TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

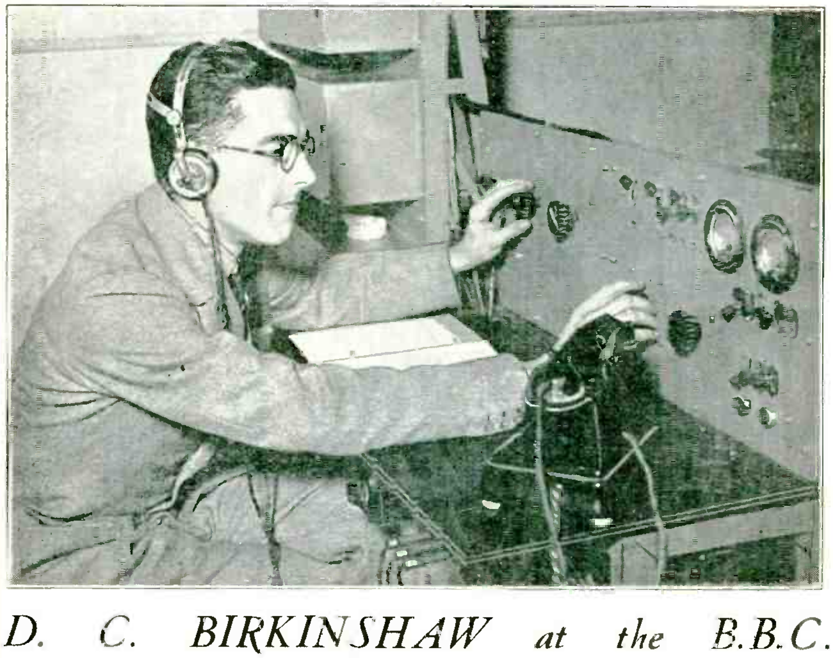
NEW SERIES
PUBLISHED BY THE PROPRIETORS OF
"AMATEUR WIRELESS"
AND
"WIRELESS MAGAZINE"

APRIL, 1934. No. 74

Remarkable Baird Development

B.B.C. Television Official and Exclusive Account

"DAILY EXPRESS" Television Kit
All Details and Working Instructions
FULLY ILLUSTRATED



D. C. BIRKINSHAW at the B.B.C. TELEVISION CONTROL (see Special Article)

MONTHLY
ONE SHILLING
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There is news in the "Television" advertisements

The Baird Grid Cell alone in its hermetically sealed bulb.

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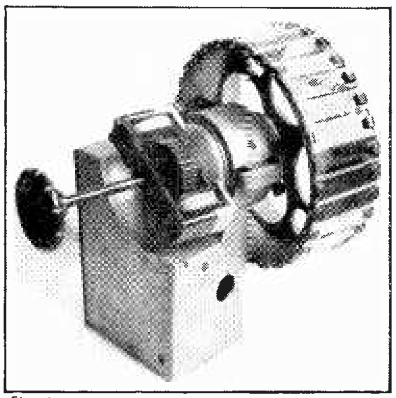
FOLLOW THE LEAD OF THE EXPERTS AND CHOOSE YOUR EQUIPMENT FROM THE PRODUCTS OF THE PIONEER TELEVISION COMPANY



Showing the Baird Precision Mirror Drum mounted with driving motor, sychronising mechanism, stand and lamp housing.

Using individually tested Baird projector components it is a simple matter for everyone to build up complete apparatus for the purpose of showing received television images on a screen. Every drawback associated with home-made or imperfect light modulating devices is swept away by using the latest Grid Cell Unit which, complete, comprises a special holder housing two light polarising prisms, a *hermetically sealed* cell, condenser lens and projector lamp.

To obtain the maximum advantage with this unit, it must be used in conjunction with components of proved merit as listed in the complete Baird Projector Kit. In use a light source of constant brilliancy is modulated by the incoming television signals passed to the Grid Cell and the resultant varying light-beam passes through an optical system to a revolving mirror drum from which it is reflected to a screen to build up a bright black and white image.

It must be emphasised that no guarantee of performance can be given with the Baird Projector Kit unless every specified part is used. Substitutes definitely give inferior results, and this applies particularly to the mirror drum.

Send for fully illustrated brochure dealing with the assembly and working of our projector Kit.

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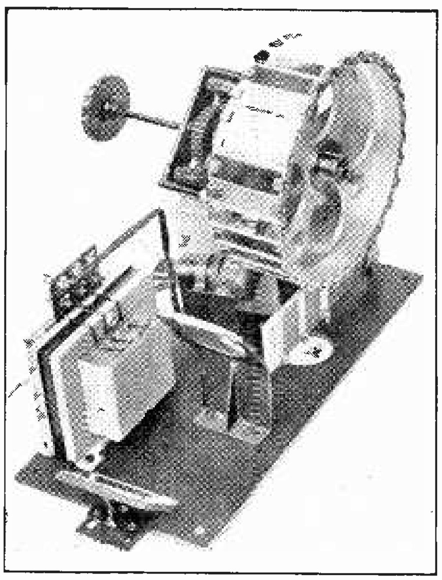

The complete Baird Projector Kit assembled ready for use.

Projector Kit Prices

	£	s.	d.
Motor and synchronising gear, with stand and lamp housing	6	0	0
or			
Motor and synchronising gear only	5	0	0
Mirror Drum with flexible coupling	5	10	0
Grid Cell unit complete with projector lamp	5	0	0
Drilled Baseplate with Swivel Mirror and lens mount ...	1	0	0
Lens		4	0
Lamp Transformer	1	5	0
Variable Resistance		17	6
Fixed Resistance		7	6

Baird Grid Cell-Unit Prices

		£	s.	d.
Grid Cell alone ...	each	2	0	0
Square ended polarising prisms—				
6 mm. aperture ...	,,		17	6
7 mm. aperture ...	,,	1	2	6
8 mm. aperture ...	,,	1	7	6
Projector Lamp (12 volt, 100 watt)	each		12	0
Grid Cell unit complete with prisms, lens, mount and 100 watt projector lamp	each	5	0	0

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Telegrams : "TELEVISOR, SOWEST, LONDON."

No. 74 VOL. VII APRIL, 1934.

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THE FIRST TELEVISION JOURNAL IN THE WORLD

In This Issue

TELEVISION

Proprietors :
BERNARD JONES PUBLICATIONS, LTD

Editor-in-Chief :
BERNARD E. JONES.

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Editorial, Advertising and Publishing Offices :
58-61, Fetter Lane, London, E.C.4.
Telephone : Central 4341 (four lines).
Telegrams: Beejapee, Fleet, 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," 58-61, Fetter Lane, London, E.C.4.

COMMENT OF THE MONTH

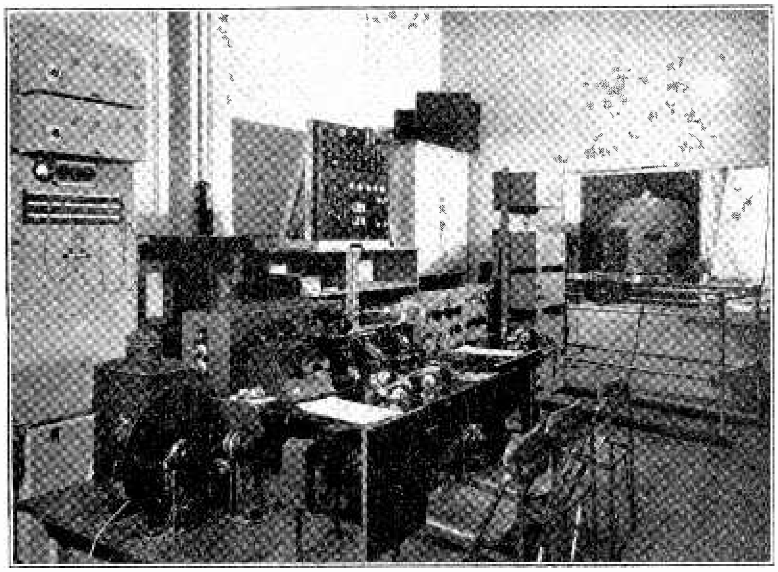
The Thirty-line Transmissions.

As we go to press with this issue we learn that the B.B.C. has officially confirmed its decision to curtail the television transmissions to two a week. After March 31st transmission by the Baird 30-line system will be radiated on Tuesdays at 11 p.m. and on Fridays at 11 a.m.

This is a most unfortunate decision and it indicates how little those responsible for it are aware of the true facts of the situation and what little notice has been taken of the opinions of those who are engaged in the development of television either experimentally or commercially. There has been much just criticism of the lateness of the hour of the transmissions, so presumably as a reply to this one transmission is to be given in the morning, the apparent reason being that this will enable dealers to demonstrate the apparatus which is now steadily becoming available to the public. But could any decision be more futile ? Can customers be found who will buy comparatively expensive apparatus which they will only be able to use, if the present arrangements are maintained, once a week for thirty minutes and at an hour approaching midnight ? And then again, assuming that there are a number of people who are able to take advantage of the morning transmissions (and they must be a very small minority of those interested in television), are they going to the trouble of darkening their rooms and causing a great deal of inconvenience at this time of the day ?

The fact that the Baird Company has demonstrated that high-definition television is now possible does not alter the situation at all, for it is obvious that for some time to come apparatus of the kind required can only come into the possession of a comparatively small section of the public, both on account of the cost of the apparatus and the limited service range.

Public interest in television has increased very considerably of late and the B.B.C., holding a monopoly as it does, has a very definite responsibility to a steadily growing section of the public. There is another factor of which the B.B.C. has taken no cognisance. No pronouncement has been made of the possible duration of the 30-line transmissions and naturally people fear that there is the possibility of being saddled with apparatus which may become useless. If the B.B.C. wishes to help the development of television in this country its first step should be to make a definite statement that the present transmissions will be continued for a reasonable period, and this latest decision regarding the times of transmission should be reconsidered.



The control room contains the scanner, check receivers, control and mixing panels, amplifiers and a small transmitter all of which can be clearly seen in this photograph.

THE B.B.C's NEW TELEVISION STUDIO

FROM the commencement of the transmissions of television by the B.B.C. from Broadcasting House, a certain amount of difficulty has always been experienced owing to the fact that the studio was never wholly designed for television. In addition, owing to the expansion of broadcasting, the maximum amount of studio accommodation became essential in Broadcasting House and it was felt that it would be desirable to construct a new studio especially for television, and to take the old television studio once more into service for sound broadcasting for which it was originally designed. The new studio has been constructed in No. 16, Portland Place.

The Studio

The studio is 26 ft. long by 28 ft. wide, the length is thus slightly shorter than studio BB which formerly housed television, and which was 27 ft. 6 in. long, but a considerable increase in width has been secured, a feature which was greatly desired by the producer, as it would give much greater freedom of action to dancers, trick cyclists and other artists, and would also be of help in revues and other more ambitious productions. The increase of width is about 10 ft. The studio is situated on the first floor and the back screen, against which the beam is projected, is just behind the windows which open on to Portland Place.

It was, of course, necessary to treat the studio acoustically in order that good reproduction of the sound side of the programmes could be secured, and the walls which themselves formed a good solid background were covered with large slabs of building board, the edges being bevelled and presenting a very pleasing appearance very similar to that of dressed stone.

At the rear end, large building board doors were arranged which open inwards and allow the original windows to be opened, permitting natural ventilation to be used. These doors are completely flush with the rest of the rear wall when closed, and the whole wall has been covered with white sheets, which permit of the ventilating doors being opened, but nevertheless present an unbroken white surface to the televisor; thus the back wall itself can be used as a screen. Formerly, in studio BB a large white screen of painted building board formed the main background, and had, for reasons of support, to project 4 ft. 6 in. into the studio, a loss of length which is now avoided; the new studio is therefore effectively 3 ft. longer.

The producer has made increasing use of detachable pieces of back-cloth, painted to represent various scenes, and in order that the presence of these shall not prevent instant availability of a plain white background, a large roller curtain is being installed, especially designed to present a smooth uncreased surface, and which may be lowered in front of the back wall, thus a scene may be built up on either of these white surfaces, leaving the other available for producing a quick change of scene, or alternatively, a plain background.

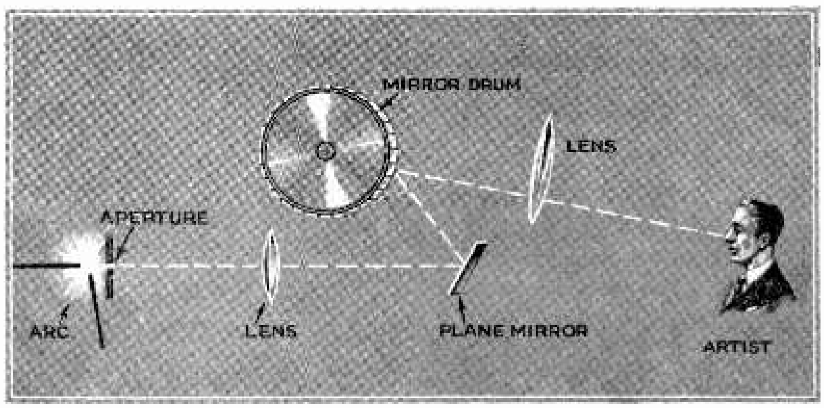
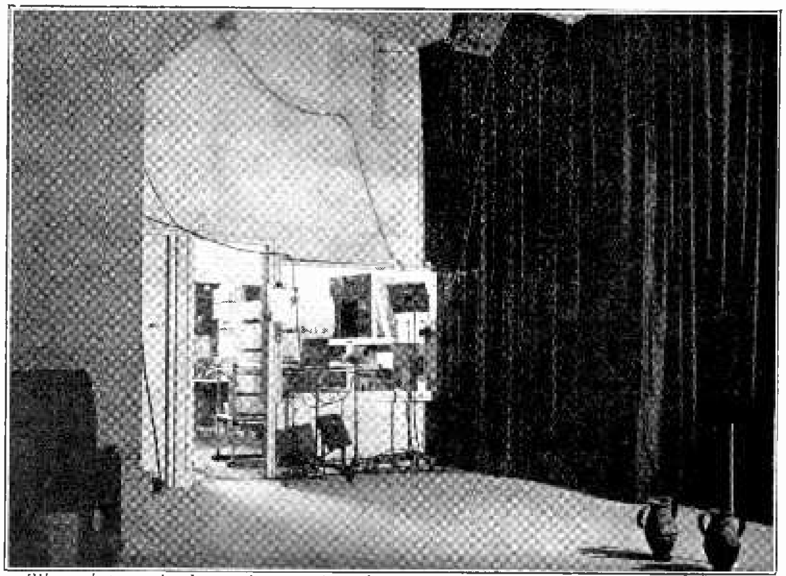


Fig. 1. This sketch shows the light and optical arrangements of the scanner.

AN OFFICIAL AND EXCLUSIVE DESCRIPTION

By
D. C. Birkinshaw,
B.B.C. Engineering Research



This photograph shows the actual studio. Ample space is now available; the window through which the scanning is done can be seen on the left.

The Projector and Scanning

The beam is projected into the studio through a much larger window than formerly; this is 6 ft. wide by 5 ft. high, thus allowing for a more extensive movement of the projector, and allowing the producer and controlling engineers a much better view of what is happening in the studio.

The projector is an interesting piece of apparatus, and it may be of interest to describe it in some detail. What is desired is that an accurately defined square spot of light of as great an intensity as possible shall be thrown upon the screen, moved from the bottom to the top of the picture, extinguished, and followed after a slight interval by a second spot displaced to the left-hand side by exactly the width of the spot, and moving in the same manner, the process being continued until 30 such spot traverses have been made, whereupon the whole

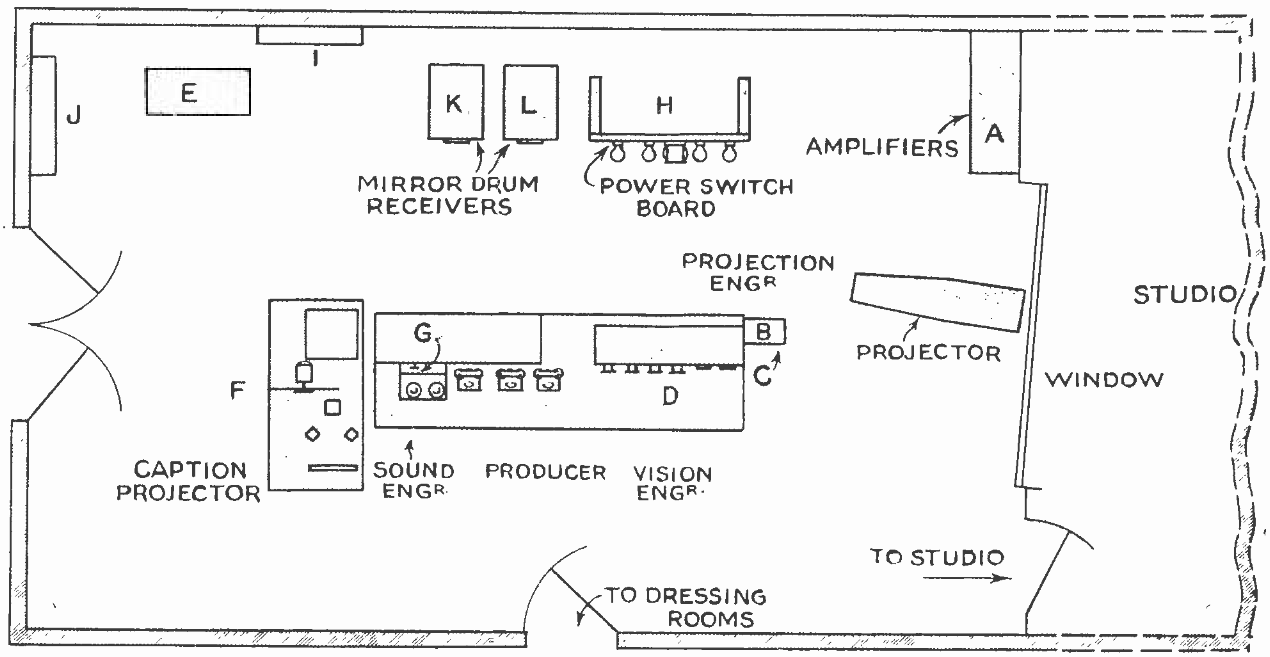


Fig. 2. A plan of the control room from which the positions of the various units can be clearly seen. Reference to the photograph on the opposite page and the text will enable all these to be identified.

cycle must be repeated uniformly 12.5 times per second.

This is achieved as follows. The source of light is the positive crater of an arc consuming 12 amperes; at half an inch distance from the crater is placed a vertical metal plate containing a square aperture one-eighth of an inch side. It is the illuminated aperture and not the arc which is, for the purposes of television, the light source. Light from the aperture is incident upon a convex lens of 5 inches

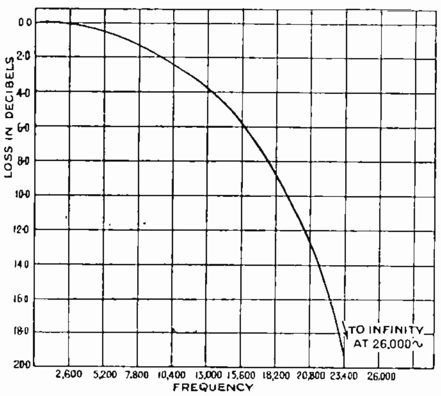


Fig. 3. This diagram shows a typical frequency characteristic for an aperture.

in diameter and 22 inches focal length, corrected for spherical and chromatic aberration, and the light passes through this on to a plane mirror. This mirror reflects the light backwards and upwards on to a mirror drum from which it is reflected forwards on to the screen. The drum has 30 mirrors of which only one is parallel to the axis of the drum, the others making progressively larger angles with the axis in either direction. The angle of deviation between any two mirrors is 10 minutes, the total deviation between the first and last mirrors is therefore 30 times this, or 5 degrees.

The 30 mirrors are of course spaced radially round the drum at equal angles of 12 degrees. It is interesting to note that at this stage there occurs a loss of 50 per cent. of the available light, as owing to the movement of the mirrors, it is necessary for the incident cone of light from the plane mirror to cover the width of two mirrors at once, and as only the light from one mirror is used at any one instant, the loss is evident.

Fig. 1 shows the arrangement of the projector and is self-explanatory. The vertical traverse of the emergent beam is restricted by a mask so that a small interval occurs between the finish of one beam and the commencement of the next, in order to generate the synchronising impulses. The drum is driven by a squirrel-cage synchronous single-phase motor designed to run at 900 r.p.m. when supplied with current at 60 cycles. When supplied therefore with current at 50 cycles, it runs at 750 r.p.m., which gives the desired picture repetition frequency of 12.5.

To cover sideways movements of the artist, the projector is swung about a central pivot, and to cover vertical movements, the mask is rotated in the vertical plane about a pivot at its rear. The light spot will only normally be in focus at one particular distance from the projector, and in order to cover forward and backward movements of the artist, the distance of the arc from the convex lens is variable by means of a handwheel, thus allowing the spot to be focused at any position from the extreme rear of the studio up to about 5 ft. from the projector. At this minimum distance, however, a head by no means fills the picture, and a very close-up view is not possible.

Focusing

If no method of focusing other than the above were available, it would mean that in order to present a very close-up view of a head, the artist would have to approach so that his head was inside the hood of the projector, a state of affairs which would, to say the least of it, be uncomfortable both for the artist and the projector engineer, in addition to which the arc would have to be withdrawn so far from the lens that the projector would be too long to be manageable. To get over this an additional convex lens of long focal length is fitted (see Fig. 1) which converges the emergent beam after reflection from the drum, thus reducing the scanned area, or virtually increasing the size of the scanned object. This lens may be swung into position by means of a bevel gear and rod operated from the outside of the projector.

In the studio, some of the light from the spot is reflected by the artist on to the photo cells. At the commencement of the transmissions, the studio was fitted with four movable banks of photo-electric cells, there being four cells to a bank. The positioning of these cells has been the subject of much experiment and co-operation between engineers and producer to secure the best results, and as a result, additional cells have been fitted in various positions in the studio. It must be remembered that the projector aperture represents the position of the eye, and the photo-cells, although they emit no light but rather receive it, represent the positions of the sources of light by which the artist appears, as televised, to be illuminated. The position of the cells, therefore, is of extreme importance and must be different for every artist or scene televised.

In the one or more rehearsals which precede every transmission, much care is spent in adjusting the cell positions, this being known as 'setting the lights.' The photo-cells used are of the gas-filled caesium-oxide-silver type, and are connected together in the studio so as to emerge as four groups, each of which is led at once to a preliminary two-stage amplifier.

An interesting point arises here. The use of transformers between cells and connecting line and between line and amplifier is absolutely impossible, as the sudden changes of reactance with frequency at certain specific frequencies which occur in all transformers, cause serious disturbances between the phase relationships of the various composite frequencies in the wave form of the photo-electric currents; this results in serious distortion which must be avoided. It is necessary, therefore, to couple the photo-cells to the amplifiers with resistance-capacity coupling, and, in particular, to keep the capacity in shunt to the cells as low as possible. This involves the use of very large

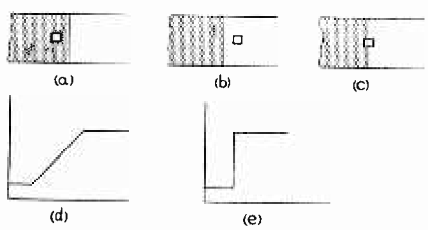


Fig. 4. Diagram showing an aperture scanning a picture in which there is a sudden change from black to white.

capacity cable between the cells and amplifiers, and also limits the maximum length of cable which can be used to 18 ft.

Frequency Band

The band of frequencies in the photo-cell output ranges from 10 to 26,000 cycles, and the preliminary amplifiers are adequate to cover this range. Apart from the question of adequate frequency response, amplifiers, including those which do not use transformers, can also introduce serious disturbance of phase relationships, and all the amplifiers used are carefully designed to guard against this.

Also the inevitable upper frequency loss in the photo-cell circuits is compensated for by the use of an especially designed retro-active circuit for augmenting the gain of the A amplifiers over the range of frequencies involved. In the diagrammatic representation of the control room in Fig. 2 the preliminary two-stage amplifiers or A amplifiers are shown at *A*. The gain of these amplifiers is 42 decibels.

The outputs of these amplifiers are taken in further low capacity cables to the control desk shown at *D* in Fig. 2. Here sits the controlling engineer who has grouped in front of him all the controls for varying the lighting of the subject and of the out-going volume and of the small transmitter. On his left sits the producer, and on the producer's left the sound controlling engineer, all of whom are thus closely in touch, can see the studio, and see the picture reproduced in front of them simultaneously on two televisors, one showing the direct picture from the amplifiers and the other showing a picture as received by radio.

The vision desk is provided with a special resistance mixer, by means of which any four sources of photo-electric cell output may be mixed in any proportion. This mixer is of very different design from the four-channel mixers used in sound broadcasting, as again the dangers of phase distortion prohibit the use of mixers of the type used for sound. It has been found that four channels are a convenient number for the engineer to handle and are adequate for the requirements of the studio. The four photo-cell outputs may be connected to this mixer in any combination which the engineer desires.

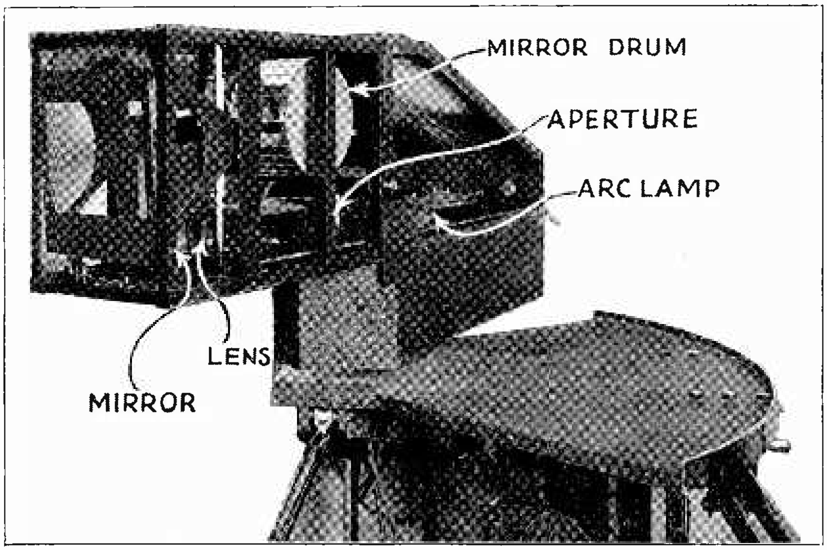
The mixer output is applied to a three-stage resistance-coupled amplifier of similar design to the A amplifiers, but whose gain is 62 decibels; this is shown at *B* in Fig. 2. These amplifiers have two outputs, each of which is connected to a constant-resistance equaliser which is known as the aperture corrector.

Aperture Distortion

For the benefit of those readers who are not familiar with the behaviour of apertures, it should be explained that a scanning aperture is essentially similar electrically to a low pass filter, or to be more accurate, to a filter which attenuates certain of the generated vision frequencies while passing others, some of which are low and some high. It is the equivalent in sound engineering of a microphone whose response to the treble or upper musical frequencies gets progressively worse as the frequency rises. A typical frequency characteristic for an aperture is shown in Fig. 3, and such a state of affairs represents distortion and must be corrected.

An aperture would only be distortionless were it infinitely small compared with the detail it is expected to scan, but no light could pass through an infinitely small aperture, which therefore must have a finite size. The problem will be made clearer if reference is made to Fig. 4 where an shown in Fig. 4 (*e*). The cell current therefore does not represent the picture.

Now the square-cornered wave of Fig. 4 (*e*) is a composite wave which consists of the summation of a number of frequencies, all of which are multiples of the lowest occurring frequency, and the gradually rising wave of Fig. 4 (*d*) is also a composite wave, but containing less of the higher multiples than the square-cornered wave. Clearly then, due to the action of the aperture, the cell current does not contain that proportion of upper frequencies which would occur in a current truly representing the picture. The object of the constant-resistance aperture corrector is to correct for this by making the gain of the amplifying chain compensate for the aperture loss.



This lettered photograph shows the principal features of the scanner, the arc lamp is arranged to move backwards and forwards for focusing purposes.

aperture is shown scanning a picture consisting of a sudden change from black to white, a condition which often exists in practice. In the position shown in Fig. 4 (*a*), the picture is reflecting no light received from the aperture because it is black, in position (*b*) it is reflecting all the received light, and in the intermediate position (*c*) it is reflecting half the received light. The photo-cell output consists therefore of a steady rise of current from minimum to maximum as shown in (*d*), but since the picture consists of a sudden change from black to white, the photo-cell current which would be truly representative, should also show a sudden rise from minimum to maximum, i.e., should be a square-cornered wave as

The equaliser operates by producing a progressive attenuation as the frequency is lowered. This loss must be made up by further amplification, and equalisers are therefore followed by further three-stage resistance-coupled amplifiers, known as the C amplifiers, shown at *C* in Fig. 2, which have a gain of 29 decibels. One of these outputs is sent to the Broadcasting House control room by line, and is there dealt with as if it were an outside broadcast, which means that it passes through one of the main control positions, and then to Brookmans Park.

As has been stated, the band of frequencies emanating from the television control room lies between 10 and 26,000 cycles, of which the important range is that lying between 10 and 13,000 cycles. Normally these upper frequencies would be seriously attenuated by the line to Brookmans Park, but special efforts have been made with this particular line which now passes all frequencies without loss up to 15,000 cycles.

Mixing and Control

The vision controlling engineer has grouped before him the mixer and all the switches for inter-connecting the various amplifiers, provision being made to ensure continuity of service by being rapidly able to switch over to spare amplifiers in the case of faults. He observes the picture on a mirror-drum receiver at *K* in Fig. 2, and a second televisor at *L* shows the picture as received by radio, so that a direct comparison can be made.

The new studio is fitted with two microphones, which was found to be necessary after experience in studio BB where the single microphone used could not adequately follow the sound from an artist who might at one moment be singing close to the projector, and at another be dancing at the other side of the studio. The microphone accordingly had to be moved while alive, which was difficult owing to the danger of introducing spurious noises. The two microphones can be mixed in any proportion by the sound engineer, and thereafter proceed to the sound A amplifier situated at *E* in Fig. 2. The output from this is also fed to Broadcasting House and treated as a second outside broadcast, and fed in the usual manner to the Midland Regional station.

The Caption Projector

At *F* in Fig. 2 is situated a second scanning apparatus, known as the caption projector, consisting of a 900-watt point-source filament lamp, light from which is distributed by a 30-hole disc driven at 750 r.p.m. by a synchronous motor over an area approximately 4 in. by 2½ in. Thus a card carrying a design may be scanned by the apparatus. Two photo-cells provide the vision current which passes to its own A amplifier at *G* in Fig. 2, and which thereafter may be mixed with the main vision signal by controls on the vision desk. It is on this projector that the now familiar "Good night" and the many other "stills" which contribute to the effective presentation of a programme are transmitted.

Power Supply

The power supply for the vision apparatus is derived from batteries of which there are two 6-volt, 120 ampere-hour banks for the low-tension, two 200-volt, 5,000 milli-ampere-hour banks for the high-tension supply to the A amplifiers, and two 300-volt, 5,000 milli-ampere-hour banks for the high-tension supply to the B and C amplifiers. Separate batteries are provided for the sound apparatus, and consist of two 8-volt, 120 ampere-hour banks for the low-tension and two 300-volt, 5,000 milli-ampere-hour banks for the high-tension. The microphone polarising current is taken from the second low-tension batteries.

The whole of the vision power supply is controlled from the power switch-board shown at *H* in Fig. 2, the sound power switch-board is at *I*, and the A.C. supply, consisting of two amperes at 240 volts for the caption projector motor, and 30 amperes at 30 volts is supplied from the caption switch-board at *J*. Signalling lights are provided between the studio and control desks to indicate cues. The desks are also fitted with head-phone points to enable the engineers to hear the programme. Telephonic communication is also available to Broadcasting House.

At the rear of the building are the artists' dressing rooms and easy access to the studio is provided by a corridor running beside the control room.

It has already been found that the new studio is facilitating the task of programme presentation, both from the producer's and engineer's points of view, and certain technical alterations carried out at the same time as the move are already showing themselves in better results. Whereas it is hoped to carry out such further improvements as are possible, it must always be remembered that the limitations imposed by the necessity of using a narrow frequency band, which in turn limits the number of lines to 30, and the number of pictures per second to 12.5 make any further extension of picture detail a difficult problem.

Reversing Negative Pictures

The amateur is often faced with the problem of how to convert his pictures from negative to positive. There are several ways of doing this, depending on the receiver used and method of coupling. If a transformer is used in either the L.F. coupling circuit or the output feed it is only necessary to reverse the connections to the primary winding. It is advisable always to have the inside secondary connection of a transformer to the earth end of the circuit.

The picture phase may also be reversed by changing the method of detection, that is, anode bend to power grid or vice versa.

A more complicated method involves the use of an extra amplifying stage. If a separate bias for the modulating device is used, the changing of the modulating device from anode to earth, to anode to H.T. + will reverse the phase. All these methods take a little time to carry out.

The use of the new Westector WX6 which is a very good detector for present B.B.C. television reception is usually mounted with the positive end to the input. It is only necessary to reverse the Westector, that is, connect the negative side to the input circuit to reverse the picture.

To enable this to be quickly carried out in the experimenter's standard receiver the Westector may be mounted on a valve base with the anode and grid pins cut off. This will enable the valve base to be pulled out and turned through 180 degrees while the set is working and the phase can thus be altered at a moment's notice.

C. P. H.

Practical Notes

If the vertical black lines reproduced on the cathode-ray screen appear grey or are absent altogether it is probable that the amplifier used is lacking in low-frequency response. Theoretically the amplifier should respond to frequencies as low as the scanning frequency of the picture, i.e., 12½ for Baird transmission, but this ideal is seldom realised in practice.

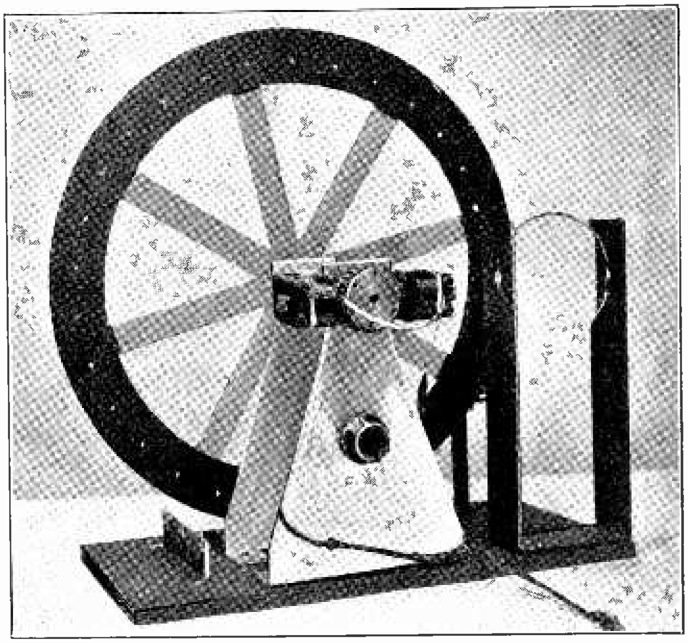
* * *

If the time bases are too tightly interlocked in the cathode-ray scanning circuit the line screen formed may have a curved top due to the vertical deflector plates being affected by the picture frequency time base. The same effect is sometimes due to the interaction between the deflector plates, and it is preferable to connect the rearmost deflector plates to the vertical scanning time base.

The Daily Express Television Kit

ALL DETAILS AND WORKING INSTRUCTIONS

By arrangement with the "Daily Express," we are able to describe this apparatus and give a considerable amount of detailed information, relating to the operation and the methods of ensuring good results. Our readers will appreciate that there are many points in the operation of even such a simple receiver as this which will need detailed explanation.



The "Daily Express" television kit assembled: synchronising gear is shown which is not included in the kit but which can be added later.

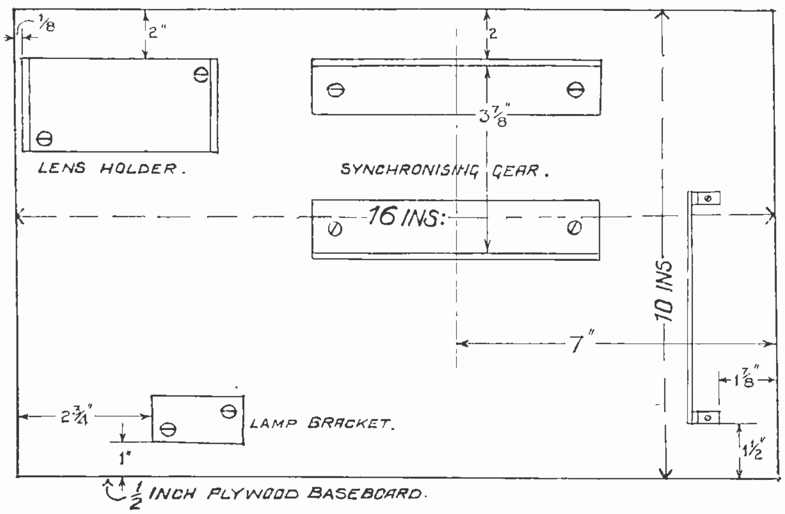
THE *Daily Express* has realised that the time has come when it is practicable to place before the public a simple television receiver, in kit form, which can be operated from the average wireless set with the certainty that it will give satisfaction. Our readers will, of course, be aware that machines of this description have been described in this journal, but we are of the opinion that the *Daily Express*, with its larger circulation, will be able to break new ground and interest a very large section of the public. This will be of great value in the development of television.

The receiver has been designed by C. P. Hall and W. J. Nobbs (two contributors to this journal) in conjunction with the *Daily Express* Wireless Correspondent. The kit is designed in such a way that by purchasing new parts it may be converted to a projector type of outfit.

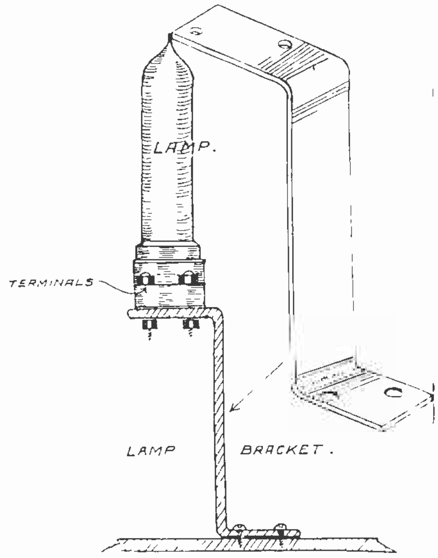
Assembly

The disc assembly consists of a main frame of two strong brackets. These support the motor, disc and motor resistance. The lamp, supported on a metal bracket, is screwed to the baseboard, behind the disc. The lens support is screwed to the baseboard, in a line with the lamp, in front of the disc. The fixed preset motor resistance is fitted to the baseboard at the opposite side to the main frame from the lens bracket. This completes the simple assembly which is indicated on a blueprint supplied. The accompanying photographs show the complete machine. Provision is made for synchronising gear which may be added later.

The spindle, on which the disc and synchronising gear are fitted, is mounted in ball bearings. The same spindle is driven by means of a rubber belt by the motor mounted below, the rubber belt having a mechanical filter action. The lens is supported in a frame of U shape, the lens being sprung into slots.



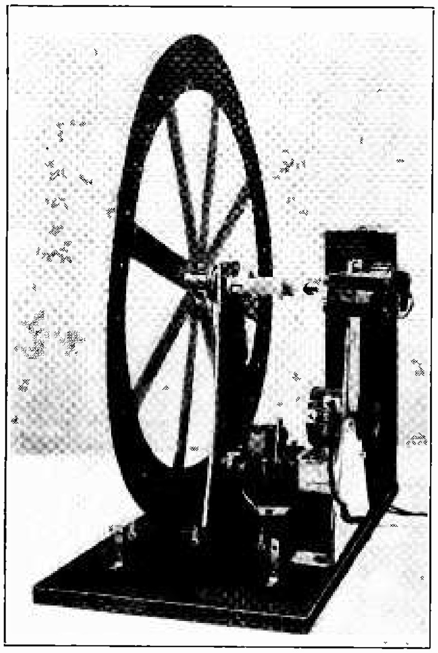
Layout of baseboard showing the exact positions of the various units.



The special Nu-Glow neon lamp on its bracket; the actual bracket is shown separately on the right.

Connections to Receiver

In some radio receivers the speaker output transformer is built inside the chassis. Unless some means of separate output from the actual anode circuit of the last valve is arranged for by the manufacturer, these connections are inaccessible. To get over the difficulty a split-anode valve adaptor is obtained from the radio dealer; one made by Messrs. Bulgin, Ltd., is suitable. This adaptor is plugged into the output valve holder and the valve replaced in the adaptor. Before purchasing an adaptor see whether the output valve has four or five pins and get an adaptor to suit. The adaptor isolates the anode pin of the output valve from the receiver. A terminal is provided on the adaptor to which one lead of the lamp and synchronising gear should be connected. The remaining lead is taken to the positive H.T. in the receiver. This positive H.T. connection will generally be found on a smoothing condenser.



An end view of the receiver : note the positions of motor and two motor resistances.

If the H.T. is of the order from 200 volts or upwards, the lamp will be found to light up when the set is switched on. If the grid or mesh plate of the lamp is dark and the reflector illuminated, the leads to the lamp should be reversed.

On tuning in to a station, if music or speech is being received, a picture of the sound frequencies should be seen through the lens if the motor be started by coupling to the mains.

Should the lamp not light when the receiver is switched on, then the voltage is probably too low for the lamp to strike. A means of getting over this difficulty is available in the form of an exciter unit supplied by the Mervyn Sound and Vision Co. This unit has a 1 : 1 ratio transformer to couple the output of the receiver to the lamp. A Westinghouse dry rectifier rectifies the current from A.C. mains, which is fed through a smoothing circuit to the lamp and synchronising coils. The input of the 1 : 1 ratio transformer is connected to the anode terminal of the split anode adaptor and to H.T. positive, as in the case of the direct coupling circuit already given.

If the receiver is fitted with a tone control, this should be turned to the position giving maximum high-note response. If the receiver is an old type, there is no reason why it should not give results if the size of condenser between the anode of the detector valve and earth be made a value not greater than .0003 mfd., and any output valve correcting circuit, such as a condenser and a resistance in the anode circuit be removed or disconnected during use as a television receiver. This alteration need not be made, of course, if the split anode adaptor is used.

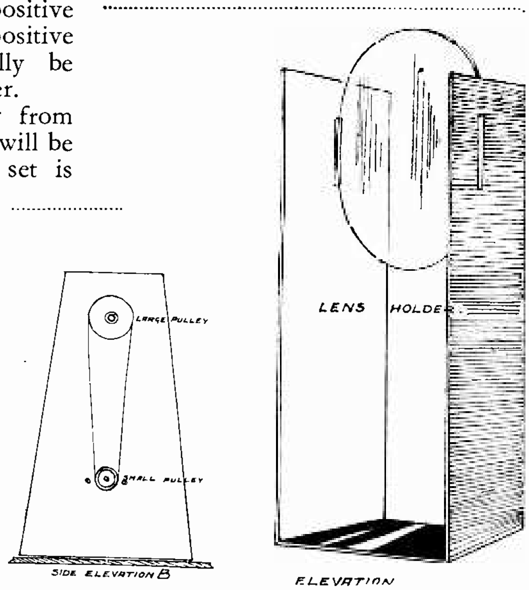
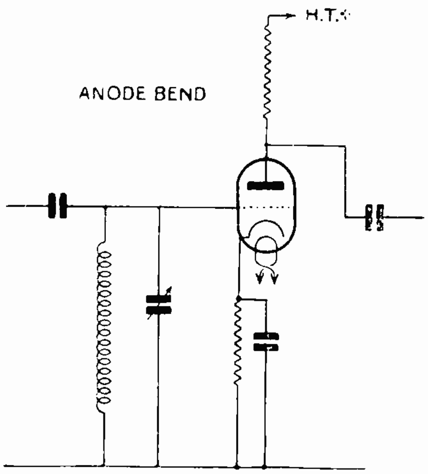


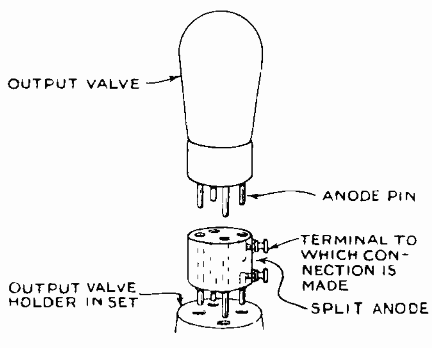
Diagram showing disc drive and method of supporting lens.

It is more than probable that when the pictures are received they will be found to be negative—that is, the black parts will be white and the light parts black. There are several methods of changing from negative to positive. If the output transformer is in use, it is only necessary to reverse the connec-

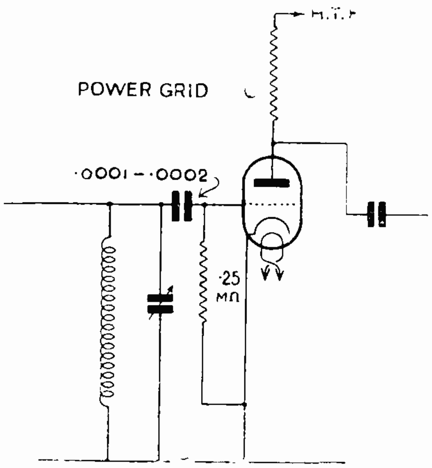
(*Continued on page* 176)



Theoretical circuit of anode-bend detection.



Drawing showing the connections of the split anode adaptor.



Theoretical circuit of power grid detection.

Getting the Best Pictures

SOME POINTS FOR THE BEGINNER

In this article J. H. Reyner deals with a number of matters of a simple nature which are apt to be overlooked by the beginner in television but which have a direct bearing on the results obtained. Chiefly they relate to the wireless reception of the television signals and it is explained how the requirements of television are more exacting than sound and how they can be attained.

ANY good quality receiver will provide reasonable reception on the 30-line transmission radiated by the B.B.C., and careful attention to detail, therefore, is not at the present moment so vital as it will be in the near future. When high-definition transmissions become the order of the day the television receiver will have to comply with some very stringent requirements.

It is worth while checking over one's own receiver even on 30-line transmission to make sure that the conditions are adequate. Sometimes it is possible for the receiver to be too good for the particular conditions obtaining! I remember being very puzzled once at a peculiar pattern which appeared as a background on the picture. It was present the whole time, whether there were any actors on the scene or not, and produced the appearance of a very fine grained check.

The Result of Interference

I spent some time looking for the cause until I discovered that the effect

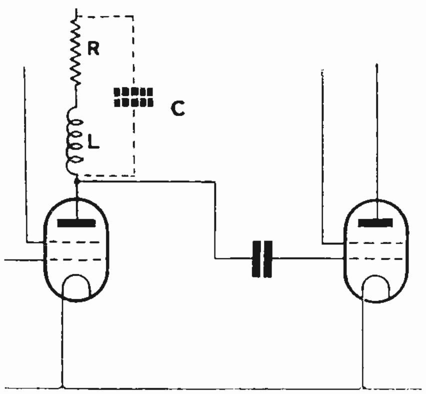


Fig. 2. *Circuit for maintaining the upper frequencies.*

was due to a high-pitched heterodyne whistle between the London transmission and a foreign station. This interference was beyond the cut-off of the loudspeaker which I was using for checking the vision signals, so that I did not detect it until I replaced the loudspeaker with a pair of telephones,

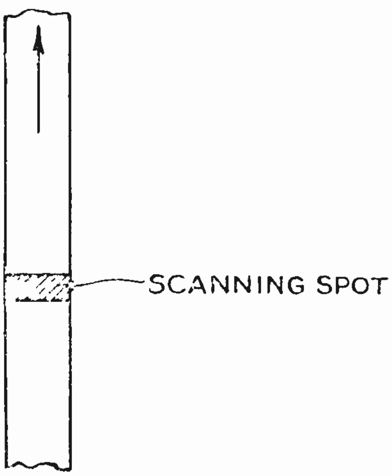


Fig. 1. *An oblong scanning spot could be used to give greater detail in a 30-line transmission.*

when the very high-pitched squeal could just be heard. The effect of the whistle was, of course, to produce a regular pattern of alternate black and white on each line of the picture, and the aggregate of these gave the faint fine check.

I got into the habit of using this phenomenon as an indication that the receiver was functioning correctly. If it became objectionable, it was an easy matter to insert a small amount of top cut, but at the same time the 30-line Baird transmissions require reproduction of frequencies up to 13,000 or 15,000 cycles if the fullest detail is to be recorded.

Let us consider this upper limit in frequency for any particular transmission. Let n be the number of lines. The smallest distinguishable detail is that of a square of side equal to the width of one of the scanning lines. If the dimension of the picture along the length of the scanning line is r times the width of the picture, then the number of complete elements of this character in any one line is nr.

If we consider the squares as alternately black and white, this will correspond to $nr/2$ complete oscillations in one line, and the frequency of this oscillation will be $\frac{pn^2r}{2}$ where p is the number of complete pictures per second.

Scanning and Detail

I am aware that this practice of considering each line as divided up into small squares has been assailed on many occasions as a method of arriving at the finest detail which can be seen. It is true that the motion of the object being televised does allow of an impression of greater detail than would be obtained from a consideration of a series of squares in this manner. It is also possible, particularly with a small number of lines, that the scanning spot may not be square, but may be flattened in shape, as indicated in Fig. 1, in which case the number of picture elements per line could be greater. The point is that we are concerned here with an estimate of the frequency required, and I have found a method just used satisfactory for ordinary purposes. If the reader has any reason to consider that greater detail is possible, he must

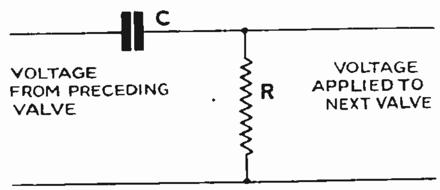


Fig. 3. *Skeleton resistance coupled network (omitting H.T. and grid bias batteries).*

modify the formula accordingly and allow for a correspondingly greater frequency.

Reverting to the formula just derived, if we apply this to a 30-line transmission having a picture ratio of 7-3, we find that the maximum frequency is 13,125 cycles per second, on a basis of $12\frac{1}{2}$ pictures per second. The receiver, therefore, must be capable of reproducing frequencies as high as this without any appreciable attenuation, for although such frequencies are not being continuously transmitted, terms of this order occur in almost every picture.

The Importance of Correct Values

13,000 to 15,000 cycles per second is comparatively easy going. When we come to high-definition images the problem is much more severe. If we have 25 pictures per second with a picture ratio of 4-3 and 100 line scanning, the frequency required becomes 333,333. This is, in fact, a radio frequency as we ordinarily regard things, and the production of an aperiodic amplifier capable of reproducing frequencies up to 300 kilocycles is no mean feat. Needless to say, a resistance-coupled system is essential, but even here the self-capacities in the circuit produce a falling-off in the amplification long before 300 kilocycles is attained. Various methods have been suggested to overcome the difficulty, one of the most suitable being that shown in Fig. 2. Here a small inductance is inserted in series with the anode resistance. This tunes with the self-capacity of the circuit (shown dotted in the figure) to produce a resonance which boosts the higher frequencies. By the proper choice of the value of inductance relative to the self-capacity the frequency response can be maintained to a very high degree.

A convenient condition is to make the inductance in henries equal to the product of the square of the anode resistance and the self-capacity in farads. Thus, for example, a circuit having an anode resistance of 10,000 ohms and a self-capacity of 20 micro-micro-farads would require an inductance of 2 millihenries. The value of 10,000 ohms quoted may seem a little low, but it is necessary to keep the resistance low, so that its impedance relative to the reactance of the self-capacity in shunt may be small.

Reduce Stray Capacities

Anything which tends to reduce the stray capacity (including valve capacity) in the circuit is of importance, so that the use of screened valves is very helpful. Screening reduces the effective grid-cathode capacity of the succeeding valve, but we are still left with the anode-capacity of the preceding valve, which is unfortunately still somewhat high. It is possible that we may see special valves developed for this purpose in which the anode-capacity is kept particularly low.

Let us now turn to the other end of the frequency spectrum. There is a good deal of confusion as regards the lowest frequency which has to be transmitted. Some workers assert that picture frequency is the lowest frequency required, so that an amplifier which will transmit 25 (or $12\frac{1}{2}$) cycles successfully is all that is required. This point of view can be upheld provided one is careful to define the word "successfully." The ordinary criterion of a resistance-coupled amplifier is that it shall amplify the lowest frequency required with only 10 per cent. loss. This condition is nothing like severe enough for television, because with a 10 per cent. loss in voltage a very considerable phase change can take place. It is necessary, in fact, to specify a transmission, according to the ordinary rules, of 99 per cent., or even more, and I find it preferable to regard the subject from an entirely different angle.

Consider the transmission of a continuous band of black. This applies a voltage across the coupling condenser which will proceed to charge up through the grid leak. Initially the charging current will be very heavy, producing practically the full value of the voltage across the grid leak, but as the condenser charges, the current through the grid leak will drop and the voltage will fall away. Obviously the condition we require is that the condenser shall have no time to charge appreciably, so that the current though the leak (and therefore the voltage across it) is substantially still at the maximum value.

This sounds almost impossible, but in practice it is not so. If the condenser is made large enough and the grid leak high enough, the time of the charge can be made an appreciable fraction of a second. In point of fact, if the product C.R. is made equal to approximately 10 t, where t is the time over which the uninterrupted black (or white) has to be transmitted, then the voltage across the resistance at the end of the period will still be 90 per cent. of the initial voltage.

With $12\frac{1}{2}$ pictures per second, and assuming that the maximum black we shall ever require is about one-third of a full line, the product C.R. would then have to be $10/37.5=0.265$. Hence a quarter of a megohm for the grid leak with a 1 mfd. coupling condenser would be satisfactory.

These values are considerably more than are usually employed, and the transmission of the blacks and whites will be materially improved if attention is paid to this end of the receiver. You should remember that this argument applies not only to the couplings between the valves, but to any choke-capacity or resistance-capacity output circuit which may be used to link the receiver to the actual producer, whether it be mirror-drum or cathode-ray tube.

GERMAN ULTRA-SHORT WAVE TRANSMISSIONS

LAST month brief particulars were given in this journal of the proposed German television service on the ultra-short waves. It is now possible to give more details regarding the actual television transmitters to be used in connection with the new ultra-short wave station. The German Post Office has ordered these from the Fernseh A.-G. This firm, by the way, recently supplied the Italian Broadcasting Company with a film television transmitter for alternative use with 60, 90, 120 and/or 180 scanning lines. For the new Berlin installation a standard film transmitter for 180 lines will be installed, together with a transmitter for direct scanning also employing the same number of lines.

Direct scanning with as many as 180 lines presents great technical difficulties, but Fernseh A.-G., it is stated, have overcome these. The apparatus will be fitted with the largest high intensity arc-lamp hitherto produced; it has a current consumption of 150 amperes, which is double the current consumption used by the arc-lamps in the projection apparatus of the largest cinema theatres.

The scanning disc is to run in a vacuum. The speed of this scanning disc at its outer periphery is 290 metres per second.

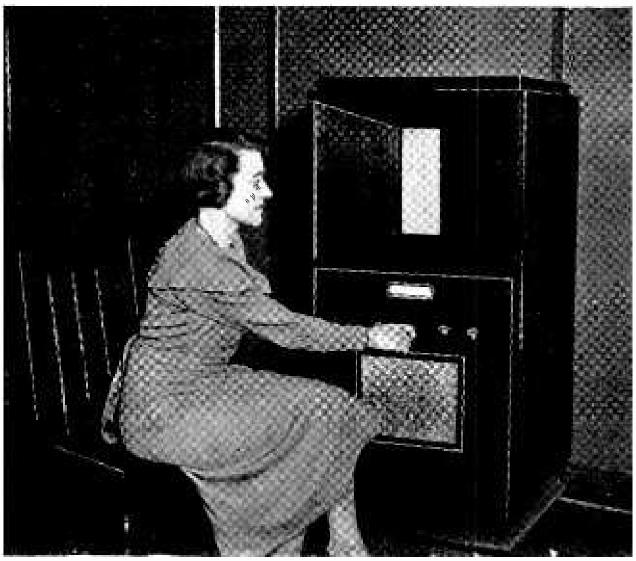
The intermediate film system which was first shown by Fernseh A.-G. at the Radio Exhibition at Berlin of 1932 and which is being developed in England also has been further perfected by Dr. Schubert of the Fernseh.

THE STIXOGRAPH AND SCOPHONY—II

Exclusive Details by the Inventor

G. W. Walton

This is the second exclusive article on the Stixograph and Scophony by the inventor, Mr. G. W. Walton. It deals with the process of obtaining a normal picture from a Stixograph and describes other types of optical systems as well as two simple types that an interested experimenter will be able to construct in order to investigate the system practically. Included also are some photographs of Scophony apparatus which are exclusive to this journal and published for the first time.



Scophony combined sound and picture receiver for the B.B.C. 30-line transmissions.

Having shown that a Stixograph of any normal scene or picture can be obtained, it is necessary to show how it can be made intelligible to the human eye by reconversion into a normal two-dimensional picture.

The Stixograph has only definition in one dimension, therefore in some way during conversion into a normal picture, definition in the other dimension must be introduced. Before this can be done, we must have some particular knowledge about the Stixograph to be converted. The reason for this is that in producing it, definition in the second dimension was dropped in a particular way, or rather according to a prearranged plan.

The Stixograph is not directly intelligible, and whilst examination of the simple one shown in the plane *E* of Fig. 6 (March issue) may disclose its characteristics, it is practically impossible to find out anything from one of high definition, such as would be produced by an echelon of 100 to 500 laminations. Particularly is this so when the Stixograph is deliberately irregular for the purpose of "coding" a picture. In fact, one Stixograph can very readily be a complete mix-up of two or three different pictures, besides having irregular characteristics in other ways. These special types will be described later, so for the present purpose of describing the reconversion, it will be assumed that the Stixograph is regular in every way.

Characteristics of the Stixograph

It must be obvious that the characteristics of a Stixograph depend entirely on the optical system used to produce it. Specifying the number of laminations in the echelon (which is equal to the number of strips into which the original picture is divided) is not very good, for several laminations may be inactive without spoiling the picture or distorting it. A better way is to give the length of a strip of the original picture dealt with by one lamination relative to the width of the strip. This immediately gives the information necessary to obtain an undistorted reproduced picture, even if some laminations at the ends of the echelon are inactive or if the echelon has not sufficient laminations to convert the whole of the Stixograph at the same time. It is also a good indication of the definition of the picture, for if the ratio is 150 to 1 we know that for the usual cinema shape of picture, the definition is about 120 strips in television parlance, whilst a ratio of 70 to 1 would be the definition of the 30-line pictures transmitted now by the B.B.C.

One other detail of information for a particular regular Stixograph is required, and that is the distance in the definition direction between the centres of two adjacent lamination images. This distance obviously is related to the amount of lateral displacement between two adjacent laminations in the echelon.

These two important points of information about a Stixograph are shown clearly in Fig. 8. In *A*, which represents a normal picture, one strip has a length *R* and a width 1, so the ratio of length to width is *R*. In *B*, which represents four sections (or lamination images) of a Stixograph having definition horizontally, the separation between two sections is *S*.

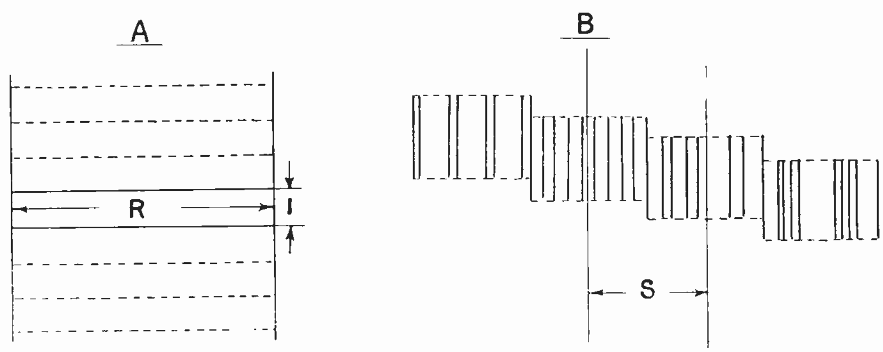


Fig. 8. *Diagrams showing the characteristics of a Stixograph in terms of the picture.*

The actual conversion of a Stixograph into a normal picture is accomplished by an optical system, having the same characteristics as are used in producing a Stixograph, i.e., the system must possess an echelon device, and if the reproduced picture is to be projected on to a screen, lenses having the resultant effect of a cylindrical lens must be used as the projector lens system. Other lenses would also be used, but these can be disregarded for the present, as also can optical stops, etc.

The optical system shown in Fig. 6 could be used for projecting a normal picture from the Stixograph in the focal plane E, for all optical systems are reversible. However, in order that the process of conversion and particular features of the conversion which are of interest shall be thoroughly understood, it will be as well to describe the conversion with reference to corresponding diagrams.

Assuming that we have a Stixograph in the form of a transparent photograph i.e., on a film or plate, and that we know its R and S values, at once we know that the displacement between adjacent laminations of the echelon used for conversion should be approximately equal to S. A source of light and a condenser lens will be required to illuminate the Stixograph. Fig. 9 shows this in side elevation and Fig. 10 in plan. The light from the source A is caused to fall on the Stixograph at C in approximately parallel rays by means of a spherical condenser lens B. This type of condenser lens is not the most efficient and a line source of light is preferable to a point source.

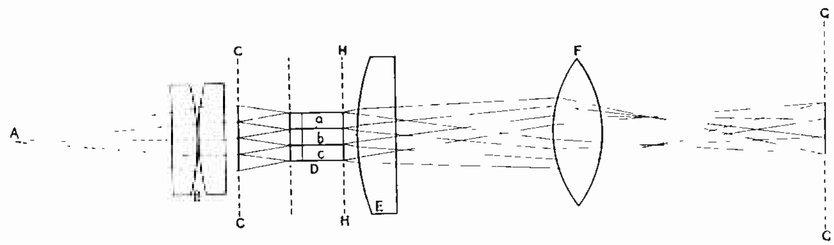
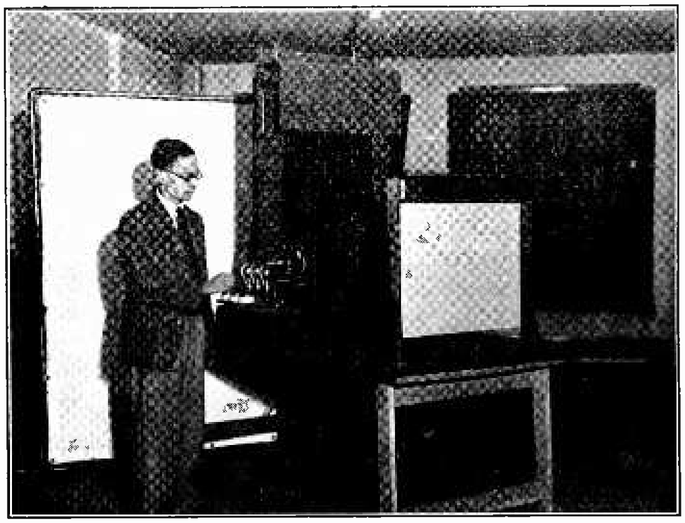


Fig. 9. Arrangement for projecting a Stixograph as a normal picture, showing the re-introduction of vertical definition.

On the screen side of the echelon D is a collimator or field lens E at its focal distance from the screen G, and between E and G is a cylindrical projector lens F, having its axis of curvature parallel to the laminations of D and its conjugate focal planes at H and G. Only three laminations, a, b and c of the echelon D are shown, but it will be understood that the description of their functions is exactly the same for every lamination, no matter how many there may be. The sections of the Stixograph in the plane C in Fig. 10 dealt with by the laminations a, b and c of D are 2, 3 and 4 respectively, and two extra sections 1 and 5 are shown also, whilst in Fig. 9 only one detail of the Stixograph is shown.



Experimental 90-line television receiver using mercury lamp and special system of transmission and reception for large screen-projected pictures. The operator is Mr. J. H. Jeffree, of the Scophony Laboratory.

In Fig. 9 the Stixograph in the plane C is illuminated by light from the source A and due to the scattering, etc., of the light, each point of the Stixograph can be regarded as a secondary source of light. Light from each point in plane C will fall on to a number of laminations of the echelon D, consequently one lamination, say b, will receive light from the whole of the detail of the Stixograph in plane C. At the same time, the adjacent laminations a and c may receive light from the same detail, but this will cause no trouble in the reproduced picture, as will be explained later in connection with Fig. 10.

At the entrant surfaces of the laminations in Fig. 9 the light may or may not fill the lamination, but in either case

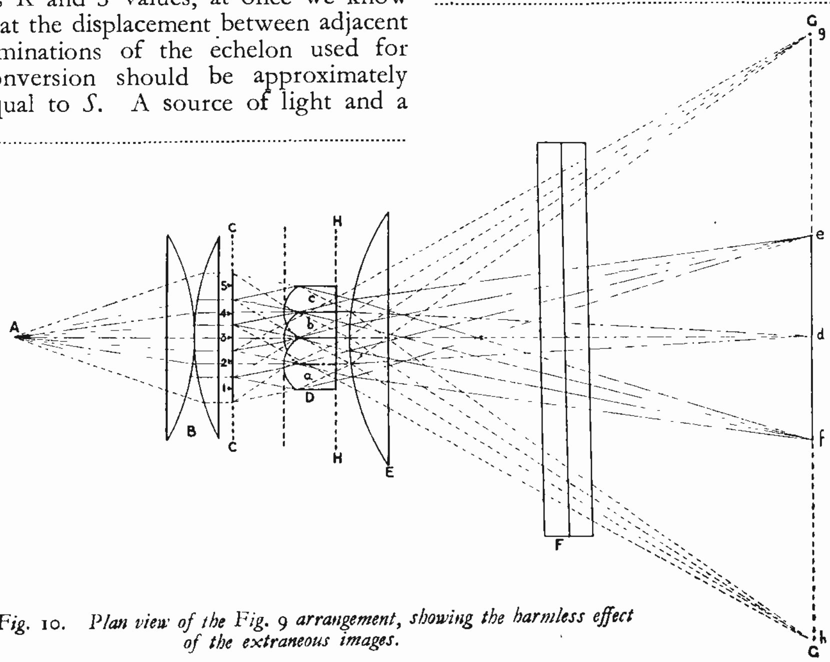


Fig. 10. Plan view of the Fig. 9 arrangement, showing the harmless effect of the extraneous images.

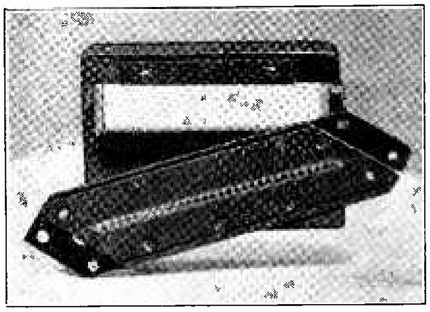
the internal reflection of the laminations as described previously in reference to Fig. 7 (March issue) will integrate the light and with a suitable length of optical path through the lamination relative to its thickness, the emergent surface of the plane *H* will be evenly illuminated.

This even illumination of lamination exit surfaces in the plane of Fig. 9 is a matter of importance, for it is quite independent of the thickness of laminations. Suppose instead of a Stixograph in the plane *C*, there is a ground glass plate evenly illuminated by *A*, then the exit surface in plane *H* of each lamination will be evenly illuminated at the same brightness, consequently an image of all the exit surfaces of *D* focussed on to a screen by a lens, will be evenly illuminated at the same brightness. Note particularly that this is independent of a Stixograph, except in so far as effects in the plane of Fig. 10 may modify it. It will be evident that the thickness of laminations need not be uniform but can be irregular to any amount, which will not seriously affect the reproduced picture. In practice a variation between plus 10 per cent. and minus 10 per cent. will not reduce the definition of the picture.

Returning to Fig. 9 the cylindrical projector lens viewing the surfaces of the echelon in the plane *H* will focus an image on the screen *G* which (as described in connection with Fig. 3) will consist of parallel strips as shown in Fig. 11. No two of these strips can possibly overlap, for no two laminations of *D* overlap in the plane of Fig. 9. Furthermore, the strips will fit close together, because the laminations fit close together and the line of demarcation between two strips if visible at all will be very thin and badly defined, if a suitable aperture of *F* is used.

The plane of Fig. 9 is the plane in which the Stixograph has no definition, but from what has just been described definition has been re-introduced by forming an image of the illuminated echelon. Obviously, the echelon is the device which removes definition in one dimension when forming a Stixograph, and also re-introduces the lost definition when reproducing a normal picture from a Stixograph.

In Fig. 10 the lamination *b* will form an enlarged image of the Stixograph section 3 on the screen *G* between *e* and *f*. As 3 normally would consist of details, the image would have similar details. Light from 3 may fall on the adjacent laminations *a* and *c* (as also described in Fig. 9) so that they will also form images of 3, but as *a* and *c* are displaced relative to *b* the images on *G* that they form will be displaced relative to the image formed by *b*.



The optical system of 30-line definition by which the first Stixograph was photographed and reconverted into a normal picture by projection.

The amount of displacement of the images depends on the size of 3 and the displacement between two adjacent laminations, but as these both are equal to *S*, a characteristic of the Stixograph, the images on *G* cannot overlap. The image of 3 formed by *a* will be between *f* and *h* and that formed by *c* will be between *e* and *g*. These images are not in one strip, for in Fig. 9 the image of *a* is below, and that of *c* above the image *b* so the three images of section 3 are in different strips, as shown in Fig. 11, and therefore do not interfere by overlap either vertically or horizontally.

Similarly, the lamination *b* may receive light from the sections 2 and 4 of the Stixograph, but due to the displacement of these sections relative to *b* the images of them on *G* will fall between *e* and *g* and *f* and *h* respectively, and they cannot overlap the image of section 3 because the sections themselves do not overlap in the plane *c*. The images of any number of sections formed by one lamination will appear in Fig. 11 in one strip without overlap.

The lamination *a* viewing its section 2 of the Stixograph will form an image on *G* which, in the absence of lens *E*, would fall part between *e* and *f* and part between *f* and *h*. The lens *E* being at its focal length from *G* brings the centre details of images of the sections of the Stixograph as formed by the corresponding laminations of *D* to the point *d*, i.e., vertically above each other in Fig. 11. Due to the effect of *E*, the image of 2 formed by *a* falls between *e* and *f*, as does also the image of 4 formed by *c* and the images of all sections of the Stixograph formed by the corresponding laminations of *D*.

The lamination *a* will form images of 1 and 3 but these will fall between *e* and *g* and *f* and *h* respectively. This is shown in Fig. 11, from which it will be seen that the correct picture falls between *e* and *f*. On the left of the correct picture may appear another picture, usually imperfect, between *e* and *g*, and even another beyond *g*. The picture between *e* and *g* is displaced one strip upwards and similarly the one between *f* and *h* is one strip down.

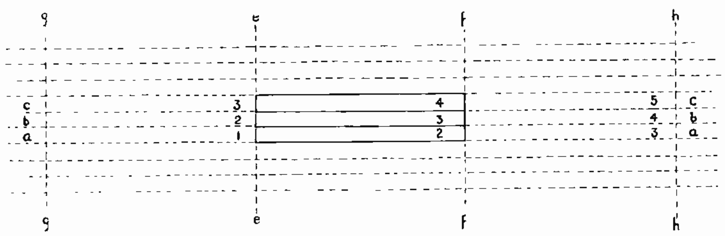


Fig. 11. *Appearance of the normal picture projected by the arrangement of Figs.* 9 *and* 10 *showing extraneous images.*

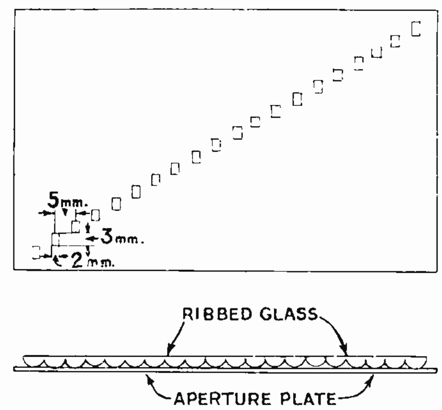


Fig. 12. *Diagram of a crude echelon using an apertured plate and ribbed glass.*

These side pictures are seldom complete for the lens F cuts off some part, for it need not be larger than the size required to form the picture between e and f, and usually a stop or vignette would be introduced between F and G to completely remove extraneous images.

The total picture formed between e and f in Fig. 11 by the optical system of Figs. 9 and 10 is a two-dimensional or normal picture, obtained from a Stixograph, which itself is a representation of some original normal picture or scene, consequently Fig. 11 is a normal picture of the original picture or scene with certain limitations of definition, which were imposed deliberately to enable the Stixograph to be made. The limitations of definition are due to dividing the picture into strips, and as any number of strips may be taken by the use of suitable echelons, the limitation can be made as small as desired and will depend entirely on the quality of reproduced picture desired.

From the R and S values of the Stixograph can be obtained the necessary characteristics of the optical system of Figs. 9 and 10. If in Fig. 9 the thickness of each lamination of D is T, and the size of the image of one lamination at G divided by T is m, and in Fig. 10 the image of one section of the Stixograph at G divided by S (the size of one section) is M, then $\frac{MS}{RT} = m$.

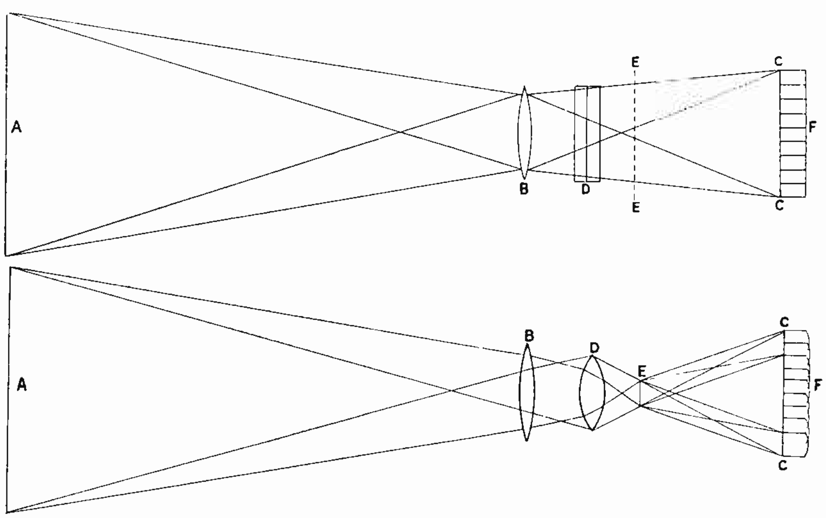


Fig. 14. Diagram showing the use of a positive spherical lens for focusing.

M can be regarded as the magnification factor in the plane of Fig. 10 and m the magnification factor in the plane of Fig. 9. From this can be derived the optical power of the echelon D, field lens E and projector lens F.

Static Conversion

From the above it is apparent that a Stixograph can be readily converted into a normal picture simultaneously for all parts of the picture, by what may be termed static conversion of optical images.

There are a very great number of different optical systems possible, together with a large number of different forms of echelon, and when anyone is familiar with the idea, I have no doubt that he could devise many more with ease, by bearing in mind the necessary features of Stixograph apparatus. These features are that a stepped device (echelon) is necessary in some form or other. The steps must be quite definite and to obtain this a laminated form is most convenient. The steps must have displacement relative to each other, which may be linear as in Fig. 5 or angular, and of course, combinations of the two may be used. The steps may be reflecting, refracting or both and can have any curvature, cylindrical or spherical, convex or concave individually, as a whole, or in groups of steps to suit particular requirements.

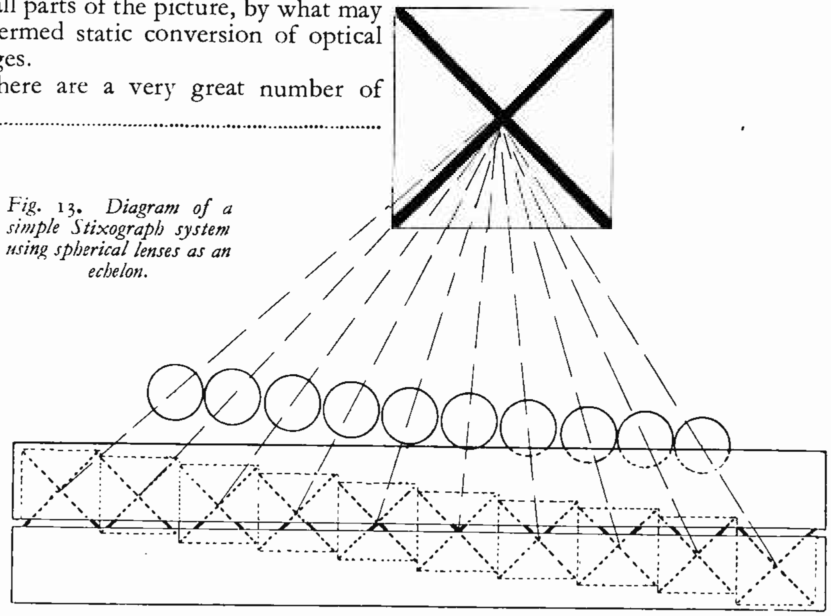
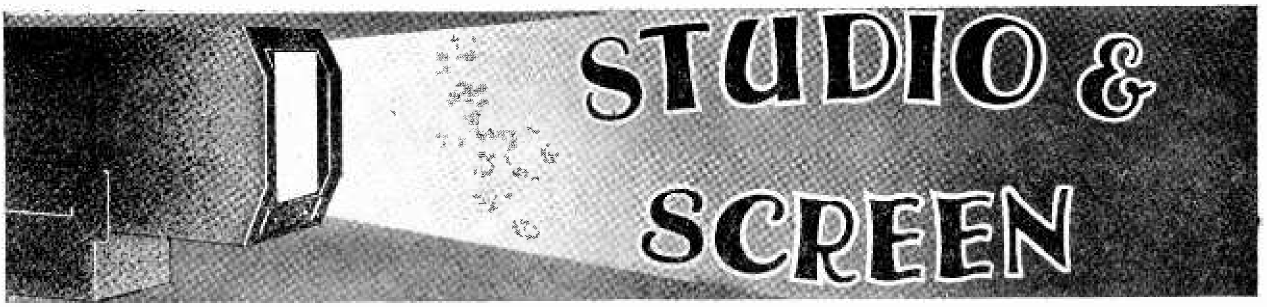


Fig. 13. Diagram of a simple Stixograph system using spherical lenses as an echelon.

Apart from the echelon itself, there is a very useful feature in splitting the focal planes, i.e., having the plane of horizontal focus completely separated from the plane of vertical focus, for by this in certain cases a considerable increase of light is possible, particularly when the echelon is put in motion, as is required sometimes in picture telegraphy and television. The last important feature is internal reflection in the laminations of the echelon for integrating purposes.

It is quite impossible to give sketches of all the possible forms of echelons and complete systems, except by taking up much more space than is available for the present article, but important types can be discussed, as well as the one or two very simple forms. These simple forms of optical systems for producing or converting Stixographs can be readily rigged up by experimenters who wish to study them. In any case, actually seeing optical images as described and studying conversions of normal pictures into Stixographs and the reverse is far more illuminating than pages of description can be.

(*Continued on page* 180)



STUDIO & SCREEN

REVIEWS OF THE PROGRAMMES AND RECEPTION REPORTS

IT would be premature to form conclusions about the performance of the new studio, but early programmes have been promising. I can already point to improvements in detail which are important and keen lookers may have discovered other ways in which production has advanced.

Dancers have gained more than other artists from the greater freedom which additional space has given to their movements. They have been able to enter the picture at a run without the risk of striking a wall and their action has been less restricted in every way. Also there is room for performers to stand at the side of the studio ready to make an entrance from the wings. The producer, too, has made good use of the additional length and, though figures have consequently been slightly smaller in the most distant shots, more artists have been seen in a picture together. It is no longer necessary to " pan " i.e., to swing the scanner from side to side in order to cover a group of three people at extreme range.

Transmission of sound is undoubtedly much improved now that it is controlled with vision by an engineer watching a speaker's movements in a visor. The musicians have plenty of room and an orchestra of ten instruments could now be seated comfortably in the " orchestra pit " at the side of the studio, screened by black silk curtains which hang from ceiling to floor.

* * *

The first few programmes showed that the studio wall was not entirely satisfactory as a background to the picture, and pending the arrival of a roller screen which was on order, the producer arranged for a large white sheet to be hung as a backcloth. Definition of outline improved at once against this lighter backscreen, but Eustace Robb is not yet entirely satisfied with the floor and I, too, miss the black-and-white check pattern of the lino in Studio BB. When this was used there was no doubt that a singer was standing on the floor!

At 16, Portland Place, the parquet has been covered by a plain light grey linoleum and the contrast between the floor and the background is not sufficiently pronounced. The producer favours a change from the rectangular design and is now thinking of some other means to overcome this snag. After all, a squared linoleum was hardly a suitable foreground to show in an exterior scene.

The roller screen will be in use when these notes appear in print and it should be a handy prop. By means of a pulley it will be raised and lowered at will like a drop scene in a theatre. The sheet will be white and scenery painted on canvas will be attached to it when needed. Sheet and scene can then be rolled up or lowered as the production demands.

As in the studio at Broadcasting House, two microphones in movable stands are used for sound. A third instrument is to be placed in the angle of the studio wall for the announcer who will thus be able to talk concealed from view. This innovation will hasten action. At present the announcer must use the artists' microphone and there is often a slight delay while he gets out of the way before the picture can be focused. A small point but one which shows the care which is taken to perfect the programmes. Larger photo-electric cells have also been ordered. Each cell will be as powerful as four of the type now used and clearer brighter images should be seen when these are fitted.

* * *

Better ventilation is a boon to all who work near the projector and a diminutive cafe has been equipped on the floor above for refreshment during a break in rehearsal. I can recommend the coffee and the room is handy for

Anton Dolin and Brigitta in the new television studio in Portland Place during the first broadcast when they gave "Pas de deux" from the Paqueritte Ballet and Ballerina.

artists who often use it between acts in costume and make-up.

* * *

Sokolova, watching her partner Harold Turner in a visor, remarked that perspective was present in a television picture but absent from a film. The great Adeline Genée herself told me that the film was unsuitable for ballet and Sokolova named the reason.

After the Egyptian programme the same evening, Robert Easton said that he sang better than ever before when broadcasting, because he had to memorise the words and act for television. He enjoyed the experience and he certainly made a fine picture.

Sokolova liked dancing in the new studio and described the conditions as normal. Her complaint about the old studio was an odd one. She had never felt entirely at ease because the squares had somehow given the impression of a pit. Sokolova, Harold Turner and pupils from her school were seen in the first complete ballet presented by television, and *Cleopatra*, with its bold and striking costumes, was a good subject for the projector. Sokolova spared no trouble to make the production a success, and after watching her pupils at rehearsal left the studio to buy brilliant white enamel which the dancers painted on their teeth for the transmission. Teeth were always emphasised in Egyptian art.

Maisie Seneshall designed the costumes from *Aida*; Susan Salaman painted the Egyptian backcloth and Sokolova was responsible for the wigs and girls' dresses on this gala evening. The music was worthy of the occasion, for we had an orchestra of six for the first time, led by Cyril Smith at the piano.

Maisie Seneshall, who is an authority on ancient dress and customs, remarked as Robert Easton fixed his beard that the process was in keeping with the age portrayed. In ancient Egypt false beards were assumed for sacerdotal purposes.

* * *

The new studio has brought additional responsibility to the fireman, who looks after Broadcasting House. At every performance he makes an appearance and I wish he could be persuaded to face the projector. The B.B.C. coat of arms adorns his cap and his uniform would make a good picture. The transfer of accommodation has also brought anxiety to Lee, faithful studio attendant, who fears that someone opening the door and catching him unaware may step right into the picture. At Broadcasting House the studio could only be approached through a vestibule.

Every month the post brings cases of freak reception. Eustace Robb has heard recently from lookers in Palermo, Peebles, Guernsey and Morocco, and it is clear from their letters that an image is obtained in distant places which is at least distinguishable and often entertaining. Other correspondents write from Edinburgh, Buxton, Newcastle, Hull, Exeter and South Shields, well outside the service area of London National, and not all complain of fading which must sometimes interfere with reception at great distances from Brookmans Park.

* * *

Several excellent light programmes followed the opening of the new studio, and the producer kept things going at a fast pace, with constant movement and a succession of short episodes. Anona Winn and the Step Sisters were in high spirits and I was impressed with Doris Hare, who was making her first appearance in the flickering shaft of light. Doris has wit and her impressions are life-like. Eustace Robb has watched her progress to stardom with special interest since he first met her four years ago at the Metropolitan in Edgware Road. He then arranged her first gramophone test and predicted a future which has been realised. Doris has played big parts for both Cochran and Charlot.

A Baird Mirror Drum in South-west London

WHEN installing new apparatus one naturally expects that some preliminary adjustments will have to be effected before pictures can be received. This was not the case with the Baird mirror-drum Televisor, however, for no sooner did the transmissions commence than a semblance of a picture appeared which by slight adjustment of the synchronising control was quickly resolved and was quite clear, the artists being easily recognisable.

As a start this seemed excellent, and that the results were not a mere chance has been amply proved since by the fact that the B.B.C. television programmes may be received consistently whenever they are on. There is naturally some variation in the quality of the pictures on different evenings, probably due to external causes, but after a very considerable period of testing on no occasion could reception be said to have been a failure.

London National cannot be considered a good station for reception in south-west London, its standard being very much below that of London Regional; but even on nights when ordinary radio reception of the National left something to be desired there was no difficulty in obtaining the pictures.

Separate aerials are used for the vision and sound receivers and as these are somewhat close together there is a certain amount of interaction which makes itself evident if too much reaction is used to tune in the sound from Midland Regional which, incidentally, is not a very good signal in this part of London.

A fairly lengthy trial of the Baird receiver makes one appreciate the sterling qualities of the Baird grid cell—no smell, no mess and above all consistent results due to the hermetically sealed bulb certainly cut out much of the trouble associated with mirror-drum apparatus.

The one difficulty in the working of this receiver that has been encountered is that of synchronisation. Sometimes it will keep steady for practically the entire duration of the programme, whereas at others, hunting takes place which requires almost constant attention. As, however, this fault is noticeable on certain evenings and is almost entirely absent on others it is felt that it may be due to transmission causes. That the type of transmission affects synchronism is evident for the picture is much more easily held steady in the case of close-ups, or where there is not much movement, than it is when there are several artists before the scanner and a fairly large amount of movement. The very sudden appearance of an artist is sometimes sufficient to upset the synchronism.

Except for this occasional hunting the picture remains very steady, swing only being at infrequent intervals and then being only very slight. It should be stated that the amplifier used in conjunction with this receiver is not built to the Baird specification and this also may account for some of the difficulty with synchronism due to insufficient input to the synchronising coils.

The First LENSED-DISC VISOR For the Amateur

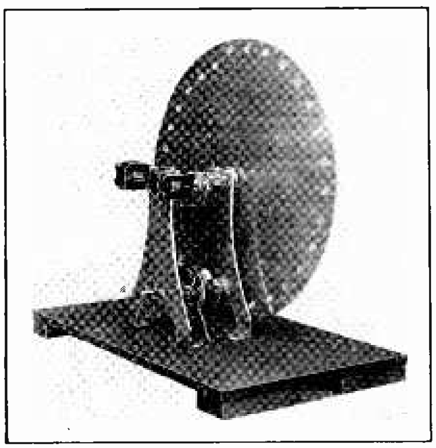
Here are brief particulars of a novel type of disc receiver which will produce a projected image.

RECEPTION of television pictures by means of the lensed-disc has received but little attention in this country, but the system is capable of giving very fine results, and it has the advantage over the ordinary method of employing a disc that the pictures are projected on to a screen instead of being viewed subjectively.

In common with most television systems, the phonic wheel arrangement used for synchronising applies to the lensed disc ; in fact, there is very much in common between this type of receiver and the ordinary disc machine. The main differences are that the disc is provided with lenses instead of holes and that a crater point lamp is used instead of the ordinary flat-plate neon.

The photographs show that the entire machine is mounted on a base-board which can be easily housed in a cabinet.

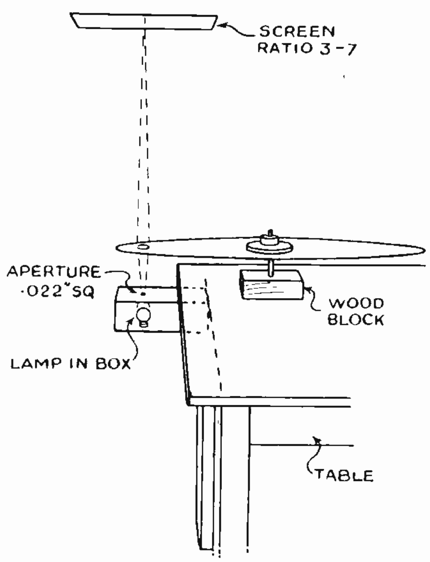
The disc is belt-driven with a step-down ratio of the pulleys, so that an ordinary small motor will be found sufficiently powerful to drive it. This is necessary if a small motor be used as, owing to the weight of the disc which must be quite stiff, more power is required than with the thinner discs generally used.



Another photograph of the receiver ; the construction is quite simple.

The parts required are few and are given below :—

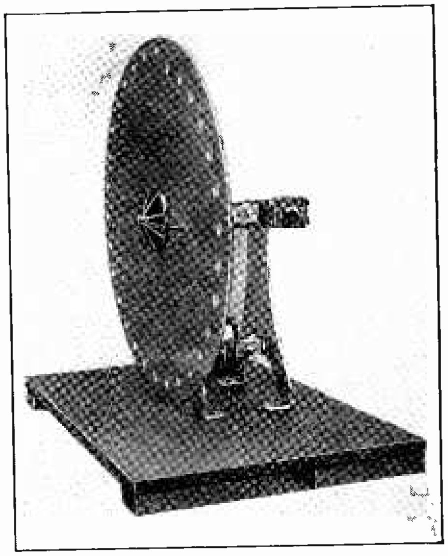
1 sheet of aluminium cut to 16 in. diameter and fitted with bush, and indexed every 12 degrees on the edge. (H. E. Sanders.)
30 special disc focus lenses. (Mervyn.)



This diagram shows how the lenses are adjusted to provide correct scanning.

1 crater lamp, .022 aperture. (Mervyn.)
1 B.M.I. motor and stand. (Mervyn.)
1 base board. (Peto Scott.)
1 variable resistance. (Mervyn.)

First we must mark out our disc, and if we keep in mind that we are going to make an ordinary disc and open out the holes to take our lenses, then it will not be too difficult. The disc can be marked out for drilling the stepped holes by placing a standard 16 in. scanning disc over the aluminium and lightly marking through the disc holes with a needle. Where necessary, or desirable, the disc can be purchased already marked and centre punched. The centre punched marks should then be drilled. Small holes are drilled first (No. 4BA drill), and then these are opened out with a pin bit to a diameter of $\frac{9}{16}$ in. ; do not, however, drill right through, but only $\frac{1}{16}$ in. deep. Now with another pin bit, $\frac{7}{16}$ in. diameter, take the hole right through. We then find that each hole has an aperture through which light can pass and a seating for the $\frac{1}{2}$ in. diameter lenses. The seating is made larger than the lenses in order that adjustment will allow us to compensate for error in marking off and drilling.



A photograph of the lensed-disc visor.

To adjust, all that is necessary is to insert a short length of $\frac{1}{4}$ in. rod in our bush and press it into a block of wood so that it is a tight fit. This block is fixed to a table as shown in the illustration. Now when we insert our lenses we adjust and set them with Durofix. As the lenses are a loose fit in the recesses, it will be found a simple matter to adjust the position of the spot on the screen, while the amount of Durofix that has been applied to the rim inside the recess will secure it in position.

The boss of the wheel contains eight spokes for speed indication in light from 50-cycle A.C. mains, and a mechanical filter is provided by allowing the disc to be free on the spindle and coupling it to the spindle by a spring or rubber band screwed to the retaining collar on the spindle. (See photograph.) An angular stop is provided by a screw head on the top driving pulley which works between the heads of the screws securing the boss of the lensed disc.

News *from* Abroad

By OUR SPECIAL CORRESPONDENTS

Germany

Cold Cathode-ray Tubes

Herr W. Schartz of Aachen, has published the results of his experiments with cathode-ray television receivers, and these experiments show that the cathode-ray oscillograph tube embodying a cold cathode, can successfully be used for television purposes, after certain modifications. In his opinion a cold cathode-ray tube is to be preferred to the more usual heated cathode-ray tube, as the light intensity is considerably increased. A drawback is the increased voltage required to operate. Although this increase can at times, be considerable, the increase in light intensity is such that it fully justifies the increased voltages.

Ultra-short Wave Transmissions

Although is it reported that very satisfactory results have been achieved by means of ultra-short waves, it is appreciated that the service areas will be limited to the big towns, due to the comparative short range of the ultra-short wave transmitter.

It has been suggested that several ultra-short wave transmitters be connected by means of ultra-short wave links, thus giving a national television service. In addition to the fact that such transmissions are very costly, another drawback has become apparent. Even on the ultra-short wave band congestion becomes noticeable. Whereas for ordinary frequencies (broadcasting), it is sufficient to have 9-kilocycle channels for complete separation of two transmitters, on the ultra-short wave band, due to high frequencies, and less selective receivers, considerable separation—5 to 10 per cent. of the carrier frequency—is thought necessary.

It has therefore been suggested to interconnect ultra-short wave transmitters by means of land lines. The German Post Office is conducting experiments to establish the suitability of such lines for interconnecting transmitters.

It is interesting to note that considerable distances have been covered by lines, and it appears that, with continued research, a definite possibility exists of interconnecting ultra-short wave transmitters by means of specially designed cables.

The Inventor of the Scanning Disc

It will be, no doubt, of general interest, to note that the inventor of the Nipkow disc, Herr Paul Nipkow, recently stated that he made this invention on Christmas Eve, 1883, and applied for the patent on January 6th, 1884. Thus, it will be seen, that the Nipkow disc is actually 50 years old. Herr Nipkow is living, at the moment, in Berlin.

The Berlin Ultra-short Wave Transmitter

The new ultra-short wave television transmitter, which is being constructed in Berlin, will have an output of 15 kilowatts. It will be possible to transmit a frequency band of 500,000 cycles, that is to say 180 lines, on 25 frames per second. The modulation system is new, and has been developed by Telefunken Laboratories.

Italy

Italian Receivers

Although a regular television service is not yet instituted in Italy, continuous television research is going on in the laboratories of the E.I.A.R., in Turin. The 48-megacycle transmitter installed there is in use for experiments on ultra-short waves. It is interesting to note that several concerns are already manufacturing receivers for television. For instance, S.A.F.A.R. have designed a very compact television receiver, more or less on conventional lines.

A Transmitter for Milan

It is expected to have an ultra-short wave television transmitter shortly erected in Milan. This will be the third ultra-short wave transmitter in Italy, two already being in operation. Experimental transmissions are going out from Rome, transmitting chiefly films, and from Turin, transmitting persons and short plays.

America

A New Glow-discharge Oscillator

Mr. B. Melchor Centeno V., E.E., claims that his new photo-electric glow-discharge oscillator is an improvement over the usual type of glow-discharge oscillator, permitting greater elasticity in the control of generated oscillating currents, and making possible many new and practical applications in the field of electronics.

Interference Problems

It is a well-known fact that ignition systems on motor cars contribute to a very great extent to the difficulties experienced with ultra-short wave reception. It is interesting to note therefore, that in America new ignition systems, new disposition of car wiring and ignition apparatus are the subject of research with a view to eliminating this trouble.

It is reported that a prominent automobile manufacturer is working with an electron tube distributor. Resistors placed in the spark plug leads have been reduced in value from early resistances of the order of 25,000 ohms, to 10,000, or thereabouts.

Switzerland

Development Work

Television is beginning to provoke interest here. In the new broadcasting headquarters now under construction, arrangements have been made for the development of television. Also several demonstrations have lately been given with 60 lines and 20 frames per second.

Phase Distortion

By Robert Desmond

What It Is—and What It Does

Of all the problems of television it is safe to say that that of phase distortion has been less commented upon in print than any other. Its bad effects are rarely mentioned, and many of the more advanced television enthusiasts do not recognise it when it appears on their television screens. It is unfortunate that after several years of radiation of television signals phase distortion is present in the signal, and that, in consequence, many of us have never seen a picture free from this defect.

PHASE distortion makes its appearance by weird "flares" over certain parts of the picture. A white object is topped with a black "flare," and vice-versa. A gentleman in evening dress often appears with dark shadows, not unlike a beard, on either side of his face. The effect of "flares" in a picture has often been referred to as bad lower frequency response, and from a practical point of view, this is true, because a falling off of the lower frequencies, except in special cases, means an increase in phase distortion. Readers who have old copies of TELEVISION handy should refer to an article on "Recognising Faults in Television Images" by D. R. Campbell in the issue for November, 1931, in which is given a description and illustration of this phase distortion or lower frequency effect.

What Phase Is

To begin with, let us first make sure what we mean by phase. In ordinary electrical engineering the terms "in phase" or "a lagging or leading phase" are well-known in A.C. work. Let us see what these terms mean. Referring to Fig. 1a we have a sine wave current, curve I; alongside this is another one, V, representing voltage in which maximum positive, zero, and maximum negative are in step with each other, or in phase. Now in Fig. 1b curve I is at maximum positive, while curve V is at zero, and so on, which means that the current leads the voltage by an angle of 90 degrees—a leading phase angle, while in Fig. 1c we have curve I at zero and curve V at positive maximum, etc., which means that the current lags the voltage by 90 degrees—a lagging phase angle. In these three cases illustrated in Fig. 1a is the result of an A.C. voltage applied to a resistance, b to a condenser, and c to an inductance. In practice b and c would never be 90 degrees as no condenser or inductance is ever entirely free from resistance. In Fig. 2a we have a condenser in series with a resistance. Two simple formulæ will tell us all we are likely to want to know about such a circuit:

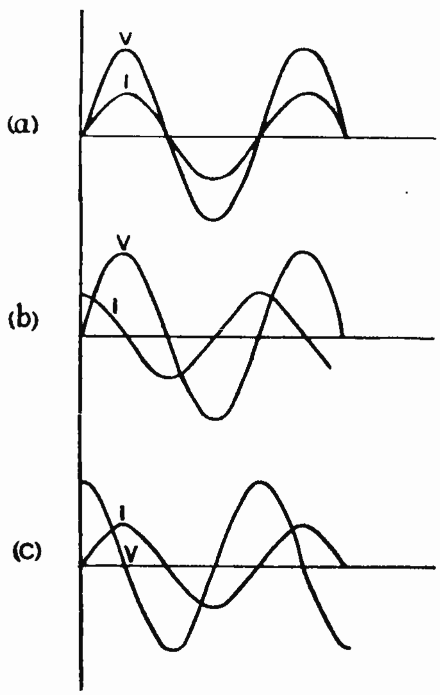


Fig. 1. Curves showing phase lead and lag.

$$I = \frac{E}{\sqrt{R^2 + (\frac{1}{WC})^2}}$$ and the phase angle

$$\text{Tan } \phi = \frac{\frac{1}{WC}}{R} = \frac{1}{WCR}$$

In Fig. 2b, an inductance in series with a resistance, the two formulæ become: $I = \frac{E}{\sqrt{R^2 + (WL)^2}}$ and the phase angle $\text{Tan } \phi = \frac{WL}{R}$ Taking two numerical examples at 100 volts at widely different frequencies for Fig. 2a:

At 25 cycles I = .0084
ϕ = 32.48 degrees
At 100,000 cycles I = .01
ϕ = nearly 1 minute

and for b:
At 25 cycles I = .094
ϕ = 17.43 degrees
At 100,000 cycles I = .00007
ϕ = 90 degrees for practical purposes.

Before leaving Fig. 2, the following should be noted: that in the case of a the voltage across R is leading that of the supply E by the phase angle, while across C it lags by 90 degrees and across C and R it is lagging by the phase angle. In the case of b the reverse is occurring, of course substituting L for C.

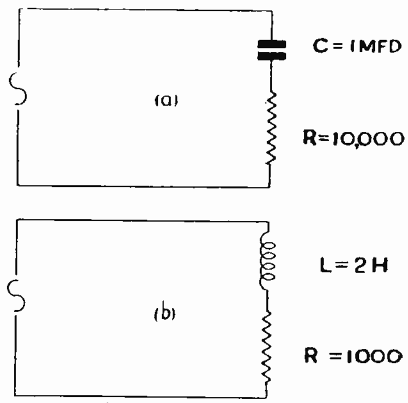


Fig. 2a. Condenser in series with resistance.
Fig. 2b. An inductance in series with a resistance.

For the moment let us leave electrical circuits and turn to the television image. For the purpose of this explanation let us only concern ourselves

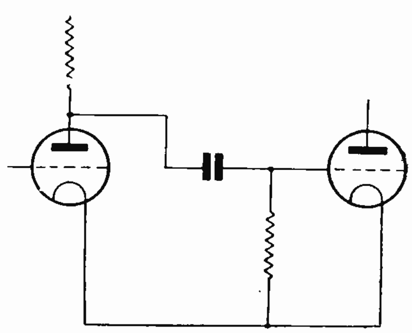


Fig. 3. Theoretical circuit of two valves of resistance coupled amplifier.

with the image being broadcast at present by the Baird process. This is a 30-line picture scanned vertically from the bottom to the top with a line traverse from right to left of a size of 3 units width to 7 units height, transmitted at a speed of 12.5 pictures per second. Of such a picture the following are three important time periods:

Time taken for scanning spot to scan 1 picture=.08 sec.; to traverse 1 line =.00266 sec.; to traverse own length =.000038 sec.

In the above paragraph and time periods the synchronising signal is included in the picture size and the times taken to complete a picture and a line traverse. The smallest period of time that the eye, the real judge of a television image, is concerned with is that of .00004 (approx.) of a second. Not that the eye would register very much in such a short period, but the effect of something happening in this period being repeated 12.5 times per second makes a definite impression. One sometimes wonders how many people looking at a television image realise, first, that they are seeing only .000476 of the whole image at an instant, and, secondly that their eyes are being excited by that area for just under .0005 of that second.

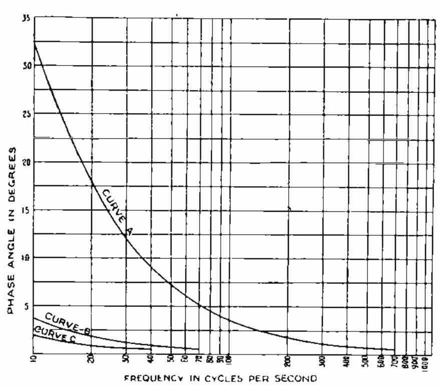


Fig. 4. Curves of phase angle plotted against frequency for different values of condenser and resistance.

From these values of time given above one realises that even for a low detail density picture a television image is very much a matter of instantaneous impression compared with that of sound; the average ear is not able to distinguish groups of sound individually separated by as little as .1 of a second. We are so accustomed to considering the flow of electricity as being instantaneous that we overlook the fact that it only appears so to our rather slow operating senses.

Obviously a signal must take a certain time to pass through an amplifier and owing to no amplifier being entirely resistive, phase distortion must take place to a greater or less degree according to the circuit; also the degree will vary for different frequencies which go to compose the signal passing through it. Fig. 3 is the theoretical circuit of two valves of a resistance coupled amplifier. The phase distortion of such a circuit may be great or small, chiefly according to the values chosen for the coupling condenser and grid resistance. Fig. 4 shows curves plotted of phase angle against frequency for different values of condenser and grid resistance. Curve a is for .1 mf. condenser in series with .25 megohm, b for 1 mf. and .25 megohm, and c 1 mf. and .5 megohm.

Curve a is definitely bad for television though a value often recommended, while c is obviously the best and could be still improved, preferably with a larger condenser. In practice the phase angle will never be quite so bad as the curves indicate owing to the effect of the anode resistance and valve impedance. It may also be mentioned that decoupling, if suitably arranged, will further reduce the phase angle. Unfortunately, phase distortion is additive for each stage of amplification, so it is imperative to keep the phase angle to absolute minimum. It will now be realised that the time period for a signal to pass through an amplifier is different for every frequency, and it is, perhaps, far better to refer to the effect of phase angles as frequency delay, as is common in telephonic line engineering.

If one stops to consider, one immediately realises that a phase angle of, say, 10 degrees, has a different time period for every frequency; the lower the frequency the greater the time. Fig. 5 is a useful graph of the time period of 10 degrees for frequencies from 10 to 100 cycles, the range of which can be readily increased by addition of zero cyphers to both ordinates. For example, the addition of two noughts to 60 gives us 6,000 cycles with the resulting time of .000014 second. Similarly, a nought may be dropped for the 1 to 10 range.

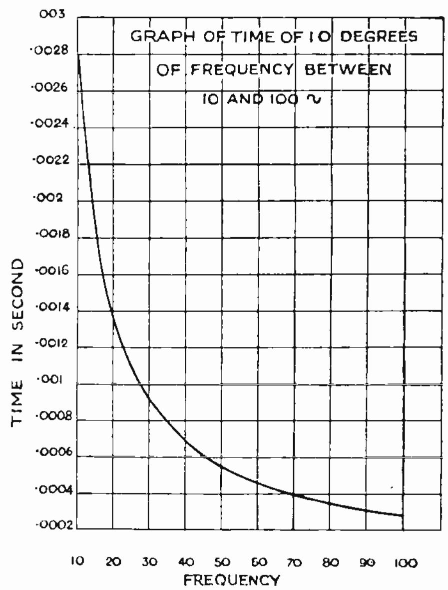


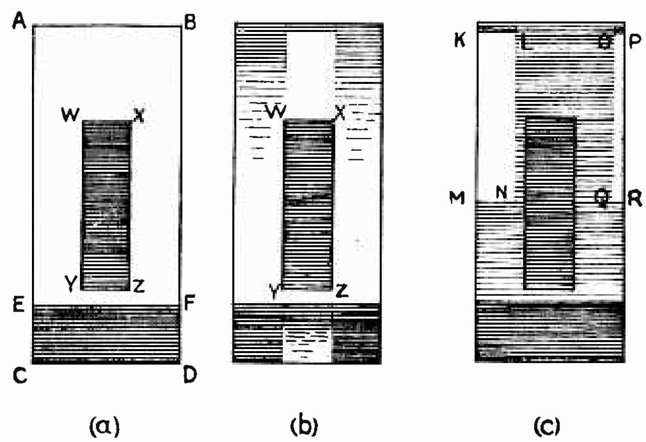
Fig. 5. Graph of the time period of 10 degrees for frequencies from 10 to 100 cycles.

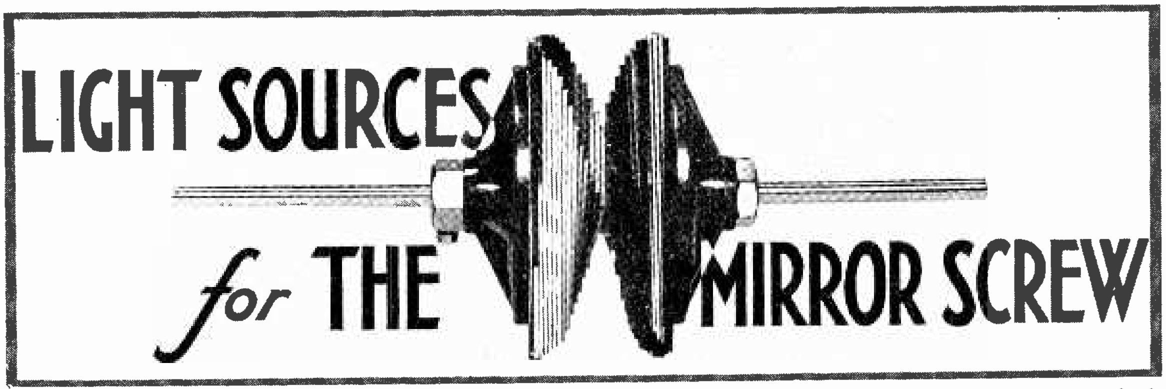
How Phase Distortion Appears

Having described what is meant by phase angle and given some idea of time periods of certain elements of a television picture, let us see how phase distortion or frequency delay makes itself apparent. In Fig. 6a the area ABCD represents the 3 by 7 television picture, the area EFCD being that part where the synchronising signal is inserted. The scene being transmitted

(Continued on page 160.)

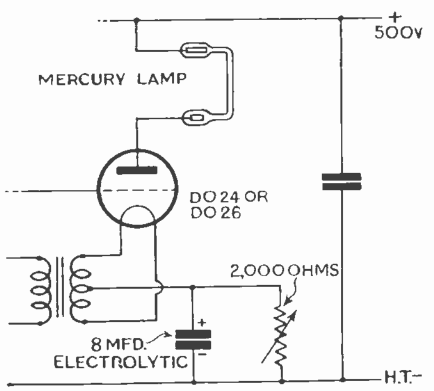
Fig. 6. Diagrams showing how phase distortion makes itself apparent on the screen; note the appearance of flares on b and c.





Successful operation of a mirror-screw receiver necessitates attention to a certain number of details which make all the difference in getting good results. Last month E. L. GARDINER explained how the screw should be driven so that correct synchronism can be easily obtained. This article details the light sources that can be used, suitable output arrangements to feed the lamp and the general layout of the optical system.

THERE are at least three special sources of light in use which provide a thin line of light suitable for the mirror screw. I refer to the sodium tube; the mercury tube; and a special form of neon or other rare gas filled tube designed to give a line of light. The sodium tube, which gives a very bright yellow light, is practically unobtainable in this country at present in a suitable form. It is not easy to make, since sodium vapour attacks glass of the usual kinds; also these tubes have in general a very low working impedance and a tendency to self oscillation which make them very difficult to modulate satisfactorily.



A series output circuit suitable for use with the mercury tube, when plenty of H.T. voltage is available.

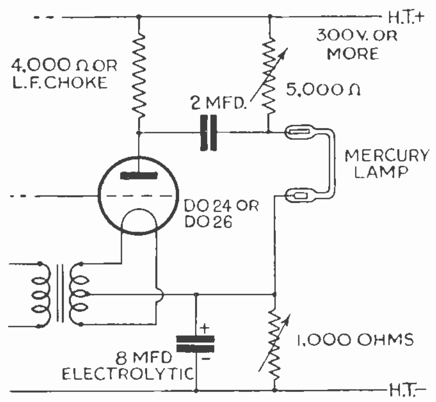
Tubes specially designed for screw work, and containing neon, or some equivalent mixture of gases giving a whiter light, are already obtainable. They have the advantages of requiring less power for their operation and having better modulation characteristics than the others under discussion, and are therefore the ideal tube for the man with a limited power output from his radio receiver, say below three watts. Incidentally, pure neon is the most widely used tube filling for work on television at more than about 60 lines, as it has a better high-frequency response than the other gases mentioned, but this fact is of no importance for 30-line working, as the response of all tubes can be made ample for this.

The Mercury Lamp

It is probable that the mercury lamp containing mercury vapour and a mixture of rare gases to assist striking and improve modulation response, is the best light source for the more advanced worker, giving excellent brilliancy which exceeds that of neon. The use of mercury lamps in television dates back to quite early days, but originally the lamps used were seldom very good in their response to modulation, and gave poor images in consequence. Those now on the market however, have been greatly improved, and can be relied upon to be first rate in this respect as far as 30-line television is concerned. They need, however, about five watts of signal power to modulate them satisfactorily, and if less is used the lighting of the tube may become irregular, and the brilliance is, of course, not the best. They are, however, very suitable for high power inputs.

The best known makes at present take the form of two small glass bulbs containing electrodes, connected together by a glass tube some 2½ in. long and 4 millimetres in diameter, in which the line of light is formed. The diameter is chosen from electrical considerations, being wider than optical conditions demand; but the use of a narrower tube results in inconveniently high impedance, which requires very high operating voltages.

The lamps described run at a current of 50 milliamperes, below which a falling off occurs, and above which their life is considerably reduced. The smaller of the two bulbs, incidentally, is the positive pole, and should always be joined to the positive high-tension side of the circuit; it is the only part of the lamp which gets seriously hot in operation, a point to bear in mind when designing a lamp mounting. Such a lamp throws off enough light to permit of reading three feet away.



In this diagram the mercury tube is shown connected in parallel, for use with low values of H.T.

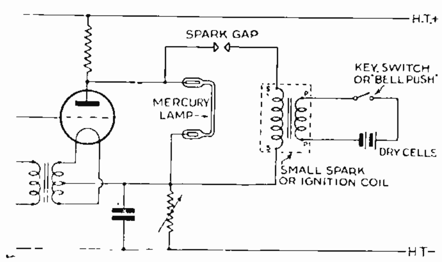
Masking

An aperture slot to narrow down the line of light should not be used at a distance from the lamp, as this causes very serious loss of light unless a cylindrical lens is first interposed to concentrate the beam. A far simpler and more effective way is to mask off with paint the glass tube itself. When operated in the "parallel circuit" in which the lamp is connected from the power-valve anode to negative high tension, a high-tension voltage of 300 can be made to suffice, although 400 is better. For the series circuit for which the lamp is well suited, it may be placed directly in the anode circuit of a valve of the 25-watt anode-dissipation class, biased to pass 50 milliamperes; in which case a high-tension voltage of from 500 to 600 volts is desirable, although again results a little below the best can be obtained from lower voltages with care.

The lamps actually drop about 200 volts across their terminals when in use, and should never be connected across a higher voltage than this without a safety resistance in series. A piece of plain mirror behind the lamp has quite an appreciable effect in increasing the efficiency.

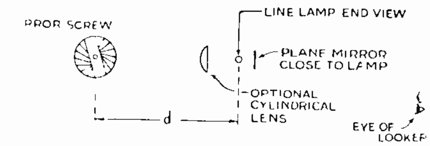
Striking the Mercury Lamp

An interesting but not serious defect of these lamps is that they are not always self-striking at any definite voltage, as is the case with neon-filled lamps. Any sudden electrical impulse will, however, usually strike them, particularly if the lamp is already slightly warm; such for example as the effect of suddenly switching on and off the high-tension, or of throwing the radio set into oscillation. Rubbing the stem of the lamp with the finger often produces an electrostatic charge which has the effect of starting up the main discharge.



An output circuit with provision for striking the tube by pressing a button.

One infallible method in stubborn cases, however, is momentarily to pass a spark through the lamp from the secondary winding of a small induction coil, such as an ignition coil. This may be incorporated in the receiver, with a "striking switch." The secondary is joined permanently across the lamp *via* a small series spark-gap.



Approximate formula for the distance d *when no cylindrical lens is used :*

$$d = \frac{\text{Height of Image}}{2 \text{ Tan } 6°} = \frac{7}{3} \times \frac{\text{Width of screw along axis}}{2 \times \text{Tan } 6°}$$

Optical layout of mirror-screw receiver for direct vision.

Before concluding this resume of points in mirror-screw working, it should be added that the line lamp is, of course, mounted at a distance from the screw, and with its glowing tube parallel to the axis of the screw. It is not vital whether the lamp be placed below or above the line of vision when viewing the image, but above seems on the whole preferable. The distance of the lamp from the screw is a vital factor, since it determines the apparent height of the image, and hence the image-ratio, which must be correct to prevent distortion.

This distance can most easily be determined by test, the lamp being moved and clamped in that position which gives to the best effect and an image of the correct 7 : 3 ratio.

This adjustment is a very simple one and the same applies to the test to determine if the image given by the screw is the right way up and in the correct sense from left to right, so that the scanning spot seems to enter the field from the bottom right-hand corner.

"Phase Distortion Simply Explained"

(*Continued from page* 158)

is the dark area WXYZ on a white background. Such an object is not unlike a full-length figure of, say, a dancer. A subject of this sort will require a band of frequencies of from 12.5 to 20,000 to give anything like proper reproduction, and, what is more, the lower frequencies will play an important part in the components of the signal from such a scene.

Many readers will have seen the result of such a scene as something like Fig. 6b. The white "flare" running up above the area WXYZ is due to phase distortion to the lower part of the frequency band which goes to make up the picture signal. As shown in Fig. 6b this "flare" penetrates into the synchronising signal. Keeping Fig. 6 in mind, we can see that the white "flare" is obviously a negative image of the black area; the fact that it is not sharply defined indicates a lack of the higher frequencies of the signal, while the fact that it is above the image proper probably means its arriving later than the positive image. (The scanning spot travels upwards.) It may, however, happen that the "flare" one sees is so much in advance that it really belongs to the following positive image.

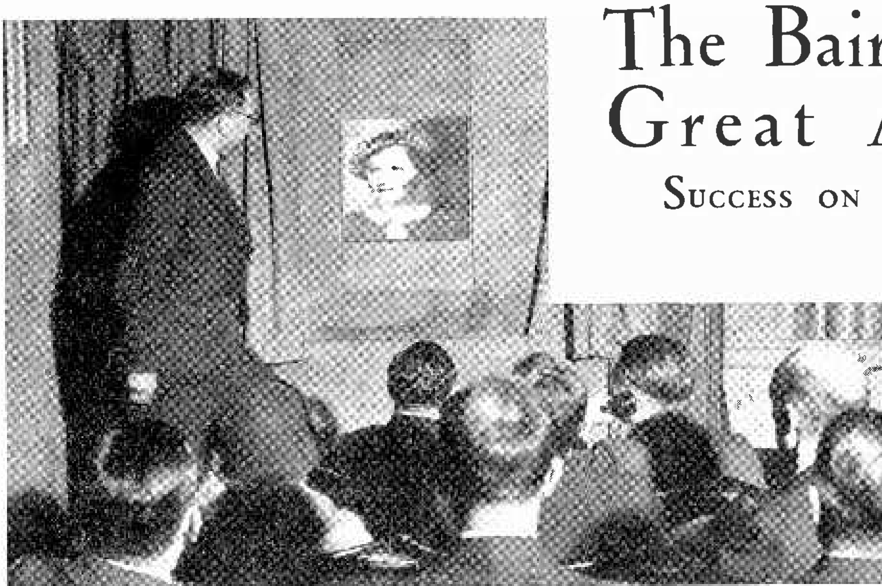
Let us assume that the white "flare" is chiefly the result of a frequency delay of 25 cycles. Obviously, the phase angle must be more than 180 degrees to produce a negative. Assuming it to be 270 degrees, which, expressed in time, is .03 second, and in picture time periods is .375 of a picture, this would give a "flare" KLMN as in Fig. 6c, the area OPQR being due to the previous picture. It is, of course, realised that a frequency lead of the same value would give nearly the same visual result. The "flare" in Fig. 6b is due to some phase delay or lead which is approximately some whole multiple of the picture time period, because if it was only about half a line period it could not be negative, as a line period is .00266 second, which, even at 12 cycles, is only equal to about 11.3 degrees, and this, of course, could not give a negative image. It must be understood in the explanation of c, Fig. 6, that, though only one frequency is mentioned, others which go to make up the signal are all arriving at different times and produce innumerable shadowy "flares" which spoils the picture.

In conclusion it should be noted that though only a 30-line television system has been discussed, phase distortion is just as serious in a high detail density picture, though perhaps not quite such a problem as the picture speed is generally of the order of twenty-five per second and therefore the lowest frequency required is an octave higher.

Cathode-ray tubes are available with screens giving a range of colours. Blue, green, red and very pale green (almost white) are available in this country, and absolutely true white tubes may be expected in the very near future.

The Baird Company's Great Achievement

SUCCESS ON ULTRA-SHORT WAVES



(Photo—Courtesy of Daily Sketch)

An actual photograph of the received picture at Wardour Street.

IMAGINE a picture of a size approximately 16 in. by 18 in. perfectly steady, and with such detail that it will bear quite close inspection without revealing more than a slight line appearance. This is the achievement of the Baird Company—*and the transmission was on the ultra short waves from the Crystal Palace*, the receiver being at Film House, Wardour Street, in the heart of London.

Those who have been closely in touch with television development have been aware that such pictures could be produced as a laboratory experiment with a short line between transmitter and receiver, but the most optimistic have doubted the immediate possibility of broadcasting these pictures and receiving them free of interference. This, however, the Baird Company have accomplished, for during a programme of about an hour's duration the only visible signs of interference were three flashes of light which passed across the screen and did not last for more than a fraction of a second.

That the system is of remarkably wide scope was amply proved by the fact that three classes of transmission were shown—living subjects which included a musician, a conjurer, a mannequin and lecturer; a transmission of a film with a large amount of detail in it, and ordinary illustrations. The reproduced pictures were of a pleasant light sepia shade of ample brilliancy.

The scheme of the new Baird system is shown in a simple manner by the accompanying diagram. It will be seen that a disc scanner is used at the transmitting end and a cathode-ray tube for reception. The actual diameter of the tube is twelve inches and the image on this is magnified by means of a lens placed in front, though in the cabinet model of the receiver which is shown on this page no lens is used, and therefore the picture is approximately twelve inches square. It will be seen that a feature of this model is the simple control, there being only two knobs.

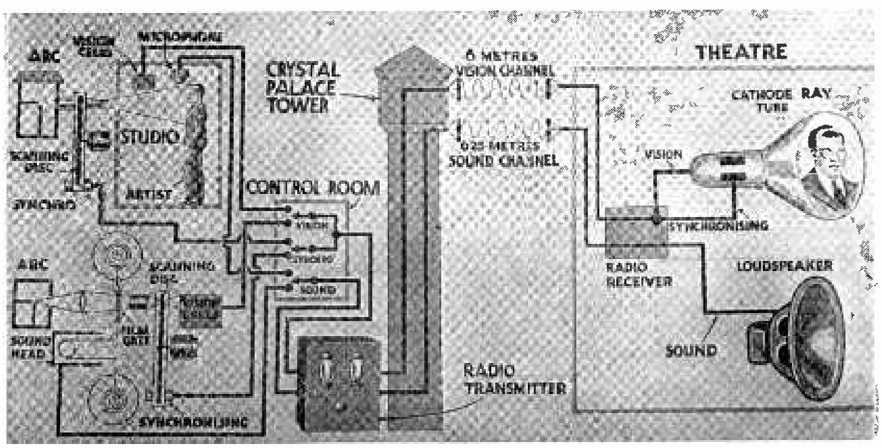
180-line scanning is employed with a picture frequency of twenty-five per second, so flicker, of course, is entirely absent and, as mentioned before, there is only a suggestion of the scanning visible, this being horizontal. Vision is transmitted on a wavelength of 6 metres and sound on 6.2 metres.

It will be appreciated that perhaps the most remarkable feature of the system is the entire elimination of interference. There in the very centre of London with thousands of motor cars, lifts, signs and other electrical devices there was hardly a trace of trouble from these sources. The service range is about thirty miles.

The cabinet model of the Baird cathode-ray receiver: Mr. Baird is at the controls and Capt. West is on the left.

Regarding this demonstration, Sir Harry Greer, the chairman of the Company, in the course of a speech which was made from the Crystal Palace and received in London said:

"It is assumed in some quarters and challenged in others that the B.B.C. is the authorised medium for television transmissions. I am not at this moment prepared to join in this issue. I can, however, most definitely tell you that your Company are in a position to transmit a programme from the Crystal Palace."

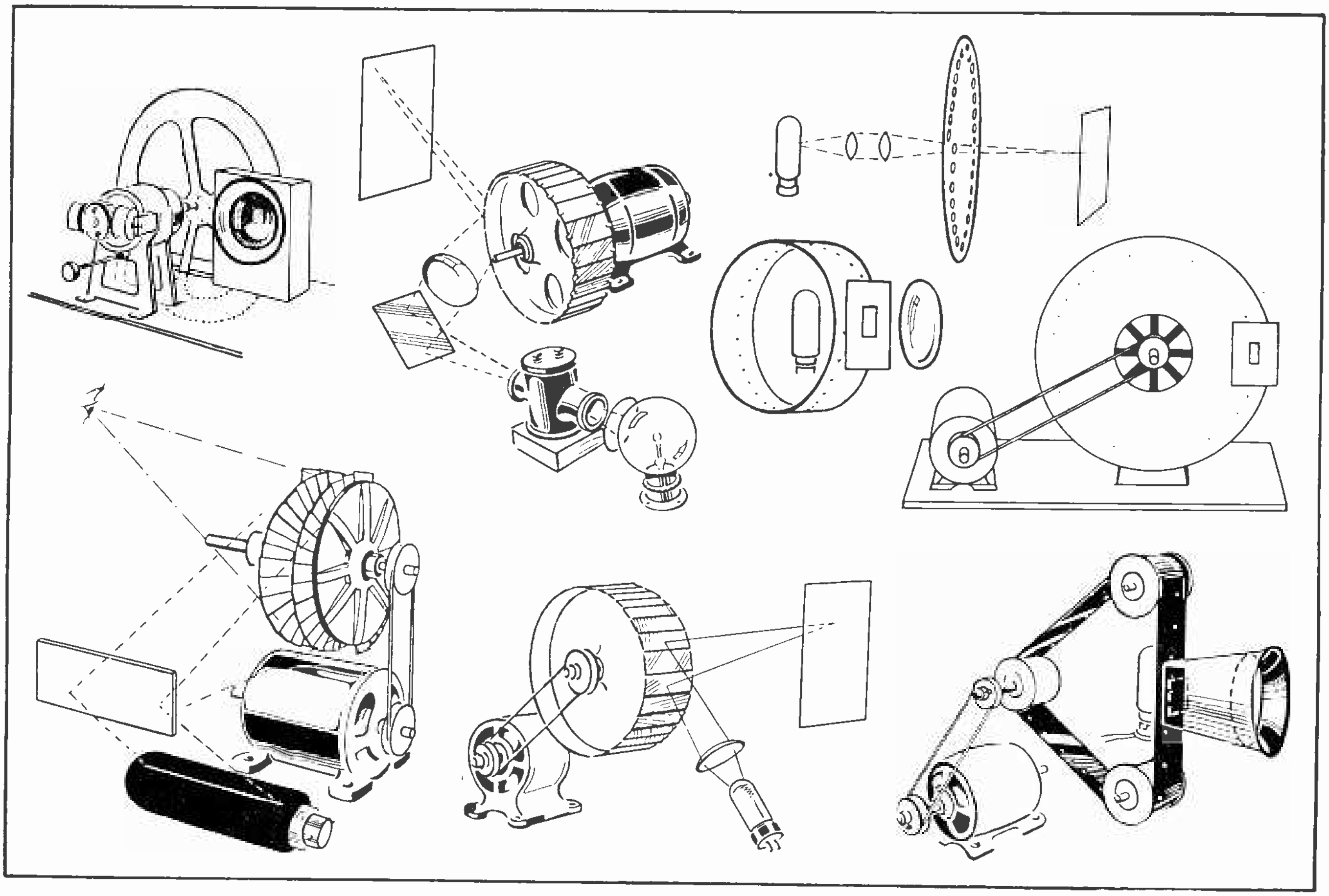


This simple schematic diagram shows the general principle of the Baird system.

Mechanical Scanning Systems

CONSIDERABLE ingenuity has been displayed in the development of the various scanning systems now employed for mechanical television; that the possibilities have been exhausted, however, should by no means be taken for granted, for the Scophony system of which first details were given in this journal shows a complete departure from the more obvious methods of scanning.

The illustrations above show various arrangements, all of which can be considered practicable and variations of a basic idea. They provide an interesting comparison and for the most part will be easily recognisable as systems which possess certain advantages peculiar to themselves. The first illustration shows the ordinary disc receiver which will be familiar to all with its disc, light tunnel, lenses and neon lamp—by far the most popular type of visor to-day on account of its simplicity. Almost equally well known is the mirror drum with an ordinary lamp as the light source and Kerr cell for modulating the light.



The Lens Disc

At the top, the lens disc is shown which allows a projected picture to be obtained with the disc and is but little more complicated than the ordinary simple disc. Below this we have what amounts to a modification of the simple disc receiver, but in this case a drum is used instead of the disc. Various modifications of this type of apparatus have been produced but have not found much favour.

At the bottom on the left is the now familiar mirror-screw scanner which was first made available to amateurs in this country by this journal. The mirror screw is an excellent instrument which is steadily increasing in favour as an intermediate step between the disc machine and the mirror drum.

The next picture to the right shows the layout of simplified mirror-drum apparatus which uses a neon crater lamp in place of the Kerr cell, a feature which allows of considerable simplification of the optical system.

It is usual in this country to drive disc machines directly, the disc being mounted upon the motor shaft. Continental practice, however, favours indirect drive and the arrangement of a machine of this type is shown on the extreme right. The advantage claimed for this method is that the speed of the disc is not so likely to be affected by small variations of motor speed, as the elastic belt and the flywheel effect of the disc counteract these to some extent.

Finally, there is the belt scanner, which, though it seems an obvious development, does not appear to have met with much success in practical use. Theoretically, it would appear to offer definite advantages over other systems but it can be appreciated that there are likely to be several practical difficulties in the mechanical construction.

PUZZLING PARADOXES IN TELEVISION

By J. C. Wilson.

IN the first place, perhaps it should be explained that the following notes are little more than excerpts from a laboratory diary and that no attempt has been made to trim them or to add that polish which materially lightens a reader's labour in following the thread ; the notes consist, however, of inquiries into such things as " What is meant by the optimum luminous efficiency of an optical system, and how is it obtained ? " ; " What frequencies really exist in television signals of certain objects ? " ; " What determines the ' noise-level ' of an amplifier, and how is it minimised ? " ; and other questions of interest.

IN this and in one or two following articles it is proposed to examine some of the many small but puzzling paradoxes and problems which have probably occurred to most people interested in television at one time or another, and to expose, if possible, a little more of the nature of each, so that those interested may have an opportunity of pursuing either the physics or the analysis of the matters into more detail at leisure.

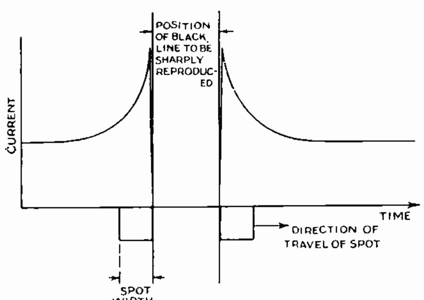


Fig. 1. Diagram illustrating the production of a transverse line.

With this apology, we will proceed to consider our first problem. There must be many who have thought about the physical aspect of the "scanning aperture effect" at a receiver, and how difficult it is to conceive why it is actually possible to reproduce fine lines on the screen, thinner than the width of the scanning spot. We remember with what surprise we first saw two stretched wires, each one-twentieth of a spot-width thick, and half a spot-width apart, resolved upon a television screen in a suitably corrected system. It is clear that the signal (for example, the current in a neon tube) must be of curious " pre-cooked " form to produce such an effect, and a popular theory of continuous rise before and fall after a thin black line, though plausible, will now be shown inadequate to meet the facts.

Investigation of Neon Form for Transverse Black Line

Let us take the original idea that the current (and therefore the neon brightness) rises according to some function of time just before the finite aperture-edge touches the position of the transverse black line, and as the edge touches (δ) falls to zero, remaining at zero or at a substantially reduced value until the whole of the aperture has passed off the position of the black line again ; (δ) then rises sharply to an abnormally high value and falls asymptotically to the steady field-brightness value.

This is illustrated by reference to Fig. 1. Now we can show that this theory is inexact by considering a point p_1, say, just off the black line. Suppose the time during which this point is transmitting light to the eye is $\delta_1 t$, then the total luminous flux reaching the eye from it is $b_1\delta_1 t$, where b_1 is the average brightness of the neon during the interval $\delta_1 t$. But for a uniform appearance of brightness in the strip $b_1\delta_1 t$ must have the same value as $b_0 T$, where b_0 is the normal field brightness of the neon and T is the time taken by an aperture to move a distance equal to its own width. Similarly for a point p_2 at a slightly greater distance from the edge of the black line, we have $\delta_2 b$ as the additional short time during which this point is transmitting rays to the eye, and if b_2 is the average brightness of the neon during the interval $\delta_2 t$, we must have $(b_1\delta_1 t + b_2\delta_2 t) = b_0 T$

That is :— $b_0 T + b_2\delta_2 t = b_0 T$

or $b_2\delta_2 t = \text{zero}$

and since $\delta_2 t$ is finite, though small :—

$b_2 = \text{zero}$

which leaves the form of the current curve indeterminate, since p_1 and p_2 are any two points whatsoever.

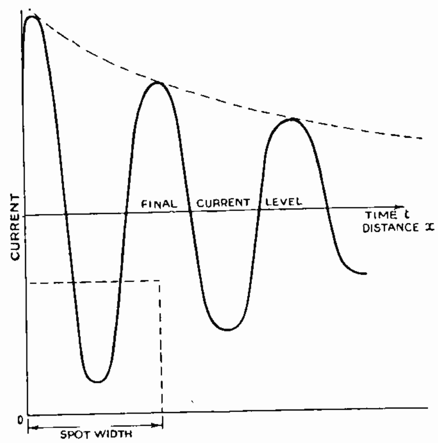


Fig. 2. Relation between amplitude of oscillation and spot travel.

It is easy to see from this that the form of curve giving an approximation to steady luminous flux to the eye from a point indefinitely close to the position of the black line must be more complex than is commonly supposed. It must have a constant value for the definite integral between the limits zero and t', where t' is any time less than or equal to T, or between any limits t'' and t''', such that (t'''—t'')=T. The function supplying an integral of this form is clearly indeterminate, but an approximation to such a function is afforded by the solution of a differential equation

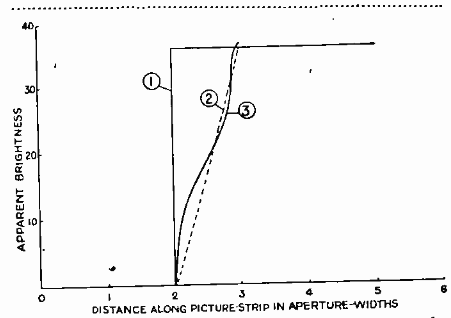


Fig. 3. Curve 1 : True shape to be reproduced ; Curve 2 : Shape reproduced without correction ; Curve 3 : Shape as corrected partially by single term transient oscillation.

of the form $\frac{d_2b}{dt_2}+m\frac{db}{dt}+c=O,$

where the roots of the subsidiary $D^2+mD+c=O$ are unreal.

This leads to a brightness function of the form :—

$$b=e^{\alpha t}(A\ Cos\ \beta t+B\ Sin\ \beta t)$$

wherein α is intrinsically negative and A and B are constants.

Since the brightness must obviously be a maximum when t=O, we may write :

$$b=Ae^{\alpha t}\ Cos\ \beta t$$

with A real, or what amounts to the same thing :

$$i=Ae^{-kt}\ Cos\ pt$$

where i is the neon current.

Now this is a damped oscillation curve, so if the cyclic variation is to be ineffective in producing changes in brightness of the resultant strip of the field, we have :—

$$p=2\pi f_2=\frac{2\pi}{T}$$

Now if L is the luminosity of any point in the strip (up to the width of the aperture away from the black line), we have :

$$L=\int_0^{t_1} b dt$$

$$=A\int_0^{t_1} e^{\alpha t}\ Cos\ \beta t\ dt$$

Putting u= Cos βt and $\frac{dv}{dt}=e^{\alpha t}$

we have :

$$\frac{du}{dt}=—\beta Sin\beta t \text{ and } v=\frac{e^{\alpha t}}{\alpha}$$

Then since $\int u\frac{dv}{dt}dt=uv—\int v\frac{du}{dt}dt$

we have :— $\int Cos\ \beta t\ e^{\alpha t}\ dt$

$$=Cos\ \beta t\ \frac{e^{\alpha t}}{\alpha}+\frac{\beta}{\alpha}\int e^{\alpha t}\ Sin\ \beta t\ dt$$

Similarly :

$$\int Sin\ \beta t\ e^{\alpha t}\ dt$$

$$=Sin\ \beta t\ \frac{e^{\alpha t}}{\alpha}—\frac{\beta}{\alpha}\int e^{\alpha t}\ Cos\beta t\ dt.$$

Multiplying one of these equations by $\frac{\alpha}{\beta}$ and subtracting :

$$\left(\frac{\beta^2}{\alpha^2}+1\right)\int Cos\ \beta t\ e^{\alpha t}\ dt=Cos\ \beta t\frac{1}{\alpha}e^{\alpha t}+\frac{\beta}{\alpha}Sin\beta t\frac{1}{\alpha}e^{\alpha t}$$

and $\int Cos\beta t\ e^{\alpha t}\ dt$

$$=\frac{1}{\alpha}e^{\alpha t}\left[\frac{Cos\ \beta t+\frac{\beta}{\alpha}Sin\ \beta t}{\left(\frac{\beta^2}{\alpha^2}+1\right)}\right]$$

It now becomes necessary to limit the function by inserting boundary conditions, so that the values of the constants may be determined.

Referring to Fig. 2, we see that it is not unreasonable to make the amplitude of the initial oscillation equal to the steady value of the field current, k, and, in addition, the amplitude after a time equal to that taken by the aperture to move four times its own length must be one-tenth of the initial value for the sake of illustration.

These give values to the constants as follows :

$\beta=2\pi f_2=2\pi\times27.6\times10^3$ radians sec-1

= 174,000

T= .0000363 sec.

But $\alpha\times4T=—2.5$ approx.

$$e^{4T\alpha}=e^{-2.5}=\frac{1}{e^{2.5}}=\frac{1}{2\cdot718^{2.5}}$$

= one-tenth

so that α= —17,250.

traverse such that the front edge of the aperture passes it at t″ and the back edge at t‴,we have :

$$L=\int_{t''}^{t'''} bdt$$

$$=\int_{t''}^{t'''} b_0dt+\frac{b_0dt}{101p}\Big[10Sin10pt—Cos10pt\Big]_{t'''}^{t''}$$

$$=b_0T+\frac{b_0}{101p}\Big[10Sin10pt—Cos10pt\Big]_{t''}^{t'''}$$

an integral which is sensibly constant for all values of t″ and t‴, such that (t‴—t″) = T.

It is, therefore, with what happens in the space of the first aperture-transition that we are concerned.

Values of the function

$$L=b_0t'+\frac{b_0}{101p}\Big[10Sin10pt—Cos10pt\Big]_0^{t_1}$$

are set out in the following table :

A plot of the above figures for the very slight correction indicated in the last column but one, together with the true shape to be produced, and that which would result without any correction are given in Fig. 3. It is to be noted, however, that this brief analysis

t secs.	e^{-pt}	10Sin 10pt	—Cos 10pt	f (t)	L	Standard.
0.00000	1	0	—1	0	0	0
0.0000091	.856	10	0	5.52×10^{-6}	14.6	36.3
0.0000182	.735	0	1	$.845\times10^{-6}$	19.0	36.3
0.0000273	.625	—10	0	$—3.02\times10^{-6}$	24.0	36.3
0.0000363	.535	0	—1	$.268\times10^{-6}$	36.6	36.3

Thus we see that we can put β=—10α approx.

Put α=p. Then we have at any point such that the time taken for the back edge of the aperture to reach it from the position shown in Fig. 2 is t′<T.

$$L=\int_0^{t'} bdt$$

$$=\int_0^{t'} b_0dt+\frac{b_0dt}{101p}\Big[10Sin10pt—Cos10pt\Big]_0^{t'}$$

$$=\beta_0t'+\frac{b_0}{101p}\Big[10Sin10pt—Cos\ 10pt\Big]_0^{t'}$$

and for any point at all in the line

is very crude: more accurate curves showing the form of current in a corrected system have been given by the author in the *Journal of the Television Society*, Series II, Vol. I, Part VIII at page 267.

Over-modulation in a cathode-ray television viewer results in a "soot and whitewash" effect combined with curling of the ends of the lines forming the white portion of the image. This is due to the excessive decrease in shield bias which causes the beam to wander slightly on its vertical travel. Under-modulation, giving a grey image without sufficient contrast, can be remedied by lowering the anode potential of the tube if it is impossible to increase the signal strength.

RECENT DEVELOPMENTS

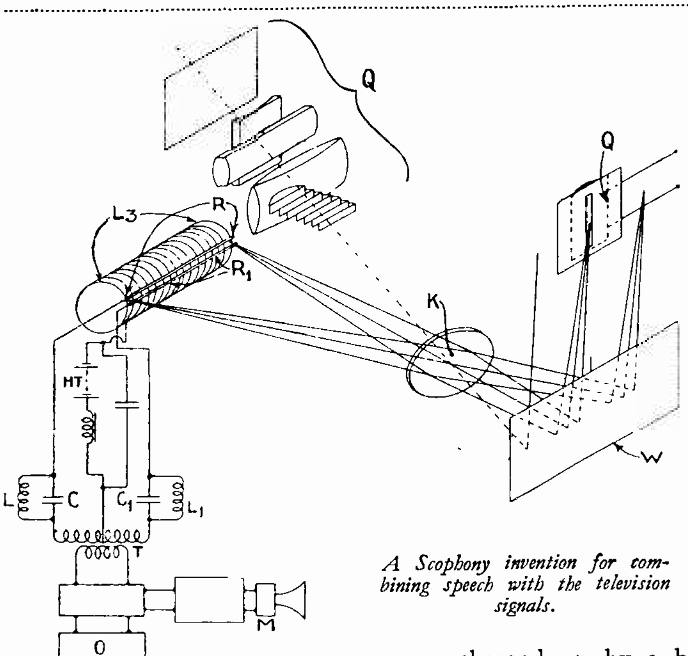
A RECORD OF PATENTS AND PROGRESS

Specially Compiled for this Journal

Picture-with-sound transmission
(Patent No. 403397.)

The invention is a development of Patent No. 403395 (described in last month's issue) in which single-line or Scophony scanning is used. It is now proposed to combine speech with television, and to utilise the same method of scanning for both. This necessitates, in the first place, the conversion of ordinary sound signals into an equivalent "light" or visible effect, which is then "viewed" by similar apparatus to that used for scanning the picture, the result being a single "line of light" which includes the complete programme.

The idea of converting sound signals into visible form, so that both the picture and speech can be handled by the same type of apparatus, is an unusual and original contribution to the art. Actually the conversion is effected by applying the microphone currents to a pair of rod electrodes which have been charged up to a point just below that at which a spark-discharge will take place. The addition of the microphone voltage then acts as a "trigger" to produce a series of sparks which are a visible representation of the applied speech. Original differences in tone frequency are converted into a definite spacing of the corresponding spark along the rod electrode, so that a particular audible frequency always occupies the same position, whilst a complex of frequencies, such as would be produced by an orchestra, gives rise to an extended band of sparks.



A Scophony invention for combining speech with the television signals.

As shown in the lower part of the figure, currents from the microphone M are amplified at A and are then modulated on to a carrier wave generated at O.

The modulated output is fed through a transformer T to two circuits L, C and L_1, C_1, tuned respectively to the upper and lower side bands. From here they pass to two rod electrodes marked R, R_1, which are placed in close proximity to a coil L_3. The electrodes are charged up by a battery H.T. to a point just short of that at which a spark-discharge will pass across to the rods. Actually the two rods and the coil are all mounted inside an evacuated glass bulb.

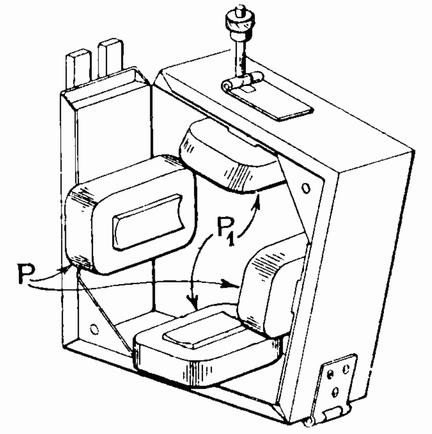
The effect of the amplified voltages from the microphone is to increase the voltage between the charged coil L_3 and one or other of the rods R, R_1, so that sparks begin to pass. They do not, however, pass in a haphazard fashion but select the particular point along the coil at which the resulting discharge current finds itself in tune with the circuit opened up by the spark discharge.

For instance a high-frequency note sets up a spark near the beginning of the coil L_3 and discharges itself through the coil L, one half of the secondary winding of the transformer T, and the condenser C_3. On the other hand a low-frequency note selects a point near the far end of the coil L_3, and discharges itself through the whole of the windings of that coil, and then as before. In this way the original sound frequencies are transformed into a spaced series of sparks.

The resulting band of light is projected by a lens K on to a vibrating mirror W, which simultaneously receives the picture elements from an echelon scanning-device S, of the kind described in the previous patent. The combined speech and picture signals are then swept by the mirror W across a photo-electric cell Q, and so pass to the transmitting aerial. In reception the "spaced" sound signals are converted back to their original frequency values by a system of rod electrodes and tuned circuits similar to that shown in the figure.—(*G. W. Walton.*)

Deflecting electrodes
(Patent No. 403671.)

The two pairs of deflecting poles, P, $P1$, one carrying a high and the other a low-scanning frequency, are mounted on a common magnetic yoke, which may be hinged at one corner so as to facilitate fitting it into position around the walls of the cathode-ray tube.



A deflecting system for use with the cathode-ray tube.

Owing to the symmetrical disposition of the pole-pieces, current passed through one pair produces substantially no change in the magneto-motive force between the opposite pair. The common yoke also serves to reduce the production of external magnetic fields.—(*Electric & Musical Industries Ltd.* and *M. Bowman-Manifold.*)

Cathode-ray Tubes
(Patent No. 404169.)

There is a tendency under intense ionic bombardment for the electron-emitting coating of the cathode of a cathode-ray tube to become atomised and dispersed. To prevent this, the electrode upon which the barium oxide is deposited is formed with a series of fine grooves into which the sensitive material collects, when the cathode becomes overheated, and so escapes destruction.—(*International General Electric Co. Inc.*)

Television Receivers
(Patent No. 405006.)

Two of the most important problems in television are synchronisation and an adequate light intensity. The first depends, in mechanical systems of scanning, upon keeping the mass of the moving parts as light as possible, whilst the second is determined by the efficiency of the optical system between the source of light and the screen.

As shown in Fig. 1 the lamp *L* contains an apertured stop or screen *S* arranged at a distance from the filament equal to the diameter of the projected light-spot. The diameter of the lens L_1 is equal to its focal length and it is placed at a distance from *S* equal to its focal length. All the rays passing through the stop *S* are therefore collected by the lenses L_1, L_2 and pass through the Kerr cell and Nicols *N* on

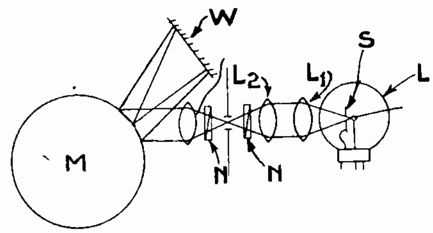


Fig. 1. The optical arrangements of the Pye mirror drum receiver.

to the mirror drum *M* and thence to the viewing screen *W*.

Fig. 2 shows a cabinet containing

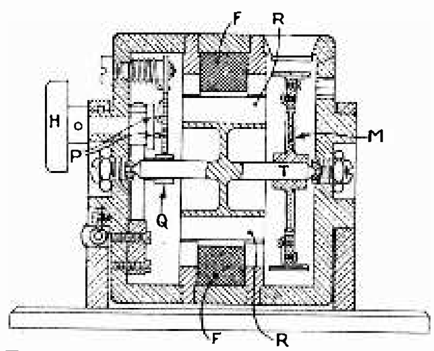


Fig. 2. Cross section of Pye receiver showing the phonic motor.

a two-inch mirror drum *M* mounted on the shaft *T* of a phonic motor comprising an induction rotor *R* rotating within the field of a coil *F*. A starting handle *H* is used to start up the rotor through pins *P* and a toothed quadrant which engages a wheel *Q* on the shaft *T*.—(*Pye Radio Ltd.* and *P. C. Goldmark.*)

Other Television Patents

(Patent No. 403818.)
Improvements in the electrode structure of cathode-ray tubes suitable for television and like purposes.—(*Telefunken Co.*)

(Patent No. 403865.)
Distribution system for television signals in which the original carrier wave is stepped down in frequency.—(*Marconi's Wireless Telegraph Co. Ltd.*)

(Patent No. 404281.)
Television scanning apparatus adapted for rapidly changing or selecting the particular subject or part of a scene to be transmitted.—(*J. C. Wilson* and *Baird Television Ltd.*)

(Patent No. 404299.)
Improvements in cathode-ray tubes arranged in cascade to produce high acceleration of the beam.—(*British Thomson-Houston Co., Ltd.*)

(Patent No. 404351.)
Cathode-ray tubes with water-cooled cathode for television or picture-recording.—(*Marconi's Wireless Telegraph Co., Ltd.*)

(Patent No. 404642.)
Means for rendering the synchronising-motor of a television receiver self-starting.—(*W. W. Jacomb* and *Baird Television Ltd.*)

Television Stations in the U.S.A.

W2XR—Radio Pictures, Inc., Long Island City, N.Y. 1,000 watts. 60 lines. 176.5—187.5 metres.
W8XAN—Sparks-Withington Co. 100 watts., Jackson, Mich.
W9XAO—Western Television Corp., Chicago, Ill. 500 watts. 45 lines. 150 metres.
W6XAH—Pioneer Mercantile Co., Bakersfield, Cal. 1,000 watts. 60 lines.
W9XK—Iowa State University, Iowa City, Iowa. 100 watts. 60 lines.
W3XAK—National Broadcasting Co. 5,000 watts. Portable. 140 metres.
W2XBS—National Broadcasting Co., New York, N.Y. 5,000 watts.
W6XS—Don Lee Broadcasting Corp., Los Angeles, Cal. 1,000 watts.
W9XAP—National Broadcasting Co., Chicago, Ill. 2,500 watts.
W9XAK—Kansas State College, Manhattan, Kans. 125 watts.
W9XAL—First National Television Corp., Kansas City, Mo. 500 watts. 135 metres.
W9XG—Purdue University, W. Lafayette, Ind. 1,500 watts. 60 lines. 105 metres.
W9XD—The Journal Co., Milwaukee, Wis. 500 watts. 3.75 to 7 metres.
W9XE—U. S. Radio & Tele. Corp., Marion, Ind. 1,000 watts.
W3XAD—RCA-Victor Co., Camden, N.J. 2,000 watts.
W2XBT—National Broadcasting Co., Portable. 750 watts.
W2XR—Radio Pictures, Inc., Long Island City, N.Y. 1,000 watts.
W2XF—National Broadcasting Co., New York, N.Y. 5,000 watts.
W6XAO—Don Lee Broadcasting System, Los Angeles, Cal. 150 watts.
W3XE—Philadelphia Storage Battery Co., Philadelphia, Pa. 1,500 watts.
W2XAK—Atlantic Broadcasting Corp. New York, N.Y. 50 watts.
W10XX—RCA-Victor Co., Portable and Mobile. 50 watts.
W8XAN—Sparks-Withington Co., Jackson, Mich. 100 watts.

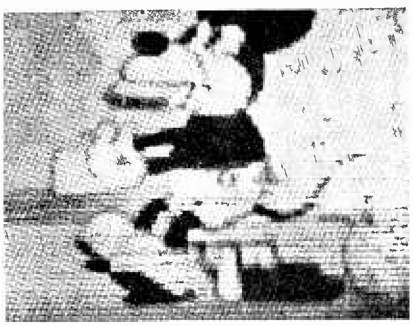
Provided that good headphone strength is obtainable from a receiver it will be suitable for producing television images on a cathode-ray tube. This is of interest to those who have no electrical supply installed in their homes The cathode-ray equipment itself can be operated from 2-volt cells and H.T. batteries of low capacity.

TELEVISION IMAGES

AN EXPERIMENTAL METHOD OF OBTAINING DATA

In television we are concerned with moving images and with a succession of movements or scenes which have certain continuity. Also, the vision is aided by sound accompanying the picture. Because of the wide gap between a still picture of certain detail and a television reproduction having the same equivalent detail, it is difficult to draw any definite information regarding the number of scanning lines desired.

Motion in a picture directs the observer's interest to the objects in motion. Under these conditions the eye requires less detail than for a still picture, assuming that the detail is sufficient so that the purpose of the movements may be understood. Proper use of this may be made in television in the choice of "story action" and choice of background for the action. Also, in an image which is the result of scanning at the pick-up end, motion of the objects being scanned positions these objects for particular frames in favourable relation



A reproduction of sixty-line horizontal scanning: the stepped effect is apparent.

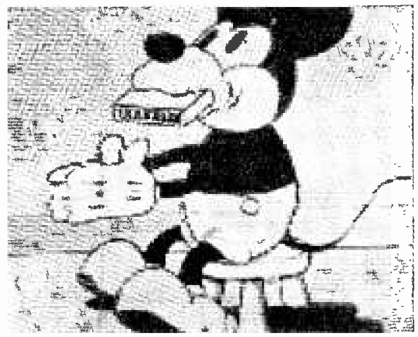
to be analysed and reproduced when these objects are small and approach in at least one dimension the size of the scanning beam.

Television Equivalents

For a complete study of television image it seems necessary to have available the ability to produce image reproductions which have picture structures equivalent to television, controllable illumination, controllable size, flicker frequency equivalent to television, and capacities for subjects which will be used in television.

This article describes the methods used to obtain quantitative information on the characteristics of television images particularly those relating to image detail. It is an abstract of a paper by E. W. Engstrom in the Proceedings of the Institute of Radio Engineers on tests which were conducted by the use of equivalents in order to determine operating standards, satisfactory performance and obtain useful information in development work.

It is also desirable to cover a range of picture detail equivalent to television images of 60, 120, 180, 240 and even



This picture is the equivalent of a television image produced by one hundred and twenty lines.

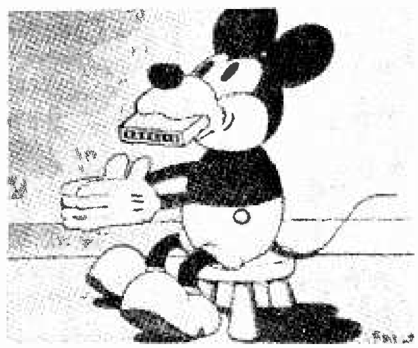
larger numbers of scanning lines. These equivalents should be so made that they represent nearly perfect picture structures for the detail included. This seems desirable so as to avoid mistakes in judgment. Also, it will permit study with images equivalent to the more advanced stages of television which will later be attained as a result of continued development. Such an experimental set-up will allow reasonable determination of several related picture properties—picture detail, picture size, and viewing distance.

It is impracticable to make use of television systems for this study. This is because of limitations in our ability at present to produce television images with sufficient detail, illumination, and size for this investigation and to have these characteristics variable. We must, therefore, resort to suitable equivalents. A motion-picture film having a picture structure equivalent to a television image provides a very flexible means for carrying out this work. There are numerous ways in which such a film may be made, but the method used for this investigation is flexible and presents only a reasonable amount of preparatory work.

In the system of television that we are considering, the scanning paths are horizontal and the beam progresses from left to right (when facing the object or reproduction) and from top to bottom. The scanning beam is usually round or square in cross section. Since the scanning beam has width in the direction of the scanning path, a certain form of distortion is introduced. This is known as aperture distortion.

Optical Arrangements

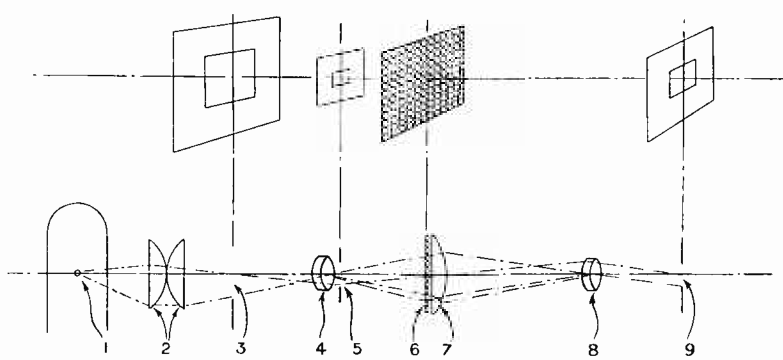
The equipment used in making sixteen-millimetre motion pictures with detail structure equivalent to television images consisted essentially of a thirty-five millimetre to sixteen millimetre optical reduction printer. A system of optics was interposed between the picture gates for the purpose of break-



One hundred and eighty lines result in a picture which has no marked step effect.

ing up the picture image into small areas, each of which was uniformly illuminated, and which transmitted the same total quantity of light as a corresponding area in the picture image. A diagram of the optical system is shown in Fig. 1.

The filament of an incandescent lamp 1 is focused by means of condenser lenses 2 upon a corrected lens 4. Lens 4 in turn forms an image of the thirty-five millimetre picture aperture 3 on the plane surface of condenser lens 7. The equivalent of thousands of tiny spherical lenses 6 are placed directly in front of lens 7. Each of the tiny lenses forms an image of aperture 5. The plane containing the many images of aperture 5 is brought to focus upon the sixteen-millimetre aperture 9 by means of a lens 8. Condenser lens 7 makes it possible for lens 8 to collect an equal quantity of light from each of the images formed by lenses 6. The horizontal dimension of the rectangular aperture 5 is such that the sides of the images formed by lenses 6 just touch, thereby forming continuous bands of light in the horizontal direction. The dimension of aperture 5 in the vertical direction is narrower, thereby producing narrow dark spaces between the horizontal lines formed. This was done to simulate television image lines. The image at aperture 9 of a motion picture film at aperture 3 is broken up by the optical system into as many elementary areas as there are lenses or equivalent lenses in 6, each of which contains no detail within itself. By adjusting the reduction ratios of lenses 4 and 8, and by having sufficient equivalent lenses at 6, it is possible to vary the number of picture elements.



Details of the equipment used for producing a film equivalent of television images.

Miniature Lenses

Since it would have been difficult actually to obtain the thousands of minute spherical lenses, an approximate but more practical scheme was resorted to. It is known that two crossed cylindrical lenses are very nearly equivalent to a single spherical lens. Thus, it would be quite possible to approximate the required condition by crossing two layers of fine glass rods, the rods being in actual contact with each other. Fortunately, an even simpler solution was found. Kodacolor film is embossed with minute cylindrical lenses having focal lengths of about 6 mils. By crossing two pieces of Kodacolor film with the embossed surfaces in contact, very satisfactory results were obtained. The focal lengths of the equivalent spherical lenses formed by crossed Kodacolor film were so short that the size of aperture 5 would have had to be larger than the diameter of lens 4. This condition was corrected by forming a cell made up of two pieces of Kodacolor film crossed, and filling the space between the embossings with a transparent solution having an index of refraction greater than air and less than the index of the film base. By varying the index of refraction of this transparent solution, it is possible to make the lenses have any desired focal length from 6 mils to infinity.

The Kodacolor cell and lenses 4 and 8 were arranged in a suitable mounting and mounted on the reduction printer between the thirty-five millimetre aperture and the sixteen millimetre aperture. Arrangements were provided for adjustment of these various lenses. The subject matter was taken from a thirty-five millimetre positive print. The first printing operation gave a sixteen millimetre negative having the desired picture structure. A sixteen millimetre positive was then made by printing from the negative in a sixteen millimetre contact printer. The sound was transferred in the usual manner.

> *INSTEAD of a diode in the double time base for television scanning with a cathode-ray tube, try a pentode. The anode current-anode volts characteristic of the pentode corresponds to a saturation curve, and the impedance of the valve can be altered by adjustment of the screen volts. The grid can be connected to the filament, and provided the screen volts are not too high the valve will be economical in current consumption.*

Films were made up for a variety of scenes and subjects. These, in general included: Head and shoulders of girls modelling hats; close-up, medium and distant shots of a baseball game; medium and semi-close-up shots of a scene in a zoo; medium and distant shots of a football game; animated cartoons; titles.

These were assembled for one group with all scenes of the same detail (line structure) on the same run of film. For another group these were assembled with each scene progressing from 60 to 240-line structure. The pictures made included: 60-line, 120 line, 180-line, 240-line structure, and normal projection print.

Up to 240 Lines

It was planned at the start to produce pictures having detail structures greater than 240 lines, but it was found that limitations, mainly in film resolution, prevented this. The resolution of the sixteen-millimetre film used was naturally considerably greater than a 360-line structure, but with the averaging process used in producing each small section of the picture, the resolution was not sufficient to prevent merging of one section into the next. Later determinations made from viewing these films indicated that the 240-line structure pictures were sufficient for the purposes of the investigation since the results were of such a nature that the relationship could be extended to higher numbers of scanning lines.

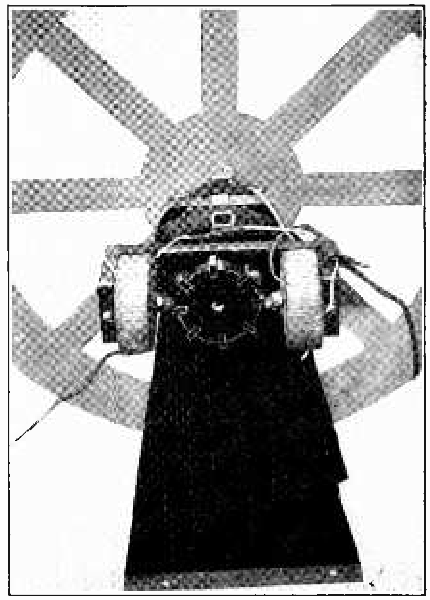
Samples of three picture frames are given by Figs. 2, 3 and 4. There ase enlargements from the sixteen-millimetre negatives and include structures of 60, 120, and 180 lines.

An RCA Photophone sixteen-millimetre sound-projector equipment was used in projecting these films. The light cutter in the projector was modified so as to interrupt the light only during the time that the film was being moved from one frame to the next by the intermittent movement. This modification consisted in removing one blade from the light cutter. The light was, therefore, cut off once per frame, giving for these tests a flicker frequency of 24 per second. The films were shown to several groups of people, using projected picture sizes 6, 12 and 24 inches high. The major reaction from these show-

(*Continued on page* 170.)

An Amateur Transmitter—II

This is the concluding article of the amateur transmitter of which first details were given in last month's issue.



A photograph showing the synchronising gear using an 8-tooth phonic wheel.

THE circuit of the amplifier is given by Fig. 2. The main points to remember are short leads and good soldered joints. The amplifier chassis consists of a metal base with three equally spaced out valve holders mounted flush with the top. The bias batteries are mounted inside the box. They can conveniently be fountain pen torchlight cells. The one cell, used on the grid of the first valve, is soldered with a short thick piece of copper wire to the grid pin socket of the valve holder.

Non-inductive condensers must be used. A screened lead connects the photo-cell to the amplifier. The photo-cell should be mounted on the amplifier chassis and shielded by a can with an aperture cut in to allow the rays of light to pass through to the photo-cell.

When the amplifier chassis has been made, three pieces of sheet lead about $\frac{3}{16}$ in. thick are obtained and cut to form three screened lead cans with open tops for the valves. The lead acts as a screen to electrical fields and helps to reduce microphonic interference. Small angle-bracket feet, fitted to the bottom of the lead covers, will enable them to be screwed to the chassis after suitable fixing holes have been drilled.

The wiring is completed as shown in the diagram and the present owner of a disc receiver is ready to set up his apparatus and transmit and receive pictures.

The lamp house support is screwed to the baseboard so that there is a distance of $1\frac{1}{2}$ in. from the condenser lens to the disc. The focusing lens is mounted about 5 to 7 in. from the disc. This distance will depend on the size of scan required. On account of the greater illumination obtainable, a scan of not more than 2 in. to 3 in. wide should be used to begin with. A full face picture from the daily newspaper will do to start operations. This news photograph should be mounted so that it is nicely scanned by the light spots through the disc and lens. The light spot should be focused sharply on the photograph before switching on the motor.

The photo-electric cell is then placed to face the picture and so that it does not interfere with any of the scanning lines (see Fig. 3) in the beam from the disc. A frame of carbdoard, wood or metal, is placed between the scanning disc and the lens and the frame is of such a size that as one light spot leaves the top of the picture being scanned there is a period of about two spots width before the other spot appears. This cutting off of light creates a synchronising signal which will be required when a separate receiver is used with a separate scanning device.

If a pair of earphones are available they should be coupled to the output of the amplifier. On no account should bias be applied to the photo-electric cell while any fairly strong light is shining directly on the cell. When the cell is exposed only to the scanning light, reflected from the picture, the cell may be biased to 100 volts

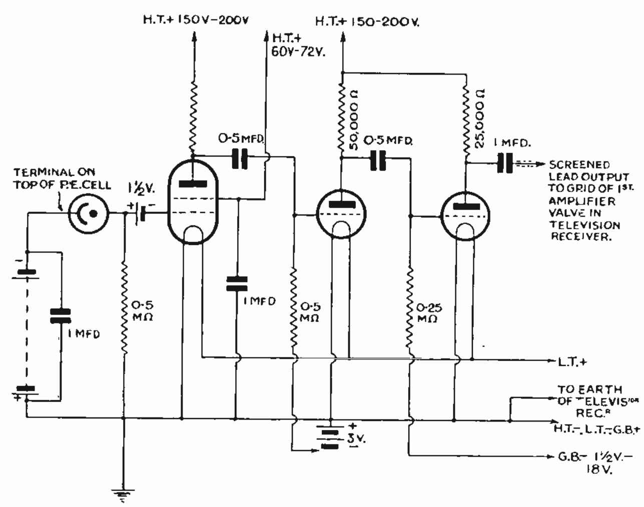


Fig. 2. Circuit showing the amplifier and photo-electric cell.

PARTS REQUIRED FOR THE TRANSMITTER

Condenser and focusing lenses	Mervyn Sound & Vision Co., Ltd.
Motor and brackets	,, ,, ,,
Synchronising gear	,, ,, ,,
Scanning disc	,, ,, ,,
Motor resistance	,, ,, ,,
Photo-electric cell	Osram CM98
Lamp	Philips 1,000-watt projector type.
Lamp holder, screw pattern ..	G.E.C.
THREE-VALVE AMPLIFIER	
Valves: PM12, PM1HL, PM202	Mullard.
3—1-mfd. condensers, 250 v. D.C.	T.C.C., N.1.
2—0.5-mfd. condensers, 250 v. D.C.	T.C.C., W.1.
2—0.5 megohm resistances ..	Erie 1-watt.
2—25,000 ohm ,, ..	,, ,,
1—50,000 ohm resistance ..	,, ,,
1—250,000 ohm ,, ..	,, ,,
4—4-pin valve holders ..	Whitley Radio Co.

"An Amateur Transmitter"

(*Continued from preceding page*)

which gives maximum results. If black lines pass across the receiver screen it is a sign that everything is not properly earthed or that the lead coupling the photo-cell to the grid of the amplifier is too long.

The amplifier is sensitive to weak electrical fields and will pick up A.C. mains interference unless every precaution be taken to screen the photo-cell circuit and grid leads. If serious difficulty is experienced with external interference, the photo-cell, amplifier and batteries may be housed in a sheet

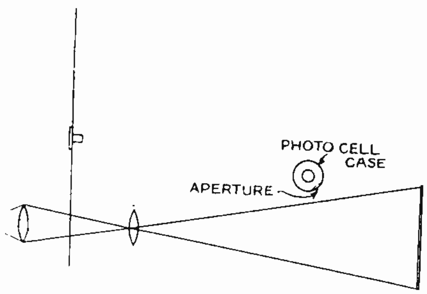


Fig. 3. Position of photo-cell relative to the subject being scanned.

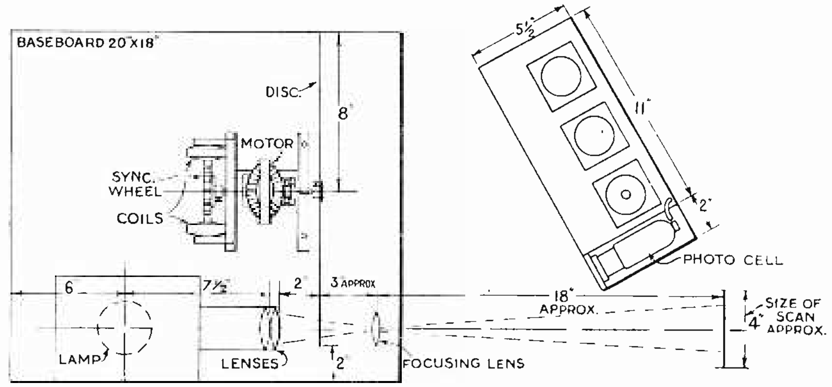
metal or tinned iron box. An aperture will be required to allow light to pass to the photo-cell. Another important point to remember is that if any light from an ordinary household lamp falls on the cell, A.C. hum will result.

The limit of size of the subject to be successfully scanned can be found by gradually enlarging the area scanned. To do this the subject is placed further away from the scanning disc and the focusing lens readjusted, until the definition in the received picture begins to disappear, due to the decrease in illumination. After a certain point is reached results can be improved by having two photo-cells in place of one.

A constant-speed device may be made in the form of a standard synchronising gear as used in the average receiver. The thirty-toothed wheel is replaced by one having eight teeth instead of thirty teeth. The coils are connected in series and coupled to the mains direct. If the frequency of the mains is fifty cycles, the scanning disc will revolve at a speed of 750 revolutions per minute.

The output of the amplifier may be connected to a separate television receiver either in the same room or in another room. If this receiver is fitted with synchronising gear the apparatus will remain in step with the transmitter.

It should now be possible to arrange for a full-face transmission. The person should sit in such a position that the scan from the disc falls on the face. The lens should then be focused so that distinct faint black lines are visible. A large sheet of white paper behind the subject is also advisable. This paper or screen should not be glossy, but matt. A circle or a triangle drawn on a sheet of paper and placed in the scanning ray will show up any defect in the system, as will a checkerboard pattern. These test pieces should be reproduced without alteration to the shape or pattern.



This diagram shows the arrangement of the scanner, subject and photo-cell with amplifier.

"Television Images"

(*Continued from page 168.*)

ings was the expression of satisfaction obtained from viewing pictures 12 inches high and larger in comparison to smaller pictures.

It will be of interest at this point to record some of the reactions on how well these films form equivalents of television images. These reactions were formed as a result of observations and tests made with the films. The changes of contrast along the horizontal "scanning" lines for the 60-line structures appeared somewhat "mosaic" in arrangement. This was because the boundaries of the individual picture arrangements were determined by the multiple lens arrangement used to produce the image. This effect was not noticed in 120-line structure, or in those of higher detail. The 120, 180, and 240-line structures, and also the 60-line structure, except for the effect explained above, were well suited for study of image detail. In general a particular line structure on the film was considerably better than a television image (as we are at present able to produce them) of the same number of scanning lines. This is a desirable condition because the results of the tests will then be in terms of television of an advanced stage rather than in terms of present capabilities.

Radio Photo Service in U.S.A.

A radio facsimile inter-city service is planned by the Radio Corporation of America. The plan calls for extension of the service, with Chicago, Washington, Boston, New Orleans, San Francisco and other cities linked in a short-wave system to transmit pictures as well as letters, as now accomplished by telephoto on wire lines. A wavelength of approximately 5 metres is to be used.

The engineers have further developed a multiple transmission system whereby three different messages can be flashed simultaneously on the same wave without interference at a speed of 180 words a minute. It is expected that "booster" or relay stations will be required because the micro-waves cover only a limited area under present methods. Two sites for automatic relay stations have been selected at New Brunswick and Trenton, N. J., for the New York-Philadelphia circuit.

The Baird Flat-plate Neon

In last month's issue a disc receiver was described, and in the list of parts specified the neon lamp was attributed to the G.E.C. This lamp is manufactured under the Baird patent, and should be obtained from the Baird Television, Ltd., 133, Long Acre, London, W.C.2.

Correspondence

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

Write to the B.B.C. :: Thirty-line and High-definition Transmissions

Write to the B.B.C

Sir,

I have read Mr. E. H. Ware's letter in the March issue of Television and thoroughly agree with his argument.

Acting on his request I have written to the B.B.C. asking for a continuance of the present transmissions.

It is to be hoped that all interested will write to the B.B.C. *without delay*.

Television in its present state is of definite entertainment value—apart from its fascination to the experimenter, and although it is agreed that it is by no means perfect yet I do not see why the hours of transmission should be curtailed on that account. Broadcasting was by no means perfect when it first started, but the hours of transmission were not cut down until improvements were made—on the contrary the hours were gradually increased, improvement taking place at the same time. The time devoted to television transmission on 30 lines is short enough as it is and at a very inconvenient hour. The inconvenience can, perhaps, be put up with but the curtailment of hours of transmission should be strongly opposed by all the thousands who are devoting time and —equally important—money, to the furtherance of television. My personal opinion is that the B.B.C. should continue the 30-line transmissions as at present until a better form—60, 120 line, or whatever is found to be practicable—can be definitely transmitted and received anywhere in Great Britain.

F. G. Maunde-Thompson (Major, A.C.G.I.) (West Byfleet).

* * *

Thirty-line and High-definition Television Transmissions

Sir,

I have been noting, with growing concern, the various reports, official and unofficial, about the possibility of the discontinuance of the B.B.C. 30-line transmissions. It was, therefore, with a feeling of relief and complete agreement that I read Mr. Sagall's suggestion for the running of two services—one of 30 lines on the medium wavelengths and the other for high-definition work on the ultra-short. My fears for the fate of the 30-line transmissions have, however, been revived on reading Mr. O. S. Puckle's letter in the February issue.

It is quite obvious that Mr. Puckle is overlooking the position of the very large number of keen television amateurs who, like myself, live many miles from London and to whom the 30-line B.B.C. transmissions are and could be, for some time to come, the only possible means of pursuing their experiments.

Mr. Puckle's attitude is, of course, typical of many Londoners who are secure in the knowledge that even if 30-line experiments were dropped immediately in favour of high-definition work they, at least, would have the best possible facilities. Either that, or they are ignorant of the difficulties involved in "putting over" high definition television.

Does it appear likely that, in the near future, television transmissions of, say, 120 lines could be introduced which would enable the general public (and by that I mean the general public of Gt. Britain, not of London only) to get the entertainment value about which we have been hearing so much? I contend that for some time to come television transmissions will and should be mainly for the use of those interested in the technical aspect and cannot, as yet, cater for those concerned solely with the programmes provided: though this is no reason for saying that the present 30-line television does not provide a good measure of entertainment—it does! But it could, I believe, provide better!

No one is in a position to say that 30-line transmissions, limited in scope though they may be, have reached their highest possible limit of perfection. If that were so, then why are we still working with troublesome mechanical devices and imperfect cathode-ray tubes at the receiving end?

If Mr. Puckle does possess the "intimate knowledge of the problems involved" then surely he will be the first to admit that high-definition television has never, so far, been demonstrated under conditions which would make it a feasible proposition in the hands of the public. Further, only ultra-short waves are suitable for these transmissions and transmissions on these wavelengths are still of an experimental nature. In these circumstances it does not appear likely that the B.B.C. will, even in a period of years, be operating the chain of ultra-short wave transmitters which would be necessary for this purpose. What about the technical difficulties of feeding all these transmitters with high-definition television signals when at present it doesn't even seem possible to feed all the Regionals with simple 30-line signals?

By all means develop high quality television, but until it is a workable proposition, there is nothing to be gained, and possibly a good deal to be lost, by depriving a large body of amateur workers of their only means of practical experiment. Some of these amateurs probably possess knowledge and ideas concerning the perfection of television which would confound many of the laboratory experts.

Hugh J. Miller (Linlithgow).

THE surrounding temperature has an important effect on the characteristics of mercury-vapour rectifiers and relays. Generally speaking it is advisable to operate them at a constant temperature, as an increase usually reduces the safe anode voltage at which they will operate. A mercury-vapour relay will have its striking voltage slightly reduced as the bulb warms up, and therefore it should be switched on for some minutes before any readings are taken to enable it to settle down. In very cold climates they may even require warming before they will work satisfactorily, but that is not likely to trouble the experimenter in this country.

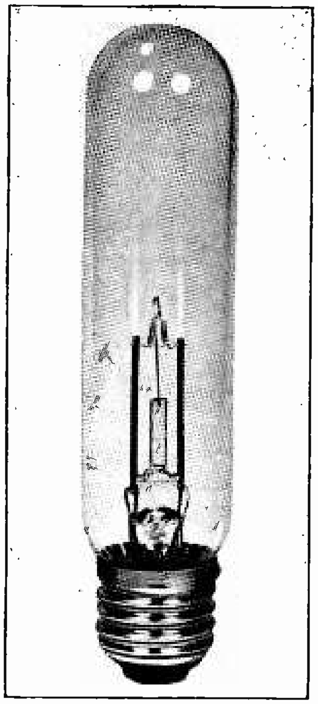
A small subscription will ensure the delivery of "Television" regularly each month.

Apparatus *for the* Experimenter

"Ediswan" Projector Lamps

The projector lamps manufactured by the Ediswan Co. are of two types, vertical mounting and end-on mounting. The illustration shows one of the vertical type in a tubular bulb.

The lamps are supplied in the following wattage ratings :—100, 150, 200, 250, 500 and upwards, and the voltage ratings are 12-260, although the lamps supplied for use on the standard voltages of 100 and 200-240 are cheaper. End-on lamps are only supplied in 100, 200 and 500 watt ratings.

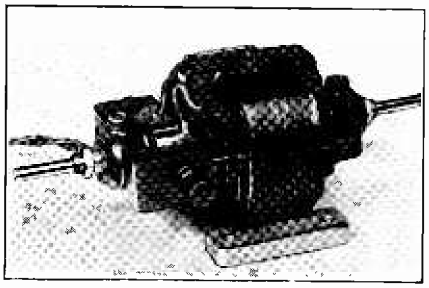


The Ediswan Projector Lamp

Both types are fitted with Ediswan screw caps, and the makers state that it is important to mount the lamp in the correct operating position with the filament connecting wires downwards. Failure to do this will lead to a flash-over between the wires owing to the ionisation of the gas when the lamp is switched on. The bulb is marked plainly to correspond with the correct running position, and therefore there is no liability of accident if care is taken. The standard types are 10s. 9d. and the higher wattage ratings are approximately £1 1s.

A Television Motor

The photograph shows a neat motor for television purposes which has been placed on the market by Peto Scott, Ltd. This is a universal type and will

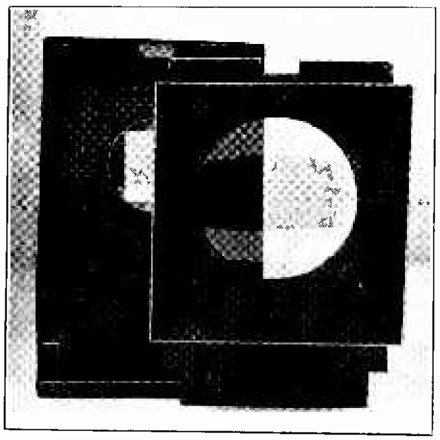


The Peto Scott Motor.

work on either D.C. or A.C. mains. It has laminated fields, a large diameter and substantial commutator and extended spindle. The motor is constructed with four main parts, the laminated fields, armature and brackets and aluminium base plate. A feature of the motor are extensions of the bearings at each end to enable synchronising gear to be fitted in a simple manner. The price is 30s. and the motor can be recommended.

Lens Holders for Disc Machines

The Bennett Television Co. of 50a, Station Road, Redhill, Surrey, have sent us two models of their lens holders for

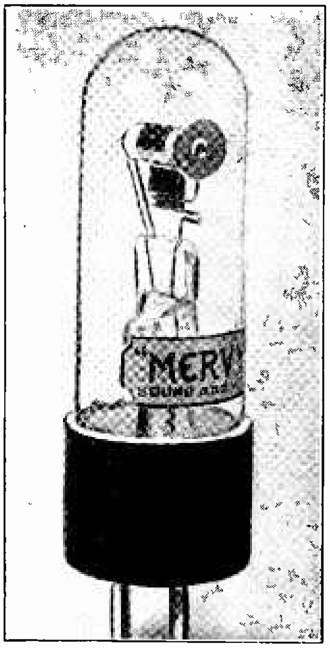


Bennett Lens Assembly.

disc machines. One of these is totally metal enclosed and the other is of wood; the former is illustrated by the photograph. These are useful units which will save the amateur a considerable amount of constructional work and as they are made adjustable and can be supplied for any centre height they are suitable for any disc visor. The prices are 10s. 6d. for the metal-enclosed model and 5s. for the wooden one. A pair of matched lenses can be supplied for 6s. the pair.

A Crater-Point Lamp

We have had an opportunity of examining the Mervyn crater-point lamp M.S.V. 206 which is intended for use with mirror-drum receivers.



A new Mervyn Crater-point Lamp.

It is rated to strike between 200-250 v. D.C. and the sample tested would strike lower than 200 v. The current recommended for good modulation combined with brilliance is 25 m.a. to 30 m.a. and a bright field results on a screen 7 in. by 3 in. The lamp will carry considerably heavier currents and 40 m.a. can be applied with safety, but high currents shorten the life of the lamp.

Conventional coupling methods as applied to ordinary flat-plate lamps also apply to crater-point lamps. The price is £2 10s.

ANSWERS to QUERIES

Punching a Scanning Disc

Will you give me some hints on the punching of a scanning disc? The methods that I have used leave a considerable amount of burr which is difficult to remove cleanly.—R. A. (Leicester).

The secret of successful punching lies in using a sharp punch and suitable material under the disc. This latter should be lead or very close grained hard wood, the end of the grain being used to support the disc which must be pressed closely into contact before the blow is struck. The edges of the punch must be absolutely square and sharp, the finish being obtained on an oil stone. If difficulty is found in making a punch (it should be of hard steel) one can be obtained from dealers who supply tools for clock and watch repairers.

Speed Control of Scanning Disc

Which is the better—mechanical or electrical control of scanning disc speed?—R. D. (Guildford).

Quicker control can be obtained by some light frictional device, but electrical control should always be included in the motor circuit so that the current can be adjusted as nearly as possible to that which the motor requires. Heavy frictional braking will result in the motor getting hot, so the frictional control should be just sufficient to vary the speed of the motor a few revolutions per minute. A piece of thin cord wrapped once round the motor shaft and attached to a light spring, the other end being fastened to a screw so that the tension can be varied makes an excellent mechanical control.

Working a Mirror-screw Receiver

I have built the mirror-screw receiver described in the January issue of "Television" and have had fairly good results, except that the picture has a stepped appearance which is particularly noticeable when any lettering is being transmitted or when there is a horizontal line. How can this be remedied?—B. M. (Brighton).

It is evident that the fault is due to incorrect setting of the mirrors of the screw. Its correction will require readjustment of all the mirrors by the method described in the article. It is not practicable to set the mirrors by measurement, as the slightest inaccuracy will cause the effect which you mention.

Cathode-ray Reception and Distortion

I have had very good results with the cathode-ray tube, but I notice that the picture is distorted at times, the lines not appearing straight. To what is this due?—D. M. (London, W.).

We take it that you do not refer to the whole television screen, but the appearance of the lines when the picture is actually shown. If the modulation applied to the shield is too high, the lines will curl at the ends owing to the loss of focus which occurs when the shield volts are varied over too wide a range. Try reducing the modulation slightly. If the whole screen is not vertical, you may have an external magnetic field near the tube, or the deflector plates in the tube may not be exactly at right angles. But before taking this up with the makers, be sure you have no cause for distortion in your own layout of the apparatus.

ANSWERS TO QUERIES

An expert service is available to assist readers who experience difficulties in the construction, operation and maintenance of television apparatus or associated wireless receivers and amplifiers.

The following rules should be observed:

Please write clearly giving all essential particulars.

A stamped, addressed envelope and also the coupon on the last page must accompany all queries. Not more than two questions should be sent at any time.

Reply will be made by post.

Queries should be addressed to the Query Department, TELEVISION, 58-61, Fetter Lane, London, E.C.4.

Focusing the Spot

I find a difficulty in keeping the spot in focus on my cathode-ray tube. Can you suggest the cause?—M. R. (Bristol).

You do not say whether the tube is mains operated or battery operated, but assuming the latter, it is probable that the 2 v. cell supplying the cathode is running down gradually. If the cathode is too cold no amount of shield adjustment will produce a sharp spot. You will probably have noticed that when the spot is expanded to a line a slight readjustment of focus is necessary. If the cathode is at the correct temperature, the anode volts may be fluctuating, or there may be a slight external interference sufficient to blur the spot at times.

Mirror-drum Performance

I built a mirror-drum receiver a few months ago and for a time secured very good results, but latterly there has been a gradual falling off, the pictures lacking contrast and brilliancy. Can you suggest a likely cause of this?—D. G. (Aldershot).

If you are using an open type of Kerr cell it is probable that this has deteriorated, due to the absorption of moisture by the nitro-benzine. Remove the element from the cell and allow the nitro-benzine to drain off; then empty the container and carefully wipe it quite clean taking care not to allow the fingers to come into contact with any part of the interior. The cell should then be refilled with fresh nitro-benzine preferably obtained from some firm which specialises in this for television purposes.

Crater-point Lamp or Kerr Cell

What are the relative advantages of the crater lamp and the Kerr cell?—G. M. (Eastbourne).

The crater lamp does not give such a high degree of illumination as the Kerr cell used with a suitable projection lamp. On the other hand the assembly of the crater lamp optical system is more simple and it is cheaper in the first place. Against this must be reckoned the fact that the life of a crater lamp is not likely to exceed six hundred hours.

PROBLEMS IN CATHODE-RAY TELEVISION—IV.

By G. Parr

A Design for the Double Time Base

IN designing the simplest and most economical form of television scanning circuit for cathode-ray tubes the choice would seem to lie between the diode-condenser circuit shown diagrammatically in the last article or in the straightforward resistance-condenser circuit. The only disadvantage of the latter is the high voltage required for its operation, but since H.T. mains transformers can be obtained very reasonably for the purpose this is not such an important one.

In the resistance-condenser time base the initial portion of the exponential charging curve is utilised, and provided that the total H.T. charging voltage is high enough this initial portion is sufficiently linear for all practical purposes. For a full travel of the beam in a 9 in. cathode-ray tube at 1,500 volts H.T. the voltage change across the condenser will be of the order of 300 volts, and if the "saturation point" of the condenser charging curve is at 1,000 volts the charging voltage will still be linear when the mercury relay flashes. The approximate conditions are shown in Fig. 1 which represents an exponential curve with 1,000 volts max. value. When the time base is operating the condenser voltage should not exceed the point shown.

It will be noted that should the relay become open-circuited the condenser will immediately charge to the full potential of the H.T. supply, and for this reason it is advisable to use first quality condensers of a working voltage equal to that of the H.T.

The Circuit

The complete circuit diagram is shown in Fig. 2 and will be dealt with in detail. The time-base is naturally intended to be all mains operated, but there is no objection to the use of batteries, except on the score of expense. The horizontal travel of the beam is controlled by the 0.5 mfd. condenser shown on the left, this value being correct for 12½ scanning speed. The resistance which varies the speed of scan is the 2 meg. shown in series with the condenser, a 0.1 meg. fixed resistance being included for safety. The mercury-vapour relay used was an Ediswan MR/A.C.1 although the Osram G.T.1 will prove equally satisfactory. The grid of the relay is connected through the 5,000-ohm resistance to a tapping on the bias battery below.

Since the grid bias of the relay serves as an adjustment of length of travel of the beam it will be found sufficient to plug in the potentiometer across about 3 v. of the battery, the position of the tap depending on the initial amount of traverse required. Unfortunately the bias adjustment also alters the speed of travel, an inevitable drawback to mercury-vapour relays.

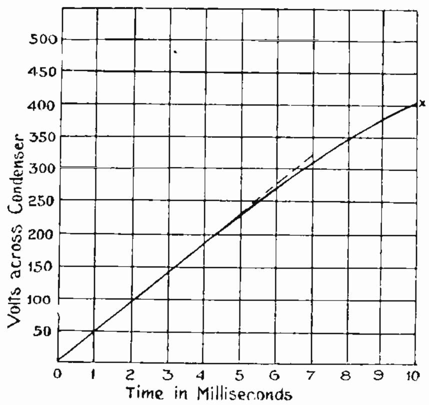


Fig. 1. Theoretical charging curve of ·01 mfd. condenser with 2-megohm resistance. The dotted line indicates true linear charging rate.

The speed depending on the voltage to which the condenser charges, it follows that an alteration in the grid bias will affect the striking voltage of the relay and consequently the speed. In some cases this interdependence of the length and speed controls may be turned to good account for getting a fine adjustment under operating conditions.

A similar circuit is used for deflecting the beam vertically with the exception that the higher speed of travel necessitates a smaller value of charging condenser (.01 mfd.). A common bias battery can be used, interaction between the grids being prevented by the series resistances shown.

The deflector plates are connected one to each of the relay anodes, and one to the slider of the biasing potentiometer.

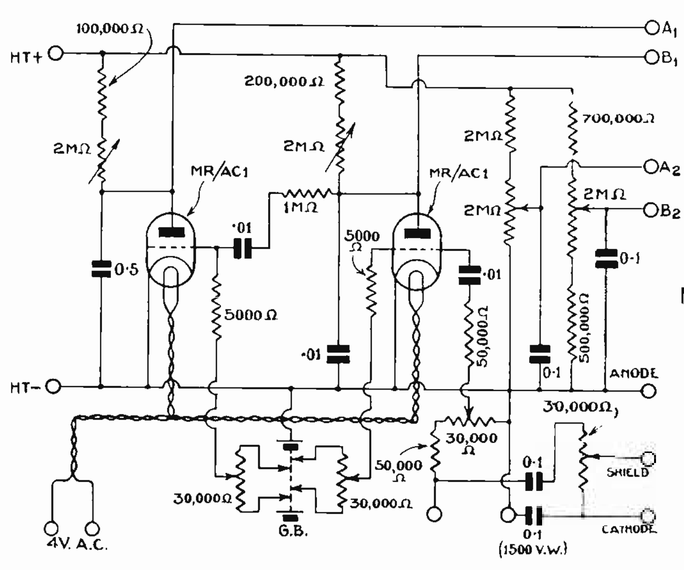
These potentiometers have fixed resistances connected in series with them for the double purpose of reducing the load on the H.T. and biasing the beam to approximately the correct position for normal operating. Each potentiometer is by-passed by a 0.1 mfd. condenser.

The synchronisation of the time-base to the television has already been described (see the article in March issue) and the circuit for feeding the synchronising impulse to the grid of the "vertical" relay is shown to the left of the bias potentiometer.

The grid is connected through a

(*Continued at foot of page 176*).

Fig. 2. The complete theoretical circuit of the double time base.



"'Daily Express' Television Kit"
(*Continued from page* 146.)

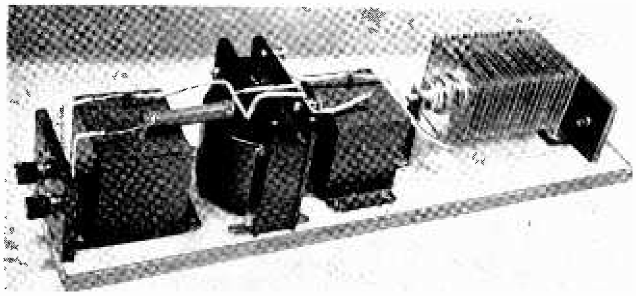
tions to the input of the transformer.

Other methods are the changing of the method of detection from anode bend to power grid or *vice versa*. This latter alteration should not be carried out in a receiver made by one of the manufacturers, but only to home-made receivers or kit receivers. This alteration consists of biasing the valve negatively to convert to anode bend. To convert anode bend to power grid remove the method of bias; if this consists of a resistance in the cathode circuit, connect a piece of wire across. Then connect a condenser of 0.0002 mfd. in the grid circuit and a grid leak of 0.25 megohm between grid and cathode.

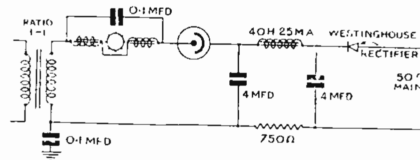
The scanning disc is provided with eight spokes for the purpose of indicating the correct speed at which the disc should turn. If a small neon lamp be fitted so that the rays from it fall on to the spokes, the disc will appear to stand still, when the lamp is connected to 50-cycle A.C. mains and the disc is revolving at 750 revs. per min. If this neon indicator is not available, the motor should be started and the corner of a stiff card held on the phonic wheel. The card will give a note of the teeth vibration on the card edge. If the radio be tuned to the vision signal, the speed of the motor may be increased until the note from the card is of the same pitch as the note from the speaker of the wireless set. This will give an approximate idea of the motor resistance setting.

The lamp should then be viewed through the lens and revolving disc. A series of black lines will be seen; if they slant towards the right of the receiver, the motor is travelling too fast; if they slant towards the left, the motor is travelling too slow. That is, assuming the speed has been brought as near to 750 r.p.m. as possible by one of the methods indicated.

The resistance should be gradually altered, until the black bands are horizontal, one at the top of the picture and one at the bottom; these are the synchronising signal bands. The synchronising gear should now hold this speed, if the radio signal is strong enough. The picture can be framed in a central position by turning the synchronising frame by means of the knob fitted to it. If the picture is split, the speed will have to be altered to allow the pictures to pass either upwards or downwards, until the subject comes into the centre. A useful way of doing this is to fit a switch to short circuit the synchronising coils. This allows the picture to slip, and when the required one comes into view the synchronising coils can be switched in again. With a little patience the machine will be found to do everything claimed for it.



Photograph of exciter unit showing simple construction



Method of lighting the neon lamp from a separate source: this diagram includes the synchronising circuit and if this is not used the connection should go straight from the neon lamp to the transformer.

"A Design for a Double Time Base"
(*Continued from page* 174.)

.01 mfd. condenser and 50,000 ohm resistance to the synchronising potentiometer. Actually 1 volt is all that is required to keep the relays in synchronism but the available output from the receiver will be about 10-30 volts and it will have to be reduced accordingly. Incidentally an excessive synchronising impulse will shut the time-base up altogether.

For convenience the modulation control for the tube is mounted on the same panel, and this is shown connected across the terminals marked "input." Since the tube is fed from its own H.T. supply it is necessary to insulate it completely from the receiver by means of the two condensers shown which are 1,000 v. working. It might be thought that larger capacity condensers were desirable in the signal input circuit to the tube, but considered in relation to the impedance of the shield circuit of the tube and the potentiometer, 0.1 is quite satisfactory.

For the convenience of those readers who already have a tube with its attendant exciter circuit this latter has not been incorporated in the time-base, although if the design is considered as a whole it would be preferable to accommodate the cathode rheostat and focusing control of the tube on the same panel as the time-base.

Accordingly an alternative layout of panel will be given in the constructional article next month

A New Detector

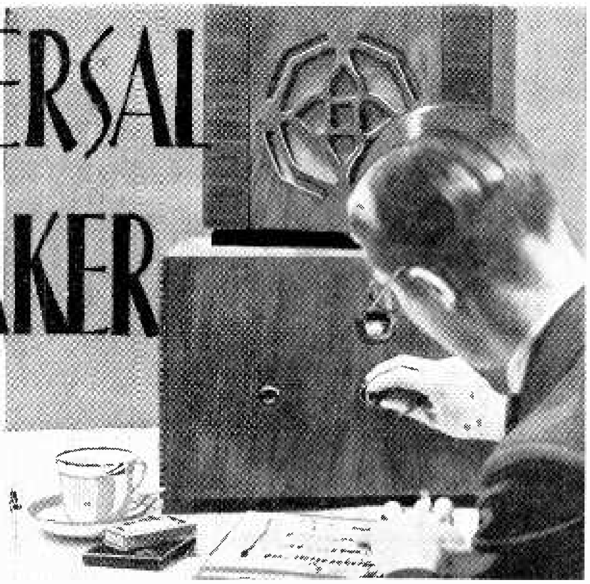
The main sphere of utility of the original W-type Westector was as second detector in a super-het, employing an intermediate frequency in the neighbourhood of 100 kilocycles. The relatively large self-capacity, however, made this device unsuitable for rectification at radio frequencies of the order of 1,000 kilocycles.

The new WX6-type Westector, however, is designed with a specially low self-capacity in order to overcome this difficulty, and is suitable for use at frequencies up to 1,500 kilocycles (200 metres).

This property renders the WX6 useful as a distortionless rectifier in television receivers, working on the London National station at a frequency of 1,149 kilocycles. Besides giving practically linear rectification the Westector acts as a high frequency stopper and so promotes stability.

The input for optimum rectification should not fall below 3 volts, unless a small bias is applied to the rectifier. An important function of its use in television receivers is that reversal of the Westector will serve to change a negative to a positive image.

Gas-filled Relays:—Owing to the special demands on our space in this issue the third and concluding article on Gas-filled Relays has been unavoidably held over.



The Television Society

President: Sir Ambrose Fleming, M.A., D.Sc., F.R.S.

Hon. Secretaries: J. J. Denton, 25, Lisburne Road, Hampstead, London, N.W.5. W. G. W. Mitchell, B.Sc., "Lynton," Newbury, Berks.

The PRESIDENTIAL ADDRESS by *Sir Ambrose Fleming, Kt., M.A., D.Sc., F.R.S.*

"INVENTION IN RELATION TO NATIONAL WELFARE AND LEGISLATIVE CONTROL."

AT the Sixth Annual General Meeting of the Television Society held at University College, London, on March 14th, an address was given by the President, Sir Ambrose Fleming, F.R.S., on "Invention in relation to National Welfare and its Legislative Control."

The address began with a reference to the progress in television as an instance of one of the most interesting of the technical applications of science. It fulfils the same function with regard to the eye that radio-telephony does for the ear. It annihilates distance and enables us to see living and moving objects which would otherwise be invisible. In short it enables us to be in two places at the same time. We are then led to consider the question how such an achievement can be made to contribute to national welfare apart from its interest as a mere scientific novelty or amusement.

Wireless telegraphy has an enormously valuable application in effecting communication between ships and the shore, and has been the means of saving countless lives in ship disasters. It is now seen, however, that all these mechanical and scientific inventions have a double character. They may be in some ways of great utility and create new industries.

Give Television a Chance

At the present time television has hardly had a chance of proving its utility. Controlled as it is, for reasons later explained, by the B.B.C., its exhibition is only given by them now at the greatly inconvenient hour of 11 p.m., when few persons are able to see it and not induced therefore to obtain television receivers. The great advances made in the use of short-electric waves and closer scanning and in photo-electric cells and cathode-ray tubes have made corresponding advances possible in television, and we can now transmit images of pictures, diagrams, or living persons and reproduce them on screens 3 or 4 feet square, visible to large audiences at the receiving stations. We have in this ability an extremely valuable means of education. Lectures and school lessons can be given by radio speech and illustrated by television diagrams or pictures. Botany, astronomy, physiology and other sciences can thus be taught by visible diagrams. Where more entertainment is desired it will before long be possible to transmit special films of moving objects and bring, as it were, the cinema into every home.

Invention requires guidance and control and it is difficult to introduce new methods and ideas when any one branch of activity has become centralised in a few hands or petrified by becoming a Government monopoly. This makes it necessary to point out how many disadvantages arise from erroneous or premature legislation intended to control invention. This may be illustrated by the history of telegraphy, telephony, electric lighting and wireless telegraphy. When after 1837 electric telegraphy became practicable by numerous inventions, public companies were formed to exploit it. About 1866 or so an opposition began to be raised to the growth of what was called another "monopoly." The British Government of that day then passed Acts of Parliament in 1868 and 1869 to enable them to buy out the telegraph companies and place electric telegraphy under the control of the General Post Office.

These Acts were, however, drawn with such skill that even ten years later when the telephone was invented and exchanges established, telephony was held to be subject to the above Acts. Unfortunately this decision rested merely on a judgment given in a Court of first instance and was never confirmed by a higher Court. The General Post Office offered the telephone companies a licence for 30 years in exchange for a royalty of ten per cent. on their receipts. During those 30 years it took nearly a million and a half sterling from the telephone, but it blocked the way to advances in the art during all that time.

An Anomaly

Television is now also in the grasp of the same power and they give it no chance to prove its utility at 11 p.m. when few people have any use for it. Accordingly it is clear that premature legislation can easily cripple a nascent industry and bind it in bandages of red tape. It is beyond defence that an invention which was not dreamt of at the date of a certain Act of Parliament should be controlled by that Act.

In conclusion Sir Ambrose Fleming advocated an extension of the period of patent protection which at present is 14 years in Great Britain, unless specially extended. An invention is no use to the public until it becomes practically available or commercialised, and this generally requires time and great expenditure. It is not possible to secure this without some reasonable prospect of return upon the capital, and in most cases a large part of the period of patent protection has elapsed before the point of commercial success is reached.

Finally, the President said: The members of the Television Society are all labourers in a new and fruitful field of work. Mr Baird's great pioneer work has shown the way to success. The labourers are now many and the opportunities are manifold. Let me wish them all success and conclude with the official motto of University College, London.

Cuncti Adsint, Meritaeque Expectent Praemia Kalmae, which as regards the Television Society may perhaps be translated very freely as follows:

Let as many join up as possible and let the rewards be to those who really deserve them.

As the prolonged applause subsided, the Chairman, Dr. Clarence Tierney, F.R.M.S., proposed the vote of thanks, which was supported by Mr. Wm. C. Keay (Treasurer) and Professor Clinton who spoke for the visitors, and passed with acclamation.

The next meeting was announced for April 11th, when a paper will be read on "Recent Advances in Photo-Cells," by Mr. H. Ruff (of the B. T. H. Co.).

Tickets of admission, and particulars of the Television Society, with proposal forms for membership can be had on application to J. J. Denton, hon. sec. (membership), 25, Lisburne Road, London, N.W.3.

In television you can SEE the effects of second-best components – so insist on

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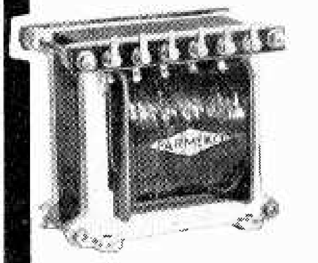

In the reception of speech and music quite an appreciable amount of distortion is possible without the result being displeasing. That is the excuse for the numerous Transformers and Chokes whose characteristics fall short—far short in many cases—of the standard of excellence achieved by PARMEKO. But in television *any* distortion is regrettable. In fact, only the best components are tolerable. Tell your dealer that is why you insist on PARMEKO. A complete catalogue of Transformers, Chokes, Loudspeakers, etc., will gladly be sent on application.

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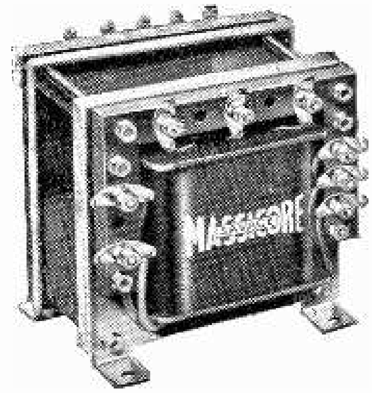

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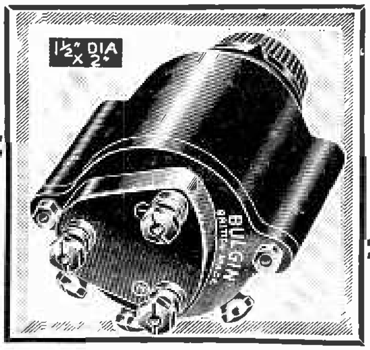

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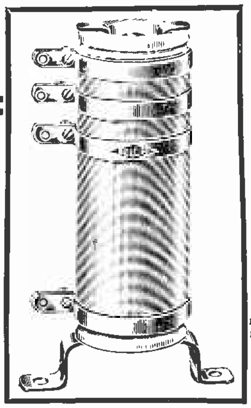

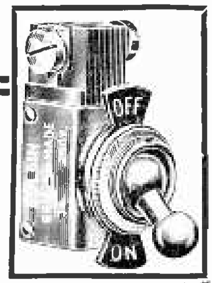

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"The Stixograph and Scophony"

(*Continued from page* 152)

A very simple echelon can be made with a piece of ribbed glass. The ribbing should be smooth waves, the the image represents the whole picture at once provided the latter is not too large, in which case the picture must be cut down until the sections of the Stixograph image do not overlap in a direction at right angles to the ribs.

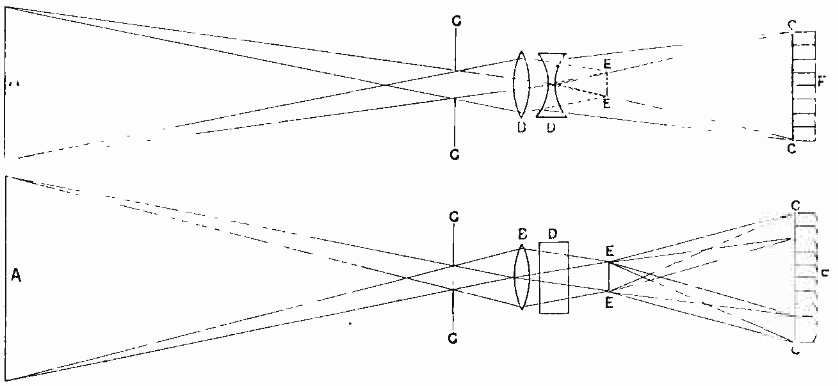


Fig. 15. Diagram of an alternative way of using a positive spherical lens for focusing.

distance between two adjacent waves about 5 mm. Better still are a number of glass rods, arranged like the ribbed glass, the rods being in contact. Obviously each rib is a cylindrical lens. As there are no laminations, two pieces of black paper can be pasted on the ribbed side of the glass plate to make a narrow slit at an angle of about 30 degrees with the ribs; or a metal sheet having a line of spaced holes may be put in contact with the ribs, so that each hole comes on the apex of a rib. This is shown in Fig. 12. With 5 mm. between the ribs, the holes can be spaced as shown, and each of the sizes given. Twenty active ribs will be quite sufficient to observe what takes place. A cylindrical lens of about 10 cms. focal length, about 12 cms. long and 2 to 3 cms. across the curve will be suitable as object lens. At a pinch a cylindrical bottle about 10 cms. diameter and filled with water will serve as object lens.

The object lens should be placed about 10 cms. from the ribbed side of the glass plate and at right angles to the ribs, and a slit parallel to lens, 1 to 1.5 cms. wide as a stop, should be placed between the lens and picture, adjusting distance for best definition. A picture can then be placed 10 cms. on the other side of the object lens and adjusted until a sharp cylindrical image is formed on the apertured plate. The image formed by the ribbed glass will be a stixograph, which can be focused on a ground glass screen or waxed paper. It will be noticed that

Scanning Actions

Try moving a pencil and other objects—even the picture—in the plane of the picture and observe the peculiar movements of the image points. Replace the picture with a screen, and make a thin line of light, which is parallel to the ribs, by focusing through a thin glass rod an image of a lamp filament in the focal plane of the ribbed glass. When the glass rod is moving in a direction parallel to the line of apertures, the normal television scanning action of a spot of light will be seen on the screen. Playing with even such crude apparatus will give one a very good idea of the principle characteristics of a Stixograph.

Another simple form of apparatus requires a number of small spherical lenses arranged in a line as shown in Fig. 13. No other lens is required, but in the focal plane of the lenses, which should all be of equal focal length, there should be a slit which crosses the bottom of the image of one end lens and the top of the image of the other end lens. The image visible after the slit is a Stixograph, though not a very good example.

The optical systems so far described are fixed-focus types, for any attempt to focus by varying lens or echelon positions would lead to distortions of the picture ratio, which would be unsatisfactory. In order that focusing at different distances of the object or screen may be accomplished, use has to be made of spherical lenses, or the equivalent. The reason for this is self evident, for a lens of one focal length, in order to focus a given object, requires moving a certain distance, whilst a lens of twice the focal length requires approximately a movement of twice that distance.

If the focal length of a lens giving horizontal definition is different from the lens giving vertical definition, then there will be unequal movement and unequal magnification or reduction, as the case might be. A spherical lens

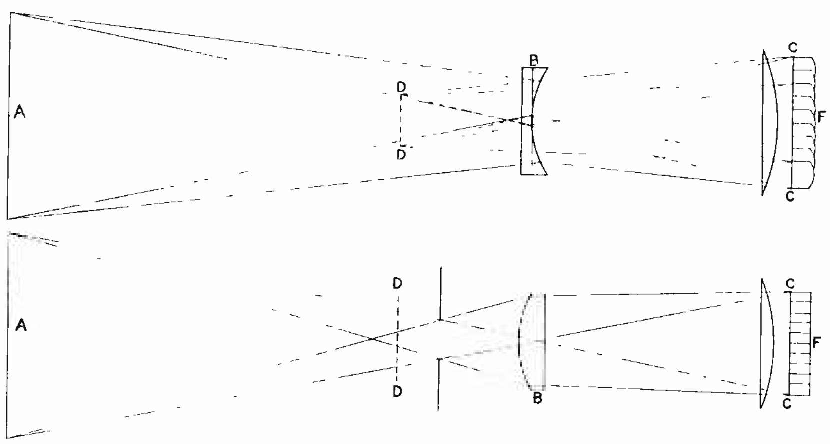
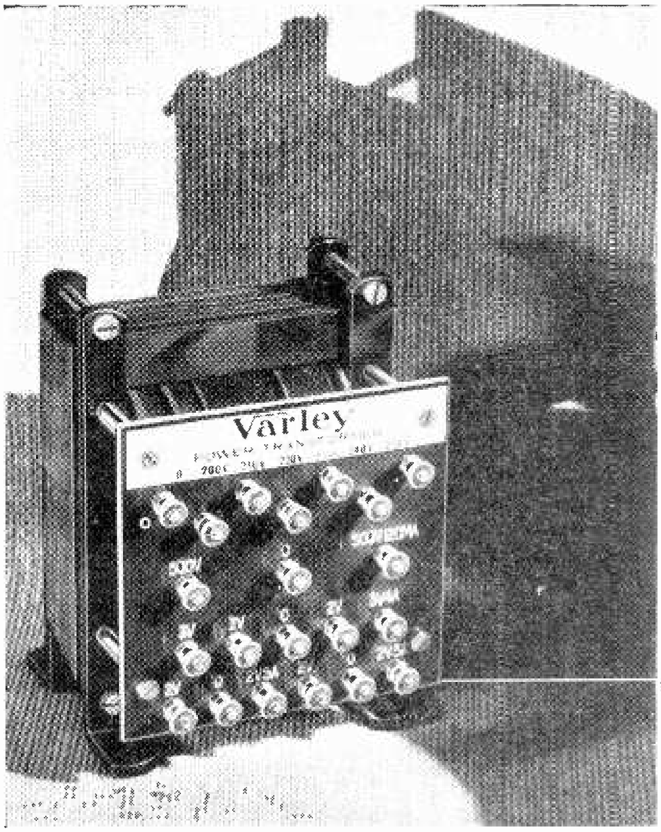


Fig. 16. Diagram showing the use of a double cylindrical lens for focusing.

focuses horizontally and vertically for the same movement, consequently there can be no distortion when one is used for focusing.

In Fig. 6 a negative spherical lens (i.e., plano-concave, bi-concave, or convex-concave with concave having smaller radius of curvature) of suitable power introduced between object lens *A* and object *B*, or in Figs. 9 and 10

(*Continued on page* 182)



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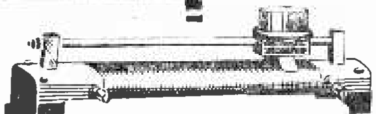

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"The Stixograph and Scophony"

(*Continued from page* 180)

between lens F and screen G, will enable one to adjust the focus satisfactorily. Positive (i.e., plano-convex, biconvex, or convex-concave with convex of smaller radius of curvature) spherical lens can also be used.

For instance, B in Fig. 6 may be a two-dimensional image of a scene formed by a spherical lens, so that without disturbing the arrangement as shown in Fig. 6 objects at any distance can be focused in the plane B by simply adjusting the spherical lens.

A spherical positive lens may also be used as shown in Figs. 14 and 15 in plan and side views. In Fig. 14 A is the object, B the spherical lens, which is adjustable for focus, C the fixed plane in which B would focus a two-dimensional image, but for the interposition of the fixed cylindrical positive lens D so that one cylindrical image having vertical definition is formed in the plane C, and another cylindrical image having horizontal definition is formed in the fixed plane E. The echelon F views the image in plane E to form the Stixograph, and has its entrant surfaces in the plane C. A little consideration will show that the Stixograph is formed by the processes previously described, or is converted into a normal picture by the reverse action.

In Fig. 15 the spherical lens B, which is adjustable for focusing, would form a two-dimensional image in the fixed plane E of the object A, but for the fixed cylindrical negative lens D, so that as before two cylindrical images are formed with definition at right angles in the planes E and C. A stop G obviates the use of a field lens before the plane E.

Spherical lenses are not essential for focusing, as is shown by Fig. 16. The adjustable lens B is a double-cylindrical lens, having convex curvature on one side, and concave on the other, the axes of these two curvatures being at right angles. The lens therefore will simultaneously give a real cylindrical image of an object A, having vertical definition in the plane C, and a virtual cylindrical image, having horizontal definition in the plane D. When the two curvatures are equal, or rather when the focal length as a negative lens, is equal to the focal length as a positive lens, the two planes C and D are a fixed distance apart for accurate focusing of A, no matter what the distance A may be from B, which means that one adjustment of B simultaneously focuses in planes C and D. The echelon F has its entrant surfaces in the plane C and views the virtual image in plane D to form the Stixograph, or used reversed will project a normal picture from a Stixograph in any plane A.

The arrangement of Fig. 16 is one of the best for projecting a normal picture from a Stixograph, whilst those of Figs. 14 and 15 are more useful in forming a Stixograph. The reason for this is that the size of the pictures must be limited to prevent overlap of sections of the Stixograph, and to do this there must be a real image, which can be limited by a field stop, which the echelon views. When projecting a normal picture, this limitation of picture size is not so important, for as shown in Fig. 11 the required picture cannot be disturbed and the unwanted side pictures can be readily removed by a suitable size of screen.

In Figs. 9, 10 and 16 a field lens is shown before the echelon. Field lenses are very useful, for with them it is more easy to obtain a regular Stixograph, i.e., one in which all sections or lamination images are of equal size and equally spaced. Field lenses are useful also on the Stixograph side of the echelon, particularly in television. Actually in this position, they act as condensers in the case of projection, serving to fill the echelon fully with light.

A Chat with Okolicsanyi

HERR FRANZ VON OKOLICSANYI, during a flying visit to London, recently gave the writer some details of the work being done in Germany with regard to television. The laboratories of the Tekade in Nurnberg have been engaged in developing the 180-line mirror-screw. The research work has now been completed and the apparatus is ready.

The mirror-screw gives an image 18 by 21 cms. and the picture is black and white. A Kerr cell of the ordinary wet type giving a slit of light 6 cms. high which is then magnified to the required size by cylindrical lens is used. The reason why a wet Kerr cell is used in this receiver in preference to a zinc sulphide crystal cell is because, due to the considerable length of slit required, a liquid cell had to be used as a zinc sulphide crystal of such length was unobtainable. Research work on zinc sulphide cells has been going on and several other suitable crystals have been found.

The writer mentioned to Mr. Okolicsanyi that English experimenters had had little success with the crystal cells, at which he seemed very surprised. He said that he considered the problem of crystal cells one of the simplest he had yet come across in television and he has many such cells working very satisfactorily in the Tekade laboratories. He assured the writer that those who understand the use of the crystal should be able to get excellent results without difficulty.

These zinc sulphide cells together with the 180-line mirror-screw receiver will be shown at the forthcoming Radio Exhibition in August.

With regard to ultra-short wave transmissions, work is going on in Berlin. At the time of writing the second transmitter for sound will have been completed, the other one having been modified to take the additional band width of 500 kc. to accommodate 180 lines. A series of tests will then be made using different forms of synchronisation; firstly a system of Telefunken's will be tried in which the synchronising impulse is modulated downwards, and after that a system of Herr von Okolicsanyi's will be tried in which the synchronising impulses are transmitted with the sound instead of with the vision.

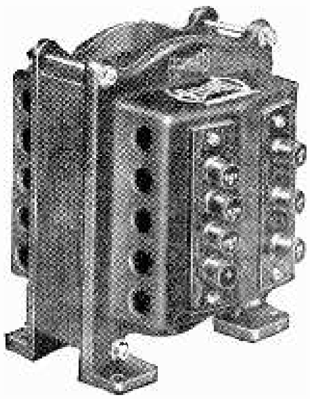
By the time of the exhibition it should have been decided which one of these two systems will be used. The Germans hope to start a regular service on 180 lines in the autumn providing that the progress associated with the ultra-short wave transmission and reception is sufficiently advanced by then.

E. TRAUB.

Television in S. Africa Soon.

Mr. I. W. Schlesinger, chairman of the African Broadcasting Company, at the opening of the new broadcasting station at Cape Town, said there were now 70,000 licence-holders on their books. He predicted the early operation of television in South Africa. He said, "Some little time may elapse ere this can be done, for the presence of a television engineer whose services are not available at the moment will be necessary. He has made me a promise, however, to come out here during the course of this year.

"With the least possible delay, therefore, I shall carry into effect the undertaking I am giving you to-night, when entertainments now possible only within the four walls of a place of amusement will be projected in your own homes, the cost of which will be within the reach of all."



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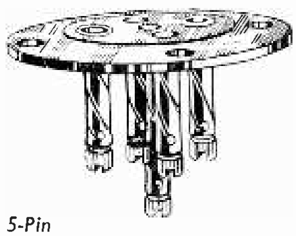

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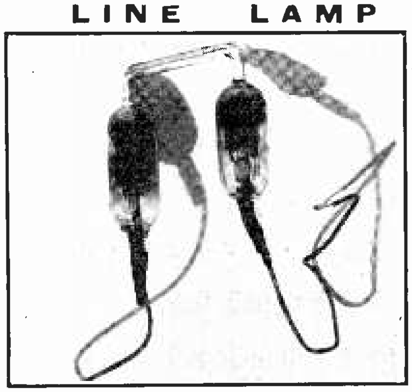

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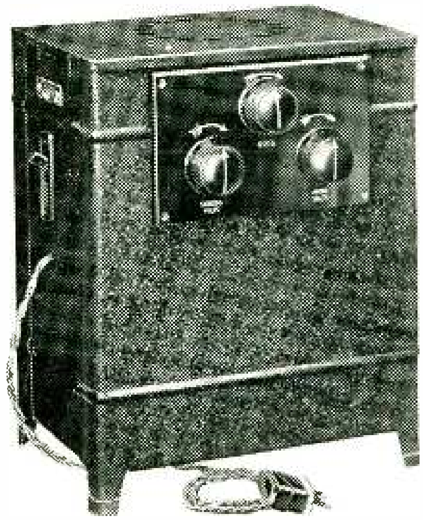

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