TELEVISION

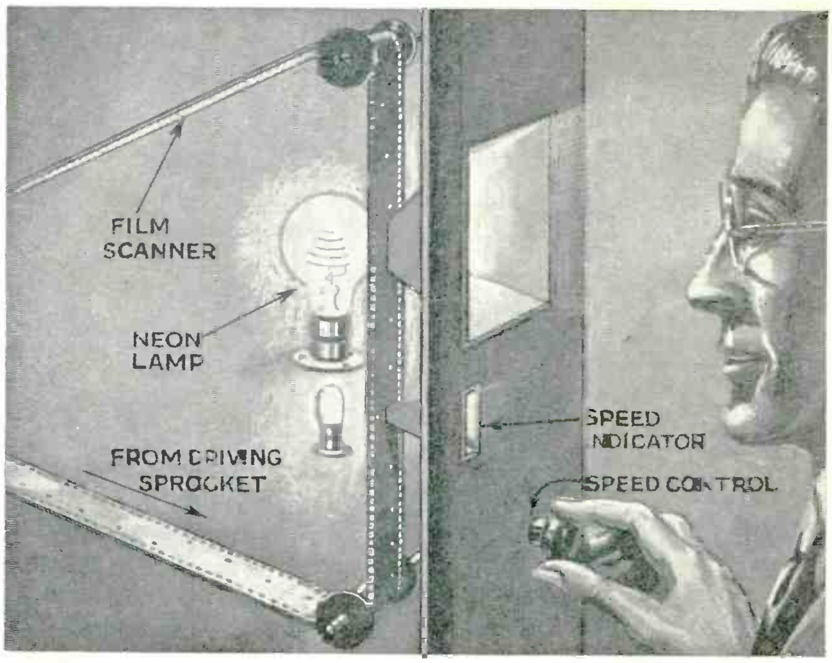
THE FIRST TELEVISION JOURNAL IN THE WORLD

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
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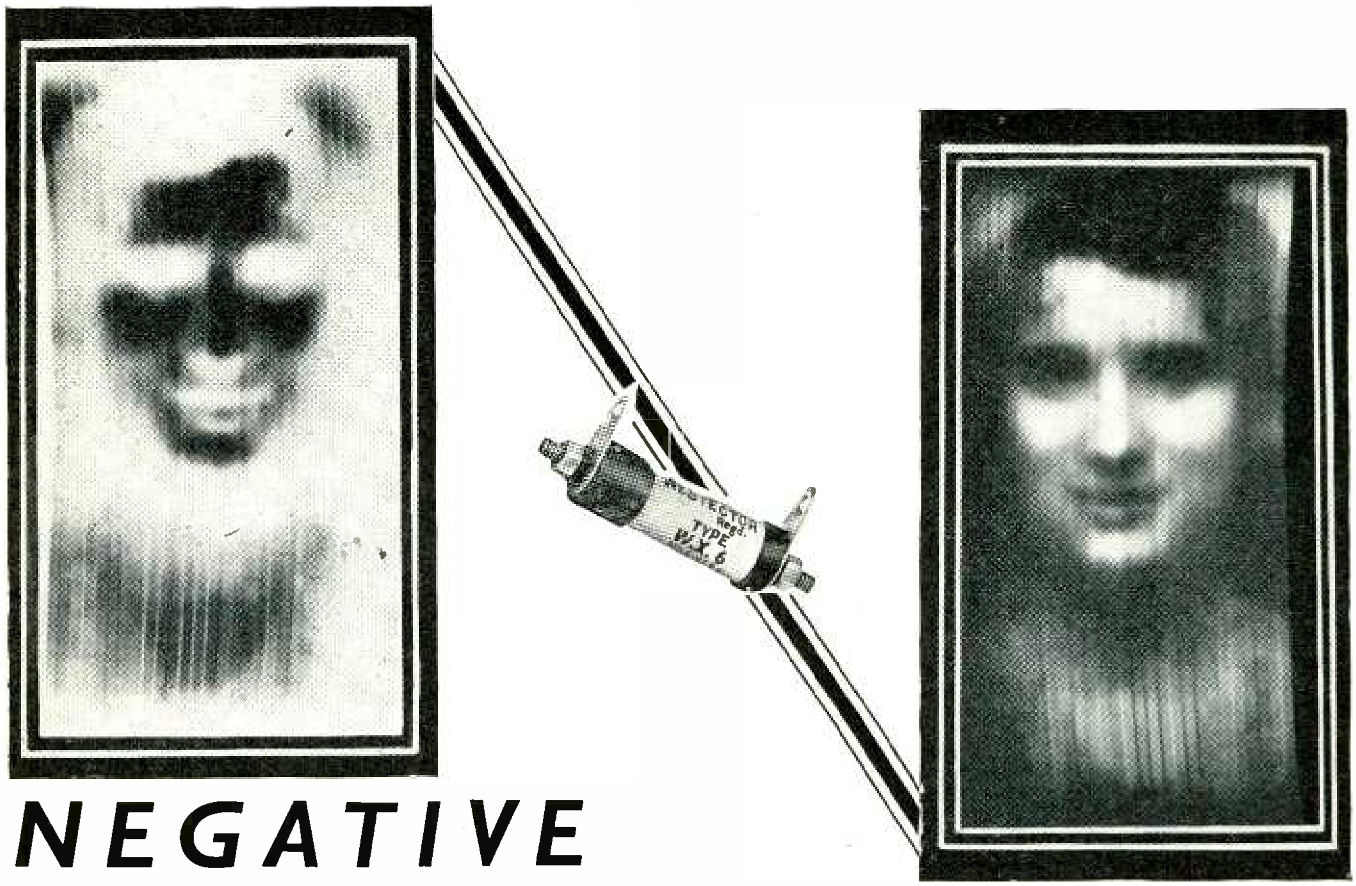
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A REMINDER

Have you considered the outstanding properties of

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.

The Baird Grid Cell alone in its hermetically sealed bulb.

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.

In addition, it may be applied to sound recording on film and the stroboscopic inspection of rapidly moving parts.

Interested readers are invited to write for an illustrated and descriptive brochure, and the company is at all times prepared to furnish technical assistance dealing with the divers uses of this unique product.

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.

BAIRD TELEVISION LIMITED

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Telegrams : "TELEVISOR, SOWEST, LONDON."

Mention of "Television" will ensure prompt attention

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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 demarcation. 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.

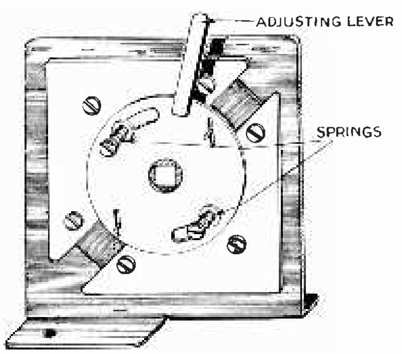

Fig. 1. The complete mask.

The materials required for the construction 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.

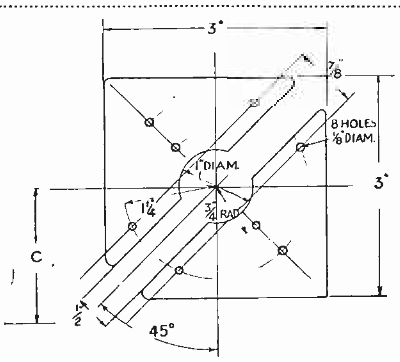

Fig. 3. The guide plate

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 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.

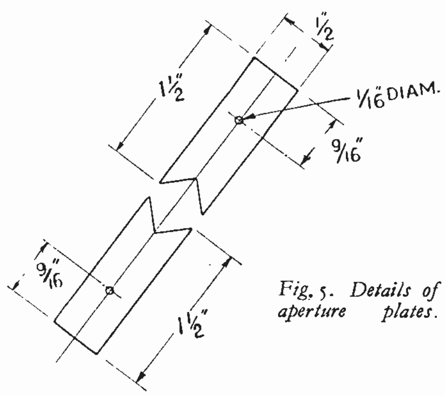

Fig. 5. Details of aperture plates.

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 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.

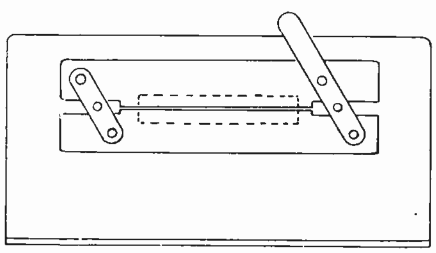
Fig. 6. An alternative construction for use with a mirror screw.

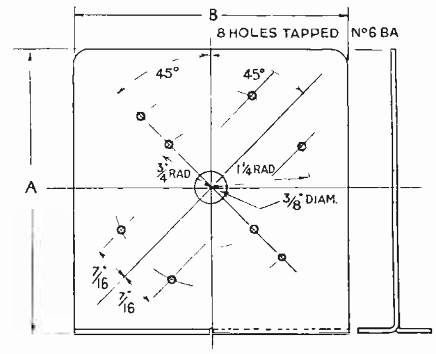

Fig. 2. Details of main frame.

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

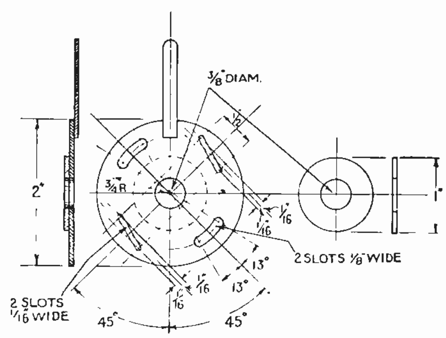

Fig. 4. The moving slotted disc.

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

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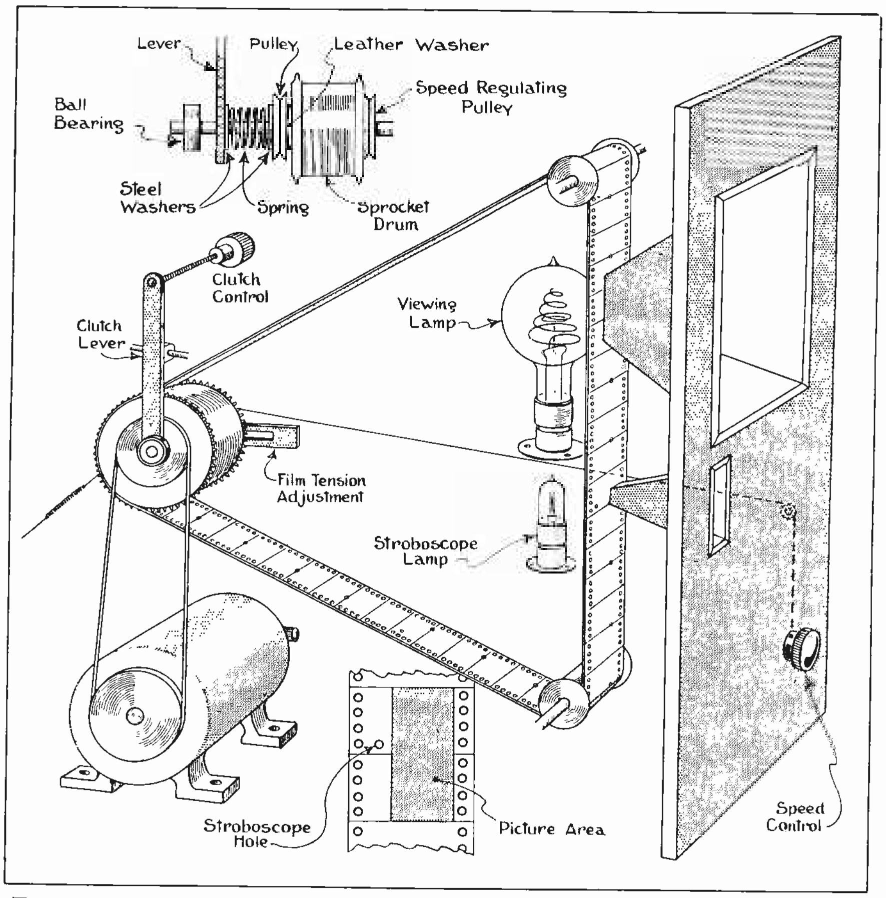


These drawings show the construction and some details of the film scanner. At the top left is shown the driving sprocket and at the bottom the method of obtaining a stroboscopic effect from special perforations in the film.

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.

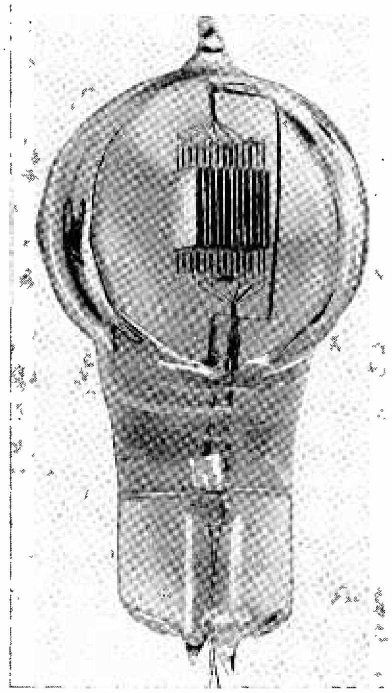
The Marconi engineers are aiming to add vision to the "public address" systems so extensively used by politicians, etc. In the future the speaker whose speech is relayed to another hall will also be *seen* by the second audience.

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.

Hungary

Transmissions to Start

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

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.

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—between 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:—

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

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.

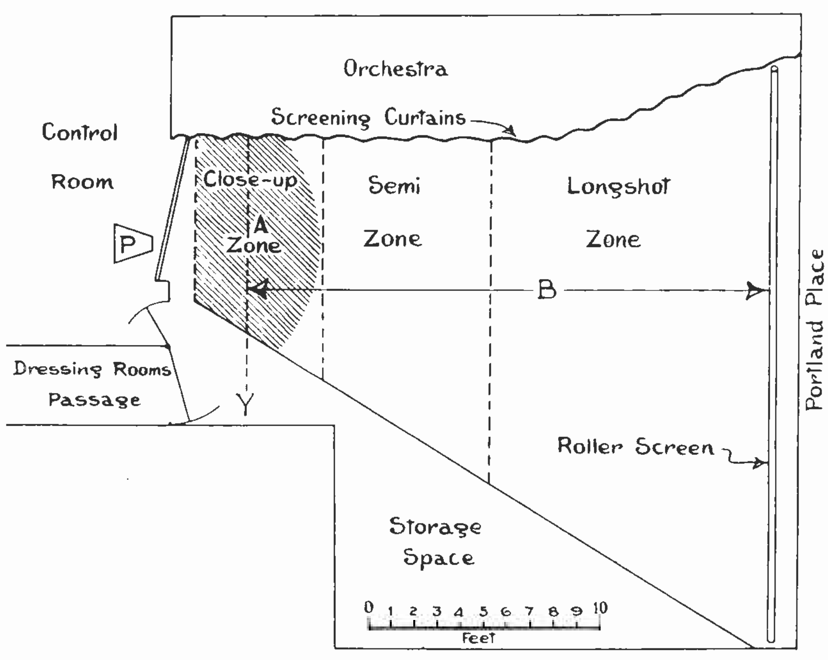
sion of new effects from what appeared to be extremely simple ones until they have become more complicated. Actually, the simple effects of earlier days gave us as much trouble to put into practice as the more complicated effects of to-day. Our organisation has become more used to dealing with the new 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 .. 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.

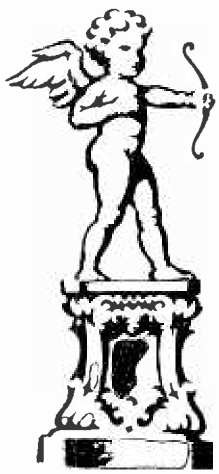
Dancing Technique

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

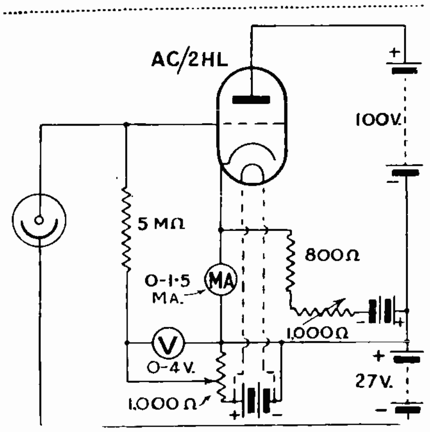


Fig. 1. The circuit of the photo-cell photometer described in the text. The instrument will measure the electro-optical values of light.

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.

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.

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

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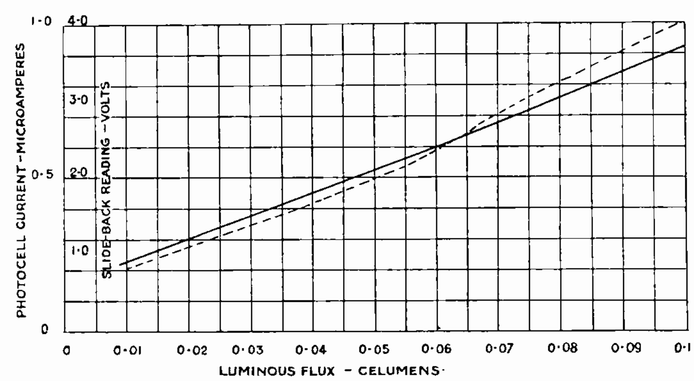
Fig. 2. The calibration curves of the photo-cell photometer.



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.

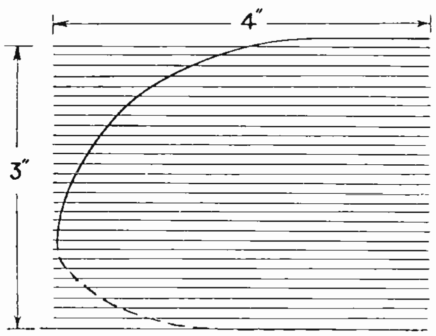


Fig. 1. Correct position of flyback for horizontal scanning from top left-hand to bottom right-hand corner.

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.

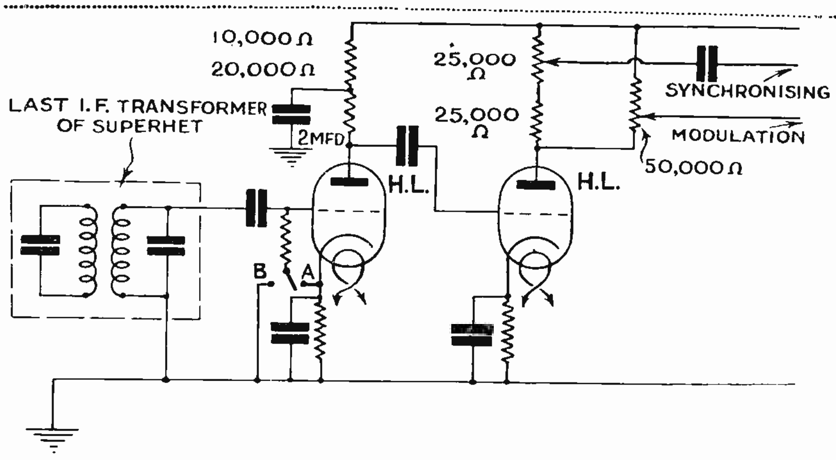


Fig. 2. Essentials of receiving circuit: the switch at A gives grid rectification and that at B anode bend.

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 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.

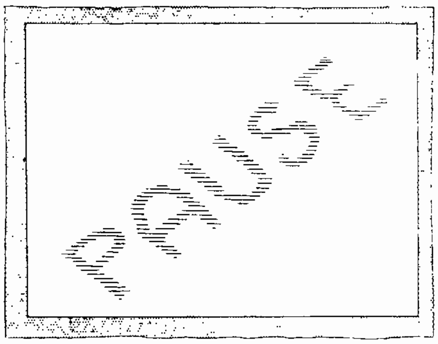


Fig. 3. An impression of the interval signal on the Zeesen transmission.

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.

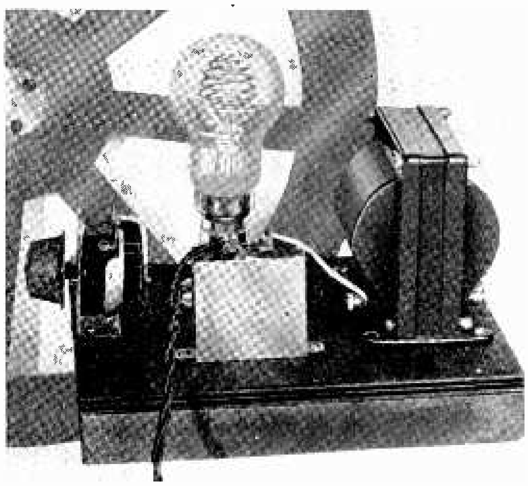
A Stroboscopic speed indicator *for* d.c. working

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 possessed 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.



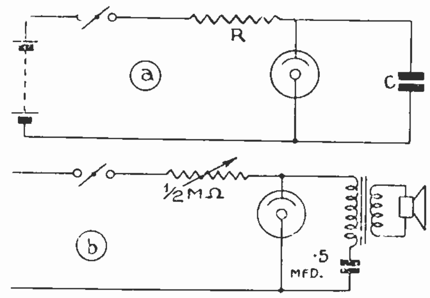
An experimental hook-up designed on the lines of Fig. 1b. As will be seen it merely consists of a variable resistance, a fixed condenser, a loudspeaker output transformer and a neon lamp.

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.

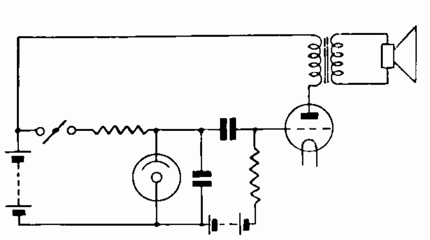


Fig. 2. Diagram showing how to add a single-valve amplifier to neon oscillator to facilitate checking its frequency against a constant-frequency source.

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.

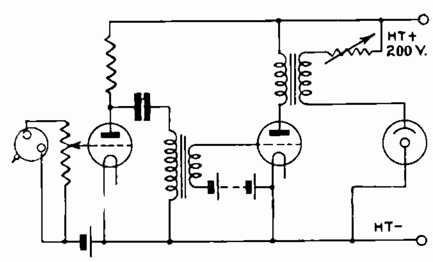


Fig. 3. A useful circuit for modulating a neon lamp from a gramophone pick-up. If constant-frequency records are used the lamp will be caused to flicker at the frequency injected by the pick-up.

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.

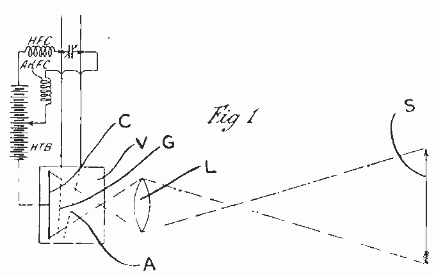
RECENT DEVELOPMENTS

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

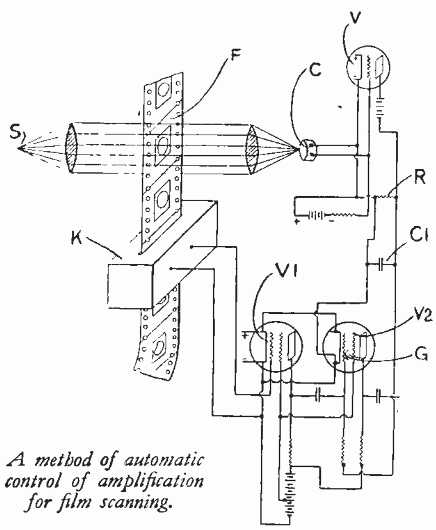
(Patent No. 406,957.)

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

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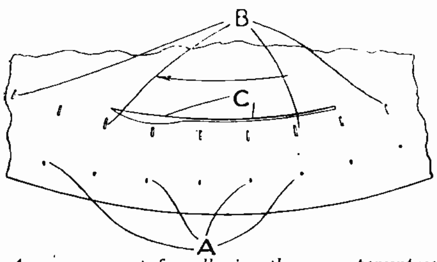
is supervised and controlled by the action of the photo-electric cell. A condenser C1, of large capacity, by-passes the effect of any rapid fluctuations, due to picture "details," and only allows comparatively slow changes of background transparency to control the gain of the amplifier V2.—(*Cie Pour La Fabrication Des Compteurs et Matèriel 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.*)

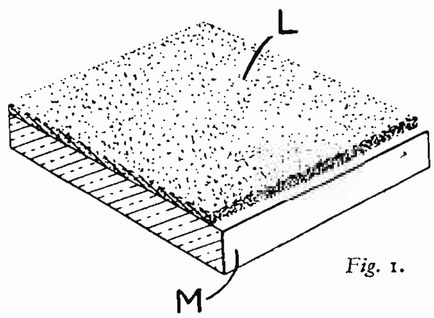


Fig. 1.

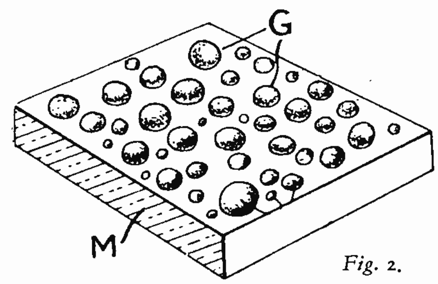


Fig. 2.

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.)

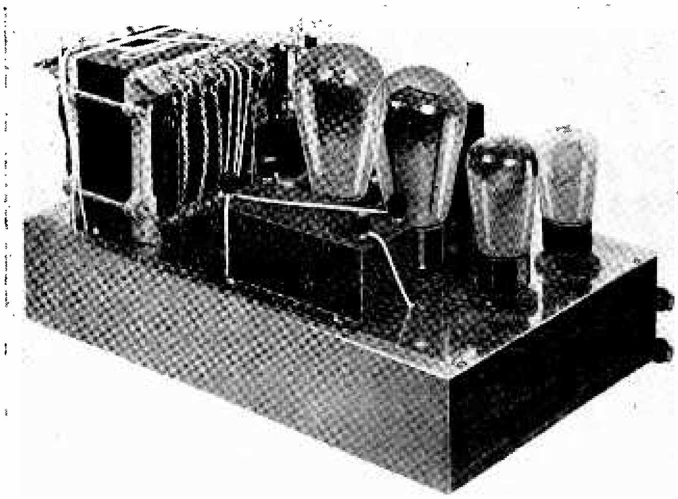
Device for increasing the life of the cathode in a cathode-ray tube.—(*M. von. Ardenne.*)

(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.

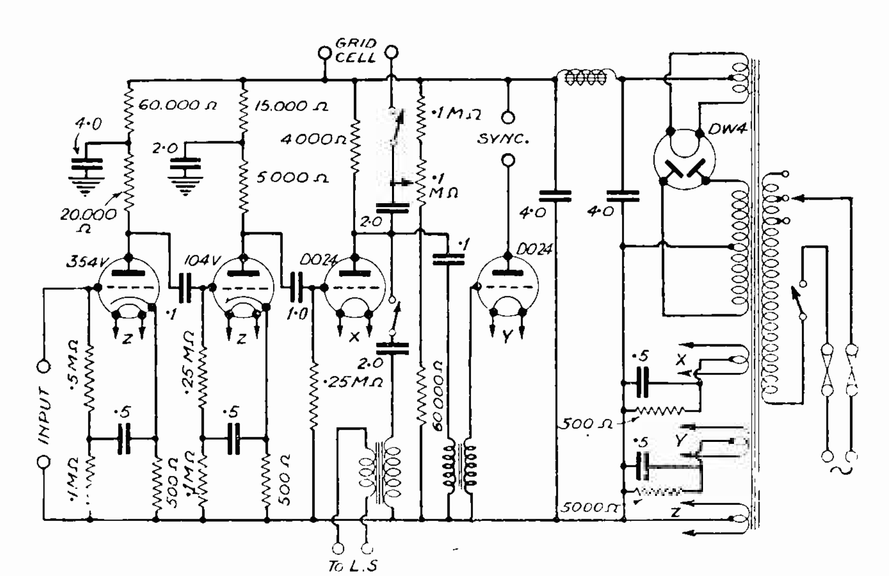
Three stages of resistance coupling are employed, terminating in a modulator valve of relatively low impedance, and working with about 400 volts on the anode.

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

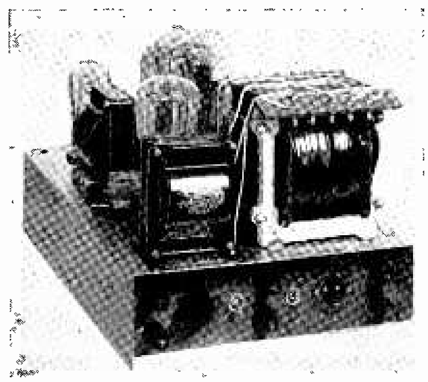


The circuit is that recommended by the Baird Co. for use in conjunction with their mirror-drum scanner.

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



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

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.

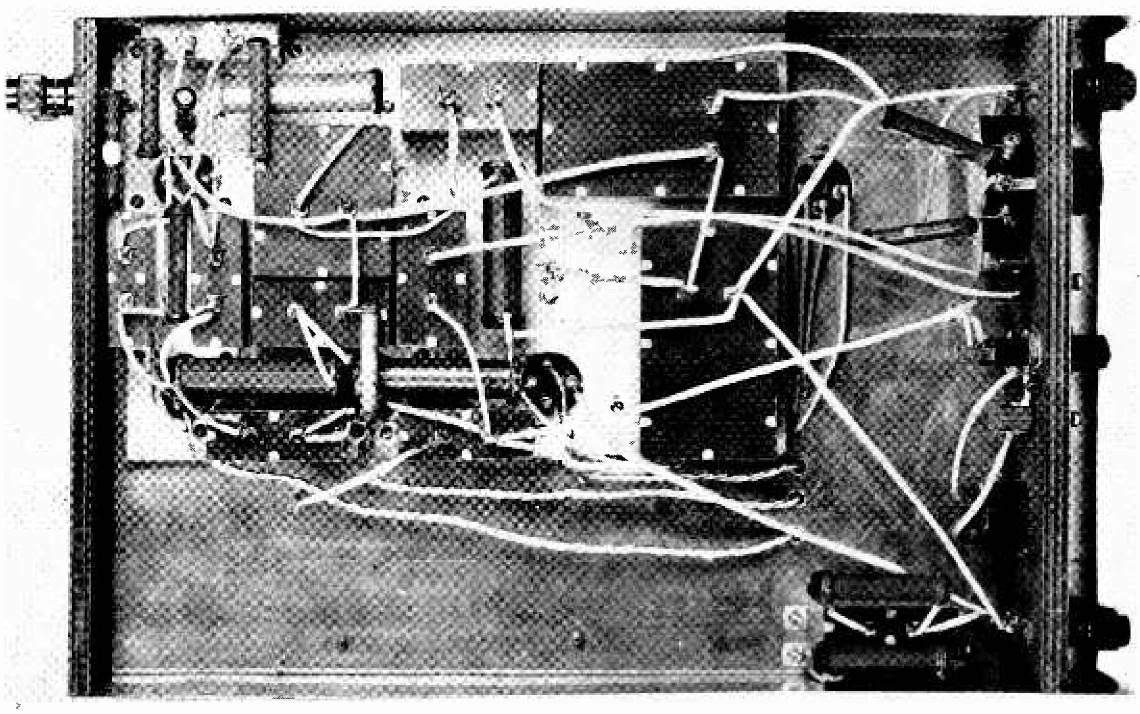
The polarising voltage for the Kerr cell is obtained by means of a potentiometer consisting of two .1-megohm resistances in series with a 60,000-ohms resistance, across the total high tension supply. The middle .1-megohm resistance of this potential dividing chain is made variable and the polarising 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.

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.

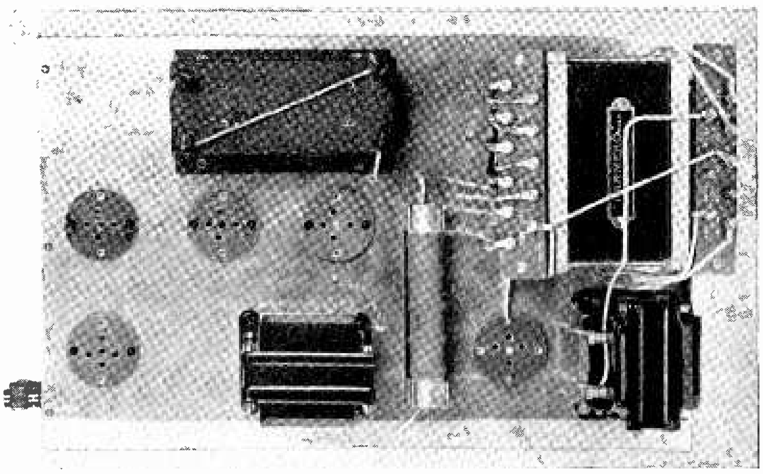
Adequate smoothing is ensured by the use of a 20 henry choke bypassed to earth by a 4-microfarad condenser, which has a working voltage of 750. In order to ensure freedom from breakdown all the high-tension decoupling condensers, together with any coupling condensers which are in any way connected to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

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.

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.

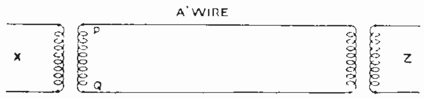
Capacitance

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 $\frac{G}{C}$



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

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.

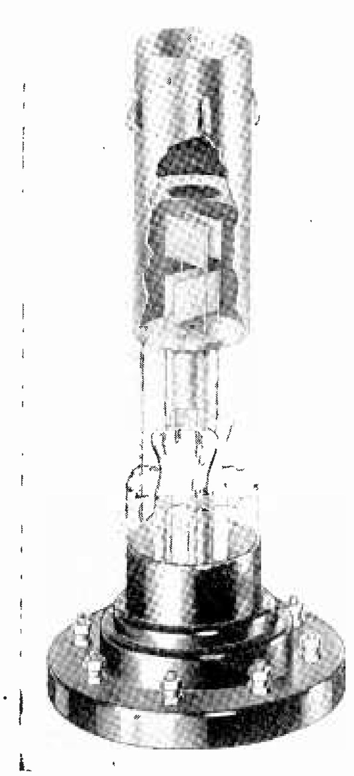
It has been suggested in other countries that the problem could be solved by multi-channel transmission, using, say, four or more channels, each channel taking only a portion of the picture. Even so, specially-constructed cables are required, and the distance over which such high frequencies can be transmitted 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 transatlantic 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 ½-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 1½ 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.

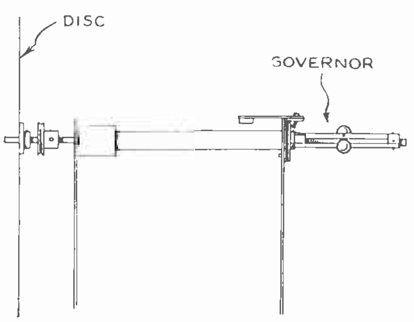
The public demand for 30-line transmission is insistent and it is up to the B.B.C. as public servants to supply their requirements immediately

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



Using a governor for speed control.

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.

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.

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.

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

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

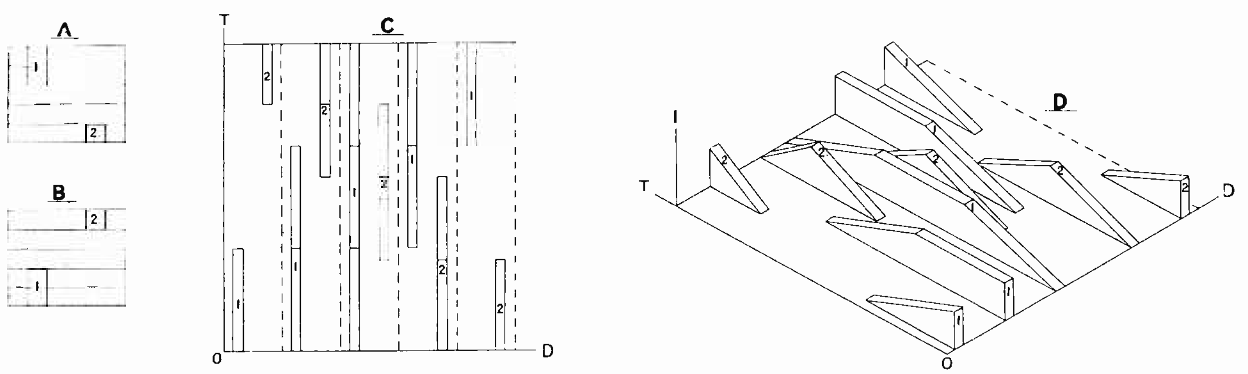


Fig. 25. Diagrams and graphs showing movement of details in a direction across the strips of the picture.

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.

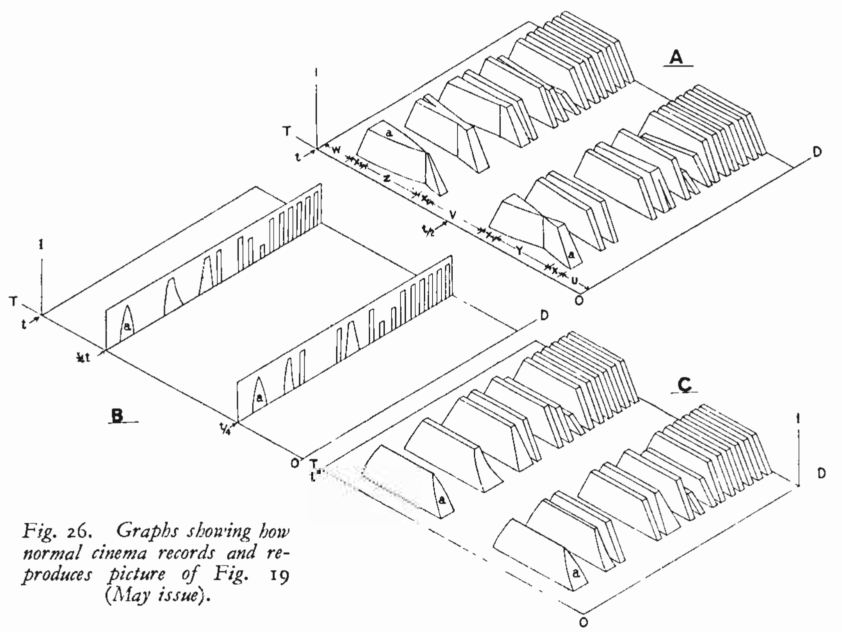


Fig. 26. Graphs showing how normal cinema records and reproduces picture of Fig. 19 (May issue).

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.

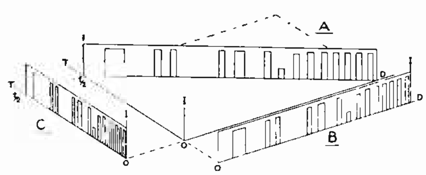


Fig. 27. The effects of scanning shown graphically.

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.

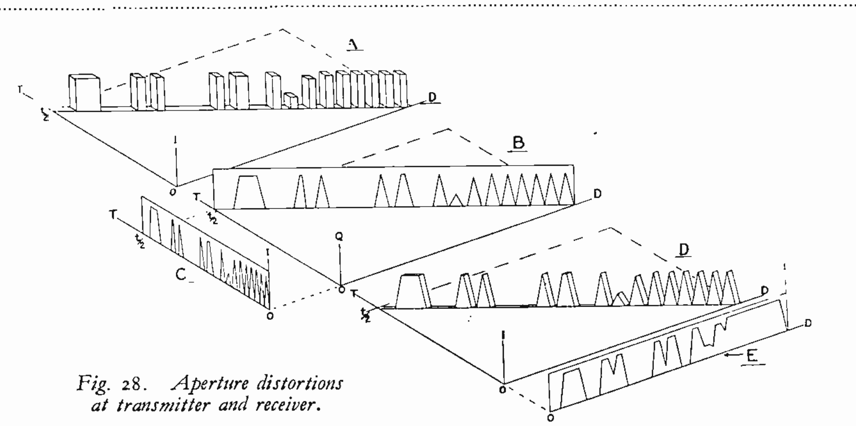


Fig. 28. Aperture distortions at transmitter and receiver.

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

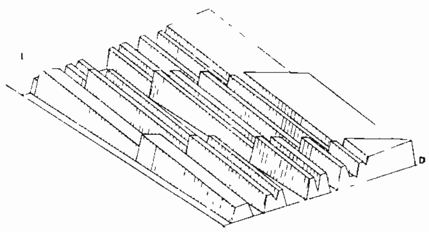


Fig. 29. Persistence of vision and effects in received television pictures shown graphically.

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

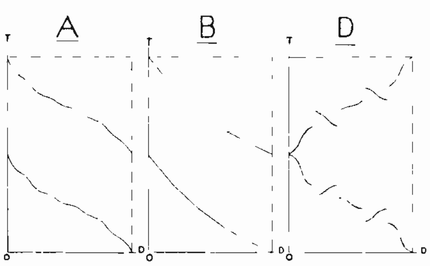


Fig. 30. Scanning characteristics of mirror-drum Nipkow disc and oscillating mirrors.

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

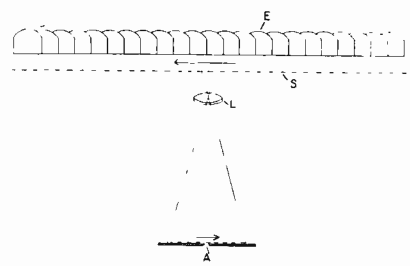


Fig. 31. Scanning with a traversing echelon.

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,

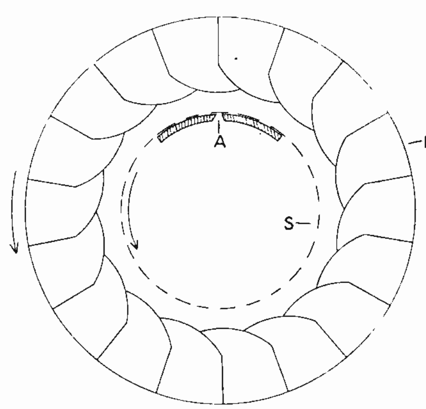


Fig. 32. Scanning with a moving echelon of drum type.

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 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.

Leonie Zifado, soprano.

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

Eileen Tai, Chinese dancer.

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

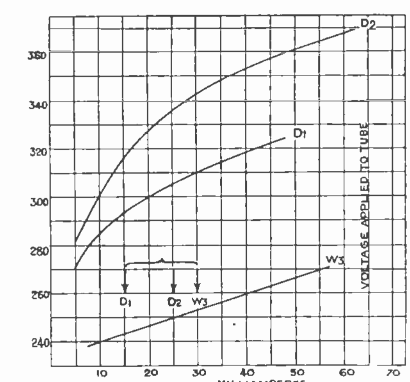


Fig. 3. Curves showing the variation of tube current with applied voltage.

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:—

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

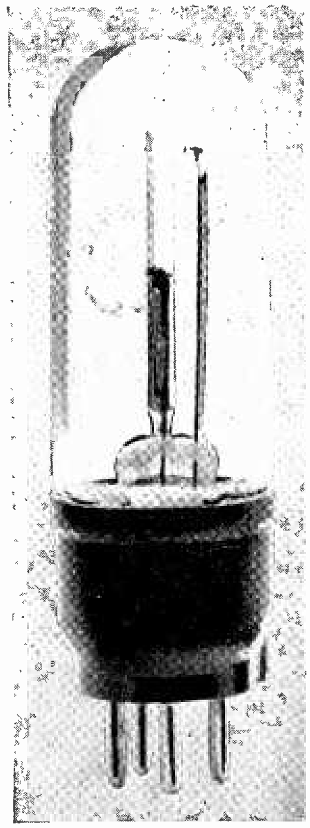


Fig. 1. The types D.1 and D.2 gas-discharge tubes.

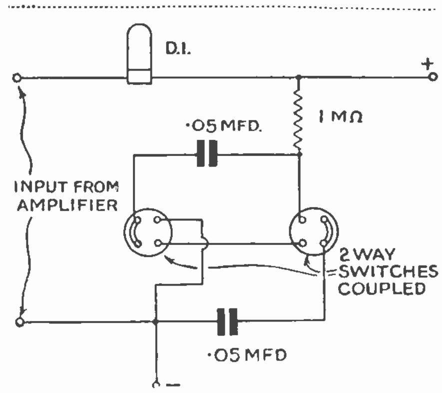


Fig. 4. An arrangement for starting the tube by condenser discharge.

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.

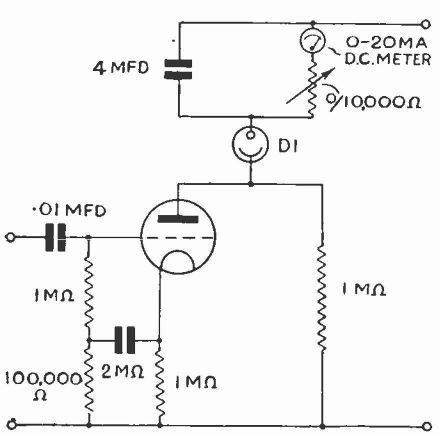


Fig. 5. A method of starting the tube by means of the H.T. supply.

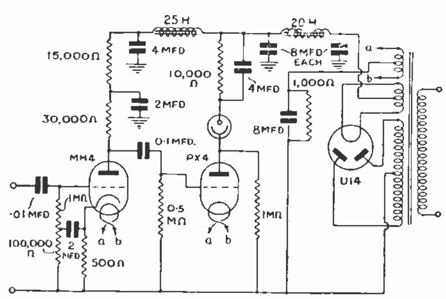


Fig. 6. A circuit of a complete amplifier for mains operation.

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.

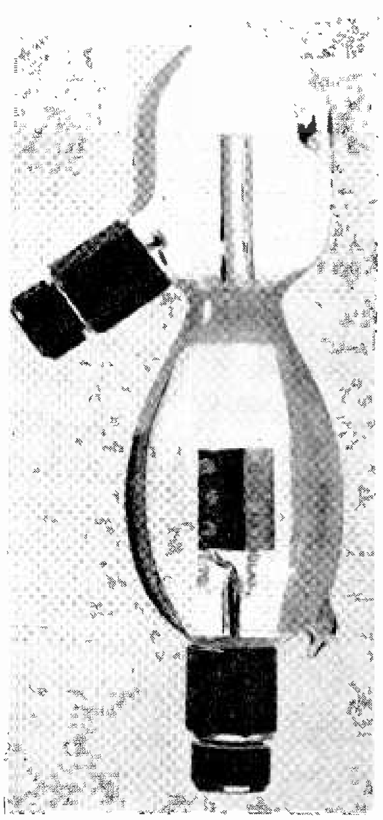


Fig. 2. The W.3 type gas-discharge tube.

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

(Continued in 3rd col. of next page.)

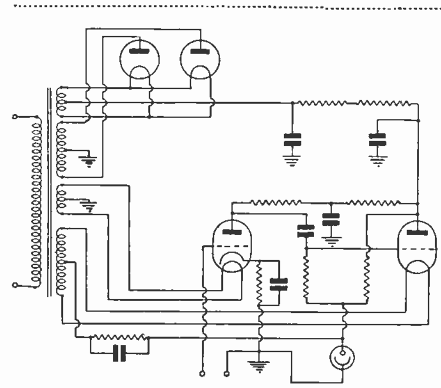
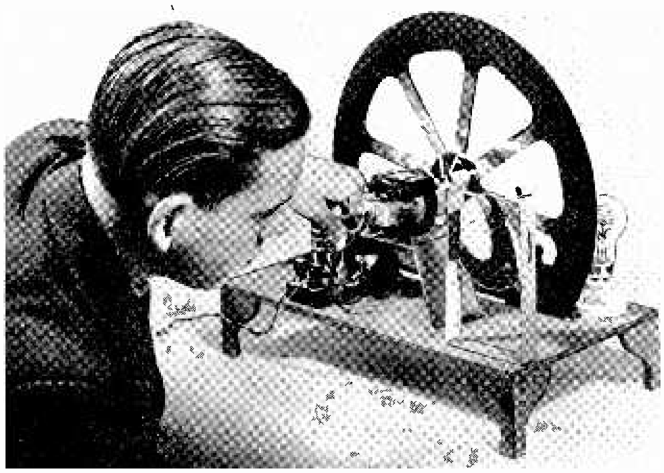


Fig. 7. A simplified form of the amplifier circuit given by Fig. 6.

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

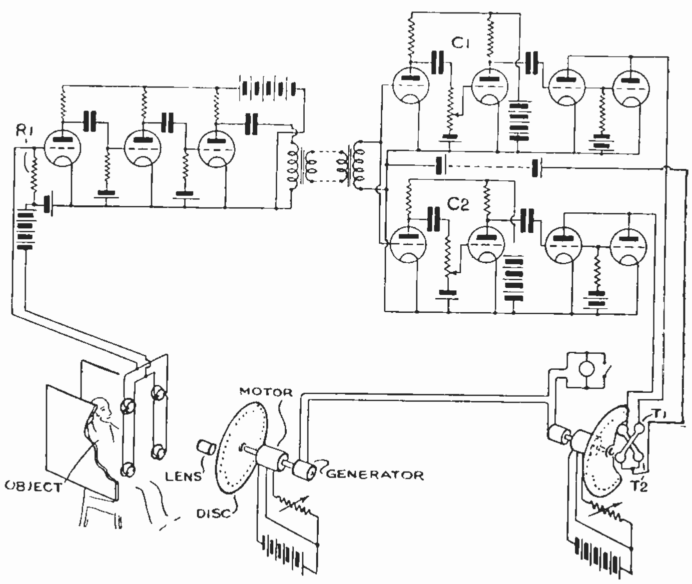


Fig. 1. A diagrammatic layout of the apparatus actually used in the first Baird demonstration of colour television.

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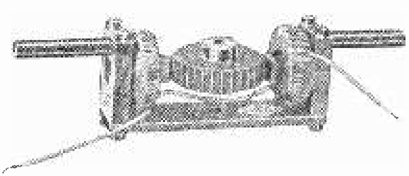

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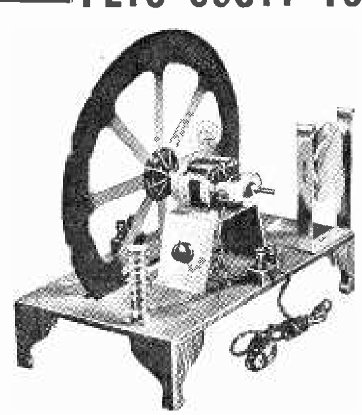

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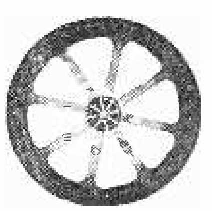

EACH disc is of light gauge aluminium, dull black one side, and centres cut out to reduce weight. The centre boss is an 8-ribbed black bakelite moulding. Each rib being faced white to give true stroboscopic effect, and thereby visual speed indication. A heavy brass bush insert with Grub screw provide 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** 20" diam. **12/6** (Postage **9d.** extra).

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375 cycle Peaked Transformer	**12/6**
Parmeko Type H.M.T./500 Mains Transformer as specified	**£4 : 0 : 0**
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As described in April issue.

COMPLETE KIT as detailed in April issue of "Television," less essential accessories. Cash or C.O.D., Carriage Paid **£4/15/-.** 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.

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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.

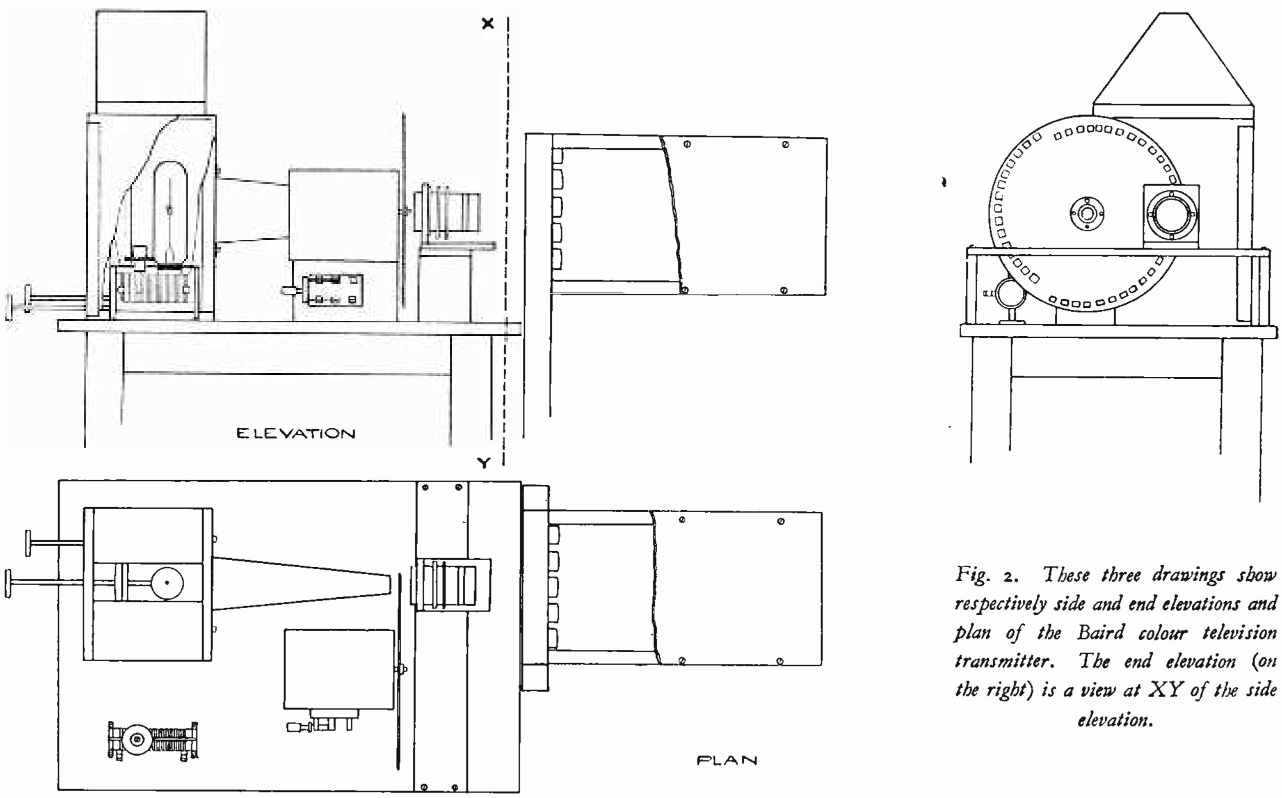

Fig. 2. These three drawings show respectively side and end elevations and plan of the Baird colour television transmitter. The end elevation (on the right) is a view at XY of the side elevation.

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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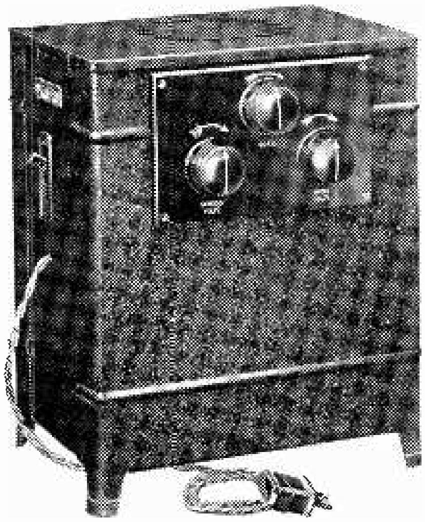

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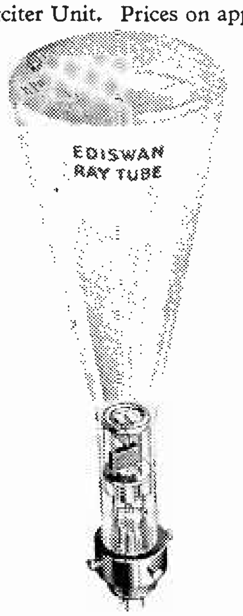

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the projector is traversed first with red light, then with green and finally with blue, the cycle of operations being repetitive, and, at the receiver, the geometrically corresponding series of apertures are covered with similarly coloured filters. 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:—

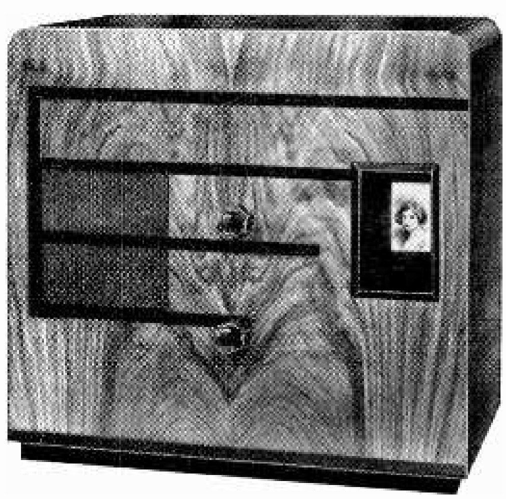
It is uneconomical as regards the full utilisation of the capabilities of the transmission channel to use markedly unequal signal-amplitudes during different-coloured traverses; but, on the other hand, it is undesirable to cut down the effective "blue" and "green" signals by rendering the filters more 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: (a) in beam.	Celumens: (b) incident on cell	Current for ten cells (micro-amps)	Voltage across 100,000 ohms.
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.

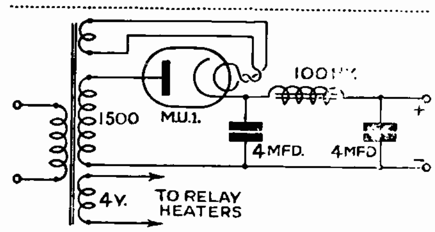


Fig. 1: H.T. supply circuit for double time-base unit using a gas-filled rectifier.

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

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 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.

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 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.

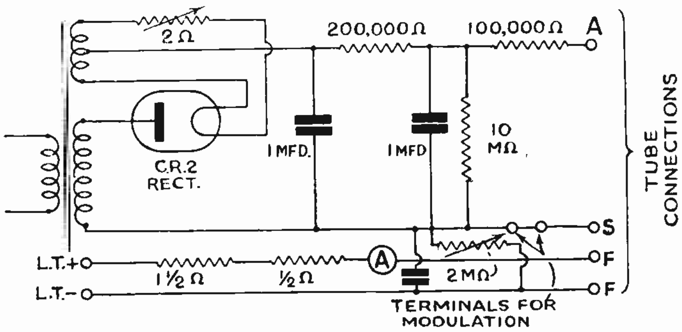


Fig. 2. Theoretical circuit for the H.T. supply unit for the cathode ray tube. The cathode of the tube is fed from a 2-v. cell connected to the L.T. terminals.

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 microamps.) 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.

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.

COMPONENTS FOR TUBE H.T. SUPPLY UNIT.

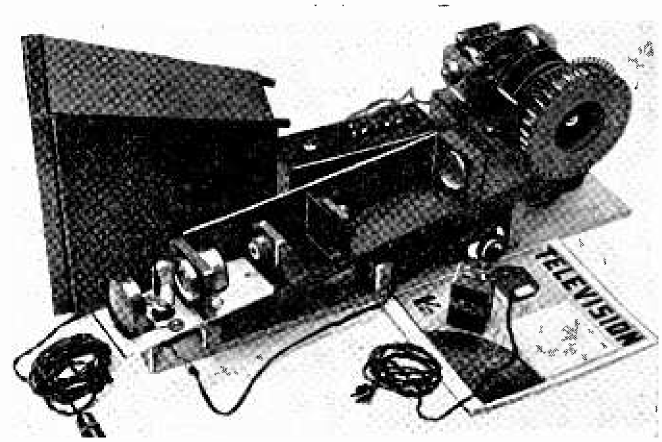
Transformer: 1,500 volts, 2.0 volts C.T. (Sound Sales).
2 1 mfd. 1,000v. condensers (Dubilier).
1 1 ohm fixed resistance.
1 ½ ohm variable resistance (Reliance Mfg.).
1 2 megohm potentiometer (Reliance Mfg.).
1 200,000 ohm resistance (Erie).
1 100,000 ohm. resistance (Erie).
1 2 ohm variable resistance (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.

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.

CONSTRUCTORS' CIRCLE
Additional Members

R. M. Sloan, "Inverdoon," Clarke Avenue, Ayr, Scotland; E. Bailey, 1, Eaton Terrace, Sidmouth, Devon; R. Cox, 233, Albert Road, Wood Green, N.22; W. Nuttall, Town Hall, Settle, Yorks; R. F. Vigurs, 28, Seymer Road, Romford, Essex; F. Ward, 59, Balaam Street, Plaistow, E.13; P. Morris, 230, Grove Road, Hounslow; L. Perkins, 128, Dundas Road, Tinsley, nr. Sheffield; G. W. Morris, 149, Manchester Road, Altrincham, Cheshire; E. Hole, 54, The Avenue, W. Ealing, W.13; L. Hewett, 104, Westbourne Street, Liverpool, 6; G. Harvey, 66, Westheath Avenue, Grangetown, Sunderland; R. J. Thompson, B.A., Grenoble, Broughton Avenue, Southport; K. Britter, 40, Ennis Road, Plumstead, S.E.18; B. D. Sampson, Mill Street, Chagford; C. E. Allchurch, 104, Whitmore Gardens, N.W.10; G. H. Bown, 102, High Street, Maltby; L. R. Jones, 20, Rupert Road, Guildford, Surrey; E. H. Fabb, "Mudros," Althorne Road, Redhill, Surrey; J. Barker, 20, Strawberry Bank, Linlithgow; E. Harrold, Lynnwood, Hill Street, Hinckley, Leicestershire; E. G. Hayman, 23, Westhill Avenue, St. Marychurch, Torquay; J. R. Dennis, Avenue House, Priors Avenue, Bury St. Edmunds; N. Crathorne, Knights End, Grimes Hill, Wythall, nr. Birmingham; J. W. Matthews, 3 Balfour Road, Wimbledon, S.W.19; T. Keane, 1, Copper Place, Stoke Road, Plymouth; J. E. Roberts, 7, Ainsworth Road, Owley Wood, Northwich; A. S. Jennings, 22, John Street, Nelson; E. Turner, 30, Ettrick Grove, Sunderland; Miss D. M. Orme, 74, Hospital Street, Nantwich, Cheshire; H. Ronson, 32, Stirling Grove, Whitefield, nr. Manchester; E. J. Copp, 31, Portman Avenue, East Sheen, S.W.14; W. Cheevers, 19, Thornton Way, Hampstead Garden Suburb, N.W.11; J. Tarttelin, 203, Roberts Street, Grimsby, Lincs.; A. Bell, "Byways," Lundin Links, Fife, Scotland; R. H. Wolfenden, 18, Stanley Road, Hollinwood, Oldham; A. Lord, 3, Holly Avenue, Syke Side, Haslingden, Rossendale, Lancs.; G. T. Grapes, 6, Hazeleigh Avenue, Woolston, Southampton; H. G. Stanley, 9 Gordon Road, Kilburn, N.W.6; R. A. Lowes, Blackhills Road, Horden; W. Oakes, 29, Hales Road, Wednesbury; J. W. Robinson, 24, Hedley Street, Millfield, Sunderland; S. F. Simmonds, 59, Holmstall Avenue, Edgware, Middlesex; G. W. H. Larkby, 105, Farm Road, Edgware, Middlesex.

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.

THE CONSTRUCTORS' CIRCLE

Application for Membership

To be filled in and sent with a *stamped envelope for reply* to the Editor, " Television," 58-61, Fetter Lane, London, E.C.4.

(1) I already subscribe to your journal at the address below.

(2) I have placed a regular order for TELEVISION with my booksellers, Messrs..........

* ....

....

and desire to be enrolled as a member of the TELEVISION " Constructors' Circle."

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*Strike out lines not applicable.

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Readers who wish to sell, exchange or purchase apparatus will find this column a very successful means of disposing of their surplus gear, or obtaining new apparatus at bargain prices.

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June, 1934.

"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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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.

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