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
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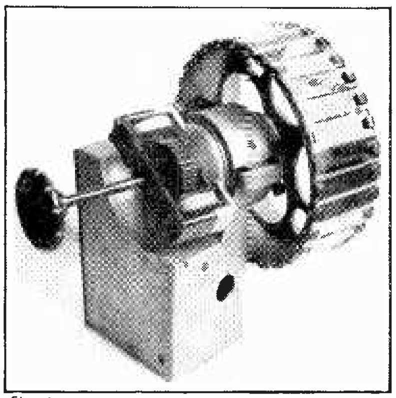

Showing the Baird Precision Mirror Drum mounted with driving motor, sychronising mechanism, stand and lamp housing.

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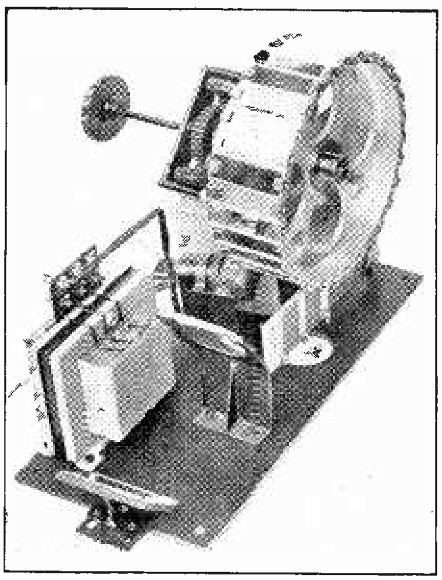

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	£	s.	d.
Motor and synchronising gear, with stand and lamp housing	6	0	0
or			
Motor and synchronising gear only	5	0	0
Mirror Drum with flexible coupling	5	10	0
Grid Cell unit complete with projector lamp	5	0	0
Drilled Baseplate with Swivel Mirror and lens mount ...	1	0	0
Lens		4	0
Lamp Transformer	1	5	0
Variable Resistance		17	6
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Grid Cell alone ...	each	2	0	0
Square ended polarising prisms—				
6 mm. aperture ...	,,		17	6
7 mm. aperture ...	,,	1	2	6
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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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In This Issue

TELEVISION

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COMMENT OF THE MONTH

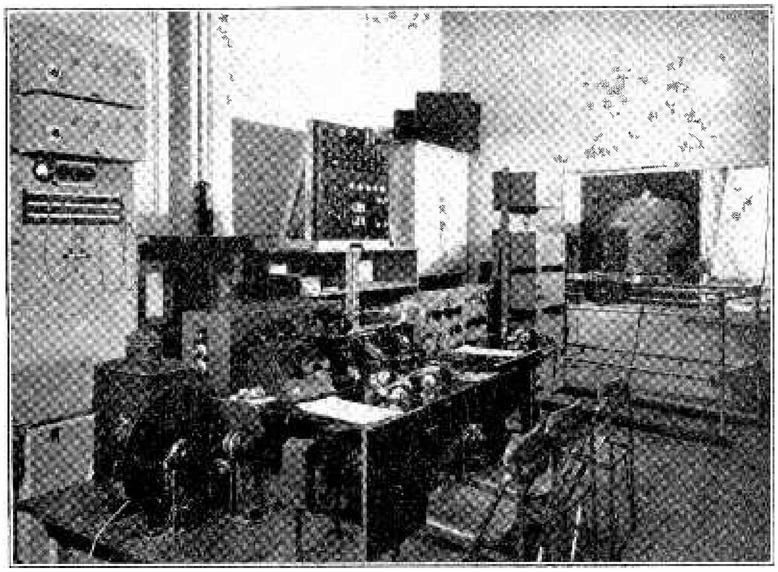
The Thirty-line Transmissions.

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.

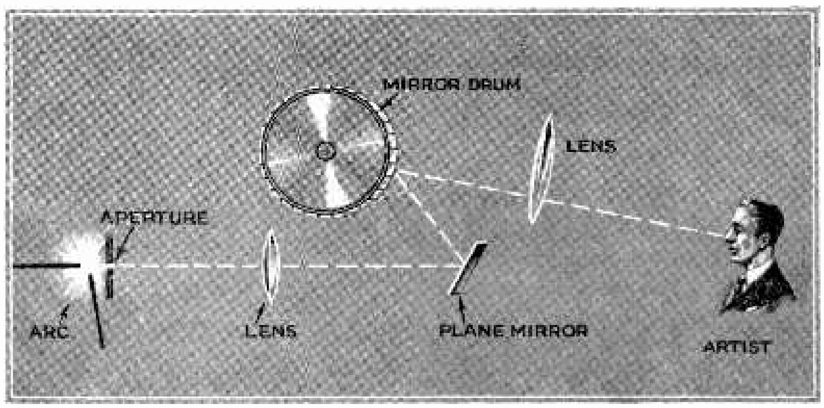
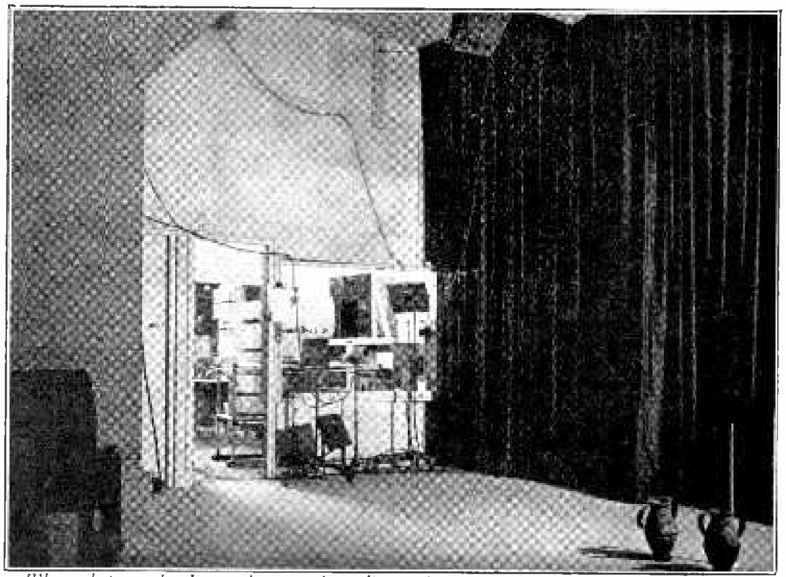


Fig. 1. This sketch shows the light and optical arrangements of the scanner.

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

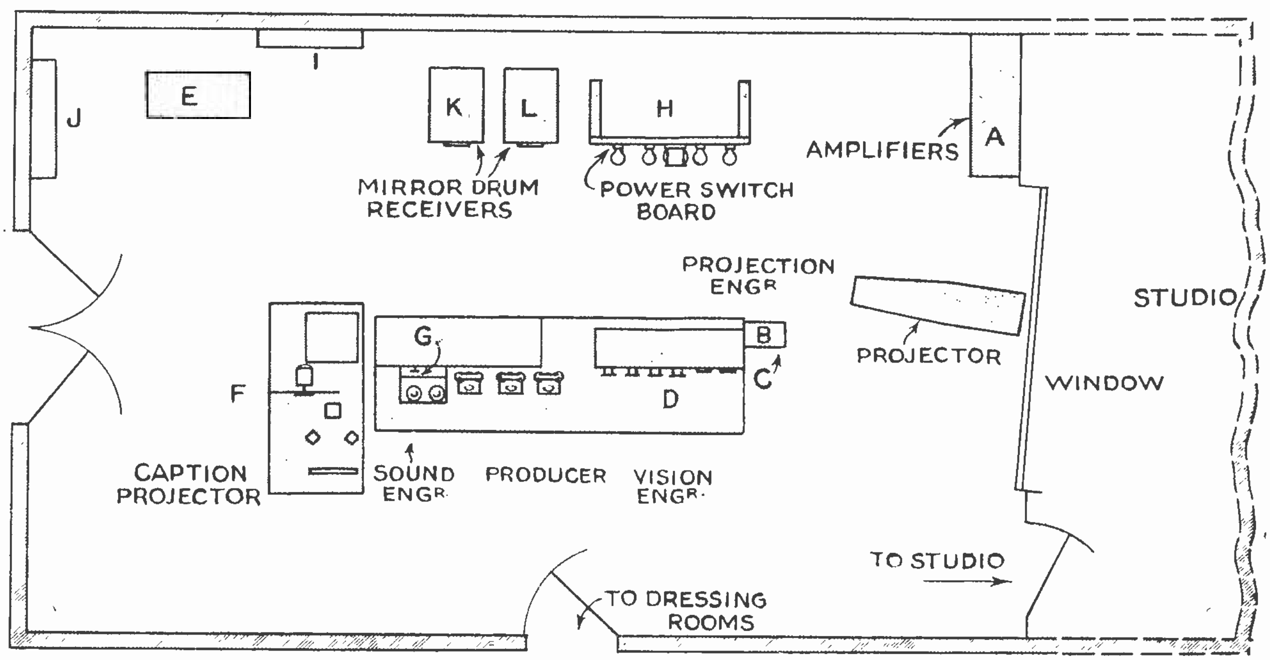


Fig. 2. A plan of the control room from which the positions of the various units can be clearly seen. Reference to the photograph on the opposite page and the text will enable all these to be identified.

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

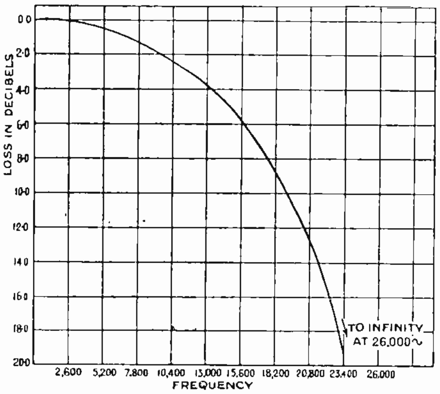


Fig. 3. This diagram shows a typical frequency characteristic for an aperture.

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

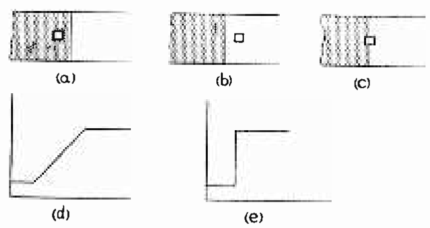


Fig. 4. Diagram showing an aperture scanning a picture in which there is a sudden change from black to white.

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.

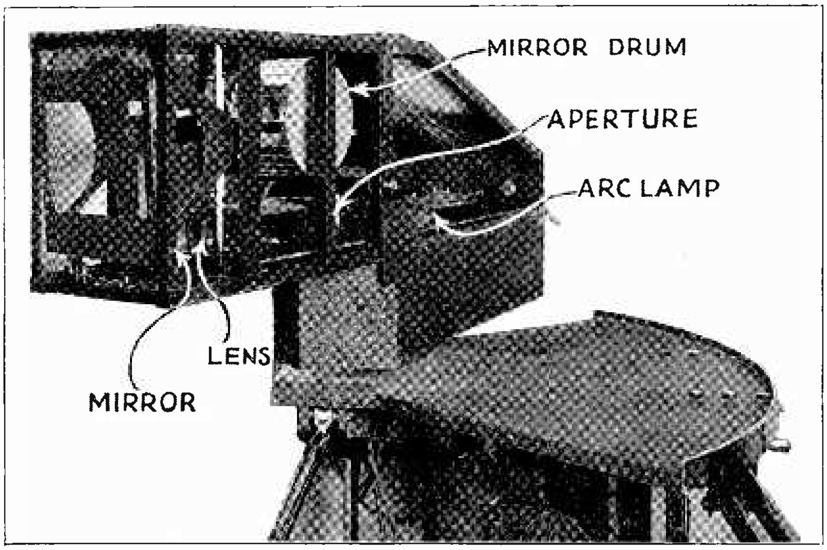
The mixer output is applied to a three-stage resistance-coupled amplifier of similar design to the A amplifiers, but whose gain is 62 decibels; this is shown at *B* in Fig. 2. These amplifiers have two outputs, each of which is connected to a constant-resistance equaliser which is known as the aperture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

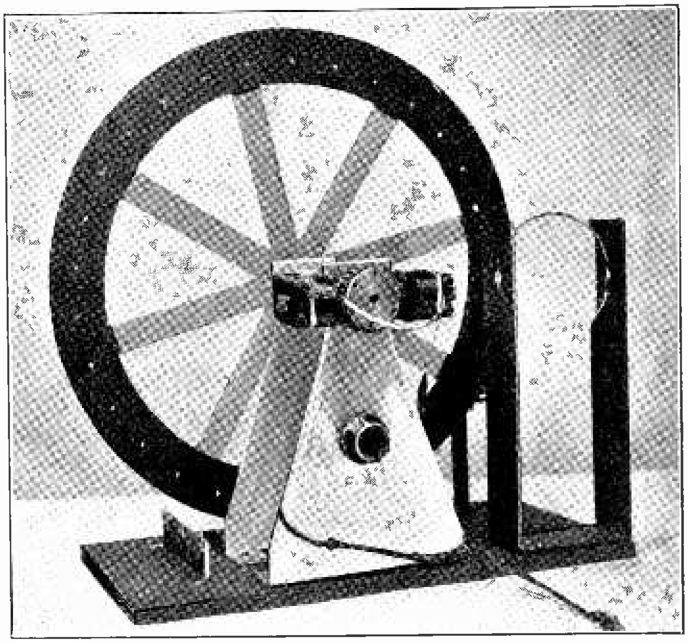
* * *

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 inter-action 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.

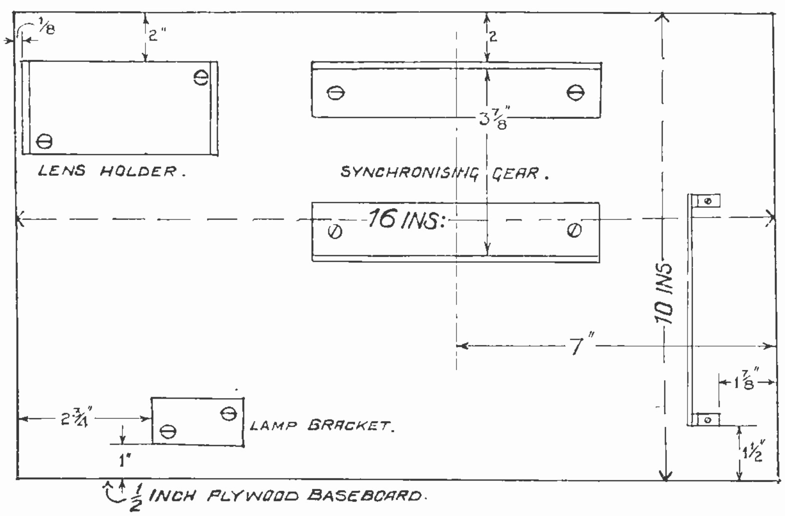
THE *Daily Express* has realised that the time has come when it is practicable to place before the public a simple television receiver, in kit form, which can be operated from the average wireless set with the certainty that it will give satisfaction. Our readers will, of course, be aware that machines 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.

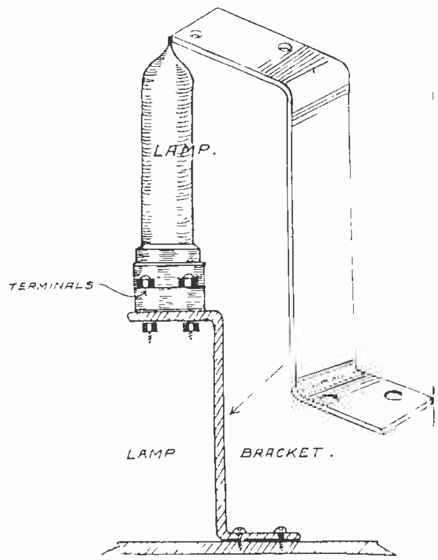
Assembly

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.



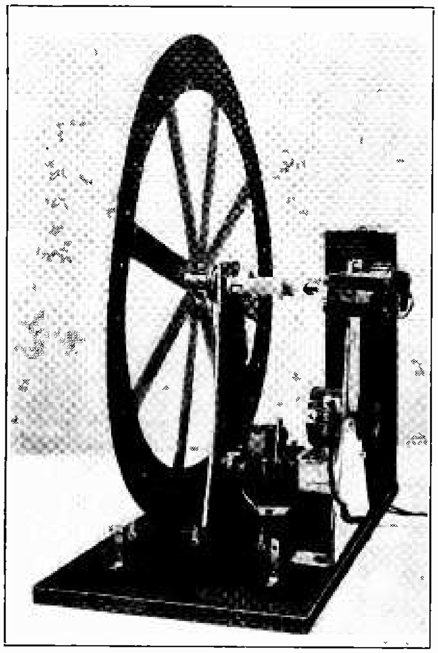
Layout of baseboard showing the exact positions of the various units.



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



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

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.

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

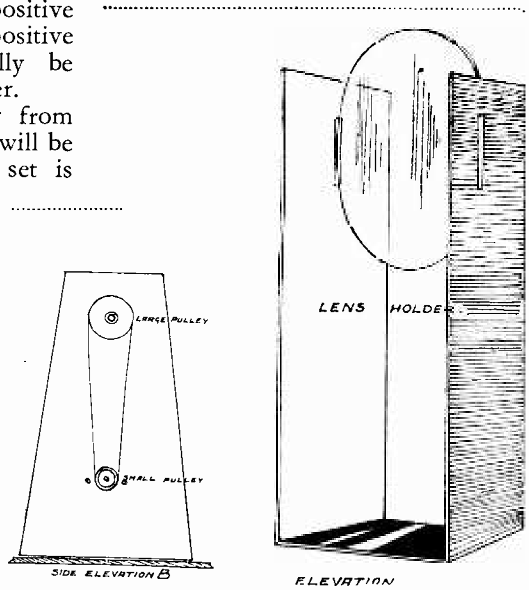
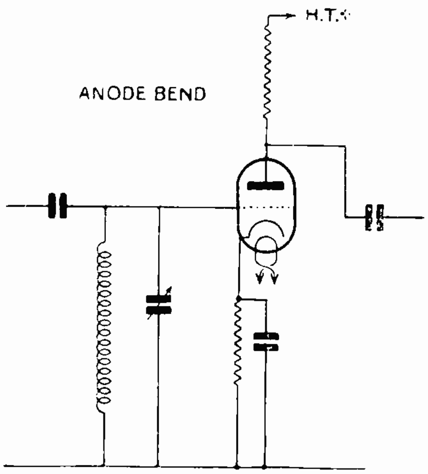


Diagram showing disc drive and method of supporting lens.

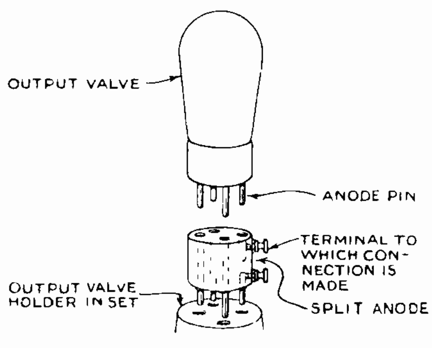
circuit be removed or disconnected during use as a television receiver. This alteration need not be made, of course, if the split anode adaptor is used.

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-

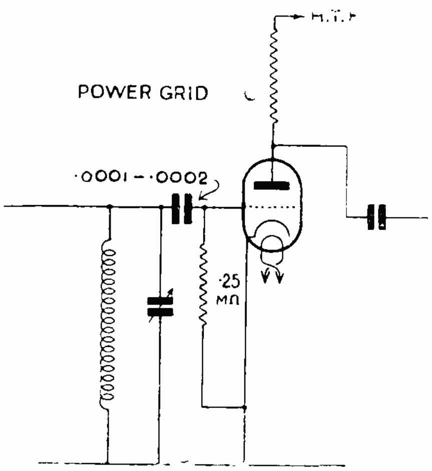
(*Continued on page* 176)



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 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, 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.

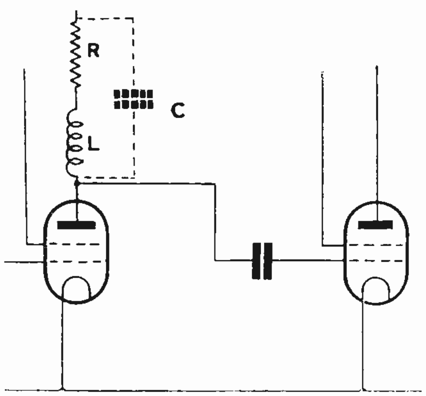


Fig. 2. *Circuit for maintaining the upper frequencies.*

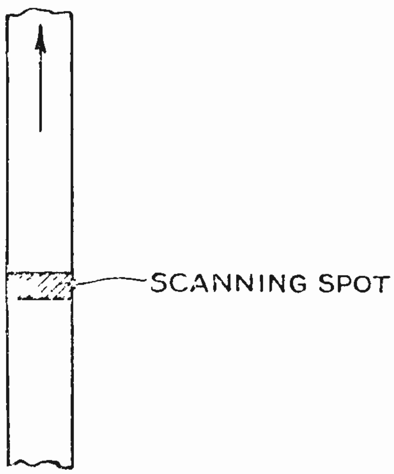


Fig. 1. *An oblong scanning spot could be used to give greater detail in a 30-line transmission.*

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

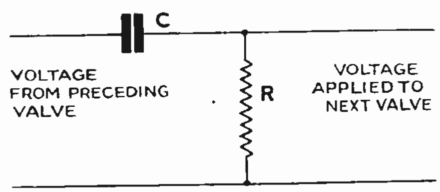


Fig. 3. *Skeleton resistance coupled network (omitting H.T. and grid bias batteries).*

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.

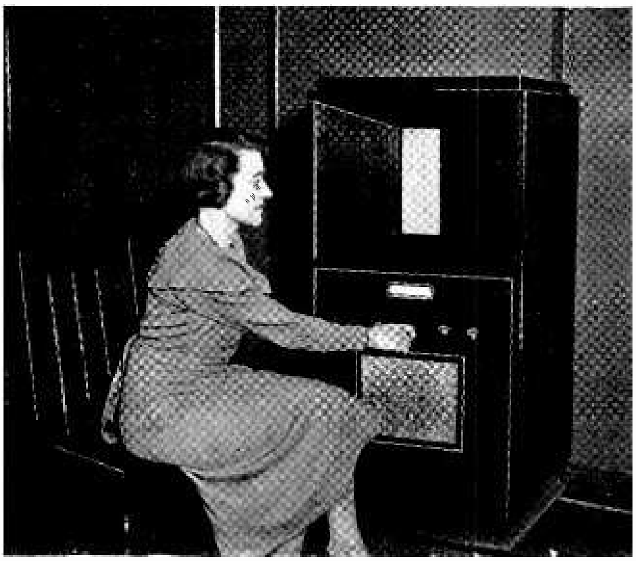
The scanning disc is to run in a vacuum. The speed of this scanning disc at its outer periphery is 290 metres per second.

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



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.

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.

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*.

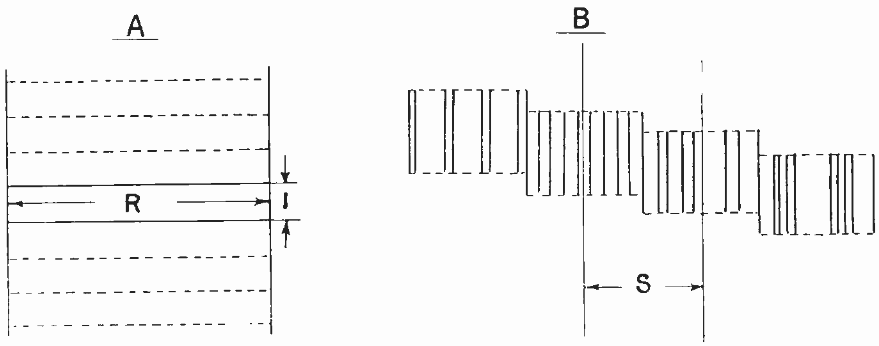


Fig. 8. Diagrams showing the characteristics of a Stixograph in terms of the picture.

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.

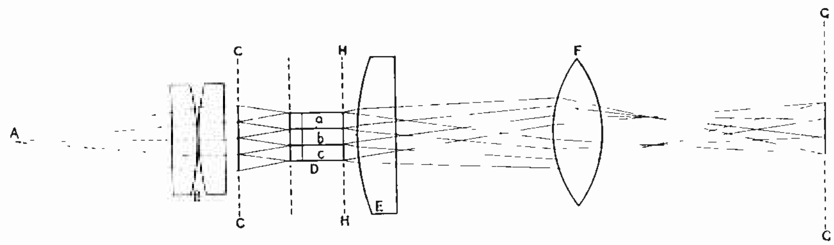
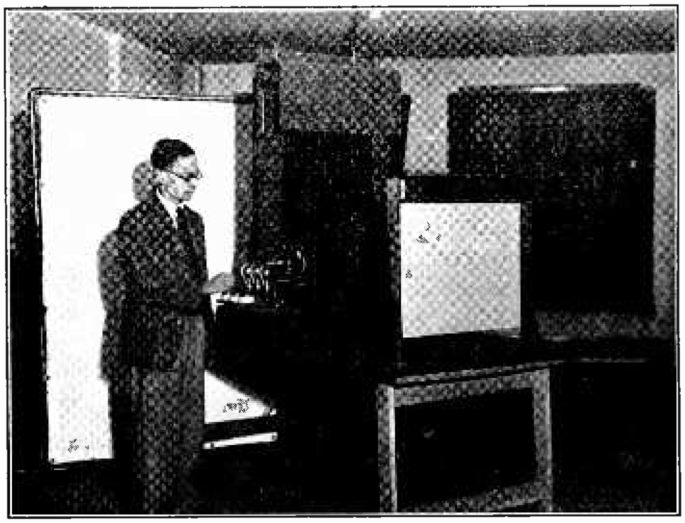


Fig. 9. Arrangement for projecting a Stixograph as a normal picture, showing the re-introduction of vertical definition.

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.

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.

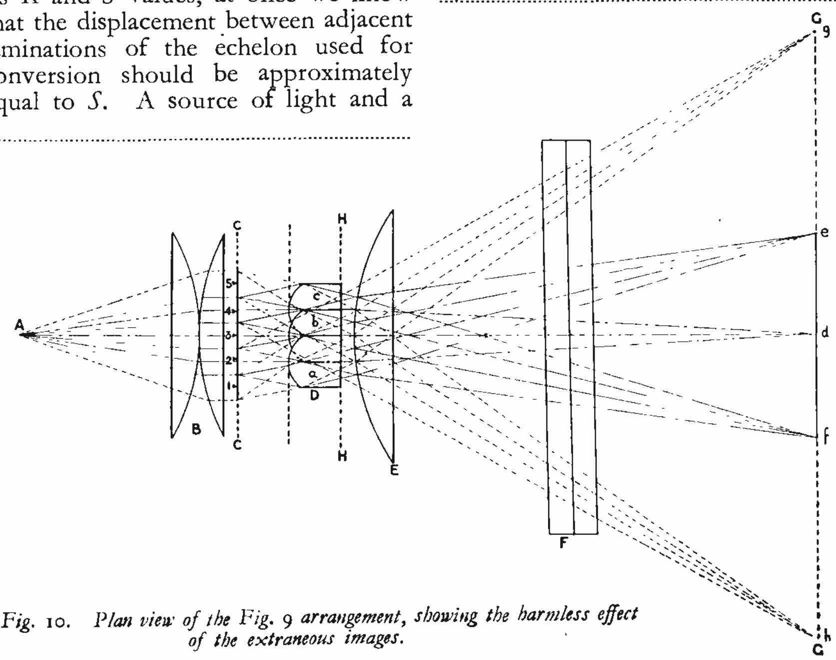


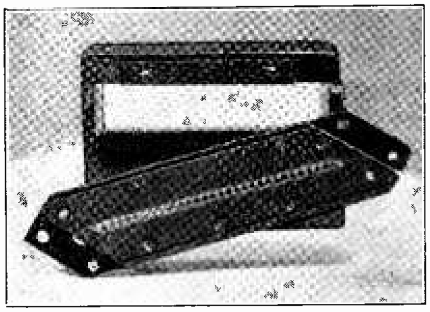
Fig. 10. Plan view of the Fig. 9 arrangement, showing the harmless effect of the extraneous images.

At the entrant surfaces of the laminations in Fig. 9 the light may or may not fill the lamination, but in either case 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 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 are in different strips, as shown in Fig. 11, and therefore do not interfere by overlap either vertically or horizontally.



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

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.

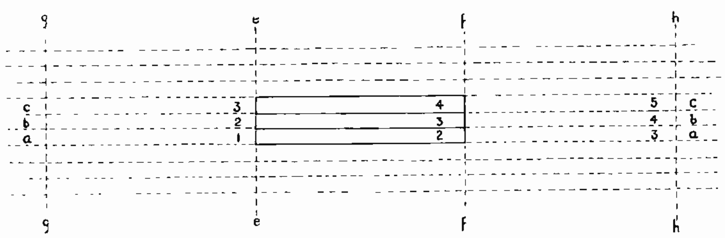


Fig. 11. Appearance of the normal picture projected by the arrangement of Figs. 9 and 10 showing extraneous images.

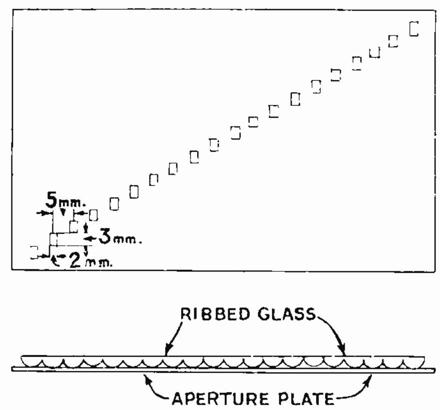


Fig. 12. Diagram of a crude echelon using an apertured plate and ribbed glass.

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, 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 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

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 $\frac{MS}{RT} = m$.

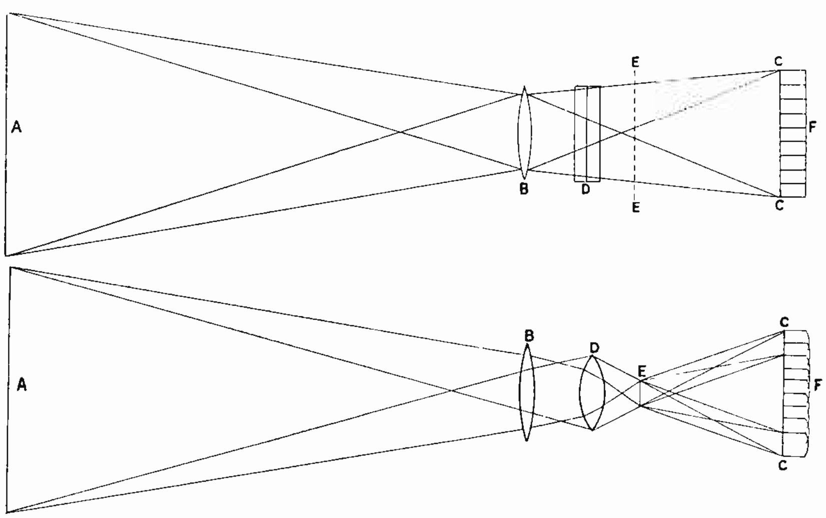


Fig. 14. Diagram showing the use of a positive spherical lens for focusing.

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

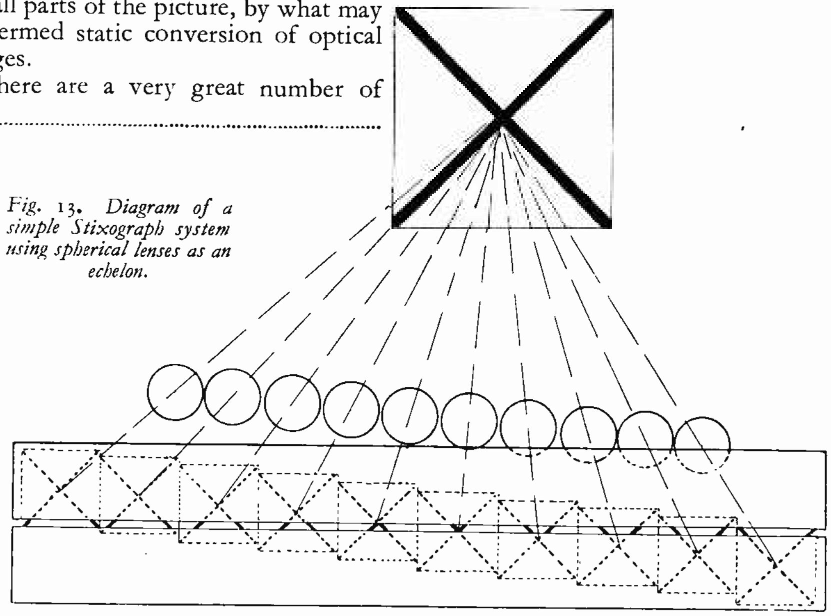


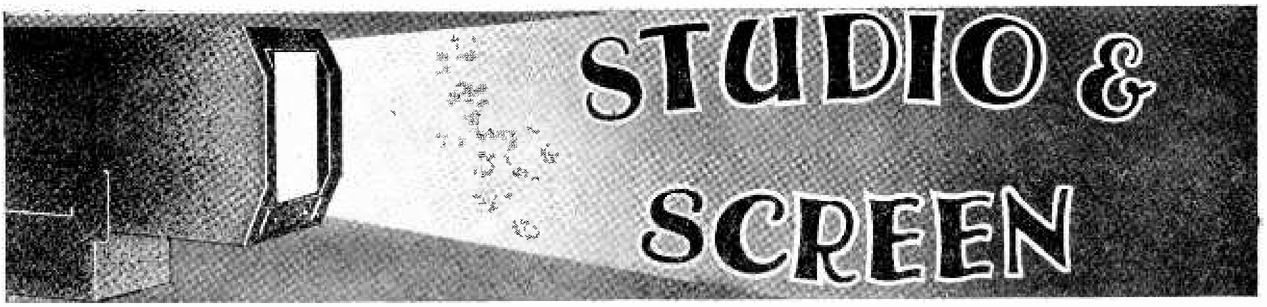
Fig. 13. Diagram of a simple Stixograph system using spherical lenses as an echelon.

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.

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)



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

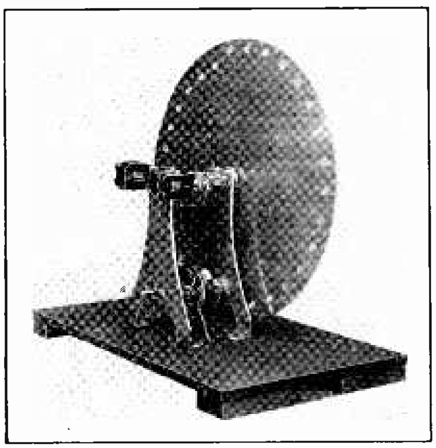
Here are brief particulars of a novel type of disc receiver which will produce a projected image.

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.

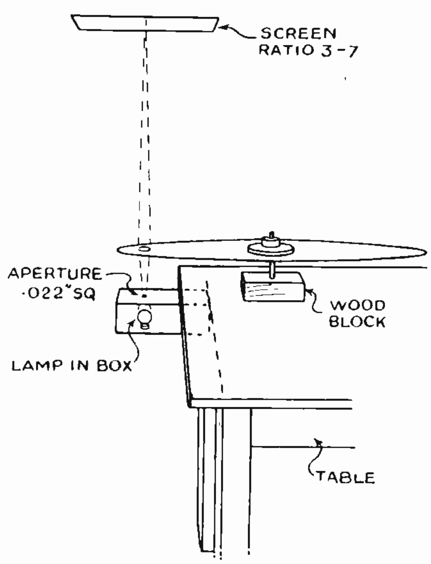
The disc is belt-driven with a step-down ratio of the pulleys, so that an ordinary small motor will be found sufficiently powerful to drive it. This is necessary if a small motor be used as, owing to the weight of the disc which must be quite stiff, more power is required than with the thinner discs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



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

The parts required are few and are given below :—

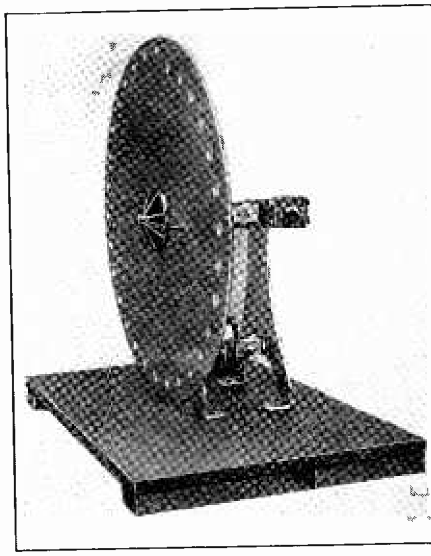
1 sheet of aluminium cut to 16 in. diameter and fitted with bush, and indexed every 12 degrees on the edge. (H. E. Sanders.)
30 special disc focus lenses. (Mervyn.)



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

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

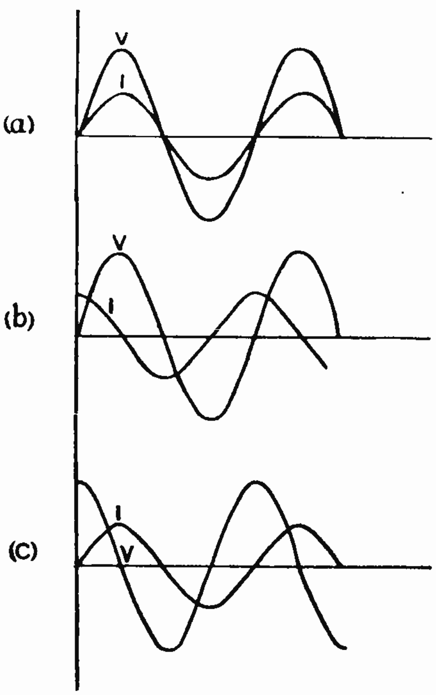


Fig. 1. Curves showing phase lead and lag.

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" 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:

$I=\frac{E}{\sqrt{R^2+(\frac{1}{WC})^2}}$ 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.

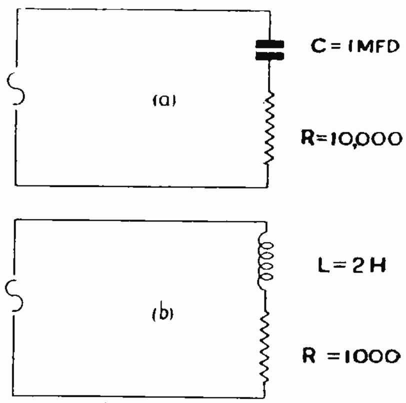


Fig. 2a. Condenser in series with resistance.
Fig. 2b. An inductance in series with a resistance.

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

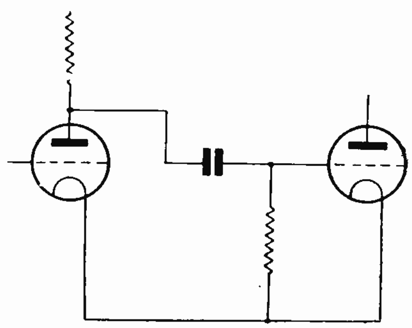


Fig. 3. Theoretical circuit of two valves of resistance coupled amplifier.

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

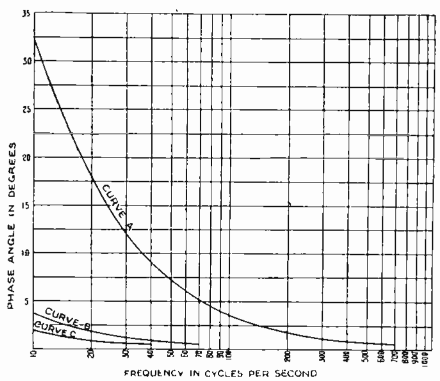


Fig. 4. Curves of phase angle plotted against frequency for different values of condenser and resistance.

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.

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

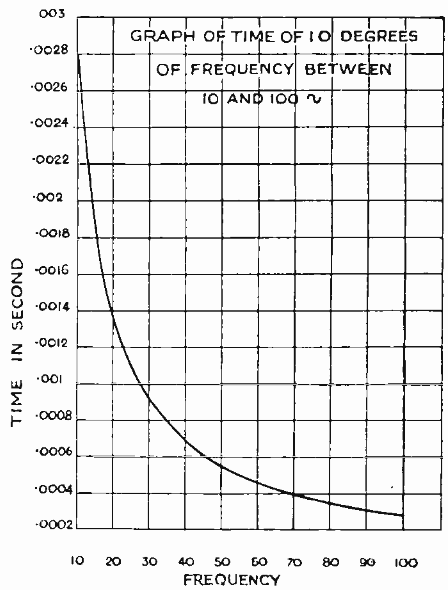


Fig. 5. Graph of the time period of 10 degrees for frequencies from 10 to 100 cycles.

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.

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.)

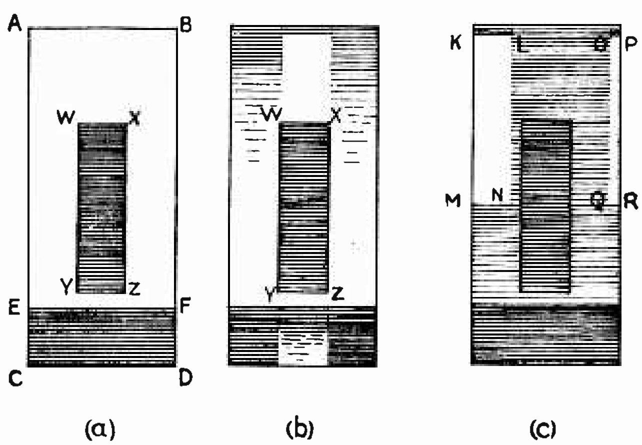
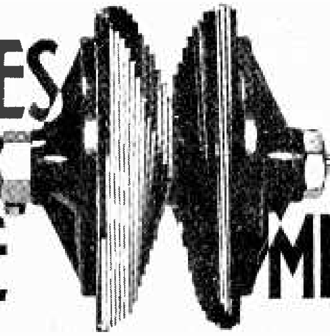


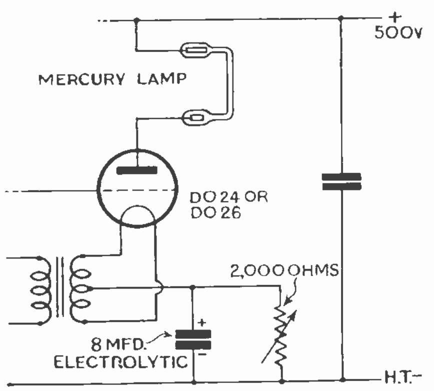
Fig. 6. Diagrams showing how phase distortion makes itself apparent on the screen; note the appearance of flares on b and c.

LIGHT SOURCES for THE MIRROR SCREW



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.

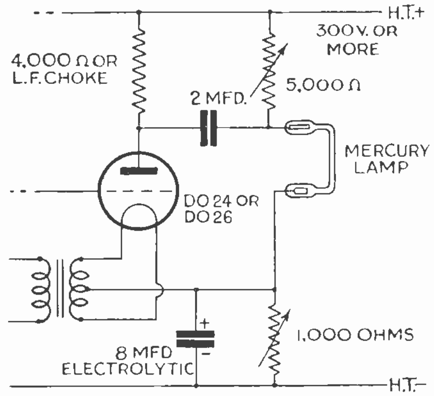
Tubes specially designed for screw work, and containing neon, or some equivalent mixture of gases giving a whiter light, are already obtainable. They have the advantages of requiring less power for their operation and having better modulation characteristics than the others under discussion, and are 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.

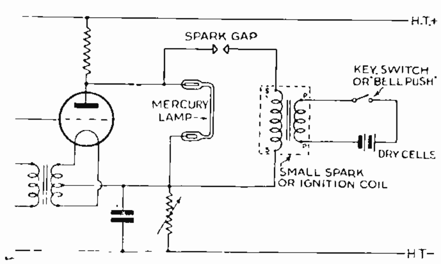
Masking

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.

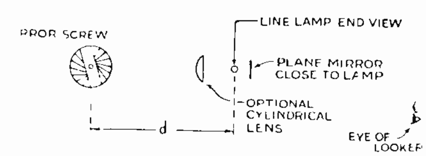
Striking the Mercury Lamp

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:*

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

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.

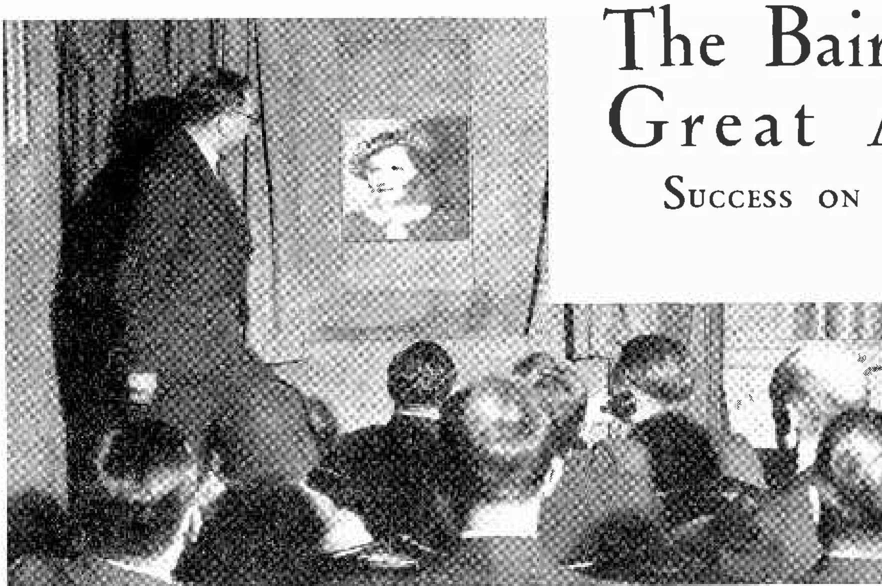
Let us assume that the white "flare" is chiefly the result of a frequency delay of 25 cycles. Obviously, the phase angle must be more than 180 degrees to produce a negative. Assuming it to be 270 degrees, which, expressed in time, is .03 second, and in picture time periods is .375 of a picture, this 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.

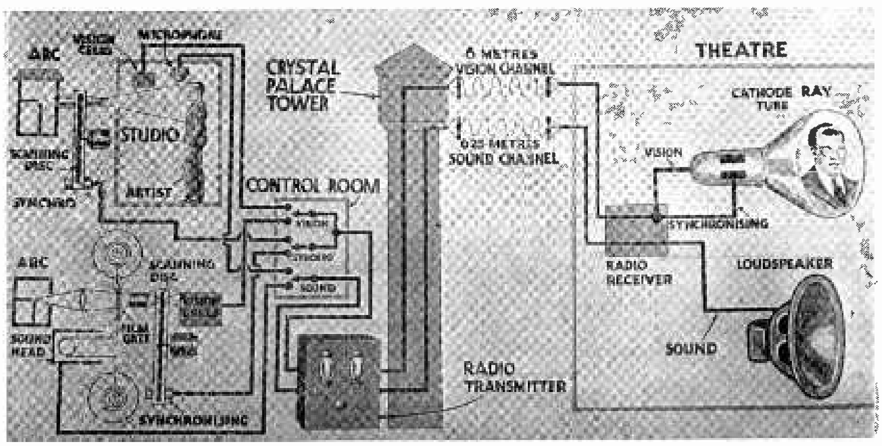
The scheme of the new Baird system is shown in a simple manner by the accompanying diagram. It will be seen that a disc scanner is used at the transmitting end and a cathode-ray tube for reception. The actual diameter of the tube is twelve inches and the image on this is magnified by means of a lens 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.

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."

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



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

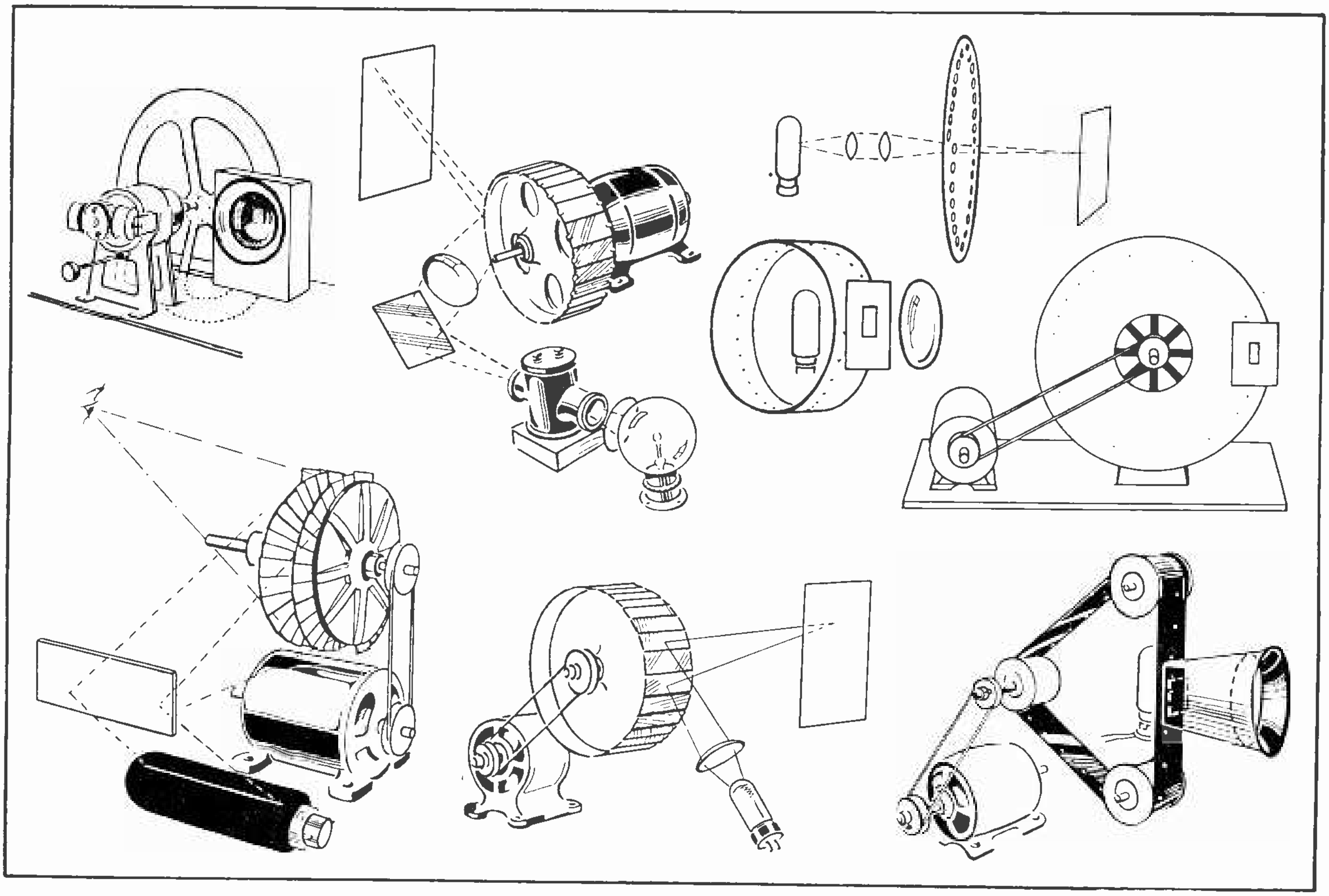
At the top, the lens disc is shown which allows a projected picture to be obtained with the disc and is but little more complicated than the ordinary simple disc. Below this we have what amounts to a modification of the simple disc receiver, but in this case a drum is used instead of the disc. Various 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.

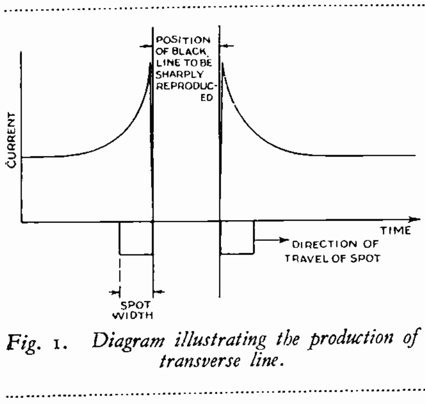


Fig. 1. Diagram illustrating the production of a transverse line.

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_0T, 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 $(b_1\delta_1 t + b_2\delta_2 t) = b_0T$

That is :— $b_0T + b_2\delta_2 t = b_0T$

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.

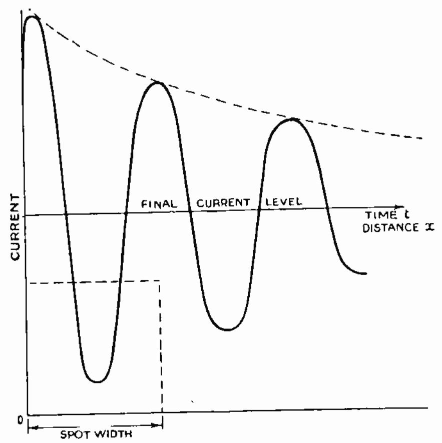


Fig. 2. Relation between amplitude of oscillation and spot travel.

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

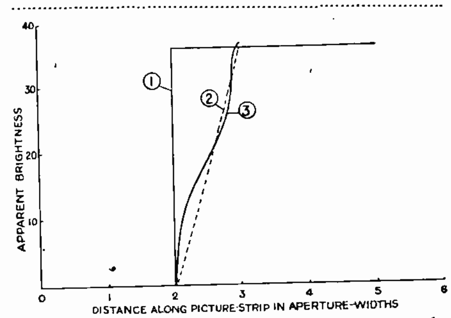


Fig. 3. Curve 1: True shape to be reproduced; Curve 2: Shape reproduced without correction; Curve 3: Shape as corrected partially by single term transient oscillation.

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 :—

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

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 :

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

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

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

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 :

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

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

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

we have :

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

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

we have :—

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

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

Similarly :

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

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

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

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

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

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

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 :

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

$=174{,}000$

$T=.0000363$ sec.

But $\alpha\times4T=—2.5$ approx.

$$e^{4T\alpha}=e^{-2.5}=\frac{1}{e^{2.5}}=\frac{1}{2{\cdot}718^{2.5}}$$

= one-tenth

so that $\alpha=—17{,}250$.

traverse such that the front edge of the aperture passes it at t'' and the back edge at t''' ,we have :

$$L=\int_{t''}^{t'''} b\,dt$$

$$=\int_{t''}^{t'''} b_0dt+\frac{b_0dt}{101p}\Big[10\mathrm{Sin}10pt—\mathrm{Cos}10pt\Big]_{t'''}^{t''}$$

$$=b_0T+\frac{b_0}{101p}\Big[10\mathrm{Sin}10pt—\mathrm{Cos}10pt\Big]_{t''}^{t'''}$$

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

$$L=b_0t'+\frac{b_0}{101p}\Big[10\mathrm{Sin}10pt—\mathrm{Cos}10pt\Big]_0^{t_1}$$

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 $\beta=—10\alpha$ 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.

$$L=\int_0^{t'} b\,dt$$

$$=\int_0^{t'} b_0dt+\frac{b_0dt}{101p}\Big[10\mathrm{Sin}10pt—\mathrm{Cos}10pt\Big]_0^{t'}$$

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

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.

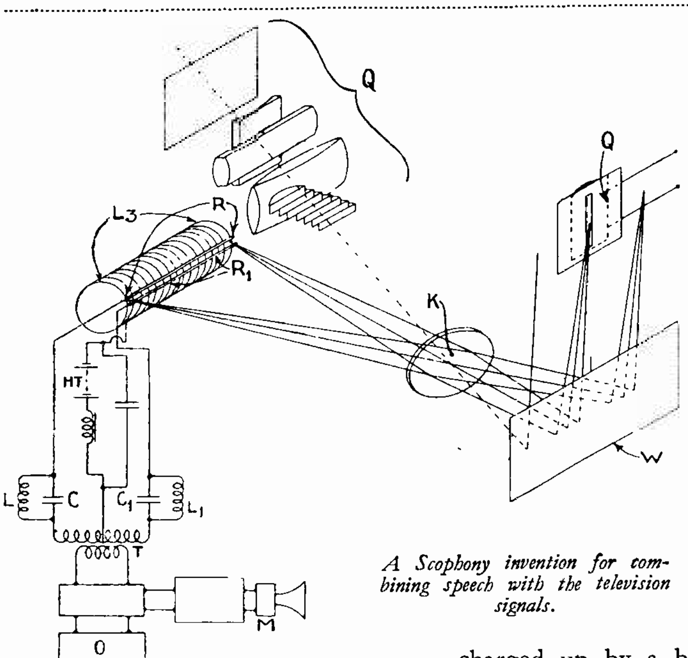
Over-modulation in a cathode-ray television viewer results in a " soot and whitewash " effect combined with curling of the ends of the lines forming the white portion of the image. This is due to the excessive decrease in shield bias which causes the beam to wander slightly on its vertical travel. Under-modulation, 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.



A Scophony invention for combining speech with the television signals.

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.

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.

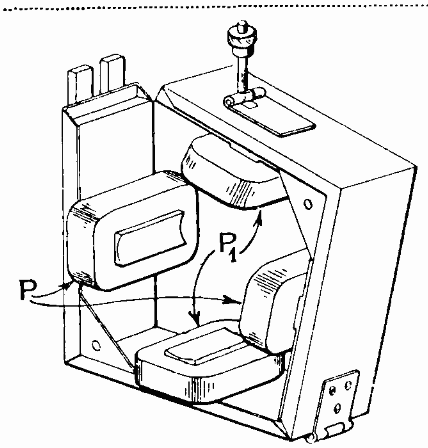
The effect of the amplified voltages from the microphone is to increase the voltage between the charged coil L_3 and one or other of the rods R, R_1, so that sparks begin to pass. They do not, however, pass in a haphazard fashion but select the particular point along the coil at which the resulting discharge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

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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

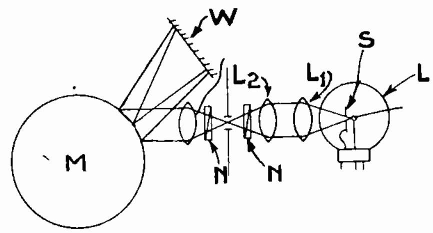


Fig. 1. The optical arrangements of the Pye mirror drum receiver.

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

Fig. 2 shows a cabinet containing

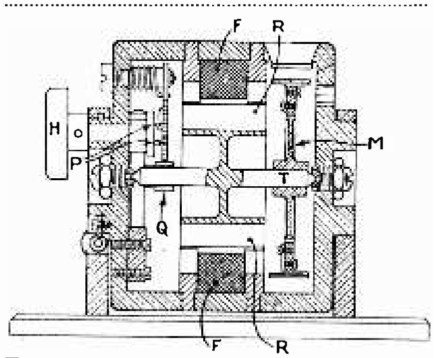


Fig. 2. Cross section of Pye receiver showing the phonic motor.

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.

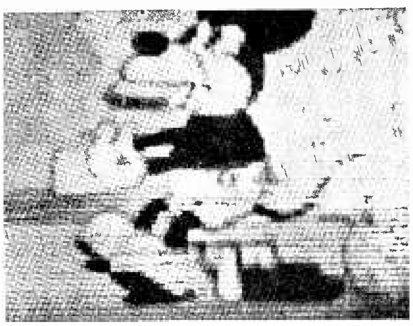
Provided that good headphone strength is obtainable from a receiver it will be suitable for producing television images on a cathode-ray tube. This is of interest to those who have no electrical supply installed in their homes The cathode-ray equipment itself can be operated from 2-volt cells and H.T.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

TELEVISION IMAGES AN EXPERIMENTAL METHOD OF OBTAINING DATA

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.

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

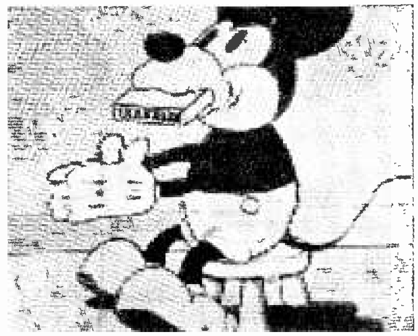


A reproduction of sixty-line horizontal scanning: the stepped effect is apparent.

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. 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.

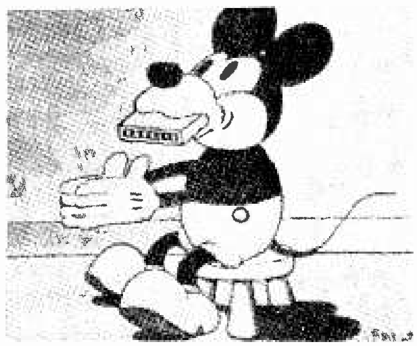
larger numbers of scanning lines. These equivalents should be so made that they represent nearly perfect picture structures for the detail included. This seems desirable so as to avoid mistakes in judgment. Also, it will permit study with images equivalent to the more advanced stages of television which 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

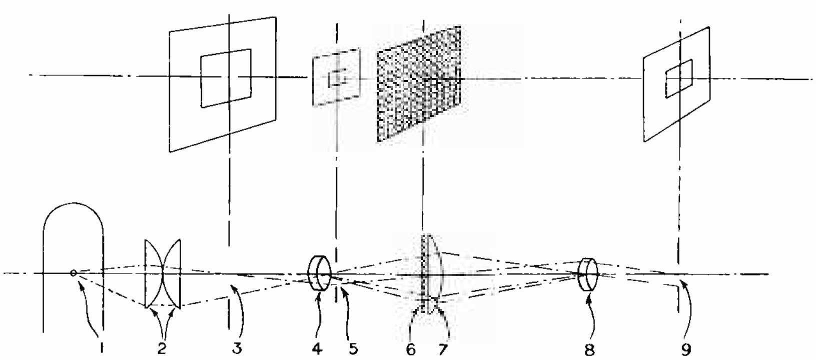
The equipment used in making sixteen-millimetre motion pictures with detail structure equivalent to television images consisted essentially of a thirty-five millimetre to sixteen millimetre optical reduction printer. A system of optics was interposed between the picture gates for the purpose of break-



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.

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.

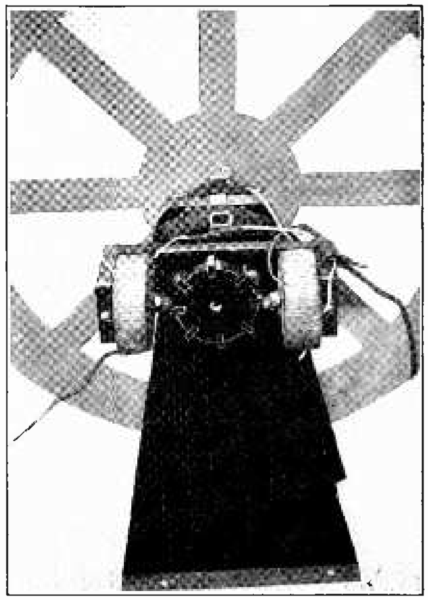
When the amplifier chassis has been made, three pieces of sheet lead about $\frac{3}{16}$ in. thick are obtained and cut to form three screened lead cans with open tops for the valves. The lead acts as a screen to electrical fields and helps to reduce microphonic interference. Small angle-bracket feet, 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



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

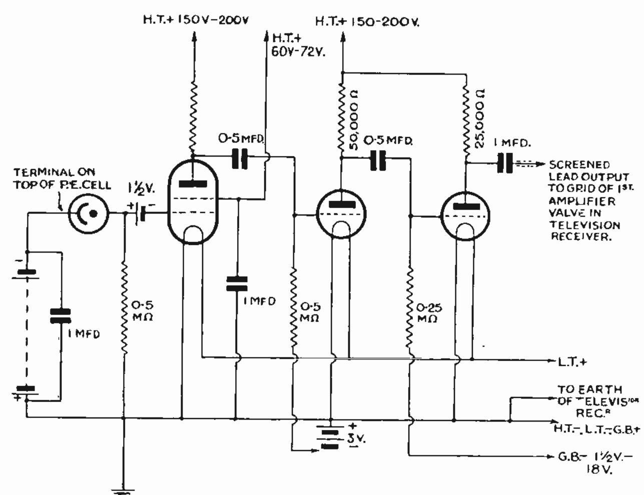


Fig. 2. Circuit showing the amplifier and photo-electric cell.

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

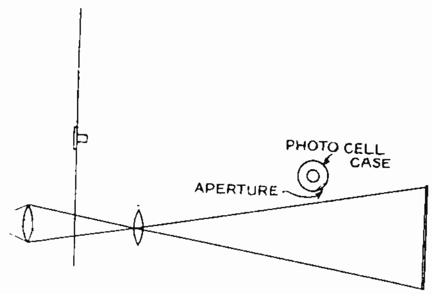
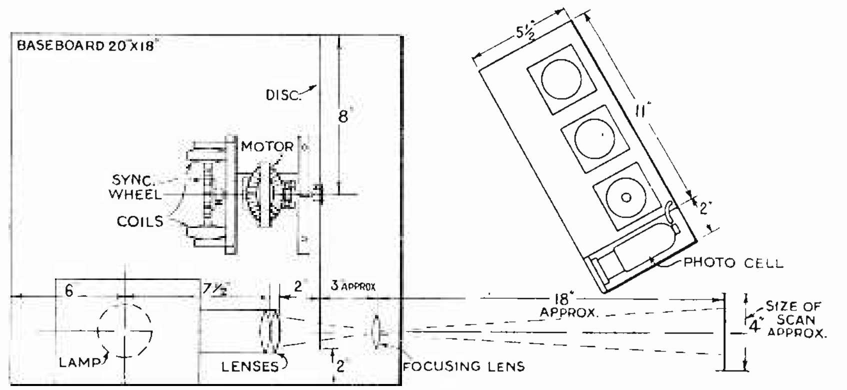


Fig. 3. Position of photo-cell relative to the subject being scanned.

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



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

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.

"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.

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.

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).

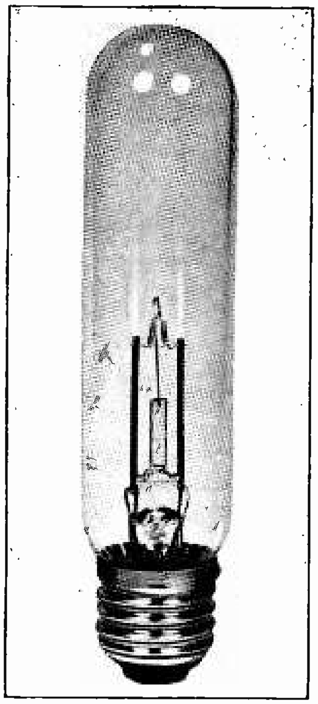
A small subscription will ensure the delivery of "Television" regularly each month.

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.

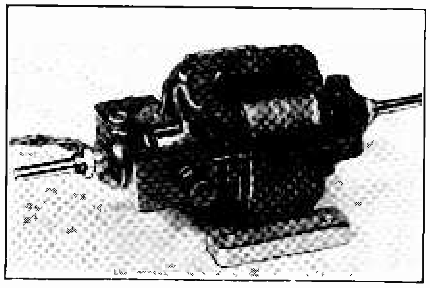


The Ediswan Projector Lamp

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

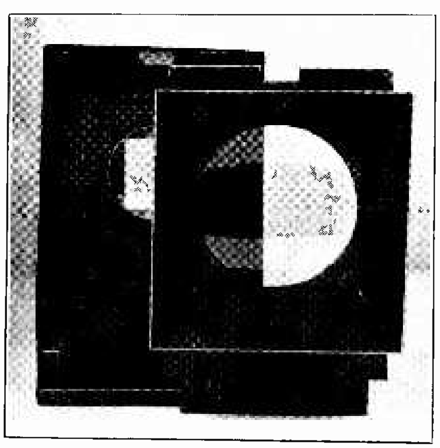


The Peto Scott Motor.

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.

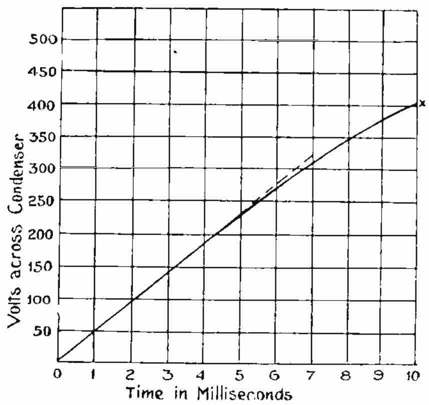


Fig. 1. Theoretical charging curve of 01 mfd. condenser with 2-megohm resistance The dotted line indicates true linear charging rate.

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*).

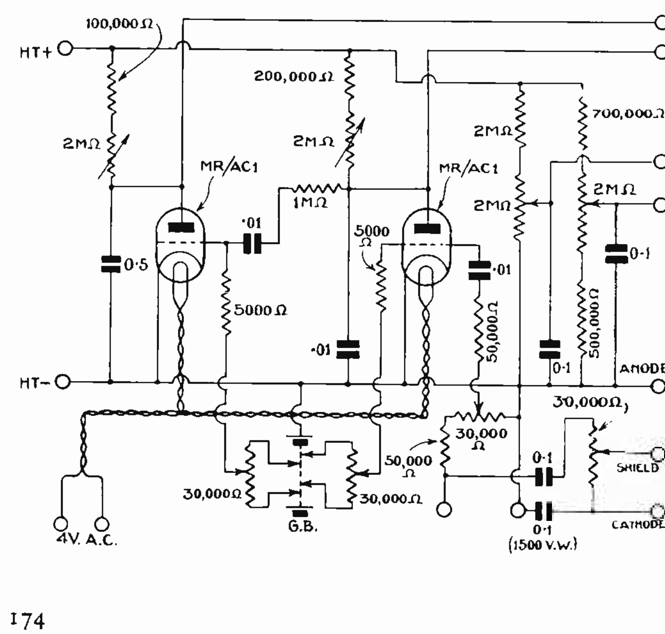


Fig. 2. The complete theoretical circuit of the double time base.

PETO-SCOTT

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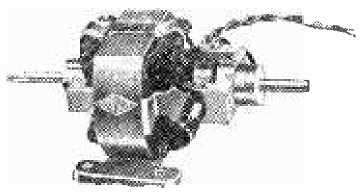
PILOT TELEVISION KITS and SPARES

CASH, C.O.D. or EASIWAY

PETO-SCOTT UNIVERSAL TELEVISION MOTOR



A SOUND engineering job, specially designed for Television and built to stand hard usage, yet runs with the perfect precision so essential to Television. ¼" diam. spindle extended 1½" each side. Each end bearing is turned and screwed to accommodate synchronising gear. The heavy cast aluminium frame ensures freedom from mechanical vibration and absence of noise. Phosphor Bronze self-oiling bearings provide even running. Armature and field coils accurately wound, insulated and baked to prevent electrical breakdown. Absolutely Universal for A.C. or D.C. Mains. 200-240 volts and A.C. 40 to 60 cycles. Cash or C.O.D Post free. **30/-** or Deposit 5s. and 6 monthly payments of 4/9

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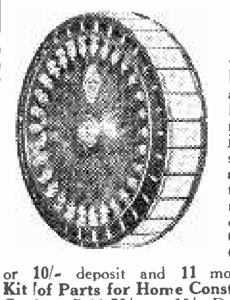
Baseboard Fixed Type

A UNIVERSAL resistance for controlling Television Motors on either A.C. or D.C. from 200 to 240 volts. Fixed Type (Baseboard Mounting). Accurately wound on porcelain air-cored former to a total resistance of 1,600 ohms, tapped at 600, plus 250, plus 150, plus 150, plus 150, plus 150 ohms; carrying capacity, 0.25 amps. at 240 volts without overheating.

Variable Type (Panel Mounting)

A perfect, variable controlling resistance wound to 150 ohms and carrying safely 0.25 amps without overheating. Smooth action and perfectly continuous contact over whole winding ensures the delicate control vital to easy adjustment of correct peed. **Both the fixed and variable types are required to secure perfect voltage regulation.** Cash or C.O.D. Per Pair. Post free. **11/6**

PETO-SCOTT MIRROR DRUM



CONSTRUCTED of a high-grade non-distorting BakeliteMoulding with a patented centre fixing bush, providing accurate alignment on driving shaft. Fitted 30 optically-perfect mirrors, each separately adjustable to obtain perfect scanning. Light in weight and perfectly balanced, thus ensuring perfectly even running for the production of good images. Cash or C.O.D. Carriage Paid **70/-** or 10/- deposit and 11 monthly payments of 6/-. **Kit of Parts for Home Construction,** Cash or C.O.D., Carriage Paid 50/- or 10/- Deposit and 9 monthly payments of 5/-

DISC RECEIVER

COMPLETE KIT

as detailed below, less essential accessories. *Cash or C.O.D. Carriage Paid.* **£4-15-0**

*Or deposit **25/-** and **11** monthly payments of **7/-***

If essential accessories required add **£3 18 6** to cash price or **8/6** to first payment and **7/-** to each monthly payment.

	£	s.	d.
1 **Peto-Scott** 16" Scanning Disc		7	6
1 **Peto-Scott** Universal Motor	1	10	0
1 pair **Peto-Scott** Motor Controlling resistances		11	6
1 **Peto-Scott** Wood Motor Stand		1	0
1 pair **Peto-Scott** Condensing Lens		12	6
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1 **Peto-Scott** Switch Panel ready drilled and fitted with window		2	6
3 On-off toggle switches		3	9
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3 Terminals, marked Earth, LS+, and Input+		1	6
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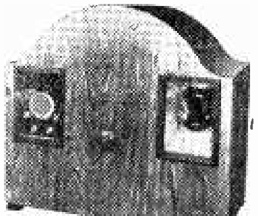

An attractively designed cabinet with beautiful Walnut finish, **as specified** for the **Disc Receiver.** Soundly constructed of finest materials. As illus. Cash or C.O.D. **25/-** Carriage and Packing 3/6 extra.

ESSENTIAL ACCESSORIES.

	£	s.	d
1 **G.E.C.** Flat Plate Neon Lamp	1	5	0
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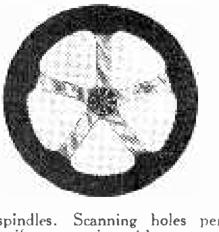
1 **Parmeko** B.25/50 Smoothing choke	1	5	0
1 **Peto-Scott** Walnut finish Cabinet (as specified)	1	5	0
Cash or C.O.D., Carriage Paid	£3	18	6

IMPORTANT **Miscellaneous Components,** *Parts, Kits, Finished Receivers or Accessories for Cash, C.O.D. or H.P. on our own system of Easy Payments. Send us a list of your wants. We will quote you by return. C.O.D. orders value over 10/- sent carriage and post charges paid (GREAT BRITAIN ONLY). OVERSEAS CUSTOMERS CAN SEND TO US WITH CONFIDENCE. We carry a special export staff and save all delay. We pay half carriage—packed free. Send full value plus sufficient for half carriage. Any surplus refunded immediately.* **Hire Purchase Terms are NOT available to Irish or Overseas customers.**

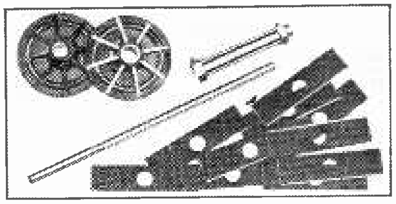
PETO-SCOTT SCANNING DISCS



EACH disc is of light gauge aluminium, dull black one side, and centres cut out to reduce weight. The centre boss is an 8-ribbed black bakelite moulding. Each rib being faced white to give true stroboscopic effect, and thereby visual speed indication. A heavy brass bush insert with Grub screw provide simple and accurate fixing for ¼" motor spindles. Scanning holes perfectly punched to secure uniform scanning without preventable lines.

Made in 2 sizes and ready for immediate use. 16" diam. **7/6**
(Postage **9d.** extra.) 20" diam. **12/6**

PETO-SCOTT MIRROR SCREW SPARES



ONE of the cheapest and most satisfactory forms of Television scanning is by means of the newly devised Mirror Screw. You can easily build your own from Peto-Scott components. Each part is a perfect example of the mechanical engineer's art, and the chromium-plated and optically polished plates give a perfect and undistorted reflecting medium, thereby providing a sharp and evenly lighted image.

SPARES LIST.

	s.	d.
Mirror edged plates, drilled, finished dull black. each	1	0
Brass Centre Boss complete with locking nuts and bored for ¼" spindle ... ... each	2	6
Moulded Bakelite end plates, 8 ribbed, and with heavy brass insert, 9" long ... ... the pair	4	6
¼" mild steel spindle, accurately ground for perfect fitting inside Centre Boss ... ... each		6

Postage extra on orders under **10/-**.

PETO-SCOTT Co. Ltd., (Dept. T4, 77 City Rd., London, E.C.1, Tel.: Clerkenwell 9406/7
West End Showrooms: 62, High Holborn, London, W.C.1. Tel.: Holborn 3248.

Dear Sirs,—Please send me CASH/C.O.D./H.P ....

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Please send me your TELEVISION LISTS.

FIRST IN 1919—FOREMOST ALWAYS

There is news in the "Television" advertisements

" 'Daily Express' Television Kit"

(*Continued from page* 146.)

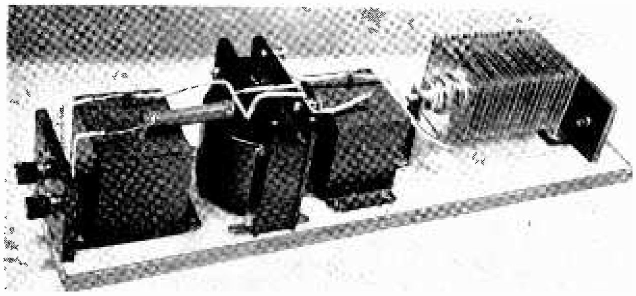
tions to the input of the transformer.

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.

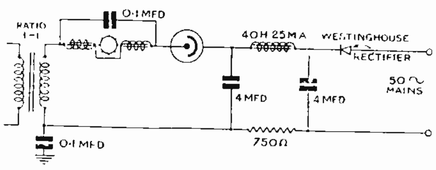
The scanning disc is provided with eight spokes for the purpose of indicating the correct speed at which the disc should turn. If a small neon lamp be fitted so that the rays from it fall on to the spokes, the disc will appear to stand still, when the lamp is connected to 50-cycle A.C. mains and the 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

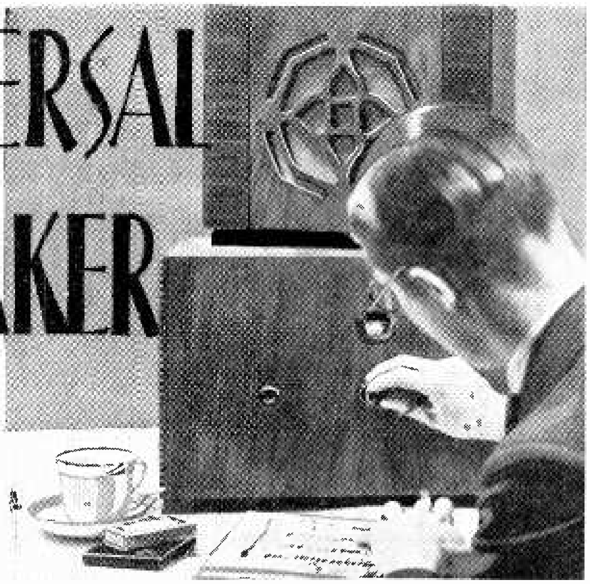
The main sphere of utility of the original W-type Westector was as second detector in a super-het, employing an intermediate frequency in the neighbourhood of 100 kilocycles. The relatively large self-capacity, however, made this device unsuitable for rectification at radio frequencies of the order of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

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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 Palmae, 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.

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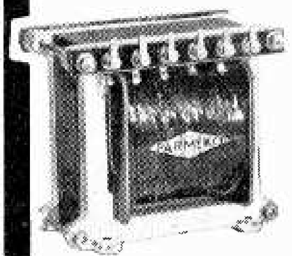

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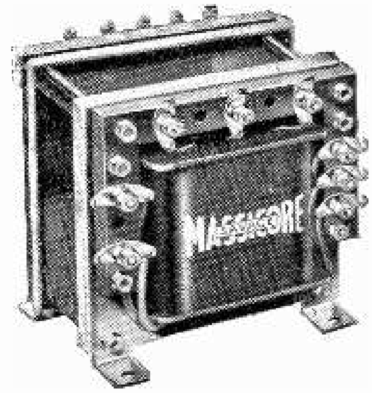

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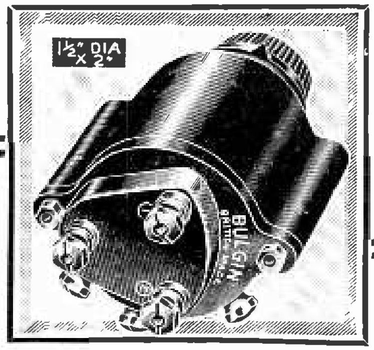

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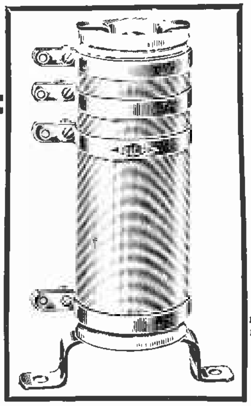

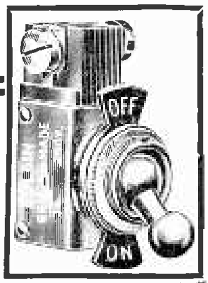

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"The Stixograph and Scophony"

(*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.

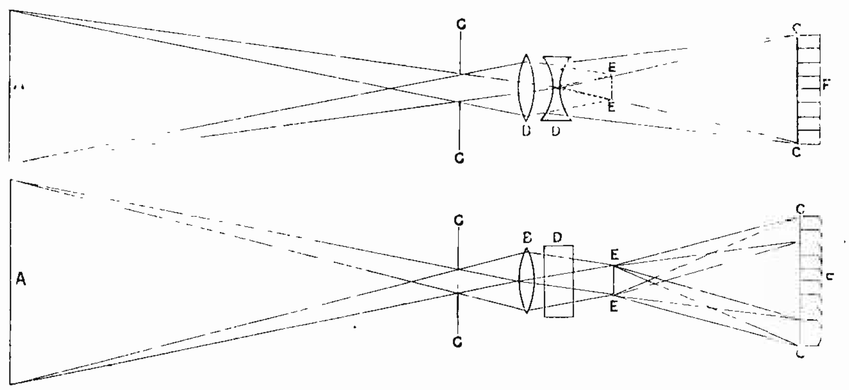

Fig. 15. *Diagram of an alternative way of using a positive spherical lens for focusing.*

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

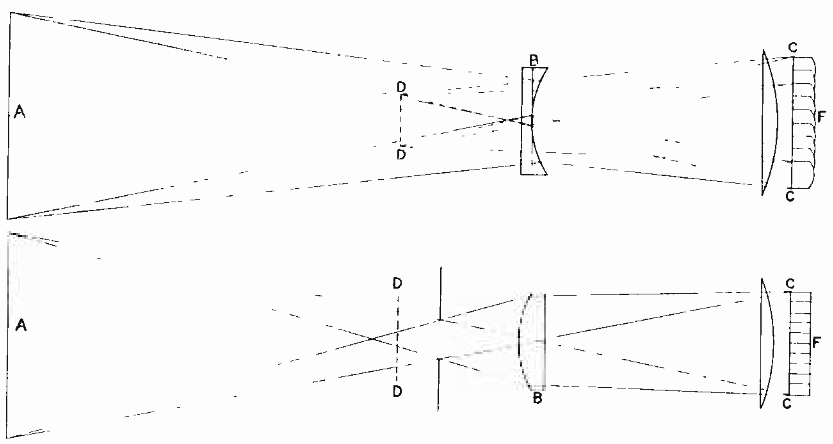

Fig. 16. *Diagram showing the use of a double cylindrical lens for focusing.*

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)

When replying to advertisements, please mention "Television"

"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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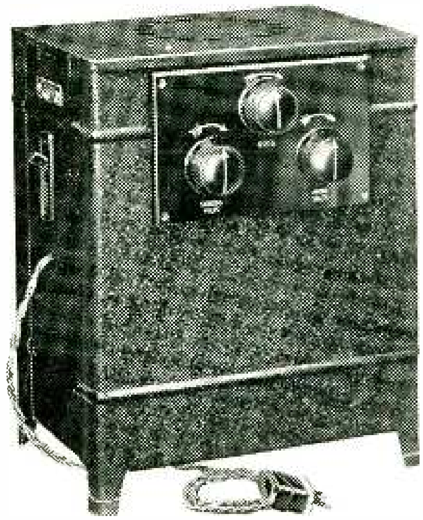

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TELEVISION

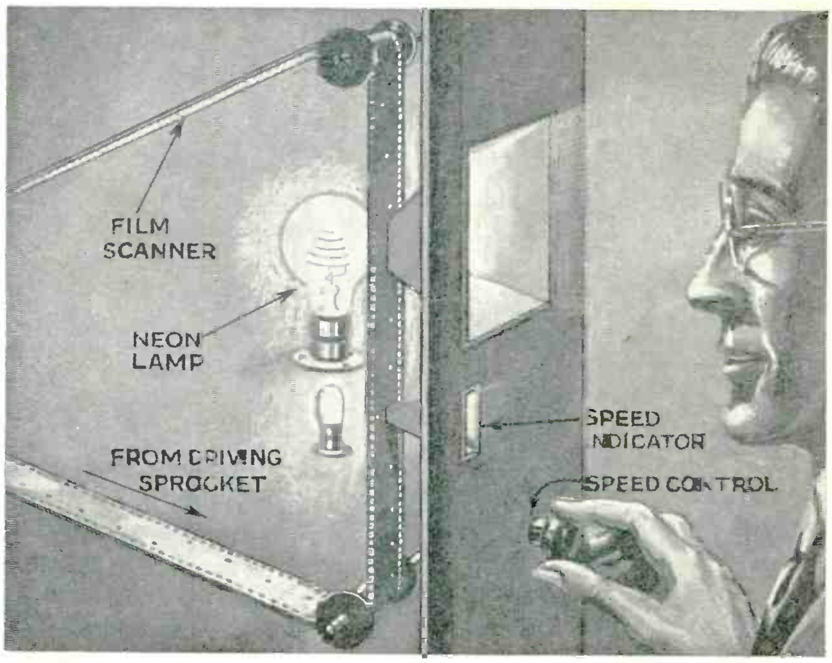
THE FIRST TELEVISION JOURNAL IN THE WORLD

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

JUNE, 1934. No. 76

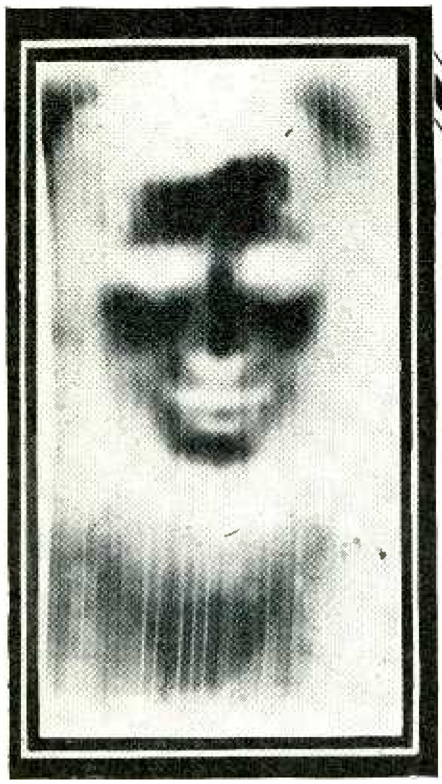
The Television Service the Public Wants.

Eustace Robb
(B.B.C. Television)
Writes in This Issue



How to Make a Film Receiver—Full Details

MONTHLY
ONE SHILLING
NET



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The Television enthusiast is often faced with the problem of converting his pictures from negative to positive.

There are several ways of doing this . . . . . ***BUT THERE IS ONLY ONE METHOD OF CONVENIENTLY EFFECTING AN INSTANTANEOUS CHANGE,*** that is by the use of a WX Westector as the detector.

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A REMINDER

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THE BAIRD GRID CELL UNIT

Indispensable to Research Worker, Student, Engineer and Home Constructor

Workers in the fascinating field of television have repeatedly found their activities curtailed because of difficulties associated with inefficient light modulation devices. The latest form of the Baird Grid Cell Unit removes completely all these drawbacks.

It is a component of proved performance, developed on sound scientific lines after months of research by the pioneer television company.

The unit is complete in itself, comprising a special holder accommodating two light polarising prisms constructed to a highly efficient formula so as to bring about a considerable increase in available light ; the Grid Cell built up from a set of very thin interleaved electrodes giving a clear aperture 0.1 inch square immersed in a fluid and hermetically sealed in a glass bulb ; condenser lens and 12 volt, 100 watt projection lamp.

When used according to instructions in conjunction with a mirror drum or lens disc, the resultant television image is almost black and white, and bright enough to be seen by a roomful of people at the same time.

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Quite apart from its use in connection with television apparatus, this modernised version of the original and early Kerr cells has applications in many other scientific fields. The cell itself has minute inertia, and the variations in light passing through the combination of cell and prisms are proportional over a wide range to the corresponding voltage variations due to an applied signal.

It will be seen, therefore, that the unit is ideally suited to the photographic recording of electrical signals associated with race track timing gear or projectile velocity measuring apparatus.

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Baird Grid Cell Unit Prices.

		£	s.	d.
Grid Cell alone ...	each	2	0	0
Square ended polarising prisms—				
6 mm. aperture ...	each		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

TECHNICAL DATA.

Important Operating Characteristics.

Internal capacity ...	0.0015 mfd.
Internal D.C. Resistance ...	300,000 ohms.
,, ,, ,, after potential is applied for 1 min.	1 megohm.
A.C. Impedance when polarised at 50 cycles ...	3 megohms (app.).
Optimum D.C. polarising potential ...	375/450 volts.
Signal voltage for full modulation ...	125/150 volts.

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Mention of " Television " will ensure prompt attention

No. 76 VOL. VII JUNE, 1934.

TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

In This Issue

TELEVISION

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COMMENT OF THE MONTH

The P.M.G.'s Committee.

ON the whole, considerable satisfaction is expressed regarding the formation of the Postmaster-General's committee. It is appreciated that it is the first co-ordinated effort towards the development of television that has been made in this country, and that it may be the means of putting the science upon a sound basis. The committee has a peculiar and a hard task, and it is doubtless really a task which demands an advanced technical knowledge of the subject. It is obvious that only those who are actually engaged in television research are fully acquainted with all the problems, but as for the most part these have various commercial interests it would be difficult for them to act without bias.

Lord Selsdon is to be the chairman of the committee which is to consider the development of television. Formerly Sir William Mitchell Thomson, he was Postmaster-General from 1924 to 1929, and was intimately connected with the beginnings of broadcasting in this country. Sir John Cadman, G.C.M.G., the oil magnate, is to be vice-chairman. Other members of the committee are :—Colonel A. S. Angwin, assistant engineer-in-chief, General Post Office; Mr. Noel Ashbridge, chief engineer, British Broadcasting Corporation; Mr. O. F. Brown, Department of Scientific and Industrial Research; Vice-Admiral Sir Charles Carpendale, controller, British Broadcasting Corporation, and Mr. F. W. Phillips, assistant secretary, General Post Office. The secretary of the committee is Mr. J. Varley Roberts, of the Telegraph and Telephone Department of the General Post Office. The terms of reference of the committee are: "To advise the Postmaster-General on the relative merits of the several systems (of television), and on the conditions under which any public service should be provided."

So we have no fault to find with the composition of the committee except for one exception—and this is that the now large section of the public that is taking a keen and active interest in television is not represented; and in this regard our thoughts turn to some member or official of the Television Society which is doing so much useful pioneer work. We feel that there is a danger of the committee aiming at an ideal which in the present state of the art does not appear in sight. Television is beginning to develop at a time when kindred sciences have attained a high degree of perfection and there is a risk of it suffering in comparison because it is not sufficiently well appreciated that it is an infant science. If the committee is to consider it as an immediate source of entertainment for the general public then its work will be futile; but if it provides a general policy upon not too ambitious lines and is the means of giving facilities for the development of this then it will have accomplished much.

THE TELEVISION POLICY

The response to the Television Questionnaire which was published in the May issue of this journal has been exceptionally gratifying; it does, in fact, provide the most complete information ever obtained of the wishes of a very considerable section of the wireless public on the question of television policy, and we tender our thanks to all readers who have replied. At the time of going to press with this issue replies

? Do you consider the recent curtailment of transmissions will correspondingly curtail television progress

Ninety-eight per cent. of the answers to this question are definitely in the affirmative and a large number are qualified very strongly, particular reference being made to the amateur experimenter. For the most part those who have answered this question in the negative have also added some qualifying clause, in some cases indicating that experimental work will be possible by arranging for amateur transmissions.

? Are you able to use either or both of the present bi-weekly transmissions

Approximately sixty-five per cent. of the replies state that only one transmission can be made use of, and this is the one that takes place on Tuesday evenings. Ten per cent. are not able to make use of either of the transmissions, and five per cent. can use the Tuesday evening transmission occasionally. About five per cent. make use of the morning transmissions regularly. The remainder of the replies on this matter are indefinite, and it may be assumed that occasional use can be made of both transmissions.

? In your opinion is 30 minutes long enough either for entertainment or experimental work

The answer to this question is definitely "NO." The general opinion is that thirty minutes is certainly not a sufficiently long period, for as conditions vary so much it is quite impossible to get the apparatus adjusted properly in the short space of time available; also it is opined that it is out of the question to make any alterations to the receiver during the period of the programme, and any that are made between transmission times are likely to be nullified owing to different conditions. Readers who have answered in the affirmative have qualified their replies by stating that the half-hour is sufficient if given a greater number of times per week.

? What is the minimum weekly programme time you consider desirable

Opinions as to the number of hours that should be given weekly vary very considerably, and for the most part they show moderation. The average works out at approximately six hours a week. Many readers do not consider that there need be any fixed minimum programme time providing that a reasonable time be given, and in regard to this question emphasis is again put upon the value of longer programmes even if the total weekly time amounted to only two or three hours.

? At what hour do you consider it necessary to retire at night in order to keep fit for following day's work

The average person interested in television, it seems, retires at 11 p.m.; but many readers express their willingness to wait until a later hour providing there are programmes on more evenings.

? Bearing in mind the B.B.C.'s difficulties what do you think is the latest reasonable hour for the transmissions

Ten-thirty at night is the average time stated so far as evening programmes are concerned; but it is difficult to place a correct average interpretation

THAT THE PUBLIC WANTS

are still coming in ; we are unable, therefore, to give a complete analysis at present, but on this and the following pages we give a general summary of the opinions so far received. Readers will be interested to know that we hope to place the information obtained before the Postmaster-General's Committee which is about to deliberate the future policy of television in this country.

on the answers as quite a number advocate earlier evening transmissions on certain days and later ones on other days. However, the general impression appears to be that the present times are unreasonable, especially as delay often occurs which makes matters worse.

? Do you consider it essential to extend and encourage low-definition transmissions until such time as high-definition apparatus becomes available in reasonably inexpensive form, for use in any part of the country

A surprisingly large number of readers have replied " YES " to this question. This answer, in fact, constitutes over eighty per cent. of the replies received, and in several cases the suggestion is made that the next step should be to transmit sixty lines on a low medium waveband. Readers realise the desirability of high-definition television, but appreciate that for some time to come it cannot possibly be available for the whole country or be within the reach of the person who has only a moderate purse. The opinion is generally expressed that low-definition television will allow the collaboration of experimenters and lead to better results and steady progress, as was the case in the earlier days of broadcasting.

? Roughly, what amount of money have you spent on television apparatus ?

The average amount of money spent by those who have answered the Questionnaire is just upon twelve pounds. This figure may seem rather large, but there are quite a number of fifty pounds and figures round about this, and there are one or two individual cases with amounts between four and five hundred pounds which, of course, makes the average somewhat high. The total amount spent by readers will be a very large sum, and we hope to publish this when all the replies have been received.

? Approximately, how many people do you know who have been receiving the television broadcasts within the past twelve months ?

The average figure in answer to this question is three, the figures in the replies varying from none to twenty. Approximately thirty per cent. of the replies received state that the writers are acquainted with other people who are receiving or who have received the programmes.

? Are you experimenting with any particular improvement or system of your own ?

About twenty per cent. are conducting some definite line of research.

? If so, state whether scanning, light-modulation, synchronism or projection.

The replies to this question include every phase of television, though scanning, modulation and projection appear to be receiving the most attention.

? If up to the present you have not received the television broadcasts, is it your intention to purchase or build apparatus to do so, provided that better facilities are given ?

The reply to this question only concerns those who have not yet received the programmes, and these, of course, are a very small minority so far as this Questionnaire is concerned. In the case of these the answer is " YES " practically without exception.

An Adjustable Mask

It will be found that when experimenting with various optical systems, using either Kerr cell or crater lamp, an adjustable square aperture is of great assistance.

The one about to be described has proved especially suitable for the purpose as the size of the aperture can be varied *while viewing* the television image, thus minimising the strip de-

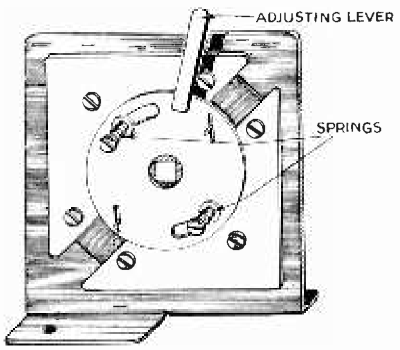


Fig. 1. The complete mask.

marcation. Moreover, however the size of the aperture in the mask is varied, the opening *remains at the optical centre* of the apparatus and the shape is a perfect square.

The materials required for the con-

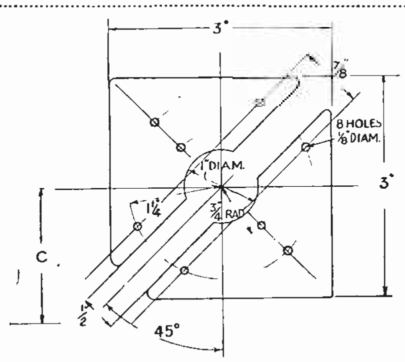


Fig. 3. The guide plate

struction of the mask are few in number and can usually be obtained from the experimenter's scrap box. They are as follows :—

A piece of sheet metal, say 16S.W.G. brass, approximately 9 in. by 4 in., and a strip of hard brass or phosphor bronze about 28S.W.G. thick and $\frac{1}{2}$ in. wide by 4 in. long; eight No. 6 B.A. screws, two short spiral springs, and two washers and 6 B.A. nuts.

The mask is shown assembled by Fig. 1, and will be seen to comprise three parts; a main plate (to be mounted on the bench of the optical system), the guide plate in which moves the slides forming the square aperture, and the circular slotted member controlling the size of the opening.

The Main Frame

This is shown in detail in Fig. 2 and is cut from the 16S.W.G. material; the dimensions *A*, *B*, and *C* are not given as these depend on the rest of the optical system already in use.

It will be seen that the bottom edge of the plate is turned up for about $\frac{1}{2}$ in. to allow it to be mounted securely on the optical bench. After bending up

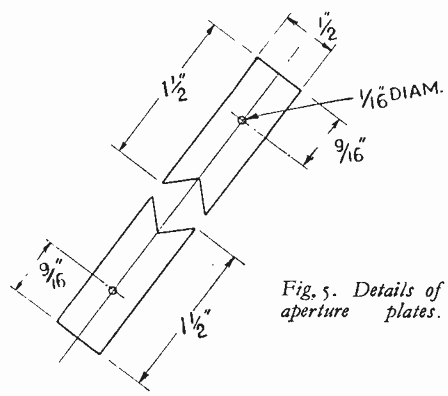


Fig. 5. Details of aperture plates.

this foot portion the plate can be marked out with the centre and main diagonal lines; the $\frac{3}{8}$ in. centre hole can also be drilled, but before drilling the eight 6 B.A. holes it is best to proceed with the guide plate, Fig. 3.

This is also cut from the 16 S.W.G. material and after marking out the dimensions given in Fig. 3, the $\frac{1}{8}$ in. holes may be drilled and the plate then cut diagonally into the two portions shown. This may be conveniently

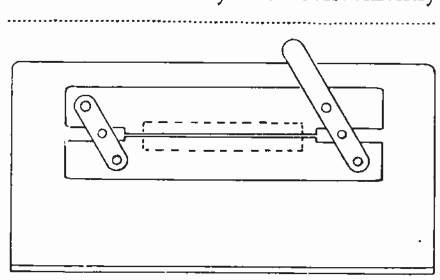


Fig. 6. An alternative construction for use with a mirror screw.

accomplished by using metal cutting fretsaw blades. The two portions of the guide plate may now be placed on the main plate, taking care that the centre lines register correctly; the $\frac{1}{8}$ in. holes may be marked through to the main plate and the holes drilled and tapped No. 6 B.A. The two parts of the guide plate are then screwed in position.

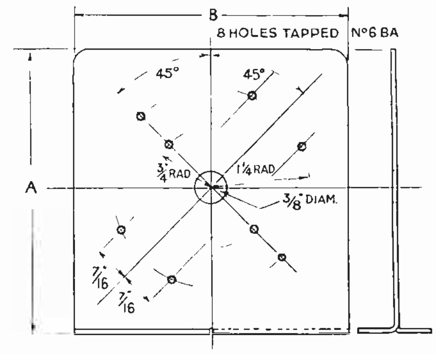


Fig. 2. Details of main frame.

Next the slotted disc, Fig. 4 is made by cutting two discs from the remainder of the sheet metal. A $\frac{3}{8}$ in. hole is drilled in the centre of each and they are soldered together while they are lined up on a piece of $\frac{3}{8}$ in. rod, a small

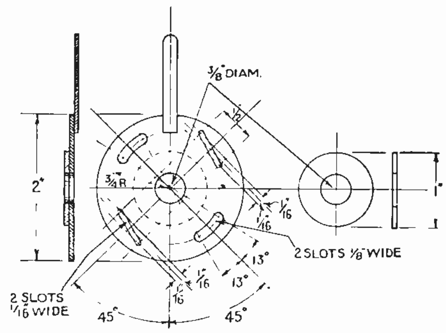


Fig. 4. The moving slotted disc.

strip is also soldered to the large disc to serve as a handle.

The completed assembly should now appear as in the left-hand sectional view, Fig. 4. The slots shown in the large disc must be cut as carefully as possible; the fretsaw will be found very useful for this and the small disc must be a snug fit in the centre portion of the guide plate.

The aperture proper, details of which are given in Fig. 5, is made from the strip of No. 28S.W.G. material and it should be cut into two equal lengths, one end of each piece being cut to an angle of 90 degrees as carefully as possible so that when the strips are placed one on top of the other in the

(Continued on page 250.)

MAKING A FILM SCANNER

This article gives details of a novel scanner using a film. As is explained, in some respects it is an improvement on the disc and no doubt some of its disadvantages could be eradicated by careful construction and experiment. It is a type of apparatus of considerable interest to the experimenter.

HERE are details of a unique type of scanner made from a piece of film—which the writer has used for some time with considerable success.

First of all obtain a piece of ordinary blank opaque film approximately 45 in. in length (standard width 35 mm.). The type with the frames only slightly marked with black lines should be obtained and not the type that has each frame bordered with a white transparent line, which was used for spacing in connection with the old disc method of sound reproduction some years ago and is now practically obsolete.

Having obtained the film you will find that it consists of 60 picture frames in length and it will thus be seen that every second frame line will mark a 30th part of the whole length. The film must now be perforated for the scanning holes and this is done in a similar manner to that employed for discs.

Perforating the Film

It is best to first lay the film across a piece of glass with a light underneath in order to show the frame lines up. Then start on the second line from one end, punching the first hole about 5-16 in. from the edge or exactly on the inner edge of the blank sound-track (if any). This is to ensure that the picture area is reasonably in the centre of the film. Each successive hole is then punched on every second line from the preceding one, working from the right to the left in a similar manner to punching discs. The film must then be joined up—that is the two ends cemented together to form an endless band.

As a description of this operation would occupy a large amount of space and serve no useful purpose, as it takes some time to acquire the knack of doing it, those readers not already acquainted with the method of joining film are advised to enlist the services of the local cinema projectionist. In all probability this individual would also be able to supply the film. When joined the scanner should consist of exactly 60 frames (45 in. in circumference).

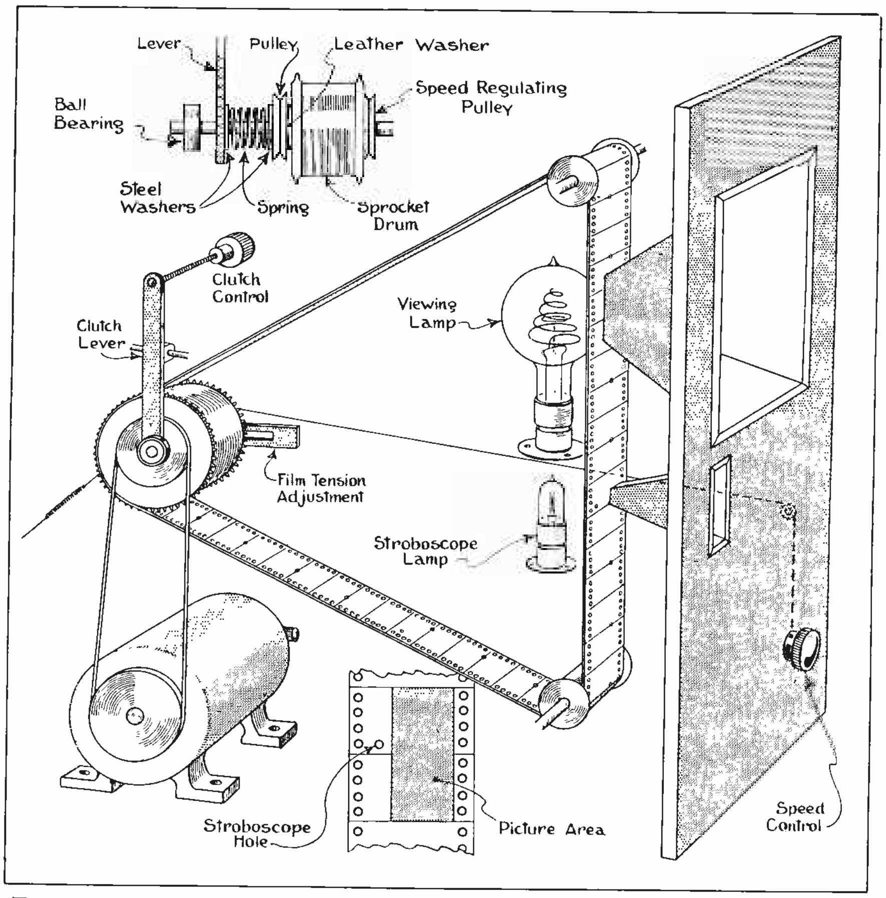
The next item is the method of propulsion and here the reader can to a certain extent use his own ingenuity. The writer used a sprocket (fitted with ball bearings) and two large diameter guide rollers taken from a cinema projector, but ordinary bobbins or rollers can also be used and can be recommended on account of the lighter weight.

They are fixed as illustrated to form a triangle, each roller at top and bottom and the sprocket (which is also fitted with a pulley) in the centre behind. The rollers should be in correct alignment and placed so as to apply a slight tension to the film to ensure a proper grip when running.

The drive sprocket spindle is fixed to a plate which can be moved backwards or forwards to adjust the tension and allow the film to be put on or taken off when required. Care should also be taken to see that the rollers are running as freely as possible, otherwise results may be impaired.

The driving sprocket is friction driven being coupled to the driving

(*Continued at foot of next page*)



These drawings show the construction and some details of the film scanner. At the top left is shown the driving sprocket and at the bottom the method of obtaining a stroboscopic effect from special perforations in the film.

Public-address Television

A new use for television. The Marconi Engineers are developing a short range system with screen projection for public-address purposes

AT Electra House, London, the headquarters of the great Cable and Wireless Combine, Marconi engineers have been working out a system of television designed primarily for "public address" work. I have been allowed to see it in operation.

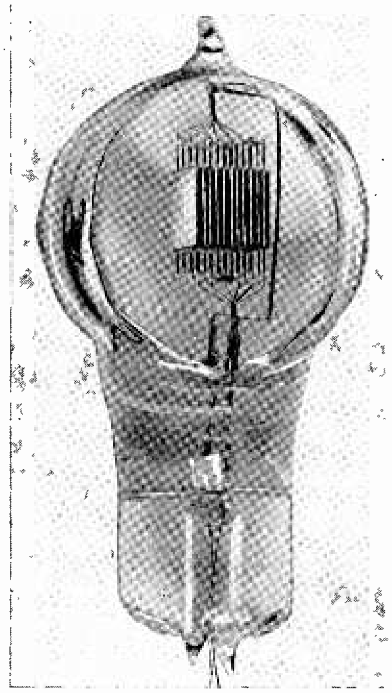
The Marconi engineers are aiming to add vision to the "public address" systems so extensively used by politicians, etc. In the future the speaker whose speech is relayed to another hall will also be *seen* by the second audience.

For such a purpose the cathode-ray tube in its present state of development is useless—a tube large enough to give an image for a really large audience to see does not exist. Marconi's are therefore using the mirror-drum type of reproducer.

Their mirror-drum lies horizontally, instead of vertically like the Baird. It throws a pure black and white image on the screen. At the time of my visit the image was four feet square, but I was told that a size of five feet square is possible.

The definition was 50 lines, but the engineers are now working up to 100 lines. I found the image exceedingly pleasing to look upon, both by virtue of its clear colour and its good definition.

This, I must emphasise, was not a radio transmission of television. The "sitter" was in an adjoining room or studio, facing a rotating-disc transmitter, which was connected up to the receiver by wires.



The Marconi multiple-plate Kerr cell used in the public-address system

It was particularly interesting to notice how the Marconi studio technique differs from that used by the B.B.C. for their 30-line transmissions.

Only one photo-electric cell was used in the studio at Electra House. Several cells in different parts of the studio are favoured by the B.B.C. The Marconi engineers prefer to depend on a single cell, behind which is placed a parabolic mirror, about a foot in diameter. The cell is at the focus of the mirror, which collects light and concentrates it on the cell.

Nor are the Marconi engineers dependent on darkness, or even semi-darkness, in the studio. They half drew the blinds, letting in so much daylight that one could easily read a paper, and when I went back to the reception room I found that the image was practically unchanged from its brilliancy when the studio was in darkness. Another interesting point was the entire lack of "make-up" on the subjects televised, in contrast to the elaborate special "make-up" used by B.B.C. artists.

LESLIE BAILY.

Most amateurs are aware that the time taken for an electron to travel from filament to screen on a cathode ray tube may be considered as being negligible, but few realise the great speed at which it travels; with maximum gun voltage the speed is in the neighbourhood of one-tenth of that of light, about 17,000 miles per second.

"Making a Film Scanner"

(*Continued from preceding page*)

pulley through the medium of a friction washer made from leather. The other side of the roller has a small pulley fixed to it which is used in conjunction with the usual spring and string arrangement as a speed regulator. It is advisable to use small aluminium pulleys for lightness.

The motor used by the writer is a $\frac{1}{8}$ h.p. and revolves at a speed of 1,500 revs. per min., and with a $4\frac{1}{2}$-1 step-up ratio from motor to scanner, the scanner runs at about the required speed. The speed can then be adjusted properly and held quite steady with the spring and string arrangement referred to above. At present there is no synchronising gear fitted.

If desired a stroboscopic effect can be obtained by punching a small hole on one side with a leather punch opposite every 30th sprocket hole, all the way round the band. The diameter should be about 1-10th inch, and care should be taken to see that they are outside the picture area. They must be viewed with a separate lamp connected to a 50 cycle A.C. main supply.

Picture magnification is the same as employed for discs, but masks must be made to exclude the sprocket holes and also the stroboscopic holes from the picture, while a small mask is required to surround the latter holes in a separate viewing tunnel below the picture.

Whilst being unique in design and in some points an improvement on the disc, it is only natural that this apparatus has certain inherent faults; for instance, the nature of the material itself instantly suggests fragility, but as one who has worked with film for years the writer can assure readers that it will stand a fair amount of abuse, and if care be taken a single band should last well over a year, although the film is travelling greatly in excess of the speed for which it was originally intended.

An additional refinement, not shown in the illustration, is an adjustable clutch. It is an ordinary spiral spring on the spindle carrying the sprocket, and is situated between the driving pulley and a lever controlled by an adjusting knob. After the motor is switched on the tension is gradually increased on the pulley which then connects with the sprocket through the medium of the friction washer. This enables the sprocket to pick up speed gradually which minimises the strain on the film when starting.

News *from* Abroad

By OUR SPECIAL CORRESPONDENTS

Germany

A Post Office Report

The German Post Office, describing the progress of their electrical communications during the year 1933, write in connection with Television, as follows :—

"During the year 1933, the progress of television led to pictures consisting of 180 lines, 25 frames per second. As, for this purpose, the frequency band required is from 0 to 500,000 kilocycles, it became necessary to design special amplifiers. As receivers for television images, cathode-ray tubes have chiefly been used. The design and properties of all cathode screens have been greatly improved. During the whole year experimental television transmissions have taken place on 7 metres, and these give very valuable information and experience for both transmission and reception."

Picture Telegraphy

Transmissions have greatly advanced during the year 1933-1934, and pictures can now be telegraphed between the following countries :—Great Britain, Denmark, Germany, France, North Ireland, Italy, Holland, Norway, Austria, and Sweden. Also between Buenos Aires, New York, San Francisco, The Vatican, Bandoeng, and Bangkok, and also London—New York, Amsterdam—Bandoeng.

Ultra-short Wave Transmissions

As mentioned in TELEVISION of April, 1934, ultra-short wave television transmissions in Berlin have now started, 180 lines being used. These transmissions commenced on April 3, but due to delays which occurred during installation, only a provisional film transmitter was installed at first. However, this has now been displaced by another transmitter.

The second ultra-short wave transmitter for the sound counterpart of the programme will, it is anticipated, commence operations some time during the middle of July. Definite transmission times cannot yet be stated, as, due to installation operations, these must necessarily be somewhat irregular, although a time-table has been made out, and this is as follows :—

Time.	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*
9 –11	Films	Films	Films	Films	—	Films
11 –12	—	Music	—	Music	—	Music
15–16	Films	—	Films	—	—	—
20½–22	Music	Films	Music	Films	Music	—

The transmissions are from an ultra-short wave transmitter on 6.985 metres, 42,950 kilocycles, and a power of 4 kilowatts. 180 lines, 25 frames per second, ratio 5/6.

Japan

A Television Society

A Television Society has been formed in Japan, its object being to study and develop the science, and also to co-operate with institutions and engineering societies already in existence.

Russia

Television experiments are being carried out in accordance with previous reports given in TELEVISION of January, 1934.

The Governor of the Ministry for Broadcasting recently spent a considerable time in the United States of America. It is understood that the reason for his long stay was to study the developments of television in that country. The electrical industry of Russia is greatly influenced by the United States of America, and it would seem now that television will also be greatly influenced, technically, by American methods.

Hungary

Transmissions to Start

It is announced in Hungary that television transmissions will be commenced almost immediately.

De Forest Praises Vision in Europe.

[*An extract from the "New York Sun".*]

Compared to the pathetic quiet of television in this country at the present time, experimenters in Europe are showing activity that is resulting in worth-while developments. A picture of the Continental status of vision is given by Dr. Lee De Forest in a letter written to J. E. Smith, president of the National Radio Institutes, following the former's return from a trip abroad. Said Dr. De Forest :—

"I found the British Baird Company making fine progress in commercial television. Four nights each week they broadcast half an hour of genuine entertainment, using mirror drums in place of lens discs, and Kerr cell valved light from an incandescent bulb in place of our crater lamps.

"Baird is limited by British regulations to 9,000-cycle side bands. Imagine getting a good picture out of that. Yet Baird does it—by the use of 30-line pictures and 12½ pictures a second. Considering the handicaps, the results are amazing. *Vertical scanning is the answer—incomparably superior to horizontal scanning* when less than 120 lines are employed.

"As a result his 'lookers,' as they were styled in England, see a black and white picture 9 x 4 inches in size."

PUTTING VISION ON

By EUSTACE ROBB, B.B.C.

The advent of television into our already complicated modern in the presentation of entertainment. The veil that separates light, and the beautiful blonde will once again score unless the exclusive article by the B.B.C. Television Director explains

THE public may not be aware of the fact that it is the habit of many expert searchers for microphone talent to close their eyes at the theatre or music hall when listening to an artist, in an effort to obtain the effect the artist would give over the mike without being seen, and when charm of appearance and personality have been lost.

When I took over the presentation of television programmes, I found that exactly the opposite methods became necessary, and I had to develop my powers of observation which had been intentionally suppressed over many years. It stands to reason that many forms of entertainment and many excellent acts had been eliminated from one's mind as being of no interest in radio or gramophone activities, solely on account of their appeal to the eye. These became the very thing of which I was in need, and my problem was to decide how the more complicated of them could be presented to television audiences in a limited studio space, under strange working conditions, and with the drawback of primitive results when compared with the stage and cinema.

This comparison is constantly made—though quite unfairly—be-

Eustace Robb, the writer of this article, is here seen rehearsing the Eight Step Sisters in the television studio at Portland Place.

tween television results, and the home cinema, though the latter has had the benefit of many years of development. This brings us to consideration of the problem of:—

Recorded and Personal Appearance

The last generation has seen the introduction of a new form of entertainment, the recording, by various mechanical means, of performances to be reproduced at will in other locations. I am, of course, speaking of film and gramophone. A mistake unnoticed on the stage becomes acutely irritating when repeated by mechanical means. In the case of film, the best shots are retained and edited until a high degree of presentation is achieved, and with gramophone recording, several masters may be put through the final process, and the best performance only will be issued to the public.

On the other hand, in stage and broadcasting the artist must be rehearsed till able to give a performance up to the requisite standard, but with the introduction of the human element that performance must vary. Further, the mechanical means of editing as understood in the film world have to be eliminated. As I have already said, it is my business to invent and develop a new technique, and in so doing there are many things which can be borrowed from the two arts—Stage and Cinema—in much the same way that the talking film borrowed from both stage and silent film technique, building up an entirely new form of entertainment. We must borrow and adapt, not copy.

In stage and broadcasting work there can be no rejection of the final performance and a re-take, no cutting and editing. For these reasons effects must be practical and able to be carried out at the transmission with success. It is useless to evolve a routine so complicated that the final performance is liable to breakdown. We cannot re-take as in the films, and for this reason the more elaborate visual effects as seen in some recent films must, I feel, be confined to the film art. I have, however, introduced a form of editing by means of the caption machine, but I will go further into the uses of this apparatus later.

Eye Boredom

This must be studied and overcome as of paramount importance. Some ingenious fellow in the film world, I believe, got down to measuring the time it takes for the eye to become bored with one subject, and estimated this to be twenty seconds. What strange mechanism he used I do not know. Furthermore, eyes must vary—being human like the rest of us. This applies

A design by Eugene Lourie for the Russian Ballet programme. The figure of Petrouchka for use in the caption machine.

THE RADIO PROGRAMMES

TELEVISION DIRECTOR

lives necessitated the invention and perfection of a new technique artists from listeners is to be torn asunder. Sound is to receive photo-electric cells turn her into a brunette! This first and the whole technique of the production of the programmes.

principally to mechanical means of entertainment—that is by film or television, though it must be remembered that television may be both mechanical and personal.

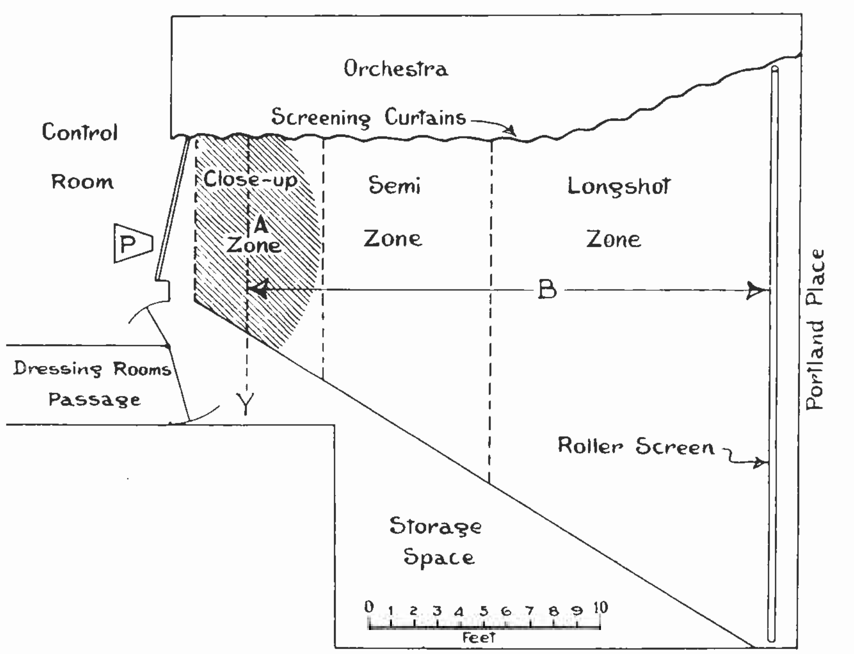
sion of new effects from what appeared to be extremely simple ones until they have become more complicated. Actually, the simple effects of earlier days gave us as much trouble to put into practice as the more complicated effects of to-day. Our organisation has become more used to dealing with the new studio technique as it grows. Amongst the earlier effects introduced were entrances from long-shot to close-up, fades to silhouette, the return of the artist to take a curtain at the end of the performance, and to walk up from long-shot to close-up for a bow before the close of the programme. An old hand at stage presentation, who happened to be looking at a television programme one night, was particularly pleased with this little innovation—as it was then—not only because it gave movement to the picture, but particularly as it gave him the impression that the artist was making a personal appeal to him. But after a while the eye demanded a change—hence the change-over from " Walk-up " to the " Close-up Parade." These "Visual Goodnights " round off the programme well, and give the far-flung audience the opportunity of one more glimpse of a " lovely lady," in closer detail.

By placing the photo-electric cells in a low position to the artist it was found that fire-light effects could be obtained. Many items call for what is known on the stage as a "Black Out." Technically, this is impossible in television—we must always have a white screen for synchronising purposes. We, therefore, have

On the left is a simple caption for the purpose of introducing the artist. The centre design shows a caption used in the Rokoko programme, and on the right is an example of visual announcement in decorative form.

There is certainly a definite period after which the eye tires of looking at one subject—I have experienced it myself. Visual radio programmes must be produced with constant change of subject, using, the invention of ever-changing effects. Film " fans " will have noticed how methods of film presentation have been subject to what might be described as "waves of fashion." Effects are constantly being abandoned in favour of new ones—for example: large close-up, formerly very popular, is employed more sparingly now than some years ago, and recently a change of scene by a "wind-screen wiper" effect has become increasingly common. I expect the film expert would admit that eye boredom over a period was responsible for this.

We have the same problem in television—a new effect which appeals the first time gradually tends to pall after repeated use. A regular " looker " to television programmes will probably have noticed a progres-



A plan of the television studio at Portland Place showing the different scanning zones.

to introduce what appears to a "White Out," called in television language a "Flash Out." Other items are not suited to an abrupt finish—hence the introduction of the slow fade, which had already been seen constantly in film work.

Providing Contrasts

I then introduced a drop curtain, which gave rise to caustic remarks from the artist because it was not much larger than a couple of bath towels, but it gave us the effect we wanted, and certainly many "lookers" have admitted that its introduction gave them the impression they were peeping in to a far distant theatre. Incidentally, this gave the control man a tricky job in controlling the signal strength. I found that rapidly moving subjects lost their sense of movement in front of a white background, though the old black and white squared floor in Studio BB certainly helped to overcome this loss. By the use of simple scenery, I found that movement became more apparent, even though the picture was narrow and only one or two figures were seen. They were at least seen moving in front of a changing panorama, which satisfied the eye that they were travelling.

I abandoned the black and white floor in the new studio, as after inquiry, I found that many people had become tired of the continual presence of the black and white squares, which were inclined to their boldness to detract from the subject. On the other hand, the plain floor at present in use undoubtedly gives less third dimension than the old floor, and some means will have to be found to put back the lack of depth. The staircase, which was first used in the musical comedy programme "Roko-ko," gave a welcome perspective to the picture, and enabled better use of the existing picture ratio. Anyone looking at the television programme on Friday, May 4, would have noticed that the appearance of the staircase in the picture helped to make up for the loss of floor squares, and gave a greater depth than any picture which we had had hitherto in the new studio.

From left to right these are the introductory captions used during the overture to the Russian Ballet, the design used for the dances from Le Beau Danube performed by Massine and Danilova, and one of a series for the Russian Ballet programme.

Costume Changes

The appearance of an artist in several changes of costume through a programme is of great importance in keeping the eye interested. I have frequently introduced dancing and miming into the middle of a song, commenced by the artist in person, and then sung off stage while a dancer performs—the change of scene keeps the "looker" interested, and appears to reduce the length of the number. There are, however, only a limited number of songs which lend themselves to this method of treatment.

The popular number "Shadow Waltz," which we did some time ago, was sung by an artist in the picture, and as she moved out of the picture, two figures were seen dancing in silhouette, and her voice still came over the air to us off stage. This is also useful in giving us the detail of the close-up with the movement of the long-shot. A dancer about to perform a doll dance is shown entering and leaving in an upward movement in close-up—the reason being that I want to introduce the dancer with recognisable detail before her whole figure is seen in the long-shot, with consequent loss of detail, and the "looker" will gain the impression of a jack-in-the-box.

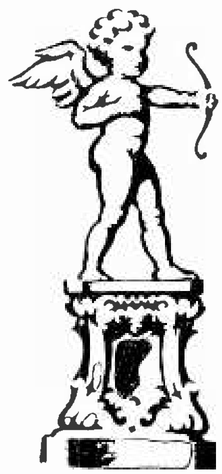
Dancing Technique

This brings us to what is almost a new technique in dancing. On 30-line television there is obviously far greater detail to be obtained in the close-up than the long-shot. Furthermore, the constant position of the artists in long-shot causes dull and flat picture. Therefore, wherever possible, I have had to persuade dancers to rearrange their dances with forward and backward movement rather than lateral movement in order to create depth, which is at the same time an excuse to bring the figure sufficiently near to give greater detail of costume and facial expression.

In arranging an entirely original dance, which was being performed by Laurie Devine by television for the first time, I planned the choreography of the dance to introduce her miming in the close-up position. My reason for this was that, as she was dressed in eighteenth-century costume of the most extravagant period, and was wearing a magnificent white wig, complete with a sailing ship perched on the top of her head—as in the true manner of the bright young things of those days—I wanted the audience to get a good view of these details and of her expression before showing the entire figure with less detail in the long-shot.

With the beginning of her dance she is faded into view—through a caption in the oval form of a dressing table mirror—showing her with small hand movements, powdering and patching her face, and we fade out as she is seen expecting the arrival of her beau. This completes the first section of the number. We now fade in for a few seconds to the outlines of a window, and as the window fades it gives place to the now distant figure of the dancer in the full splendour of her hoops and draperies. Majestically she sails down the steps, which have now miraculously appeared—placed in position during the fade—to dance the pompous measure of the Pavane before her imaginary beau, and as the music moves from slow measure to quick, with frightened little runs the dancer is seen to fly this way and that until she escapes from our view and her imaginary lover, and the studio is faded out.

This sort of treatment depends entirely on the type of dance. Obviously quick moving dances are less suited, owing to greater difficulty in following and focusing, and a tend-



Atmosphere created by captions used in Rokoko programme where the scene was set at the Court of Maria Theresa in the 18th century.

ency for the picture to blurr. They must be confined to long-shots. Care must be taken, as in certain cases rapid movement in close-up tends to put the picture out of synchronisation. In dances where the arms and hands are of greater importance, close-up or semi close-up positions may be used with success, but the choreography has to be worked out carefully so that the dancer has allowed enough steps taking him to the long-shot in time for passages necessitating greater movement.

The first two dancers of international repute, who successfully re-arranged a complicated ballet routine, were Adeline Genée and Anton Dolin. These two great artists did a ballet suite as performed at the Coliseum on that enormous stage. I had to memorise their movements while at the Coliseum in order afterwards to put them down on paper in the form of a scenario on my return to the office, so that the projector man could be coached in their movements, otherwise he would have focused to the wrong figure, and the whole effect would have been spoilt.

Studio Manipulation

The accompanying sketch shows you a plan of the new television studio. I have divided it into two sections—A and B. Section B shows a large area which can be scanned with fairly uniform results, and over which area an artist can be focused and lit to satisfaction. But the artist cannot approach closer to the projector, which is marked P, than line Y without the insertion of a lens. The section marked A shows you the area in which the artist may move with the lens in. If I wish to present a picture with greater detail than can be obtained without the lens, a momentary blurr must take place while the picture is re-focused unless the artist exits from the beam of light and leaves a blank screen.

In the early days of television programmes, a cabaret singer would open with a bright number and dance his way up to the close-up shot for his first song and exit. Then, with a quick movement, the lens was put in, and the picture re-focused, and the artist reappeared as a big close-up with greater detail, to sing a second number, which would be specially chosen as requiring greater facial expression. There were, however, cases where items did not permit of an exit. Therefore, excuses had to be made to meet the requirements of each occasion. I found that the momentary blurr to the picture caused by the insertion of the lens was less irritating when the face was turned away, so I would choose a passage in dialogue or a song, when the artist could turn away and the lens be inserted.

In a recent programme, Leonie Zifado sang arias from "Manon Lescaut" in a beautiful costume of the period. It was necessary for the atmosphere of the aria that she should make a long-shot entrance with such movement and miming, but after coming up to the ordinary close-up, one felt a desire to see greater detail of her face and powdered wig and little three-cornered hat. As she was carrying a muff, what could be better than that she should coyly hide her face with it, giving the projector man the opportunity to slip his lens in almost unnoticed. The same thing can be done using fans, veils, etc. All these effects need careful rehearsing. The movement must be carried out on a cue, otherwise the projector man has his hands full. He has to follow the quick movements of the artist, focus them as they approach and recede, and raise or lower the beam by means of a mask, as the projector has no vertical movement.

The Caption Machine

This is particularly awkward in the case of a tall man singing in a close-up position, as we are unable to raise the beam sufficiently high, and

An example of scattered lettering necessary to fit a long name into a narrow space. The figure is a symbol of the art of the dancer.

the top of the head would be cut off. He must, therefore, sit. For an artist to make an entry to the close-up shot and sit down would be found to be clumsy and unpleasing. This is where the caption machine comes in useful. The studio can be faded out or to a picture or a title; the artist can seat himself, and we fade through the name to discover his head and shoulders before us.

I have also to preserve a balance of greater and lesser detail. Detail is obtained in television with the sacrifice of movement; conversely—movement is obtained with the sacrifice of detail. With most people, the eye will become tired of seeing the restricted close-up shot for long periods on end. There will, however, also be a sense of irritation at the lack of detail should there be nothing but long-shot.

A painted back-cloth which is suitable for, say, a group of Spanish songs, often proves confusing or unsuitable for the rest of the pro-

(Continued on page 280)

MEASURING SMALL LIGHT VALUES

In television research it frequently becomes necessary to compare, and it is sometimes desirable to measure, the absolute value of very small quantities of light. This article describes a method of measuring the electro-optical value of light.

COMPARISON of light values can of course usually be effected by means of an optical device, such as a Bunsen or a Lummer-Brodhun photometer-head, but this process of visual comparison, quite apart from its well-known disadvantages of observational error and colour-mismatching, is often not capable of giving a useful rating for the flux to be measured owing to the fact that it is frequently not the *visual effect* but the *electro-optical action* of the light in which the interest lies.

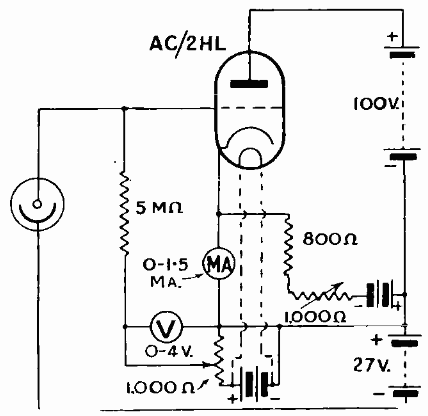


Fig. 1. The circuit of the photo-cell photometer described in the text. The instrument will measure the electro-optical values of light.

For example, suppose we wish to compare the relative merits of different devices for scanning at a television transmitter, each comprising several elements interposed in the light-path, such as lenses, mirrors, prisms and so on. It is obviously of very little use to compare the visual values of the light finally reaching the photo-electric cell in each case, for the electric response of the cell depends to a marked extent upon the spectral distribution of the light-energy reaching it, and we might quite well have two light beams of apparently equal intensity, judged visually, while the photo-electric currents generated by them, when incident upon the same kind of photo-electric material, might be two or three times more in one case than in the other.

Values of Different Media

Accordingly, a form of photo-electric fluxmeter or "lumeter" is a very desirable laboratory instrument for design purposes. In addition, an instrument of this kind can usually be adapted easily for measuring the absorption of various optical media, and for comparing the efficiencies of various metals or methods of silvering for mirrors. In this connection it is interesting to note that some metals which have good reflecting power in the red and yellow end of the spectrum (and therefore, judged visually, might be supposed to be excellent for specular surfaces of mirror-drums and the like) have marked absorption bands in the blue and violet, and therefore with potassium photo-cells, the useful reflection-coefficient would be low compared with that of silvered glass.

The Circuit

In designing the present instrument, it was decided to choose a slide-back, or "zero-return" type of circuit, in order to eliminate as far as possible errors due to non-linearity of response of the various elements of the circuit. Luminous fluxes of the order of 0.1 lumen (*a lumen is properly a "rate of passage of light through an area," but in view of the constancy of the velocity of light, the unit has come to represent a quantity of light*, 4π *lumens, spherically distributed, are emitted by a point source of one candle-power*) or less are required to be measured, in order to be able to deal with scanning-beams of effective value just sufficient or less than sufficient to generate a television signal capable of over-riding valve-parasitic and Johnson noise with modern photo-cells; hence it is necessary to employ an indirect method of measurement, using a thermionic valve with a meter of fair robustness in its anode circuit, in order to avoid the use of exceedingly delicate galvanometers. Fig. 1 is the circuit.

A certain amount of difficulty was unexpectedly encountered in stabilising the circuit, especially when using valves of high mutual conductance, like the AC/2HL which has a slope of 6.5 milliamperes per volt. It will, of course, be appreciated that the slope and not the amplification-factor, determines the choice of valve for maximum sensitivity zero. A form of Barkhausen Kurz oscillation was developed in the circuit at an extremely high frequency, and stability was secured by arranging all leads to be as short and direct as possible, and by using a high-tension voltage of 100 on the valve.

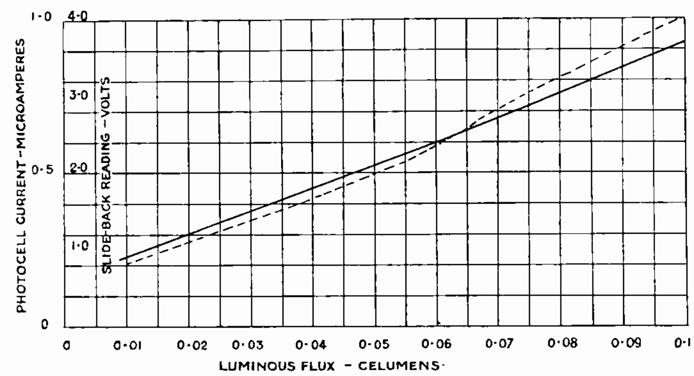


Fig. 2. The calibration curves of the photo-cell photometer.

The photo-cell chosen was a large vacuum-caesium type, about 4 in. in

(*Continued at foot of page 248.*)

Television from Zeesen

ANYONE who has listened on the long waves at odd times during the day will have encountered the television programmes radiated from Zeesen on 191 Kc. These transmissions, which occur twice a week at the moment, have the characteristic thirty-line hum and are capable of being received quite well in this country.

This article is an account of the personal experiences of J. H. REYNER, in cathode-ray reception of the thirty-line transmissions from Zeesen. Horizontal scanning is employed which necessitates a little alteration to the time bases and details of this are explained

I myself have been receiving them on a cathode-ray receiver. It is necessary to make certain modifications for the occasion, but these are easily carried out.

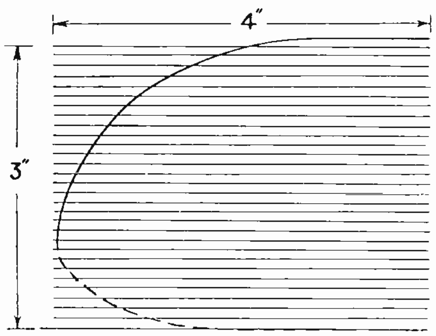


Fig. 1. Correct position of flyback for horizontal scanning from top left-hand to bottom right-hand corner.

Horizontal Scanning

The principal difference between these German transmissions and our own is that the scanning is carried out in a horizontal direction from the top left-hand corner to the bottom right-hand corner. It is necessary, therefore, to interchange the connections of the X and Y plates and also to reverse the connections on the Y plates. The position of the "flyback" will indicate when the scanning is in the right direction. When the picture is scanning from left to right and top to bottom the "flyback" is in the position shown by Fig. 1.

It will be noticed that this is not simply obtained by turning a Baird picture on its side because if the scanning is left as for the B.B.C. transmission the picture would scan from left to right, but from bottom to top. Hence it is necessary to change over the connections to the Y plates.

We are left, therefore, with the $12\frac{1}{2}$ cycle scanning on the Y plates and the 375 cycle scanning on the X plates. The next point to be altered is the picture ratio which is not the somewhat elongated 7/3 proportion adopted by the Baird Company, but is a 4/3 ratio, which gives a much more normal field of vision. The larger dimension is, of course, horizontal so that the picture is one-third longer than it is high. The shape of the picture is easily altered by adjusting the travel of the scanning spot by means of the X and Y sweep controls on the time-base unit.

Receiving the Signals

This is all the alteration that is necessary. The rest of the controls work in the same way as before. The input signal must be fed from a suitable receiver. In my original receiver the television portion contained the detector and output valves with the necessary controls for modulation and synchronising, so that all that was necessary was to feed the signal from the high-frequency portion of a suitable set on to this detector. In other words I disconnected the detector and output stage of the receiver I was using for the purpose and used instead the detector and output valve in my television receiver. Whether this procedure is followed by the reader is entirely a matter for personal preference. All that is necessary is to feed a reasonably clean signal (i.e., free from atmospherics and interference) on to the shield of the tube and to have some method of varying the intensity of the modulation and the permanent bias. Fig. 2 shows the circuit I use.

There are two points to watch here. Firstly, the form of rectification used at the detector should be capable of being changed if necessary from anode-bend to leaky-grid or vice versa, because the correct rendering of the image depends solely upon this point. If the rectification is wrong you will obtain a negative image in which the whites are black and vice versa and with a cathode-ray receiver you cannot reverse matters by simply changing over the connections from the output of the receiver.

Rectification

The transmission is the same as with the B.B.C.

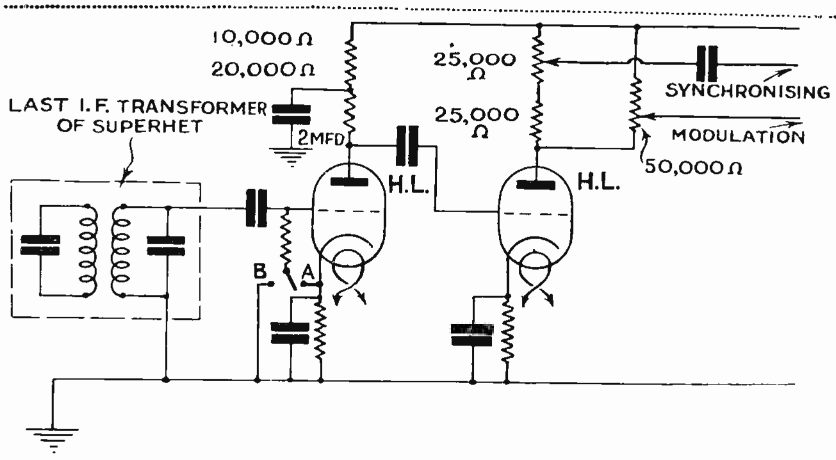


Fig. 2. Essentials of receiving circuit: the switch at A gives grid rectification and that at B anode bend.

programmes so that the system of detection used for the B.B.C. transmissions is satisfactory for Zeesen.

It should be noted that too strong a signal will cause a grid detector to "anode-bend" and this can produce a negative image.

The second point requiring attention is the detail in the transmission, which means that the receiver employed for picking up modulation must not have a serious top cut. As many of the long-wave circuits in modern receivers produce a very marked top cut, this point requires special attention if the best results are

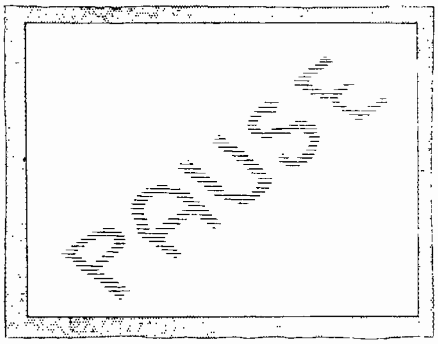


Fig. 3. An impression of the interval signal on the Zeesen transmission.

to be obtained. Make sure, if you can, that you are receiving at least 10 kilocycles on either side of your carrier wave on 191 kilocycles and you will then find a crisp and clear image having real entertainment value.

The actual reception of the programme is facilitated by the fact that in the intervals between the various items a curtain is thrown on the screen containing the word "Pause." (Fig. 3.) This can very easily be focused and adjustments made to the framing and synchronism. Various items then appear on the screen and on the few occasions which I have so far had an opportunity of looking-in, I have found the composition good, although apt to be somewhat variable.

Picture Ratio

The beauty of the 4/3 ratio is that two head and shoulder portraits can be obtained quite easily and a third figure can come into view without in any way producing a sensation of crowding. Since there are only thirty lines the detail is, of course, limited, but a good soft picture can be obtained with surprising clarity. Synchronism is obtained on the German system by transmitting a sharp pulse at the end of each line in exactly the same way as is done by the B.B.C. Consequently the synchronising arrangements already in use apply equally well to this horizontally scanned arrangement, and in fact the controls operate in exactly the same way as they do in the ordinary Baird transmission, if allowance is made for the fact that scanning is now horizontal.

For instance, with the Baird transmission, when the picture is first found it is usually observed to be split vertically, the left-hand half of the picture appearing on the right and vice versa. To correct this we slip the synchronism between the 375 and the 12½ cycle bases (by using the control marked "horizontal framing" on my receiver). With the German transmission the effect will occur turned on its side so that the top of the picture appears at the bottom and vice versa, and we again correct it by slipping the picture.

In exactly the same way there is a control on my receiver marked "'vertical framing." This is a fine adjustment of the 375 cycle base and causes the picture to move slowly through the frame in the direction of the 375 cycle scanning. Since we are scanning horizontally, this now controls the horizontal framing. The black bands on the picture which run diagonally when one first starts must be resolved into vertical streaks and not horizontal ones in order to pull up the picture.

At the time of writing I have not yet discovered where the speech comes from relative to these transmissions. In any case it is doubtful whether I should be able to follow it with all my attention concentrated on the picture. I have found, however, that it is quite easy to obtain good entertainment from the picture without any sound at all, particularly because of the assistance given by the word "Pause," which appears between the items as already stated. At the conclusion of the transmission the word "Ende" is thrown on the screen.

If any reader feels disposed to follow my example and tune in these transmissions he should set up his tube to give thirty lines arranged as shown in Fig. 1. Focus the tube sharply during the counting and adjustment of the lines. Then increase the shield bias (make it more negative) till the lines become soft. The effect of modulation can be tried on any ordinary signal and dance music in particular will produce patterns which will serve quite well for testing the effect of the modulation. When the actual transmission comes on, adjust the control marked "vertical framing," which is a fine adjustment of the 375 tube, till the picture pulls in, when it can be held by the application of a small amount of synchronism.

At present the transmissions are being radiated on Tuesday mornings at 9.5 to 10 a.m., and Saturday mornings from 9.5 to 9.45.

"Measuring Small Light Values"

(Continued from page 246.)

diameter and having an aperture of 3.75 in. diameter, manufactured by the Oxford Instrument Co. This cell had a sensitivity of rather more than 8 micro-amperes per lumen, and saturated completely, at incident fluxes of a lumen or less, at about 25 volts P.D. A section of the high-tension battery serves to maintain a potential of 27 volts across the cell in operation.

In Fig. 2 are shown the calibration curves of the instrument, (*a*) being that obtained by direct measurement against a "Pointolite" standard source, previously checked visually by comparison with a Hefner lamp, and (*b*) being the theoretical calibration, calculated from the known current/luminous flux curve of the cell by itself. The slight curvature of the measured curve is probably due partly to residual "dark-current" in the cell, partly to leakage in the grid circuit of the valve, and partly to flow of grid current. Since abscissæ of these curves cannot properly be called *lumens* (which can only be used to designate fluxes evaluated by reference to their visual effect), units of flux measured by the instrument with reference to their photo-electric effect have been termed "celumens."

EXPERIMENTS IN MY LAB.

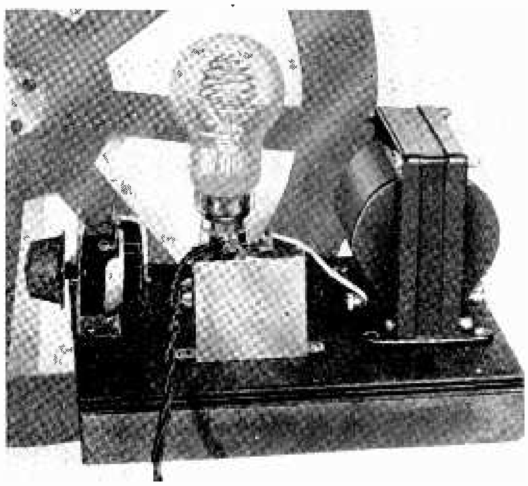
A Stroboscopic speed indicator *for* d.c. working

This is one of a series of articles dealing with experimental apparatus. Many readers will no doubt be able to adopt the suggestions made to suit their own requirements.

THE speed of the scanner plays a very important part in the reception of good pictures on the mechanical types of television apparatus. Unless it is such as to synchronise exactly with the speed of the transmitter it will be impossible to receive a properly formed picture.

A normal television disc or drum is provided with eight spokes or a like stroboscopic device so that when viewed by the light of a lamp working on 50-cycle A.C. mains and revolving at the correct speed of 750 revolutions per minute, the eight spokes will appear to be stationary on the disc. This is due to what is known as the stroboscopic effect and will naturally only be obtained when the disc is viewed by a flickering or alternating light. If, for instance, the source of illumination were D.C. no separate spokes would be noticed, no matter at what speed the disc was running.

It is thus a fairly easy matter for people who are possesed of A.C. mains to ensure that their disc is running at the correct speed at any time previous or during the transmission. Thus no time is wasted when the transmission actually begins in experimenting with the mains resistance in series with the motor in order to find the voltage required to run the disc at the prescribed 750 revolutions.



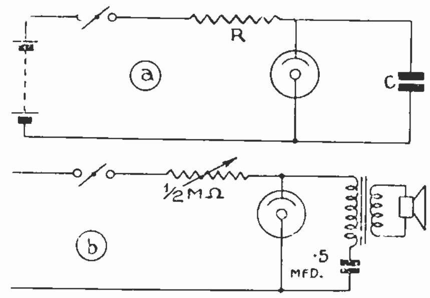
An experimental hook-up designed on the lines of Fig. 1b. As will be seen it merely consists of a variable resistance, a fixed condenser, a loudspeaker output transformer and a neon lamp.

For those unfortunates who have to run their television apparatus from D.C. mains or batteries, however, no such simple device is available, and consequently much time is wasted in synchronising the disc. More often than not, before correct synchronisation is obtained the half hour's television transmission has ceased. I have therefore been doing a bit of experimenting lately with a view to finding some simple piece of apparatus which will give a constantly flickering light when run off D.C. mains or batteries, the flicker being of such a frequency as to enable the stroboscopic effect to be obtained with a disc running at the correct speed.

Flickering Light on D.C. Supply

The solution to the problem is provided by that simple piece of apparatus the neon lamp. When a neon lamp is arranged in circuit with suitable resistance and capacity and is fed with about 190 to 200 volts high tension, it can be made to give what is known as relaxation oscillations. These oscillations are very similar to those given by an oscillating valve, with the exception that the wave form is not sinusoidal but has a peculiar saw-tooth shape. A circuit suitable for producing such relaxation oscillations is shown in Fig. 1a.

When a D.C. voltage is applied to a neon lamp the latter will not light until a certain critical voltage, which is in the neighbourhood of 190 volts, is reached. When the lamp



Figs. 1a and 1b. Suitable circuits for producing relaxation oscillation using a neon lamp operated from a direct-current battery supply.

is once lit, however, the voltage can be decreased well below this figure before the lamp is extinguished again. These two voltages are known as the striking and extinction voltages of the neon lamp.

Referring to Fig. 1a, you will see that when a voltage is applied to the circuit, the condenser C will charge up through the resistance R, thus creating a voltage drop across R. As the condenser charge increases the voltage dropped across the resistance R gets less until finally the voltage across the condenser becomes greater than the ignition voltage of the neon lamp, which then lights up.

When the lamp is alight, however, it is a much better conductor than when it is dark and therefore directly the lamp strikes, the condenser C discharges through the neon lamp which is then extinguished. The cycle is then repeated.

Working Frequencies

The frequency at which the lamp is lit and extinguished is determined by the value of R and C and also by the constants of the lamp. If the lamp can be so arranged that it is lit and extinguished fifty or one hundred times a second, this will give a similar state of affairs to a lamp which is lit from alternating current mains, and thus the fluctuating light necessary for the stroboscopic effect will be easily obtained.

With the values shown in the circuit diagram and using an ordinary beehive neon lamp it is possible to alter the frequency of the oscillator from a few cycles up to 80-100 cycles per second. Alteration of frequency is obtained by varying the ½ meg. resistance. If, however, it is necessary to cover a higher range of frequencies the fixed condenser should be suitably decreased in capacity.

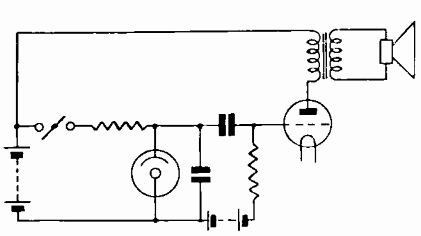


Fig. 2. Diagram showing how to add a single-valve amplifier to neon oscillator to facilitate checking its frequency against a constant-frequency source.

Determining the Frequency

The only difficulty about such an oscillator as is shown in Fig. 1a is that it is difficult to determine the exact frequency at which the lamp is alternating. One method of getting the correct frequency is to wait until you are receiving a steady picture during a television transmission and then switch on the oscillator and vary the resistance R until the correct stroboscopic effect is obtained. This position of the resistance can then be noted and when on future occasions the oscillator is required for use it will only be necessary to turn the resistance to this predetermined point in order to assure yourself that the light is flashing at the correct number of cycles per second.

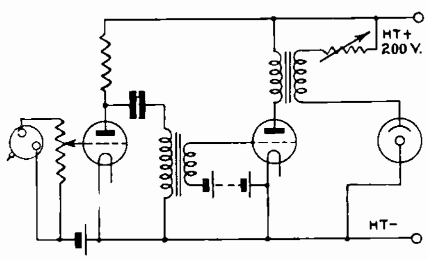


Fig. 3. A useful circuit for modulating a neon lamp from a gramophone pick-up. If constant-frequency records are used the lamp will be caused to flicker at the frequency injected by the pick-up.

A slightly simpler method is to use the circuit of Fig. 1b in which an output transformer is included in series with a condenser across the neon lamp. If a loudspeaker is connected to the secondary of this transformer a note will be heard corresponding to the frequency of oscillation of the neon lamp. This frequency will now depend on the values of resistance and capacity present and also on the inductance of the primary of the output transformer.

To ensure that the correct frequency is obtained it will now only be necessary to check the note obtained in the loudspeaker by beating it with that obtained from a similar loudspeaker, fed from a 50 or 100 cycle constant-frequency record. If no such record is available you will in all probability be able to check the oscillator up against the note obtained from 50-cycle A.C. mains in somebody else's house.

If the note in the speaker attached to the oscillator is not loud enough to enable you to check its frequency easily, it is a simple matter to add a valve amplifying stage as shown in Fig. 2. Incidentally such a piece of apparatus is useful purely as a low-frequency oscillator checking amplifiers, etc., or for any purpose when a low-frequency oscillator is needed and when a sinusoidal waveform is not strictly necessary. By varying the condenser C it is possible to alter the frequency of oscillation from about 5 cycles a second up to 20 or 30 kilocycles.

A More Accurate Method

A rather more acurate method of obtaining a stroboscopic effect is to modulate a neon lamp with signals derived from a constant-frequency record of 50 or 100 cycles which have been amplified with a valve amplifier. A simple circuit suitable for this is shown in Fig. 3. Care will have to be taken to see that the couplings are designed to pass the required frequency, but apart from this there are no snags in the design of the apparatus. The output valve should be capable of passing about half a watt so as to give adequate modulation to the neon lamp. It will be seen that the modulating circuit is very similar to that used on a neon lamp that is required for reception of television pictures.

"An Adjustable Mask"

(*continued from page 238*)

gap between the two portions of the guide plate, the shape of the opening in the centre is as nearly as possible a perfect square Two $\frac{1}{16}$ in. holes are drilled in each piece and a short length of $\frac{1}{16}$ in. wire soldered in place to fit the small straight slot shown in Fig. 4. Needless to say, the strips should be an easy sliding fit in the diagonal slot in the guide plate.

The final assembly of the mask is performed by placing the built up slotted disc in the centre portion of the gap between the guide plates and on top of the overlapping square ended strips and secured in position by two No. 6 B.A. screws on which have been threaded the spiral springs and washers. These screws may be finally locked in position when the spring tension has been adjusted, by a nut placed on the protruding end of each screw at the rear of the main plate.

If a mirror-screw system is in use, as described in the January issue of TELEVISION, then the mask may be modified for variable strip aperture on the lines shown in Fig. 6 and the neon lamp mounted on brackets and clipped to the rear of the mask.

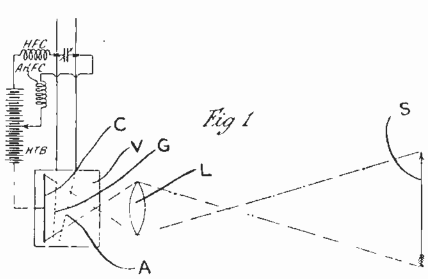
RECENT DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS
Specially Compiled for this Journal

A " Non-Scanning " System

(Patent No. 406,368.)

The inventor discloses a method of television which requires no separate scanning device, either mechanical or otherwise. Instead of first scanning each part of the picture, point by point at the transmitting end, and receiving and reassembling the different signal elements by a second scanning device synchronised with the first, the picture is sent out as a whole, each point on the picture being radiated at a frequency peculiar to itself. In other words every part of the picture is identified with a particular frequency, and the light and shade value of each part is represented by a corresponding depth of modulation.



The Marconi system of television which requires no separate scanning device.

In transmission, the picture frequencies are generated by a special thermionic valve V, arranged to operate on what is known as the Barkhausen Kurz method, the grid G being biased to a high positive voltage whilst the anode A is substantially at cathode potential. Under these conditions very high frequencies are produced, the actual wavelength being determined by the time taken for the electron stream to pass from the cathode to the grid.

As shown in the figure, the cathode C, instead of being a single-wire filament, as usual, consists of a plate of photo-electric material, so that when an image of the picture S is projected on to it by a lens L, electrons are emitted from each point on the surface at a rate which depends upon the intensity of light reaching it at that point. In addition the grid G and anode A, instead of being parallel are set at an angle to each other.

Since the distance between the electrodes varies from point to point along the surface of the cathode, and since the valve as a whole is operating as a Barkhausen Kurz oscillator, a wide range of wave lengths is generated, the waves growing shorter and shorter as the distance between the electrodes diminishes. The result is that the top of the picture is radiated on one wave length and the bottom on another, with graded wave lengths for the intermediate parts.

The density of the electron emission at each point (which represents the light-and-shade value of the picture) automatically controls the depth to which each carrier wave is modulated. The receiver is of the cathode-ray type except that the cathode is an indirectly-heated plate, similar to C, and the control electrodes are sloped to converge together so that the electron stream impinging on the fluorescent viewing-screen is controlled at each point (a) by the frequency of the received carrier, and (b) by its depth of modulation.—(*Marconi's Wireless Telegraph Co., Ltd.; H. M. Dowsett* and *R. Cadzow.*)

Fluorescent Screens

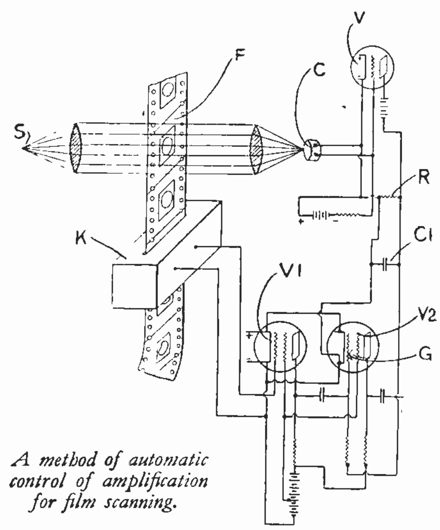
(Patent No. 406,957.)

Zinc sulphide and zinc-cadmium are found to surpass other available fluorescent materials in the output of light which they give out under the impact of a cathode stream. But there is a tendency for the luminescence to persist unduly, which is particularly undesirable when television signals are being reproduced, because it leads to " blurring." According to this invention this persistence is removed by the addition of a small amount of nickel salt to the primary substances.—(*Siemens-Reiniger-Werke, Akt.*)

Film Television

(Patent No. 407,230.)

A problem in televising a moving-picture film is to adjust the degree of amplification of the outgoing signals to the average transparency of the film. For instance, when the ground colour of the film is dark, the amplification should be more intensive than when the general background is light, and vice versa. As shown in the figure the required regulation is effected by a method very similar to that used in ordinary automatic volume control. A source of light S, is arranged to "sample" the film



A method of automatic control of amplification for film scanning.

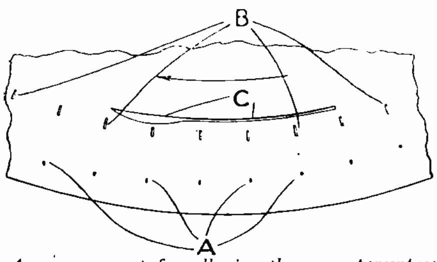
F, immediately before it enters the scanning apparatus, shown diagrammatically at K, the average transparency of the film being measured by the amount of light which reaches a photo-electric cell C. The cell is coupled to a valve V, and controls the value of the plate current flowing through a resistance R.

The modulated signals from the scanning apparatus K, are fed to the first amplifier V1, and then to a second amplifier V2, which is of the variable-mu type. The bias applied to the grid G, of the valve V2, depends upon the voltage drop across the resistance R, so that the overall amplification of the picture signals is supervised and controlled by the action of the photo-electric cell. A condenser C_1, of large capacity, by-passes the effect of any rapid fluctuations, due to picture "details," and only allows comparatively slow changes of background transparency to control the gain of the amplifier V_2.—(*Cie Pour La Fabrication Des Compteurs et Matériel D-Usines à Gaz.*)

Cathode-ray Systems

(Patent No. 407,409.)

In a 60-line cathode-ray system, the scanning disc at the transmitting end is provided with the usual spiral line of scanning holes A, and with a circular series of holes B, which produce impulses for line synchronising. A single elongated slit marked C gives the picture-frequency synchronising signal. Both synchronising frequencies are superposed on the same carrier wave as the picture signals, and as both are transmitted at an amplitude considerably greater



An arrangement for allowing the same percentage modulation of the carrier for both horizontal and vertical scanning impulses.

than that of the picture signals, they are readily separated from the latter at the receiving end.

In order to distinguish in turn between the two synchronising impulses, one is given a steeper wavefront than the other.

The enlarged end of the picture-frequency slot C is arranged to black out the cathode-ray from the viewing screen during the vertical return period, i.e., from the end of one picture to the beginning of the next. The arrangement allows the same percentage modulation of the carrier by both horizontal and vertical scanning impulses, and also enables the picture signals to be developed at a high voltage level so as to increase the effective range of transmission. —(*Marconi's Wireless Telegraph Co Ltd.*)

"Iconoscope" Screens

(Patent No. 407,521.)

In the "Iconoscope" transmitter, the picture to be televised is focused upon a special mosaic surface of cells, which develop electric charges proportional to the light-and-shade value of the picture. The mosaic surface is then scanned by a cathode-ray, which discharges each cell and so sends a corresponding signal impulse to an amplifier valve, forming part of the chain feeding the transmitting aerial.

The invention is concerned with the manner in which the special mosaic surface is formed. In the first place a thin layer L, Fig. 1, of finely-powdered silver oxide or silver carbonate is sprayed or dusted on to a plate of mica M. The prepared plate is then heated in a furnace to a temperature of 800° C. for a period of fifteen seconds. This serves to reduce the silver compound to a metallic silver, which settles into a series of individual globules deposited as shown (greatly enlarged) at G in Fig. 2. The splitting-up of the original layer into individual and separate particles is due to the action of surface tension.

Each individual particle of silver is next covered with a thin layer of oxide, by admitting oxygen gas and subjecting the mixture to high-frequency current. Finally, a thin coating of cæsium is applied by condensation, so as to convert each globule into a miniature photo-sensitive cell.—(*Marconi's Wireless Telegraph Co., Ltd.*)

Summary of Other Patents

(Patent No. 406,709.)

Mirror drum arranged for high-definition scanning, free from end-curvature effects.—(*Marconi's Wireless Telegraph Co., Ltd., H. M. Dowsett and L. E. Q. Walker.*)

> *THE cathode-ray tube can be used to produce television pictures on the 'velocity modulation' system. In this, the beam is caused to scan the picture at a varying speed throughout its travel, although the total time taken to scan the picture remains constant. The faster the beam moves across the screen, the fainter the fluorescent trace produced, and this will give a dark line on the screen. As the speed of the beam decreases the intensity of the fluorescence increases and the trace becomes brighter, corresponding with the light portions of the received picture. This method of transmission and reception has been successfully developed in Germany, and lately in this country.*
>
> *The Cossor Company in their new system use a combination of velocity modulation and 'intensity modulation' at the receiver to produce a better image.*

(Patent No. 406,845.)

"Film" scanning system with means for feeding the film continuously forward at a predetermined rate and for accurately "framing" the picture.—(*Marconi's Wireless Telegraph Co., Ltd.*)

(Patent No. 406,905.)

Method of improving electron emission, particularly in a cathode-ray tube, by surrounding the cathode with a very fine metallic mesh.—(*Telefunken Co.*)

(Patent No. 407,309.)

Improvement in light-sensitive cells as used in picture-telegraphy telegraphy and television.—(*P. V. Auger.*)

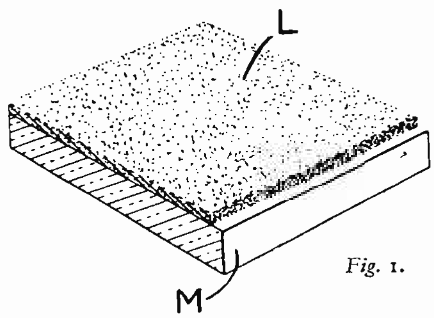


Fig. 1.

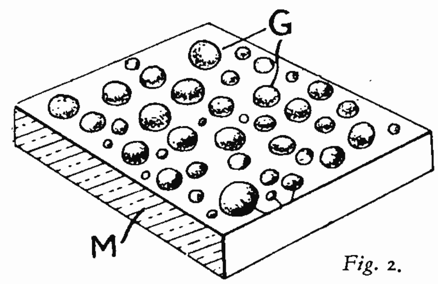


Fig. 2.

Two diagrams explaining the composition of the mosaic screen of the Iconoscope type.

(Patent No. 407,318.)

Method of preparing the fluorescent viewing-screen of a cathode-ray tube.—(*Telefunken Co.*)

(Patent No. 407,322.)

Preventing false operation of the synchronising signals in a television receiver.—(*Marconi's Wireless Telegraph Co., Ltd.*)

(Patent No. 407,377.)

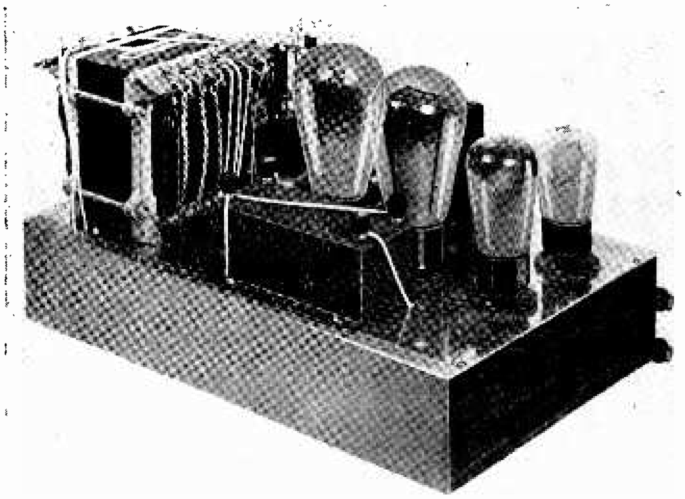
Device for increasing the life of the cathode in a cathode-ray tube.—(*M. von. Ardenne.*)

(Patent No. 407,383.)

Improvements in photo-electric cells.—(*A. L. Williams and The Westinghouse Brake and Saxby Signal Co., Ltd.*)

(Patent No. 407,385.)

Light-control valves of the Kerr cell type.—(*G. W. Walton.*)



An Amplifier *for* Mirror-drum Television

This month we present to our readers a design for an amplifier built to the Baird circuit suitable for mirror-drum television. Every care has been taken to make it as efficient as possible and special attention has been given to the layout to produce a powerful, efficient and compact unit.

THE output necessary for efficiently modulating the Kerr cell of a mirror-drum television apparatus is much too high to be obtained from the normal run of broadcast receivers, and it is usually necessary to build a special amplifier, solely for the purpose of modulating the cell. Moreover this procedure is advantageous from the point of view of quality of pictures, because the frequency range that would be excellent for providing sound output from a broadcast set is quite inadequate for the production of the necessary detail in picture reception.

Four Watts Output

Accordingly we have this month designed a special amplifier which will give anything up to 4 watts output and which will adequately reproduce those very high frequencies, which far from being advantageous to broadcast reception are usually definitely attenuated, to prevent the reception of heterodyne whistles and cross talk. To this end resistance coupling has been used throughout, not only in the various intervalve couplings but also in the output stage. You will notice that instead of a choke filter output circuit a 4,000-ohms resistance has been included in the anode circuit of the output valve. The reason for this is that the self capacity of the L.F. choke, more commonly used in this position, would result in the curtailment of frequencies above 7,000 or 8,000 cycles. A similar state of affairs would result were we to use transformer intervalve coupling. The high frequency attenuation in this case would be due to the shunt effect of the interelectrode capacity of the output valve, on the high inductance secondary winding of the intervalve transformer.

Moreover the presence of such iron cored inductances in the circuit would give rise to a change of phase in the signal, which would result in distorted images appearing on the screen. The final circuit which we decided upon has been closely modelled on the standard amplifier provided by Baird Television, Ltd., for use with their mirror-drum visor, and which has given excellent results.

Three Stages of R.C.

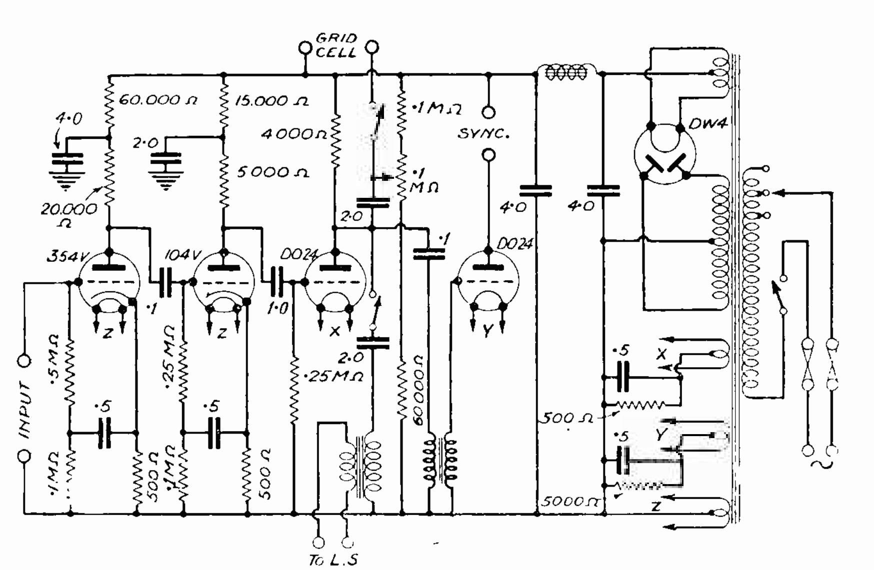
Three stages of resistance coupling are employed, terminating in a modulator valve of relatively low impedance, and working with about 400 volts on the anode.

It is necessary for an amplifier of this description to have H.T. supply of at least 400-volts, as a polarising voltage of this order is required by the Kerr cell, before it will function satisfactorily.

Synchronising

Coupled to the DO24 modulator valve is another similar valve which is used for providing the synchronising signals for actuating the synchronising coils which keep the mirror-drum revolving at a constant speed.

As the maximum current passed through the synchronising coil should not be more than about 25 milliamperes, this latter valve is

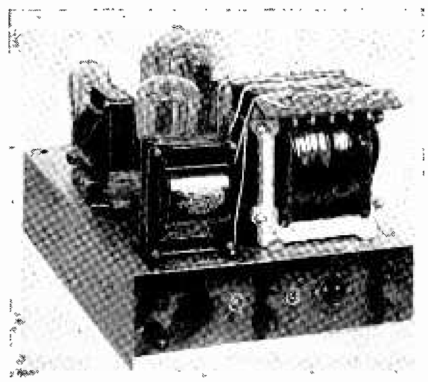


The circuit is that recommended by the Baird Co. for use in conjunction with their mirror-drum scanner.

over-biased until its anode current is of the above order.

Synchronising Output

A transformer is used for coupling between the modulator valve and the synchronising valve, the latter being peaked at 375 cycles. That is to say the transformer will tend to amplify signals of 375 cycles to the exclusion of signals of other frequencies. There is no objection to using a transformer in this position as a little phase distortion will not affect the synchronising current and the question of attenuation of the higher frequencies does not occur. This transformer is parallel fed from the anode of the modulator valve by means of a .1 condenser, acting in conjunction with the 4,000-ohms anode resistance already mentioned.



As will be seen most of the wiring is underneath the chassis.

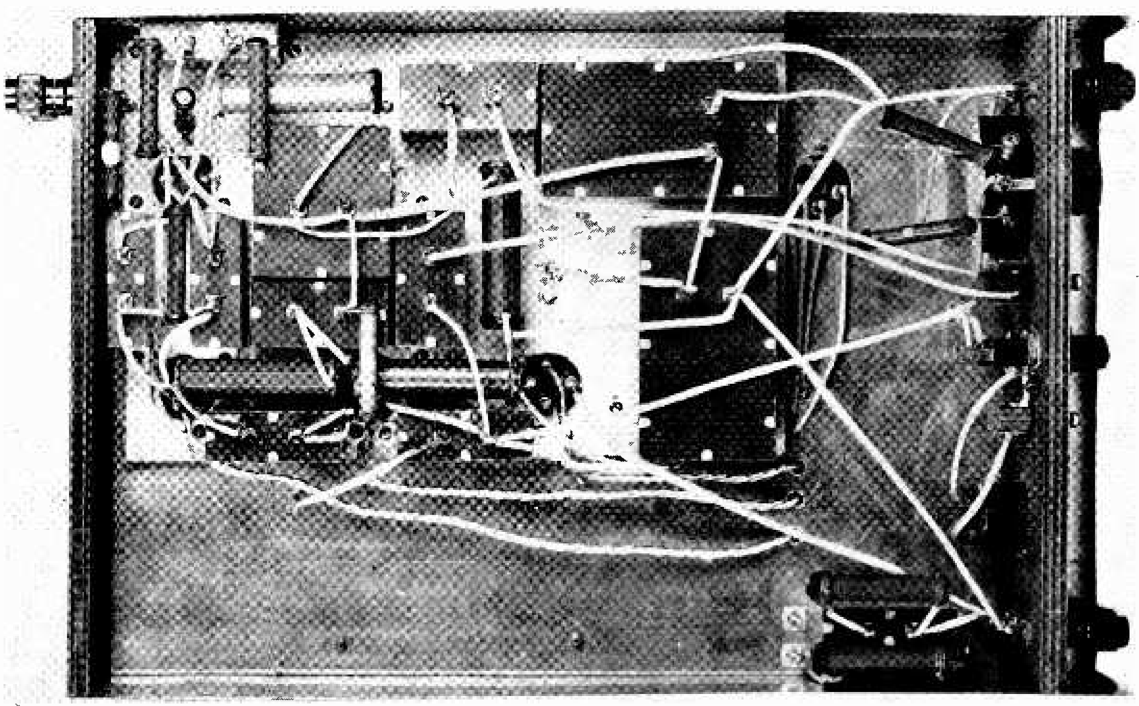
The polarising voltage for the Kerr cell is obtained by means of a potentiometer consisting of two .1-megohm resistances in series with a 60,000-ohms resistance, across the total high tension supply. The middle .1-megohm resistance of this potential dividing chain is made variable and the polarising voltage for the Kerr cell is taken from the slider. This enables the voltage applied to the Kerr cell to be varied until the best operating point is found.

A switch-over arrangement is also provided in the anode circuit of the output valve to enable either the Kerr cell or a loudspeaker to be fed with the modulating signal. This latter arrangement is very useful when checking up for correct tuning in of the National programme before the actual television commences. It must be stated, however, that it is by far a better idea to employ a detector tuning meter so as to have actual visual indication of when the programme is correctly tuned-in, as incorrect tuning will result in attenuation of the lower frequencies in the transmission which are necessary to give the picture the required "depth."

The couplings in the early stages have been carefully designed to allow of adequate amplification of the full frequency range from about 25 up to 15,000 cycles. For this reason the anode resistances have values which may seem a trifle low when compared with the impedance of the valve. This procedure no doubt results in a lower overall amplification, but prevents attenuation of the higher frequencies. For a similar reason the grid leaks have been made a trifle on the low side to prevent the higher frequencies being lost, due to the shunting effect of the interelectrode capacity of the succeeding valve.

In the first stage a valve of medium impedance is used, the actual valve being a Mullard 354V. Following this is a small power valve, the Mullard 104V, which is capable of giving, without overloading, the grid swing needed to load up the DO24 modulator valve.

A decoupling resistance of 60,000-ohms by-passed to earth by a condenser of 4-microfarad adequately prevents back coupling in the first stage and also acts as a dropping resistance, so as to ensure that not more than about 200 volts is applied actually to the anode of the 354V. A high resistance of this description is



This underside view studied in conjunction with the circuit will make the wiring easy to follow.

necessary, owing to the fact that the overall high-tension supply available is in the order of 500 volts. The second valve of the amplifier is also decoupled by a 15,000-ohms resistance and 2-microfarad condenser to earth. Extensive grid decoupling is provided throughout to ensure that there is no back coupling through the grid circuits of the valves. In each case this is provided by a 100,000-ohms resistance, and .5-microfarad by-pass condenser. The intervalve coupling condensers have fairly large values, the second one having a value of 1-microfarad. This is to prevent phase distortion occurring which would upset the picture.

In the interests of neatness and rigidity a metal chassis is used and most of the wiring is underneath the chassis. Sub-baseboard type valve holders are employed and care should be taken to drill a hole in the aluminium chassis of adequate clearance to prevent shorts occurring between adjacent valve holder sockets.

CHASSIS.
1—Peto-Scott 15½ in. by 10 in. by 3 in.

CHOKES, LOW-FREQUENCY.
1—Ferranti, type B2.

CONDENSERS, FIXED.
4—T.M.C. Hydra, type 25, values: .5-microfarad.
7—T.M.C. Hydra, type 50, values: .1-(2), 1-, 2-4-microfarad (3).
2—T.M.C. Hydra, type 75, values: 4-microfarad.

HOLDERS, FUSE.
2—Belling Lee, type 1064.

HOLDERS, VALVE.
5—Clix, type Airsprung, 4-pin (3), 5-pin (2).

RESISTANCES, FIXED.
9—Erie, type 1 watt, values: 500-(2), 60,000-, 100,000-(3) 250,000-(2), 500,000-ohm.
2—Erie, type 2-watt, values: 500-, 5,000-ohm.
4—Erie, type 3-watt values: 5,000-, 15,000-, 20,000-, 60,000- ohm.
1—Zenith, 4,000-ohm, type B2, complete with clips.

RESISTANCE, VARIABLE.
1—Bulgin, 100,000-ohm, type VC40.

SUNDRIES.
1—Peto-Scott Metaplex strip 10 in. by 6½ in. by ⅜ in.
2—Peto-Scott strips plywood 10 in. by 3 in. by ⅜ in.
1—Bulgin flush mounting mains plug and socket, type P20.
Connecting wire and sleeving (Peto-Scott).
3 yd. thin flex (Peto-Scott).
2 yd. of mains flex (Peto-Scott).
1 doz. 1 in. 6BA bolts and nuts (Peto-Scott).
Ebonite strip 5 in. by 1 in. (Peto-Scott).

SWITCHES.
1—Bulgin on-off toggle, type S80T.
1—Bulgin double pole double throw, type S89.

TERMINALS, ETC.
6—Belling Lee, type B, marked: Input (2), black (2), red (2).

TRANSFORMER, LOW-FREQUENCY.
1—Mervyn, type 375—cycle peak.
1—Ferranti, type OPM1.

TRANSFORMER, MAINS.
1—Parmeko, type HMT/500 with following windings:—
500-0-500 volts 100 milliamperes.
Four windings, each giving 2·0-2 volts, 2 amperes.

VALVES.
1—Mullard 354v.
1—Mullard 104v.
2—Mullard Do24.
1—Mullard DW4.

H.T. Supply

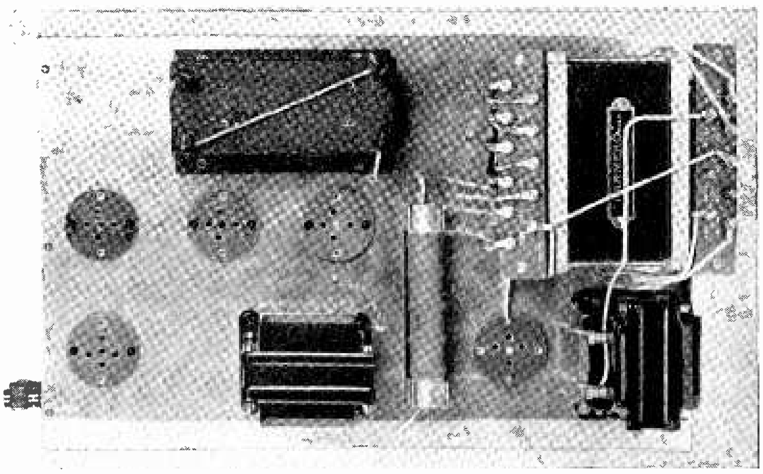
The high-tension supply is provided by means of a full-wave rectifying valve and suitable mains transformer designed to give a high-tension supply of 500 volts, 100 milliamperes. Besides the high-tension winding and the rectifying valve filament winding, this transformer is provided with three other 4-volt windings, one of which supplies 4 volts to the heaters of the 354V and the 104V, both of which are indirectly heated valves. The other two 4-volt windings supply filament current to the two directly heated DO24's. The biasing resistances for the two latter valves are connected between earth and the centre tap of the corresponding filament winding. In each case these resistances are decoupled by a .5-microfarad condenser.

Adequate smoothing is ensured by the use of a 20 henry choke bypassed to earth by a 4-microfarad condenser, which has a working voltage of 750. In order to ensure freedom from breakdown all the high-tension decoupling condensers, together with any coupling condensers which are in any way connected to the high-tension circuit, are of the high-working voltage type.

The wooden panel on the right-hand end of the chassis is a mains distribution panel. On this will be found the mains input plug, on-off switch and fuse, also the bias potentiometer for the Kerr cell. The two pairs of terminals serve to make connection to the Kerr cell and to the synchronising coils.

As the amplifier has a fairly low overall gain a reasonably high radio frequency input should be used to ensure sufficient modulation for the Kerr cell. One way of obtaining this input is to use a radio-frequency receiver employing one screen-grid high-frequency stage of fairly high magnification, followed by an anode bend detector of the power type. Care will have to be taken in the design of the anode-bend detector stage to see that no distortion is introduced and that any bypass condensers, etc., are not large enough to give a high-frequency cut-off. Efficient radio-frequency choking must be employed to prevent any unwanted radio-frequency getting through into the low-frequency amplifier. Otherwise this will in all probability cause low-frequency oscillation, and will certainly give rise to picture distortion.

Another suitable high-frequency arrangement for this amplifier would consist of two stages of screen-grid amplification, followed by diode detection. The latter is useful in that it gives distortionless rectification of large radio inputs and enables a high-value of rectified voltage to be applied to the input of the amplifier. We are at present engaged on the design of a high-frequency amplifier on these lines, using a Westector as diode detector. The use of this device is beneficial in that it enables the phase of the signal to be changed in the event of a negative picture, merely by reversing the connections to the Westector. We hope to describe such a unit in next month's issue of TELEVISION.



This is a plan view showing the arrangement of the components on the top of the chassis.

TELEVISION AND THE ULTRA-SHORT WAVES

Ultra-short waves continue to engage the attention of all serious television workers, and, from all the indications, it would appear that the utilisation of these extremely high frequencies will provide the ultimate solution of a regular, high-definition television service.

ONE of the first problems which comes to the mind regarding ultra-short waves, is their limited service range; although in this connection it is worth noting that because of the smaller distances to be covered, we in this country have a distinct advantage over the United States and Germany. In these latter countries it has been proposed to establish "chain" television services, the idea being to relay the original signal by successive relaying transmitters until a point is reached where re-broadcasting is necessary.

If it were possible to link the broadcasting stations together by means of a high-grade telephone cable, as is done in the case of "chain" broadcast telephony, the problem of providing a regular *service* by means of ultra-short waves would be much simpler. Unfortunately, cables which will carry the enormous frequencies used in high-definition television exist at present only in the imagination.

Capacitance

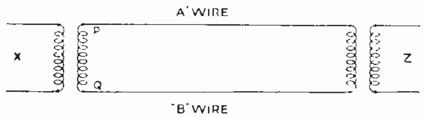
The chief difficulty in a cable link is caused by the capacitance of the pair of wires which form the link. The diagram shows a simple circuit indicating the principle of transmitting modulated currents from *X* to *Z*; the two insulated wires *A* and *B* forming a metallic circuit around which flow currents induced in *PQ*. In actual practice these circuits are rather complicated; repeaters are used at intervals to boost the currents.

Since the wires *A* and *B* form only one pair in a cable which may contain dozens of similar pairs, it is evident that several unwanted capacitances will be set up. In the first place, a definite capacitance will exist between the *A* wire and the *B* wire; the *A* wire will also set up a capacity effect between itself and other pairs of wires in the cable. It may also, in conjunction with the outer lead sheath of the cable, form a capacity to earth. The *B* wire also experiences capacity effects between surrounding wires and earth, and it will presently be shown that these large and unwanted capacitances are the limiting factor in the transmission of television by land-lines.

In the transmission of the much lower frequencies used in speech and music, the capacitances mentioned can be neutralised by inserting "lumps" of inductance (known as loading coils) in the line, or by covering each insulated wire with a continuous tape of "permalloy"—which method is known as continuous loading.

Now the whole point about these capacitances is that they cause the current waves to lead the voltage waves by an angle which varies with the frequency, and since in television, as in speech, the frequency varies from instant to instant, phase distortion is set up. Currents of varying frequency may also be attenuated unequally, which provides another source of distortion so far as the relaying of television is concerned. The absolute elimination of distortion can only be achieved by making the line independent of frequency, so that for a distortionless line $\frac{R}{L}$ must equal $\frac{G}{C}$

where R=Resistance per mile, in ohms.
L=Inductance per mile, in henries.
G=Leakance per mile, in ohms.
C=Capacitance per mile, in farads.



A simple circuit showing the principle of transmitting modulated currents by wire.

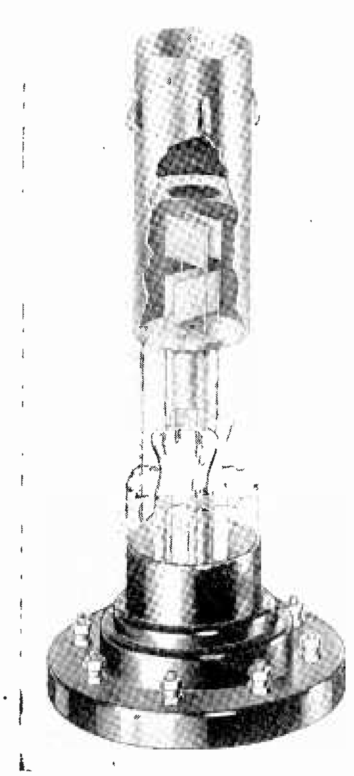
It has been suggested in other countries that the problem could be solved by multi-channel transmission, using, say, four or more channels, each channel taking only a portion of the picture. Even so, specially-constructed cables are required, and the distance over which such high frequencies can be transmitted is very limited. Generally speaking, this method is very expensive, and is not at the moment an economic proposition.

The alternative method to the cable link is the radio link, and this alternative may solve the problem of an ultra-short wave television service. But a great deal of hard thinking will first be necessary in order to lay-out the stations so that the number of relay stations is kept down to an absolute minimum. In practice it will most likely be found that it is impracticable to relay high-definition television signals more than once without seriously impairing the quality. In this connection it must be borne in mind that the eye can detect distortion more readily than the ear.

As an example of the distortion which relays *can* cause, consider for a moment the transatlantic broadcasts of Mr. S. P. B. Mais. When Mr. Mais spoke from New Orleans his speech was almost unintelligible owing to the distortion caused by the numerous relays, but, as he approached the north-eastern sea-board and the trans-atlantic radio station, the quality improved considerably.

Television will suffer a similar fate

(*Continued at foot of page* 258.)


A cut-away photograph showing the electrode arrangement of the Cossor cathode-ray tube.

Correspondence

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

Photographing the Image :: *Puzzling Paradoxes*
Amateur Transmission :: *The B.B.C.'s Inexplicable Action*

Photographing the Image

Sir,

I am enclosing two television photographs which you have presumably seen at Broadcasting House. These photographs were not taken with a camera; they were taken by placing a $\frac{1}{2}$-plate in the place of the screen on my mirror-drum receiver, with the spot scanning direct on to it. A plywood screen is placed in a slide in front of the plate and used as a shutter. The plates I used were Ilford hypersensitive panchromatic, and the exposure was about $1\frac{1}{2}$ seconds.

My mirror-drum receiver is entirely home-made, and the 80 volt 100 watt lamp has to work from 100 volts D.C., and so will not be as efficient as one working from A.C. mains.

F. V. Whitehead (Bradford).

* * *

Puzzling Paradoxes

Sir,

Referring to G. J. McDonald's letter on page 216, in your May issue, the omission of the "b" in the final term of the differential equation in my article was, of course, a slip; my thanks are due to him for so promptly bringing it to my notice, for I had read the text through without seeing it.

J. C. Wilson (North Harrow).

This photograph of a transmission of Betty Bolton was produced by scanning direct on to the photographic plate as explained in a letter on this page.

* * *

Amateur Transmission—A Suggestion

Sir,

It seems a pity that in view of the short service available from the B.B.C. transmissions, some of our amateur telephony transmitters on the 160-metre band do not collaborate with someone prepared to make up a television transmitter and radiate transmissions on, say, Sunday mornings. I myself am contemplating doing this, and would be glad of any information you could give me with regard to the position of such amateurs, as there may be some regulations prohibiting such experimental work of which I am not aware.

I would certainly be very obliged if you would offer your suggestions in this respect.

T. W. Humphreys (Putney).

[We shall be glad to hear from readers who are interested in this suggestion.—Ed.]

* * *

The B.B.C.'s Inexplicable Action

Sir,

Ever since the inauguration of the Pilot Kit Service in 1919 this company has consistently maintained the closest contact with home constructors throughout the world, hence we have an unparalleled opportunity for gauging and anticipating the needs and interests of both the amateur experimenter and the average broadcast listener.

Therefore, it is not surprising that the B.B.C.'s inexplicable action in reducing television transmission has resulted in our being inundated with bitter complaints from regular "lookers-in" on the one hand, and a truly amazing number of prospective experimenters on the other.

Surely the B.B.C. must be cognisant of the fact that the general public are now immeasurably more interested in 30-line television than ever before, and such being the case the present situation is absurd.

What would have been the position of radio broadcasting to-day if the responsible authorities instead of following a policy of gradual development, had reduced transmissions from Writtle, giving as their excuse that at some time in the future they would have a network of stations transmitting regular programmes at all hours, and that until then the public must be satisfied with Writtle.

We all know that high-definition television is the ultimate outcome of the present experimental developments, but until suitable transmission and low-priced receiving apparatus are available, it is obviously impossible for the general public to enjoy the benefits of the more perfect systems.

An important point which must not escape attention is that just as in the early days of radio, the experimenters and amateurs were able and did in fact assist in its development, so to-day the same circumstances exist, but the opportunities afforded are so limited by the paucity of the transmissions that there is grave risk of the public's enthusiasm being permanently destroyed in so far as 30-line work is concerned.

Another photograph produced by the same method of direct scanning on to the photographic plate. The exposure was one-and-a-half seconds.

Finally, there is no disputing the fact that 30-line transmissions have a definite entertainment value and the apparatus necessary for receiving is very inexpensive; these facts coupled with the keen interest displayed by the general public, are the vital factors which must surely influence the B.B.C. to arrange for considerable extensions in the programmes transmitted.

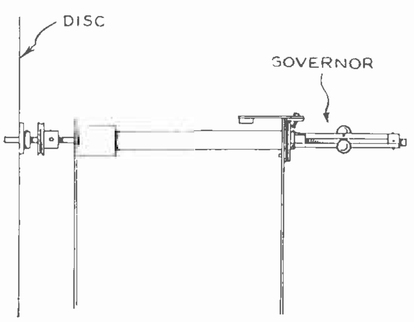
The public demand for 30-line transmission is insistent and it is up to the B.B.C. as public servants to supply their requirements immediately.

For and on behalf of
THE PETO SCOTT CO., LTD.,
W. SCOTT WORTHINGTON,
Managing Director.

A Governor for Speed Control

SIR,

I have been in possession of a *Daily Express* visor for a short time and have found it almost impossible to keep the scanning disc running at 750 revolutions for more than a few seconds. I noticed your answer to a correspondent in the April issue re fitting a slight check on the motor, so I thought the following arrangement which I have fitted might be of some interest, as it has increased my results by at least 50 per cent.



Using a governor for speed control.

You will note from the enclosed sketch that I have fitted a ¼ silver steel rod for the spindle which is about 4 in. longer than the standard rod, and mounted on the extension a governor from a gramophone. It was found necessary to reamer out the bushes of the governor to ¼ in. as they were a shade too small. A small right angle bracket was mounted on the side of the upright at the top to accommodate the felt check and arm which needed a little bending to make contact with the governor.

I think I should get even better results by fitting slightly larger governor weights (or weaker springs) as a gramophone governor appears to run at about 1,000 revolutions or more.

I also propose to fit to the speed control arm a screw with a fine pitch thread to make adjustment of the brake more critical.

Although the efficiency is no doubt much less than synchronising gear it only costs a few shillings to fit and is a real help.

A. H. GREGORY (Bristol).

Television and the Ultra-short Waves

(*Continued from page* 256.)

if a "chain" system is adopted as a means of providing a service.

As previously mentioned, we are fortunate in the matter of U.S.W. television, because of the compactness of our country. It ought, therefore, to be possible ultimately to provide a nation-wide service by means of a small number of central broadcasting stations, with relay stations situated circularly on the edge of their respective service areas.

To make this point quite clear, an omni-directional U.S.W. television transmitter suitably placed in London would have a service radius of about 25 to 30 miles in all directions. A relay station situated, say, in Luton, could pick up the *original* signals and re-broadcast them over an area 60 miles in diameter: four such relay stations situated on a thirty mile circle around London would serve the whole of south-east England and the Home Counties, and no signal would be relayed more than once.


Lord Selsdon. Chairman of the Postmaster-General's Committee which is to deliberate the future policy of television.

Finally, we come to the question of interference on the U.S.W. band. This is caused mainly by radiation from the ignition systems of motor cars, and as things stand at present, it must be admitted that it is a nuisance. This ignition interference extends over a considerable part of the U.S.W. spectrum, from about 14 megacycles to 60 megacycles, being at its worst at 28 mc.

A. E. SEMPER, F.T.S.

A New Television Company

A new private company has been registered, which will be known as Marconi—E.M.I. Television Co., Ltd. The shares are held equally by the Marconi Wireless Telegraph Co., Ltd., and the Electric and Musical Industries, Ltd.

Lord Inverforth is chairman and the board includes the Marchese Marconi and Mr. Alfred Clark, chairman of Electric and Musical Industries, Ltd. It is intended that the new company shall maintain close contact with television developments in all parts of the world and, it is understood, develop the systems with which both these concerns have been experimenting.

A Successful Exhibition

The Pittville Radio, of Cheltenham, recently organised a television exhibition as a section of the Cheltenham Better Homes Exhibition. The exhibits included the Baird mirror-drum receiver, the *Daily Express* television kits, various experimental visors, Cossor and Ediswan cathode-ray tubes and various components and units.

The exhibition proved a remarkable success, the number of visitors to the television section being approximately 4,000, all of whom paid an additional charge for admission to this section. Pittville Radio have inaugurated a free help bureau and any of our readers residing in the Cheltenham district and wishing for advice would do well to get into touch with this firm.

The Stixograph and Scophony

By the Inventor, G. W. Walton.

This article, the fourth of the series, on the principle of the Stixograph and Scophony continues the analysis of the quality of the reproduced picture and later deals with television problems describing the meaning of scanning and the effects of aperture distortion. The series comprises the only complete and authentic description of the Scophony system ever published and is exclusive to TELEVISION.

FROM the last two paragraphs last month it will be seen that Figs. 19 to 23 portray all changes in the picture including all directions of movement, speeds and characteristics of change of speed. In order that movement across the strips shall be quite clearly understood, in Fig. 25, two details moving at right angles to the strips are shown. In Fig. 25A the picture at $T=O$ is shown, and Fig. 25B shows the picture at $T=t$. The detail 1 moves at uniform speed downwards, and the detail 2 moves at an increasing speed upwards.

Fig. 25C shows the time-size-position graphs of the picture, and of course corresponds to Fig. 21. Fig. 25D shows the complete time-size-position-intensity graphs and corresponds to Fig. 23 for the picture of Figs. 25A and B during the time period t.

In Fig. 25D the graphs of the details appear to be interrupted, but this is quite correct, for the details do not remain in one strip but appear successively in the strips, and it will be noted that at every instant of time there is an accurate representation of both of the details 1 and 2. As detail 1 moves at uniform speed, it appears for the same length of time in each section of the Stixograph, whilst the detail 2 moving as it does at a changing speed appears for the longest time in section five and decreasing lengths of time in the other sections, being shortest in section one.

The direction of motion is indicated by the order in which the details appear in the sections, the detail 1 appears to move away from O as it is moving downwards in Fig. 25A, and the detail 2 moves towards O as it is moving upwards in Fig. 25A. Obviously, Figs. 25A and 19A combined could be represented by a combination of Figs. 23 and 25B. This is not necessary, for Fig. 23 does actually show all changes that can take place in any monochrome picture.

In Fig. 23 a most useful tool has been fashioned, which can be employed in the study of all monochrome pictures involving time and motion. It is quite accurate in terms of an actual picture reproduction, which is all that we are concerned with in pictorial arts concerned with recording, reproducing, transmitting and receiving, as distinct from instantaneous direct viewing apparatus, such as telescopes and microscopes. By the use of Fig. 23 all the imperfections of present well-known methods of cinematography and television will be readily visualised, and some possible improvements will appear.

It may seem ridiculous to make such a statement in respect of cinematography which has been developed over some forty years to its present state of high perfection. Naturally it is difficult to see possible improvements or alternative methods, otherwise they would have been employed at the beginning. If a problem requiring a solution is not reduced to its most simple form its requirements are complex, and therefore the solution is likely to be complex and probably inadequate.

With the help of Fig. 23 the ordinary cinema can be discussed and its advantages and disadvantages ascertained. The ordinary cinema camera records an animated picture over a period of time as a series of separate pictures taken at intervals of time. The ordinary apparatus consists essentially of a photographic lens forming an image of the picture on a photographic recording surface, mechanism to shut off the light from the film whilst the latter is being moved, and mechanism to move the film intermittently so that it is stationary when light is active on it to impress the image, and moving during the time the light is obscured.

Suppose such a camera to be recording the picture of Fig. 19A, with all the changes previously mentioned, over the period of time t, then the record to be accurate and complete should be equivalent to Fig. 23. If it is not, then a time-size-position-intensity graph such as Fig. 23 will show what differences there are.

The camera does not record at every instant of time, for the shutter cuts off the light whilst the film moves. Suppose $T—O$, t_2 and t to be the middle points of successive periods when light is cut

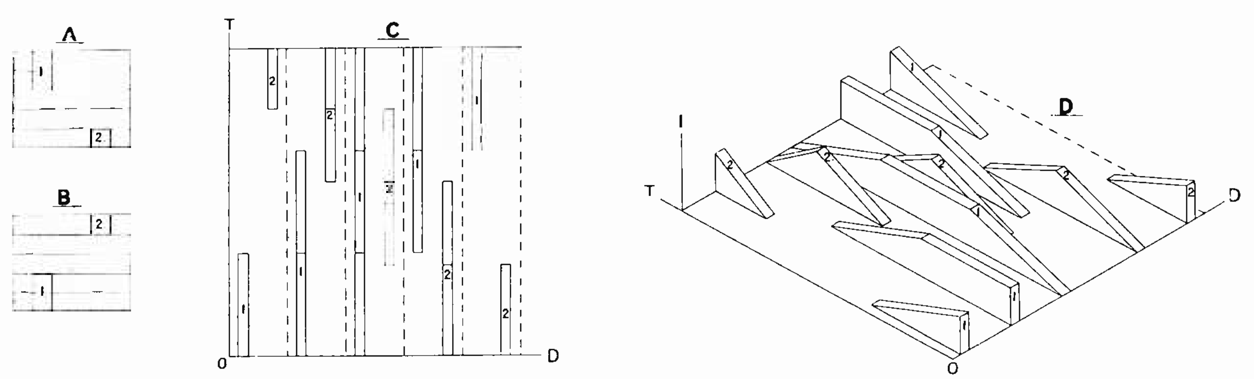


Fig. 25. Diagrams and graphs showing movement of details in a direction across the strips of the picture.

off, then the period of one cycle of the camera operations is therefore t_2 and of this a part is completely inactive, say 40 per cent.

The shutter does not open or close instantaneously, but takes some appreciable time during which the light is increasing or decreasing. Suppose the time required to open or close is 10 per cent. of the period of one cycle, then the parts of the event Fig. 19 for the time t which are actually recorded, will be as shown in Fig. 26A. (The term event is used with the popular meaning of something happening over a period of time and not with the usual scientific meaning of a situation at one point of time.)

In Fig. 26A the parts U, V and W in the time axis represents the periods when the shutter is closed and there is no record at all, consequently no matter what happens during these intervals to the picture, there will be no record. The portions X represent the periods during which the shutter is closing or opening and Y and Z the periods of full opening. During the X periods, the picture is recorded at changing intensities, which have been taken in Fig. 26A as being the same in every part of the picture, whereas in actual practice some parts would be obscured before others depending on the form, position and movement of the shutter. During the periods Y and Z, the picture is at maximum light intensity.

Fig. 26A represents only the parts of the original event recorded, and does not show how they are recorded, nor what the reproduced event will be like. The portions of the event for the periods X-Y-X_1 and X_2-Z-X_3 are recorded as shown in Fig. 26B for the picture is integrated over the whole of those two periods. This integration is no disadvantage in the case of details which do not change position or intensity.

Details changing intensity are recorded at a mean intensity for the period of exposure. Details which are moving particularly at high speed, are badly distorted. The reason for this is that one picture of a cinema film is really, when represented as a Stixograph, similar to Figs. 20A and 20C, i.e., at one instant of time, but the recording takes place over a period of time.

Moving details such as b and f of uniform light intensity have, because of their motion, to distribute their light over a larger area, which results in an increase of detail size and a decrease of light intensity for that larger detail. This is shown in Fig. 26B which is the size-position-intensity graph of two successive pictures on the film for the event in Fig. 26A for the time t and it will be noticed that the details a, b and f are distorted in size and light intensity and that their positions in the picture are their mean positions during the period of exposure.

Having shown in Fig. 26A the parts of the original event actually recorded, and in Fig. 26B how those parts appear as records, it is necessary to show the equivalent of the reproduced event such as would appear on a projection screen. This is shown in Fig. 26C where the pictures of Fig. 26B are shown for a period of time with black-outs between.

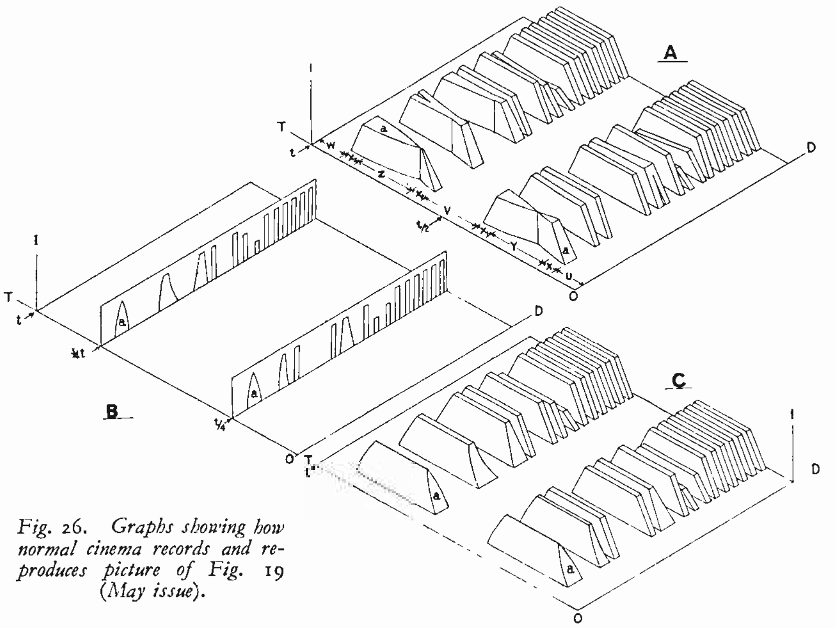


Fig. 26. Graphs showing how normal cinema records and reproduces picture of Fig. 19 (May issue).

Compare Fig. 26D with Fig. 23, which is a true representation of the original event, and it is seen that there is a considerable loss of information and of definition and contrast of moving details. Moving details are usually the chief points of interest in a scene, and if the highest speed of movement in the picture is taken as two seconds across the whole picture horizontally, then the movement during one exposure is about three times the minimum detail size.

This speed is not high as it is only that of a full-size person, comfortably accommodated in the vertical height of the picture, crossing the field of view at an average walking pace. Much higher speeds are used in average cinema pictures, for instance a person striking a blow is easily three times that speed.

Cinema Picture Defects

The examination of the ordinary cinema with the aid of Fig. 23 shows several defects, but this must not be taken as proving the ordinary cinema to be unsatisfactory by any means. The results in pictures to-day are remarkably good, and the modern cinema is a monument to the patience and perseverance maintained over a period of many years in perfecting it, despite many obstacles and inherent defects of the original conception. All who have taken part in the development of the cinema can be proud of their achievement, even though the method of jerking a record through a complex machine at a speed varying between two miles per hour and dead stop twenty-four times per second, is decidedly brutal.

The question now arises, can an animated picture be recorded in any better way? Fig. 23 itself is an answer to this, for it is a perfect record for a pre-determined definition of reproduced picture. Unfortunately, it is three dimensional, though not impractical. For instance, a negative of Fig. 23 made of some transparent or translucent material, so that the thickness in the intensity direction would decide the light intensity of details, would be quite satisfactory. However, there is no need for this, as a photographic emulsion can record light intensities.

Imagine Fig. 21 with details of correct light intensity to be impressed on a photographic surface, and a positive print taken of that photograph, a record in every way equivalent to Fig. 23 would be obtained. The light intensities of details would be recorded as different densities of the film, and in the plane of the film, size and position as well as time would be recorded as in Fig. 21. To obtain such a record from an original scene, apparatus such as shown in Fig. 8 (March issue) would be employed, forming a Stixograph real image on to a slit which crossed every detail in that image. A photographic film would be moved at some uniform and constant speed in the vertical direction of Fig. 6 and the image in the slit would be impressed upon it continuously. Note *no* shutter is required and the film is continuously exposed.

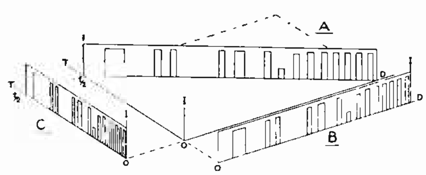


Fig. 27. The effects of scanning shown graphically.

The dimension of the film in the direction of movement corresponds to the time axis of Figs. 21 and 23. The dimension at right-angles to this corresponds to the *D* axis of those Figs. and therefore accommodates size and position of details. The density of the film corresponds to light intensity. Consequently, a record of the intensity, size and position in the picture of every detail is simultaneously obtained at every instant of time.

A reproduced animated picture could be obtained by projection from a positive of such a record through a slit and a Stixograph optical system, by passing light continuously through slit and film whilst the latter moves, as in recording, at a uniform speed.

What has been described above, is the Stixograph cinema film, which approaches the perfection of Fig. 23 very closely, and if recorded and reproduced through a very narrow slit it would be practically equivalent to Fig. 23. It has the following features, which are of advantage. The whole of an event is recorded, no part being left out, for there is no intermittent exposure and as the film is continuously in motion, a new surface is being continuously presented to receive the impression of the picture at every moment.

The film moves very slowly at a uniform speed in recording normal movement in a scene, in fact one millimetre per second has been found satisfactory, if definition of moving parts is equal to the ordinary cinema. Usually to ensure correct recording of all likely speeds of movement in a monochrome picture 3 to 5 mm. per second is more dependable. (Note this is only 18.5 yds. per hour, against one mile per hour average of the 35 mm. normal cinema film.) There is not the slightest flicker in the reproduced picture, quite an uncanny effect to anyone accustomed to the ordinary cinema.

All motion in the picture is smooth without jerkiness, and it is possible to traverse the camera in any direction without special precautions, though if the speed of traverse is too high, the reproduced picture will be blurred. Stroboscopic effects such as wheels turning in the wrong direction cannot possibly occur. In reproducing, slow motion or speeded up effects are readliy obtained by changing the speed of the film, *but no matter how slow the film moves, there is no flicker and all motion is smooth.* The film may be stopped at any point in reproduction and a stationary picture corresponding to a particular instant of time in the original scene will appear. As regards continuity, viewing the reproduced picture is absolutely the same as viewing the original scene.

With the usual photographic emulsions 5 to 10 microns in the width of the film is ample for the minimum size of detail, i.e., the equivalent of a home cinema picture can be accommodated in a 10 cm. width of film. For the same event 16 mm. home cine film would require an area of film 5 to 10 times greater. Another point is that other things being equal, there is about twice the light available compared with the normal cinema, for there is no shutter, and therefore no idle period. The camera and projector required for Stixograph films do not use complex mechanisms, for there is no shutter and no intermittent movement of the film, and the speed of the film is very low.

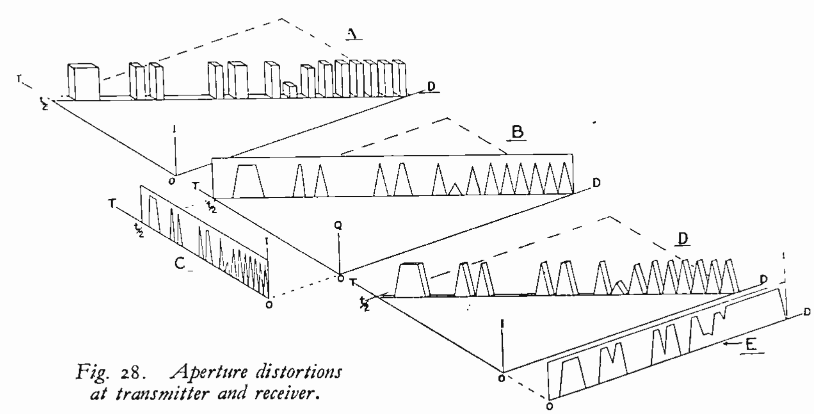


Fig. 28. Aperture distortions at transmitter and receiver.

There are other advantages in natural colours and stereoscopic pictures, which will be described later, as it is confusing to consider all these features of pictures at the same time.

The Stixograph has shown itself to be very useful in studying animated scenes, i.e., where there is movement in the scene. In picture telegraphy and television, using scanning, quite a different kind of motion is introduced, or, rather, time enters into the process in another way.

Pictures consist of details distributed in space, but *in scanning it is necessary that the details should be also distributed in time.* The reason for this is that only a tiny part of the picture can be allowed to be active at any one instant. This can be portrayed graphically using the Stixograph, for there are only three co-ordinates involved, which are position and size of details in one dimension of space, intensity of details and the distribution of details in time, i.e., the *D*, *I*, and *T* co-ordinates of Fig. 23 (May issue).

Suppose in Fig. 23 a plane is taken parallel to the *I* axis but inclined to the *D* and *T* axes, meeting *O*—*T* at $t/2$, the appearance of the details of the picture in that plane will be as shown in the plane *I*—$t/2$—*D* in Fig. 27A. Obviously the details are distributed in both space and time and intensities are also shown. The picture in the plane *I*—$t/2$—*D* is a true representation of a received television picture formed by scanning with an infinitely small scanning aperture, and a projection of that picture in a plane *I*—*O*—*D* will show how the picture appears to the eye or what a photograph of the received picture would look like, as shown in Fig. 27B. In addition, a projection of the picture of *I*—$t/2$—*D* in the plane *I*—*O*—*T* shows the variations of the controlled light which in turn corresponds to the electric television signals as shown in

Fig. 27C. In picture telegraphy an unchanging picture is transmitted so that the details would not change as shown in Fig. 23 but would be constant as shown in Fig. 26D for the period *Y*.

Time Characteristic

Fig. 27 shows clearly a picture possessing a *time characteristic* which is the first requirement in methods of

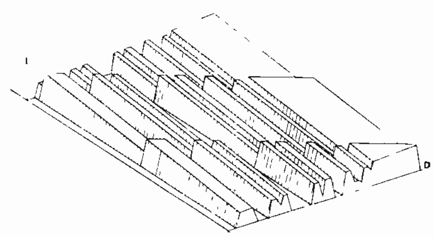


Fig. 29. Persistence of vision and effects in received television pictures shown graphically.

picture transmission using scanning. Impressing a time characteristic on a picture is readily accomplished by putting a picture (or optical image of a picture) in motion relative to an aperture. This may take three forms, moving picture with stationary aperture, e.g., mirror drum; stationary picture with moving aperture, e.g., Nipkow disc, apertured drums, etc.; or both picture and aperture may be in motion, e.g., some methods of television transmission from films where the film moves in one direction and an apertured disc scans in a direction at right angles.

Strictly speaking the true scanner is the aperture, and it acts as a gate between a space distributed picture and

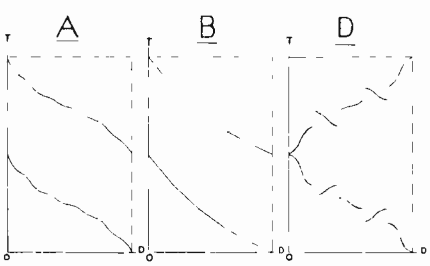


Fig. 30. Scanning characteristics of mirror-drum Nipkow disc and oscillating mirrors.

a time distributed picture. For instance, in Fig. 27A the aperture is always the line of intersection of a time intensity plane and a space intensity plane, i.e., of a plane parallel to *T—O—I* and a plane parallel to *D—O—I*. As the aperture is a line in Fig. 27A it is obvious that only that line can appear in the picture at any instant of time, and therefore the rest of the picture is blanked out.

Stixograph and Scanning

This shows the difference there is between what a Stixograph optical system forms of a picture and what scanning produces. Scanning produces Fig. 27C, whereas a Stixograph optical system gives the *whole* of Fig. 23, a tremendous difference. Even if one takes a picture formed by scanning, it is only equivalent to Fig. 27A and not to Fig. 23.

Fig. 27 is not strictly accurate, for in practice the scanning aperture would have an appreciable size, consequently instead of the plane *I—t/2—D* of Fig. 27A a part of Fig. 23 between two parallel planes separated in the *D* axis by a distance equal to the size of the scanning aperture, must be taken into account. Fig. 28A shows this part of the original event, and it can be regarded as the part which passes through the scanning aperture.

Light Intensity

As a television transmitter, the light which passes through the aperture falls on to a photo-electric cell, the response of which is proportional to the *quantity* of light at every instant. Fig. 28A, to show quantity of light, must be integrated in the *I—D* planes for each instant of time, and expressed as a new intensity *I* which has also corresponding *D* and *T* values. The new intensity is the average intensity for the full area of the scanning aperture; for instance if at a particular moment a detail at full intensity covers half the area of the scanning aperture, the other half being at zero intensity, then the new intensity is 50 per cent. Fig. 28B shows Fig. 28A after integration, and the distortion due to integration is known in television as aperture distortion. A projection of Fig. 28B into a plane parallel to *T—O—I* as in Fig. 28C will represent light falling on to the photo-cell and obviously represents also the photo-cell electric current or the picture signals.

The picture reproduced at the receiver by scanning is not a replica of Fig. 28B, for the scanning aperture at the receiver has an appreciable size so that the intensities of Fig. 28B have to be distributed in the direction *O—D* for a distance equal to the size of the aperture. The reproduction from Fig. 28C after this distribution is shown in Fig. 28D, and a projection of this in a plane parallel to *I—O—D* gives Fig. 28E which is the appearance of the picture, assuming persistence of vision effects to be perfect.

Aperture Distortion

In practice, aperture distortion is not so pronounced as in Fig. 28B, for the details would not be so sharply defined in the picture. This was

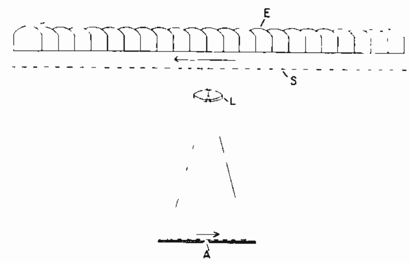


Fig. 31. Scanning with a traversing echelon.

explained previously in connection with Figs. 17 and 18, where it was shown that the minimum detail diameter need not be less than 1.5 times the strip width and also that the light intensity falls off gradually. The size of the scanning aperture in the direction of scanning must obviously be less than the minimum detail diameter; the smaller it is the less aperture distortion will be, but there is not much advantage in reducing it to less than one-third of the minimum detail size. Generally,

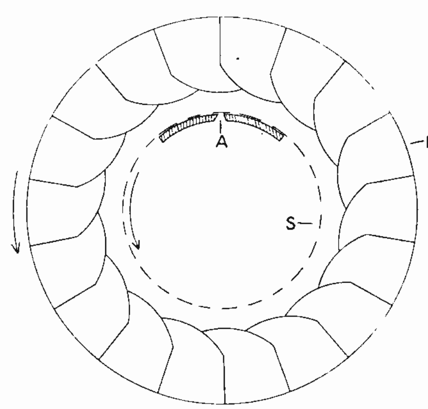


Fig. 32. Scanning with a moving echelon of drum type.

the maximum size of aperture should not exceed two-thirds of the minimum detail size particularly at a transmitter.

(To be continued).

REVIEWS OF THE PROGRAMMES AND RECEPTION REPORTS

THE interests of opera lovers and "lookers" have clashed this month. On May 8 the second act of *Fidelio* was being relayed from Covent Garden and the wavelengths could not be cleared for television until 11.20 p.m., which is an unreasonable hour to start a programme. Apart from the inconvenience to "lookers," the time is awkward for artists who are often engaged to appear in cabaret at midnight. While eleven o'clock is late enough, it happens to be a good time for the producer, who has frequently been able to persuade artists to squeeze in an appearance in the studio between engagements on the

Leonie Zifado, soprano.

stage and in cabaret. So the opera season became an embarrassment and the B.B.C. decided to change the dates of programmes rather than ask "lookers" to sit up until midnight. The programme for May 22 was postponed to May 23, and Doris Hare, Sutherland Felce and company, booked for May 29, will be seen on May 30.

Eve Becke was making her début before the scanner on the night when the programme opened at 11.20. Though best known for her microphone work, this artist has a good stage presence and with plenty of gesture made an excellent picture. Her booking happened this way: Eustace Robb, wishing to get her for a programme, rang up her home and found that she was out. A few minutes later and quite independently, Eve, wishing to televise, rang up the producer, when he was out. On the same evening, they met by chance at a party at John Watt's house and a date was fixed. So it looks rather as though that engagement had to be.

* * *

Eustace Robb holds one of those coveted passes which admit the privileged few to rehearsals at Covent Garden. He has enjoyed watching Dr. Ehrhardt producing and has spent some time studying the lighting system. The knowledge gained will be applied in the studio. The end of Act I of *Schwanda*, a novelty of the season, would make a good picture and I wonder whether Kuhlmann, who sings the name part of the bagpiper, could be persuaded to come to the studio. He would prove to "lookers" that an operatic tenor need not be fat. By way of returning the compliment, Fraulein Hassait, daughter of the lighting director at Covent Garden, turned up to watch a transmission. It was a morning programme which was divided into three distinct groups, Spanish, eighteenth century and religious. Each phase had different illumination and Fraulein got an excellent impression of the capability of the plant.

It is much easier to get a good picture from white dresses now that the large top cells are in use. Have you noticed a more brilliant effect?

* * *

High Tension Harry, billed as the versatile announcer, might be a very good act. Announcers, as glamorous figures, are fair game for ridicule, and the idea of "codding" them is good. But there is room for two opinions about Harry. I have met "lookers" who liked his act, but my own feeling is that he attempted too much. He can and does dance, sing and play the banjo, besides announce. The snag is that announcers, though clever chaps, are not so accomplished, or if they are,

Eileen Tai, Chinese dancer.

they hide their secondary talent. High Tension Harry was a trifle too remote from the original.

Another new feature of the programmes is "Cocktail Club" on June 1, when Eve Becke, Sarah Allgood, Pat Waddington and J. Espin-

·osa are expected to drop in. The party promises to be amusing. An advantage of a programme of this kind is that it is infinitely flexible. No act would be out of place at such an informal affair and I expect to find the experiment repeated.

* * *

It pays to popularise a title, as Eric Maschwitz has found in the variety side of broadcasting.

An authoritative lecture on Alsatian dogs was combined with a demonstration by three of the finest specimens of the breed. Their jumping was difficult to focus and I am afraid that "lookers" may have missed the finer points of a startling act. E. T. Cox, secretary of the Alsatian League and Club, gave the commentary and Snapkels dogs gave the show. The act, which is to perform before Royalty at the Aldershot Horse Show, this summer, is the property of Vesta Kelley, a secretary at Broadcasting House, and Mr. Snapper, of Chelsea. Vesta takes her dogs for exercise every morning before leaving for the office, and spends week-ends in keeping them in training for the jumps. Her Crumberg Ruby of Belvale showed such perfect manners in the studio that I became quite endeared to the breed about which I had formerly had some misgiving.

There is no very startling technical development to report this month. More room and good ventilation are still a comfort to the engineers. Standing behind the control desk during a transmission last week, I noticed that the radio picture was a great deal clearer than the image on the screen connected by line, despite the journey to Brookman's Park and back. A winch for rolling up the backscreen *has arrived*, as the sporting pages say.

Dennis Noble (Baritone), songs from The Golden Toy

Sokolova shone in a repeat of the Egyptian programme in which I detected several refinements of detail. The marriage scene with three figures was obviously difficult to transmit and this time the grouping was simplified. Sokolova and Harold Turner, principals in the ceremony, were placed nearer to the projector, with guests and officials well in the background. These figures were given their chance to be seen before the curtain at the end.

* * *

Nini Theilade, eighteen years old, is a joyful dancer. Eustace Robb certainly spots winners in the dancing field; we shall hear more of this sylph, who has a story as pretty as a fairy tale. Her great-grandmother, a daughter of the Sultan of Djokjokarta on the Island of Java, was put to death for eloping with a Polish officer, while her father, a Danish journalist, incurred the wrath of Hitler and had to leave Germany in a hurry. Nini herself has been more lucky. Born in Java, she was brought to Denmark at the age of ten. Pavlova arranged her début at the Hague and Reinhardt introduced her to London. Nini is a fascinating blend of East and West. Did you notice her hands? Krama, an aged servant, taught her to use them as a child when she danced to the music of the gammelang in Tahiti. There's a lot more like this, and it is all true!

TELEVISION RELAYS

With the use of ultra-short waves the quality of the pictures has improved, but the reception of television is now limited to local areas. Programmes must be relayed over wires to different senders. The cables used must transmit the band between 0 and 500 kc. The higher frequencies travel 20 miles in about 0.1 millisec., the lower frequencies take about 1 millisec. To prevent the dispersion of frequencies it is necessary to superimpose the whole band upon a carrier frequency of about 1,000 kc. Along cables the attenuation of R.F. waves is proportional to the frequency, the amplitude being reduced to about 0.5 after 1,000 m. at 1,000 kc. Assuming that the use of high frequency cables allows an amplification at the end of the lines of 70 decibels, the useful range is about 20 miles. Telephone lines are expected to give a range of three miles. [F. Kirschstein and J. Laub, German Post Office Laboratory.]—(*Ferns. Tonf.* 5: 1-4 (Feb.), 1934.)

CONTROL OF ELECTRON BEAM

The adoption of 40,000 elements per picture (180 lines) and 25 pictures per second makes it indispensable that the voltage curve causing the beam to sweep to the next line repeat itself at intervals which are equal to within one ten-millionth second. To control with such a precision relaxation oscillations by using the principle of the suppression of the natural frequency (wrongly called pulling into step) by waves from the sender becomes very difficult, and the R.F. circuits are fairly complicated, although being self-sustained the oscillations prevent the beam from spoiling the screen in case the signal from the sender fails to arrive. To transmit the entire sweep voltage absorbs too wide a frequency band. The best solution is for the transmitter to send out a rectangular impulse at the end of the line, and a longer interval at the end of each picture, impulses which make the grid of a discharge tube momentarily positive so that the tube discharges across a condenser. In the present arrangement the impulses are obtained by suppressing the remaining carrier frequency amplitude. The light spot disappears during this time. [M. von Ardenne, Berlin.]—*Zeits. tech. Phys.*, 15 (2): 62-64, 1934.

USING MERCURY-VAPOUR TUBES

Though primarily designed for recording sound on film by the variable density method the gas discharge tubes described here can be very successfully used for television reception. In this article the chief characteristics of three types are outlined and some suggestions given to the experimenter of suitable circuits to be used with them.

ALL these tubes operate under similar conditions. They are characterised by freedom from parasitic disturbances and a long and useful life may be anticipated if they are operated within the current limits for which they are designed.

No resistances are included in the bases of these tubes so that it is essential for the current to be limited by a resistance of several thousand ohms in series or by some equivalent impedance to the circuit which supplies steady direct current to the tube.

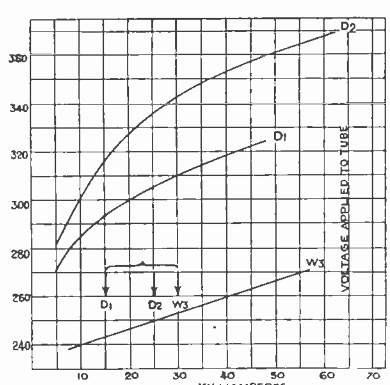


Fig. 3. Curves showing the variation of tube current with applied voltage.

Three Types

The three types with which it is proposed to deal are made by the G.E.C. and are types D.1, D.2, and W.3. The first two are housed in the same size bulb as illustrated by Fig. 1. The cathode is the electrode within the inner glass tube and is connected to the grid pin of the standard valve base with which these two types are normally fitted. The anode or second electrode is brought out to the anode pin of the valve base.

The third type, W.3, is made in a special form of bulb shown by Fig. 2 (shown on next page), the construction of which is clear. The anode is the small point electrode and is taken out to a screw cap at the side of the bulb.

All these tubes are, of course, connected either directly or coupled to the output valve of a multi-stage amplifier, the modulation of the steady discharge reproducing a visual or photographic record of the incoming signal.

As distinct from the plate type neon tube which has been used very considerably for television reception, these recording tubes contain a neon mercury mixture which produces a highly actinic illumination and which is far preferable to the red neon glow. When the discharge strikes, it exhibits the characteristic pink glow of neon, but this gradually changes to a bluish white a few seconds after the amplifier has been switched on, the change in colour travelling gradually up from the cathode till it fills the whole of the inner tube.

It may be necessary to keep the tube warm by lagging to prevent mercury being deposited at the end of the tube and obscuring the spot, though this precaution is not usually necessary. Also the tube may be operated in any position except that in which it is vertical and the cap uppermost. Naturally in this position since the discharge is viewed in the direction of the axis of the bulb, the small blob of mercury present in the bulb will be in the direct line of sight.

Characteristics

The characteristics of the D.1 tube are:--

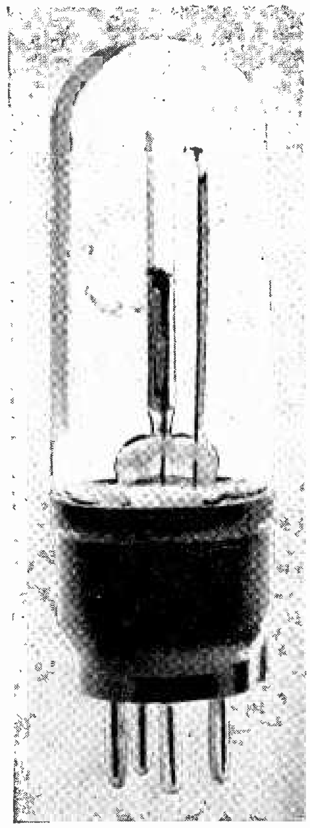


Fig. 1. The types D.1 and D.2 gas-discharge tubes.

Impedance	1,500 ohms
Steady current	15 milliamperes
Average tube voltage	295
Anode voltage on valve (PX.4)	150
Total volts	445
Grid bias	−22
A.C. Input (R.M.S. volts on grid for full modulation)	10

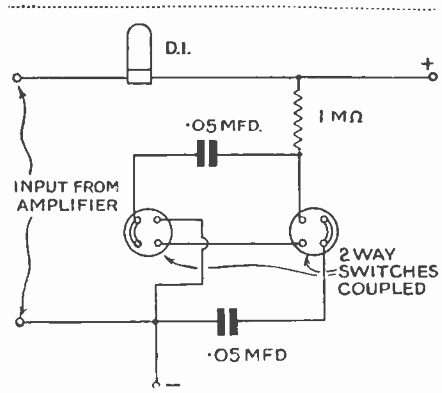


Fig. 4. An arrangement for starting the tube by condenser discharge.

In calculating the circuit conditions which follow below, the A.C. impedance of the tube can be considered as a non-inductive resistance of about 1,500 ohms. Fig. 3 shows the variation of tube current with applied voltage and the normal operating points both of this tube and also the D.2 and W.3.

The D.2 has a higher current rating than D.1 but requires a higher grid output voltage for full modulation and also a higher starting and operating applied voltage. Its dimensions are the same as the D.1.

The characteristics of the D.2 are:

Impedance	1,600 ohms
Steady current	25 milliamperes
Average tube voltage	336
Valve voltage	200
Total applied voltage	536
Grid bias (volts)	−35
A.C. Input (R.M.S. Volts on grid for full modulation)	25

Type W.3 is useful in cases where there is a comparatively large power output from the amplifier and where an intense point of light at the sacrifice of compactness in size is essential.

The characteristics of the W.3 are:

Impedance	760 ohms
Steady current	30 milliamperes
Average tube voltage	254
Anode volts on Valve L.S.6.A.	150
Total applied volts	404
Grid bias (volts)	−22
A.C. input (R.M.S. volts on grid to give full modulation)	15.5

In all cases it is desirable not to exceed the operating current specified, otherwise the end of the tube will blacken and its useful life be very seriously curtailed. Over-running also tends to facilitate the introduction of parasitic disturbances which will produce background noise if recording on film, or distorted illumination of a visual image in television reception.

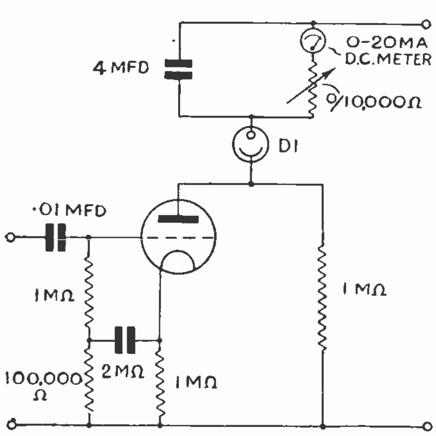


Fig. 5. A method of starting the tube by means of the H.T. supply.

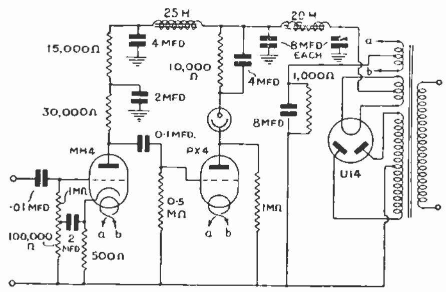


Fig. 6. A circuit of a complete amplifier for mains operation.

Methods of Operation

The amplifier equipment will to some extent be governed in design by the supply from which it is to operate and the restrictions of size and weight of the apparatus. These points being settled it is essential that the amplifier shall have a good frequency response, otherwise the advantages of an efficient response in the recording tube will, to a large extent be lost.

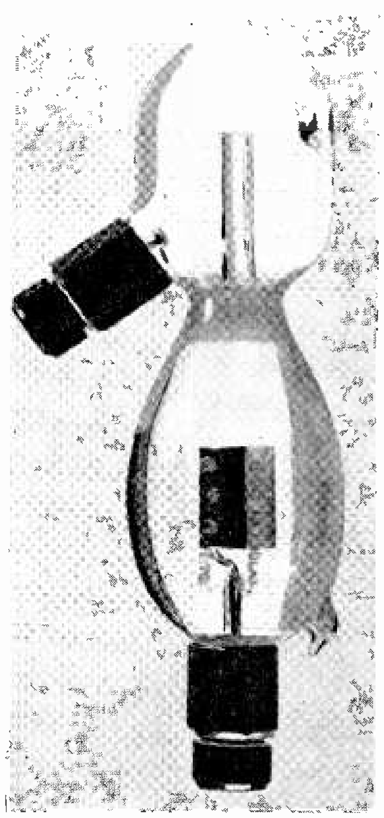


Fig. 2. The W.3 type gas-discharge tube.

Circuits for Testing and Operating

As in the case of all the familiar types of neon lamps, the striking voltage is considerably higher than the extinction voltage and consequently the tube can be operated at an applied potential which is considerably below that required to start the discharge. A momentary increase in voltage is sufficient to start the glow and this can be done in several ways. In sound film recording it is sometimes a habit, and a bad one, to rub the end of the tube with a dry cloth, the static charge accumulated on the glass by friction being just sufficient to upset the potential gradient in the tube and start the glow. More satisfactory methods are:—

(1) By a condenser discharge. Fig. 4 shows an arrangement with two coupled two-way switches. In the knob-up position the two condensers are charged in parallel from the supply. Switching over to the lower position the condensers are put in series and the potential applied to the tube is momentarily doubled and is then sufficient to strike the discharge.

(2) By a transformer starter, the secondary of 240-1,000 volt transformer being momentarily connected across the tube with a protective resistance of, say, 30,000 ohms in series.

(3) By a self-starting circuit as shown in Fig. 5. In this case the recording tube is connected across the H.T. supply in series with the anode of the output

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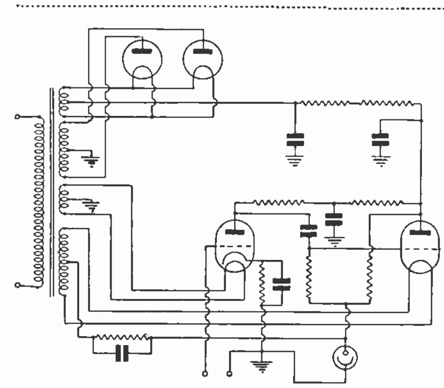
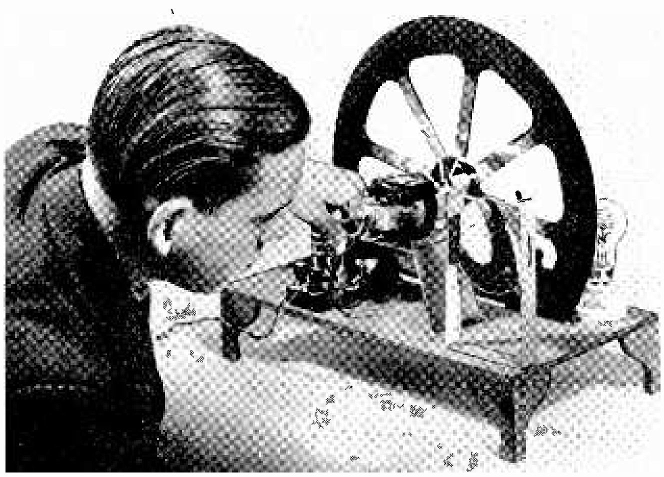


Fig. 7. A simplified form of the amplifier circuit given by Fig. 6.

A Test of A Low-priced Disc Set

THE disc visor on account of its simplicity and low cost is, of course, by far the most popular; undoubtedly apparatus of this sort provides the most suitable introduction to the science of television for no one after a little experience can fail to get pictures and acquire a considerable amount of useful information.

The visor was next connected to the receiver described in last month's issue of TELEVISION, which, it will be remembered, employs a four-valve superheterodyne circuit and was specially designed for use with this type of apparatus in any part of the country. Although a simple beehive neon is used in the Peto Scot kit a very even field of vision was produced by coating the lamp bulb with black paint and then scraping a window in this of suitable size, which was then covered with thin tissue paper.



Here is a photograph of the Peto-Scott disc kit assembled. It will be seen that it is built upon practical lines.

Recently the Peto Scott Co., Ltd., placed at our disposal a kit of parts for their disc television receiver for the purpose of testing what apparatus of low price would do. Appreciating that successful use of any visor depends upon ensuring that running conditions are all that they should be, very careful attention was paid to assembly and this included checking over the lubrication of the motor and the adjustment of the brushes, etc. Incidentally, it may be remarked that the actual assembly was a very simple matter and occupied a little more than half an hour.

Preliminary Running-In

As a preliminary the motor was given a run of three hours; this was for two reasons—to ensure that the motor should be properly run in and any roughness of the brushes, etc., eliminated, and to test the rise of temperature. At the end of three hours the motor was only perceptibly warm to the touch, so any possibility of heating troubles is entirely ruled out.

Observation of the field showed that the scanning holes were very accurately positioned, only a trace of black line being noticeable in two parts of the screen.

Holding the Image

The kit does not include synchronising gear and at first a little difficulty was experienced in securing and maintaining the correct speed, but readjustment of the connections to the fixed resistance enabled this difficulty to be overcome sufficiently to keep the speed within very narrow limits, and it was then found that frictional control made it possible to hold the speed quite steady. It would appear that some simple form of frictional control in addition to that of the variable resistance would be an advantage, but this is a simple adjunct which anyone can fit in a few minutes; alternatively, the synchronising gear, which is also available, can be fitted, though of course this means an additional stage in the wireless receiver.

Although only a single lens is used with this visor there is no observable distortion of the image, providing that the viewing angle is not too great; this means that two or three people can comfortably view the received picture. With the kit is supplied a full-size blueprint and a 12-page instruction book on its operation and connection to different types of receiver. The visor is remarkably good value and can be recommended.

Using Mercury-vapour Tubes

(*Continued from preceding page.*)

valve and a limiting resistance. The valve is in parallel with a very high resistance and thus practically the full H.T. is applied to the tube on switching in circuit. As soon as the glow appears the normal anode current passes through the valve and its value is determined by the valve impedance and the limiting resistance. Suitable valves for each tube are indicated in the characteristics set out above.

Fig. 6 shows a complete amplifier for mains operation and Fig. 7 a simplified form of the same circuit. This amplifier requires about 0.25 volt input from the detector valve and is suitable for television reception.

To meet the requirements of apparatus which has limitations in space the types D.1 and D.2 are now available in bulbs of smaller diameter, these modifications being named types D1A and D2A. These modifications have a third electrode, the function of which is to eliminate the necessity for any auxiliary device for starting the discharge. The cathode is connected to both filament pins, the anode to the anode pin and the starting or auxiliary electrode to the grid pin of the valve base.

The subsidiary striking electrode should be connected to the H.T.+ through a switch and a resistance of at least 75,000 ohms. The striking potential of the tube is then about 350 volts. As soon as the discharge starts, the circuit to the auxiliary electrode should be broken by opening the switch in series with it.

The general remarks and circuits previously outlined apply with suitable modifications to these tubes with the auxiliary electrode.

THE TELEVISION ENGINEER

Trichromatic reproduction in television

By J. C. Wilson (of the Baird Laboratories.)

The following is an abstract of a paper read before the Royal Society of Arts on May 2, by J. C. Wilson. It deals with the problem of transmission of television pictures in natural colours, and comprises a description of the Baird process.

THE problem of transmitting television images in colours is not a new one. Amongst the early investigators in this field the names of von Bronk and Adamian may be mentioned. But it is not until comparatively recently that results have been achieved. In 1928, J. L. Baird produced colour pictures over a short line circuit, using a single bank of gasfilled potassium photo-cells, and demonstrated his results at the meeting of the British Association held in Glasgow that year. A little later, Dr. Ives, working in the Bell Laboratories in America, produced coloured television images using a composite bank of photo-cells of differential colour sensitivity, with a system of correspondingly increased complexity.

Both Baird and Ives used mechanical scanning and reconstituting devices, and in contra-distinction to these may be mentioned the proposals of Ardenne, Zworykin and Siemens & Halske A.G., to employ cathode-ray reconstitution, while of those employing mechanical methods, the suggestions of Hammond, Ahronheim, and the British Thomson-Houston Co. are of interest. In some of these systems a colour-mosaic screen is interposed in the path of the scanning-beam at some suitable point, or, alternatively, adjacent lines of the traverse are differently coloured. In these types of system the fine-structure of the picture is not truly coloured, but the impression of coloured reproduction depends upon the inability of the eye to discriminate between a patchwork of primary colours in small discrete areas, and the hue which would be formed by, as it were, smearing them slightly. In others the coloured effect is obtained by carrying out a whole scan in one homogeneous, or effectively homogeneous, colour and then repeating the process within the period of retentivity of the eye in another colour, the quickly-repeated coloured impressions being superposed, of course, by the psychological effect of persistence of vision.

The Baird System

First of all, it is necessary to scan the scene an image of which is to be transmitted, and in the "light-spot" method this is accomplished by causing a spot of light to explore the whole scene cyclically in parallel strips, either vertically or horizontally, the strips lying closely adjacent to each other. Some of the light scattered back or diffused from the scene during this process is incident upon the sensitive surfaces of photo-electric cells suitably placed in front of the scene, in much the same positions as lamps would be if the scene were to be photographed by artificial light.

Now the current through the photo-cells depends upon the amount of scattered light falling on them, and this in turn depends upon the diffusivity of the portion of the scene instantaneously irradiated by the spot: thus the photo-cell current can, with suitable precautions, be made a faithful electrical representation of the brightness or darkness of the surfaces of all the objects within the ambit of the area scanned, strip by strip. In the normal scanning process, of course, white light, or light to which the cells are particularly sensitive, is used to form the travelling spot.

If, instead of white or heterochromatic light, we use coloured light from a narrow spectral region, or substantially monochromatic rays, we shall expect to find that the light is scattered copiously only from those parts of the scene which are the same colour as the light, or which contain that colour as a constituent; other portions will absorb much or most of the radiation falling on them and will appear dark or black in the television reproduction.

It is upon this physical effect that a colour-television process depends. The scene is scanned first with a red spot, then with a green one, and finally with a blue one, the photo-cells generating meanwhile a signal proportional first to the light scattered back during the red traversal, then to that during the green and blue traversals. At the receiving station a red colour-filter is held in the path of the image-forming rays while the "red signal" is being received, a green one during receipt of the "green signal," and a blue one during that of the "blue signal"; since the traversals take

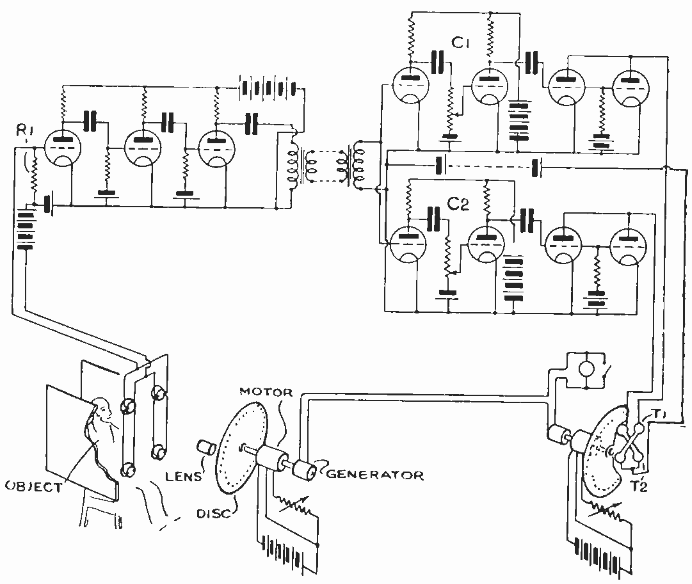


Fig. 1. A diagrammatic layout of the apparatus actually used in the first Baird demonstration of colour television.

place very rapidly, the effect of three superposed coloured transparencies is yielded to the observer, and the analogue of the three-colour process in photogravure will make plain how the appearance of a naturally tinted picture results.

Fig. 1 shows a diagrammatic lay-out of the apparatus actually used in the first colour-television demonstrations in the Baird laboratories. At the transmitter, a scanning disc similar to the ordinary Nipkow disc, but having three-part spirals of apertures each occuppying a third of the marginal portion of the disc, is used, and light passing through the apertures is focused by a lens on to the object, in front of which are also arranged a number of photo-electric cells of the potassium hydride in argon type.

The photo-cells are connected by wires to the input of a three-stage resistance-capacity coupled valve amplifier; the output from this amplifier is taken through a high-ratio step-down transformer to minimise the attenuating effect of the capacity between the line-wires upon the higher frequencies in the television signal. At the other end of the line the secondary of a corresponding step-up transformer feeds the signal to the initial valves of two separate valve amplifiers, termed the "red" amplifier and the "green and blue" amplifier respectively; these are similar to the "initial" amplifier except that amplitude-controls, C^1 and C^2, are provided at the input to the second stage and the valves are capable of handling much larger signal voltages.

The output stages of these two amplifiers comprise two large high-voltage valves of the T250 class, in parallel; in the common anode circuit of the "red" amplifier output valves there is connected a neon positive-column gas discharge tube, T^1, and in the other output circuit is connected a positive-column tube, T^2, filled with mercury vapour with a little helium. These tubes are crossed behind the viewing-area of the receiving scanning disc, which is geometrically similar to that at the transmitting end; in the original experiments, the discs each contained forty-five apertures, fifteen in each spiral segment, and the apertures in each segment were of such a size, and so staggered, that they completely traversed the field of view. Motors, the speed of which could be regulated by variable resistances, were used to drive the discs at about 600 r.p.m., corresponding with a colour-cycle rate of 10 per second, and an image-speed of 30 per second. On the shaft of each motor there is coupled a small alternating-current generator, and these generators are coupled together by means of an additional line, with a small electric lamp in series at the receiving end: this lamp serves to indicate when the motors are in synchronism, and a short-circuiting switch allows them to be locked in step.

After the receiver is locked in step, the disc is phased, and the picture "framed," by rotating the carcase of the motor and generator together.

Fig. 2 shows additional constructional details of the transmitting apparatus: the projector-lantern for illuminating the marginal portion of the transmitting disc intensely can be seen.

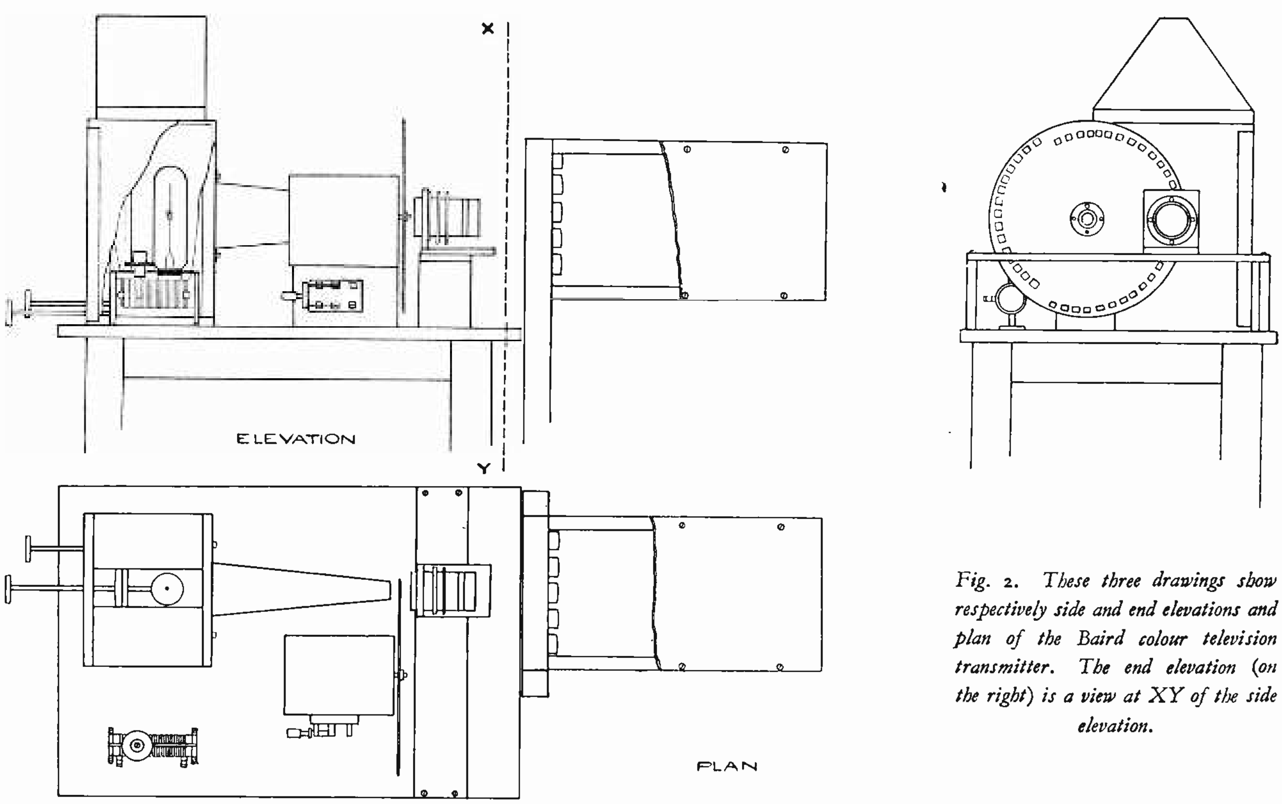


Fig. 2. These three drawings show respectively side and end elevations and plan of the Baird colour television transmitter. The end elevation (on the right) is a view at XY of the side elevation.

Scanning

The manner in which this apparatus functions will now, in the light of the previous discussion of colour-systems generally, have become clear; the three series of scanning apertures in the discs are covered with red, green and blue gelatine colour-filters severally, so that, at the transmitter, the object or scene in front of

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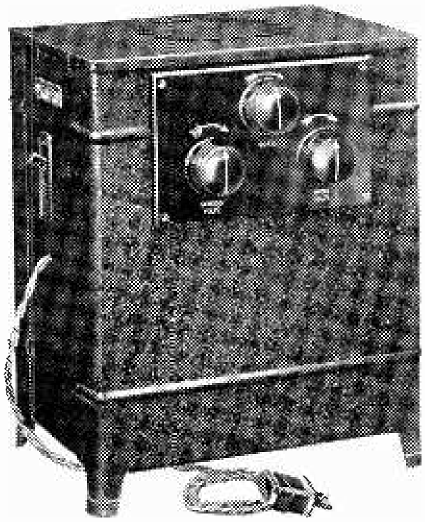

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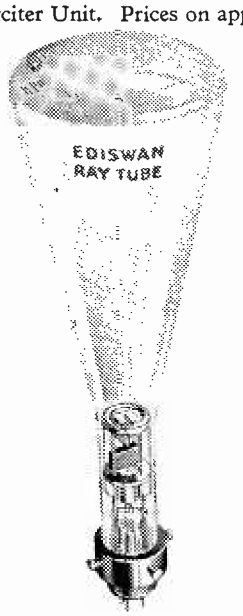

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the projector is traversed first with red light, then with green and finally with blue, the cycle of operations being repetitive, and, at the receiver, the geometrically corresponding series of apertures are covered with similarly coloured filters. Then during the red traversal at the transmitter and the receipt of the "red signal" at the receiver both gas-discharge tubes are modulated in brightness in accordance with the instantaneous intensity of the signal, but only red light (principally from the neon tube) is allowed to reach the observer's eye, while during the blue and green traversals, and receipt of the "blue" and "green" signals, both tubes are again modulated, but it is only blue and green light from the blue and green spectral lines of the mercury-vapour tube that is allowed to pass through the holes of the receiving disc during the respective traverses.

The light source used in the light-spot projector is a 900-watt bunched-filament gasfilled tungsten cine lamp having a working temperature of about 2,800° K. The filament bunch is about ¼ in. square and gives about 2,930 H.C.P.; using a spherical reflector 7.5 in. in diameter and 7.5 in. focal length, an image of the filament is focused upon the periphery of the Nipkow disc, the effecting scanning area of which is 0.5 in. radially by 0.98 in. circumferentially. The image of the filament upon the disc is slightly more than 1 in. square, and with a coefficient of 0.7 for the spherical reflector, a flux of 3,314 lumens upon the disc is obtained, giving a flux per square inch of 2,920 lumens. The disc apertures are 0.033 in. square and the flux through each is 3.25 lumens.

An image of the picture area on the disc is brought to a focus substantially in the plane of the scene to be scanned by means of a lens of focal length 3.5 in. and aperture 1.5 in.

Small pieces of colour filter are fastened to the scanning disc to cover each hole. We must notice a most important difference between colour-television and colour-photography; the sensitive material of the photographic plate can be so chosen that it has a substantially even response to light of all colours, but the photo-electric materials are usually selectively responsive, and, further, have a more or less sharply defined "critical frequency." To light of wavelength corresponding to frequencies lower than this they are not sensitive at all, however intense the incident radiation.

Ordinary potassium coatings, suitably sensitised, do not respond to light of wavelength longer than about 585 millimicrons, while monatomic potassium layers on silver, although having a lower critical frequency, are not sufficiently responsive to blue light; for use with incandescent tungsten, which is very deficient in blue rays, the high sensitivity of ordinary potassium cells to the blue is very desirable, and a mixture of the two forms of cell is necessary in practice. In this connection, it may be mentioned that sensitised barium cells of the type developed by T. W. Case, although they can be made to have a sensitivity-curve closely corresponding with that of the eye, are not sufficiently responsive overall, and the method of sensitisation adopted by Olpin and Stilwell is not satisfactory from the same point of view.

The response of the system in the yellow, orange and red is markedly lower than in the green and blue; instead of the term "effective lumens," which really has little meaning in view of the fact that a lumen is a measure of radiant energy evaluated by reference to the visual effect produced by it, let us take a "celumen" as the corresponding measure for photo-electric response; then the celumens passed in the scanning beam, the amount of scattered light caught by one cell of effective area 2.76 square ins. situated 20 ins. from the object scanned, the photo-electric current for ten such cells in parallel, and the voltage developed across the resistance R^1 of Fig. 1 when the value of this resistance is 100,000 ohms, are set out in the following table:—

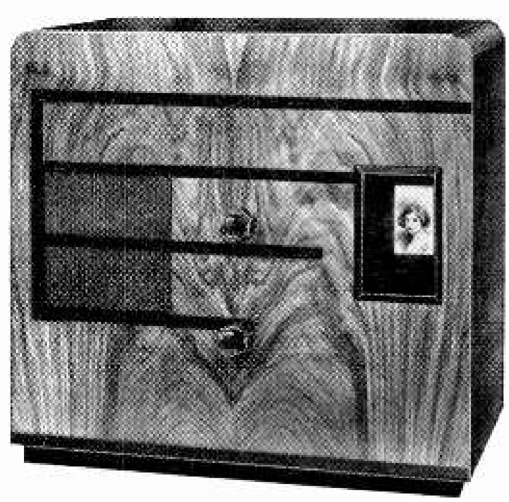
It is uneconomical as regards the full utilisation of the capabilities of the transmission channel to use markedly unequal signal-amplitudes during different-coloured traverses; but, on the other hand, it is undesirable to cut down the effective "blue" and "green" signals by rendering the filters more opaque because the "red" signal, with the particular apparatus described, was not very far above the parasitic-and general-noise-level of the amplifiers. Compensation for inequality of amplitude of this kind can, of course, be readily obtained by adjustment at the receiver, but a preferable method, involving incidentally a desirable increase in "red" response, will be described later.

Traverse.	Celumens :		Current for ten cells (micro-amps)	Voltage across 100,000 ohms.
	(a) in beam.	(b) incident on cell		
Red ...	0.021	14.9×10^{-6}	782×10^{-6}	78 microvolts.
Green ...	0.0909	64.5 „	3380 „	338 „
Blue ...	0.0952	68.6 „	3600 „	360 „

The amplifier and receiver will be described in our next issue.

A Cabinet for the "Daily Express" Receiver

The photograph shows a cabinet which has been specially designed to house the *Daily Express* television receiver. As will be seen it provides a fitting finish for this very popular kit set and it is so constructed that the minimum amount of work is required in installing. The price of the cabinet is 29s. 6d., delivered free, and is obtainable from Stanton's Cabinet Works, Lyme Grove, London, E.9.



The Stanton "Daily Express" cabinet.

It helps us if you mention "Television"

Providing High-tension *for the* Cathode-ray Viewer

By G. PARR

Last month constructional details of a double time-base for cathode-ray television were given. This article describes the method of obtaining the high-tension supply for the tube from the mains, and readers desirous of making a suitable unit up will have no difficulty from the instructions that are given.

As explained in a previous article (TELEVISION, April, 1934, p. 174) the successful working of a resistance condenser time-base depends on the application of a high voltage to the circuit. If the supply voltage is below 600, with the values of condensers and resistances given there will be a tendency for the charging potential curve to depart from linearity before the mercury relay strikes, and this will give rise to unevenly spaced lines.

To be on the safe side, therefore, it is advisable to cater for an H.T. voltage of 1,000-1,500, provided by a half- or full-wave rectifier.

Another consideration leads to the adoption of the high voltage stated, and that is the operating anode potential of the tube itself. While quite satisfactory images can be produced at, say, 900 volts, there is a distinct advantage in raising the anode potential to 1,000 or 1,200, as brighter images can be produced and the range of modulating voltage applied to the shield is correspondingly increased.

In this respect the tube is exactly analogous to the power valve. An increased anode potential means a correspondingly higher signal handling capacity before distortion is apparent. The distortion in the case of the tube is that giving rise to blurred focus, which occurs if the signal applied to the shield is too big.

Finally, since an increase in anode potential on the tube means a decrease in sensitivity, a larger voltage swing must be applied to the deflectors to cover the whole surface of the screen. If the anode potential is reduced, and in consequence the tube becomes more sensitive, all that is necessary is to reduce the bias applied to the mercury relays, and the deflector plate voltage is lowered to correspond.

Time-base High-tension

It is not proposed to give full details of the construction of the H.T. unit, as it follows on the conventional lines of most A.C. mains rectifier units. The requirements of the transformer are as follows:—

Secondary Windings:

1,500 volts, 10 ma.

4.0 volts, 4 amps.

4.0 volts, 2 amps.

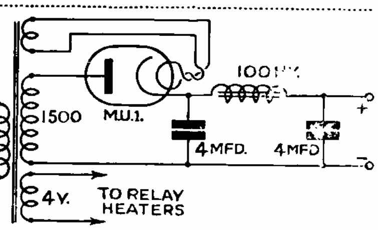


Fig. 1: H.T. supply circuit for double time-base unit using a gas-filled rectifier.

The 4 ampere winding is for the supply of the relays, and the 2 ampere for the rectifier filament. The rectifier used was an Ediswan M.U.1 —a half-wave gasfilled rectifier with an indirectly heated cathode brought out to the centre pin in a 5-pin base.

The valve holder requires considerable care in the selecting and mounting as its insulation has to withstand 3,000 volts between anode and cathode sockets. Ordinary 5-pin holders are not recommended, and the most satisfactory one was found to be the "Eddystone" type 950 short-wave holder, which is assembled to give the maximum air spacing between sockets.

The circuit diagram for the rectifier is given by Fig. 1. The current taken by the time-base depends on the values of the charging condensers, but may be taken to lie between 5 and 8 milliamps. The reservoir condensers are 4 mfd. 1,500-volt working. As these are somewhat expensive, 500-volt electrolytic condensers may be tried, two 8 mfd. being connected in series.

The smoothing choke is 100 henry. The whole unit should preferably be mounted in a steel box both for protection from shock and to minimise possible interference with the tube.

In any case it should be placed at least three feet away from the tube and connection made to the time-base by means of H.T. cable, thick twisted cable being used for the supply to the relay heaters.

Alternative Construction

In setting out to construct a cathode-ray tube television equipment the experimenter will necessarily have in mind that the tube can be used for a variety of other purposes, and it is therefore not desirable to "tie-up" the equipment too much.

For this reason the double time-base unit was designed as a separate component which could be brought into use when required. The supply for the tube is therefore better obtained for a separate H.T. source, although reasons of economy may prevent this.

To complete the equipment, there are therefore two alternatives:—

The time-base H.T. unit can also be used to supply the tube from a separate H.T. winding on the same transformer, and the controls for the tube can, if necessary, be mounted on the panel of the time-base unit itself.

or An independent H.T. unit can be made up for supplying the tube, and a pair of terminals can be provided for the application of the modulating signal to the shield.

The latter alternative, being the more elastic, has been considered in designing the present equipment, but

When replying to advertisements, please mention "Television" it is, of course, possible to mount the controls for the tube on the same panel as the time-base controls. This course can be adopted if it is desired to make up a complete television unit. In any case the H.T. supply unit should always be mounted separately from the control panels, and the tube can be connected to its control panel by means of a 4-core braided cable.

The connections for the supply of the H.T. and L.T. to the tube itself

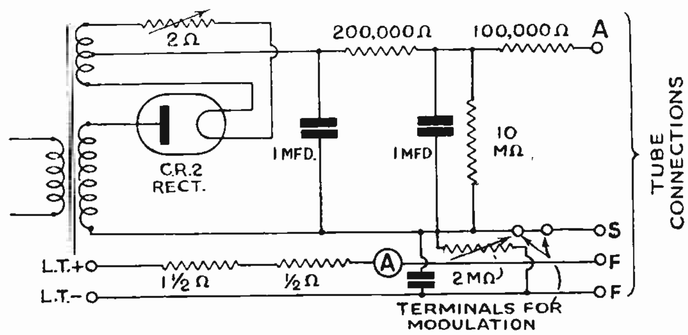


Fig. 2. Theoretical circuit for the H.T. supply unit for the cathode ray tube. The cathode of the tube is fed from a 2-v. cell connected to the L.T. terminals.

are given in Fig. 2. The anode of the tube is connected directly to H.T.+ through a safety resistance of 100,000 ohms. To avoid any A.C. interference it is not advisable to operate the cathode of the tube from raw A.C., and accordingly two terminals are provided for the L.T. 2v. accumulator. The anode of the tube is connected to chassis, and therefore the cell is " live " and should be well insulated from its surroundings.

Shield Potential

The shield potential for focusing is derived from an automatic bias resistance in the L.T.- lead. The value of this resistance must be high owing to the very low current (20 micro-amps.) taken by the tube. Cathode-ray tubes vary in their focusing characteristics, and hence the correct value is a matter of trial. For the Ediswan tube about 1-2 megohms will be correct. Owing to the inherent properties of self-biassing circuits, it would be a difficult matter to obtain complete cut-off of the beam without the provision of an extra resistance in the H.T. supply. This is shown as a 5-10 meg. fixed resistance connected between H.T.+ and L.T.-, and ensures a small permanent current flow through the auto-bias resistance irrespective of changes in the current of the tube.

To avoid loss of modulating signal across the auto-bias resistance, it is shunted with a 2 mfd. condenser.

The cathode is fed through a fixed resistance of 1½ ohms and a fine adjustment rheostat of 0.5 ohm for accurately controlling the temperature. A cathode ammeter is not absolutely essential but is very desirable. The one used in the circuit was a Weston Model 517, 0-1½ amps., but a Ferranti meter is a suitable alternative. No allowance has been made for the resistance of the meter itself, and the 1½ ohm, fixed resistance may need to

COMPONENTS FOR THE TIME-BASE SUPPLY UNIT.

Transformer: 1,500 volts, 4.0v. 4.0v. (Sound Sales).
100 henry choke (10 ma.) (Sound Sales).
2 4 mfd 1,500v. condensers (Dubilier).
Or 4.8 mfd. 500v. electrolytic (Dubilier).
5-pin valve-holder type 950 (Eddystone).
4 Belling-Lee terminals (2 A.C. Mains and + and — H.T.).
1 Ediswan M.U.1 rectifier or Osram G.U.1.

be reduced to obtain the working voltage across the pins of the tube.

The complete list of components for the tube supply is given in the accompanying panel, and full constructional details will be given next month, together with operating notes on the complete equipment.

COMPONENTS FOR TUBE H.T. SUPPLY UNIT.

Transformer: 1,500 volts, 2.0 volts C.T. (Sound Sales).
2 1 mfd. 1,000v. condensers (Dubilier).
1 1 ohm fixed resistance.
1 ½ ohm variable resistance (Reliance Mfg.).
1 2 megohm potentiometer (Reliance Mfg.).
1 200,000 ohm resistance (Erie).
1 100,000 ohm. resistance (Erie).
1 2 ohm variable resistance (Reliance Mfg.).
1 4-pin valve-holder (Bulgin).
1 Ediswan C.R.2 rectifier.
1 2 mfd. fixed condenser (Dubilier).

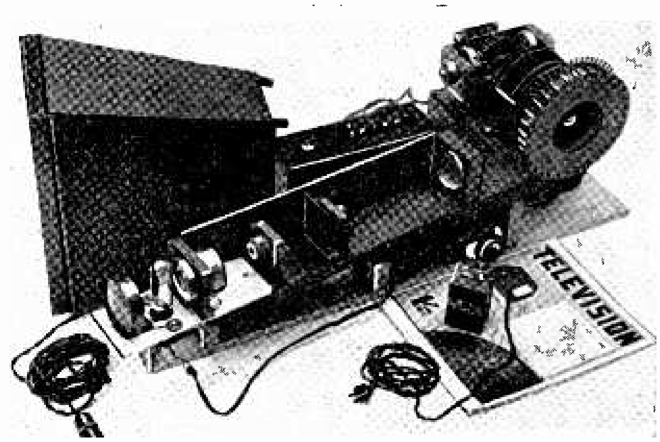
The Time-Base Circuit—A Correction

In the theoretical circuit diagram on p. 219 the modulating potentiometer was inadvertently shown connected to *shield* and *cathode* of the C.R. tube. The end should be connected to *H.T.-ve* of tube. An examination of Fig. 2 will make this point clear, the terminals shown being for the insertion of this potentiometer in the tube supply circuit.

Television To-day and To-morrow:

Sir Isaac Pitman & Sons, Ltd., announce the publication of the fourth edition of this book. It consists of a general review of television practice and a considerable amount of history, particularly in relation to the development of the Baird systems and it will be found of assistance in obtaining a general knowledge of the subject. Its authors are H. J. Barton Chapple and Sydney Moseley, and the price is 7s. 6d.

The mirror-drum visor constructed by Mr. F. V. Whitehead of Bradford. It was with this apparatus that the direct photographs shown in our correspondence pages were taken.



THE TELEVISION SOCIETY

President : Sir AMBROSE FLEMING, M.A., D.Sc., F.R.S.

Founded in 1927 for the furtherance of Study and Research in Television and allied Photo-electric Problems.

Ordinary Fellows are elected on a Certificate of Recommendation signed by Two Ordinary Fellows, the Proposer certifying his personal knowledge of the Candidate. The Admission Fee for Fellows is half-a-guinea, payable at the time of election, the Annual Subscription is £1 payable on election, and subsequently in advance on January 1st in each year, but the Annual Subscription may be compounded at any time by the payment of Ten Guineas.

Any person over 21, interested in Television, may be eligible for the **Associate Membership** without technical qualifications, but must give some evidence of interest in the subject as shall satisfy the Committee. For Associate Members the Entrance Fee is 5/-, payable at the time of election, with Annual Subscription 15/-, payable in advance on January 1st in each year.

Student Members.—The Council has arranged for the entrance of persons under the age of 21 as Student Members, with Entrance Fee 2/6 and Annual Subscription 10/-, payable as above.

The Ordinary Meetings are held in London on the second Wednesday of the month (October to May inclusive) at 7 p.m. The business of the meetings includes the reading and discussion of papers. **A Summer Meeting** is usually held, and affords Members the opportunity of inspecting laboratories, works, etc. A **Research Committee** and the preparation of **An Index of Current Literature** are active branches of the Society's work.

The Journal of the Television Society

is published three times a year. All members are entitled to a copy ; and it is also sold to Non-Members, at an annual subscription of 15/- post free.

Forms of proposal for Membership, and further information regarding the Society, may be obtained on application to the Business Secretary, J. J. Denton, 25, Lisburne Road, Hampstead, London, N.W.3.

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.

Abstract of the Paper on Recent Developments in Photo-electric Cells and their Application read before the Television Society on Wednesday, April 11th, 1934.

MR. H. R. RUFF, B.Sc., A.M.I.E.E., of the Engineering Laboratory of the B.T.H. Company, commenced his paper by showing the extent to which the fundamentals underlying the photo-electric cell characteristics have been appreciated, and the extent to which these devices were now being rated in common units, enabling their relative merits to be adjudged correctly. The particular merits of each type of light-sensitive device making it particularly suitable for any specific applications were discussed.

The confusion that has arisen from the lack of definite agreements and use of common units or incompletely defined units was particularly stressed, and in particular the necessity for stating precisely the exact light source from which the light was obtained to test and rate the light-sensitive device was explained.

It was shown how the characteristics of the photo-voltaic cell in that it generated a voltage when light was shone on it and would operate a current meter without any further applied potential made this device particularly suitable for measurements of radiation or ordinary visible light. It was shown that the selenium cell could be employed for general experimental work while the recti-linearity of the response of the photo-electric cells to changes of light-intensity, the reliability and interchaneability of this type of cell, and its response to light modulated at high frequencies made the cell generally the unit for industrial use, particularly for such applications as sound-film reproduction and television.

The Caesium Cell

It was pointed out that now that the time had come to adjudge the relative merits of photo-electric cells for general use, the only type of cell which was very seriously considered was the thin film cæsium cell of which the Mazda cell was the pioneer in this country. The reason for this was explained in detail. It was due chiefly to the necessity for increasing the sensitivity of cells to light of long wave lengths to both visible red light and infra red radiation.

The advantage which the increase of sensitivity to red light had given in actual output was illustrated by means of demonstration equipment, and there was no doubt that the gain which has been obtained by increasing the cell sensitivity to long wave length light was very considerable when such cells were employed with normal artificial light sources, which contain an enormous amount of red light and infra red radiation, but are very deficient in blue light. In addition it was pointed out that the fact that these thin-film cæsium cells are sensitive to such a wide range of wave lengths of radiation makes them more sensitive to daylight than any other type of surface at present known.

Examples of the applications of these light sensitive devices to industrial processes were demonstrated with a particular view to showing the uses to which the cells are employed as mechanical eyes. As illustrations the photometry of lamps, the sorting by colour of articles, the measurement of temperature, and the artificial control of artificial lighting were explained. The use of these cells to enable beams of light to carry out the many operations, such as counting, aligning of articles on moving belts, weighing, the use of means of light for protecting machinery and for door-opening were also illustrated. In addition it was pointed out that light was now being considered as a definite medium for conveying or storing signals. The sound film was illustrated as a great example of this while a further interesting machine for inserting photogravure in printed magazines or newspapers was also shown as another example, as an instance where the engineer had used light as a medium to overcome a difficulty.

The extent to which invisible radiation was now used as well as light was also stressed. The trend of the use of a cell for television in that the light sensitive devices were being employed so that their current outputs were stored by means of a capacity action to enable very much larger current impulses to be obtained was illustrated and explained with reference to Zvorykin's "Iconoscope."

Meetings of the Television Society are held throughout the session at University College, London. Invitation cards for these, and particulars of the Society, with member's proposal form can be had on application to Mr. J. J. Denton, 25 Lisburne Road, Hampstead, N.W.3.

There is still time to fill up the Questionnaire on page 217 of the May issue of "Television"

Television Society for Cheshire

A Television Society has been formed for Cheshire and South-west Lancashire, and all readers interested are invited to write to the Secretary, c/o Messrs. Jensen and Base, Radio and Television Specialists, 223 Seaview Road, Wallasey, for particulars of the next meeting. It will assist if readers will state their present activities in television, what type of apparatus they possess, and evenings in the week on which they could attend.

It is hoped by massed interest to carry out various television transmission and reception experiments, and to present to the B.B.C. further proof of the needs for an increased service. Also to provide a bureau of information where non-technical members can obtain the help necessary to ensure good results. A meeting place will be arranged at an address most suitable to the majority of members.

Members of the last meeting included:—W. Stanley-Atkin, Wallasey; R. C. Base, Wallasey; E. Bates, Willaston; J. L. R. Jensen, Wallasey; P. W. Piggot, Birkenhead; J. W. Willis, Chester.

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Owing to the demands upon our space in this issue we have been obliged to hold over a large number of names.

"Putting Vision on the Radio Programmes" (*Continued from page* 245)

gramme for which a plain background is better. I therefore had a white roller screen installed one foot in front of the long-shot wall. This wall is covered with a white material on to which we fix our painted scenery. In this manner a quick change of scene may be made in the middle of transmission. All that is necessary is a studio fade of five to ten seconds.

Use of Captions

In the Control Room there is a disc apparatus for scanning a small area of $4\frac{3}{4}$ ins. x $2\frac{1}{4}$ ins. as well as the mirror-drum scanner. Specially designed captions to convey written intelligence or picture designs can be scanned by this machine and faded in to the picture obtained in the studio. I find the use of captions of increasing importance. They can be used to maintain synchronisation while the picture is faded out, to link items together, to announce the names of artists by visual means, to suggest atmosphere by means of different types of drawings and even to superimpose scenery.

The first important use made of the caption machine was on November 3 last, when the Russian Ballet was televised. Their dances were of such widely different character—ranging from the romantic to the modern period—that I found it necessary to have special drawings designed, suggesting in advance the atmosphere of each dance, examples of which are reproduced. On this occasion I also announced the name of the dance and the names of the artists, and even the design of the lettering was changed to suit the style of the drawing that was to follow. The effect in miniature was very similar to that given at the Russian Ballet itself, when a large drop scene, specially designed in the character of the ballet, holds the stage during the playing of the overture.

I used a new effect recently, when Laurie Devine performed her famous Gothic dance, portraying the figure of a saint coming to life. It would obviously be expensive to have scenery painted and designed for the single performance of one item. By cutting out a card in the form of a Gothic arch, and mixing the two scanning apparatuses together, she appeared to be dancing, and posing, under the arch of her little niche.

I have received letters from "lookers" commenting favourably on the announcement of artists by captions. Another pleasing effect is to fade through the names and see a short glimpse of the artists posing during the overture to the programme. This serves the purpose of a visual introduction before the programme starts.

Make-Up

Make-up is used to overcome colour discrimination of photo-electric cells, and also for theatrical effect. I have been accused of using make-up to overcome lack of detail. This is not correct. The photo-cells being more sensitive to the red and infra-red end of the spectrum, red goes white, and the colour pigments in some faces appear to have peculiar effects on the photo-electric cells. After all, make-up of the most peculiar kind was used in early film days, though it has since become greatly modified with the technical progress in that art. I remember my old friend Ellis Jeffreys complaining bitterly in having to walk about with what she called "a rotten egg face."

The only difference between early television and early film make-up appears to be in the disease. Early film stars appeared to suffer from advanced stages of jaundice; television artists from complete decomposition, but if the result achieved is good, what does it matter? Yet even in the short time that television programmes have been transmitted by the B.B.C., make-up has been considerably modified owing to the improvement of the radio picture, and once the eye has become attuned to dark blue lips, the effect is not nearly so alarming as it sounds.

Phase Distortion

We have another problem—that of phase distortion. Briefly, certain frequencies which go to make up a picture, travel at a different speed to others, and arriving out of place, cause a smudged effect. Make-up can be useful in counteracting this effect. Deep shadows under the eye can be reduced by the use of dead white. This also has the effect of sharpening the eyebrows. The nose can be made to stand out, and keep its shape by the use of purple or blue shading. I remember gently breaking it to that great dancer Karsavina that she would not look pretty when made up for television, with a purple shaded nose. She replied that she always shaded her nose for stage work, and also for photographs. So you see—*plus ce que ça change plus ce que c'est la même chose.*

The same problem of phase distortion necessitates the careful study of costume. Large areas of black must be avoided owing to their tendency to throw up a smudged effect, and completely white costumes are comparatively useless against a white background. In the first instance, I have to break up the areas of black with white in various ways, and in the latter, costumes must be edged in black, or black trimming added. Sometimes the intended effect would be completely destroyed by black edging—that is why you have probably noticed low lighting and shadow effects introduced, and in this way a white costume can sometimes be used.

I have been unable to cover the many points of television programme production in great detail in one article, but I hope my readers have been interested, and that those who may be counted amongst our audiences will receive added enjoyment in knowing how the effects they see are obtained.

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"Photocells and Their Application," by Messrs. Zworykin & Wilson (**Chapman & Hall, Ltd.**). In the three hundred and fifty pages which comprise this volume is contained much information of both a theoretical and practical nature, and many aspects of the photocell are dealt with which are not usually found in publications of this description.

The mathematical side of the general theory of the photocell is concisely and clearly dealt with, and the chapters dealing with the use of the photocell in television and talkie apparatus are full of interesting information. Chapters are also included giving details of the use of photo-electric devices for such modern purposes as traffic control and counting.

This book represents a very useful addition to any scientific library, and can be recommended to anybody wishing to go fairly deeply into the subject of photocells, without wading through pages of arduous mathematics.

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