TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

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Some of the Contents :

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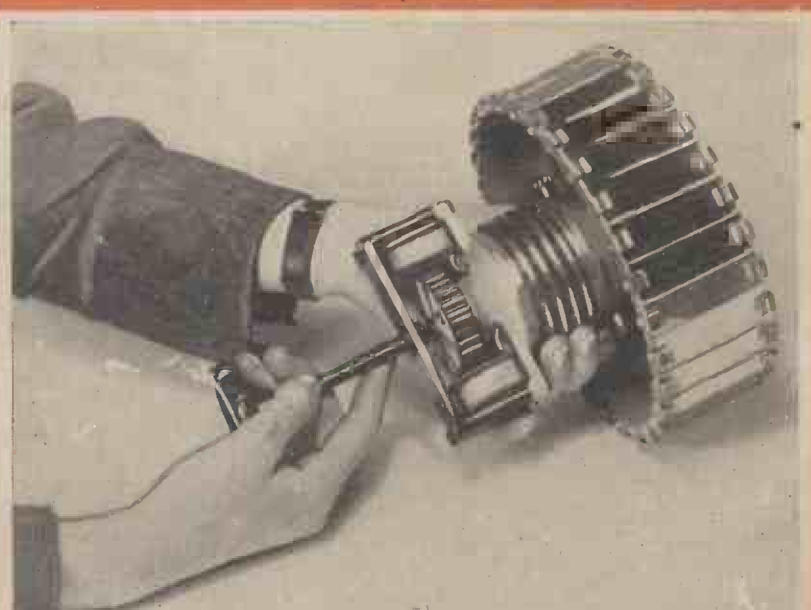

THE MODERN MIRROR DRUM

The photograph shows the Baird Mirror Drum with motor and synchronising gear.

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In This Issue

TELEVISION

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BERNARD E. JONES.

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H. CORBISHLEY.

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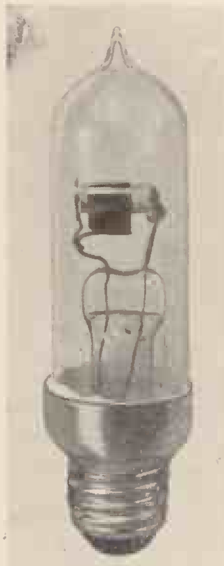
COMMENT OF THE MONTH

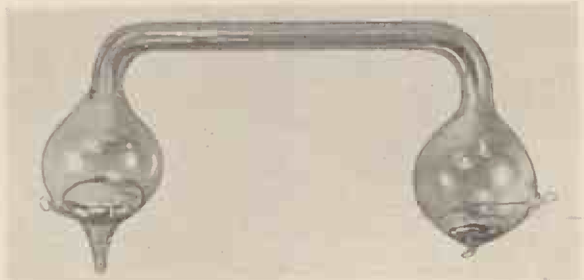
Entertainment Value

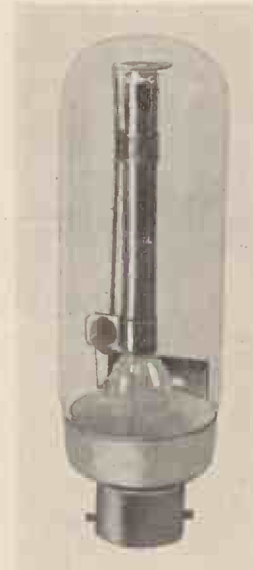
A PHRASE has come into general use in discussions of television policy which needs some definition. We refer to "entertainment value." What exactly does it mean? If it is intended to convey the idea of entertainment all the time for all the people, then let us be frank and admit that television has not reached that stage—probably never will—but neither will any other form of entertainment. Television now is entertaining many thousands of people, and its ranks of enthusiasts are increasing rapidly every day. In its present state, therefore, it has entertainment value for a considerable and growing section of the community, despite the fact that results, compared with other standards such as the present-day cinema, may be somewhat imperfect. It is difficult to obtain an accurate estimate of the number of people who are taking an active interest in television, but we can state positively that during the past few months the number has increased by several thousands. "Entertainment value," then, need not necessarily mean perfect reproduction; it did not in the early days of broadcasting. A valuable suggestion was made by a correspondent in this journal last month. This was that vision in some of the broadcast items should be secondary to sound; a speaker, for example, should be televised. Such a procedure, if generally carried out, would enhance the value of broadcast items of this class, and at the same time be of material assistance in the further development of television. We commend the suggestion to the B.B.C.

Towards Simplification

WE appreciate that two of the needs in the popularisation of television are simplification of apparatus and reduction of cost. With these ideas in view, last month we presented our readers with the design of a mirror-screw receiver, the first ever to be described for amateur construction, and this month we describe a standard wireless receiver suitable for use in conjunction with a mirror-drum visor, or a type which makes considerable power demands. The mirror-screw receiver marked a great advance in amateur construction, for it is much superior to the disc type of apparatus and is practically as easy to build and maintain. Similarly, the wireless vision receiver and amplifier, of which particulars are given on other pages of this issue, represents an advance in simplification; the object in the design being to provide a high output from a relatively simple type of set and at the same time to maintain the high standard of reproduction that is necessary for clear picture reception. The receiver described is a simple three-stage arrangement introducing the rather unusual double bandpass tuning described by the designer last month.







Gas-Discharge Lamps

By W. J. Nobbs

Facts About the Construction and Use of Neon and Mercury-vapour Lamps

MANY people know what is meant by the term "gas-discharge lamp," the best known types of which are the negative glow "Osglim," flat plate and crater-point lamps used for television receivers, as well as the positive-column type so much used for lighting and advertising purposes.

Few people, however, are aware of the production technique and the difficulties that are experienced in the manufacture of suitable types for television purposes.

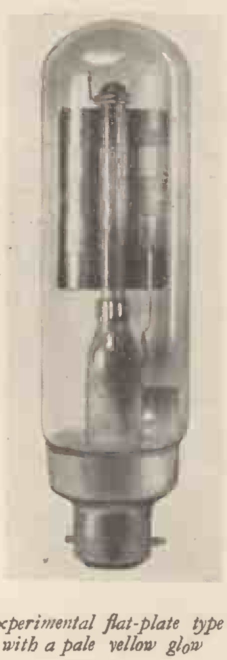
The metal from which the electrodes are made, the type of glass, washing out, filling, mixing of gases to obtain the required colour, are matters that have to be carefully considered, as also are the type of filling (gas or vapour) and pressure to give a good modulation response and brilliance.

Different metals for the electrodes require a different voltage for the initial striking of the lamp and with this question must be considered the freedom from cathode spluttering. Stainless steel is very suitable, being resistive to the spluttering and oxidising. It does, however, require a little more voltage than some other metals for striking and running but this is offset by the increase in cathode life.

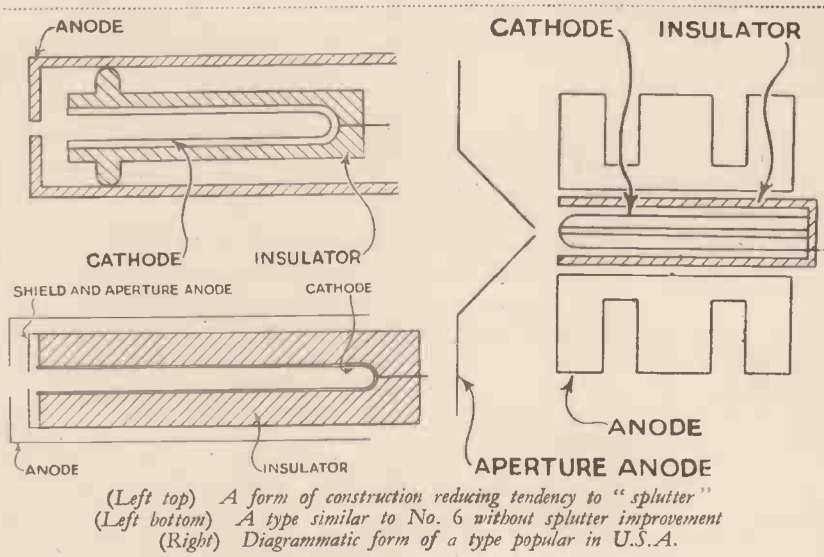
The photographs in the heading show (left) A new crater point lamp of high brilliancy (centre) Positive column mercury vapour and gas lamp (with three electrodes) giving line of light for mirror screws (right) A crater-point lamp with long cathode

The electrodes are mounted in the glass envelope of a suitable glass. Practically any standard glass can be used for the envelope, but the writer avoids the use of lead glass in order to avoid the possibility of darkening the bulb or releasing gas from the lead content when heating and sealing off.

After the lamp is mounted on the pump and placed under vacuum, the electrodes and glass envelope are heated to remove impurities. The glass, of course, retains at the surface gaseous impurities which if not removed by



Experimental flat-plate type with a pale yellow glow



(Left top) A form of construction reducing tendency to "splutter"
(Left bottom) A type similar to No. 6 without splutter improvement
(Right) Diagrammatic form of a type popular in U.S.A.

A crater lamp made for 120 line experiments heating under vacuum would spoil the colour of the glowing gas.

Washing

When the process is completed the lamp is given a filling of gas, usually a cheap neon-helium mixture and a potential is applied to the electrodes, causing a discharge. This is the "washing out" process and it serves further to free the electrodes from any residual gases. After this filling has been removed, by the pump, the lamp is ready to be filled with a gas giving the required result.

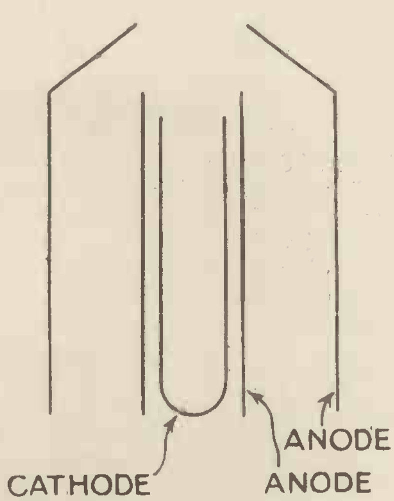
The interior of a neon tube filling laboratory. The pressure gauge can be seen on the left of the operator: on the bench is the lamp bank sealed to the pump

Colour

Neon gas gives a rich red orange glow and it has been found to give the best modulation response. A slight addition of helium produces an orange pink, while helium alone provides a colour similar to ivory. Neon and argon give a bluish pink light which is very pleasing.

A neon-helium mixture with traces of kripton, argon and xenon gives an almost pure white light, but unfortunately this mixture is not stable, the rarer gases quickly being absorbed.

The hot cathode lamps give greater brilliancy and will handle larger power, but are more difficult to modulate. This type of lamp also has a much smaller voltage drop than the cold type and for this reason can be operated at a lower voltage.



Internal construction of a hot-cathode lamp

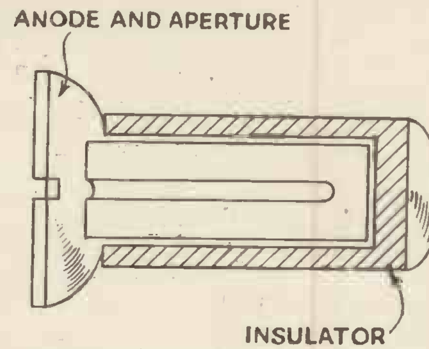
The actual construction of the electrodes and spacing is not critical within fairly wide limits. However, for television purposes the capacity between the electrodes is kept as low as possible.

An interesting lamp of the crater type is illustrated diagrammatically and several interesting features will be noted.

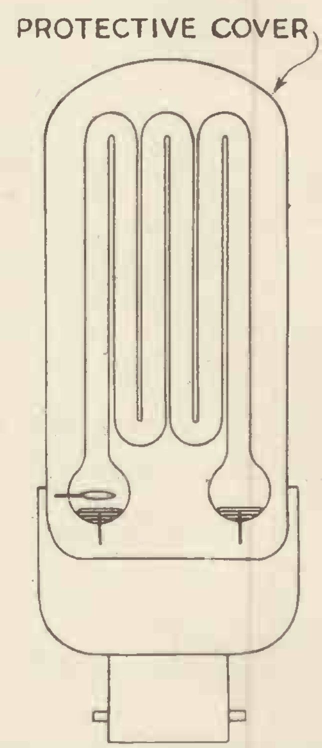
In the course of experimental work many extraordinary effects have been noticed. In one form of advertising lamp of the negative-glow type it was found that two independent colours could be obtained in the same envelope in a predetermined position.

Positive Column Lamps

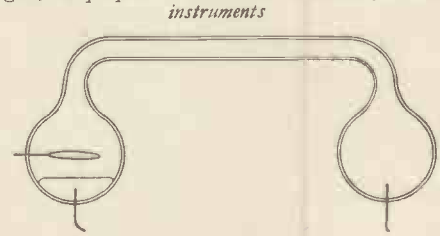
Of the positive column type it has been found that the mercury lamp is the most suitable for television purposes. The striking voltage is somewhat on the high side, but this feature should not present great difficulty to the enthusiast.



Internal construction of high brilliancy crater-point lamp



Diagrammatic form of a tube filled with mercury and gas; the purpose is to increase brilliance for disc instruments



Electrode arrangement of positive-column mercury-vapour lamp

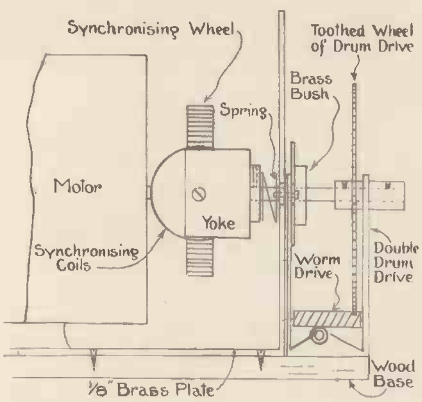
One of the photographs shows a mercury and gas-filled line-of-light lamp which is undergoing test at the

(*Continued at foot of next page*)

An Experimenter's Notes—*Fitting Synchronising Coils*

THE fitting of adjustable synchronising coils to a motor not specially designed for television is usually a difficult matter for the amateur with only a few tools at his disposal. The following method, however, is quite simple and only requires a drill and a screwdriver for the constructional work, whilst a condenser drum drive has been used to provide the necessary adjusting mechanism.

Mount the motor, as shown in Fig. 1, on a sheet of brass, $\frac{1}{8}$ in. thick, one end



Showing how an old-type condenser drive can be used for coil adjustment.

of which has been bent up at right angles, and then mount the whole on a thick piece of wood. This is essential as the brass is apt to bend when the synchronising coils are adjusted unless this is done.

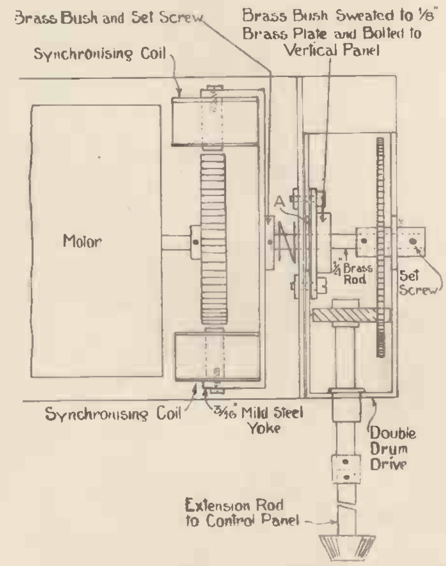
The yoke should be of mild steel, about $\frac{3}{16}$ in. thick. It is fixed to a $\frac{1}{4}$ in. brass spindle by means of brass collar and grub screw which is sweated on to the yoke. The spindle passes through a brass bush, which is mounted on the vertical brass "panel." The holes in the brass bush, through which the fixing bolts pass, and the hole in the vertical brass panel through which the spindle passes, should be in the form of slots, so that the bush may be adjusted to the correct position.

The synchronising coils tend to move a little owing to the magnetic pull on the toothed wheel when the motor is running. To prevent this, some kind of gearing should be used between the adjusting knob and the spindle supporting the yoke and coils. The adjusting knob should preferably be brought out near the viewing screen to obviate the necessity of leaning over the apparatus to make any adjustment.

In the case of a disc receiver an ordinary geared condenser dial can be fitted, whilst with a mirror-drum projector a drum drive can be used. The type which will take condensers on both sides is admirably suited to this purpose. The bracket on one side of the drum, *A*, Fig. 2, which will normally support a condenser, is clamped under the brass bush on the vertical brass "panel," and the feet are screwed to the wooden baseboard. An extension rod is then fitted to the operating spindle of the drum drive and brought out to the front of the apparatus in any convenient position.

The synchronising coils need only be adjustable through a small arc, some 15 degrees is sufficient, and stops should be fitted to the drum to limit the movement.

The poles of the coils should be adjusted, with the aid of thin iron



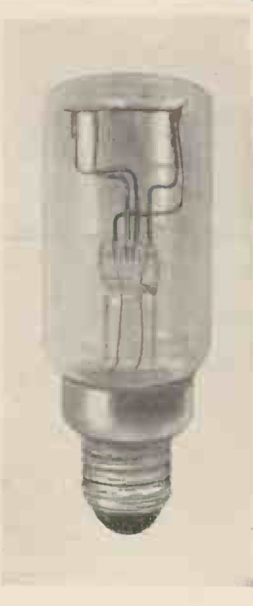
A plan view of the improvised coil support.

washers, to within .006 inch of the teeth of the synchronising wheel.

Quite good results will be obtained with this apparatus, especially if a separate valve fed from a transformer tuned to 375 cycles is used to operate it.

"Gas-discharge Lamps"

(*Continued from preceding page*)



Special flat-plate lamp with neon and helium filling for high brilliancy.

present time and is being developed for use with the mirror screw type of scanning arrangement. It is hoped with the special three-electrode scheme to reduce the striking voltage to reasonable proportions.

The brightness of this lamp is much greater than the ordinary neon type and it can be modulated by a valve of the DO24 type.

The use of "getters" as in the practice of wireless valve manufacture applies also to gas-discharge lamps, but their control is difficult and they are not usually employed.

"Television" is the only journal exclusively devoted to the subject.

A new lamp that should help to give a brighter image on disc receivers is of the mercury positive-column type having the normal straight tube bent into a grid formation. Such a tube is illustrated diagrammatically and further details will follow after tests have been completed. Tubes of the same type but filled with different gases are also undergoing test at the present time.

Finally, always remember that with all gas-discharge lamps some form of resistance in series is necessary to limit the flow of current, otherwise the lamp will be destroyed. In practice a choke coil or the primary of a transformer are normally sufficient. When the lamp is used directly in the series with the plate of a valve the resistance of the filament-plate circuit will limit the current flow.

STUDIO SCREEN

REVIEWS OF PROGRAMMES AND RECEPTION REPORTS

IT is interesting to watch newcomers before the projector. The flickering light is always an embarrassment at first and I have noticed at auditions that recruits tend to behave in the same way. Most people instinctively close their eyes as a protection from the glare. This gives the picture a pathetic blind effect and has to be corrected at once. Then women often incline their heads forwards, which throws the chin into shadow, while men, on the contrary, throw their heads back, so placing a false emphasis on the jaw. But artists quickly get used to the light and these initial faults are rarely seen in the programmes. The producer has the knack of making a new artist act naturally, though one mannerism is hard to cure because excitement is often the cause.

Performers are encouraged to exaggerate their gestures and at the end of their turn, when taking a curtain, are liable to make a sweeping movement with their arms which takes their hands right outside a close-up or semi-extended picture. Women are particularly prone to fall into this trap.

* * *

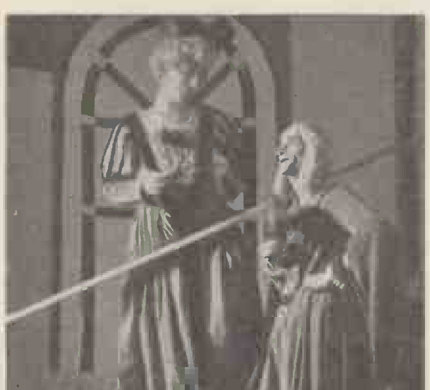
Alanova reached the studio after a night crossing from Paris and was still affected by the motion of the boat when she faced the scanner. At the end of a brilliant rehearsal she explained that the flicker had positively helped her to regain her composure, her sole disappointment being that she could not see herself performing. Like other dancers, she was not keen on draping black chiffon over her white ballet frock. Had it been possible, a glimpse of her own dress in the visor would have satisfied the dancer at once.

* * *

Sir Oswald and Lady Stoll visited the studio on the night when Rupert Harvey, Robert Algar and Dorina were in the bill. After watching the programme in the visor in the Listening Hall, Sir Oswald inspected the studio, and Lady Stoll, who remained at the receiver, was much intrigued when her husband took his place before the scanner and blew kisses to her from the studio below. It was at the Coliseum that television was first demonstrated in a London theatre and Sir Oswald was impressed with the progress that has since been made.

* * *

When Rupert Harvey carried his easel into the picture, I was puzzled by a wobbly head in black and white, which I first mistook for one of his cartoons, and it was not until he socked the figure on the jaw, when the face disappeared with a sharp report, that I realised we had been watching a painted balloon. A scenic panorama was another novelty of the same programme. For this experiment, Rupert Harvey had brought with him what looked like a roll of wall-paper about four feet deep. Unrolled, it was found to be a continuous picture fifteen feet long to illustrate his number, "An Eriskay Love Lilt." Placing the roll in the hands of an attendant, stationed at one side of the studio, the artist stretched the first section of the roll in focus across the back-screen. Then, as he sang, from the other side of the studio, unseen by lookers, he slowly pulled the roll of paper towards him, until at the end of the tune the last few feet of his scene were in focus. Good ideas, Rupert. Have you got any more?



Leslie Rome and Fred Douglas as the Ugly Sisters.

Laurie Devine and Tom Rees in a speciality dance in the Cinderella pantomime.

* * *

There are possibilities in this roller picture notion which the producer will exploit. Black and white drawings transmitted from the caption machine are already a familiar feature of the programmes, and there seems to be no reason why the miniature transmitter should not be adapted to take a roller picture. A couple of film winders from a pocket camera fitted on either side of the small screen should do the trick. Drawings of this size would economise effort and should be more effective in transmission than the larger pictures, because the rustling of paper would be eliminated.

* * *

A dancer arrived one evening to

find that she had mislaid a garment which she had worn at rehearsal in the morning; but an awkward situation was retrieved by the discovery that another artist had packed in his bag some dark blue bathing trunks which he had worn at the swimming baths in the morning.

* * *

A friend just home from America tells me that they have something good up their sleeves and he is convinced that it is only a matter of time before the television world is startled by an important disclosure from the States. He makes this deduction from the fact that the big men are saying nothing, and he moves among the people who could say a lot if they would. The process of his reasoning is odd. As a frequent visitor, he knows the Americans pretty well, and when they have nothing to conceal they talk, he says. Again, if they have some development in view they say nothing. Now, when mum's the word, they must have something big to hide, the figures. We shall see.

* * *

The discovery of fresh talent is often romantic. Those capable tap and acrobatic dancers, Syd and Max Harrison, appeared again during the month, and the story of how they came to the studio for the first time shows how luck plays a part in building careers. In search of a theatrical costumiers which had changed its address, Eustace Robb called at a shop selling ballet shoes in an alley off Charing Cross Road. While talking with the proprietor, a photograph of two dancers caught his eye. It was signed by Syd and Max and addressed to "the makers of the best dancing shoe." The producer recognised in the photograph the possibilities of the act for television and, getting the dancers' address from the shoe shop, called them up for audition. The result we know.

* * *

B.B.C. engineers were able to convert a wine warehouse beside the Thames into one of the best orchestral studios in Europe, and I do not put it beyond their powers to adapt a London drawing-room for use as a television studio. The B.B.C. has the use of numbers 14 and 16, Portland Place, large Regency houses, two doors away from Broadcasting House. For some days workmen have been coming and going from number 16, where their activity seems to be concentrated on the first floor above the ground. It is here that houses of this type have their largest reception room, which usually extends from front to back, covering several rooms on ground level.

* * *

Tom Webster has promised Eustace Robb, the producer, that he will come along and talk and draw one evening soon. The producer is looking for a programme with a suitable sporting interest before finally fixing with the great little cartoonist. The producer also has in mind a novel "cycling" race, which he discovered at an exhibition at Olympia. In this competition, two riders take the saddle and pedal, but there are no road wheels and while the racers remain stationary, two dials driven from the pedals register their speed in miles per hour. This would make a tricky picture.

Miss Montu Ryan—You should be able to recognise this artist on your screen.

* * *

The Programmes in the North of England

FROM time to time, letters have appeared in the columns of this journal, giving information on the reception conditions in the remote parts of the North of England, and even Scotland. These efforts have always intrigued the writer. They have a touch of dogged determination about them.

The writer, being anxious personally to test what difficulties these deserving amateurs worked under, included a television equipment in the luggage on a trek north recently.

The equipment consisted of a television receiver together with a mirror drum Kerr cell optical system. The circuit of the receiver included two H.F. screen-grid pentode stages, a diode rectifier with A.V.C. Westector circuit. The L.F. amplifier and synchronising section was the one described in the December issue of this journal. The scanner consisted of a Mervyn mirror drum, Mervyn standard motor fitted with synchronising equipment. The light source was a 100 watt lamp, the screen size being approximately 10 in. by 4 in.

300 Miles Range

The gear was first set up at a place called Blackhill in north-west Durham on December 22nd, 1933. It was at first very difficult to find the National 261-metre station, which was surrounded by several stations of very much greater field strength in that locality. Heterodyne interference was very marked, and it was feared that results would be poor. The mains supply was 40 cycles and a stroboscope had to be made to suit this frequency.

The motor was warmed up and the speed of approximately 750 revs. per minute obtained. Shortly after 11 p.m., a distorted voice from a three valve receiver, announced that television broadcast was about to begin. The Midland Regional then completely faded out and the lamp was switched on in the television receiver. The usual curtain scene appeared with startling suddenness, the clearness of definition being totally unexpected. Apart from a little interference the result was as good for a short time as has been received in the London area on this apparatus.

When the first artist appeared, the picture was slightly distorted and faint, due to the fading of the National signal. After a minute or so the picture became clear and well defined, this lasted for three minutes, after which fading again became pronounced. The longest period during which the picture was of any value was 6½ minutes whilst the period of complete fade-out never exceeded 30 seconds. This occurred three times only. When the vision signal faded the sound signal came up strong and vice versa.

It was interesting to note that when the signal was of good strength, the definition and detail of the picture was every bit as good as the average reception in the London area. It was marred only by heterodyne interference. The floor in the long shot scenes was

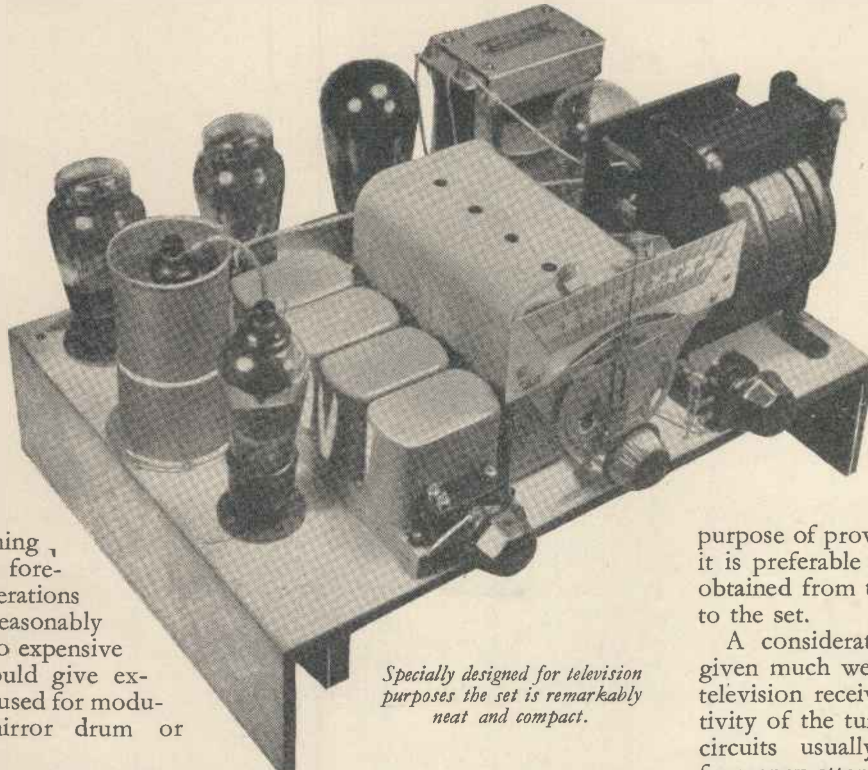
(*Continued on page* 84)

The Standard Television Receiver

Designed and described by S. Rutherford Wilkins

NEARLY FOUR WATTS OUTPUT

SPECIAL DOUBLE BAND-PASS TUNING



Specially designed for television purposes the set is remarkably neat and compact.

WHEN designing this set my foremost considerations were to provide a reasonably simple set, not too expensive to build, which would give excellent results when used for modulating either a mirror drum or other type of visor.

The " Standard " has been designed to provide a relatively low cost instrument that will give excellent results and a large power output, so that it is suitable for use in conjunction with a mirror drum visor.

The first requirement of such a receiver is that it should have a frequency range adequate to produce the maximum degree of definition possible within the limitation of the transmission. The maximum modulation frequency transmitted by the B.B.C. is in the neighbourhood of 10,000 cycles, and therefore, in order to obtain the required picture definition, there should not be appreciable attenuation in the receiver of frequencies below this figure.

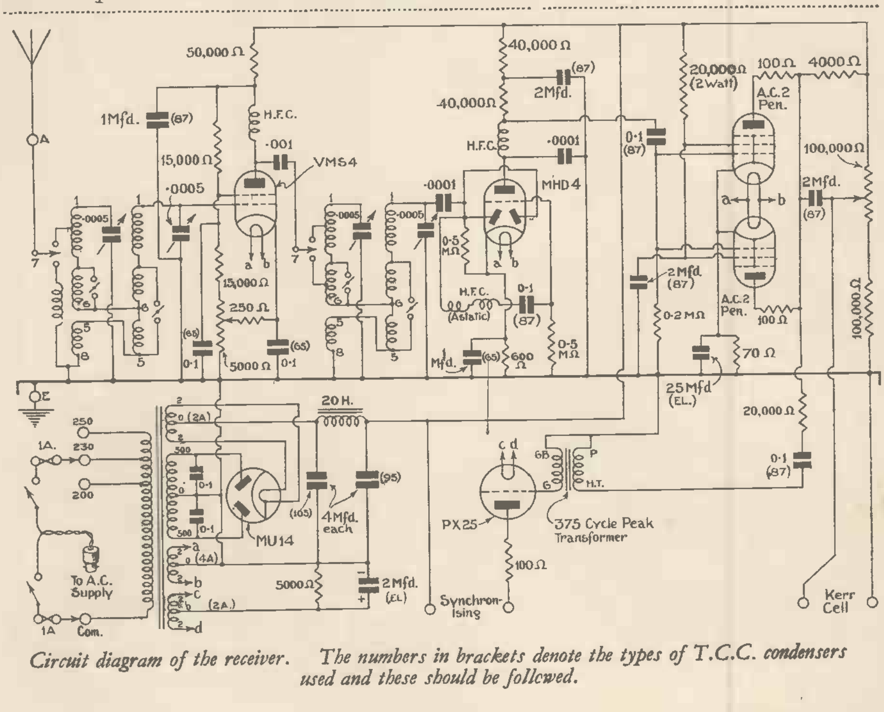
The Output

The maximum undistorted output will be sufficient to modulate the Kerr cell of a mirror-drum apparatus, which means that not less than three, and preferably four, watts are necessary.

Provision in the set is made for synchronisation, and the synchronising signal is obtained from the same input as the modulating signal.

In the case of mirror-drum receivers, the Kerr cell requires a biasing voltage of some 400 volts, and since it would be quite an expensive proposition to build a separate eliminator for the sole purpose of providing this bias voltage it is preferable that such a voltage be obtained from the high-tension supply to the set.

A consideration that is not often given much weight in the design of a television receiver is that of the selectivity of the tuning system. Selective circuits usually give rise to high-frequency attenuation, and in order to avoid this the tuning circuits of a television receiver are usually made fairly flat. It is also very important, however, to avoid interference from nearby transmitters, as such interference will



Circuit diagram of the receiver. The numbers in brackets denote the types of T.C.C. condensers used and these should be followed.

THE STANDARD TELEVISION RECEIVER *(Continued)*

give rise to various forms of picture distortion.

So much for the fundamental considerations of our receiver. It now remains to consider the best practical design that will conform to all the above requirements.

Selectivity Requirements

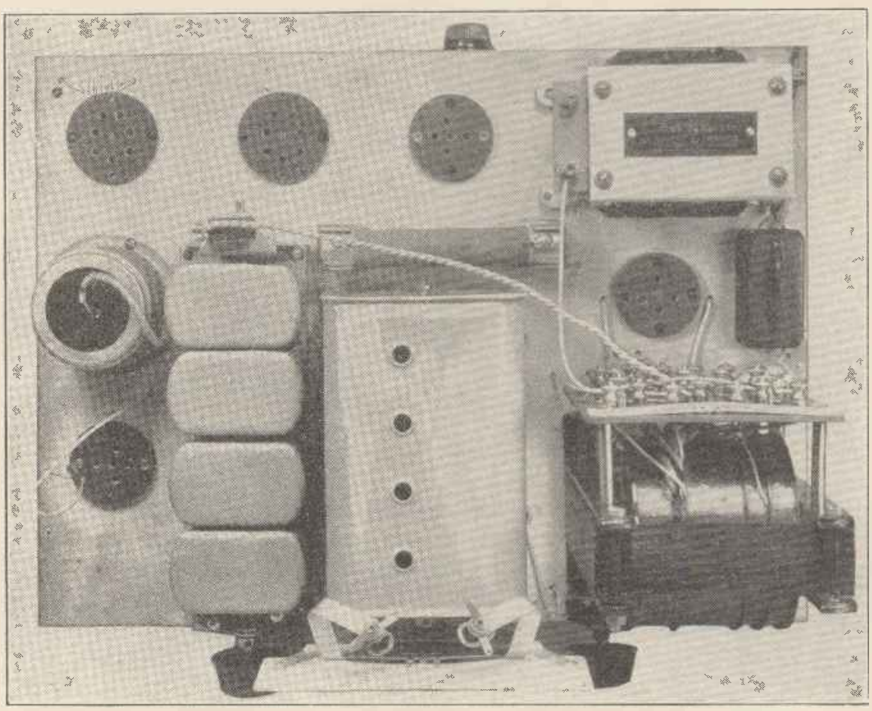
In order to satisfy the two rather opposing requirements of selectivity and ultra-high frequency response, I have adopted a bandpass system similar to that described in my article in the January issue of TELEVISION. To this end, Messrs. Colvern, Ltd., have provided me with a set of four coils arranged as an aerial and anode bandpass system, with a peak separation of roughly twelve kilocycles at 250 metres. This separation is wider than that usually provided on commercial bandpass filters, but it ensures a good response of the higher frequencies up to 12 kilocycles.

Good selectivity is assured by the use of two filters in cascade, and in order to approach the conditions of the ideal bandpass filter, and to steepen the sides of the overall tuning curve, the new iron-cored coils have been utilised.

This arrangement in practice gives a degree of selectivity better than that provided by the more usual arrangement of an 8 or 9-kilocycle aerial bandpass filter followed by a single tuned-grid coil. At the same time it ensures that there will be no appreciable attenuation of frequencies of the order of 10,000 cycles.

For the sake of simplicity one screen-grid stage only has been provided, but as the only station on which the set is likely to be used is the London National transmitter, a single stage should provide enough amplification to fill up the output stage.

For listeners who are situated at very great distances from the London National station I shall describe later a modified version of this set, making use of two screen-grid amplifying stages.



This plan view shows a l the necessary details of baseboard layout.

Minimum Distortion

In order to ensure the minimum of distortion, diode detection has been used, as this gives straight-line rectification, even with very high input voltages. In this connection use has been made of the double-diode-triode valve. This is, as its name suggests, a combination of a double-diode and a low-frequency triode in the same bulb and working from the same cathode. The diode portion of the valve is used for rectification and the triode is suitably biased to amplify the rectified signal. As will be seen from the circuit diagram, resistance coupling is used between the diode and triode circuits.

In order to preserve an adequate high-note response, it was found necessary to use resistance-capacity coupling between the double-diode-triode and the succeeding amplifying stage, which is in this case the output stage of the set. Transformer coupling was first tried in order to provide a greater low-frequency magnification. Even with one of the best low-frequency transformers on the market, however, considerable attenuation was observed of frequencies above 6,000 or 7,000 cycles. This was found to be due to the shunting effect of the comparatively large inter-electrode capacity of the output valve. Consequently resistance coupling was used with a low value of 200,000 ohms, for the grid leak preceding the output stage.

There are many commercial pentodes on the market working on 500-volts high-tension which will give an output of 4 watts, but these require an input of some 20 or 30 volts in order fully to load them. 20 or 30 volts, however, was rather too much output to expect from the double-diode-triode, and I therefore had to look round for an even more sensitive arrangement. The arrangement that was finally decided upon was the one shown in the circuit diagram. It consists of two extremely high efficiency pentodes in parallel. The pentodes used are the new Mazda A.C.2 Pens, and such valves are capable of supplying nearly 2-watts output with an input of less than 5 volts. Therefore two such valves in parallel will give an output of nearly 4 watts for a similar input. Moreover, as a maximum high-tension voltage of 250 volts is necessary, and the total consumption of the two valves in parallel is only about 60 milliamperes, it was found possible to use a resistance load in the anode circuit of the output stage. The optimum load for a single A.C.2 Pen is about 7,000 ohms. Therefore the optimum load for the combination of the two valves in parallel will be roughly half this figure.

In order to be on the safe side and to ensure that the maximum possible output was obtained, an anode resistance of 4,000 ohms was used. A simple calculation will show that with a 500-volt maximum high-tension

THE STANDARD TELEVISION RECEIVER *(Continued)*

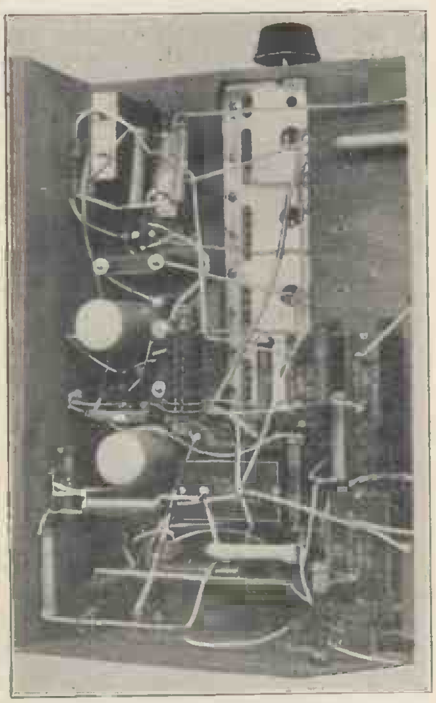
voltage and a total anode current of about 60 milliamperes, the drop in this anode resistance will be about 240 volts. With allowances made for a few volts drop in the smoothing choke, etc., this will assure an anode voltage of about 240 volts for the A.C.2 Pen, which is very near the maximum figure recommended by the makers.

The voltage to the screens of the two output pentodes is dropped through a 20,000-ohm 2-watts resistance, which is by-passed by 2-microfarad condenser to earth.

As the other valves, with the exception of the synchronising valve, require a maximum anode potential of 250 volts, it is possible to make use of decoupling resistances of quite a high value. This is all to the good, as it ensures stability.

The use of a resistance as an output load makes it unnecessary to include a pentode high-frequency filter. This is because the impedance of the resistance is constant at all frequencies, and therefore the magnification of the pentode does not rise steeply at the higher frequencies, as it would when an iron-cored inductance was used. To prevent self-oscillation two small 100-ohm resistances are included directly in the anode circuit of the pentode output valve.

Another way of overcoming this difficulty would have been to insert fairly high resistances of a value of, say, 100,000 ohms in the grids of the pentode valve. Unfortunately, however, this precaution would result in the loss of some of the higher frequencies, which must be avoided at all costs.



A view under the baseboard of the H.F. end of the set.

Synchronising

The valve used for synchronisation purposes is a Marconi PX25. The input to this valve is obtained from the anode circuit of the two modulator valves, via a limiting resistance and a 375-cycle peaked transformer. In order to limit the anode current of the synchronising valve to less than 30 milliamperes (the maximum value required by the synchronising coils on the visor) the valve is over-biased by means of a 5,000 ohm resistance, which is decoupled by means of a 2-microfarad electrolytic condenser.

It is essential that the high-frequency choke in the grid circuit of the double-diode-triode is of the astatic type, as otherwise a bad hum will be developed. The by-pass system in the anode of this valve is equally necessary, to remove the last traces of high-frequency from the low-frequency amplifier. If this precaution were not observed and a small amount of high frequency was allowed to stray into the high-efficiency pentode circuit, low-frequency oscillation would, in all probability, result.

It will be noticed that the double-diode-triode is enclosed in an aluminium screening box. This precaution is rather unusual nowadays, but was found to be necessary in order to prevent interaction between the double-diode-triode and the output stage.

The Kerr cell is modulated from the anode circuit of the A.C.2 Pens via a 2-microfarad condenser, and the biasing potential for the cell is provided by means of a resistance network across the full high-tension supply. This potential can be varied by means of a potentiometer knob which protrudes from the back of the set. This should be set to roughly 400 volts and then varied slightly until the best picture is obtained.

Construction

In order to simplify construction and to get a scientific layout of components a chassis type of baseboard has been employed. The chassis is not of aluminium, as this would present a great deal of trouble to the amateur when he

(*Continued on page* 86)

COMPONENTS FOR THE STANDARD VISION RECEIVER.

CHASSIS.
1—Peto-Scott Metaplex 16 in. by 12 in. by 3¼ in.

CHOKES, HIGH-FREQUENCY.
2—Wearite screened, type HFP.
1—Lissen astatic, type LN 987

CHOKES, LOW-FREQUENCY
1—Sound Sales, type 1250 SRC

COILS
1—Set Colvern types G1S, G2, G11S, G12 with on-off and pick-up switches, mounted on one base

CONDENSERS, FIXED
2—T.C.C. .0001-microfarad, type 34
1—T.C.C. .001-microfarad, type 34
3—T.C.C. .1-microfarad, type 65
2—T.C.C. .1-microfarad, type 87
1—T.C.C. 1-microfarad, type 65
1—T.C.C. 1-microfarad, type 87
3—T.C.C. 2-microfarad, type 87
1—T.C.C. 2-microfarad electrolytic, type 561
1—T.C.C. 4-microfarad, type 95
1—T.C.C. 4-microfarad, type 105
1—T.C.C. 25-microfarad electrolytic, type 511
1—T.C.C. .2-microfarad centre tapped type 125A

CONDENSERS, VARIABLE
1—Polar four-gang .0005-microfarad, type Star Minor, with slow motion drive, type horizontal

HOLDERS, FUSE
1—Belling Lee, twin complete with 1-ampere fuses

HOLDERS, VALVE
1—Clix four-pin, type chassis mounting
2—Clix five-pin, type chassis mounting
3—Clix seven-pin, type chassis mounting

RESISTANCES, FIXED
1—BAT 70-ohm
3—BAT 100-ohm
1—BAT 250-ohm
1—BAT 600-ohm
1—BAT 5,000-ohm
2—BAT 15,000-ohm
1—BAT 20,000-ohm
1—BAT 40,000-ohm (2 watt)
2—BAT 40,000-ohm
1—BAT 50,000-ohm
1—BAT 100,000-ohm
1—BAT 200,000-ohm
2—BAT ½-megohm
1—Zenith 4,000-ohm

RESISTANCES, VARIABLE
1—Claude Lyons 5,000-ohm type M5
1—Claude Lyons 100,000-ohm type ST 100

SUNDRIES
1—British Radiogram 2 in. metal mounting bracket
Connecting wire and sleeving (British Radiogram)
2 ft. screened sleeving (British Radiogram)
1—British Radiogram valve screen
4 yd. thin flex (British Radiogram)

TERMINALS
1—Clix chassis mounting strip, marked: A1, A2, E
1—Clix chassis mounting strip, marked: L.S.+, L.S.—, Pick-up

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

TRANSFORMER, MAINS
1—Varley type EP 24

VALVES
1—Marconi VMS4
1—Marconi MH4D
2—Mazda AC2/Pen
1—Marconi PX25
1—Marconi MU.14

News *from* Abroad

By OUR SPECIAL CORRESPONDENTS

France

Experimental Work to be Inaugurated

The Service de la Radiodiffusion, of the Ministere des Postes, Telegraphes et Telephones, states that the French administration is actively interested in the subject of television and wishes to establish a permanent television service as soon as possible. Facilities are to be given for experimental work. The systems to be used have been tested by the French Radio Industry, the Administration, and the l'Ecole Superieure des P.T.T., and the following systems have been investigated, and are available for experimenters: Barthelemy system, systeme de France, Baird system.

The possibilities of transmitting television programmes on ultra-short wavelengths are also the subject of intensive investigation, as this will be the ultimate wavelength for television service.

America

The Balance Sheet of Television

Included in the December number of *Electronics* is "The Balance Sheet of Television," which is interesting, as it gives some idea as to the conditions of television in the United States of America. Under the heading "Discouraging," the following points are given.

1. Lack of detail in pictures.
2. High cost of television sets.
3. Expense of tube replacements.
4. Small range of single transmissions.
5. Difficulty in "chaining" stations.
6. Tremendous studio expenses.
7. Problem as to who will pay for transmissions.

Under the heading "Encouraging," are given:

1. New cathode-ray pick-up devices.
2. Improved cathode-ray television tubes.
3. Increased intensity of illumination.
4. Large projected pictures.
5. Wide band transmitting by new conductors (2,000,000 cycles).
6. Possibility of outdoor news scenes
7. Development in ultra-short wave apparatus.

Although the points are, no doubt, characteristic of the state of television development in the United States of America, it is interesting to note that nearly all the points are equally applicable in Europe.

The comments continue: "Here is much evidence of progress, yet also this testimony falls short of proving that commercial television may be expected in 1934 or 1935, but the men who know are talking more optimistically than ever before. Where there is such an increasing volume of smoke, there must be fire. Television may have a surprise for the conservatives before another twelve months roll around."

A special committee in the United States of America has been organised to confer with the Federal Radio Commission. The special objective will be to obtain increased facilities for future broadcasts of television, etc.

Germany

Cathode-ray Developments

Manfred von Ardenne made some investigations into the possibilities of heating cathode-ray tubes by means of alternating current. He suggests that, similarly to radio valves, cathode-ray tubes will be heated by means of alternating current in the near future.

The importance of this is thought to be considerable, and with gas-filled cathode-ray tubes, more than 1,000 hours of useful life at a tension of 1,000 volts have been obtained.

F. von Okolicsanyi reports a new system of transmission of television. Although in the usual cathode-ray receiver the circuit must incorporate two Kipp oscillator stages, in this system the electrodes of the cathode-ray tubes are connected to two ultra-short wave receivers. This is said to automatically give a synchronized framed image.

Television Programmes

By making a comparison with talking films, Herr R. Thun discusses some suggestions for television programmes. Comparing television sound pictures he comes to the conclusion that whereas in the latter the spoken word is supplementary to a picture which can be said to be perfect, in broadcasting, television will be supplementary to the spoken word, assuming, of course, that the present condition of sound broadcasting can be said to be perfect.

Herr R. Thun suggests that talks, news, etc., should be illustrated by means of a television image. He continues with the announcement that such illustrated programmes will assist the development of television tremendously, much more, in fact, than any other methods.

Russia

Transmission Times

The Leningrad transmitter is reported to transmit on the 5th, 11th, 17th, 23rd, and 29th of every month. The Moscow transmitter broadcasts every other night. Times are not definitely stated, but generally transmitters are on the air transmitting television programmes in the evening.

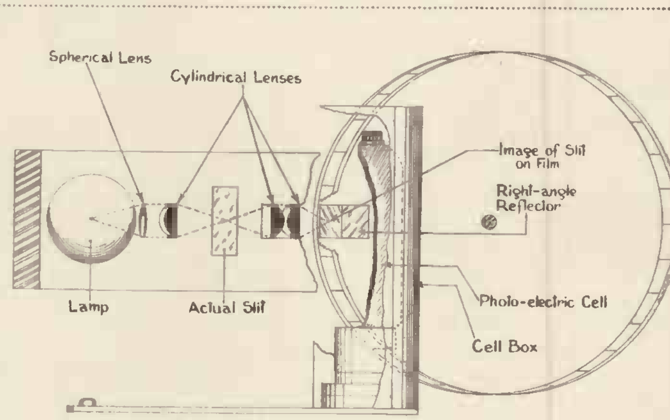
In their programme for 1934, the largest Leningrad radio works scheduled the production of television receivers. Apparently the Russian Government attaches considerable importance to supplementing the spoken word by television.

Television *at the* Physical Society Exhibition

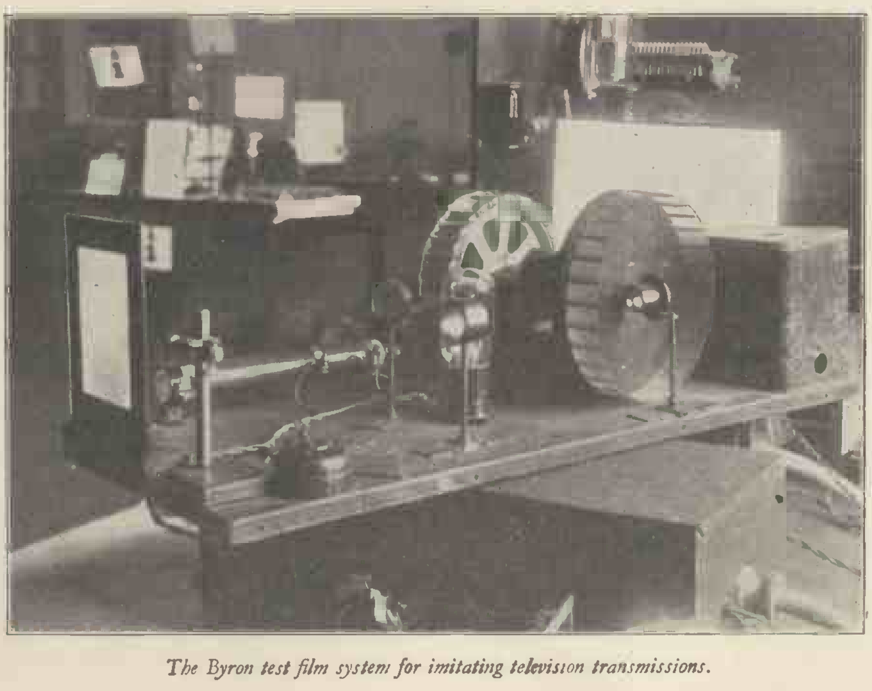
THOUGH there was only one complete television receiver at the Exhibition of the Physical Society, there was a considerable amount of associated apparatus which proved of great interest to television enthusiasts.

A test film system was shown, designed by D. H. Byron, at the stand of the Wilson Laboratories, who co-operated in producing the demonstration apparatus. The purpose of this is to imitate a television transmission, or, at any rate, to modulate a light in a way corresponding to perfect transmission. A very strong "signal" is produced from a quite modest source of light, so its use may well include the testing of various scanning devices, the testing of amplifying gear and modulated lights, photocells, etc., by using such links in the connecting chain from the test-film to the receiver.

Another use is as a convenient cheap-running generator of constant "television" signals for any test purpose—even for actuating a cathode-ray equipment. A diagram is given of the signal generator.



Schematic arrangement of the Byron test film apparatus.



The Byron test film system for imitating television transmissions.

The films used are closed loops, rotating at scanning speed, having across, say, their whole width a "ladder" of variable density (similar to a "variable density" sound-track on a talking film) in a number of sections corresponding to the number of scanning lines used.

For 30-line films, the "lines" are made in lengths equal to the height of a normal cinematograph picture on the film; thus films to simulate the B.B.C. television transmissions, having a length of 30 ordinary cine pictures, fit round a drum of approximately $7\frac{1}{8}$ in. in diameter. The same diameter of drum may conveniently be used for 45-60- and 120-line pictures (made on ordinary 35 mm. cine film).

A Novel Receiver

The complete receiver shown was that described by E. L. Gardiner in the January issue of this journal. The receiver has been remounted on a steel stand similar to that used for cinema projectors. A suitable projecting lens is now incorporated, fitted in a focusing mount which is carried on a bracket of the main framework (this lens did not originally form an integral part of the assembly).

The field coil is supported from a base, which contains a stepdown coupling transformer to increase the circuit in the coil. The glow discharge tubes used contain a helium-neon mixture, which, while not very sensitive to high-frequency excitation, possesses a good colour. They are "diaphragmed" with dead black paint.

About 12 watts of high-frequency energy is required in the field coil to excite the tubes; and about 100 watts modulated 80 per cent. will give a projected image of about 7 in. by 3 in.

The Kymograph

A photographic type of cathode-ray oscillograph was on view which is being used by Mr. R. O. L. Curry, M.A. and Dr. E. G. Richardson, of Armstrong College, Newcastle-on-Tyne, to observe and record speech-sounds as a basis for the study of modern northern English dialects.

The potential from a calibrated moving-coil microphone recording the speech-sounds is passed through an R.C.C. amplifier to one pair of deflection plates of the C.R.O. The resultant line on the blue fluorescent screen can be photographed directly in a split-aperture moving-film camera with a lens of large aperture and short focal length at a normal film-speed of 6 ft. per second. The waveform of the speech-sounds can also be made visible by applying an alternating potential derived from a linear time-base sweep

TELEVISION AT THE PHYSICAL SOCIETY EXHIBITION

circuit across the other pair of deflection plates so that the speech waveform is spread out across the screen. If the frequency of the two displacements mutually at right angles is synchronised, the result is a stationary waveform on the screen. So it is easy to observe the waveform of the speech-sounds before they are recorded permanently.

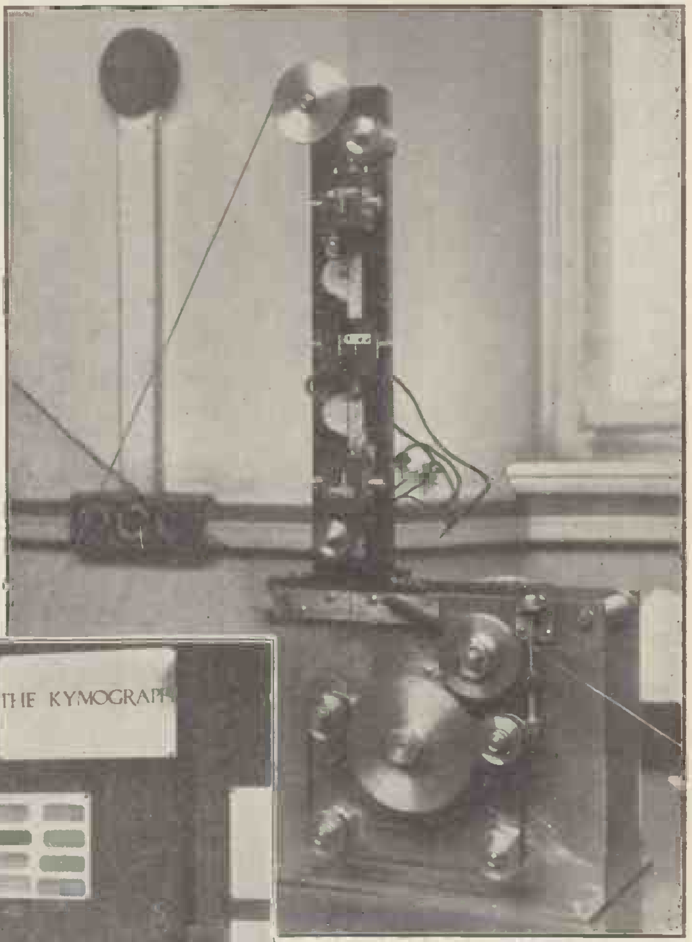
Delayed Speech

Marconi's Wireless Telegraph Co. Ltd., showed an adaptation of the Marconi-Stille recording apparatus; this was used for the production of delayed speech. Magnetic recording is applied to a thin flexible steel tape which has been made into a continuous band. This tape is driven at a constant speed by a special driving mechanism.

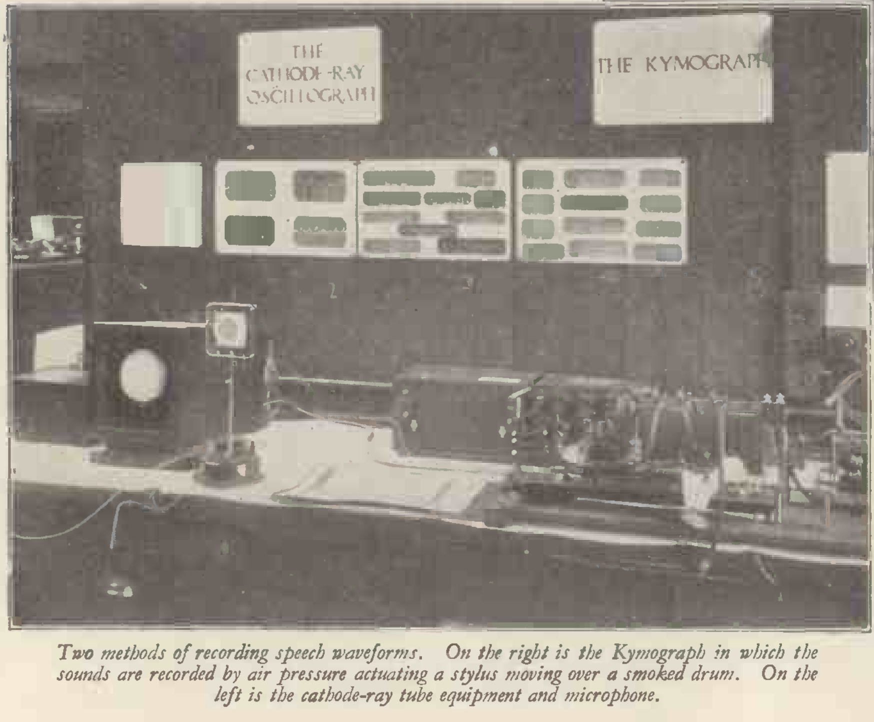
In the normal equipment the three electro-magnetic systems which perform the functions (1) of obliterating any previous magnetic record on the tape; (2) of recording the speech on the tape; and (3) of reproducing the speech from the tape, are so close to each other that there is a time interval of only one-tenth of a second between the recording and reproduction process (thus allowing a very effective comparison to be made between the quality of the recorded speech and that of the original).

In the experimental apparatus exhibited, however, by means of reproducing systems placed at various distances along the tape, speech can be reproduced at time intervals of up to several seconds after the original speech, thus producing delayed speech, or a type of artificial echo. It will thus be possible for a person to speak a short sentence into the microphone, which will be repeated back almost immediately from a loudspeaker to which the apparatus is connected.

Demonstrations of various interesting effects obtainable with the apparatus were given.



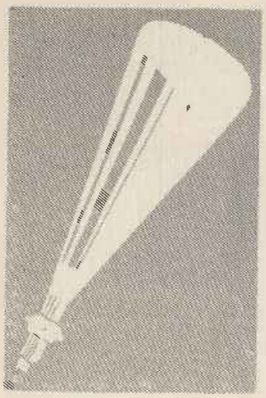
The recording apparatus used by The Marconi Co. for reproducing speech from steel tape. On the vertical panel are mounted the recording mechanism, the reproducing mechanism and the 'wipe-out' for demagnetising the tape. The tape itself can be seen passing over the top pulley on its way through the recorder.



Two methods of recording speech waveforms. On the right is the Kymograph in which the sounds are recorded by air pressure actuating a stylus moving over a smoked drum. On the left is the cathode-ray tube equipment and microphone.

Another Light Crystal

It is reported that Franz von Okolicsany, the discoverer of the light modulating properties of the zinc sulphide crystal and the inventor of the mirror screw, has found yet another crystal which is more efficient than zinc sulphide and more easily obtainable in a condition suitable for television purposes. We hope to give further details in our next issue.



Problems in Cathode-ray Television

By G. Parr

II—SCANNING CIRCUITS FOR CATHODE-RAY TUBES

THE production of the multi-line screen at the end of the cathode-ray tube is accomplished by means of a pair of electrical circuits which cause the beam to move in a vertical and horizontal plane respectively. The essential requirement of the circuit is that the beam shall cover equal distances on the screen in equal intervals of time, returning rapidly to its initial position at the end of the travel. The potential applied to the deflector plates to produce this movement must therefore increase uniformly with time, and fall rapidly to zero after a definite value has been reached.

Most circuits for the production of linear voltage variation depend fundamentally on the charge and discharge of a condenser which may be used in an oscillatory valve circuit or associated with a discharge tube device.

Discharge Tube Circuits

Taking discharge tube circuits first as being simpler, the basic circuit is that shown in Fig. 1, which will be familiar to radio experimenters. The condenser is charged from the h.t. supply through a variable resistance, the rate of charge depending both on the resistance and on the capacity, according to the formula :

$$\text{Time constant (secs.)} = C \times R \times \frac{Vs - Ve}{E - \frac{Vs \times Ve}{2}}$$

C=Capacity in mfds.
R=Resistance in megohms.
Vs and Ve=Striking and extinguishing voltages of the lamp.
E=h.t. voltage.

Across the condenser is a neon glow lamp, the ionising voltage of which is about 150. One pair of deflector plates of the tube is connected across the lamp. When the condenser is charged to the ionising potential of the lamp, it lights and the condenser discharges through the shunt path formed. When the condenser potential falls below the ionising value the lamp goes out and the condenser recharges to repeat the cycle. The difference between the "striking" and "extinguishing" potentials of the lamp is some 30 volts and this will be applied as a deflecting potential to the beam (Fig. 2), causing it to move at a proportional rate to the charge of the condenser and to flick back rapidly as the lamp lights. The ratio of charging time to discharging time being several hundreds to one, the return path of the beam is so rapid as to be barely visible to the eye—an important point in the production of the line screen.

The drawbacks of the simple arrangement of Fig. 1 are :—

(a) non-linearity of charging voltage,
(b) limited travel of the beam.

With ordinary values of resistance and capacity the charging potential follows an expotential curve (Fig. 2) and only a limited portion in the saturation region can be taken as approximately linear. Secondly, the difference between the striking and extinguishing voltages of the neon lamp is so small that the travel of the beam will only amount to a few centimetres.

The sensitivity of an ordinary small cathode-ray tube is of the order of .5 m/m. per volt with high anode voltages, and the production of a line screen 12 cms. by 5 cms. will accordingly require 240 volts and 100 volts on the vertical and horizontal deflectors respectively.

The voltage range of the neon lamp could be increased by a suitable valve amplifier—in fact, this has been done successfully by Messrs. Appleton and Builder (Physical Society Proceedings, 1932. 44, 85.), but the majority of experimenters will not consider this worth the trouble while simpler and more direct means are available.

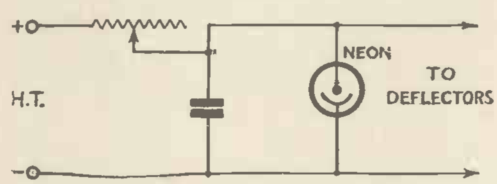


Fig. 1. Simple form of time base using neon lamp.

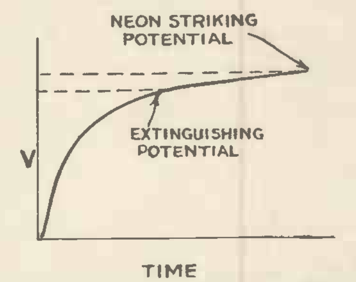


Fig. 2. Curve showing the striking and extinguishing potentials of the neon.

If the neon tube is replaced by a thyratron the difference between the striking and extinguishing potentials is controllable by the grid bias adjustment and the range of travel of the beam can be extended at will. The action of the thyratron is seen on reference to Fig. 3 which gives the characteristic of the Ediswan MR/AC.1 tube. The relation of grid bias to striking potential has been plotted and it will be seen that with a bias of 9 volts no discharge takes place until the anode potential exceeds 180 volts. Once the discharge has started it will persist until the potential has fallen below the ionising potential of mercury vapour (about 20 volts, from the curve). The range of voltage is therefore (180—20) =160, compared with 30-50 for the plain neon lamp.

The improved circuit is therefore as Fig. 4, the deflector plates being connected across the thyratron anode and cathode.

It is essential to avoid excessive current flow in both the anode and grid circuits of the thyratron, since on discharge the tube has negligible internal impedance, and the current in some cases may reach the emission current of the cathode. For this reason safety resistances are usually desirable in both anode and grid leads to limit the current, 500 ohms in the anode and 5,000 ohms in the grid being typical values. In the particular circuit in question a high anode resistance would make the discharge time of the condenser appreciable, and provided the value of capacity is small it is preferable to omit it altogether.

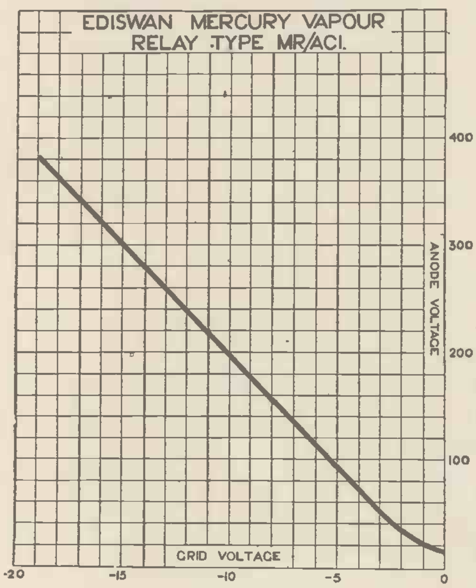


Fig. 3. The characteristic curve of the M.R./A.C.1. thyratron.

Improving Linearity

In order to improve the linearity of the time base produced by this circuit, the Edison Swan Co. have been experimenting with higher values of resistance and charging potential, in order to make use of the initial portion of the expotential charging curve. By applying a voltage of about 1,000 to a condenser in series with a resistance of 2-3 megohms the curve of Fig. 2 is extended as regards the linear portion at the commencement and a good working range can be obtained.

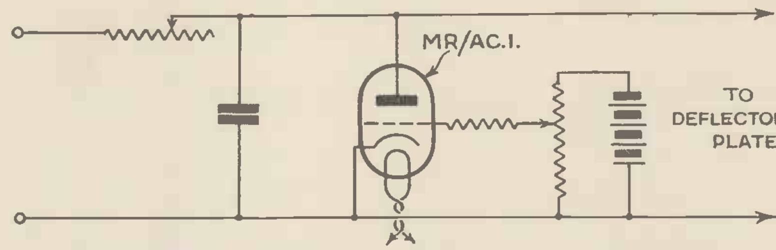


Fig. 4. An improved circuit: note that the deflector plates are connected across the thyratron anode and cathode.

The advantage of this method is its simplicity, although the use of a high charging voltage necessitates components of the best quality. The difficulty of obtaining a steady high voltage supply, however, makes the consideration of alternative methods worth while, and in a succeeding article the use of constant-current charging devices will be considered.

An order placed with your Newsagent will ensure regular delivery of "Television."

The principal factor which affects the satisfactory performance of thyratron circuits is that of temperature of the discharge tube, and for this reason circuits have been developed with a view to their elimination.

During operation the rise in temperature of the discharge tube causes an increase in mercury vapour pressure in the bulb with a consequent gradual alteration of striking potential. This has the effect of causing the scanning lines to " drift " slowly until the stable operating temperature has been reached. The effect can be minimised by careful arrangement of the tube and its circuits, and also by a preliminary warming up, but with 120-line screens, where the least variation will make an unsteady picture, it is probable that the thyratron will have to give way to a more stable thermionic device.

For introductory experimental work in television the simplicity and flexibility of the thyratron make it a very satisfactory component on which to base the scanning circuit.

Preventing Motor Interference

Interference in radio reception due to the motor in the case of mechanically operated television receivers is not usually serious but when it occurs a 0.1 mfd. centre-tapped condenser, or better, a good motor interference filter, should be obtained. The earth terminal of this is then connected to the main earth line of the circuits, and it is best to connect flexible leads to the two live terminals of the filter, so that these can be tried in various places, as the best connection depends on circumstances such as the motor used, the circuit wiring, and the earthing of the local mains.

The standard method is to join them to the two motor brushes; but better results are sometimes obtained by connection to other points in the motor circuit, such as across the motor itself, or one to the junction between the motor and the control resistance and the other to either one brush or one side of the mains which is not earthed. Trial is much the best method, and a satisfactory arrangement is usually easily found.

A Simple Lens for the Mirror Screw

Amateurs who have made the mirror-screw receiver which was described in the January issue of TELEVISION may care to experiment with the following simple expedient for providing a lens of the cylindrical type. The lens consists merely of a glass test tube filled with water, care, of course, being taken that the tube is absolutely full before being sealed up. Tests with tubes of different sizes can be made as they are available in different diameters and it will be found that when the correct focus has been obtained a sharpening of the image results.—B.R.

A report from U.S.A. says that it has been discovered that by applying constant potentials at the light entrance and exit to zinc sulphide crystal, in addition to the modulating potential the necessity for employing nicol prisms is obviated.

Adjusting Mechanical Scanning Devices

This article, by C. P. Hall, explains a common fault associated with scanners of the mirror-drum type and shows how almost perfect adjustment of the mirrors can be obtained.

MANY amateurs, after either purchasing or making a mirror drum receiver, have adjusted the light spots reflected from the mirrors, to give a good scan on the screen with no black lines, only to find that the pictures they receive are distorted beyond recognition. This is due to two reasons. Sufficient care has not been taken in the adjustment of the mirrors so that the light spots divide the circumference of a circle into 30 equal portions or triangles with angles at the centre of the circle of 12 degrees. Secondly, the width of the scan has not been taken into account with reference to the height to give a picture of the proportions of 7 by 3.

The following method, consisting of two operations, enables anyone with a little patience to obtain a high degree of accuracy quite easily, if sufficient care is taken.

The first procedure is a very accurate way of getting the drum mirrors set in the 12 degree angular separation. The eye does not tolerate too much distortion of this adjustment, whereas a fair amount of latitude is possible on the side-to-side scan without being objectionable.

Angular Adjustment

In order to make the angular adjustment satisfactorily a very good divided head is desirable, but as these are expensive and beyond the reach of the average experimenter a cheap but highly successful substitute is described.

Now before we proceed with the actual system let us appreciate that we shall use our phonic wheel or a 30-tooth gear wheel (or a multiple of 30) to hold the drum, but as this will not be sufficiently accurate we must have a means of correcting it. And we correct by correcting our screen chart to a large divided disc.

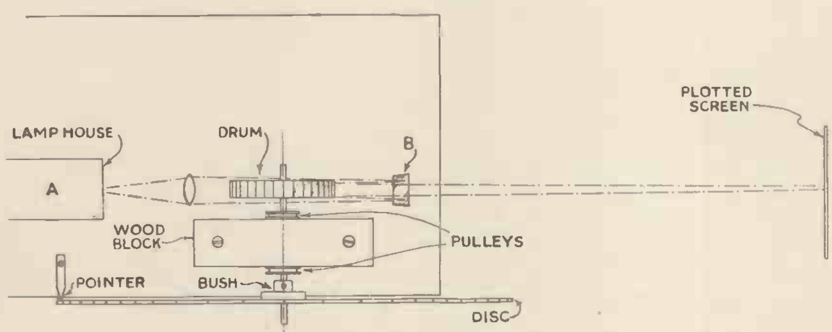


Fig. 1. This diagram shows how the correct angular setting of the mirrors may be secured by the use of a large wooden disc and pointer.

Now read just how the work is performed.

It is first necessary to obtain a piece of plywood which is flat and rigid, or very stiff cardboard will do. The material chosen should be as large as possible. The suggested size is 3 ft. square.

The centre of this piece of material should be found and a circle cut out as large as possible. This may be done by driving a nail through a piece of flat wood about 2 in. by $\frac{3}{8}$ in. and of a length equal to the radius plus 3 in. of the required circle. The nail is then driven through the centre of the disc into a board underneath. A sharp pointed scriber is then pushed through the other end of the strip of wood 1 in. from the end.

Using the scriber as a scorer and the wood as a trammel the circle can be scribed; each time the circle is completed the scorer will cut deeper, until finally the circle will be completely cut out. The edge should now be sand-papered until smooth.

A brass bush of the type used with mirror drums should be screwed to the side of the disc, taking care that it is in the centre.

A block of wood 3 in. thick by 4 in. by 10 in. is now drilled with a $\frac{1}{4}$ in. drill or bit about the middle of the length and $\frac{1}{2}$ in. to 1 in. from the edge of the 4 in. wide face. A piece of mild steel rod $\frac{1}{4}$ in. diameter is obtained, say 10 in. to 12 in. in length. and is pushed through the hole in the block of wood so that equal lengths of rod protrude at either side. Two 1 in. pulleys are pushed on to the rod, one on either side, and the grub screws are tightened when the pulleys rest against the wood block.

The wood block should now be fitted to the bench, or on some support which is rigid, in such a position that one end of the spindle projects over the edge. The drum to be adjusted is fitted to the other projecting portion of the spindle.

The only difficult part of the work is now to be faced and the results obtained depend on the care taken in carrying this out. The disc should be laid flat on the bench and the periphery divided into thirty equal parts by first stepping off the radius, which will divide the disc into six parts and then dividing each of these into five. The dividers or compass can be set for these five divisions by the use of the following formula:

Multiply the diameter of the circle by 0.10453.

When satisfied that the disc is divided into 30 equal parts, it may be fitted to the projecting shaft, nearly half of the disc will be below the level of the table or bench top. A pointer is fixed to the support so that it rests against the edge of the disc where it is marked off into 30 sections.

Making the Screen

Next a piece of white cardboard is obtained and a line is drawn horizontally fifteen inches in length. Other lines are drawn horizontally and vertically so that thirty squares with $\frac{1}{2}$ in.

sides are produced. These squares should be marked plainly with large numbers from one to thirty. The card is now set up about 6 ft. 6 in. from the drum as shown by Fig. 1.

A lamp is set up in a metal box with a small aperture of about $\frac{1}{16}$ in. square in the position marked *A*. A lens is placed between the lamp and the mirror *B*. The lens and mirror are adjusted for position until a square spot of light the size of one of the squares, i.e., $\frac{1}{2}$ in. square, falls on the card after being reflected from one of the mirrors on the drum.

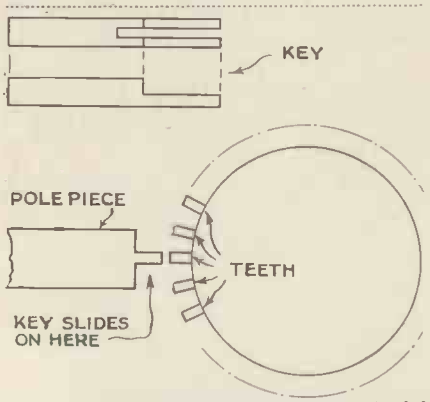


Fig. 2. The drum during adjustment is held stationary by means of a key which fits the teeth of the synchronising wheel.

The drum is now turned until the sixteenth mirror is reflecting the light beam on to the card and the disc is rotated so that the pointer rests against a division mark. Holding the disc in this position the drum is readjusted until No. 16 spot is on the line of squares.

The mirrors are all adjusted so that they throw a square of light on the same number square as the number of the mirror, moving the disc for each mirror through a marked division and securing it. When this operation is completed the 12 degrees adjustment will be correct.

The drum should now be fitted to the motor shaft which is eventually going to drive it. A key is now cut out of metal of such a size and shape that it will hold one of the teeth of the synchronising wheel to the pole piece. A suggested shape for the key is shown by Fig. 2. The motor drum and synchronising gear are now fitted up in place of the wood or card disc.

The drum is revolved so that one tooth at a time is locked in position by means of the key placed between the synchronising gear teeth and the pole piece. Each time this operation is performed the place where the light spot falls is recorded by drawing a square. Care should be taken to mark the position of the toothed wheel when starting by a spot of paint on the first tooth of the wheel corresponding to mirror number 15 or 16. This gives a chart of the 12 degree adjustment correcting the errors in the gear wheel. (See Fig. 3.) Using this chart the motor may be started up and the resultant scan observed on the white card. Where black lines appear the mirrors are brought together and where white lines appear they are separated; each time a mirror is moved the light spot must fall on the same horizontal plane as the corresponding numbered square which has been plotted. Be sure to do this final adjusting commencing from 15 or 16 and working to 1 and then from 15 or 16 to 30.

To obtain the correct distance of the card from the drum it is only necessary to take the distance between two spots in a vertical plane, in inches and multiply by three, then divide by seven. This will give the width of the scan.

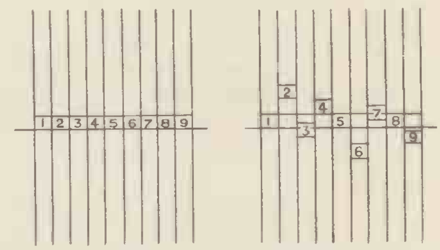


Fig. 3. (Left) Chart for correction of phonic wheel. (Right) Appearance of chart after correction and to which the drum is set.

As we have fixed this at 15 in. the distance bweteen two of the vertical spots should be 15 in. multiplied by $\frac{7}{3}$, $=35$ in. When the card is at the correct distance from the drum, the distance between two vertical spots, after the 12 degree operation has been carried out, will be 35 in.

When this adjusted drum is fitted to the television equipment, any small errors will be too small to be detected with the reduced picture.

Remember that although you adjust on a chart that looks incorrect, the resulting pictures received will have a high degree of accuracy.

NEW GERMAM TELEVISION TRANSMISSIONS

By Dr. Alfred Gradenwitz.

PLANS for the future development of television in Germany have now been made known by the authorities concerned, viz., the Post Office, and the Department in charge of Broadcasting.

Methodical tests will, first of all, be conducted by these departments in conjunction with the leading industrial firms, with a view to ascertaining transmitting and receiving conditions in connection with ultra-short wave television. These are expected to afford a reliable basis on which to found the organisation of a television service and the provision of suitable receiving sets.

The starting point of the new tests will be a new ultra short-wave transmitter constructed by Telefunken, which is being installed side by side with the one erected in Witzleben two years ago. The new transmitter will be able to work on waves intermediate between 7 and 8 metres and is primarily intended for tele-talkie transmissions. Pictures will be transmitted on the same wavelength as heretofore, and sound transmission will be on the old ultra short-wave transmitter in the 7-metre range. Synchronism between the picture and sound transmitters will be secured by having picture and sound on the same film, just as in the case of the cinema.

The new ultra short-wave transmitter will have an output of about 15 kW., and it is designed to enable a frequency range of as much as 500,000 cycles to be transmitted without distortion. This is suitable for 180 lines and 25 pictures per second.

The new transmitter works with step-up modulation the carrier wave reaching its lowest value when no current impulses are being supplied from the television scanning device.

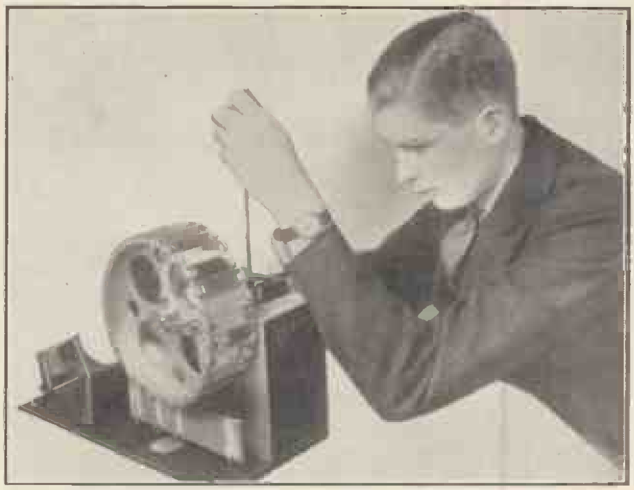
The method of modulation used is new and has been developed at the Telefunken works, picture frequencies and the synchronising impulses being sent over the same carrier wave. This scheme secures a perfect absence of pendulation, the pictures on the screen of the cathode-ray tube being perfectly steady.

The old ultra short-wave transmitter installed in the Witzleben Radio Hall, and so far used in connection with regular picture transmissions and television tests, has now definitely been taken over the by Postal Department. The new transmitter is expected to be ready for its appointed task in the coming spring.

The Baird Mirror-drum Kit

For the Home Constructor

Here is a description of the assembly of the Baird Mirror-drum Kit together with some notes on the adjustment of the optical system and the receiver and amplifier



The assembly of the Baird kit is quite simple and requires very few tools.

THE Baird mirror-drum Televisor is now available as a kit of parts which can be assembled with the simplest of tools. This at once brings a high-grade receiver of the mechanical type within the ability of any amateur to build.

The kit of parts includes the following :—

One universal mains motor complete with support and lamp housing.

One grid cell unit.

One 30-mirrored drum complete with flexible coupling.

One aluminium baseplate ready drilled, complete with swivelling mirror and lens mount.

One bi-convex lens.

One aluminium back plate.

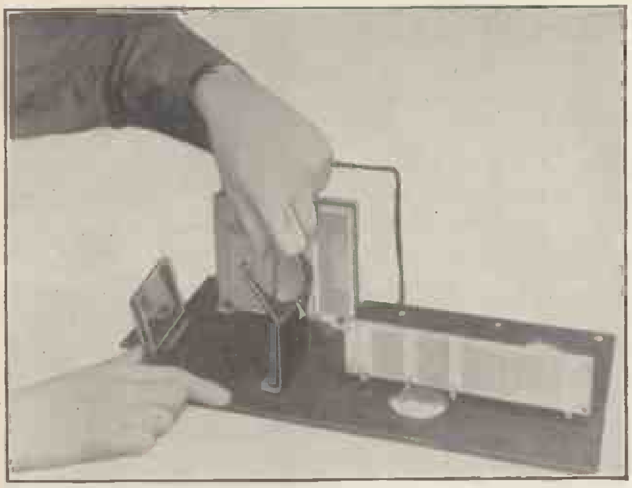
One mains transformer for feeding the projection lamp.

One fixed resistance, with brackets.

One variable resistance.

First let us say that the Baird kit is a very fine mechanical production and that the design shows an amazing amount of thought ; it is difficult, in fact, to see that the efficiency optically, electrically and mechanically could be improved upon. The mirror-drum, for instance, is an aluminium casting with the mirror beds machined to the correct angles ; no adjustment is therefore provided and none is required, for short of real abuse the drum and mirrors cannot alter. The lamp housing also is a casting, and additionally it serves the purpose of a mount for the motor which rests in a bed at the top and is rotable as a whole for framing purposes.

The bed-plate is a stout aluminium casting with all the necessary holes drilled and tapped. In the layout of the base a particular feature is the clever arrangement of the optical system which permits of the entire assembly being kept within fairly small dimensions. Slight adjustment of the reflecting mirror and lens is allowed for, so that the greatest efficiency can be obtained from the optical system. The grid cell is attached by screws to the front of the lamp housing, and this and the lamp holder form a complete unit with the correct positioning already determined. It will be clear, then, that in the assembly nothing is left to chance.



This picture shows the baseboard with the motor resistance, lamp transformer, mirror and lens in position.

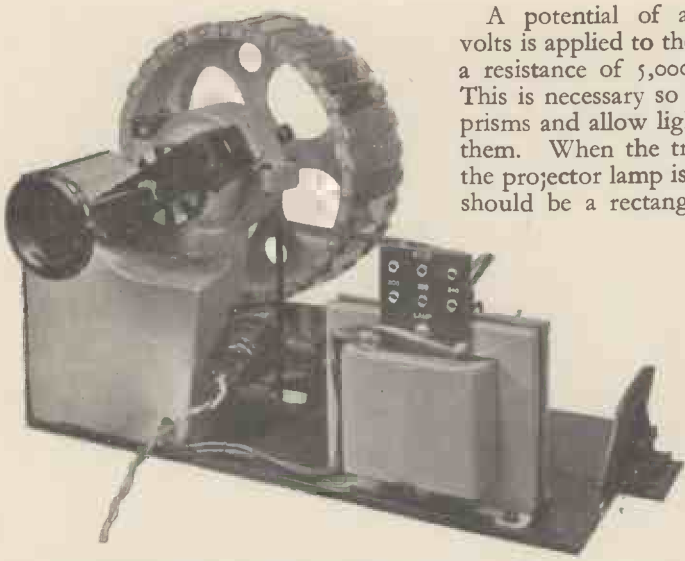
The first constructional operation is to mount the complete Baird grid cell unit in the aluminium housing. This is done by removing the three screws holding together the faces of the nickel and black finished sections. The lamp and nickel-plated section are then placed inside the housing and the black finished section outside so that the two connecting pins are horizontal as seen in the photographs.

The housing is secured to the aluminium baseplate by means of the four round-headed screws which pass through from the underside of the baseplate (the holes being countersunk to accommodate the screw heads), the nuts being screwed on from the top of the baseplate and in this way holding down the four feet of the housing.

The lamp is easily inserted at a later stage by bending up the lamp holder in the grid cell unit. The fixed resistance is mounted on the two brackets by fixing the feet to the aluminium base with screws.

The lens is mounted in its holder so that the top section, which has been ground off flat, is parallel with the baseplate. Then the feet of the lens mount are screwed to the baseplate in the position shown, leaving the screws just finger tight so that, if desired, the mount may be moved slightly. The reflecting mirror should then be fixed in its swivel mount and attached to the baseplate at the front. The mirror drum is attached to the motor shaft end by loosening the grub screw in the flexible coupling, pushing the collar direct on to the shaft and then tightening the grub screw so that it grips the motor shaft.

There is a small plate which is gripped by means of a bracket to the insulated cylindrical portion of the Baird grid cell unit. This should be adjusted so that the circular hole in the plate is concentric with the front aperture, through which the light passes. With this done the assembly is completed.



Here is the completely assembled mirror-drum receiver. The grid cell unit will be observed in the centre forground.

Wiring

To wire the projector, it is necessary to join a pair of mains leads to the primary of the lamp transformer, and another pair of leads from the secondary to the projection lamp in the grid cell unit.

A switch should be included in the lamp transformer primary circuit so that the lamp itself can be switched on and off as desired.

The fixed resistance mounted on its brackets and a variable resistance (the variable resistance at some convenient place so as to make speed control easy) are connected in series, and the wiring is continued through the pair of motor sockets which are on the mount holding the motor in position. The pair of sockets feeding the motor are those close to the mirror drum, the second pair of sockets—*i.e.*, those nearest the synchronising gear—being the connections to the synchronising coils themselves. A switch is included in this motor circuit. Reference to the circuit diagram will show the circuit connections just described, including the two switches S5 and S3.

Adjusting the Optical System

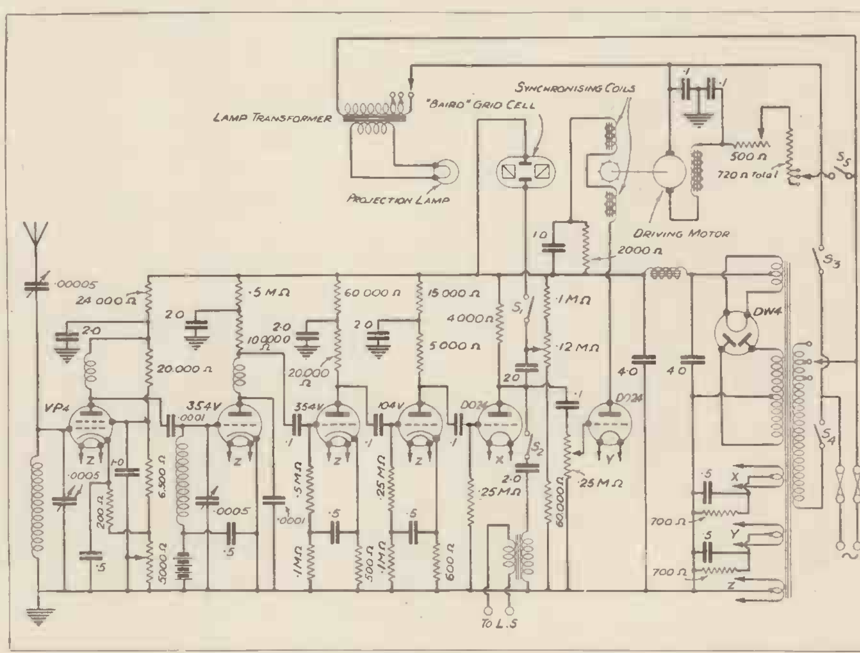
In order to focus correctly the light spot on to a screen, it is best to mount a temporary screen made from thin butter paper or tracing cloth on a wooden framework so that the size of the screen is approximately 9 in. by 4 in. This should be positioned on a centre line drawn from the baseplate and mounted vertically, about 21 in. from the front edge of the drum.

A potential of approximately 400 volts is applied to the grid cell through a resistance of 5,000 to 10,000 ohms. This is necessary so as to " open " the prisms and allow light to pass through them. When the transformer feeding the projector lamp is switched on there should be a rectangular spot of light on the screen. The ray of light passes from the cell unit to the inclined mirror, is then focussed on to the mirrors of the drum by means of the lens, and is finally reflected from these mirrors on to the screen.

It is necessary, to adjust carefully the positions of the lens and inclinedmirror so that the spot is clearly seen on the screen; both the lens holder and the inclined mirror holder being screwed just finger tight and moved slightly while carrying out this operation. In order to be sure that the whole equipment is centrally disposed, it is advisable to project the light spot on the screen both from No. 1 and No. 30 mirrors—*i.e.*, the first and the last. In this way it will be possible to note exactly the area covered by the spot of light when it is made to move by rotating the drum. After this has been done the screws are tightened so as to ensure that the positioning of the optical arrangement cannot alter.

The circuit of the receiver and amplifier recommended by the Baird Co. is shown, and consists of a high-frequency stage, an anode bend detector, and three stages of resistance capacity coupling. There is an additional R.C. stage used to feed the synchronising coils so that the control of the synchronising signal can be independent of the magnitude of the signal passed to the Baird grid cell. The component values and method of connecting the projection apparatus to the mains receiver, are clearly indicated.

When using this suggested set it is better, first of all, to tune in the television note by means of a loudspeaker —*i.e.*, switch S2 should be closed for this purpose. When tuned to maximum volume, switch S2 is opened and switch S1 is closed, the modulations now being passed to the grid cell. The motor and projection lamp are switched on and the motor run up to its normal speed of 750 revolutions per minute. The attainment of this speed is easily judged by watching the drifting of the images on the screen. If these tend to drift upwards, or alternatively if the lines slope from the bottom left-hand corner to the top right-hand corner, the speed is too high, and if they drift downwards, or the lines slope from the top left-hand corner to the bottom right-hand corner, the speed is too slow.



The receiver and amplifier circuits recommended for use with the Baird mirror-drum receiver. The motor and lamp connections are also shown.

THE TELEVISION ENGINEER

A Description of An Experimental Television System

By V. K. Zworykin

This article is a general description of an experimental television system employing the Kinescope as the image reproducing unit and is an important contribution to this branch of the science. It is published by permission of the Institute of Radio Engineers, New York.

THE experimental television system placed in operation by RCA Victor in New York late in 1931, and on which practical tests were made during the first half of 1932, was based on the use of a cathode-ray tube as the image reproducing element in the receiver. This allowed the use of a system with 120 scanning lines and a frame repetition frequency of 24 per second with adequate illumination for the reproduced image.

The units comprising the television receiver are: An aerial system feeding two radio receivers, one for sight, including the cathode-ray unit with its associated horizontal and vertical deflecting equipment, and the other for sound, including the usual loud speaker.

The Kinescope

The name "kinescope" has been applied to the cathode-ray tube used in the television receiver to distinguish it from ordinary cathode-ray oscilloscopes because it has several important points of difference; for instance, an added element to control the intensity of the beam. The tube has a diameter of 9 in. permitting a reproduced image of approximately 5½ in. by 6½ in. Fig. 1 is a cross-section view of one of the tubes, showing the relative position of the electrodes, especially the cathode and its surrounding assembly, which is usually referred to as the "electron gun." The indirectly-heated cathode *C*, operates on alternating current. Its emitting area is located at the tip of the cathode sleeve and is formed by coating with the usual barium and strontium oxides. The control electrode, corresponding to the grid in the ordinary triode, is shown at *G*. It has an aperture, *O*, directly in front of the cathode emitting surface, and besides functioning as the control element, it also serves as a shield for the cathode.

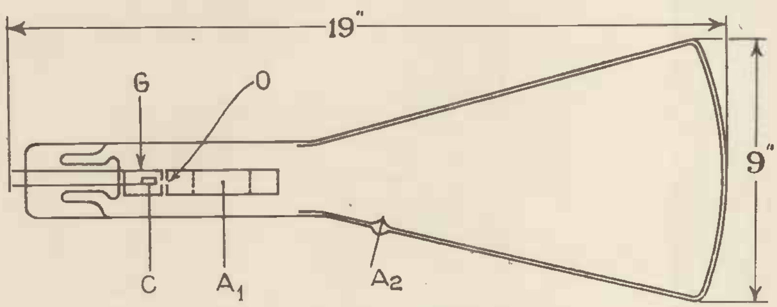


Fig. 1. Cross section of Kinescope.

The first anode, A_1, has suitable apertures which limit the angle of the emerging electron beam. The electron gun is situated in the long narrow neck attached to the large cone-shaped end of the kinescope, the inner surface of the cone being silvered or otherwise metallized, and serves as the second anode. The purpose of the second anode, A_2, is to accelerate the electrons emerging from the electron gun and to form the electrostatic field to focus them into a very small, thread-like beam. The first anode usually operates at a fraction of the second anode voltage.

The focussing is accomplished by an electrostatic field set up by potential differences applied between elements of the electron gun and the gun itself and the metallized portion of the neck of the kinescope.

Scanning

In the experimental system described, the picture is made up of 120 lines and is transmitted at the rate of 24 per second. The picture has a 5-to-6 ratio of vertical to horizontal dimensions, and, therefore, the horizontal detail is equal to 144 lines. The beam traces a succession of equally spaced horizontal lines across the fluorescent screen, constructing the television picture in the identical manner that the flying spot at the transmitter has scanned it, beginning from the top downward and after the last, or 120th line, jumping back to the position at the start of a new picture.

In order to scan with a cathode-ray beam in this manner, two variable magnetic fields are applied to the beam just as it emerges from the electron gun; a vertical one, pulsating 24 times per second, and a horizontal one, pulsating 2,880 times per second.

In order that the cathode beam at the receiver follow the uni-directional scanning at the transmitter, the variation of intensity of both horizontal and vertical deflecting fields plotted against time is of a "saw-tooth" shape. Each cycle consists of two parts; the first, linear with respect to time and lasting practically the whole cycle, and the second, or return period, lasting only a small fraction of the cycle. The picture is reproduced during the first part of the scanning period by varying the bias of the control element according to the light intensities of the transmitted picture, as described above.

In order to straighten the scanning lines and improve the quality of the reproduced picture, a more complicated circuit was used, involving one dynatron oscillator and two amplifying tubes, as shown in Fig. 2. The condenser, *C*, in the horizontal deflecting circuit is charged continuously through the resistance *R*. Periodically, at the end of predetermined intervals, the condenser is discharged. During these intervals, the accumulated charge does not reach saturation value, for the time (1/2880 of a second) is insufficient. The vacuum tube through which the discharge takes place is controlled by impulses supplied from a dynatron oscillator having a distorted wave shape. The frequency of oscillation of the dynatron (which can be made to vary over a fairly wide range) is initially adjusted to approximately 2,880 cycles per second, so that received synchronising signals will have no difficulty in pulling the dynatron into step with the synchronising impulses generated by the transmitter scanning disc, as explained later. The charging and discharging of condenser, *C*, represent saw-tooth variations of potential, which when applied to the grid of an amplifying tube, produce saw-tooth current impulses in deflecting coils connected in the plate of the amplifier.

The vertical deflection circuit is similar to the horizontal circuit just described. Both vertical and horizontal deflecting systems operate on the beam by the magnetic fields generated by coils placed about the neck of the cathode-ray tube.

Electro-magnetic Deflection

The choice of electro-magnetic deflection in preference to electrostatic was made more as a result of economical consideration than mechanical choice. The kinescope for electro-magnetic deflection is much cheaper to make than the one equipped with inside deflecting plates for electrostatic deflection. On the other hand, the electro-magnetic deflecting unit itself requires more power and is more costly to build than the electrostatic one. The predominance of one or more factors depends chiefly upon the frequency of deflection and velocity of the beam.

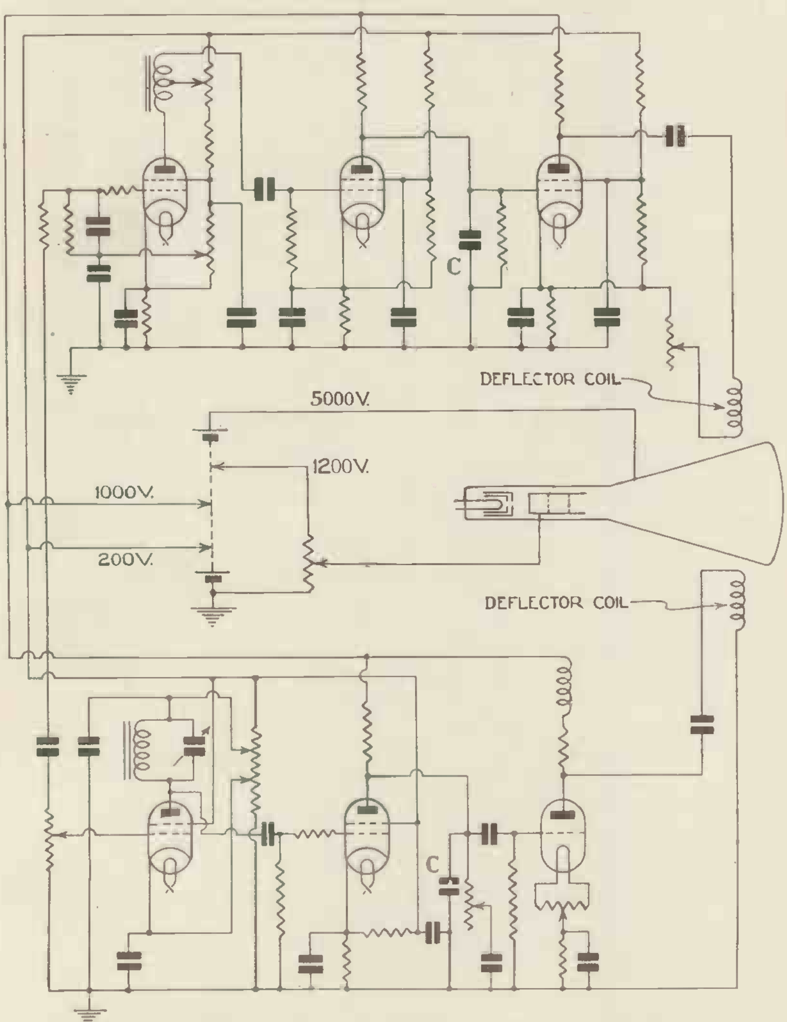


Fig. 2. Double time-base circuit used with Kinescope. A dynatron oscillator is used in conjunction with a valve acting as a discharge tube across the condenser C. The impulse is applied through an output valve to the deflecting coils.

The constants of the electrical circuits for vertical and horizontal deflection are, of course, entirely different, due to the great difference in the operating frequencies of the two deflection circuits.

For sending synchronising impulses, the transmitting scanning disc has an auxiliary row of slits, one for each scanning aperture. These slits, together with a separate illuminating lamp and photo-cell, produce impulses, one at the end of each line and at the end of each picture frame. The synchronising impulses are transmitted over the picture signal channel. They do not interfere with the picture signals, because they occur at an instant when the picture actually is not being transmitted.

To allow the transmission of horizontal synchronising signals at a time when the beam at the receiver is returning to start a new horizontal trace, the generation of picture signals is cut off for ten per cent. of the scanning time. This is done by simply spacing the scanning disc apertures ten per cent. farther apart than the width of the scanned frame. Vertical synchronisation is carried out in the same manner, synchronising impulses for this purpose being transmitted at the completion of each frame.

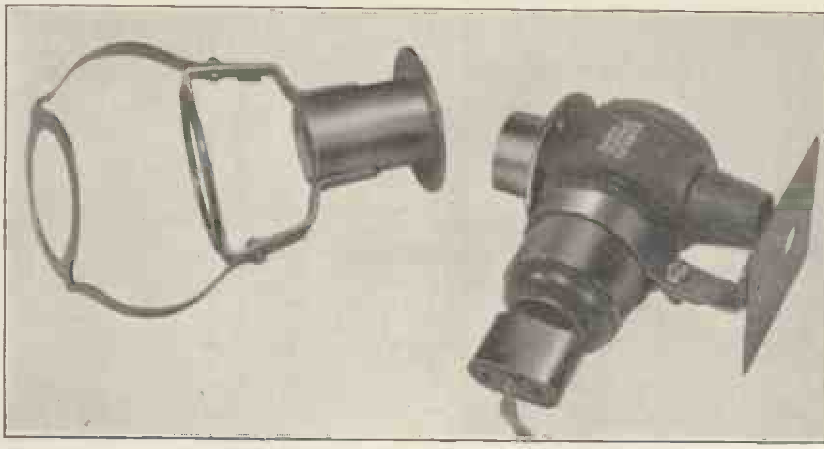
When the electron beam returns to the position from which it starts to trace a new line, and particularly when it returns from the bottom of the picture to start a new frame, an undesirable light trace, called the return line, is visible in the picture. To eliminate this the synchronising impulses which are in the negative direction are applied to the control electrode of the kinescope so as to bias it negatively and thus eliminate the return line by extinguishing the beam during its return.

To produce a picture, the intensity of light on a fluorescent screen is varied by impressing the picture signal on the kinescope control element. If the bias adjustment on the kinescope is set so that the picture signals have the maximum swing on the characteristic curve of the kinescope a picture with optimum contrast is produced. The picture background, or the average illumination of the picture, can be controlled by the operator by adjusting the kinescope bias.

The reproduced image is viewed in a mirror mounted on the inside lid of the cabinet. In this way the lid shields the picture from overhead illumination. This method also affords a greater and more convenient viewing angle.

THE TELEVISION ENGINEER

This is the fourth and concluding article of a series by J. C. Wilson on the theory and use of the Kerr cell. The present article deals with the construction and practical application of this type of light valve and describes suitable optical arrangements for use in conjunction with it.



THE THEORY OF THE KERR CELL

ONE of the earliest practical proposals for the modulation of light in a television receiver comprised the use of the Kerr effect, as opposed to the Faraday effect which necessitated the inclusion of an inductance coil in a circuit carrying the television signals, with its attendant distortion of the waveform of input impulses.

The Kerr cell was first suggested by Henry Sutton in November, 1890 (*Telegraph Journal* and *Electrical Review*, Vol. 27, p. 549), for a television receiver; he proposed that two plates immersed in carbon disulphide, and placed between crossed Nicol prisms could be used to modulate a beam of light in accordance with electric signals impressed upon the plates.

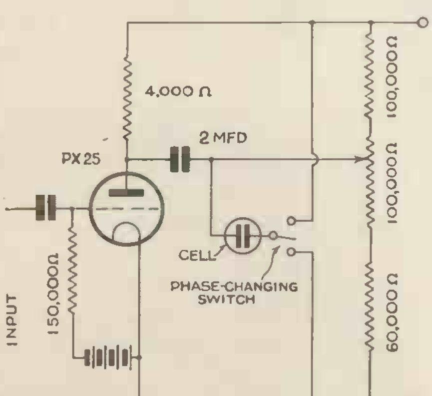


Fig. 1. This diagram shows a suitable output circuit for use in conjunction with the Kerr Cell.

In 1911 a similar scheme was published in Korn and Glatzel's well known book on picture transmission (see Fig. 209, p. 445), but the best description of the properties of the cell for television purposes before it came into prominence is given in the specification of British Patent No. 235857 (Dr. A. Karolus) dated June, 1924. This describes the form of cell in which only two opposing plates are used, and for a long time experiments in which the Kerr cell was used were not successful because of the high voltages which had to be used on account of the poor sensitivity of the cell when the plates were spaced sufficiently widely to allow enough light to pass.

The first suggestion leading to a way out of this difficulty came from J. L. Baird, who, in the specification of his British Patent No. 253957 of January 1st, 1925, described the form of cell now generally employed, in which two grids or sets of plates are interleaved, thus reducing the distance between opposing pairs of plates without blocking out the light unduly. Photographs of a cell constructed on these lines were published in *Fernsehen*, 1 Jahr, Nr. 3, pp. 101-102, in 1930.

The Practical Kerr Cell

We come now to the practical considerations underlying the construction and operation of a Kerr cell for use in a home television receiver. Of paramount importance is the voltage required in the last stage of the amplifier working the cell: this must be kept as low as possible, and to do this either the plates must be made long (in the direction of passage of the light) or exceedingly close together. The first expedient leads to loss of light owing to the fact that it is not at all easy in practice to obtain a thin intense pencil of parallel light; the second leads to lowering of the cell resistance and break-down potential of the medium. In practice a compromise is employed, and the dimensions of a good cell for general purposes in television are as follows:—

Number of plates: 11 (5 connected to one pole, 6 to the other).
Size of each: length $\frac{7}{8}$ in.; width $\frac{1}{4}$ in.
Area of overlap: $\frac{3}{16}$ sq. in.
Distance apart: 0.006 in.

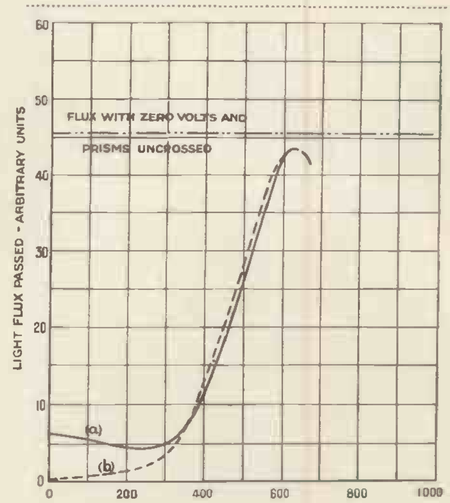


Fig. 2. Curves showing the effect of the bias voltage

Medium: Best purified nitrobenzene.
Metal of plates: Chemically pure nickel.
Insulation: Red fibre, baked.

Such a cell has a capacity of about 0.001 to 0.008 mfd. (depending on the quality of nitrobenzene) and a first light-maximum at about 580 to 650 volts; it is possible with good quality fibre to obtain a pole to pole resistance of 0.75 megohm, after the cell has been polarised.

The unduly high internal capacity of the cell is accounted for, of course, by the high dielectric constant of pure nitrobenzene. To minimise the effect of this upon the frequency-characteristic of the cell and associated circuits, it is necessary to feed it with television signals from a valve of very low internal impedance, with a low value of anode resistance. A circuit of the type shown in Fig. 1 is suitable.

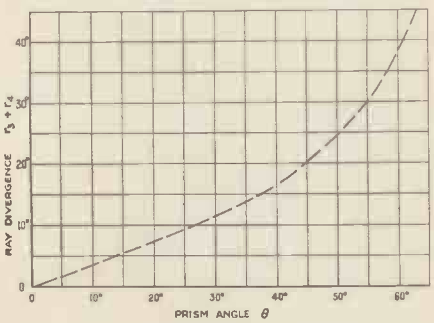


Fig. 4. Curve showing how the divergence of the rays depends upon the angle of cleavage of the Iceland spar crystal.

In order to obtain good quality reproduction from a television set using a Kerr cell as the light-modulating device it is vital to bias the cell to a part of its light-voltage characteristic at which the response of the cell to variations in voltage is approximately proportional to the voltage change; in order to determine this bias voltage, let us examine the curves shown in Fig. 2, in which (*a*) is the measured characteristic of a cell of the kind just described, while (*b*) is the characteristic calculated from theoretical considerations.

It will be seen that over the greater part of the working range the curves coincide satisfactorily, but at the lower end there is a marked discrepancy: the cell passes more light than it should at zero volts, the quantity decreasing slightly at first with increasing voltage before rising sharply at about 300 volts into the approximately rectilinear part of the characteristic. The working range extends from about 300 to 600 volts, the change in light passing through the cell over this range being about 87 per cent.

The passage of light by the cell at zero volts, even with the polariser and analyser accurately crossed, is probably to be explained by metallic reflection at grazing incidence on the plates giving rise to changes in the polarisation of the light ("Light Waves in Metals," T. C. Fry, *Jour. Opt. Soc. Amer.*, Vol. 14, p. 473, June, 1927).

Suitable Bias

It will be appreciated from the curves that it is necessary to provide a bias of approximately 450 volts on the cell, *i.e.*, considerably more than half the first light-maximum voltage. Taking the theoretical curve (*b*), however, it has been shown by E. E. Wright (*Proc. Phys. Soc.*, Vol. 45, Part 3 p. 469, "A Note on the Kerr Cell") that the mean bias for least harmonic production should be about 0.71 times the voltage of the first maximum: this gives a bias of 440 volts. This result is in excellent agreement with practice.

When a cell has been freshly constructed from new metal sheet and the purest nitrobenzene, it has still to be "formed": when the cell is first connected to a source of potential, a comparatively heavy current flows through it, and this current decreases rapidly initially, but after a few hours more slowly to a constant value corresponding with the "formed" state. (For extremely pure nitrobenzene the period is shortened considerably; see *Physik Zeitschr*, XXX, 1929, pp. 942-946; F. Hehlans). With 500 volts across the cell, in series with a limiting resistance of 250,000 ohms, the initial current might be of the order of 3 milliamperes; after about twelve to fifteen hours, however, the current will have fallen, in normal circumstances to 0.25 to 0.5 milliampere, and will remain constant at this figure until the plates are cleaned (there is, if the "forming" has taken a usual course, a chocolate-coloured deposit on the plates of the cell) or until the nitrobenzene becomes saturated with water, which it absorbs rapidly from the air at normal humidity.

Cell Maintenance

On account of the extreme difficulty of preserving the high resistance of a cell in which the dielectric is exposed to the atmosphere, even though a lid is provided and carefully clamped down, a new form of container has been developed in which the electrodes of the cell are supported on lead-in wires fused directly into the pinch of a sealed envelope; the dielectric is introduced under low pressure and does not come into contact with the air at

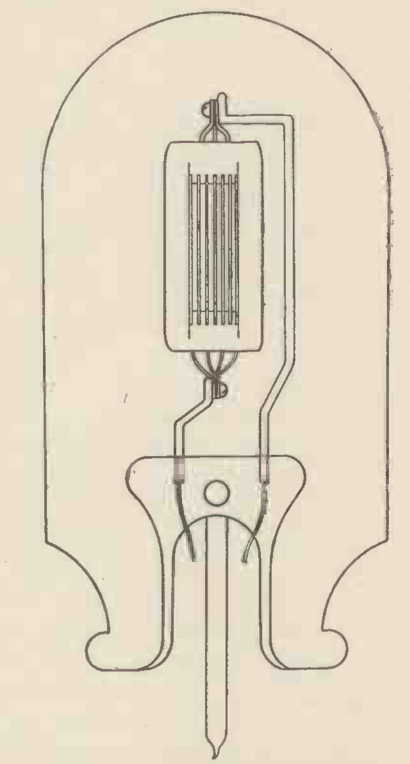


Fig. 3. Diagram showing the construction of a Kerr cell of the sealed type.

TABLE I.

Substance.	Refractive Index.	Critical Angle.	Polarising Angle.
		deg. min.	deg. min.
Air (at N.T.P.)	1.000294		
Water	1.333	48 33	53 11
Ice	1.310	49 44	—
Plate Glass	1.514 to 1.542	40 40 approx.	57 00 approx.
Canada Balsam	1.53	—	—
Crown Glass	1.560	39 48	56 35
Carbon disulphide	1.632	37 42	58 30
Nitrobenzene	1.553	40 3	57 13
Diamond	2.750	21 56	70 1
Obsidian	—	—	56 30

all during the process of filling. A diagrammatic representation of a cell of this type is given in Fig. 3 and further details of the processes used in its manufacture, together with a great deal of additional data which cannot be included here, are to be found in the specification of Patent No. 403155 (W. W. Jacomb and Baird Television Limited).

The Optical System

The optical system for use with a Kerr cell for television is extremely simple in construction. An incandescent tungsten lamp of the bunched-filament type, taking 8 amperes at 12 volts, supplies the illumination, and an image of the filament is formed by means of a condenser lens of 1 in. to 2 in. focal length inside the plates of the cell through an intervening polariser which is preferably a prism of the Hoffmann type. An opaque mask with a small aperture punched in it lies close to the wall of the cell where the light emerges from it, and the beam from this aperture passes through a double-image prism crossed with the polariser. The beam can then be dealt with by a projector-lens and mirror-drum in the ordinary way. A photograph of an optical system of this kind, manufactured in commercial form is shown.

It remains to add a few words upon the subject of the design of a simple form of polarising device, the double-image prism, which may be of use to the amateur constructor, and to give some general information about optical media which is of interest.

To begin with, refractive indices of various substances referred to air at 15°C. (with the exception of air, which is referred to a vacuum) for yellow light are given in Table I.

To a fair degree of approximation, the refractive index of any substance can be calculated from the formula adopted by Lorenz :

$$R = \frac{n^2 - 1}{n^2 + 1} \cdot \frac{m}{d}$$

where R is a constant for the substance, called the *molecular refraction*.

m is the molecular weight.
n is the refractive index.
d is the density.

Thus if we know the refractive index of a substance in, say, the liquid state and the densities in the liquid and solid states, we can calculate the index for the solid state.

In Table I, two columns, headed respectively *critical angle* and *polarising angle*, have been included : once the refractive index of any substance not given in the table has been ascertained the corresponding critical and polarising angles are given by the formulae :

$\Theta_c = \text{Sin}^{-1}n$

and :

$\Theta_p = \text{Tan}^{-1}n$.

The particular values of these two angles given in Table I are of course, those which correspond to the value of n, the refractive index, in the first column, which, in turn, is for light of only one colour, namely that of the sodium D-line, 5893×10^{-8} centimetres wavelength.

In the second article of this series, a diagram was given showing how a ray of light is split up into two beams, polarised in planes at right angles, by a double-image prism, and illustrating how these rays diverge on leaving the prism. By calculation based upon the figures given in Table II a curve has been prepared showing how the mutual divergence of these rays (that is, $r_3 + r_4$ in the diagram referred to) depends upon Θ, the angle of cleavage of the portions composing the prism in the case of Iceland spar. This curve which is reproduced in Fig. 4 herewith, will facilitate the construction of prisms of the Wollaston type to give any required divergence. Of course, the divergence is not quite the same for light of all colours : the dispersion when Θ is 30° is about 29 to 31 minutes.

From the refractive index of Canada balsam given in Table I it is easy to calculate the cone of polarised light which will be passed by a Nicol prism of any given ratio of length to breadth.

TABLE II.

Wavelength (milli-microns)	Calcite.		Quartz.	
	Ordinary Ray.	Extraordinary Ray.	Ordinary	Extraordinary
1256.0	1.6388	1.4782	1.5316	1.5402
656.3	1.6544	1.4846	1.5419	1.5509
589.3	1.6584	1.4864	1.5443	1.5534
486.1	1.6678	1.4907	1.5497	1.5590
404.7	1.6813	1.4969	1.5572	1.5667
214.4	1.8459	1.5600	1.6305	1.6427

Values of refractive index corresponding to ordinary and extraordinary rays in Iceland spar at 18°C. are given in Table II, together with values for quartz, another birefringent medium :

It will be seen that while the refractive index for Iceland spar corresponding to the extraordinary ray is *lower*, that for quartz is *higher* than the value corresponding to the ordinary ray in the respective cases.

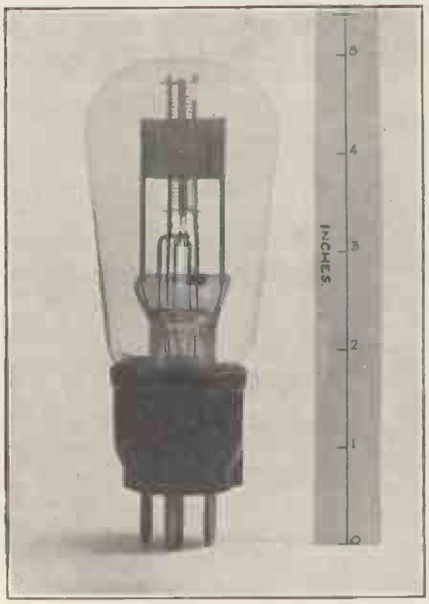
An indication that television as a commercial proposition is not so far away is provided by the fact that the engineering staffs of at least two large London stores have been invited to attend special television lectures. At these classes, which are being held at the Borough Polytechnic, London, S.E., instruction in the working of the sets is given. The instructor is Mr. J. J. Denton, A.M.I.E.E., one of the hon. secretaries of The Television Society.

THE TELEVISION ENGINEER

Gas-filled Relays

By C. R. Dunham, B.A.

The purpose of this and following articles is to introduce to the amateur experimenter the Gas-filled Relay and to describe in a simple manner the theory of its operation in a few typical circuits.



ALTHOUGH it is only in the last two or three years that the gas-filled relay (three-electrode thermionic valve, which is also known under the name of " Thyratron ") has become generally available, it cannot claim to be a novel device, its fundamental principles having been well known for many years.

However, the early examples of this type of valve can only be considered as of an experimental nature, and it is mainly due to the recent advances in valve design and vacuum technique that the gas-filled relay has reached its present commercial form.

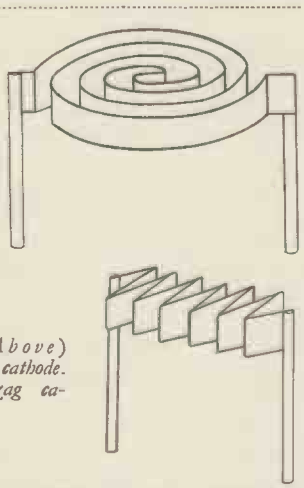


Fig. 1. (*Above*) *Double-spiral cathode.* (*Right*) *zig-zag cathode.*

What the Gas-filled Relay Is

The gas-filled relay is essentially a three-electrode valve, comprising a thermionic cathode, an anode and a control electrode or grid completely shielding the cathode from the anode, operating in an ionisable gaseous medium such as mercury vapour, neon, etc. That is to say, its only essential difference from the ordinary triode valve, is in having a low-pressure gas filling in place of the usual high vacuum. Generally the gas filling is mercury vapour, which is provided by introducing a few drops of mercury into the bulb during manufacture; however, it seems probably that for certain applications the use of one of the inert gases, e.g., argon in place of mercury vapour may offer some advantages.

The use of a gaseous filling in thermionic tubes will be, of course, familiar to most experimenters who have used one of the many forms of mercury-vapour rectifier, a typical example of which is the Osram G.U.1. The passage of a discharge through this type of valve is accompanied by ionisation of the gaseous filling, and imparts to it a luminous glow, the colour of which is characteristic of the particular gas used, e.g., blue for mercury. The ionisation of the gas has a very important effect on the electrical characteristics of the valve, and gives certain useful advantages over the corresponding high vacuum valve.

Effect of Gas

It is well known that in vacuum valves the current (which is carried by negatively charged electrons emitted from the hot cathode and drawn to the anode by an applied potential) is restricted by the space charge of the electrons. This determines the characteristic impedance of the valve; that is the current is definitely determined by the potential difference between anode and cathode. However, we must note that as the potential difference is raised, there is a certain maximum value beyond which the current cannot be increased, this corresponds to the limit of the cathode emission. In normal working this limit must never be reached, since destruction of the cathode coating would result.

When the vacuum is replaced by a gas at low pressure, the current-carrying electrons in passing from the cathode to the anode ionise, by collision, atoms or molecules of the gas, forming further negatively charged electrons and an equal number of positively charged ions. Each of these may be considered as an atom or molecule of the gas minus one electron which has been removed by the collision. The negative and positive ions thus produced proceed towards the anode and cathode respectively under the influence of the applied potential difference, but the positive

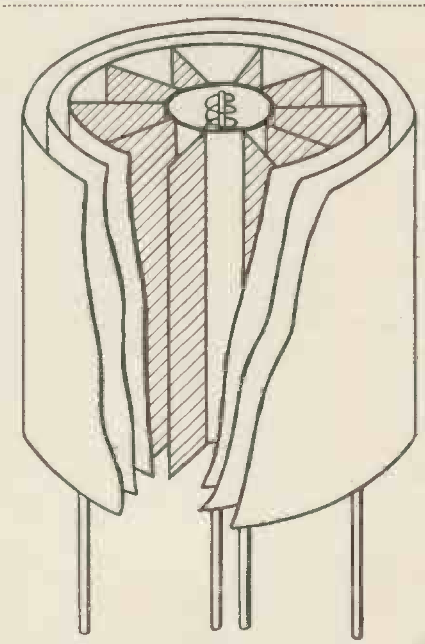


Fig. 2. *Directly-heated heat shielded cathode.*

ions cannot be assumed to be carrying any appreciable part of the current because of their much heavier mass, compared to one electron, and consequent much lower velocity.

The effect of the presence of positive ions in the discharge space opposes that of the negative electrons and reduces the space charge, and consequently the impedance of the valve. Practically it is found that over a wide range of current the voltage between anode and cathode is constant at a low value, and the impedance of the valve is zero. This means that the space charge of negative electrons has been completely neutralised by the presence of positive ions.

Since when carrying current, the impedance of a gas-filled valve is zero, it is always essential that an external impedance be used in series with it in order to limit the current taken to a safe value. What value of current is to be considered as safe is determined by the total electronic emission of the cathode. When the current taken approaches or exceeds this value, the voltage drop across the valve rises and bombardment of the cathode by positive ions sets in, causing permanent injury to it by "spluttering" or the disruption of portions of the active coating by the bombardment.

Spluttering

In the case of a gross current overload this "spluttering" is always visible as portions of the cathode are removed with brilliant scintillations, but for less severe overloads spluttering can occur invisibly, the only effect beyond a short valve life being undue blackening of the envelope. In using hot-cathode gas-filled valves it is, therefore, always essential to ensure that at no time does the current taken exceed the safe limit or "peak current rating" which the manufacturers specify for each type of valve.

For the same reason it is essential that no current is taken from the valve before the cathode has become warmed up to its full emitting temperature; that is, the anode circuit must not be closed until a certain interval after the cathode has been switched on.

The chief advantage which a gas-filled valve offers over a vacuum valve, lies, of course, in the fact that it can pass a much larger current, and that the voltage drop in the valve is low. Thus in a mercury-vapour filled valve the voltage drop is, under normal conditions, about 15 volts. This would correspond to an efficiency of 92 per cent. in a 200 volt circuit or 98 per cent. in a 1,000 volt circuit; the power used in heating the cathode is of the order of 10 watts per ampere of max. permissible anode current.

A further advantage with a gas-filled valve, which is sometimes made use of, is the possibility of heat shielding the cathode; either for the purpose of increasing the emission for a given cathode wattage or in order to prevent other electrodes in the tube from getting too hot by radiation from the cathode.

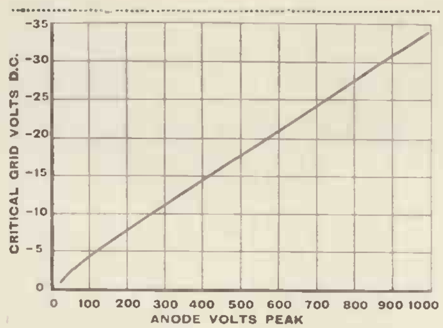


Fig. 3. Grid-control characteristic.

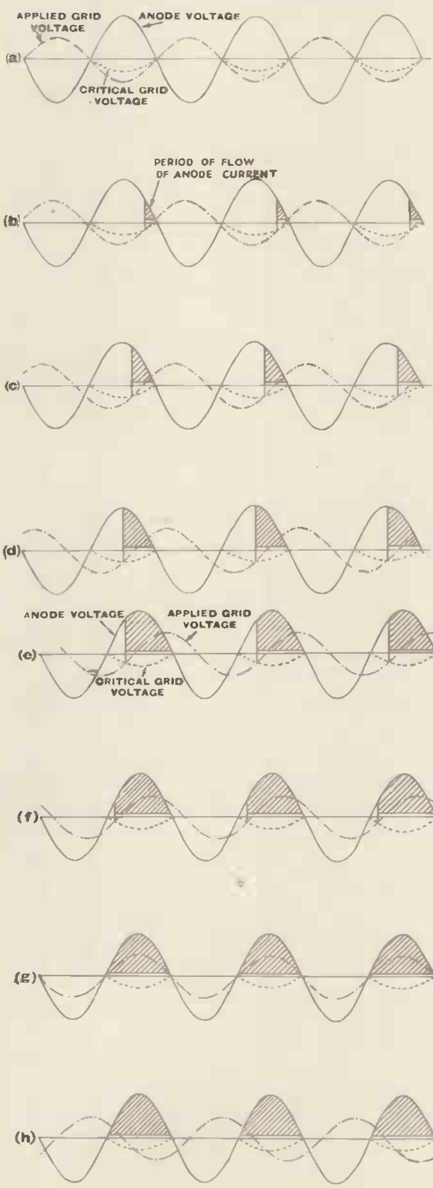


Fig. 4. Diagrams showing how the mean output of the valve can be controlled

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Two methods of accomplishing this are shown in Figs. 1 and 2. In Fig. 1 the radiation of heat from the central portion of the cathode has been reduced by the proximity of the outer parts which are not coated. In Fig. 2, the cathode is built up in the form of a miniature oven. A spiral in the centre heats indirectly the cathode proper, consisting of nickel vanes coated with electron-emitting material and the whole is surrounded by one or more cylinders which act as heat shields. Of course, in vacuum valves the principle of heat shielding is impossible, since the electrons emitted can only travel in sensibly straight lines; but when an ionised gas is present the emission can proceed along curved paths owing to the frequency of collisions and the much lower voltage drop between anode and cathode.

The Action of the Gas-filled Relay

As before stated the gas-filled relay consists of a three-electrode valve, the introduction of the control grid enables the electrostatic field in the neighbourhood of the cathode, and hence the conditions under which anode current begins to flow, to be governed. The action of the grid in the gas-filled relay is not, however, exactly analagous to the action of a grid in a vacuum valve. When the gas is not ionised, that is when no, or practically no, anode current is flowing a negative voltage applied to the grid, if sufficiently large, can prevent anode current from flowing.

In many types of gas-filled relay the minimum value of negative grid voltage required to prevent the discharge is practically a constant fraction of the anode voltage applied, and the ratio of the two is called the grid control factor of the tube.

Fig. 3 shows the type of relationship between the applied anode voltage and minimum negative grid voltage required to withold the discharge for an Osram gas-filled relay type G.T.1, for which the control factor is 25. When, however, appreciable anode current has started to flow, either caused by increasing the anode voltage above, or decreasing the grid voltage below the critical condition, so that the gaseous medium becomes ionised, the grid loses its control. The anode current immediately assumes a value which is determined solely by the external circuit impedance and the applied voltage, and the grid is unable to stop, reduce, or modulate its value.

(Continued at foot of next page.)

THE RAY "BUCKET" TUBE

EVERY reader of TELEVISION will be familiar with the cathode-ray tube as the projector and screen in a television receiver and every day makes it more and more certain that this system merits the serious consideration of all who are interested in this branch of broadcasting. Few realise the other fields in which the cathode-ray oscillograph reigns supreme or the numerous applications to which it can be put that vary from the automatic prevention of collision at sea to the photographing of the elusive atmospheric.

The Radio Research Station at Slough have found some wonderful applications for the C.R.O. which are dealt with, at length and with wealth of technical detail, by Dr. R. A. Watson Watt, in his noteworthy work on the activities of this experimental station. Probably one of the most interesting applications of the cathode ray is its use in a special "bucket" tube for the automatic filming of atmospherics.

It will be readily appreciated that the duration of an atmospheric is far too short to permit of manual photography, and it would be impossible to expose a negative to the ordinary tube to await the atmospheric, owing to the fogging that the spot and slight general fluorescence would cause.

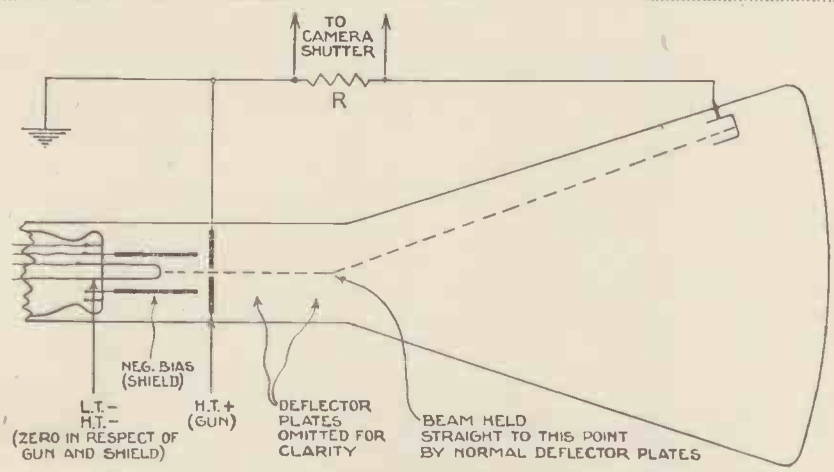
The special "bucket" tube is shown diagrammatically above and is a modification of the standard type of Cossor tube, the only difference being the presence of the miniature closed cylinder fixed to the side of the globe. This cylinder is connected to earth through a resistance, and as the positively charged gun is also earthed the cylinder is held at a potential almost equal to the gun, and the beam is focussed into it and held there by the positive charge (see Fig. 1).

The resistance R will naturally have a voltage drop across it which can be used for any purpose, in this case for working the camera shutter. When everything is ready the beam is in the bucket, which is just strong enough to resist the efforts of the time base to draw it across the screen.

The arrival of the atmospheric starts this superbly delicate mechanism operating, the potential applied to the appropriate deflector plate is immediately sufficient to pull the beam out of the bucket which breaks the current through the resistance R. As a result, firstly, the spot is pulled from the gun and allowed to traverse the time dimension; and, secondly, the beam current no longer flows through R, destroying the potential across it and opening the camera shutter all in a minute fraction of time of probably a few micro seconds.

The beam now travels towards the end of its time base traverse, its rise and fall in the right-angle direction being controlled by the atmospheric's rise and fall of voltage, thus "drawing" the wave form while the negative duly records it.

At the end of the time base traverse the camera shutter is closed, the beam is returned to the bucket by the influence of a magnetic field produced in special coils, and the film moves on to the next negative to await the coming of the next phantom from the ether.



This diagram shows how the "bucket" is situated in the tube so that the electron beam can fall into it.

"Gas-filled Relays"

(Continued from preceding page)

The application of a negative voltage to the grid in an attempt to stop or reduce the anode current merely results in the collection of a sheath of slow moving positive ions around the grid, which effectively screens the rest of the discharge space from its effect.

Grid Control

It is thus seen that the grid of a gas-filled relay is able to prevent the passage of any anode current, but it cannot stop or modulate it once it has started. In order to stop anode current it is necessary to remove or reduce the applied anode voltage for a period of time long enough for the cloud of ions surrounding the grid to disperse. It is clear that when an alternating voltage of commercial frequency is used, grid control is restored every time the applied voltage swings negative.

The grid then can control the instant during the succeeding positive half cycle at which the discharge commences. By feeding the grid also with an A.C. voltage of the same frequency but of variable phase, it is possible (as is shown in Figure 4) to control the *mean* output of the valve.

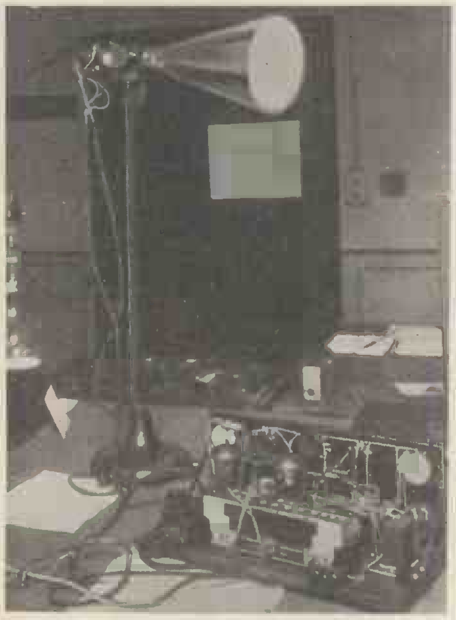
In the next article of this series methods of restoring grid control, when D.C. anode voltages are used will be discussed and a few typical applications of the gas-filled relay will be given.

The Television Society

President: Sir Ambrose Fleming, M.A., D.Sc.. F.R.S.
Hon. Secretaries: J. J. Denton, A.M.I.E.E., 25, Lisburne Road, Hampstead, London, N.W.5. W. G. W. Mitchell, B.Sc., "Lynton," Newbury, Berks.

Report of a lecture given before the Society at University College, London, on January 17. The object of the paper was to record the experimental work which has been done by the Ediswan Company Special Valve Department Staff.

THE theory and the operation of the modern low-voltage cathode-ray tube are well known, and its application to Television consists in adapting the linear time-base circuits for the production of a multi-line screen and in applying a vision signal to modulate the beam intensity as it traverses the fluorescent screen of the tube.



Ediswan experimental equipment for demonstrating television reception by the cathode-ray tube. The time-base used (foreground) is a special resistance-capacity combination operating at a high voltage, particulars of which were given in the lecture to the Television Society.

The most widely used material for coating the fluorescent screen is zinc silicate in either its natural or synthetic form. This produces a vivid green fluorescence which possesses a slight persistence or after glow. As an alternative, cadmium or calcium tungstate may be used to produce a blue-white fluorescence with a negligible afterglow. The persistence of glow is of importance in the case of television, particularly with high-definition working.

With a 30-line screen and a horizontal traversing speed of 12½ per second, a persistence lasting for a period not exceeding 1-20th second is of slight advantage, as it tends to reduce flicker and improves the quality of the picture. With line screens in which the horizontal speed is of the order of 25 per second, however, the presence of after glow would result in a comet-like appearance being given to rapidly moving small objects.

The fundamental circuit for producing a multi-line screen is that of a condenser which is charged at regular recurrent intervals from an H.T. supply through a variable resistance. Across the condenser is connected the discharge device of the neon lamp type, and the deflector plates of the tube are connected in parallel with this lamp. The charging rate of the condenser is controlled principally by the value of resistance and capacity. This type of circuit is generally known by the name of "relaxation oscillator."

The disadvantage of the neon tube as the discharge device lies in the very small difference between the striking and extinguishing voltages. This means that the deflection of the beam will be very restricted, and hence it is usual to replace the neon tube by a thyratron in practice.

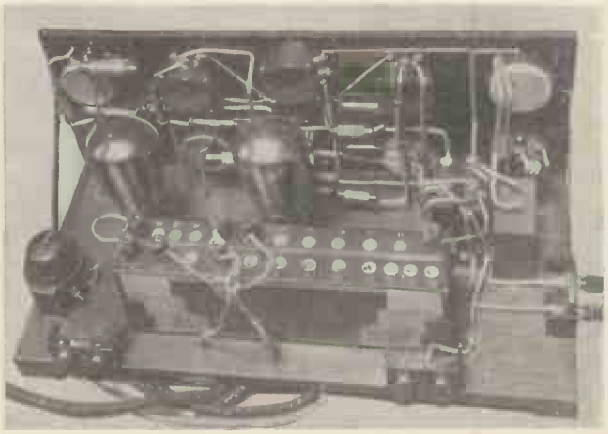
With moderate values of H.T. voltage applied to the resistance condenser combination, the curve of charging voltage is exponential, and hence the deflection of the beam can only be considered as linear over a very small working portion. The usually adopted device to overcome this disadvantage is the substitution of a saturated diode or constant current device in place of the resistance.

A bright-emitter diode of the type of the Ediswan CR.2 makes a convenient control for the charging rate of the condenser, the only requirement being a separate 2-volt battery for the filament supply. Instead of bright-emitter diodes, both screen grid and pentode valves have been used, but these necessitate the provision of a separate potentiometer across the H.T. supply to control the screen voltage, with an inevitable increase in the power consumption of the time-base circuit.

Since for the production of the line screen two time-bases circuits are required, the power consumption in the potentiometers associated with them becomes an appreciable item, and in fact may form as much as 70 per cent. of the total energy taken by the circuit. As regards their effect on the linearity of the travel of the beam, there seems to be little to choose between the diode and the screen grid valve, and for ordinary experimental work the diode-thyratron combination would seem to be the most simple and satisfactory arrangement.

With higher scanning speeds of the order of 25 per second horizontally, the changes in emissivity of the diode and slight consequent fluctuations in the space charge will lead to variations in the speed of the beam which will render synchronisation very difficult. The realisation of this problem has led the Edison Swan Co. to turn their attention again to the original resistance capacity circuit and to attempt to make the fullest use of the linear portion of the exponential curve at the commencement of the charge of the condenser.

With normal values of H.T. charging voltage, this linear portion is, of course, so small as to be useless, since voltages of the order of 100-250 are



Close-up of the layout of the resistance capacity double time-base. The two thyratrons used are Ediswan MR/AC.1's. The use of tubular condensers makes a neat and compact job of the wiring.

required to produce a full traverse of the beam. However, by raising the H.T. voltage applied to the time-base to 1,000, the initial linear portion can be made to cover a range of approximately 200 volts, and at the same time the constant-current characteristics of the circuit can be accurately maintained since the charging resistance is very high in comparison with the impedance of the condenser. For example, between the discharge and full charge conditions of the condenser, the voltage fluctuation across the resistance is only approximately 10 per cent. of the supply voltage, and this change is insufficient to cause the curve to depart appreciably from linearity. The advantage of this circuit is its simplicity and its low power consumption compared with the low voltage constant current control arrangement.

A full diagram of the double time-base is shown. In the time-base for the horizontal traverse of the beam (12½ per second for 30-line transmission), the .5 mfd. condenser is charged through the variable 2-megohm resistance shown connected in series with it and the H.T. supply. Across the condenser is the thyratron (Ediswan MR-Ac.1), the grid of which is connected to a potentiometer for adjustment of the striking voltage.

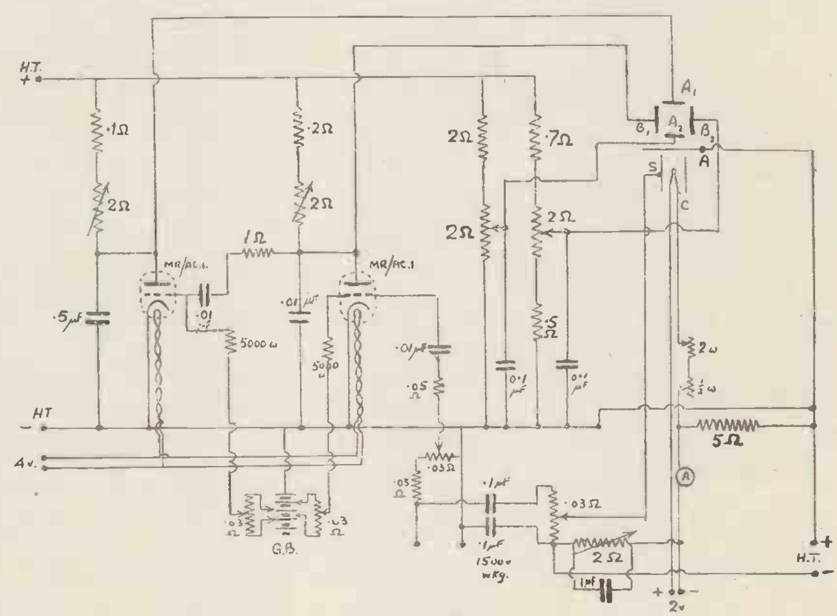
A similar arrangement is used for providing the traverse of the beam (375 cycles), the value of condenser being reduced to .01 in this case. The synchronising signal received from the transmission is arranged to trip the grid of the 375 cycle thyratron which is conected to the receiver output terminal through the condenser and resistance shown. The horizontal time-base is also interlocked with the vertical one by means of a resistance and condenser joined between the anode of one thyratron and the grid of the other. This ensures that the horizontal timing stroke receives one impulse in every 30 from the vertical time-base.

One of the vertical and one of the horizontal deflector plates of the tube are connected to the anodes of the respective thyratrons. Since these plates are now at a D.C. potential above the anode of the tube, the line screen will be forced off the centre of the fluorescent screen. It is restored by applying a bias to the opposite deflector plates which are connected to 2-2 megohm potentiometers shown across the H.T. supply.

The cathode of the tube itself is supplied from a 2-volt accumulator and the anode from 1,000 volts H.T. supply. The rectifier circuit for supplying the tube and time-base potentials is shown in the separate diagram. Owing to the low current taken by the accelerating electrode of the tube, resistance smoothing is found to be adequate and a 200,000 ohms resistance is accordingly included in the H.T. lead.

The focusing of the tube is carried out by adjustment of the negative potential applied to the cylinder surrounding the cathode which is connected through a potentiometer to a self-biassing resistance. The incoming signal from the television receiver is applied through two isolation condensers to the potentiometer, and the consequent fluctuations in the bias voltage modulate the intensity of the beam as it travels over the screen.

The notable difference between the cathode-ray system of television reception and mechanical system lies in the small amount of energy required from the receiver to modulate and to synchronise the scanning beam. Full modulation of the beam is generally accomplished by a voltage of 10/20, and in consequence the receiver need only have a medium-impedance valve in the output stage. This is a particular recommendation for the cathode-ray system for those who are unable to provide the power output required for mechanical scanning system. Although the size of tube is small, the image is of sufficient clarity to be easily viewed at a distance of 15/20 ft., as the succeeding demonstration showed.



The circuit arrangements used for the demonstration of the cathode-ray tube.

The lecture was followed by a demonstration of the cathode-ray tube used in conjunction with the circuits described above, and with the aid of a small portable scanning disc transmitter various still life pictures were shown on the screen of the tube to enable the audience to judge of the detail obtainable.

The authors expressed their thanks to Professor MacGregor Morris for taking the chair, and the University authorities who had arranged for the demonstration.

The New Moscow Station and Television

Construction of the Moscow Radio Centre is to begin early this year.

The new centre will house all Moscow broadcasting, whether long or short wave or television, and will be able to put six independent programmes on the air at once.

Soviet engineers report such steady progress in television that they believe that by the time the new centre is completed wide use will be made of this new form of broadcasting. Many of the studios, therefore, will be equipped for visual broadcasting, using equipment more advanced than any to be found in the existing stations. The possibilities of short and ultra-short wave lengths will also not be neglected.

RECENT DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS
Specially Compiled for this Journal

"Saw-tooth" Scanning for Cathode-ray receivers
(Patent No. 400976.)

In reception, the "sweep" of the cathode-ray over the viewing-screen must, of course, be synchronized with the scanning frequency used at the transmitting end.

The synchronizing line frequency applied to the receiver must, therefore, be such as to make the cathode-ray move steadily across the viewing-screen for one half of each cycle—the effective half—and then return very quickly over a non-working path ready for the next line. In the same way, as each picture is completed, the ray is rapidly returned—again over a non-effective path—to the starting point ready to begin the new picture.

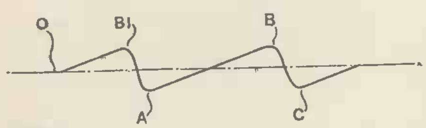


Fig. 1.

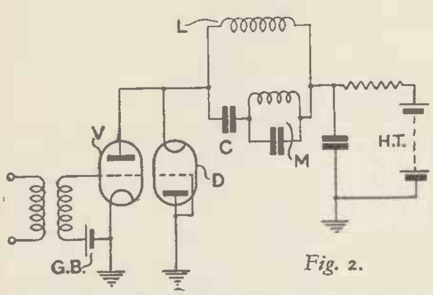


Fig. 2.

A scheme by the E.M.I. and A.D. Blumlein for the production of control oscillations for saw-tooth scanning in cathode-ray receivers.

In both cases control is effected by means of what may be called a saw-toothed oscillation, i.e., one with a slow uniform forward stroke from *A* to *B* (Fig. 1) and a rapid return stroke from *B* to *C*.

The invention is principally concerned with ways and means for producing "control" oscillations of this kind.

In the generating circuit shown in Fig. 2 a low-resistance coil *L* is connected in the plate circuit of a valve *V* with a positive bias from the battery *GB* on its grid. The positive bias gives the valve *V* a comparatively low impedance, so that the anode current is mainly determined by the inductance of the coil *L* and increases uniformly from zero o (Fig. 1) to a point *B1*. At this moment a negative synchronizing signal is applied to the grid of the valve, with the result that the valve impedance is suddenly increased.

The current is, therefore, diverted from the valve to the parallel condenser *C* across the coil *L*, and the tuned circuit starts to oscillate. After a quarter oscillation (from *B1* to *A*, Fig. 1) the current reverses in the coil *L* and the potential on the left-hand plate of the condenser *C* becomes negative.

This causes the diode valve *D* to become conducting and as it is in shunt with the circuit *L C*, it damps out the oscillation at the point *A* (Fig. 1.) The current is then reduced at a steady rate to zero by the opposing potential of the h.t. battery, so completing the cycle.

An auxiliary circuit *M* prevents spurious oscillations at half the scanning frequency. The coil *L* may either be the actual control coil applied to the bulb of the cathode-ray tube, or may be coupled to it.—(*Electrical and Musical Industries* and *A. D. Blumlein.*)

Concentrating the Ray
(Patent No. 401727.)

As the cathode-ray is swept to and fro over the fluorescent screen, during the scanning operation, there is a tendency for it to be dispersed. In other words, instead of remaining a clear-cut spot it spreads over a wider area, and so reduces the definition of the resulting picture. The inventor proposes to avoid this effect by inserting special auxiliary electrodes which are designed to ionize the residual gas-content of the tube. The resulting free ions mingle with the electron ray, and because they carry a positive charge tend to concentrate the electrons about themselves, instead of spreading.

As an alternative to the ionizing electrodes, small pockets of radio-active material may be inserted in the walls of the glass tube to produce the desired ionizing effect.—(*M. von Ardenne.*)

Fluorescent Screens
(Patent No. 402411.)

Flourescent screens made of the usual zinc-sulphide or calcium tungstate are liable to deteriorate with use, so that their sensitivity or response falls off. The inventor has discovered that by using potassium water-glass, as a binding agent for the fluorescent substance, a much brighter spot can be secured and maintained. In certain cases the spot reaches an intensity of between two and three candle power.

In addition the new material is less sluggish and has a higher electro-optical efficiency than that hitherto used. Cadmium tungstate may also be mixed with potassium water-glass and painted on to the end of the tube to form the viewing screen.—(*M. von Ardenne.*)

"Screw" Scanning Drum
(Patent No. 402401.)

A good deal of work has been done, particularly in Germany and America, with the screw type of scanning mirror built up of a number of mirror strips laid one on top of the other. Each strip is set at a slightly different angle to the common axis, so that when completed the scanner resembles a solid helix or screw.

In the television receiver shown in Figs. 1 and 2, the source of light is an elongated neon lamp *L*, carefully screened from the eyes of the observer by a shield *L1*. The lamp *L* is at the principal focus of a cylindrical lens *L2*, so that all the rays which pass through on to the screw mirror are parallel, and they remain parallel after they have been reflected from the scanner towards the eyes of the observer.

As will be seen the scanner is mounted to rotate about a horizontal axis *A*, the number of mirror strips being equal to the number of scanning lines.

The information and illustrations relating to patents are given with the permission of the Controller of H.M. Stationery Office.

The arrangement has two special features of advantage. In the first place both of the longer faces of each of the strips marked 1 to 10 act as reflectors, so that the picture to be scanned is covered twice, instead of once, during each complete rotation of the screw. The ends of each strip, it should be mentioned, are painted a dead black so as to prevent undesirable "stray" reflection.

In the second place the fact that the reflected light leaves the scanning mirrors in parallel rays means that the exact position of the observer is immaterial. In fact, the device can be regarded as a kind of window, through which the picture is projected directly, without requiring the use of any other viewing screen. So long as an observer can see the "window" formed by the outline of the rotating screw he will be able to view the received picture. —(*Electrical Research Products Inc.*)

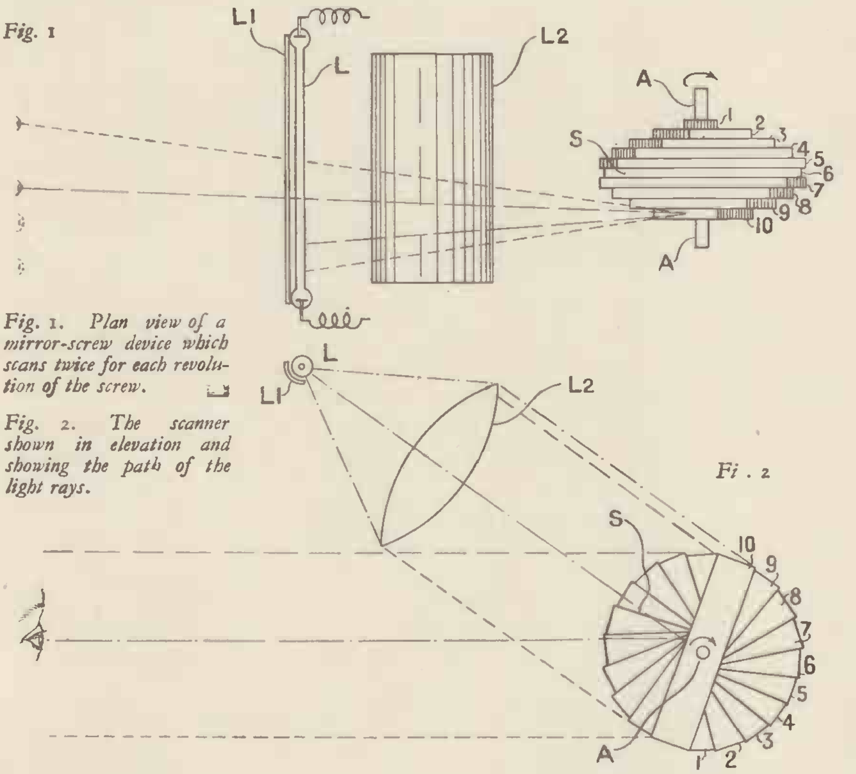


Fig. 1. Plan view of a mirror-screw device which scans twice for each revolution of the screw.

Fig. 2. The scanner shown in elevation and showing the path of the light rays.

Other Television Patents

(Patent No. 401355.)
Method of using a spark-gap or arc as the source of light in a television receiver.—(*Marconi's Wireless Telegraph Co. Ltd., W. A. Appleton* and *D. L. Plaistowe.*)

(Patent No. 401563.)
Means for controlling the level of modulation according to the changing values of average light and shade.—(*Marconi's Wireless Telegraph Co. Ltd.*)

(Patent No. 402069.)
Receiving system utilising a stationary bank of tubular photo-electric cells and a travelling band scanning device. —(*H. F. Hazell* and *R. H. Dent.*)

(Patent No. 402076.)
Scanning system including a series of light-sources arranged spirally on a disc.—(*H. F. Hazell* and *R. H. Dent.*)

(Patent No. 402121.)
Direction-finding system utilising television signals.—(*Marconi's Wireless Telegraph Co. Ltd., H. M. Dowsett* and *D. L. Plaistowe.*)

(Patent No. 402122.)
Direction-finding system utilising television signals.—(*Marconi's Wireless Telegraph Co. Ltd., H. M. Dowsett* and *R. J. Kemp.*)

(Patent No. 402134.)
Apparatus for generating saw-toothed oscillations suitable for controlling a cathode-ray receiver.—(*Electrical and Musical Industries Ltd.*, and *M. Bowman-Manifold.*)

(Patent No. 402181.)
Safety devices for preventing the fluorescent screen of a cathode-ray tube from being damaged by the electron stream.—(*Electrical and Musical Industries Ltd.*, and *M. Bowman-Manifold.*)

(Patent No. 401634.)
Producing saw-toothed oscillation for synchronizing in cathode-ray receivers.—(*Electrical and Musical Industries Ltd.*, and *M. Bowman Manifold.*)

(Patent No. 402291.)
Synchronizing systems.—(*Radio Akt. D. S. Loewé.*)

Our Policy
"The Development of Television."

Television Broadcasts in U.S.A.

Two years ago W6XAO became the first ultra-high frequency television station in the U.S.A., broadcasting on regular schedule. Five months later, on May 1, 1932, the first television image ever received in an aeroplane anywhere in the world was broadcast from W6XAO to a Western Air Express tri-motored Fokker and viewed by press representatives.

With the inaugural broadcast of W6XS on the first anniversary of W6XAO this new 1,000 watt transmitter was soon heard and received across the continent at Houlton, Maine. Immediately after the Los Angeles-Long Beach earthquake of March 10, 1933, the Los Angeles television stations transmitted scenes of the disaster before the public was admitted to the stricken area, demonstrating the ability of television to transmit pictures quickly and accurately.

Soon after this the stations began showing regular editions of Pathé newsreels, Paramount trailers, shorts and full length features. Estimates of films shown reveal that nearly five million feet of motion picture films have been televised on regular schedule. This is believed to be the largest television footage ever exhibited.

* * *

The Jenkins—De Forest Radio & Television Corporation of U.S.A. has been purchased by the R.C.A.

* * *

The Mervyn Sound & Vision Co. Ltd. state that an error occurred in their advertisement last month. The bearings, spindle, etc., for the mirror-screw receiver were priced at 4s. This should have been 8s. They also state that the price of the mirror plates has been reduced to 1s. each.

Correspondence

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

Mechanical Filter Devices :: Television Nomenclature
The Theory of the Kerr Cell :: The Case for High Definition
The Special Disc Receiver :: The Mirror Screw

MECHANICAL FILTER DEVICES.

Sir,

I should like to state as a reply to the letter from the Baird Company on mechanical filters that I was aware of their patent.

However, I should point out that the use of an elastic member between the drive and the scanning device was used and publicly demonstrated at least three years ago to the writer's knowledge for the express purpose of reducing hunting when used for television. Parallel usage can be found also in the talkie industry.

I think that the quoted phrase "the apparatus may take the form of a spring coupling between the drive and the scanning device" is inclined to be a little misleading. No specific mention is made of such an arrangement in the specification.

However, I do think that the arrangement as protected and used by the Baird Company deserves credit, although it has, of course, certain disadvantages.

C. P. Hall (North Cheam).

* * *

Sir,

I should like to add a few remarks on the use of a flexible coupling between the driving motor and the scanning device in television apparatus, as was described in an article which appeared on page 389 of your November issue, and subsequently commented upon in a letter from the Baird Television Ltd. in the January issue.

I am afraid that the patent referred to therein may have been taken out with the unfortunately mistaken idea that the use of a flexible coupling in this way was not previously known in television circles. In the course of our experimental work Captain R. Wilson and myself have regularly used such flexible couplings for some five years, and the television apparatus which we have publicly exhibited at the four annual exhibitions given by the Television Society has incorporated such a flexible coupling between the motor and scanning device on each occasion. This was first shown at the Exhibition at the old Engineers Club in 1928, but had been shown to many people in our laboratory even earlier than that. I am always open to correction, of course but it seems that our work anticipated the patent mentioned by some two years.

I am afraid that a somewhat similar situation may exist in the case of certain quite recent patent applications which have been brought to my notice, and which concern the use of both the ordinary and extraordinary rays with the help of double-image prisms, in apparatus of the Kerr cell type. This improvement is, I believe, the invention of my colleague, Mr. Leonard M. Myers, who demonstrated it to me in May, 1932, after having given numerous previous demonstrations. Mr. Myers described this arrangement in his recent lecture to the Television Society.

E. L. Gardiner (London, N.W.I.)

* * *

TELEVISION NOMENCLATURE.

Sir,

In your January issue I noticed with interest an article "Television Nomenclature" in which Mr. J. Peers very ably places before the reader a hundred and one ways of naming television and radio apparatus. Many months ago I contributed a postcard bearing a lot of similar names. Mr. Peers has collected a very imposing and formidable number of names. May I suggest that our next step is to begin a process of elimination? May I also suggest we endeavour to tend towards simplicity, i.e., to eliminate unwieldy words?

In speaking of a broadcast set, for instance, I definitely prefer to give it the short and sharp American name of "Radio" rather than the more clumsy English "wireless set" in spite of the fact that thousands of Englishmen will disagree with me. The French "telegraphie" or "telephonie sans fils" makes me shudder. Also every European country, including France herself, understands the word "Raa-dio," whereas "wireless set" would probably be meaningless to them.

May I therefore suggest those names which, out of all those mentioned in Mr. Peers' article, appeal to me as being suitable for everyday use?

Sound receiver only—radio (or radio receiver); vision apparatus only—visor (or vision receiver); amplifier for vision apparatus—vision amplifier; amplifier for radio apparatus—radio amplifier; combined sound and vision outfit with or without associated amplifiers—radiovisor (or radiovision receiver); as above with gramophone equipment—radiovisorgram; ditto, with cinematograph attachment—cineradiovisorgram.

The latter, I admit, does not sound so simple, but I have only added one syllable for each addition to the apparatus and I don't suppose there will be many who will build such an outfit. The above list carefully avoids the word "tele" and the Baird Company's registered trade mark "Televisor" which Mr. Peers turns down in his article. Audio-vision or audiovisor and audiovisorgram are all good words worth consideration. It will be interesting to watch and see which words will ultimately establish themselves in the limelight.

C. Blatherwell (Leeds)

* * *

THE THEORY OF THE KERR CELL.

Sir,

I should like to point out some discrepancies which appeared in an article in the January issue of Television. On page 22 a table of Kerr constants is given for three liquids. Now this particular constant is obtained from the Kerr expression:

$R = K1$ (cms.). P^2 (volts per cm.)

using the same notation as in the appendix of the article. R is the linear retardation and for this purpose is expressed in Angstrom units. This gives as Kerr constant:

Carbon bisulphide, $3.2 \cdot 10^{-7}$
Nitrobenzene, ... $19.2 \cdot 10^{-6}$
Meta Nitrotoluene, $17.3 \cdot 10^{-6}$

These results have been confirmed by Schmidt (Ann. d. Phys., 7.142. 1902.)

In appendix 1, page 37, it is stated that for a birefringent liquid

$$KP^2 = \left(\frac{1}{\lambda_x} - \frac{1}{\lambda_y}\right)$$

but this is incorrectly expressed. The expression for a birefringent liquid is, as above, $R = K1P^2$.

Now if the retardation is to be

expressed in terms of the wave lengths of the two components, we have, from the elementary theory of birefringence

$$R=Z\left(\frac{\mu}{x}-\frac{\mu}{y}\right)$$

(Preston "Light" 5th ed., p. 106.)

If we now express μ in terms of the ratio of the velocity of light in air to that in the liquid we have

$$R=Z\left(\frac{V}{v_x}-\frac{V}{v_y}\right)$$

in which V is the velocity of light in vacuo. Substituting for the wavelengths we have

$$R=Z\lambda\left(\frac{1}{\lambda_x}-\frac{1}{\lambda_y}\right)$$

or $$KP^2=\lambda\left(\frac{1}{\lambda_x}-\frac{1}{\lambda_y}\right)$$

which is the desired expression.

The angular phase difference is given as $\Delta=2\pi K1P^2$.

Now linear retardation is to the wavelength as angular phase difference is to 2π. Thus $R : \lambda=\Delta : 2\pi$. Hence $\Delta=\frac{2\pi R}{\lambda}$

Substituting for R we obtain:

$$\Delta=\frac{2\pi K2P^2}{\lambda}$$

which is the desired expression.

In appendix 2, the intensity expression should be

$$I^1=I\sin^2\left(\frac{\pi K1P^2}{\lambda}\right)$$

In this case a^2 does not equal unity; it is equal to the intensity of polarised light emerging from the polariser. The presence of λ will serve to explain the occurrence of chromatic dispersion discussed in the last section of the article. The final expression should be:

$$I^1=I\sin^2\left\{\frac{\pi}{2}\left(\frac{V}{E}\right)^2\right\}$$

As above I represents the intensity of light leaving the polariser, the intensity of light entering the polariser being twice this amount.

In appendix 1, I, the intensity, cannot stand for the incident light vector. It is usual to express the incoming light as a vibration—a sin wt (Preston "Light" p. 410.).

L. M. MYERS (*Hampstead*).

* * *

SIR,

With reference to Mr. Myers' letter that you have afforded me an opportunity of reading, I feel that Mr. Myers' difficulties may be cleared up by reference to the excellent paper by H. E. Kingsbury ("The Kerr Electrostatic Effect": Review of Scientific Instruments, Vol. I, No. 1—new series), of which, as I stated in my article, I have made extensive use.

My authority for the values of Kerr constants for nitrobenzene and metanitrotoluene is F. Hehlgans (Ueber die Abhaengigkeit einiger elektrischer und elektrooptischer Konstanten von Nitrobenzol und Nitrotoluol vom Reinheitsgrade: Phys. Zeitschr. XXX, 1929, pp. 942-946).

This reference was given in a footnote to my article but was unfortunately left out on publication owing to a compositor's error.

J. C. WILSON (London, W.C.2).

* * *

THE CASE FOR HIGH DEFINITION.

SIR,

With reference to the article by Mr. S. Sagall, in the issue of TELEVISION for January, 1934, may I make a few comments? Mr. Sagall is more than justified in complimenting the B.B.C. on the thought and work that they have brought to bear on the improvement of studio technique, in connection with the 30-line television transmission by the Baird system. I think that, especially in the televising of small plays, ample entertainment value has been provided at the transmitter but, in my opinion, there is no real entertainment value in watching a single person singing, dancing or speaking, especially when only head and shoulders are shown, save in exceptional circumstances.

In the case of plays, although the entertainment value may be present at the transmitter, it certainly does not exist at the receiving end and as long as the present band widths are restricted to 8 or 12 Kc. it is quite impossible to obtain pictures of a quality sufficient to keep the general public looking at a televisor for more than 5 or 10 minutes at a time, while after three or four occasions they will cease to be interested at all. In order to provide entertainment which will attract the general public it is necessary to provide something approaching that given by the home cinema. If we assume that the smallest size of picture which is suitable, is, say, 8 in. by 8 in. and that the maximum permissible picture element size is about $\frac{1}{16}$ in. square, it follows that we shall require a band width of:—

$$\frac{(8\times16)^2}{2}=8{,}192 \text{ cycles per second}$$

for one picture per second. Now, since flicker is still slightly visible with high brilliance even at 25 cycles per second we cannot afford to drop below this frequency so that the band width thus becomes:—

$$8{,}192\times25=204.8 \text{ Kc.}$$

In the opinion of many people even 25 pictures per second are insufficient, while a picture of 128 lines (8 × 16) is certainly not capable of giving as good definition as a home cinema film, therefore one cannot contend that these aims are too high.

For these reasons, I consider that Mr. Sagall's complaint that the B.B.C.'s attitude needs defence, is quite unfounded, for, if the B.B.C. were to continue on the present basis no "further progress in the direction of supplying the public with good receivers" could possibly be envisaged. This is no criticism of the B.B.C.'s action in having provided 30-line transmission, for it is necessary to learn to crawl before one tries to walk, but, having learnt to walk it would seem a pity that the B.B.C. should continue to crawl at Mr. Sagall's request.

I, also, "speaking with some measure of intimate knowledge of the problems involved" would say that a high-definition transmission of much better quality, more easily handled and controlled by the recipient, and of almost unlimited dramatic scope, could easily be broadcast at a very early date.

With reference to Mr. Sagall's remarks on the Berlin Radio Exhibition (August, 1933), I myself spent four entire days there and I disagree with the statements in his article on this subject, except with regard to synchronisation.

Good synchronisation was certainly not demonstrated at the Exhibition but, in fact, *absolutely perfect synchronism* has been obtained in this country.

Dr. Skaupy's statement that "the making of cathode-ray tubes, which would preserve unvaried, over a long period, their small gas contents, which is essential for a sharp concentration of a picture, is not at all easy, etc." is not agreed with by the writer.

Mr. Sagall says that the Berlin Exhibition showed that a 90-line mechanical device was superior in definition to a 180-line cathode-ray tube. This statement is definitely misleading, for Mr. Sagall is obviously referring to a 90-line mirror screw receiver which was receiving only a head, not even head and shoulders, and had the advantage of a (spurious) three-dimensional effect, due to the fact that the image was seen directly in a mirror; while the cathode-ray receivers were showing larger scope

(*Continued on page* 80)

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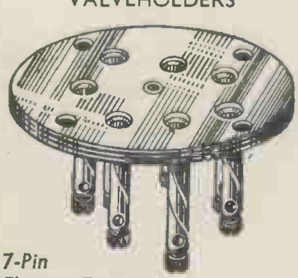

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Correspondence

(*Continued from page* 78)

pictures, at least one or two full-length persons and often crowds of hundreds of people. Even neglecting the advantages weighing heavily in favour of the mechanical method, the definition was only just appreciably better. When one considers the difference in the band width which the amplifiers were called upon to handle, and the fact that the cathode-ray system provided real entertainment by the television of moving films of out-of-doors scenes, etc., as against a head only, no reasonable individual will disagree that the statement is most misleading.

I would suggest that much better service will be done for the community and for television in particular if all 30-line developments are dropped so soon as the broadcast transmission of high-definition pictures commences. To develop picture receivers for 30-line transmissions is now a waste of time, and I am glad to hear that the laboratory of Scophony Limited is devoting some of its attention to high-definition television.

O. S. PUCKLE (London, N.).

THE SPECIAL DISC RECEIVER.

SIR,

I am a schoolboy aged 15 and this is my first attempt at building a television set, and, having built your special disc receiver I think that you might be interested to hear of my results. I have built the receiver with the specified parts and I am working the neon lamp off your 1931 "Century Super." I have also built a two valve set of my own design on which to receive the sound. The television receiver has no synchroniser.

I usually set the motor running a quarter of an hour before the programme begins in order to allow it to settle down to the correct speed. The "Century Super" is tuned in on the speaker to the National for vision and the two-valver is tuned in to the Midland Regional. The programme begins. The output of the "Century Super" is disconnected from the speaker and connected to the neon lamp. A series of pictures are seen either floating up or down. The speed is adjusted until the picture is steady. Then very slowly the tuning condenser is slightly altered until a clear image is received. (It is usually distorted at first.) There is hardly any "floating" and I have had a steady clear picture for sometimes seven or eight minutes without having to readjust the speed of the motor, and this without a synchroniser.

I am well satisfied with my television receiver and I can thoroughly recommend it to anyone who is thinking of building this excellent piece of work.

DENIS RIDGEWAY, (London, N.W.8.)

THE MIRROR SCREW

SIR,

In view of the interest now displayed in a type of television receiver known as the "mirror screw," we have to formally announce that Scophony patents cover the manufacture, sale and use for television purposes of stepped devices, which are reflecting, are laminated, have angular displacement of the steps and are put into motion for the purpose of scanning, and also arrangements including such a device where definition in the horizontal dimension of the reproduced picture is due to the steps of the device, and definition in the vertical dimension is obtained from an image in a plane distinctly separated from the plane of the steps.

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The Ediswan Thyratron

The mercury-vapour relay, or thyratron, has a wide application to circuits requiring a relay operated by potential variations, and its use in photo-cell circuits will no doubt be familiar to our readers.

In addition, valves of this type are utilised in the scanning circuits of the cathode-ray tube when used as a television viewer, and we have tried two Ediswan MR./AC.1's in the double time base circuit with complete success.

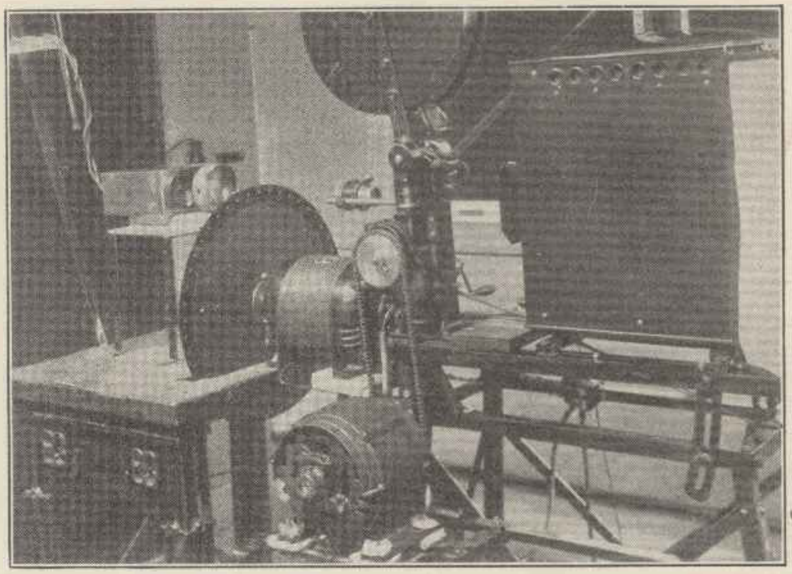
The valve is indirectly heated, consuming 1.2 amps. at 4 volts, and has a control ratio of 20 : 1—*i.e.*, one volt bias on the grid raises the striking potential of the anode 20 volts above the normal ionising potential of the mercury vapour.

It should be remembered that in mercury-vapour relays the impedance of the valve when the discharge takes place is very low, and it is essential to insert a series resistance in the anode circuit to prevent excessive current flow on "striking."

Full instructions and suggested circuits are supplied with the tube which is listed at 35s.

The makers are The Edison Swan Electric Co., 155, Charing Cross Road.

IN A LONDON TELEVISION LABORATORY



The 90 or 120-line film transmitter of the International Television Corporation showing from right to left arc lamp housing, projector head and drive, scanning disc and drive and photo-cell with associated first amplifying stage.

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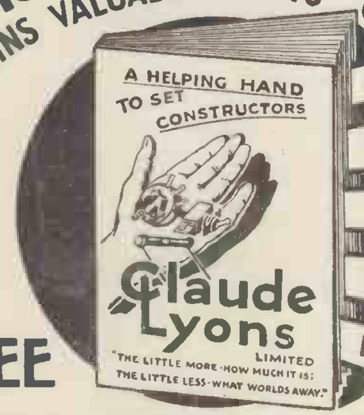

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ANSWERS to QUERIES

Using a Kerr Cell with Disc Receiver

Is it possible to use a Kerr cell or crater lamp in conjunction with a disc receiver ?—D. R. (Bradford).

Either will work, but their efficiency compared with the flat-plate or ordinary Osglim neon lamp is quite low. A combined system of Kerr cell and disc is at present being evolved, but no details are available yet.

Effect of Strong Signal

Sometimes, on a particularly strong signal, the neon lamp of my disc receiver is extinguished, as also happens when the set is oscillating. Can this trouble be prevented ?—F. L. A. (London, S.E.).

This phenomenon sometimes occurs, but it can be prevented by applying a greater voltage to the lamp.

Too Much Contrast

I am receiving pictures quite successfully, but there seems to be too much contrast between light and shade. Do you consider that this is due to the conditions under which the set is operated, and if so is it possible to effect an improvement ?—S. R. F. (Dorking).

Pictures with too much contrast are usually the result of too small a value of current passing through the neon; the remedy is the addition of a little extra voltage so that the lamp will glow more brightly when no signals are being received. A variable resistance placed in series with the lamp is a useful refinement (unless the lamp is directly in the anode circuit). A suitable value for this resistance is 1,000 ohms, and it should be adjusted by trial and error until the best picture is obtained.

The Layout of a Mirror-drum Receiver

I am designing a mirror-drum receiver and propose allowing the light beam, after emergence from the Kerr cell, assembly to pass under the drum. There is very little space for shielding unless the drum is raised, and I want to avoid doing this. Is a shield between the beam of light and the mirrors of the drum necessary, or shall I be in order in not fitting one ?—R. B. A. (London, S.W.).

There is no necessity for a shield providing that you take care that none of the light falls directly on the mirrors. The diameter of the emergent beam is quite small, and a space of one and a half to two inches should be ample.

Television from Batteries

Is it practicable to operate a television receiver from batteries, as electric light is not installed in my house ?—R. A. D. (Guildford).

Querist does not state what type of reception he intends taking up and what apparatus he intends using. However, battery operation is quite practicable using either the cathode-ray system, or the disc or the mirror screw. Battery operation in the case of cathode-ray reception is in many respects simpler and more convenient than mains operation. Though a high value of high tension is required, and current is required, the current consumption is negligible and the life of the batteries is equal to their shelf life; in other words, the batteries will last as long as they would if they were not used. In the case of mechanical systems the chief consideration is the current for driving the motor, and this can be obtained from an accumulator. High tension current consumption is not much in excess of that required for an ordinary wireless receiver. It may, perhaps, be considered impracticable to operate a receiver of the mirror-drum type from batteries for an output of approximately four watts is required from the amplifier, in addition to the current for driving the motor.

ANSWERS TO QUERIES

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

The following rules should be observed:

Please write clearly giving all essential particulars.

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

Reply will be made by post.

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

Direction of Rotation

I know that it is usually stated that the direction of rotation of the scanning disc is anti-clockwise, but does this mean when viewed from the front or back ?—B. M. (Redhill).

The direction of rotation is anti-clockwise when viewed from the front—that is the normal position for seeing the image which, of course, appears on the right-hand side when receiving the B.B.C. transmissions. To receive the German transmissions, the viewing aperture must be placed at the top because of the horizontal scanning that is employed.

Life of Cathode-ray Tube

I am thinking of buying a cathode ray equipment, but I have been told that they are fragile and do not last long.

The tube itself is just as robust as any glass bottle of similar size.

The manufacturers state that the life will not be less than 500 hours with a moderate anode voltage, but the life is reduced if the voltage is increased. You should not leave the tube running unnecessarily for long periods, and the filament current should be as low as possible consistent with good focus.

Zinc Sulphide Crystals

I shall be glad if you will tell me where I can obtain zinc sulphide crystals for use in light modulation —B.R. (Leeds).

Zinc sulphide is the natural ore of zinc, usually termed blende. Supplies can be obtained from Messrs. Johnson & Sons, Hendon Way, Hendon, London, N.W.4. Usually zinc sulphide crystals contain impurities which render them unsuitable for television purposes, this being a difficulty which has precluded their use up to the present.

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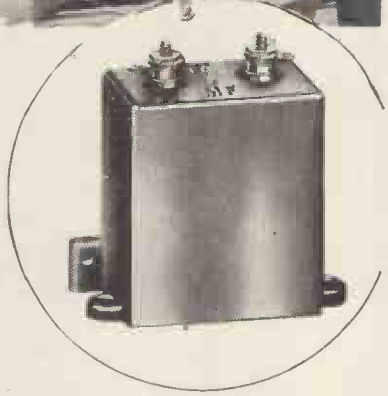

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There is news in the "Television" advertisements

"The Programmes in the North of England"

(*Continued from page 52*)

remarkably good at times and the result of the first attempt was very promising. The few friends, who saw this test, were very impressed.

The second test was made at a village called Leadgate in north west Durham. This place is situated between 800 and 900 feet above sea level. The mains supply was 220 volts 50 cycles. The pantomime Cinderella was received and the results were an improvement on the previous test. The fading was not so severe. Twice during the half hour ghost pictures appeared above the actual image.

The repeat performance of *Cinderella* on the Wednesday night was received much the same as previously with the exception that ghost images were more pronounced. In one instance the ghost image became so strong that the writer was uncertain as to whether it would replace the previous image completely. This state of affairs lasted 45 seconds and then the image disappeared.

On Friday, December 29th, the apparatus was moved to North Shields in Northumberland. There was a marked improvement in the pictures at this place. Fading was still experienced though not so severe in character. The Midland Regional however, was more difficult to obtain and faded very badly. No ghost pictures appeared. Doubtless this was due to atmospheric conditions. The synchronising difficulties were not so great as expected. This was, no doubt, due to the efficiency of the A.V.C.

The equipment was returned to Leadgate for the January 1st programme. The best results were obtained on this evening and were pronounced as very entertaining.

For the amateur in the north, there is every encouragement in the fact that while the picture signal is strong enough, little or no detail is lost through the long distance reception. Perhaps the alteration of wavelengths will reduce the amount of heterodyne interference giving added entertainment value to the looker-in.

This was the first television demonstration that any of the audience who viewed the tests had seen. One and all were amazed that such clear pictures were obtainable and were unanimous in their opinion that television had entertainment value.

The Ardenne Medium-voltage Cathode-ray Tube

IN the latest von Ardenne cathode-ray tube all the electrodes with the exception of the plate are made of non-magnetic material; the plate is slightly magnetized so as to reduce to zero the deflection caused by the earth's magnetic field. Platinum is now being used as a support for the oxide; the heating current may vary by 5 per cent. without affecting the results. The fluorescent material is no longer deposited upon the glass bulb and viewed from behind, but on a separate glass surface 4 in. by 4 in. placed obliquely with respect to the axis of the tube, the image being observed from in front.

A special committee to confer with the Federal Radio Commission on future broadcast facilities for television, facsimile, etc., comprises Walter E. Holland, of Philadelphia, chairman; J. A. Chambers, of Cincinnati, chairman of engineering for the National Association of Broadcasters; Ray H. Manson, of Rochester, N.Y., and Dr. W. R. G. Baker, of Camden, N.J.

"The Standard Television Receiver"

(*Continued from page 55*)

comes to drill large holes therein, for the mounting of components, etc. I have used, instead, a chassis constructed of the new metallised wood which, although it acts excellently as a screening material, is quite easy to work.

The wiring and layout of components should be quite easily followed from the various photographs of the set, and in order to avoid high-frequency instability you are strongly advised to keep as near as possible to the layout of the original set.

The components on the high-frequency and detector side of the set are necessarily rather cramped in order to keep all essential anode and grid leads short. But with the layout shown no undesirable interaction has been noticed.

The controls are quite straightforward and are three in number. Looking from the front of the set, the centre knob is the tuning knob which varies the four-gang condenser; that on the right is the volume control which controls the bias to the variable-mu valve, and the knob on the left of the set is the combined wavechange and on-off switch.

For operation as a television receiver the wavechange knob should be set to medium waves and the set should be tuned to the London National programme. The four tuned circuits should now be ganged up in the normal manner on this station. Ganging should be quite easy on this set, as the only station which really matters is the London National, and provided that the four circuits are accurately matched on this station no further trouble need be taken.

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(*Continued on next page*)

THE CONSTRUCTORS' CIRCLE

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* (1) I already subscribe to your journal at the address below.
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The Institute of Wireless Technology (Incorporated)

Those professionally engaged in television engineering or research will doubtless be interested to learn that provision will again be made by the Council of the Institute of Wireless Technology for such people to take a paper on Television in the Associateship Examination as an alternative to the second paper on Wireless Technology. Those taking the Associate Membership Examination will, of course, have the option of taking, in Part 2 of the Examination, subject (*o*) Television and Allied Engineering. Two papers.

The increasing importance of television has not been lost sight of by the London and Home Counties Section of the Institute, and on January 31st a lecture on the subject was given by H. J. Barton Chapple, B.Sc., A.M.I.E.E. In February a paper will be read on a different aspect of television.

In case anyone is not familiar with the Institute, it may be well to state that the Institute holds examinations in all branches of wireless technology yearly in June in various parts of the country and overseas.

The Institute of Wireless Technology is a professional institution. Two of its main objects are: (1) To promote the general advancement of, and to facilitate the exchange of, information and ideas on wireless technology, which term shall be deemed to mean and include the science, practice and engineering of wireless telegraphy and all kindred subjects and their applications. (2) To maintain the status of the profession of persons engaged in wireless technology and to set up a high standard of scientific and practical efficiency. Interested persons may obtain information respecting the examinations and membership from the Honorary Secretary at 4, Vernon Place, Southampton Row, London, W.C.1.

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Copies of TELEVISION, *Wireless Magazine*, and of *Amateur Wireless* containing descriptions of these sets can be obtained at 1s. 3d. and 4d. respectively, post free. Index letters, T., A.W. and W.M. refer to TELEVISION, *Amateur Wireless* and *Wireless Magazine* respectively. Address letters:

Television Blueprints Dept.
56-61 Fetter Lane, London, E.C.4.

Television for the Newcomer

PERCY HARRIS reviews the possibilities for the amateur experimenter

THE gratifying reception given by the public to the first number of the new series of TELEVISION shows very distinctly that many wireless enthusiasts who have hitherto confined their experiments to sound broadcast alone, are now turning their attention to visual reception.

I do not propose in this article to give you any constructional suggestions or assistance—that is admirably done in other articles—but I would like with your permission to give a few general hints and suggestions because I see so many experimenters following the path which I *know* to be a wrong one. This applies as much to sound as to visual reception but here naturally, I only want to deal with the latter aspect.

The chief danger which faces the new experimenter in television is the blind acceptance of the dicta of so-called "experts." It is a strange fact in all sciences that anything new, anything novel, anything out of the way is immediately met by opposition, disbelief and discredit. Denials, on the other hand, or alleged explanations why certain new things cannot be, are accepted at once without question or investigation, by the very people who are so clamorous in their opposition to the new thing.

If you realise it at the beginning of your experiments it will not only save you a good deal of trouble, but will give you greater confidence in what you are doing and will prevent your being misled into thinking that your ideas must necessarily be wrong, because they are not shared by, say, some noted laboratory. One of the greatest tragedies in science is that even earlier than Hertz, Professor Hughes of carbon microphone fame was actually dissuaded from proceeding with experiments in which he thought he had detected the presence of wireless waves, because scientific friends convinced him that he must be mistaken.

Progress on the Ultra-short Waves

At the present time television is making great progress on very short waves. Special receiving apparatus is necessary for these wavelengths, but the technique is by no means as difficult as many people try to make out. It seems to be generally accepted that these ultra-short waves have a carrying power which is infinitely less than that of the longer wireless waves, their range being to all intents and purposes, limited by the horizon. Being strictly analagous to light waves they are stopped by such obstacles as hills, high buildings and the like. At least, that is what most "experts" say.

Now this is, quite probably, all nonsense. It is all the more likely to be so because similar statements have been made before, in other branches of the art, and repeated at once by all the so-called experts who are always willing to believe everything which implies limitation and nothing which indicates progress.

I could give plenty of examples where the amateur has beaten the expert on his own ground. I was very amused, therefore, to observe the immediate general acceptance of the idea that ultra-short waves will not carry, and already this theory is breaking down. Dr. R. L. Smith-Rose and Mr. J. F. McPetrie, B.Sc., of the National Physical Laboratory have recently issued a paper on ultra-short radio waves which quotes several cases of transmission of these ultra-short waves beyond the distances thought possible, theoretically. Marconi, for example, using wavelengths of 50 centimetres obtained a range of 168 miles, whereas the range obtainable on the assumption that these short waves are not bent round the earth was only 107 miles. Again, the Radio Corporation of America, exploring the possibilities of providing radio telephone communication between certain islands in the Hawaiian group used a wavelength of 7 metres and found the actual ranges obtained were considerably in excess of those given by the optical or rectilinear path. In one case, according to the optical path theory the range would have been 134 miles whereas, actually 190 was obtained.

And, by the way, just to keep you thinking, are you quite sure that all of the current theories about definition in television are correct?

The Baird Crystal Palace Transmissions

It is understood that the Baird Company have been carrying out experiments with the object of improving the quality and range of the short-wave television transmissions. Regular transmissions are expected to start again almost immediately. The following are particulars of the transmissions which were made regularly during the months of October and November, 1933.

Vision transmitter: Wavelength, 6.25 metres; power, 500 watts.

Sound transmitter: Wavelength, 6.1 metres; power, 500 watts.

No. of lines on the vision transmitter: 30, 60 and 120.

No. of pictures per second: 25.

Picture shape: 4 horizontal by 3 vertical.

Scanning: Horizontal (except in the case of a 30-line transmission, which is vertical).

Miscellaneous Advertisements

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.

The charge for advertisements in these columns is 12 words or less 2/-, and 2d. for every additional word. All advertisements must be accompanied by remittance. Cheques and Postal Orders should be made payable to Bernard Jones Publications Ltd., and crossed, and should reach this office not later than the 15th of the month previous to date of issue.

The Miraco Kit Set

We are informed that arrangements have been made for the Miraco Kits to be supplied by The Mervyn Sound & Vision Co., Ltd., in the future instead of being obtainable from Grafton Radio, Ltd., as heretofore.

Two models will be available, one using a crater lamp of high intensity with standard Miraco radio receiver, at £21, and an improved Kerr cell light modulator model giving large pictures at £27 10s. A radio receiver kit will also be available for use with existing apparatus.

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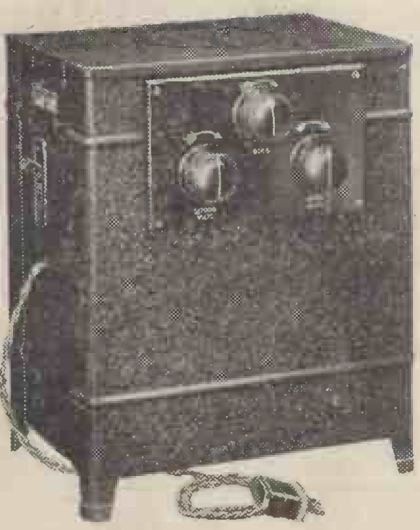

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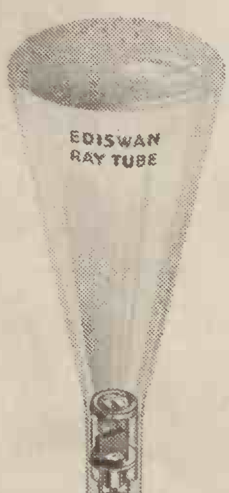

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Price £6. 6. 0.

EDISWAN

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