cells, we should mention that the current produced by the influence of light is very minute—perhaps not more than one-hundred-thousandth of the current in an ordinary electric lamp. This current is made to produce a correspondingly small voltage which, by means of valve amplifiers, can be magnified to any desired amount.

The Whys and Wherefores of Scanning—Part II

We have now cleared the ground to explain scanning in the television sense of the word. Turn to Fig. 1a, the scene we wish to scan. Here, the circle represents the scanning area, which for the sake of clearness is relatively of large area compared to the area to be scanned, that is to say, what is known as low definition. Suppose the picture in Fig. 1a was in darkness except for a round bright spot of light, the size of the scanning area, the picture would appear as Fig. 5b which is very similar to 5a. Now move the lighted area by some means, as we did in the case of Fig. 5a, and we would see the picture as though it was illuminated as a whole owing to the persistence of vision effect.

Consider what we have actually done. The area of the scanning spot is one-sixty-first of the whole, so we have broken up the area of the scene into sixty-one positioned elements, but instead of seeing them all at once they have been recorded one after another by the brain via the eye so quickly that the sensation of "sight" still remembers what each element looked like, when another glimpse of each element is given to refresh its memory, so to speak.

When we look at the scanning area in Fig. 5b we are aware of the detail within the area because this area is relatively large compared with the limiting area of vision, due to the finite size of the retina cones of the eye.

Obviously we could reduce the scanning area to something comparable with this limiting area and get the same result upon moving the scanning area over the whole, which is what is actually done when a scene is scanned in the television sense of the word.

Again returning to Fig. 1a, let us consider the scanning spot as representing one cone in the retina of the eye. The cone, therefore, will not be able to distinguish detail within itself and if, for example, it was located half and half on a black and white area the signal or intensity produced to the sense of sight would be of a fifty-fifty value, which would be the same state of affairs when the full-stop previously referred to was smaller than the cones of the eye.

Converting Light into Current

It is the purpose of television to reproduce a scene at a distant point instantaneously (by instantaneous we mean a period of time which is so small as to be negligible). We can achieve this when we can convey to that particular cone in our eye the same amount of light as would fall on it if it were viewing the scene direct, therefore having solved the problem of presenting the elements of a scene, one after another, so as to deceive the eye that it is seeing the elements all at once, we must turn our attention to transporting our value of light or its equivalent to the distant point.

Again consider Fig. 1a in darkness except for the scanning area (as shown in Fig. 5b). Nothing but the scanning area reflects any light. The light reflected from the scanning area, however, taken as a whole, has a definite value and if this

value of light falls on to what is called a photo-cell, the given value of light will be converted into an electric current. On moving the scanning area across the scene the amount of light reflected will vary, and so will the electric current correspondingly. This is shown diagrammatically in Fig. 1b for the scanning area travelling once across the scene.

Having converted the light value of each element into an electric current, this current can be transmitted either via wire or radio waves, to control a light source at some distant point which will alter in value according to the light reflected into the photo-cell from the scanning area. So we are only left with the problem of transferring these light values into the similar cones of our eyes as if they had viewed the scene direct.

High and Low Definition

To do this we must move our light source at the receiving point position for position as that of the original scene, making the area of the light source and the area over which it moves or scans in the same ratio as the two areas at the original or transmitting point. All this superficially sounds simple, but to put it into practice many thousands of pounds have been spent so far without the general public being greatly aware of the results obtained.

Before examining how scanning is brought about, the explanation of the terms of low and high-definition should be made clear. In Fig. 1a, as already pointed out, the picture is composed of small black and white dots, which are not observed by the eye at a usual reading distance. Now look at Fig. 8, a head which may not appear as such till viewed at a distance of some eight feet; about ten feet away all trace of the black and white dots have vanished.

Definition and Viewing Distance

From this we see in the size of the scanning area in relation to the whole depends the nearness which we can view and in consequence, of course, the amount of detail recorded.

Now let us see how scanning is accomplished in practice. First, let it be understood that there is more than one way of doing exactly the same thing of which we will only describe those which we understand will be used in the new B.B.C. service. Television engineers subdivide scanning methods into two groups, mechanical and electrical. In some quarters the former is considered as belonging to low-definition television and the latter to high-definition. This, of course is an erroneous idea, probably originating in the fact that electronic scanning has only been used for high-definition work.

As low-definition television will be a thing of the past by the time these words are in print we will not examine in any detail the systems employed. But with apologies to old readers we feel for the benefit of new ones that the principle of Nipkow disc must be briefly explained. This form of scanner consists of a spiral of holes equally angularly spaced round a disc, the actual pitch of the spiral, the size of the holes and number being fixed by the picture constants (see Fig. 9).

If this spiral of holes during the rotation of the disc passes through that part of an optical or "magic" lantern where the slide is usually placed, a series of enlarged spots of light are projected, any one of which may represent the scanning area of Fig. 1a. On rotation of the disc the spot

ELECTRONIC SCANNING

moves across the predetermined area, the varying value of reflected light falling on one or more photo-cells, thus converting the light values to equivalent electrical ones.

After one spot of light has crossed the scene another one proceeds to do so, but owing to the pitch of the spiral it passes an adjacent line, the process being repeated for all the holes. The disc having made one complete revolution within the time limit of persistence of vision repeats the process. Such methods were originally used for low-definition television broadcasting.

In low-definition systems, say up to 90-line scanning, a Nipkow disc can be constructed so that the area to be televised is scanned by one revolution, but for more lines the

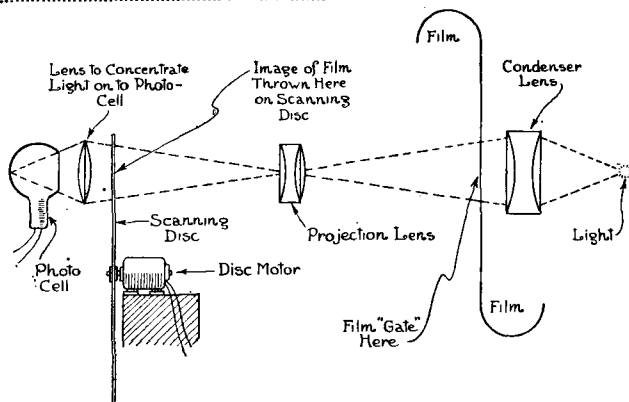


Fig. 11a.—Scanning a film. The film is passed continuously through the "gate," the optical system being the same as any ordinary projector, except that it is minus the shutter and intermittent movement. The picture or image is projected on to the scanning disc, instead of the usual screen, and may be reduced in size if convenient. The light passing through the scanning aperture is concentrated into the photo-cell.

angular spacing of the holes (unless the disc is many feet in diameter) necessitates too small a hole either to construct or to get enough light through, so other means have had to be found.

The Fernseh A.G., Berlin, has developed the Nipkow disc for 180-line work by putting four spirals on one disc which has to be rotated four times per picture and has a separate shutter device for selecting the correct spiral. The main disc, which has to revolve 6,000 times per minute, to scan twenty-five pictures, has to run in vacuo, which calls for complicated mechanical construction. The theoretical arrangement of disc and shutter is shown in Fig. 10b. We understand that some of the Baird Company's installation for the new London television station will be rather similar to that of the German firm. The scanning of films has always been a relatively easy task, as much more light can be made to fall on the photo-cell.

To scan a film, the film is continuously run through a special projector. The fact that the film runs continuously instead of with an intermittent action, as in ordinary cinematograph projectors, is a decided advantage. The scanning mechanism consists of the usual Nipkow disc, but the holes, instead of being in a spiral, are spaced at equal radii, the disc revolving once or as many times as necessary per frame or picture of the film. The actual action is shown diagrammatically in Fig. 11a. A point that should be noted is that the scanning area does not move quite horizontally across the scene. This apparent distortion, however, is not noticeable, any more than the slight curve of the line due to any type of disc scanner.

While on the subject of scanning, film and mechanical scanners, we must not forget the intermediate film system originally developed by Fernseh A.G. and sponsored in this country by the Baird Company. The system of intermediate films has come about by the practical impossibility to get enough light through the scanning aperture on scenes larger than those covering an area of about nine square feet. The method consists of first filming the scene, rapidly developing and then scanning, there being a time delay of from 20 to 120 seconds from the time of scanning to televising. The same scanning method is used as in ordinary films, while the sound can be delayed by photographic recording, as in the "talkies" or on a loop of steel tape.

Electronic Scanning

So much for mechanical scanners, which have one or two serious drawbacks. First of all to produce a flickerless picture one requires to transmit some 48 pictures per second. No mechanical system for definition of higher values than 150-lines has been attempted at speeds faster than 25 pictures per second, due to the high speeds of mechanical rotating masses that are necessary. Therefore the results are not flickerless. This perhaps is a minor point compared with the problem of getting enough signal energy out of the photo-cells.

Now the output of a photo-cell is proportional to the intensity of the light and to the time which it acts on the cell. With a picture of 120,000 elements (which is less than the E.M.I. Company, though more than the Baird Company,

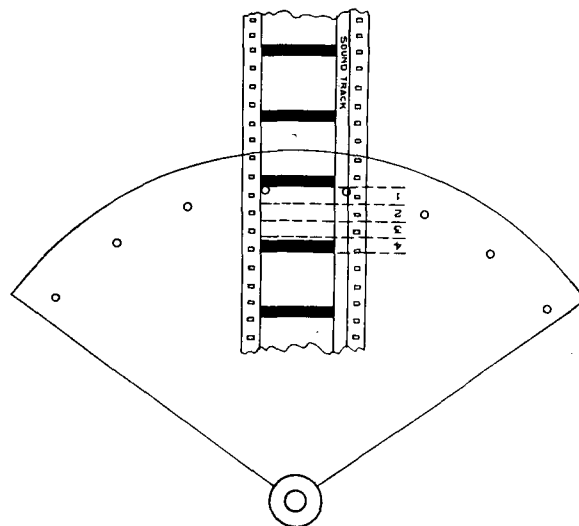


Fig. 11b.—Shows a section of the scanning disc, including 8 apertures. The fifth (counting from the left) is on the bottom right-hand corner of a frame. The disc revolving clockwise, causes the apertures to travel across to the left-hand side at the same time the film has moved in a downward direction, the speed of which is so adjusted, relative to that of rotation, so that the film moves one quarter of its height, that is to say through section one for one complete revolution of the disc, the section being scanned by the number of apertures, in the disc. For 300-line scanning the disc would require 75 apertures and revolve four times per frame.

propose to use in the high-definition service to be run by the B.B.C.) the time which one picture element has to act on the photo-cell approximates one-three millionth of a second at a picture repetition speed of 25 per second; it can be shown

PICTURES FROM CATHODE RAYS

that the signal obtained is below the practical limits of amplification.

Supposing we were photographing a scene in one-twenty-fifth of a second, it is obvious that the whole of the plate or film would be acted upon for the exposure period—one twenty-fifth second. A photographic plate absorbs energy when exposed to light which is stored in the form of a latent image and if we could do the same thing with a photo-electric device we would obviously have a more efficient link between light and electricity. Such an instrument has been produced by the American scientist Zworykin and called by him an Iconoscope.

This piece of apparatus has been developed most fully in this country by Electrical Musical Industries, Ltd. and will

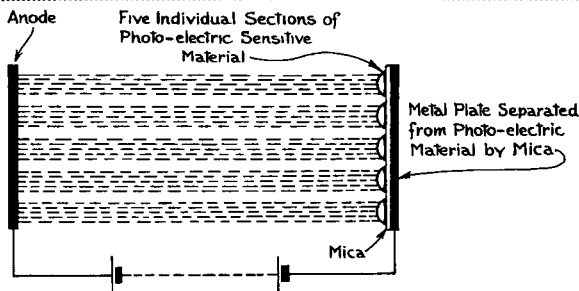


Fig. 12.—Diagram explaining the action of the mosaic in the Iconoscope.

be installed in the new B.B.C. station. Actual working details are kept a close secret but the general principles are fairly well known.

The device consists of a combination of photo-cell and cathode ray tube. Beginning with the photo-cell section first, it has been found possible to produce a mosaic of photo-electric sensitive material of very fine pattern, of which each section is a photo-cell and can be considered for purposes of comparison with the cones of the eye.

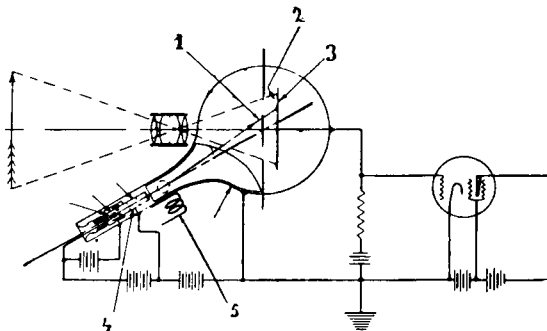


Fig. 13.—Diagram of the Iconoscope—1, electron beam; 2, mosaic; 3, signal plate; 4, electron gun; 5, deflecting coils.

Each of these minute cells are individually insulated from each other, diagrammatically shown in Fig. 12, and when stimulated by light, electrons are released, being attracted to a positive metal anode; as each cell becomes charged, the charge is proportional to the amount of light falling on it and the duration. Therefore if we expose such a mosaic to the influence of an optical image and remove the optical image we have left an electric image in the form of a number

of minute condensers, whose charges are in proportion to the optical image which produced it, not dissimilar for the purpose of comparison to the retention of vision in the eye.

If all these condensers were discharged singly one would have a varying electric current representing each picture element in value, just as one did when a light spot moves across a scene. To accomplish this discharge of condensers a cathode-ray beam is swept across the mosaic screen in the same regular way as the light spot scans in mechanical scanners. But note the great advantage that while the discharge of any one mosaic area takes approximately one three-millionth of a second (assuming our 120,000 element picture at 25 times per second) the same area has all but one twenty-fifth in which to accumulate energy from the light before it is its turn to provide the signal again. Zworykin's original diagram of the iconoscope is shown by Fig. 13.

Another interesting electronic device is that originated by Farnsworth which is being developed in this country by the Baird Company. Like the iconoscope little real information regarding this device is available.

Turning to Fig. 14, a photo-sensitive plate P, which apparently is of a translucent type, has an optical image thrown on it by the lens, L, the electrons released by the action of the light are made to travel in straight lines to the anode A where an electronic image is produced of the optical one falling on P. In the anode, A, is a small hole, H through which some electrons pass to A₁. Now if the electronic image is moved over this aperture in the anode, the electrons which pass through it and fall on the second anode, A₁ will vary in amount according to that part of the electronic image falling on the aperture. This device appears to be no more efficient in the use of light than mechanical scanners, its chief advantage apparently being in the electronic scanning. Actually in practice a special form of amplifying valve is being developed for use with it.

So far we have only considered scanning devices at the transmitting end. They are, of course, necessary at the receiving end to re-assemble the signal. For high-definition work, for that is what we are discussing, the cathode-ray tube seems to find most favour. This is certainly the case with the two concerns who are interested in the transmission side of the new service, though undoubtedly mechanical systems will appear, especially those of Scophony and Mihaly-Traub.

How the Cathode-ray Scans

With regard to the electronic scanner or cathode-ray tube the following is a short description of how this scans, whether it is used at the receiving or transmitting end.

Cathode rays consist of electrons which are drawn off a heated filament (as in a valve) by the attraction of a high voltaged anode (see Fig. 15a). The anode, however, has a small hole in it and while the main stream of electrons is stopped by it, some shoot through the aperture and if some fluorescent material is placed in the path of the electron stream some of the energy is turned into light. If after the electron stream has left the gun, as the anode is called, it passes between two plates, Fig. 15b, one being made positive to the other, the electron stream will be attracted to that plate, the amount of attraction being dependent on the strength of the positive charge and the initial velocity of the electron stream. If we applied an a.c. voltage on the two

THE NATURE OF TELEVISION SIGNALS

plates, the electron stream would swing up and down and would draw a straight line of light on the fluorescent screen, the same would apply if we placed another pair of plates at right-angles.

The combination of the two sets of deflecting plates, as they are called, will produce an effect very similar to the movement of the light spot in mechanical scanning. On one pair of plates an a.c. frequency is applied which is equal to the picture repetition frequency per second, while on the other pair the total number of lines scanned in the same time gives the necessary frequency, that is to say, for the Baird Company's signal from Alexandra Palace, 25 cycles on one pair and 25 by 240—6,000 on the other. The generators of these frequencies is called a time base and consists of a special type of oscillator which produces a voltage termed saw tooth; in other words the voltage gradually rises only to fall abruptly. Turning to Fig. 16, suppose a saw tooth wave is applied to X and X₁, the beam B will travel across to X in say, 10 units of time, flying back to X₁ in one unit of time. But supposing a voltage of a frequency of one-tenth that on XX₁ is applied to YY₁, B will move down to Y while it has also swung ten times to X and back to X₁, and will trace out the pattern shown, the continuous lines representing slow movement and the dotted fast. Note at the end of the tenth slow line both voltages abruptly change, which brings the beam back to the starting place.

Before leaving the subject of scanning we must mention the interlaced method which means all odd numbered lines are scanned first, then all even ones, or vice versa. This system of scanning is very conveniently brought about with cathode-ray scanners by simply making the X and X₁ frequencies of our example an odd number and doubling the Y and Y₁ ones. Readers interested should draw for themselves the results of 11 and 2 cycles. It must be mentioned the electron beam can be moved magnetically if desired.

Television

Impulses

It has been shown on earlier pages how the television subject is scanned and how the current from the photo-cell is proportional at any given moment to the small element of the image falling on the photo-cell in the case of the film disc-scanner, or being swept by the electron beam in the case of the Iconoscope. It will be clear that wherever each element of the image is different from the next, the current from the photo-cell will differ correspondingly, and, of course, in a detailed subject there may be hardly two elements the same, so that the photo-cell current will be continually varying.

One way of getting a good mental picture of the kind of current which is generated is to look upon the image as a relief map, and the scanning spot a traveller who is making his way in a straight line over country corresponding to the map. The dark parts will be equivalent to low country and

the brightest parts to high altitudes with the intervening half tones representing proportionate heights. Let us take a simple subject such as a human face (see Fig. 1a) and, for the sake of illustration, consider one of the scanning lines which we show rather like a Roman road straight across

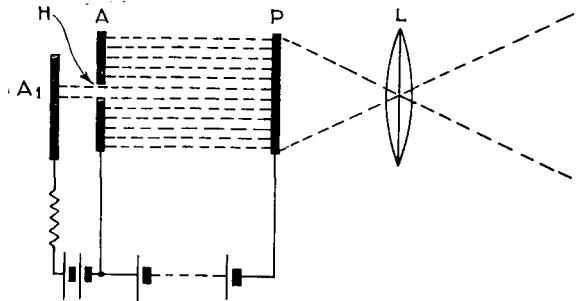
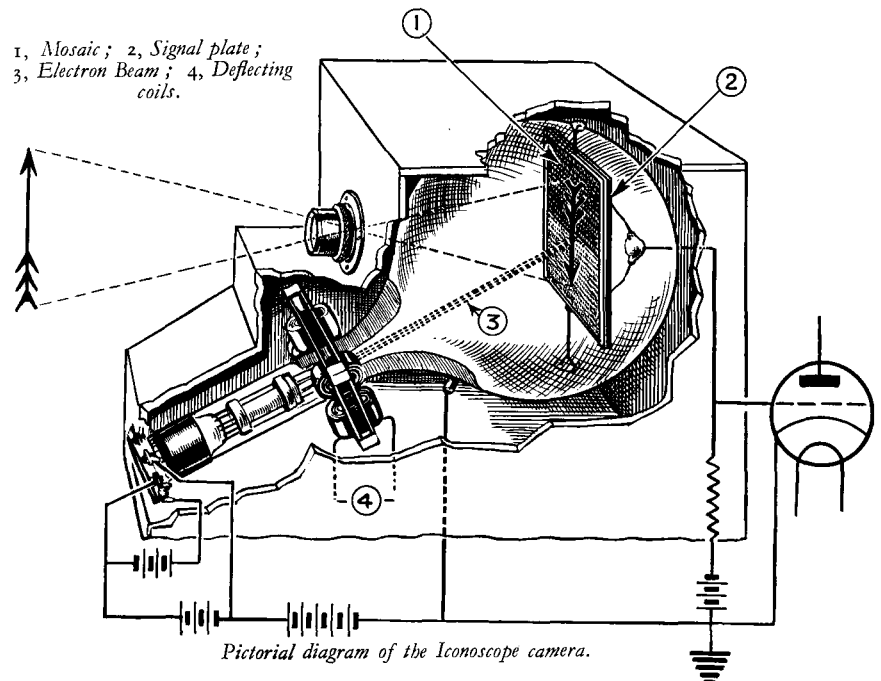


Fig. 14.—Diagram showing the principle of the Farnsworth dissector

our map. Starting at the left-hand side, we first encounter some fairly level but high land which shortly descends to a deep valley followed by several small ridges, etc. Then, after traversing this cross country road, we have to return again to the beginning with great rapidity, say by aeroplane, and make another journey along an adjacent road with all its ups and downs, and so on, and so on.

Now, to convey to a prospective traveller an idea of the sort of country he has to be prepared for, it is useful to draw a sectional view or elevation, as it is called. Such a plan

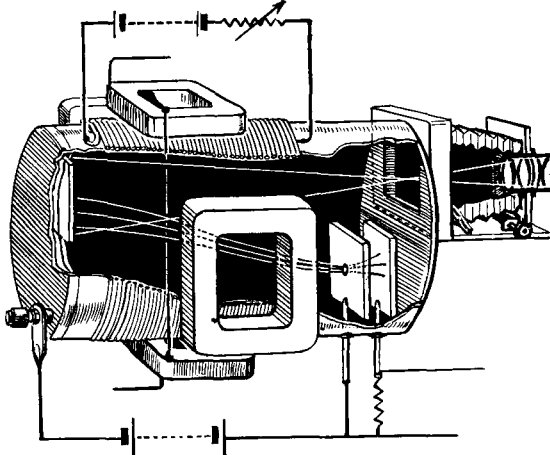


Pictorial diagram of the Iconoscope camera.

immediately reveals the gradients, and, still considering the road of Fig. 1a, would be something like the white area in Fig. 1b; the vertical distance between the line and the base line would give, according to a known scale, the height of the road above sea level at any particular point. Return-

FREQUENCIES NECESSARY FOR TELEVISION

ing to the scanning spot travelling over our image, the current from the photo-cell would be exactly depicted by the wandering line of Fig. 1c if its vertical height represented, not feet or miles, but current in amperes. Where the gradient is steep we have rapid changes of current, and where gently sloping, slow changes, while at other times the current may be quite steady, corresponding to the scanning of an even tone, or the journey across a plain.



Pictorial diagram showing the Farnsworth dissector and camera.

Thus it will be seen that we have to deal with current which is changing at different rates according to the nature of the image at any moment. The actual rate will depend on the speed of the spot, which in turn depends on the number of lines and scanning repetition frequency, as explained earlier. Clearly, the faster the spot travels the more rapid will be the current changes; and the student must get accustomed to thinking of current changes, because they are fundamental to television. In the course of his journey along the road shown in Fig. 1b the traveller has to climb uphill at the point P and then make the descent the other side. Electrically, this corresponds to a current change, a change from an increasing to a decreasing current. The distance from one side of the bottom of the hill to the other is about one fiftieth of the total length of the line, so that if the spot is travelling at the rate of 10,000 lines per second, we can calculate that the current has increased and decreased (i.e., gone right over the hill) in one fifty-thousandth of a second. Or we can say that 50,000 of such hills could be surmounted in a second, which means that there would be 50,000 current changes per second.

The reader will have observed that these rapid current changes correspond to the finer details of the image, and the more detailed the image the more rapid will such changes be, provided that (as pointed out earlier) the scanning spot is made small enough to avoid blurring. The usual technical expression for describing current changes is the word "frequency." Thus, 50,000 current changes a second is known as "a frequency of 50,000 cycles per second." It is quite an obvious, self-explanatory term. Although we have, by way of example, been referring to a high-frequency, most television subjects will also give rise to very slow current changes, i.e., lower frequencies, and in practice, with the television systems available for commercial use, we can expect to encounter frequencies from 0 to 2,000,000 per

second. A frequency of 0 would correspond to an ordinary direct current having no changes at all, such as would be produced by an image of a plain white or even-toned screen.

The reader should now pause to consider the full significance of this frequency range produced by television scanning, and compare it with that produced by sounds. (Of course, current from a microphone has changes, or frequencies, just like the photo-cell current.) The greatest range of frequencies encountered in the broadcasting of sound is about 30 to 15,000 cycles per second. The human ear is generally unable to detect air vibrations slower or more rapid than these. Thus the highest television frequency is more than 100 times that of the highest sound frequency. Therefore, television electrically becomes a problem to be treated quite differently from sound. We cannot send it along the same wires, transmit it from the same broadcasting station, or receive it on the same wireless set. By television we here mean television proper, i.e. television with as much detail, or nearly as much, as the eye can detect.

The B.B.C. has, of course, for the past few years been broadcasting a special modified system of television—the Baird 30-line process—which, as its name implies, employed 30 lines, scanning $12\frac{1}{2}$ times a second. Such a slow scanning speed produces frequencies of more than 13,000 cycles per second, which could only just be accommodated by the B.B.C. amplifying and transmitting apparatus. The low frequencies from 0 to 30 which the B.B.C. have been unable to transmit have had to be dispensed with, to the detriment of the transmitted picture.

The effect has been to flatten contrasts and prevent any changes of illumination such as the differences between an indoor and out-door scene which the producer may have wished to present. This distortion had to be tolerated together with the other limitations. The images reproduced

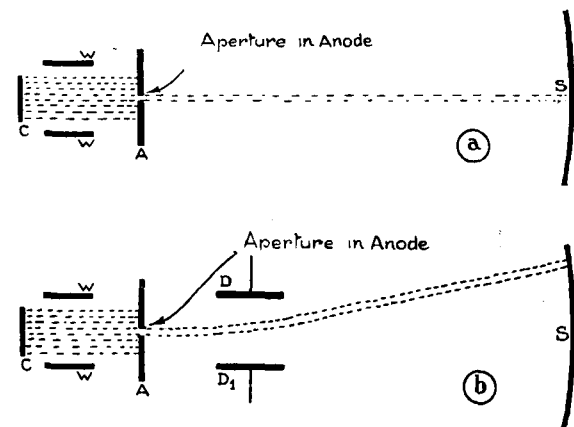


Fig. 15.—Elements of cathode-ray tube. C, heated cathode; *W*, Webnelt cylinder; A, anode; S, fluorescent screen. *DD*₁, deflector plates. In practice a second anode is generally used, which has been omitted for clearness. The upper deflecting plates would be more positive than *D*₁, so bending beam upwards. The Webnelt cylinder is the equivalent of the grid in the valve and controls the density of the electron stream.

by this system are distinctly crude, lacking in detail and flicker badly though a good amount of entertainment has been obtainable from programmes specially chosen to meet the great difficulties of transmission. This low-definition service has just been terminated, to make way for the im-

HOW PICTURES ARE BROADCAST

proved methods now being adopted by the B.B.C., and this article will deal only with television giving detail as good as a home cinema, and consequently requiring frequencies as high as 2,000,000 cycles per second.

Before considering the function of the television currents in the photo-cell circuit, the nature of which we have been discussing, let us analyse further the current curve of Fig. 1c. The base line represents zero current, and the actual current flowing is, of course, all in one direction. Since there can be no such thing as negative light, the photo-cell cannot generate negative current in the opposite direction. Thus, although the current is varying up and down, it is essentially unidirectional. Now let us draw a straight line through an average mid-point of the hills and dales of the current curve. This represents a steady flow of current, or what is generally known as direct current (d.c.).

We could, if we liked, subtract this d.c. from the whole and we should then be left with a curve of the same form as the original, but now varying above and below the zero line as shown in Fig. 1d. That is to say, the current is now alternating (a.c.), i.e., flowing alternately backwards and forwards. Thus we can say that the photo-cell current has two components, the a.c. and the d.c., and some television systems, for the convenience of transmission, leave out the d.c. part, which is quite easily done—e.g., a condenser will block d.c. but pass a.c.—and insert it again at the receiving end. It is essential that it should be re-introduced.

In practice, though, the d.c. component changes from minute to minute as the nature of the transmitted subject varies, so this method has the disadvantage that the d.c. at the receiving end will not follow the variations of the original, and some distortion is involved.* Consequently,

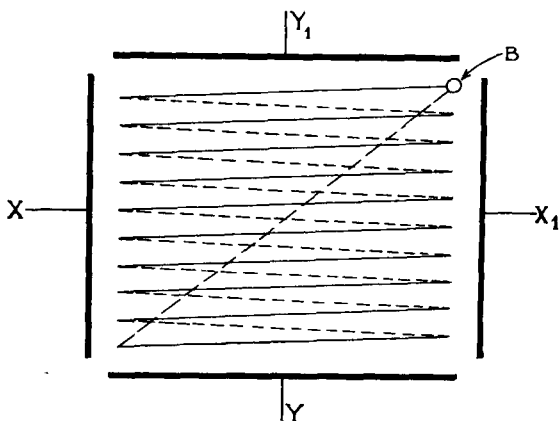
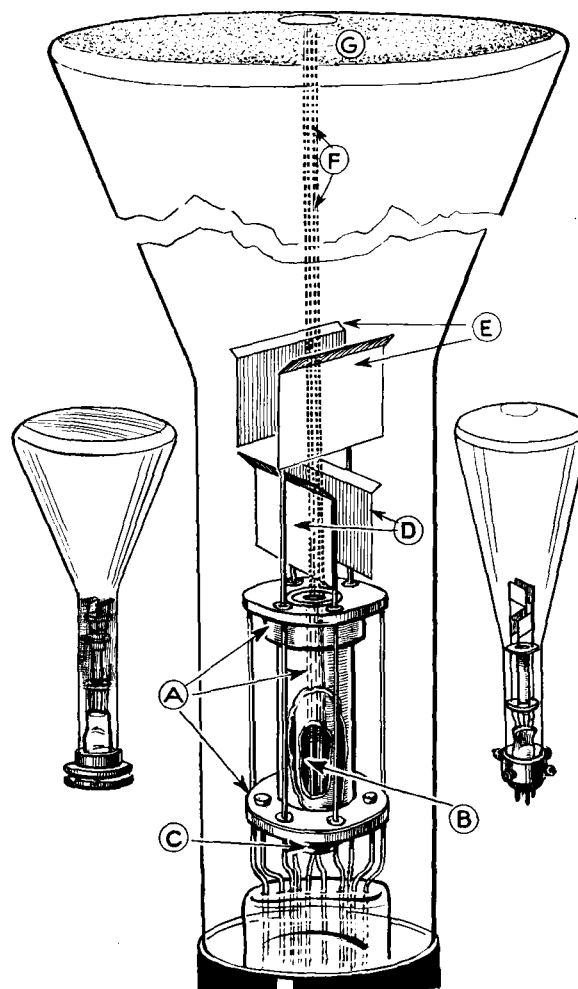


Fig. 16.—Diagram showing path of scanning beam in cathode-ray tube for producing a television screen.

the best results are only to be obtained by ensuring that the d.c. component is radiated from the transmitter. Figs. 17a and b show how an image is meant to appear, and would appear after transmission with the d.c. component. Fig. 17b shows the effect of inserting the d.c. at the receiving end at an incorrect value such as would be suitable for the darker subject. In sound broadcasting, the d.c. component of the microphone current, and there is one just as in television, is always suppressed, but as it has nothing to do with the sound itself,

* See "There is Something Lacking in Television" by J. MacPherson "Television," August, 1935.



Pictorial diagram showing the construction of the cathode-ray tube. The small illustration on the left shows the Cosser tube and that on the right the Ediswan. A, anode in three parts; B, filament or heater; C, shield over heater; D and E, deflectors; F, electron stream; G, screens.

but only with the microphone and loudspeaker circuits, this does not matter in the least.

In order to complete our examination of the television photo-cell current, mention must be made of special synchronising impulses which have to be added. The necessity for synchronism of the scanning speed of the receiver with that of the transmitter has already been stressed, and without here going into the precise method by which this is accomplished we will merely point out that special controlling impulses have to be transmitted along with the image current. Such impulses must occur at the end of every line with an extra big one at the end of a completed scan. They consist of complete interruptions to the current flow lasting only for a small fraction of the time of a line scan, perhaps one fiftieth, with a longer interruption, perhaps one tenth after a complete scan. They correspond, if we may hark back once more to the analogy of the map, to deep and narrow crevasses occurring at the end of each road across the country, and Fig. 18 shows how they would be depicted in the elevation. These impulses are prepared by special apparatus and then "mixed" with (i.e., added to) the image current. It will be clear that as they are made to occur only at the

RECEIVING THE PICTURES

end of scanning lines they will have no effect on the received image other than a small black mark which, being at the edge of the screen, can be masked off.

It is time to pass on now to see what is done with this image current in the process of broadcasting. So far we have progressed no further than the studio. In the first place it must be understood that the current is the merest

television broadcasting station the amplifiers are generally in a room adjoining the studio, known as the control room: from there the amplified currents are carried by wire to the transmitter room, which may be in the same building or several miles away. In the case of the television equipment now being installed by the B.B.C. at the Alexandra Palace, the studio and transmitter are all in one building. This is a very convenient arrangement, as long wires for television frequencies are costly owing to a special construction.

With regard to transmitters, the reader will be aware that electrical impulses or currents, such as might be due to speech or music, can be radiated by wireless by means of what we call a carrier wave. "Wavelength" is merely another way of expressing "frequency"; divide 300,000,000 by the wavelength in metres and you have the corresponding frequency. Thus the London Regional wavelength of 356 metres, for example, is a frequency of 840,000 cycles per second. (Incidentally, 300,000,000 metres per second is the velocity of wireless waves, but that need not concern us for the present.)

In order to broadcast impulses of any particular frequency it is necessary to employ a carrier wave on the back of which, so to speak, ride your impulses. Further, the carrier wave

must have its own frequency greater, and considerably greater, than that which it has to convey. Though there is no clearly defined limit, it is generally desirable to have a ratio of 25 to 1 between carrier and carried frequencies. Thus, with sound broadcasting, where the highest sound frequency is about 10,000 cycles per second, we should require a broadcast wavelength of not less than 25 times 10,000—250,000 cycles per second, equivalent to a wave-



Fig. 17 (a)—A bright out-door scene as it should be reproduced.



Fig. 17 (b)—This is how (a) would look if the D.C. at the receiving end had been set for a darker subject. Note the flatness of tone.

fraction of an ampere—a few microamps only—and therefore a great deal of amplification is needed before it can be of any practical use. It is outside the scope of such a general survey as this to describe exactly how amplifiers operate. Briefly, a series of valves and associated components produce a magnified copy of the small current put into them.

It is important that this copy should be faithful in every detail, and it is no easy matter to design amplifiers which

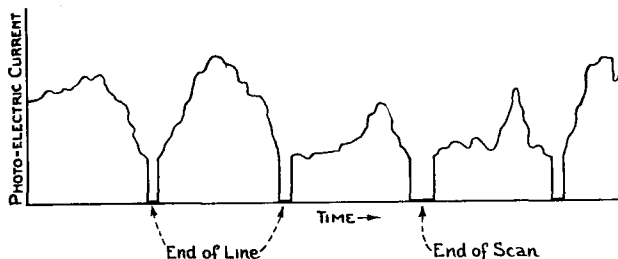


Fig. 18.—Typical television waveform, showing introduction of synchronising impulses at end of each line and of completed scan.

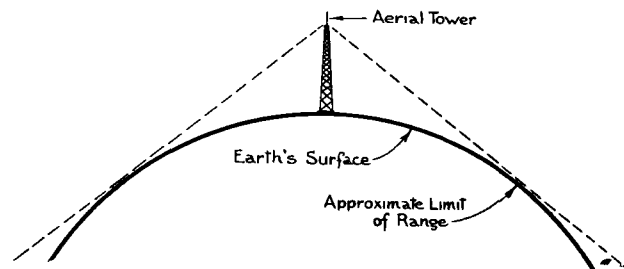


Fig. 19.—Showing how the range of an ultra-short wave transmitter depends on the height of the aerial.

can deal satisfactorily with high frequencies such as we encounter in television technique. An amplifier designed to reproduce speech and music currents might be quite useless for television purposes. However, without going into details, the student can assume that the difficulties have been overcome and satisfactory amplifiers have been made. In a

length of 1,200 metres, though, lower frequencies, i.e., longer wavelengths up to 2,000 metres, have to be used.

The effect of using a carrier wave of too low a frequency is to reduce the relative strength of the higher of the frequencies which it is carrying. In television the higher frequencies correspond to the finely detailed parts of the

RECEIVERS FOR TELEVISION

image, so if these are lost or reduced in strength, the picture will be blurred. Television has, as already pointed out, frequencies up to 2,000,000 cycles a second. Therefore, a carrier frequency of at least 50,000,000 cycles per second, or a wavelength of six metres is needed. Such a wavelength is, of course, much lower than those which are usually employed for broadcasting purposes; it is lower than what are generally known as short waves, which range from about 15 to 100 metres. It is, in fact, called an ultra-short wavelength. The precise wavelength which the B.B.C. is about to use for television will be 6.4 metres.

It is important to know that these ultra-short wavelengths, that is, below, say, ten metres, possess characteristics which considerably modify their range compared with longer wavelengths. They do not travel very much further than

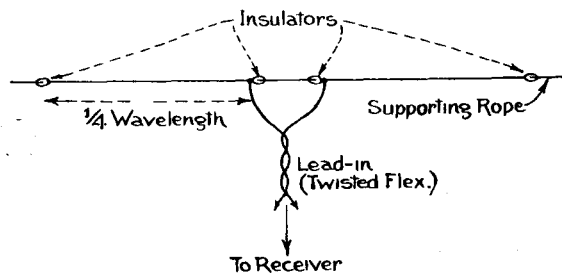


Fig. 20.—Half-wave di-pole aerial for ultra-short wave reception.

would, for example, a searchlight placed on the transmitting aerial and sweeping up and down and round in every direction. This is rather an understatement, because the searchlight cannot, like a wireless wave, penetrate the walls of a building, and it will not go far into the earth itself. Moreover, the wireless wave will bend slightly and thus travel a little further, perhaps 25 per cent. further, than the searchlight beam. One hears occasionally of reception at greater distances than this, but such reception could not be considered reliable or within a practical "service area." (Fig. 19.) It will be at once obvious that in order to cover as big a service area as possible an ultra-short wave television transmitter must be situated high above the surrounding country. This explains why the Baird Company at present use the top of one of the towers of the Crystal Palace, and why the B.B.C. are erecting an aerial tower on the top of the Alexandra Palace.

Television Reception

We have now to consider that aspect of television which to amateurs is perhaps most important of all, namely, reception. Most readers will probably be familiar with the general principles of reception of sound broadcasting, and we can therefore use these as a basis of comparison in discussing television and its special features, apart from those already referred to.

Reception consists of picking up the television carrier wave, amplifying it, detecting it (i.e., removing the carrier wave and leaving the television frequencies proper), more amplification, if necessary, and then application to the cathode-ray tube or other device. In addition the synchronising impulses have to be picked out and made to control the special circuits or apparatus which arrange the scanning.

Starting from the aerial, which is, of course, where reception begins, it is important to pay as much attention to this as possible, because a good aerial can save much expense, in that the receiving set can be made smaller than it would otherwise have to be, while sometimes it can make all the difference between good reception and none at all.

The shorter the wavelength, the shorter the aerial is a general rule which applies to all wavelengths, and ultra-short waves do not need an aerial more than about 20 feet long. It is, however, more important than on sound broadcasting wavelengths to have the aerial as high up as possible, and preferably outside the building. Although we have mentioned earlier that wireless waves penetrate walls, they inevitably suffer some loss of strength in so doing and it is therefore advisable to put the aerial outside; and the higher the aerial the greater the "signal strength," that is, the strength of the carrier wave. It often happens that the room in which the receiver is to be located is on a low floor, while it is desirable to have the aerial on the roof which may be 30 feet or more above. Under such conditions it is impossible to have a short aerial because the length of the aerial includes the lead-in, which in this case would exceed the aerial proper.

It would be very much better to use a special aerial such as a half-wave dipole (Fig. 20), which consists of a wire half a wavelength long (that would be 3.2 metres for the forthcoming B.B.C. television broadcasts) cut in the middle, the two halves being insulated and spaced slightly, and each connected at the middle to a "feeder" wire. This can conveniently be a length of ordinary twisted flex which would be brought down to the receiver and connected to it by a suitable transformer. (Articles have already appeared in TELEVISION dealing with these aerials so that we shall not refer here to specific theoretical or practical details, but merely give the reader a general idea of what is involved.)

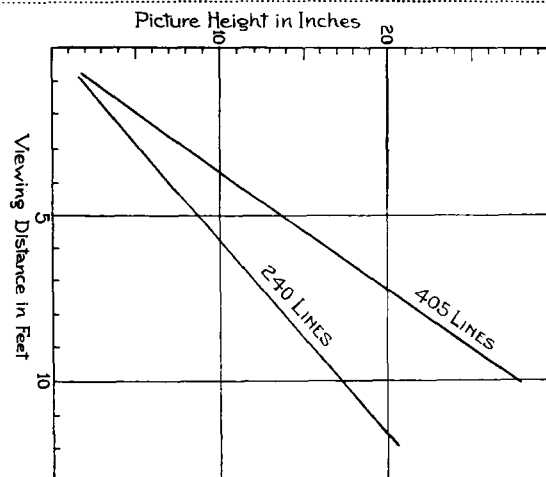


Fig. 21.—Showing relationship between the height of the image and the optimum viewing distance.

An aerial of this type is almost always an improvement on any ordinary aerial such as we use for sound reception. In practice, the exact kind of aerial to use will depend largely on the situation of the receiver. If it is favourably situated for reception from the Alexandra Palace, then almost anything will work satisfactorily: at long distances it is necessary to be much more careful.

ULTRA-SHORT WAVE TECHNIQUE

Most ultra-short wave receivers for television are super-heterodynes. This is because it is difficult to get very much amplification at the earlier frequency, which is approximately 47 megacycles. The trouble is that to such a frequency the self-capacities of valves, wiring, etc., offer a comparatively low resistance path, tending to divert the currents from the proper circuits through which they are meant to flow. For this reason a super-heterodyne arrangement is used.

Receiver Types

It is assumed that the reader is familiar with the principles of this method which converts the carrier frequency into a lower one which is easier to amplify. With television, however, we are immediately up against a serious difficulty as we mentioned earlier when discussing carrier wave frequencies—namely, the necessity for having the carrier frequency much higher than the television frequencies. Thus with a super-heterodyne the intermediate frequency must be about 20 megacycles. At the present moment there is some controversy over this subject, many people claiming that there is little advantage in using a super-heterodyne, especially as valves of very small dimensions are beginning to appear on the market, and thus reducing the amount of their self-capacities, these may eventually solve the problem for us.

Probably, the newcomer to ultra-short waves may care to try a super-heterodyne first, as requiring less meticulous care in construction. For the latter, a triode-hexode valve is needed in the first stage, followed by two or three stages of intermediate frequency amplification before the detector. The latter will probably be a diode, perhaps a full-wave diode, and then we need some more amplification—what is known in sound technique as low-frequency amplification, the word "low" implying a comparison with the carrier frequency which the detector has eliminated.

The low-frequency stages call for particular care in design without which it is almost certain that considerable loss of the higher frequencies would ensue. It is no use expecting an amplifier designed for sound frequencies to have the slightest value to television; the image produced by it would be worthless. The higher frequencies get lost simply because the self-capacities already referred to act as a by-pass to the television frequencies unless something is done to counteract them.

Transformer coupling cannot be used at all, while resistance capacity coupling, the next best thing, is not much good by itself unless a tremendous loss of amplification is tolerated, which means more stages to make up for it. One of the most successful methods of low-frequency valve coupling is that which is composed of a resistance and inductance in series. The latter exerts an effect which balances that of the stray capacities. By this arrangement quite good amplification, uniform for all frequencies, can be obtained. The size of the inductance will vary according to the valves and circuits in use as well as the highest frequency it is desired to amplify.

The Cathode-Ray Tube

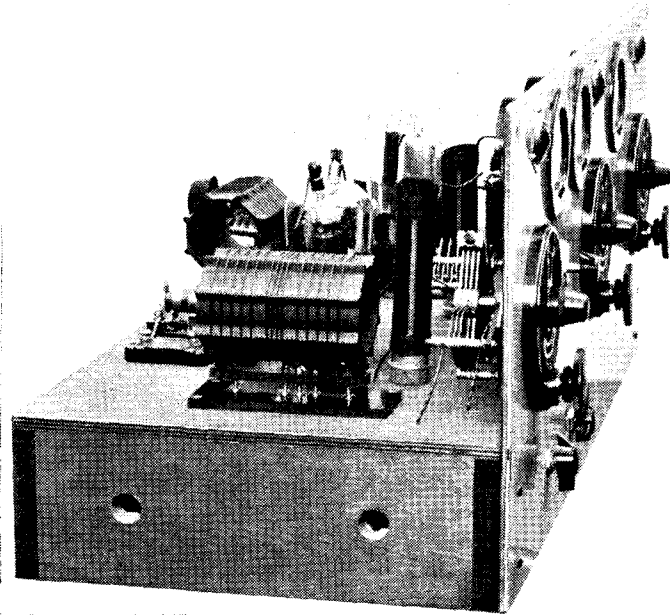
We come now to the cathode-ray tube. Other devices for producing a line screen are discussed elsewhere in this

series, and the general principles of the cathode-ray tube itself have been described in the section on scanning devices. A cathode-ray tube for receiving differs from the transmitting kind such as in the Iconoscope in that the electron beam emitted from the cathode has to be controlled. Its strength or intensity must be made to vary in proportion to the current variations in the receiver in order to reproduce the original light and shade relationships of the transmitted subject. This controlling is done by supplying the output voltage of the receiver to the Wehnelt cylinder surrounding the cathode of the tube (Fig. 15) which will act in a very similar way to the grid of a valve. The number of electrons passing through the hole in the anode and hence the intensity of the beam current, will depend on the degree of negative voltage on the cylinder. The more negative it becomes the more the electrons will be driven towards the centre.

The other important difference between the transmitting and receiving types of tube is that, whereas the Iconoscope is made to scan a photo-sensitive mosaic screen, the beam in the receiving tube scans a specially prepared fluorescent surface. The latter can be made of various materials, such as zinc sulphide, but the compositions of the more suitable kinds used for television are being kept secret by the manufacturers. The effect of the impact of the high-velocity electron beam on the surface at the end of the tube is to cause it to fluoresce, or glow, for a fraction of a section; thus as the scanning spot moves along it will trace a line behind it, and the scanning formation is built up as the spot pursues its way. The colour of the glow depends on the nature of the fluorescent surface; hence the secrecy on the part of the manufacturers. The colour used to be greenish, but has lately been much improved to almost a plain white, which will thus give good black and white images as on a cinema screen.

In the description of the Iconoscope it was explained how the two pairs of deflector plates, being supplied with special "saw-tooth" impulses from "time-base" circuits, give the electron beam its requisite scanning motion. It was also pointed out that it is essential for the scanning to occur at precisely the same speed as at the transmitting end, without which condition it would be impossible to reproduce the original image. In addition, the receiving scanning spot has also to be in step with the other, that is to say the spot must be scanning the corresponding line at each end at the same moment. This is what is called synchronism. In order to achieve it we have to arrange that the two time-base circuits oscillate at precisely the same rate as those at the transmitter, and they have to be so exactly correct that the least variation from the true speed would upset the synchronism. It has not been found possible to devise circuits that will "stay put" to such a fine degree of accuracy; the two time bases associated with the receiver can be adjusted to give exact synchronism, but they will not remain steady for more than a few seconds.

To overcome this deficiency each time-base is controlled by impulses from the television "signal" which have their origin in the time-bases of the iconoscope or whatever scanning device is employed in the studio. These impulses have already been spoken of; we make use of them by making them lock the two time-base frequencies. They do not have to supply any power to the circuits they control as the presence of their voltage alone is sufficient to keep the oscillations in step.



G5ZJ

Technical Data

First Section

We are not under the impression that our station is at all original as regards its circuit, or that it is any more efficient than any of the others on the 40- and 20-metre band, but we do feel that it looks infinitely more efficient and would do credit to any amateur station.

The link coupling coil is in the centre of the sub-amplifier anode coil. This appears to give best results.

FROM time to time we have had the privilege of inspecting quite a large number of British amateur stations and except in a few isolated areas, such as Birmingham and Coventry, hay-wire lash-ups seem to be the order of the day. While we fully appreciate that an amateur is granted a licence for experimental purposes only, we are of the opinion that if the apparatus could be made experimental and at the same time neat, tidy and free from unnecessary external wiring, then so much the better.

We are definitely in favour of rack formation except for ultra-high-frequency work, for we do not feel that it is any less efficient despite the criticisms we have received.

For Experimental Use

Our station has been designed for our own experimental use so that we could try the dozens of circuits that were sent in by contributors and the new components as they are designed. In addition the station is on the air a minimum of four hours a day testing new ideas so that they can be passed on to our readers from time to time.

The station was intended for two wavebands, 40 and 20 metres, with varying power from 20 watts up to 200 watts. While we realise that very few amateurs can afford such equipment we have no hesitation in describing the construction for it can be used with any type of gear right down to 10 watts. What we want to do is to persuade amateurs to go over to rack construction, for when made properly it is far more simple and getatable than the hay-wire breadboard.

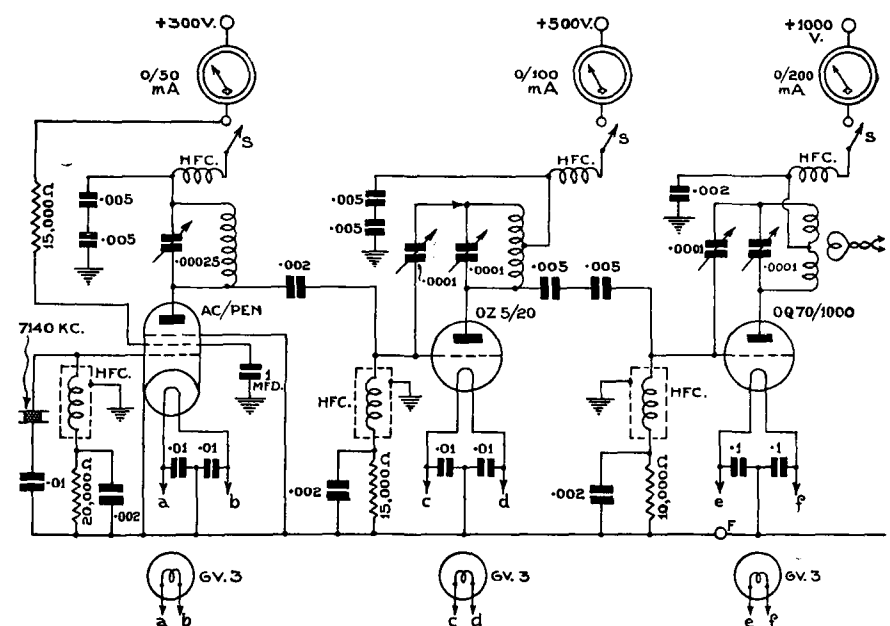
Briefly the transmitter consists of

C.O., F.D. or sub-amplifier, second sub-amplifier and neutralised push-pull P.A., two power packs to give 500 volts and 1,200 volts, while the modulator at the moment gives 85 watts of audio but is shortly to be adapted to give 160 watts of audio. In this section we are going to describe the first three valves operating as C.O., buffer and second buffer.

First of all an A.C./Pen. after a little juggling with auxiliary grid voltages was found to work very satisfactorily as a crystal oscillator. The H.F. choke in series with the bias leak is of the

screened type which was found to be most important, otherwise hum was introduced by pick-up from the power pack in the section beneath. Another small point to notice is the blocking condenser in series with the crystal, on the earthy side.

The anode circuit of the C.O. is tuned in the usual way but the coil is simply a standard four-pin Eddystone 40-metre coil with the reaction winding removed. From past experience we have discovered that a likely source of trouble are the .002 by-pass condensers.

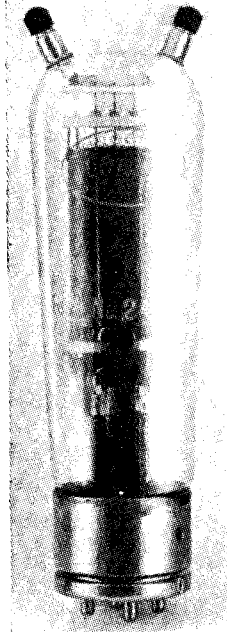


This is almost self-explanatory and is in itself a complete transmitter. A high power P.A. is to follow.

OCTOBER, 1935

To prevent any breakdown we use two .005 condensers in series so doubling the breakdown voltage. So far this arrangement has proved very satisfactory.

Capacity coupling to the OZ/520 sub-amplifier is quite standard, but again a screened H.F. choke in the grid circuit



A Tungram OQ70/1000 is used as a second sub-amplifier.

was found to be necessary. A special coil was constructed for the anode circuit and was made on 2½-in. Becol ribbed former and wound with 20-gauge enamel-covered wire, eight turns spaced quarter of an inch resonating with the tuning condenser at about one-third of its capacity. Three valve pins were screwed into the former and a base was made from ebonite strip and insulated sockets.

The only difficulty found with this

stage was the .0001 neutralising condenser. An ordinary double-spaced .0001 midget was useless so in the end we were forced to obtain some old .0005 Lissen reaction condensers and triple space them.

It is particularly important in this stage to ensure the efficiency of the bypass condensers and the plate-to-grid blocking condensers so we again used two .005's in series. However, since the Tx was first built Dubilier have brought out some 1,000-volt working condensers type B770, which can be thoroughly recommended. It certainly overcomes the need for two condensers in series.

A Second Sub-amplifier

As a second sub-amplifier the new Tungram OQ70/1,000 was finally used. This is an excellent oscillator for high-frequency work and is run at 70 watts so overdriving the two P.A. valves. In this circuit anode coupling did not prove very satisfactory, while the system of using two condensers in series also failed, so finally special Dubilier high-voltage working .002 condensers were used.

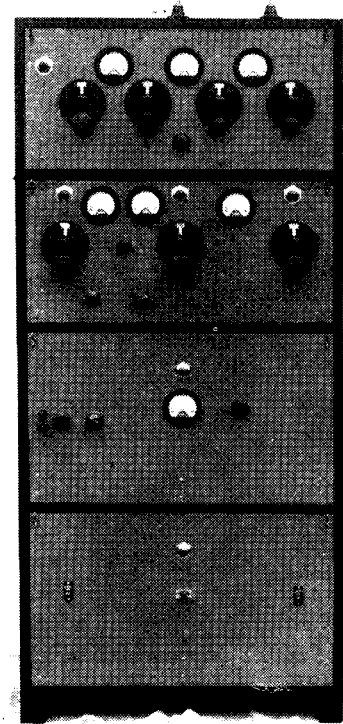
Link coupling of the conventional kind gave excellent results, but contrary to expectations the link was better in the centre of the coil than when coupled to the cold end.

Notice that switches are in series with each H.T. supply to facilitate ease of neutralising, while keying was carried out in the anode of the first buffer. Dial indicators are connected

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across each heater except in the case of the second buffer as this valve has a ten-volt heater only half the winding was used.

So far everything has been quite straightforward, but in the next issue we will give details of the push-pull



The complete equipment is housed in a wooden four partition rack.

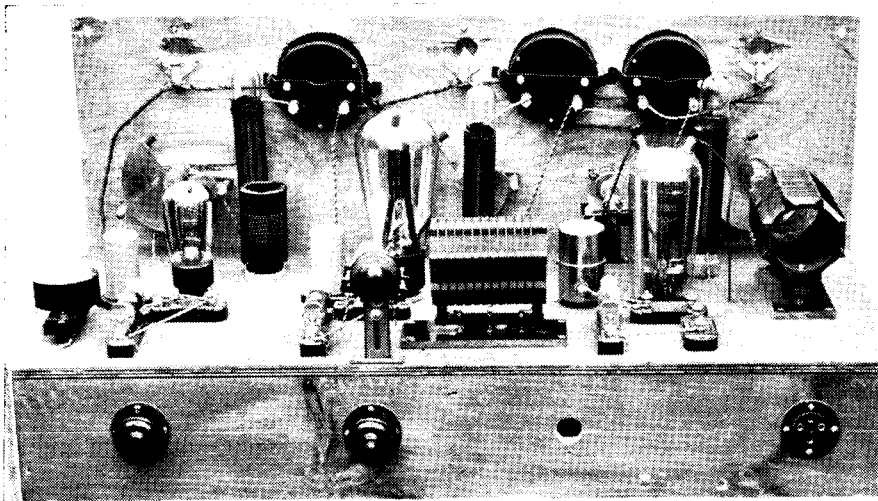
P.A. stage, the universal aerial coupler and the power packs. Also the method of interconnecting these units should prove of interest.

The Set Builders' Manual

“PROGRESS,” the new publication of A. F. Bulgin and Co., is excellent value for a shilling.

Every constructor should obtain a copy and see how to make such units as an AC/DC convertor, ten-watt A.C. amplifier, a five-valve AC/DC radio-gramophone, five-watt D.C. amplifier, a midget self-contained portable, etc.

All of these instruments are dealt with in a very comprehensive way and can be made up with the minimum of trouble. The book is particularly well-written, very lucid, while many home-builders will be amazed at the cheapness of the suggested circuits. A map of Europe, giving the location of most of the principal stations, spreads across two pages. The components shown in the book can be seen at the London showrooms of Messrs. A. F. Bulgin & Co., 64 Holborn Viaduct, E.C.1.



Each section is connected to the power pack by its own separate 4-pin plug and cable.

HAS 30-LINE TELEVISION HAD A FAIR DEAL ?

Our Readers' Views

30-line
Television

The Lorenz
Receiver

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

Radiolympia

Has 30-line Television had a Fair Deal ?

SIR,

I note you state that the 30-line television transmissions are to be discontinued after September 11; this is also confirmed by *The Radio Times*, therefore all those who have disc television apparatus, including myself, can now place them in the junk box as they will be useless for the coming transmissions (when they arrive).

In my opinion the 30-line transmissions have never been given a fair deal. When Bairds were granted a licence to transmit from their Long Acre studio the time granted was so meagre as to be useless for either experimental or entertainment value; again when the B.B.C. graciously decided to allow transmissions from their studio, the times arranged were, to say the least, unreasonable for the average person, but even these transmissions, especially of late, have been splendid, and I have upon a number of occasions written and congratulated Mr. Eustace Robb upon the excellent programmes and the fine results I had received, but it has been useless to ask or expect visitors to witness a transmission between 11 and 12 o'clock at night.

No, sir, the 30-line transmissions have never had a fair trial to allow television to become an additional form of entertainment to a vast number of listeners, which I am convinced would have happened had the transmissions been given at a reasonable time every evening during the week. Why? Well—I have my own opinion as to the reason.

LOOKER NO. 2 (London, E.11).

* * *

The Lorenz Receiver

SIR,

Being subscribers to your esteemed publication TELEVISION AND SHORT-

WAVE WORLD, we read in No. 91, Vol. VIII, of September, 1935, a note entitled "Manfred von Ardenne's Receiver."

We should like to call your attention to the fact that contents of this note leads to misunderstandings, for all of the receivers mentioned therein are designed by the television department of C. Lorenz A.G. C. Lorenz A.G. solely took advantage of the experiences of Manfred von Ardenne's laboratory regarding Braun tubes.

We should be very much obliged to you if you could arrange to publish a rectification in your next issue which plainly indicates that the television receivers are developed by C. Lorenz A.G.

Thanking you in advance for your kind assistance in this matter, we are,

C. LORENZ AKTIENGESELLSCHAFT.
DR. H. A. STEUDEL.

* * *

Radiolympia

SIR,

I see that last year Radiolympia was open for nine days and the average attendance was approximately 27,200. This year it was open for ten days and the average attendance did not reach 20,000. I don't know how much it fell below that figure. Is it a fair inference that the balance of 7,200 were looking for television and did not go to Radiolympia because they knew they would not find it there?

SCANNER (Weybridge).

Your personal opinions and experiences are helpful to other readers. We pay half-a guinea for the letter published on this page which is of the most general interest.

Appreciation

SIR,

I am sure that it would have been well-nigh impossible to have provided a better variety of good fare than that provided in the August number. Even since your magazine has appeared in its new form I have watched it closely and have also passed it on to my neighbouring "fans" to get their views on it. The outcome is that they agree to a man that it fully satisfies the need of the enthusiast and especially those (most of us) who haven't got a great deal of money to juggle about with.

G. W. BARBER (London, S.E.).

Lectures on Television

Series of lectures have been arranged to be given at the following educational centres.

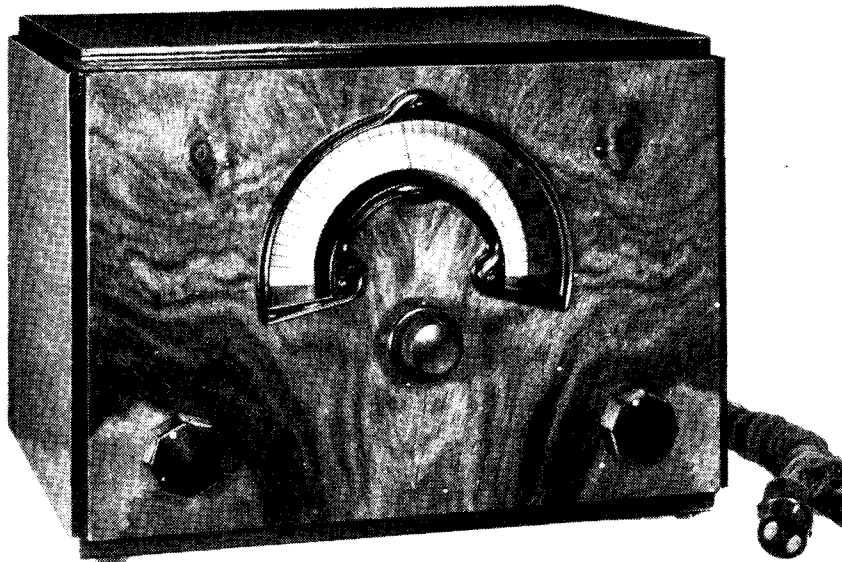
School of Engineering and Navigation, High Street, Poplar, E.14.—A course of five lectures commencing on October 7. Fee for the course, 5s.

Borough Polytechnic, Borough Road, London, S.E.1.—A sessional course commencing October 3. Sessional fees for students under 18, 10s. to 15s.; over 18, 20s. to 30.

Morley College, 61 Westminster Bridge Road, London, S.E.1.—A course of lectures commencing October 4. Fee, 7s. 6d. and entrance fee of 2s. 6d.

The object of these lectures is to provide a general outline of the fundamental principles of television and they will be illustrated by experiments and demonstrations. Further particulars may be obtained by application to the Principals of the colleges mentioned or to J. J. Denton, 25 Lisburne Road, Hampstead, N.W.3.

An Efficient A.C./D.C. Heptode Convertor



This is a very simple unit that can be left permanently connected to the existing radio set, converting it into an all-wave set.

Here are some details showing how to construct what we consider should be one of the most successful short-wave convertors available. It was designed in the first place by Unit Radio.

THIS season both short-wave fans and the ordinary broadcast listeners are thinking about obtaining reliable short-wave reception. The amateur naturally wants to improve his receiver, while the man in the street cannot make up his mind whether or not to buy an all-wave set, to make a short-wave receiver, or to buy or build a convertor to put in front of the existing family set.

Unit Radio, of 347 City Road, E.C.1, designed earlier in the year an A.C./D.C. short-wave convertor using a heptode valve. We have been using one of these convertors for several months with such success that we are giving all these details so that the constructor can, if he wishes, make up this excellent convertor. Those listeners who are merely interested in hearing short-wave stations, but not in the construction of apparatus, can buy the completed unit from Unit Radio at the above address.

Added to Any Mains Set

Actually this convertor can be added to any mains-operated receiver either super-het or straight types, no matter whether your receiver is A.C. or D.C. operated. A point to be borne in mind is this, the convertor can be linked up to the broadcast set and a turn of the switch simply converts your receiver into a powerful all-wave super-het. When it is desired to listen to normal broadcast programmes the unit can be switched out of the circuit and no wiring need be touched. This is a point that will appeal to the family man. The convertor uses a universal heptode valve as a combined detector oscillator. The aerial is loosely coupled to the grid coil while the grid of the oscillator section is also tuned. A

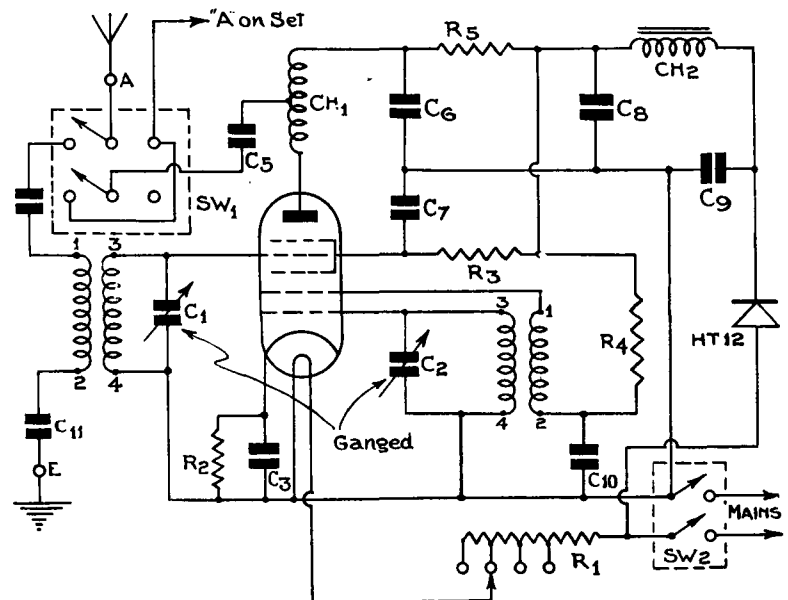
double-gang condenser tunes both circuits simultaneously, a 100/1 geared tuning drive making operation very simple. The heptode obtains its high-tension and low-tension from the mains via its own compact mains unit, so that no additional equipment is required.

The whole unit is mounted on a chassis 10 in. wide by 6½ in. deep by 2 in. in height. The actual layout of the above chassis components can be seen from the illustration. Notice how the metal rectifier and mains dropping resistance are completely shielded.

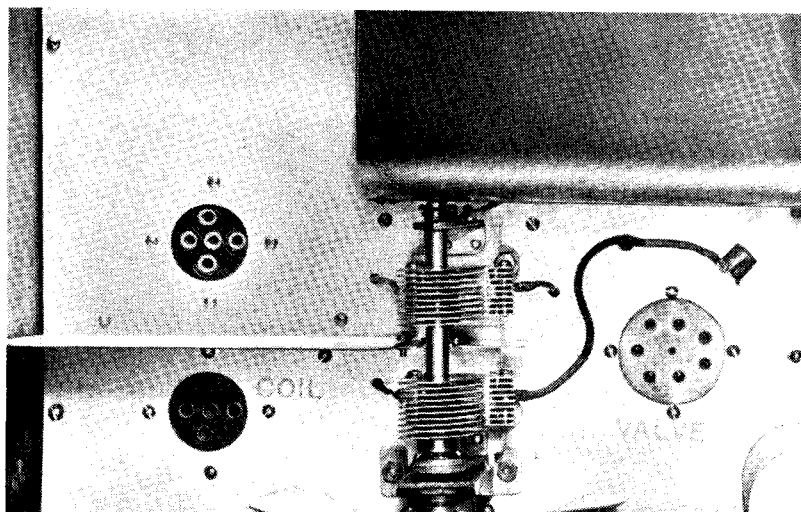
Two coils are required for each wave-band, and these can be of the conventional four-pin type, so that the unit will tune all bands including the 1.7 Mc amateur band with four sets of coils. The fixed condensers and resistances are

of the standard T.C.C. Tubular and Erie 1-watt type with the exception of R₁, which is a mains voltage dropping resistance. The theoretical circuit is almost self-explanatory, but the following values will be required:

C ₁ and C ₂	.00015 mfd. ganged condenser
C ₃	.1 mfd. tubular
C ₄	.0003 mfd. tubular
C ₅	.0003 mfd. tubular
C ₆	.1 mfd. tubular
C ₇	.1 mfd. tubular
C ₈	8 mfd. electrolytic
C ₉	4 mfd. electrolytic
C ₁₀	.1 mfd. tubular
C ₁₁	.01 mfd. tubular
R ₁	mains voltage dropping resistance
R ₂	250-ohms, 1-watt type



The heptode valve obtains its power from a self-contained eliminator.



An idea of the layout can be obtained from the top view of the chassis. Both coils are mutually screened.

R ₃	30,000-ohms, 1-watt type
R ₄	20,000-ohms, 1-watt type
R ₅	20,000-ohms, 1-watt type
Valve	Ferranti Heptode
	VHTS
Metal Rectifier	Westinghouse HT12
CH ₁	H.F. Choke centre tapped
CH ₂	L.F. Choke 30 henries

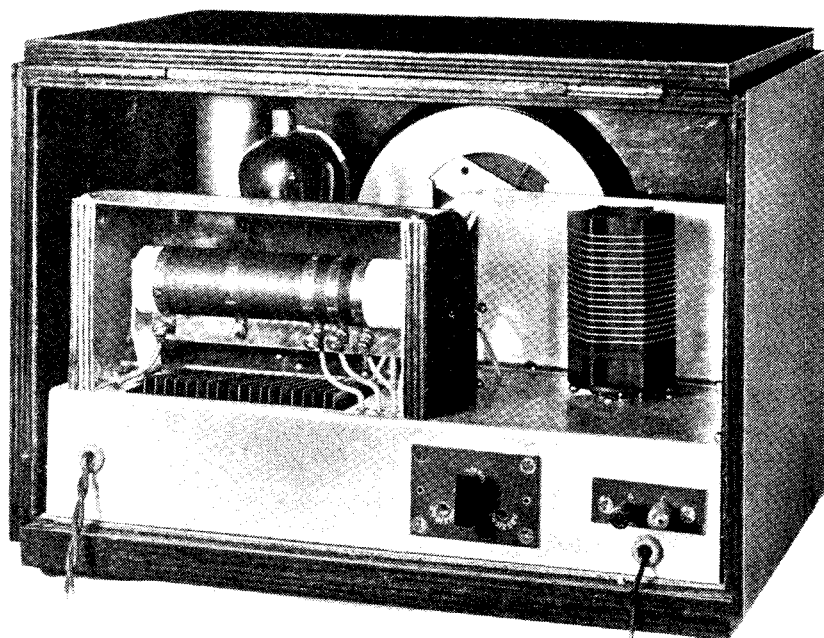
The remainder of the components such as valve holders, etc., are of conventional type.

Construction should not present any difficulties. The main double-gang tuning condenser is mounted in the centre of the chassis. On the right-hand side is the heptode valve and to the right of that the 8 mfd. electrolytic condenser. On the left-hand side of the tuning condenser is mounted a small aluminium screen parallel with the front panel and on either side of this are mounted the tuning coils. At the back of the chassis is mounted the voltage dropping resistance completely covered with an aluminium screen. The remainder of the components are all

mounted beneath the chassis. The on-off switch and change-over switch are mounted on the front lip of the chassis, while the input and output sockets and voltage adjuster are mounted on the back lip of the chassis. All other components are mounted in convenient positions beneath the chassis.

We can assure our readers who make up this unit that this is a most effective way of receiving short-wave stations. With reasonable care in construction no difficulties of any kind will be experienced and readers will be secure in the knowledge that they have equipment equal to most all-wave sets on the market.

Messrs. Unit Radio can supply a completely wired receiver for £6 15s. od., or a complete kit of parts for the home constructor for £6 2s. 6d.



The mains dropping resistance has to be screened in this way to prevent heat ruining the cabinet.

W2XAF to Move Schedule Ahead One Hour

W2XAF, General Electric's short-wave station, operating on 31.48 metres, will move its week-day schedule ahead one hour, beginning September 30. The transmitter will go on the air at 6.30 p.m., and continue until 12 midnight, Eastern Standard Time.

This change does not affect the Sunday schedule, which is from 4.15 p.m. until 12 midnight, Eastern Standard Time.

Five-metre Tests

G5RK, operated by A. F. Ramsay, will be radiating phone and I.C.W. on 56 mc. from the roof of the *Daily Express* building on Sunday, September

29. Approximate times will be from 10.30 to 13.00 B.S.T.

The transmitter in use will be an ultra-audion oscillator, with a Tungstram 15/400 triode; the transmission lines will be three feet long spaced three inches apart and feeding an eight-foot horizontal di-pole. Reports will be appreciated from any listening station who may hear these transmissions.

Quality Radio Components

Claude Lyons have just issued their latest catalogue, a sixty-four page booklet giving details of high-grade apparatus. Although quite a lot of the components are of American origin they are particularly fine as regards construction while they have a

number of original lines which cannot be bought elsewhere. For example, Sylvania American valves are available and altogether there are almost two-hundred different types. Transmitting amateurs should bear in mind that Claude Lyons can supply American transmitting valves. On looking through the catalogue we see such components as power potentiometers to carry up to 15-amps., fixed resistances up to 180 watts, general radio precision dials for frequency monitors and receivers, all types of microphones, high-voltage smoothing condensers and apparatus for the amateur such as ammeters, crystals, power chokes, wave-meters and ceramic insulators. This catalogue should be obtained by every amateur.

Home-made Short-wave Coils

Many amateurs will this season be building their own short-wave receivers. In response to requests from readers we are publishing some details showing how a set of coils can be made very cheaply at home.

At the recent Radiolympia many readers expressed regret that we did not give any coil construction details. Although most of our readers

with the correct number of turns to ensure the best possible L/C, that is inductance to capacity, ratio. Thirdly, the coils have been so arranged that

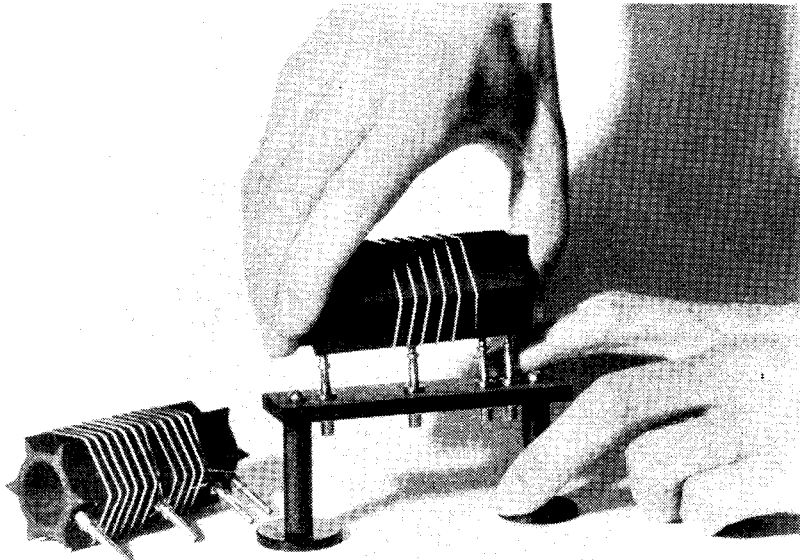
poor, so the second coil starts at 18.5 metres bringing in the 19 and 25 metre bands in the correct positions and covering up to 59 metres. The third coil covers all wavelengths between 48 and 173 metres although this wavelength depends a little on the losses in the receiver and the type of condenser used. This third coil only just brings in the 160 metre amateur band so that the L/C ratio is poor; but do not worry about this point for over 100 metres the L/C ratio is not nearly so important.

The actual construction should not cause difficulty as the illustrations clearly show the method of winding.

First of all three lengths of ebonite tubing 3 in. long and 1.5 in. diameter, including ribs are required. Also 12 Clix valve pins with three nuts on each pin, about 6 ft. of No. 20 tinned copper wire and 8 ft. of No. 20 gauged enamel copper wire will be wanted for the three complete coils.

First drill the ebonite former to take the pins making sure that they are a tight fit. The actual spacing, the same in each case, can be obtained from the drawing. Stretch some of the wire to be used by fixing one end of it in a

(Continued at foot of next page.)



The design of this coil enables all wavelengths down to 13 to be covered. Special coils for the ten-metre band can also be made in a similar way.

buy their components there are still some who wish to experiment with several receivers and, in particular, with their own coils. It is an established fact that to attain maximum efficiency from a short-wave receiver stations must be tuned in with the minimum of condenser capacity. By that we mean that if, for example, a 20 metre station could be tuned in at 20 degrees on the dial it would be considerably louder than if it were tuned in at 80 degrees on the dial.

Wavelengths from 12-175 Metres

These coils, a set of three, have been designed to cover all wavelengths between 12 and 175 metres, so that all amateur and commercial bands will be covered. But before giving constructional details here are some of the reasons for designing the coils in this unusual way.

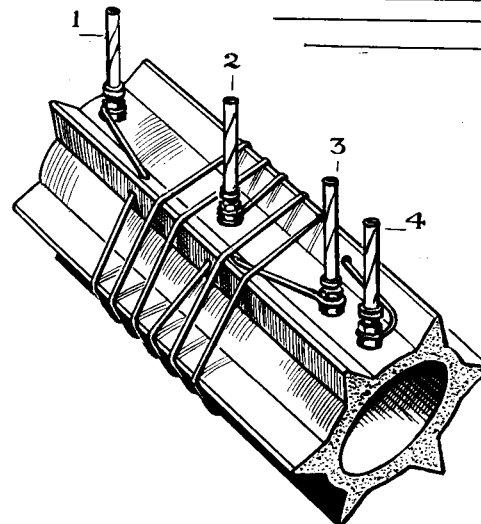
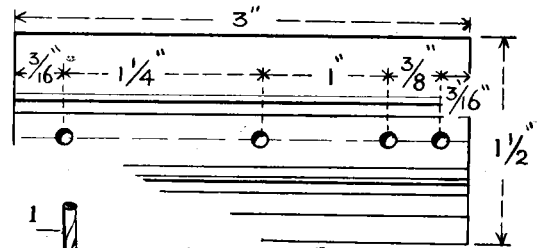
First of all the main principle underlying short-wave construction is to ensure minimum loss in every direction. Coils in particular must be wound on the best quality former with the minimum of material. Unfortunately it is not yet practicable for amateurs to experiment with coil forms made of high-quality material such as Frequentite or Steatite, which cannot be drilled or worked once it has been moulded.

Secondly, these coils have been made

they overlap in wavebands without the overlap occurring anywhere near a popular channel.

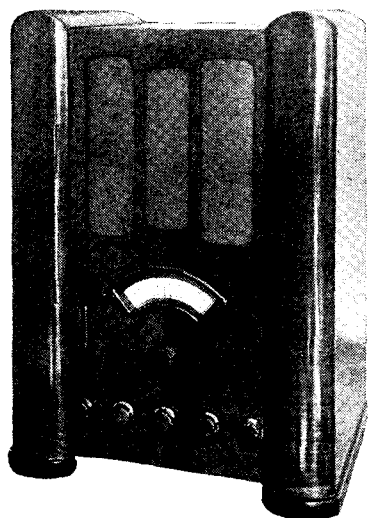
L/C Ratio

First of all as the lowest short-wave station has a wavelength of approximately 13.5 metres, a coil that tunes to 12 metres will do admirably. This means that the 13.5 metres station must come somewhere around 20 degrees on the dial. The ratio of inductance to capacity will then be as good as is practicable, so giving a high degree of efficiency. We have designed this first coil to have approximately a top wavelength of 28.5 metres. Although the coil will tune in the 25-metre broadcast bands the ratio of L/C is



Be sure to obtain the correct spacing, otherwise the coil will not fit perfectly into the holder.

Commercial Receivers for the Short-waves: No. 7.



The Hyvoltstar 7-valve all-wave super-het.

A Universal All-wave Receiver

WE know that our readers will be particularly interested in the results obtained from our tests of the "Hyvoltstar" 7-valve All-wave Superhet. It has been generally agreed that the only all-wave receivers that really were efficient were of American origin. At Radiolympia this year there was a decided trend towards all-wave receivers, but with the exception of a few, most of the receivers shown were of the standard broadcast type with a short-wave section added.

The "Hyvoltstar" is the nearest receiver of its kind to the multi-valve American set that we have so far tried. It consists of a 9-stage super-het circuit using a variable- μ high-frequency amplifier, pentagrid frequency changer, with a variable- μ I.F. amplifier, 2 Westectors for detection and delayed A.V.C., a triode L.F. amplifier, 2 push-pull pentodes giving 7-watts output and two half-wave rectifiers. As well may be imagined this receiver has an exceptional range. Noise level has been reduced in the design of the I.F. amplifier to a negligible level so that weak short-wave stations can be received without difficulty.

Short-wave Features

As most of our readers are interested in the short-wave end of this receiver, here are some of the more important points which we noted during our tests. First of all, the tuning range is approximately 13.5 to 50 metres in 2 steps. Both short-wave bands are accurately calibrated in metres, which in itself makes tuning simple. The amateur wavebands occupy quite a reasonable width of the tuning scale so that stations are not particularly cramped. As an example of what we mean, this receiver was used in conjunction with our own transmitting station for a period of

several weeks and a large number of contacts were made both on 20 and 40 metres. It is without question one of the best British built receivers of its kind and the chassis at 22 guineas should meet the requirements of many amateurs who want a reliable short-wave receiver.

Broadcast listeners who wish to hear continental and American short-wave stations should not get the idea that this receiver is solely for use on amateur bands. The 13, 16, 19, 25, 31 and 50 metre commercial wavebands are covered and so efficiently that in normal circumstances a very great number of American stations can be tuned in on the loudspeaker.

The high-frequency stage in front of the detector is certainly a very great advantage. There is an appreciable gain even down to 14 metres, while at the same time the absence of second channel whistles is particularly noticeable. It is not uncommon to receive stations such as W₂XAD, W₃XAL, and W8XX at such strength so as to load the loudspeaker to 5 or 6 watts.

On Medium and Long Waves

On medium and long wavebands we have no criticisms to make. Hum level is of a very low order and on A.C. mains averages .5 volt and on our D.C. mains .9 volt. Selectivity is a genuine 9 kc., so most of the European stations which have their own frequency can be received without trouble. A point which will prove the exceptional efficiency of this receiver is that on many occasions we were able to log American stations with an aerial consisting of 3 or 4 ft. of wire to a picture rail.

Quality on the medium waves from local stations is of a very high order. The loud-speaker has been designed so as to give a level overall frequency response and to handle the maximum output of 7-watts without stress. This speaker is, of course, of the energised type.

A refinement which every reader will find particularly useful is the combined silent tuner and automatic noise suppressor, while fluid light tuning proves useful on even the weakest stations. We have not mentioned before that the valves used are of the high potential heater type so that the receiver does not make use of any mains transformer. Consequently it can be used on mains supply A.C. or D.C. from 190 to

260 volts, and with A.C. from 25 to 100 cycles. Special models are available for 100 volts A.C. or D.C. mains.

The chassis is particularly workman-like being all steel with the majority of the components completely screened. This point is particularly interesting when the receiver is to be used in conjunction with a transmitter. Duplex working is made much more simple.

Several models of this receiver are available. A chassis complete costs 22 guineas; a table model 26 guineas, a table radiogramophone 30 guineas, while a super-console automatic radiogramophone costs 40 guineas.

This receiver is without question as efficient an all-wave instrument as we have tested so far and we can thoroughly recommend it not only for use in this country, but abroad, for all components are suitable for tropical use.

Makers are Universal High Voltage Radio Co., of 28-29 Southampton Street, Strand, W.C.2.

"Home-made Short-wave Coils"

(Continued from preceding page.)

vice and pulling the other end with a pair of flat nose plyers just before the coil is to be wound. Dealing with the lowest wave-band coil first, start at the end pin and wind on as tightly as possible three turns of the tinned copper wire finishing off at pin 2 and spaced as shown. Start again at pin 3 winding on three more turns and finishing off at pin 4.

The second coil is wound in the same way as the first coil except that in between pins 1 and 2 there are 8 turns and between pins 3 and 4, 5 turns.

Finally, the third coil which is wound with enamel covered copper wire. Turns are put on without any spacing in simple solenoid fashion. There are 23 turns between pins 1 and 2 and 10 turns between pins 3 and 4.

We know that the coils are very efficient and are quite suitable for use in wave-meters, wave-traps and similar apparatus. A complete set including mount and supports can be obtained from Messrs. Wright and Weaire, to whom we suggest you apply if you prefer not to make these coils at home. Ebonite formers are obtainable from the British Ebonite Company at Hanwell, while Messrs. Lectrolinx, Ltd., of 77a Rochester Row, are the suppliers of the coil pins.

The Short-wave Radio World

A Simple 10-metre Transmitter

THOSE who have not seen QST will have missed the interesting description of the 10-metre transmitter used by W4AGP. The equipment consists of a 59 electron-coupled oscillator and a push-pull 46 amplifier. The circuit diagram gives all the necessary information, but the following extra details will probably be of interest. The oscillator grid-tank circuit is high-C,

A Review of the Most Important Features of the World's Short-wave Literature

for because of the higher permeability less wire is required for a given inductance, so lowering the H.F. resistance and the distributed capacity. This re-

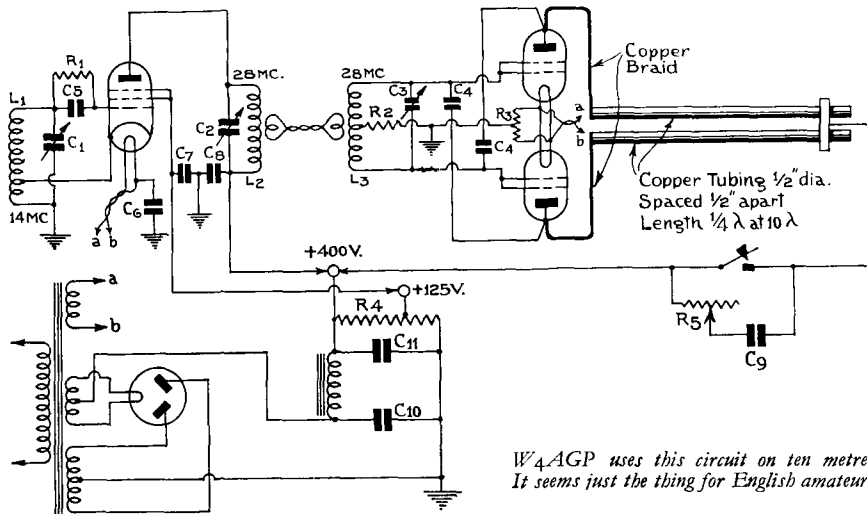
ables selectivity to be varied by means of a small-capacity condenser, which is virtually in parallel with the crystal. This arrangement has a particular feature in its favour. The crystal can be switched out of circuit very quickly when high-quality phone reception is required.

A Portable Valve Voltmeter

In the current issue of *Radio*, an interesting valve voltmeter was described which is particularly useful for measurements which require a meter of high input impedance. This arrangement is suitable for the measurement of RF across coils where the input is only a fraction of a volt. Its range is up to 1½ volts RMS. The circuit is quite simple. Several bias batteries are used for HT, while the meter reads up to 1½ volts. A small bakelite panel supports the meter, rheostat and input terminals, while the valve is mounted on a bracket underneath the panel. The meter is not provided with a bucking voltage system because the H.T. battery is only of low voltage and has a resistance of 30,000 ohms in series with it. A .5 mfd. condenser is used to by-pass all A.C. current from plate to heater, so improving the detection characteristic. Of course, the meter and resistance provide a path for D.C. plate current.

A 30-ohm filament resistance provides grid bias of about 1½ volts due to filament current drop across it, while a 20-ohms variable rheostat allows for initial reading adjustment and also provides a means for filament switching.

This voltmeter can be calibrated by using a potentiometer and a low-reading A.C. voltmeter across the filament winding of an A.C. transformer. Remember, the A.C. voltmeter reads RMS values, so that 2½ volts RMS equals 3.53 volts peak.



W4AGP uses this circuit on ten metres. It seems just the thing for English amateurs.

tuned to 14 mc., with the plate very low-C on 28 Mc. Since the coils have to be adjusted to give this capacity value it is not possible to give the exact dimensions. The oscillator-plate tank is adjusted so that it tunes to 10 metres, with C2 just above minimum value.

The link is coupled through one turn at L2 and tapped a half a turn each side of centre on L3. The quarter-wave high-Q plate tank circuit in the amplifier is used to get maximum plate efficiency. The tubes—half-inch copper, are 8 ft. long with a shorting slider for adjustment. The output voltage is 450 on no load, dropping to 400 volts at 100 m/a.

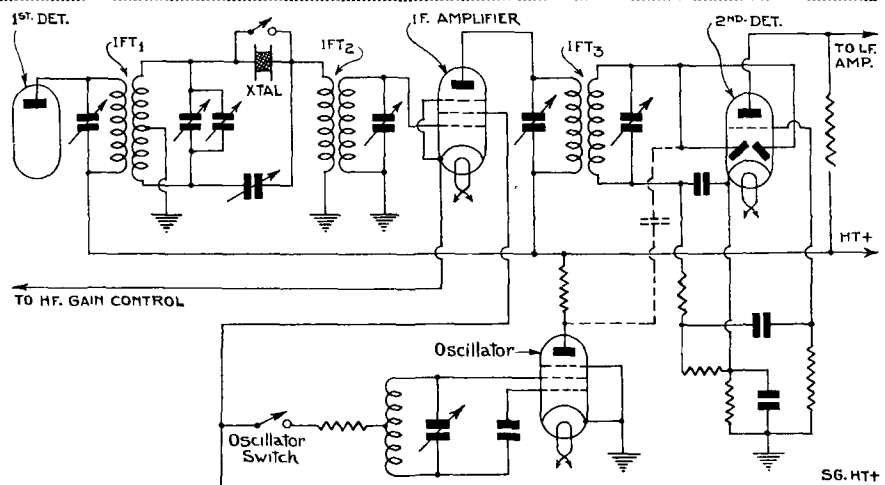
Constructors will find the following values of use. C1 250 mmfd. C5 100 mmfd. C6 and C7 .002 mfd. C8 .001 mfd. R1 50,000 ohms. R2 1,000 ohms. R3 10 ohms either side of centre. R4 20,000 ohms. C9, R5 .1 mfd. and 1,000 ohms variable. L1 four turns tapped 1½ turns from earthy end, 1½ inches diameter. L2 8 turns. L3 6 turns both 1½ inches diameter.

A Crystal Gate Super

W9KGM is using iron-cored I.F. transformers in his single signal super. Radio engineers have long been familiar with the fact that increasing the permeability of a transformer core, providing the losses in the coil are low, will greatly increase the efficiency of the coil,

results in a much higher-Q coil. The Q of a coil is, of course, the measure of its sharpness, resonance of selectivity, Q being equal to $2\pi fL/R$.

We have shown the circuit of the suggested super-het so that amateurs will get some idea how a crystal gate can be added to existing sets by only making slight modifications. The I.F. transformer coupling the first primary to the grid of the 6D6 must be of low impedance and, of course, centre tapped, so as to provide the balanced gate. This en-



There is no doubt about a crystal gate super being the thing on 20 and 40 metres. W9KGM suggests this circuit.

Calls Heard

B.R.S. 1,847, C. Jagger, Guildford, Surrey.

(14-mc.)
(August 4)—W2WAG, W3MD, W1IJL, W5DQ, VP6YB; (August 5)—W2CMJ, W1WJ, W9BXE, W4BJ, W9GYJ, W1EVO, W8JV, W9OKA, W8BO, W8DR, W8HY, W2AMV; (August 9)—W2CSU, W5LA, W1CJV, W5BDB, HB9J, W3ENY, VE2CA, W4OC, W5VNV, VP6YB, G6SR; (August 10, 00.12)—W2CGJ; (06.50-07.30, 7-mc.) I1KR, I1KB; (21.40, 14-mc.) PX1B (CW) VP6YB, W9DVP, LY1J, W4KH, TI2AV, CO8YB; (August 11, 22.00)—VE4HW, W3MD, W3EOZ, VO1I, VE3HC, W7FL; (August 12, 20.00)—LU7AZ, CT2BC, VE4DU, LU1BZ, CX1PA (all CW); (17.00) PX4XM, ZB1H (both CW), LY1AG, VE1CR, X1Q, W5LA, W9AAN, W3EOZ, W1CHG, W2DYY, VP2AC, W8EQA, W2FLL, LA1G, PY2AK, VQ8A; (August 23)—W3EOA, W2DH, W2EUG, UP6YB, W3EHY, W1CGY, W3MD, W1OXFP, W7OAF, W3ABN, W9OCP, W3VX, W4OC, W9FBD; (August 24)—VE1BD, VE5HA, W3BFH, W3ABN, CO2SV, CO2RA, HB9AQ, W9FJ, W2EDC, W2EZC, K6DUM, W4WT, W5BPV; (August 25)—CO2WZ, W5BCW, W4BLH; (August 28)—VE9CNE,

VO1I, EA8AE, W6FGY, W2BSD, VE1CR, HI7G, W3BFH, W2CKA, W4ALG, VE2BG, W3EFS, W3CUB, VE2HK, W5AVR, W9FJ, W4AFC, W7CGR, W3ZX, HH1P, W4BLH, VE4IK; (August 29, 22.00-23.00) W6IRX, W6DOY, (September 1)—W4KH, W5BMZ, W4CJ, VE1FE, HI7G, W4AGC, VE5EH, TI3AV; (September 2, 13.00-22.00)—W5BDB, J2JK, W4AOG, W5ZXU, VE3LI, W5CEW, XLA1Y.

B.R.S. 1,942, C. J. Penberthy, Longrock, Cornwall.

(14-mc. Phone.)
W3BFH, W3MD, W3BPH, W3CRG, W3CM, W3BC, W3CIG, W3DAR, W4MP, W4AXZ, W4AH, W4UM, W4AHH, W4CO, W5DVE, W6AP, G5VL, VE3LL, SM5TA, CT1BY, OK2AK, OK2KO, ON4ZA, EA4BA, EA7BA, CO6OM, CO8YB, LY1AG, LU8DR, HC1FC, VP9R.

B. McDougall, Stornoway, Scotland.

(14-mc. Phone.)
VP6YB, W3BFH, W3EFS, W3BSD, W3COT, W3EOZ, W6FQY, W3CRG, W3AAY, VE2BG.

Brian Howarth, London, W.9.

(7-mc. Phone.)
G2AV, G15MZ, G6SR, G2PS,

ON4OV, G6LX, ON4YI, G5KA, D4AG, LA4X, LY1AG.

(3.5-mc. Phone.)
(22.30-23.00)—PAOASD, PAOKO, ON4MJ, PAOIZW, PAONF, G2SH, PAONV, FM3CV.

(14-mc. Phone.)
(23.000-0100)—W3EOZ, W3BFH, W3EHY, W2MD, W2AMD, W2BS, W4CLH, W3ACI, W6KD, LX1AS, VP5HE, W4WT, W8DVC, W6CNE, W6CZ, W6BHO, CO2FG, W5NT, W4AH, W4OC, W4AXO, W4BTR, VE5HN.

2BSF, S. G. Wood, Rotherham, Yorks.
(40-meter CW.)

W2FFN, W8MGC, W1BYE, W8JMP, W8MFD, W8ABO, W9JAI, W3CMT, W8GFF, W3ERD, W3DPZ, W2HAY, W8HRD, W3CLU.

B.R.S. 1,904, R. G. Shears, New Barnet, Herts.

(20-metre Phone.)
W3BFH, W3BPH, W3LL, W3DCX, W4AHH, LU6AT, W4DLH, W4OC, W4CRE, W4AH, W4AXZ, W5LA, W5BDD, W5BND.

A. E. LeGros, London, S.E.6.

(20-metre Phone.)
W3EOZ, W3MD, W3CAG, W3ABN, W3GX, W3DQ, W3AXT, W3BNC, W3BSH, W4OC, W4AH, W4DLH, W5AOP, K4SA, VE2HK, CT1BY, HP1A, VP9R.

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A Prize-winning Listening Station

We have made a practice of reviewing each month some of the more prominent amateur transmitting stations. This month we are making a slight variation and are giving details of Oliver Amlie's receiving station which won the American Short-wave Craft Trophy.



Oliver Amlie at his station that won the Short-wave Craft Trophy this year. The set is a three-valver.

OLIVER AMLIE, with a QRA of 56th City Line Avenue, Overbrook, Philadelphia, Pennsylvania, U.S.A., makes a particular point of listening to Australian stations. He has obtained 140 reports from VK2ME, VK3ME and VK3LR during the period October, 1934, to May 9, 1935. Our readers will be interested to know that Oliver Amlie is broadcasting via W3AXU on 31 metres from Philadelphia during October, approximate time from 6 to 7.45 p.m. eastern daylight time. In the illustration of this station, Oliver Amlie can be seen operating his well-known three-valve receiver with which he won the Trophy this year. So as to give some idea as to the reliability of short-wave signals in America and to the efficiency of Oliver Amlie's receiver he has been asked by the Commissioner for Australian Broadcasting to send in regular reports on their three short-wave transmitters. A similar request was made by the Chief Engineer of the B.B.C. and by the Italian Broadcasting Company.

Australian Schedules

In his last letter to us, Oliver Amlie has sent some very interesting information regarding the schedules of the Sydney short-wave station, which is well heard in this country. The following are the times for October, November, December, of 1935.

Oct., 1935. VK2ME.
1st Sunday 12.30-3.30 a.m. 0530-0730
2nd Sunday &
3rd Sunday 4.30-8.30 a.m. 0930-1330
4th Sunday 9.30-11.30 a.m. 1430-1630
Nov., 1935. VK2ME.
1st Sunday 1.00-2.30 a.m. 0600-0800
2nd Sunday &
3rd Sunday 4.30-8.30 a.m. 0930-1330

4th Sunday 9.00-11.00 a.m. 1400-1600
Dec., 1935. VK2ME.

1st Sunday 1.00-3.00 a.m. 0600-0800
2nd Sunday &

3rd Sunday 5.00-9.00 a.m. 1000-1400
4th Sunday 9.00-11.00 a.m. 1400-1600

Oliver Amlie hopes, during the course of this year, to make 250 contacts with the three Australian short-wave stations, and this is in addition to receiving programmes from all over the world. Verifications have been received from the following stations and as their schedules have been given we are reproducing them for the benefit of our readers. Thanks are due to Mr. Amlie for this information.

All time given herein is G.M.T. (London time).

HC2RL 45.00 metres. Sundays, 10.45 p.m.-1 a.m.; Tuesday, 2.15-4.15 a.m. Guayaquil, Ecuador.

YV2RC 49.05 metres. Daily, 10.15 p.m.-3 a.m. Caracas, Venezuela.

YV3RC 48.07 metres. Daily 9.30 p.m.-2.30 a.m. Caracas, Venezuela.

HJ4ABE 50.42 metres. Monday, 11 p.m.-4 a.m.; Tuesday, Thursday, Saturday, 11.30 p.m.-1 a.m.; Wednesday, Saturday, 12.30 a.m.-4 a.m. Medellin, Columbia.

YV5BMO 51.28 metres. Daily, 11.15 p.m.-2 a.m. Maracoibo, Venezuela.

HCJB 73.00 metres. Daily except Sunday, 12.15 a.m.-3.15 a.m. Qutios, Ecuador.

CTIAA 31.25 metres. Tuesday, Thursday, Saturday, 8.30-11 p.m. Lisbon, Portugal.

HJ4ABL 49.15 metres. Daily, 11.30 p.m. to 12.30 a.m.; Saturday, 4-5 a.m. Manisales, Columbia.

VK2ME 31.28 metres. Sunday, 6-7 a.m.; 10 a.m.-4.30 p.m.; Monday, Tuesday, 2-3 a.m.; VK2ME testing with W2XAF on Monday, Tuesday, 12 noon till 1 p.m. Australia.

VK3ME 31.55 metres. Wednesday,

Thursday, Friday, Saturday, 10 to 12 noon. Australia.

VK3LR 31.34 metres. Daily except Sunday, 8.15 a.m. to 12.30 p.m. Australia.

COH 31.08 metres. Daily, 3-5 p.m.; 9-11.30 p.m.; 1 a.m.-3 a.m. Havana, Cuba.

W3XAU 31.28 metres. Daily, 4 p.m.-12.45 a.m. Philadelphia, Penn., U.S.A.

W3XAU 49.50 metres. Daily, 12 mid. to 3 a.m. Philadelphia, Penn., U.S.A.

COC 49.92 metres. Daily, 2.30 p.m. to 4 p.m.; 9-12 mid. Havana, Cuba.

W9XF 49.18 metres. Daily, 1 a.m.-2 a.m.; 4 a.m.-5 a.m.

Any readers wishing to join the 6,000-12,500 mile DX Club should write to Oliver Amlie at the address mentioned above for full details. No entry fees or subscriptions are required.

Polytechnic Evening Classes

The Regent Street Polytechnic, at 307 Regent Street, W.1, are holding a course in wireless and high-frequency engineering including television, which is commencing on September 23, 1935. The course has been arranged to give those engaged or interested in wireless, television, or talking film work a thorough training in the principles and technique of high-frequency engineering. Fees per session for non-course students are one evening of three hours or less 20s., each additional evening of more than one hour and not more than three hours, 10s. On glancing through the prospectus we notice such courses as television and high-frequency engineering in the laboratory, alternating current measurement, radio frequency measurement, the design of wireless apparatus, wave propagation and reception, electro-acoustics, etc., etc.

"30-line Television in History"
(Continued from page 587.)

signal was put on to the Savoy Hill programmes commenced. Since then television has never been unaccompanied by sound. That first famous programme in September, 1929, has been followed by nearly 1,500 others up to September 11 last, when 30-line television died with honour.

To return to the early days in the Baird studio, for sound a Western-Electric double-button microphone was first used, but the studio was too small to have really good acoustic properties. At that time, only close-up views of artists could be accommodated and the "cell lighting" was still fixed in one position.

An important occasion was July 14, 1930, when a contingent of B.B.C. producers and actors came to the studio and ingeniously managed to produce a one-act play, Pirandello's "The Man with the Flower in His Mouth," in a space which even puppets would not appreciate.

During the autumn of this year greater scope was being given to the programmes by more suitable placing of the photo-electric cells. A view of an area about 4 ft. x 2 ft. became possible by bringing some of the cells correspondingly nearer, just enabling two artists to be seen together, or to show the keyboard of a piano. Only the hands of the artist playing the piano, and not his whole figure, could, of course, be seen at the same time.

In the meantime a completely new studio and control was being equipped in Long Acre with all the latest improvements, and after one or two trial broadcasts it was brought into permanent use in April, 1931. The new apparatus included a disc projector as before, but now mounted higher up to enable the artist to stand, and with controls for adjusting the position of the beam in both vertical and horizontal directions. Beside this was a mirror-drum projecting a beam from an arc lamp to the back of the studio scanning an area about 6 ft. x 3 ft.; this also had controls for moving the beam up and down and sideways as would be required when following a dancer. There were two banks of photo-cells on moveable stands connected to the control room by leads 18 ft. long.

Hitherto it had been necessary to keep the cell leads as short as possible on account of the H.F. loss otherwise entailed, but the employment of a specially made flexible con-

centric cable made this new and better arrangement possible. The cell "A" amplifiers were just inside the control room; there was an amplifier for each group of photo-cells and the outputs of each were taken to a two-way mixing unit so that some really effective lighting could at last be achieved.

The "A" amplifiers had now two valves each, both indirectly heated, which did away with microphony troubles that loud sounds from the studio had previously caused, compelling the artists to perform *sotto voce*. The output from the mixer went into a 3-stage "B" amplifier;

then followed an aperture corrector of the newest type, a bridge-T network, and finally a 3-stage "C," the output of which was plugged to the Savoy Hill line.

Such were the main developments in the new studio which immediately extended the programme facilities. Dancing items became regular features, and small plays, as well as many other interesting diversions were included.

Two programmes in March were devoted to "tele-cine," that is to say, the televising of an ordinary cinema film. One of the two was a short

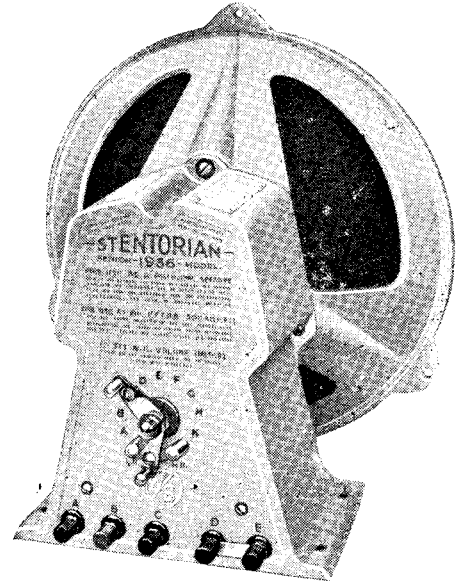
(Continued on page 622.)

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More powerful magnet at the same cost—new accurate methods of assembly—larger and more efficient "Micro-lode" transformer—these and other detail refinements bring a standard of performance higher than before possible in a popular commercial speaker.

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PRICES CHASSIS
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● Read these extracts from a Report on the 1936 Stentorian by Mr. Kenneth Jowers (G5ZJ) of "Television":

"Greater volume for the same input... quality is improved owing to better attack... gap measurement is a phenomenally good figure... glorious quality on a speaker which is actually low priced."

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PERMANENT MAGNET MOVING COIL LOUD SPEAKER

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Heard on the Short Waves

By Kenneth Jowers

ABOUT the only thing in favour of Radiolympia, from my point of view, was that I met so many of the fans who I would otherwise only have met over the air. In this way I am able to get a very good idea of just what is wanted in the receiver and article line, so consequently the next issues will be full of copy actually asked for by readers.

Looking through my QSL cards that had come to hand during the last few months, I was surprised at the number of stations who use two-valve receivers. Although I have used two-

better is the two-valver. So remember the next time conditions are bad give the small set a trial for it is surprising what can be done in this way.

B.R.S. 1,295

B.R.S. 1,295, John Preston, of Muirkirk, Ayrshire, is still listening on his 0-V-2. His last letter to me, a personal one by the way, contained so much information about well-known stations that I am sure he will not mind me reproducing a few lines here and there.

G2KT and G5MM are still good strong signals on 1.7 mc. at his QRA.

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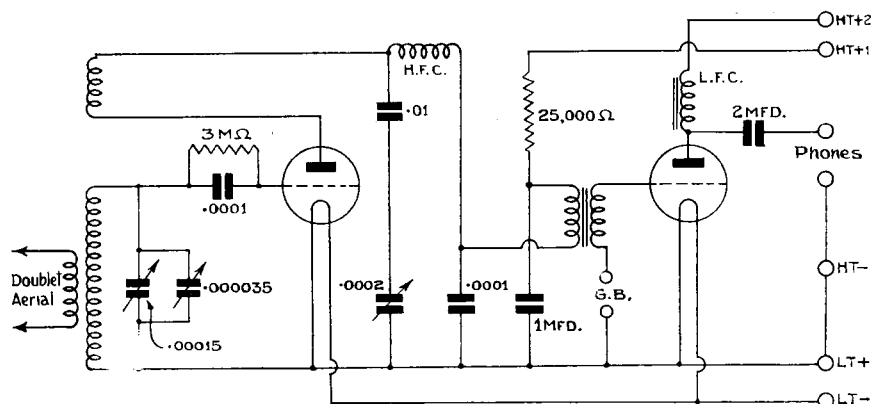
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PITMAN

PARKER ST., KINGSWAY, W.C.2



This is the circuit used by J. W. Greenshields of Burnt Oak, who is doing so well at the moment on the 40 and 20-metre bands.

valvers from time to time, I always had the idea at the back of my mind that people built two-valvers purely as a matter of economy. The Band-spread Two, during my tests, brought in quite a load of American stations, but even so I still had the impression that if I had the option of either a two or a six-valve receiver I should choose the six-valver.

Just recently on 40-metres there has been some very bad static making QSO's almost impossible late at night. I brought out the Band-spread Two and now whenever conditions show signs of dropping off I use that set with a pair of headphones. I have been able to make many more contacts and get far more QSA5 signals than on a super-het, although it must be admitted that the stronger the station the better is the super, and the weaker is the station the

W3DQ and W5IA have a lot of details about the new Breering 12 receiver, which is causing a stir in America. From information received from G5KJ it appears that PAOFB is at 6GO, so here is a chance to make two contacts at one go. Incidentally 6GO is being heard in America on 20-metres and has had good reports from Bombay and Cairo.

G6KV is doing well on 1.7 mc. in the odd times he is operating, but on 20-metres he is not so happy on phone, although CW is satisfactory. G5IL and G2DQ are also good signals on 1.7 mc. in Ayrshire, but so far no signs of G2LZP." By the way, I have heard G2LZP, at Letchworth, at R4 on 1.7 mc. This portable station is near Burnham-on-Crouch, about 70 miles as the crow flies. "6GO and 5KJ are

(Continued on page 620.)

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Giving you—in addition to ordinary programmes—

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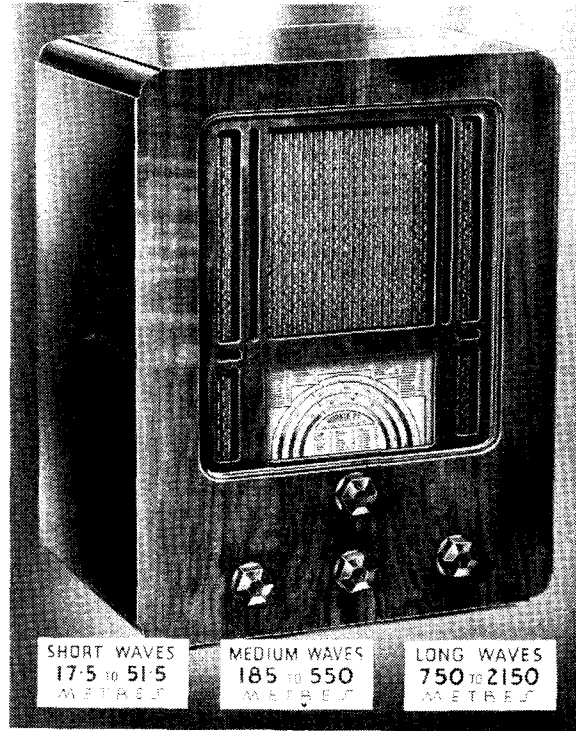
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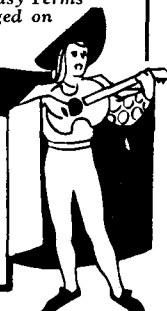
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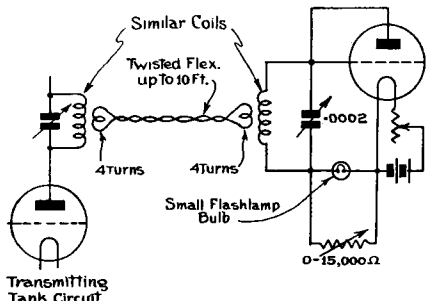
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"Heard on the Short Waves"

(Continued from page 618).

working duplex on 1.7 mc. without difficulty. Those who are interested in duplex working should find out how they do it."

Amongst stations heard by B.R.S. 1,295 were W3DQ, W3ABN, TI3AB, HI7G, VP6YB, PY3AW, W7ADF, all 20-metre phone, while 40-metre phones included EA1AS, F8LZ, F8QP, CT1ED, CT1EP, ON4KD, PAODK, EA3AN, F3AC, HB9AX, and the fol-



L. E. H. Schofield suggests this arrangement for a dummy aerial. We hope some of the G's on 40 metres will use it.

lowing G's. 5OC, 5KJ, 6TL, 2KT, 5ZJ, 6AG, 2OV, 5MM, 5GL, 6SR, 5SR, 2BL, 6DL, 5KF, 5IL, 5FR, 6KV, 2IP.

On 80-metres at 4 a.m. W4ACZ, W3ZY, and HI7G were heard. The best 160-metre stations were G6GO and G5ZJ, followed by 5RD, 5MM, 5HO, 2KT, 2QF, 5YW and 2WL. Minimum QRK on all stations R6.

2AXB, from Tottenham, finds conditions for VK very good between 07.30 and 09.00, having heard all VK districts. 40-metre CW stations included K4AA, K5AG, ZL1HY, ZL2FF, ZL2MM, ZL3AB, ZL4VQ, W5ATF, LU7AZ, LU4BC, HC2FG. 20-metre C.W. includes ZE, PY1, VQ4, VQ8, W6, VP2, U9, VS2, VK2, VK3, VK4, VK5, VK6 and VK7.

Hull is always a good district for reception. B.R.S. 1,936, A. G. Dunn, sent me a very long list of 14-mc. stations, enclosing all W, LU, CX, CK, XZ, CT3, VK4, VP2, VP5, making a total of 167 W and VE stations alone. On 40-metres over 100 G stations were logged, in addition to VK2 and ZL3. Very good going B.R.S. 1,936.

G5PPP (portable) on 7-mc. and running from a 120-volt dry battery, was logged in Gorebridge, Midlothian, by T. MacMillan. Even though the glass fell down to 29.1 conditions were very good in Midlothian as 53 G's were logged in one morning.

G5UK has gone out to Italy. Nobody quite knows when he is coming back again, but G6IF, that low-power Leigh station, has sent me some details about activities in district 14.

G5UK, in between business calls, is experimenting with five metres—I should say on five metres otherwise it gives the impression that the meters were of the Ferranti type. G6CT is trying out new aerial systems with a view to increasing radiation, but there

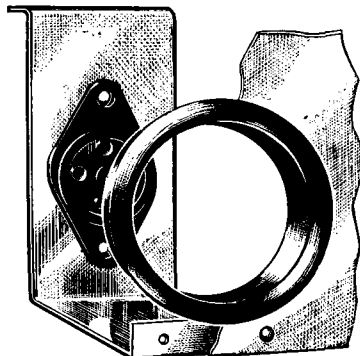
all continents. I understand that his batteries are running down so he will probably obtain anode voltage by rubbing two dissimilar metals together. Those who have seen 6NW will probably appreciate the point.

A Dummy Aerial

Last month I mentioned about stations knob twiddling with radiating aerials. This brought me a letter from L. E. H. Schofield, the Group Manager of the Artificial Aerial Research Experimental Section of the R.S.G.B. His circuit for a dummy aerial is shown in these pages. He tells me it has been found to be most satisfactory and simply employs a triode valve used as a diode, with grid and tank coils of similar inductance.

J. W. Greenshields, in Burnt Oak, who sends me most colossal logs of amateur stations, uses a simple two-valve receiver. As you can see from the illustration it is perfectly conventional, but includes provision for a doublet aerial, band-spreading and throttle reaction. It certainly brings in the stations, so it can be recommended with every confidence.

Commercial stations are coming in very well at the moment. During my sundry visits to ham stations I have heard quite a number of American stations on the loud-speaker with only two-valve sets.

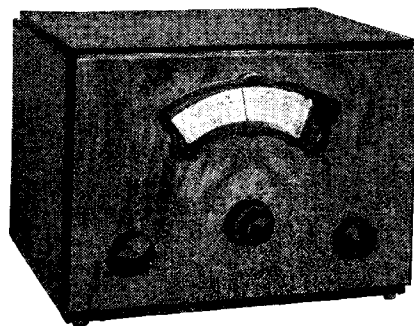


B.T.S. designed this coil-holder for the E.C. frequency meter built by G2DV and G5BJ and described in the July issue.

is no truth in the rumour that the trams are affected when 6CT gets going on the key.

6IF has been doing great things in the last few weeks, including an all but WAC in one evening. G6NW is still running from dry batteries at very low power, but all the same manages to work

UNIT HEPTODE SHORT-WAVE CONVERTER



Mr. Kenneth Jowers of Television and Short-Wave World has been using one of these "UNIT" Heptode Converters for several months with great success. Read all he says about it on Page 609.

This Unit Heptode A.C.-D.C. Converter brings to you a vast amount of real short-wave entertainment from all over the World. The beauty of it is, that you simply connect it on to your present set; no need to buy a new and expensive all-wave set. The Unit is self-contained and works on either A.C., or D.C., from 200-250 volts. 100-1 Tuning Dial makes for simple and perfect handling. A switch controls change-over from true short-wave to normal broadcast.

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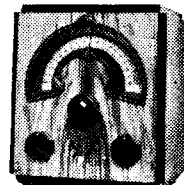
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0—25 "
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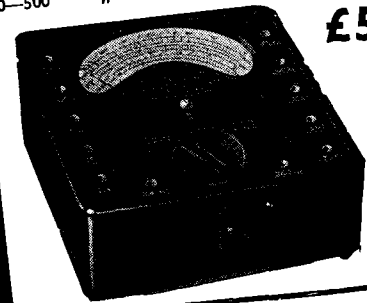
0—5 volts
0—25 "
0—100 "
0—250 "
0—500 "

MILLIAMPS

0—2.5 milliamps
0—5 "
0—25 "
0—100 "
0—500 "

RESISTANCE

0—20,000 ohms
0—100,000 "
0—500,000 "
0—2 megohms
0—5 "
0—10 "



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Deferred Terms if desired.

CURRENT
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0—120 "

VOLTAGE
0—6 volts
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0—120 "
0—240 "
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0—600 "

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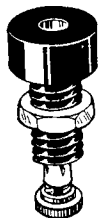
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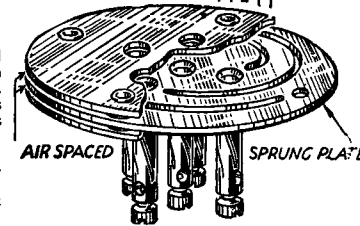
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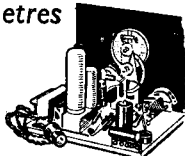
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A SIFAM TEST'S A SAFE TEST

"30-line Television in History"
(Continued from page 617.)

reel of Charlie Chaplin, and the other a boxing match. This experiment was done by means of an "Arcadia" projector, the image of the film being projected through a Nipkow disc on to a photo-cell immediately behind. The greatest obstacle to televising films then and since has been the difficulty of obtaining films that were specially suitable for television.

May 8 of the same year marked still further progress when some scenes from the roof of the Baird headquarters were transmitted, using daylight for illumination and a large mirror-drum to reflect the light on to a photo-cell behind a small aperture. This was very successful within the limits of 30-line detail.

In the meantime a special portable mirror-drum projector was being constructed. It was installed on completion in the B.B.C. Studio No. 10 down by Waterloo Bridge, and on August 19 a programme was broadcast from there instead of from Long Acre. The facilities were by no means so complete as at the Long Acre studio, but the Baird Company was pleased to have the opportunity of televising from the B.B.C. premises.

After several months, during which a weekly transmission took place from No. 10 Studio, the apparatus was moved to Savoy Hill, No. 7 Studio, and the first programme was broadcast from there in October.

Improvements were still being made in the Baird studio, however. An important step forward was the introduction of a 4-way mixer which made it possible to use four groups of photo-cells. This made for a speeding up in programme presentation, as it became possible for the

first time to change over immediately from close-up to extended shots without the delay which the moving of cells previously entailed, while special lighting effects for difficult subjects could be used.

Once again the Derby was televised—we have now come to June, 1932—and most lookers agreed that the reception was an advance on the previous year's. And then a few weeks later 30-line broadcasts from Long Acre ceased for good. It had been arranged, after long negotiation, that the B.B.C. should assume the responsibility for the television programmes, and had allocated Studio BB in the sub-basement of Broadcasting House for the purpose. Special and entirely new equipment had been provided by Baird's, two of whose engineers, Messrs. Campbell and Bridgewater, installed it and later joined the B.B.C. staff. The new studio was larger than the one at Long Acre, being 29 ft. x 18 ft., but the control room was smaller. One projector was used, a mirror-drum driven by a synchronous motor and an arc lamp, scanning from extreme close-ups less than 12 ins. wide to a full extended shot of 5 ft. wide at the back of the studio. (To be exact only about 25 ft. of the studio's total length were used, owing to the limitations of the photo-cells, the back of the studio being screened off by a very large white screen.)

There were four groups of photo-cells, as at Long Acre, a desk in the control room containing the mixing panel from which an engineer could control the cells, at the same time observing the effect on the image on a check receiver of the mirror-drum and Kerr cell type.

The first programme from the new studio took place on August 22, 1932,
(Continued on page 624.)

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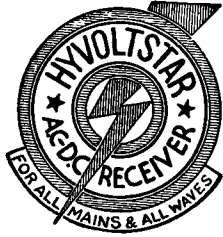
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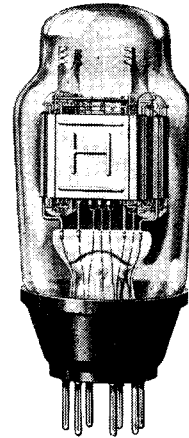


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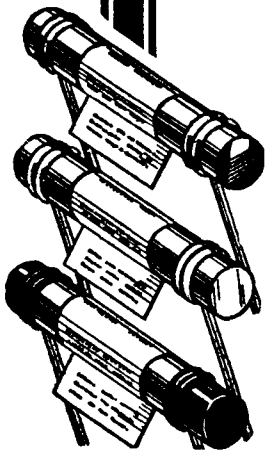
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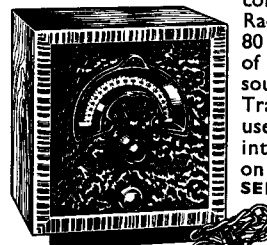
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"30-line Television in History"
(Continued from page 622.)

under the direction of Mr. Eustace Robb, who has produced the subsequent television programmes with the assistance, during most of the period, of Miss Jean Bartlett. Programmes were broadcast on four evenings a week from 11 to 11.30.

After almost exactly 18 months'

service, in February, 1934, the programmes ceased for a week while the apparatus was moved to a new studio at No. 16 Portland Place,

During the period when television was housed in Studio No. 16, some extensive improvements were made to the photo-cell equipment. Most of the small cells were replaced by large Oxford cells, and much more varied

lighting effects as well as the ability to cover a much larger area of the studio became possible. In addition more microphones were brought into use including latterly a crystal type, which is very light and portable for following artists' movements.

And so, after nearly 1,500 performances, the career of 30-line television ended on September 11 last.

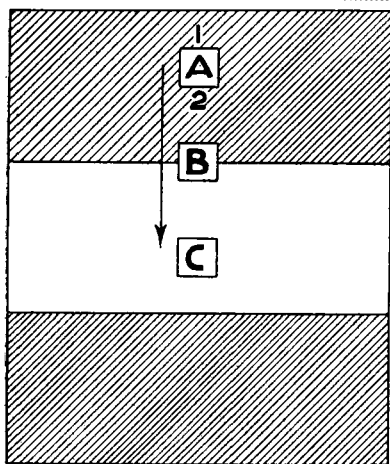


Fig. 6.—Three scanning hole positions scanning a simple white band.

"Waveform in Television Signals"
(Continued from page 591.)

form, harmonics of frequency as high as 38,000 cycles are necessary. But Fig. 7 shows that the sides of the waveform actually transmitted are not square. In fact, they approximate closely to the waveform of Fig. 4B, which contains no frequency higher than 10,000 cycles a second.

Considering everything—the type of waveform found in television signals, how this waveform is built up of simpler waveforms, and how its sharp edges are modified by the slot of the scanning disc—we can say that on the frequency of signals does not exceed 10,000 cycles a second.

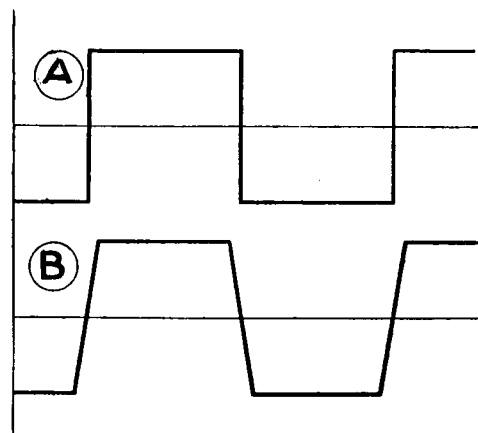


Fig. 7.—Diagram showing how the square waveform is distorted by the scanning disc.

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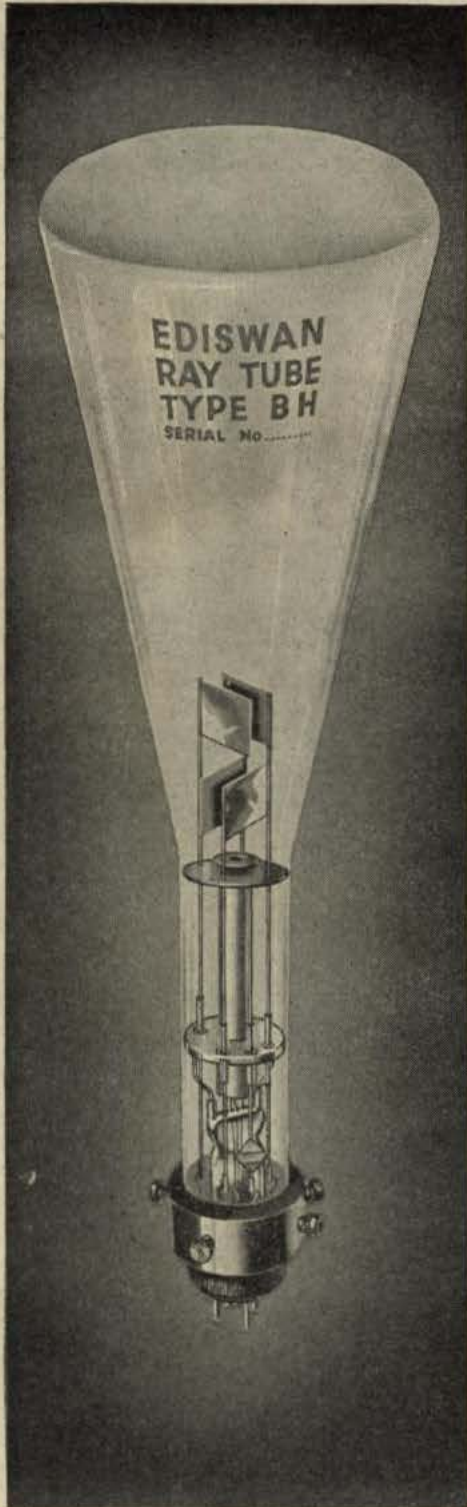


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