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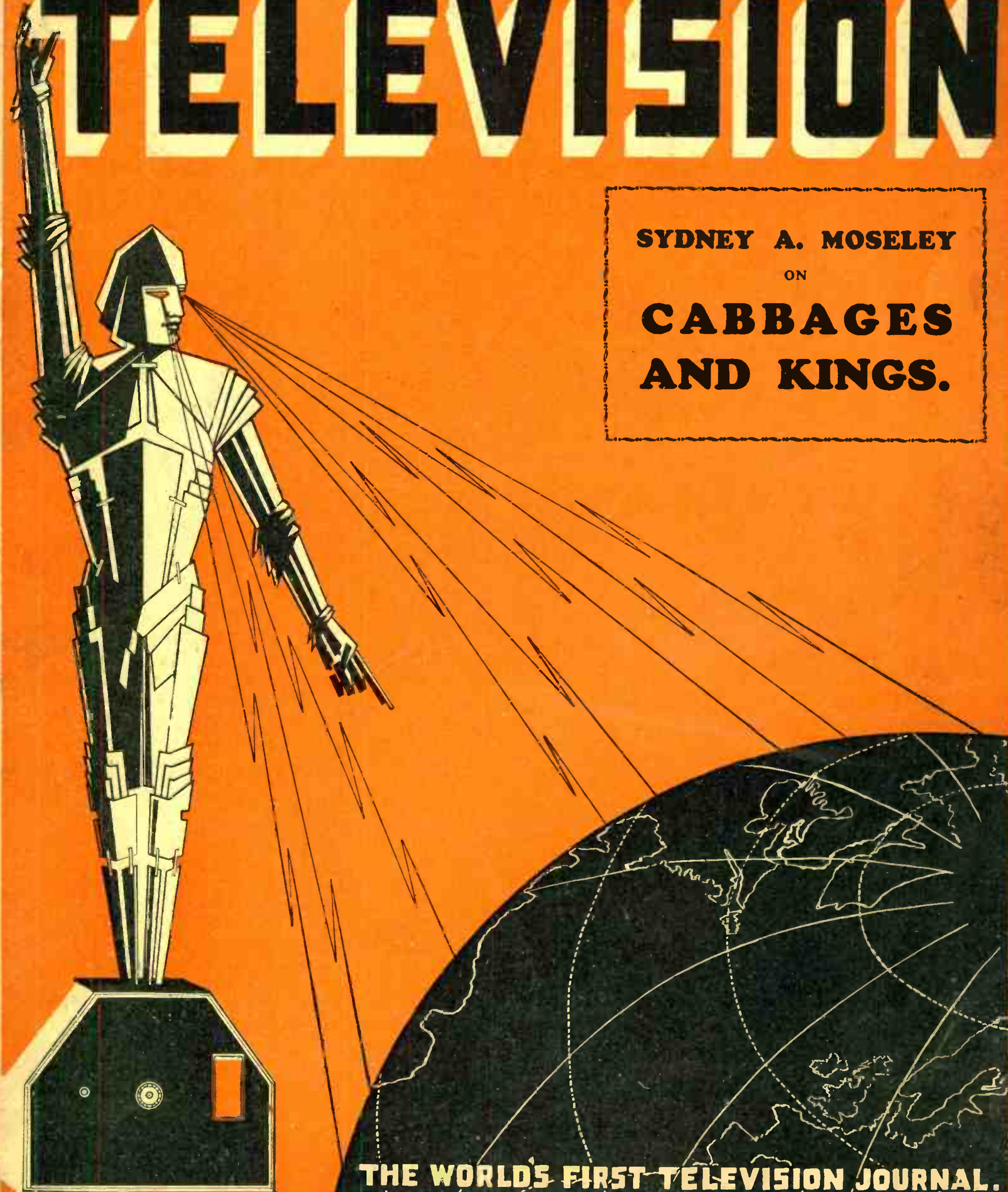
TELEVISION



SYDNEY A. MOSELEY
ON
CABBAGES AND KINGS.

THE WORLD'S FIRST TELEVISION JOURNAL.

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The Romance of Television

By *L. SAXEY.*

"TELEVISION is here!" How much more exciting and romantic that sounds than "Wireless is here!"—or "Aviation is here!"—or any other scientific wonder of this wonderful age.

We accept all these marvels with the same calmness that we pick up the morning paper, and hastily skip over any reference to the technicalities, as if they had nothing whatever to do with the matter. In the hour of triumph nobody gives a thought to the men who have done their bit towards the realisation of these scientific achievements; nobody stops to marvel at the human brain which is responsible for the ultimate result.

And since technicalities and scientific terms and illustrations are not palatable to the general public, let us take all this for granted and dwell on the lighter side of television. Let us say—"Television is here—all right. What about the people who televise? The studio—*that's* what we're interested in."

The studio, of course, is the centre of attraction. It must be, because from within those padded walls where we tread with fear and whisper behind our handkerchiefs the proof of television is to be forthcoming.

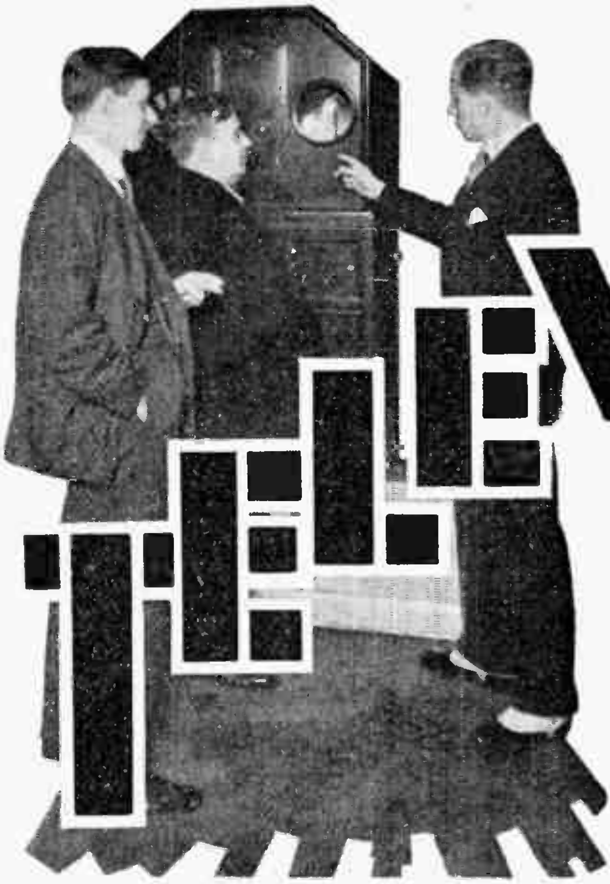
Since television has, so to speak, received official recognition, many well-known artistes have slipped into that little room, over the door of which blaze the awful words: "SILENCE—PROGRAMME ON."

In another room, larger, heavily carpeted, and in darkness, we see who it is that is sitting in front of the televisor. Ah! We have recognised that uplifted face, that halo of shining hair. Sybil Thorndike! From an adjacent loud speaker come the deep, rhythmical tones of her voice, reciting to us from Robert Louis Stevenson, and we watch, fascinated, the movements of her expressive mouth. At the end she drops her head and looks at us with a deep smile . . . . *Now* we're watching Gracie Fields—and we laugh like the dickens when she wrinkles her nose and bobs her head towards us with the absurd straw hat perched on the crown. She is telling us "Nowt about Owt," and pointing the moral with the feather in her hat. As we watch the amazing facility of her facial contortions we marvel again that "television is here."

De Groot plays to us and we see his violin; Annie Croft charms us with her smile; Marie Burke sends little cold shivers of pleasure down our spines when she sings and smiles at us. The beauty and the variety we find in that televisor!

We can *see* them all. Our favourites appear to us exactly as we know them, living, breathing; it is a friend, that large, polished cabinet, because in the glass panel we can see with our eyes who it is singing that song we like.

Television—thy name is Romance!



TELEVISION

THE OFFICIAL ORGAN OF THE TELEVISION SOCIETY

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EDITORIAL

WE have just received a report from America that the General Electric Company have given a demonstration of television on a screen measuring six by seven feet. We learn that this was achieved by means of a lens disc and Kerr cell, the picture having 48 lines. A great deal of publicity has been given to this demonstration, and it has been hailed as a great advance. It appears to have been forgotten that similar devices have been used previously to give similar results both in this country and in Germany. As early as 1928 Mr. Baird was producing life-size images with excellent detail of the head and shoulders of human beings in the check receiver which he used to observe the experimental transmissions which culminated, in March, 1928, in the successful wireless transmission of television from London to New York, while in January, 1929, a demonstration was given in the Baird laboratories of television images on a screen four feet in diameter. This demonstration was described by Dr. C. Tierney, D.Sc., F.R.M.S., in our February, 1929, issue, in the following words :—

" In company with a number of distinguished visitors to Mr. Baird's laboratories, I subsequently witnessed the received image of a well-known person projected on to a screen some 4 feet in diameter, which could be seen and recognised by a large audience. The result, though as yet not fully developed, was astonishing . . . every movement of the head, etc., was reproduced with fidelity. . . ."

In our Editorial in the same issue we wrote the following :—

" A further development described by Dr. Tierney relates to the projection of the received images on to a screen some 4 feet in diameter. Such a size of screen makes it possible to demonstrate television to a number of people at once. It could, in fact, be employed in a small hall. This marks the first step towards the ultimate development of the size of the image to cinema dimensions, so that audiences in picture theatres may witness a reproduction, not of something which happened some time previously as is the case with a cinema film, but of something which is actually happening at the moment of presentation."

In addition to the above demonstration, Dr. Karolus, of the Telefunken Company demonstrated at the Radio Exhibition in Germany images on a large screen by means of the Kerr cell, as reported in our October, 1929, issue.

There therefore appears to be little of novelty about this much advertised achievement, and it seems to us regrettable that on this, as on many previous occasions, the British Press should so readily lend itself to the intensive propaganda of the gigantic business corporations which control the electrical industries in America.

The impression created in the public mind would certainly be that the Americans have made some fundamental advance in television whereas it would appear that they are merely "stunting." Television has suffered far too much in the past from "stunts," and it is time that television workers in all countries abandoned this sort of thing and concentrated on real work.

* * *

TELEVISION-MINDEDNESS.

It was, we believe, Sir Sefton Brancker who set out to make this nation air-minded, and he is rapidly succeeding in the accomplishment of his task. During the last few months the Baird Company has been doing its best to make us all television-minded, and is fast succeeding. Commencing with the Radio Exhibition at Olympia last year, demonstrations of television were given to all the leading radio manufacturers and dealers in the country. Immediately afterwards, demonstrations were given to members of the public at Selfridges. More recently demonstrations have been given to the public at the *Daily Mail* Schoolboys' Exhibition in London, and the *Daily Mail* Ideal Home Exhibition at Olympia. At the latter exhibition alone it is estimated that 65,000 people saw television for the first time.

In the provinces, demonstrations have been given at Sunderland, Manchester, Glasgow, Southampton, Bournemouth and Reading. Altogether, several hundreds of thousands of people must have witnessed these demonstrations. In the early days of wireless broadcasting it was just such demonstrations as these which made us all radio-minded, and provided the country with a new industry. Let us all become television-minded and provide the country with still another and sorely needed industry which will help to reduce our appalling unemployment figures. We appeal to all our readers, especially members of the Television Society, and all radio-minded people to infuse with their enthusiasm for this new science all their friends and acquaintances. Talk to them about television. Tell them what it is. Demonstrate it to them where possible. Make them television-minded.

There are some enthusiasts to whom it appears that television is progressing all too slowly. Our answer is that, as Einstein has shown us, speed means nothing without a relative point with which to compare. Less than thirty years of flying have produced an Amy Johnson. Less than four years of television have produced a daily broadcasting service and a commercial instrument for use in the home. *Verb. sap.*

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TELEVISION AND THE TRADER.

A large number of far-sighted wireless dealers up and down the country have lost no time in taking up television. A full list of them appears on another page of this issue. It is the early bird who catches the worm, and these enterprising traders will undoubtedly reap the benefit of their determination to be first in the field in the budding new television industry.

In this connection we are interested to note in the current issue of *The Wireless and Gramophone Trader* a letter from "Uncle Tom" Payne, of Payne & Hornsby, Newcastle-on-Tyne, in which he describes how he was the first in the north of England to receive the experimental night television transmissions from Berlin-Witzleben. To this letter the Editor adds the following significant note :—

"A particularly interesting feature of Mr. Payne's television success is that it is bringing him well-deserved publicity in the local press. A representative of the Newcastle *Evening World* attended the successful experiments detailed here, which will certainly react to the benefit of his ordinary business."

We therefore exhort everyone to *become television-minded*, and HELP US TO HELP YOU !

Television for the Beginner

PART VI

By *John W. Woodford*

WELL, readers, we have negotiated the first "obstacle," namely, the transmitting end, in our examination of television for the beginner, and I hope you have found little difficulty in appreciating and absorbing the details which I have endeavoured to put before you in relatively simple language. It is not an easy matter to write about a highly technical science like television in non-technical phrases, and if I err on occasions, be sure and let me know your difficulties, big or small, and I will endeavour to help you by tackling the queries from another viewpoint.

At the Receiving End.

We promised ourselves a trip to the receiving end in this instalment, so that an examination could be made of the principles to be fulfilled for the vision signals to be transposed into intelligible images. I must admit that at first sight the whole thing seems to border on the impossible. I felt the same way myself when I first read in the daily press three or four years ago of Mr. Baird's exploits, but I was soon converted when I examined the whole scheme carefully, and I want to convince you in the same way.

Now it is perfectly obvious that since the vision signals are broadcast into space through a wireless transmitting station, a wireless set is necessary for receiving them in your own home. Nearly every month this journal has some interesting information to impart through the medium of its contributors about wireless receivers for television, so for the time being at least we will direct our efforts towards the vision-receiving apparatus itself.

This has very appropriately been called the "televisor" by the Baird Company. In just the same way as your loud-speaker acts as the medium for conveying sound to your ears, so the "televisor" acts as a vision recorder and appeals to your sense of sight. The combination of loud-speaker and "televisor" with the present dual transmissions being broadcast from the two Brookman's Park stations is sufficient to convey complete intelligence to the individual who takes advantage of them.

First of all let us draw up a list of the component parts which must be included in our vision apparatus, and we can then discuss each one in turn.

Parts Required.

Speaking broadly, we shall want :—

(*a*) A scanning disc complete with its spiral of 30 square and rectangular holes, so that the process of graduated exploration which I discussed in Part 4 can be undertaken.

(*b*) A suitable motor for driving the disc at its correct speed, namely, 750 revolutions per minute.

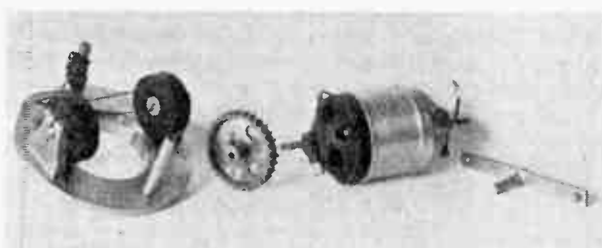
(*c*) Synchronising mechanism to "hold" the image steady.

(*d*) A neon lamp.

(*e*) A variable resistance to act as a speed regulator for the motor.

(*f*) A suitable lens assembly to magnify the size of the image so that it can be watched in comfort.

Since we have discussed the disc fairly thoroughly when considering the transmitter, it will be unnecessary to go over the same ground again. The spiral of holes should turn towards the centre of the disc from the outside in a *clockwise* direction. Then when the disc is rotated by the motor in its correct direction, namely, *anti-clockwise*, the scanning operation will be in order, that is, hole movement from bottom to top and strip direction from right to left.

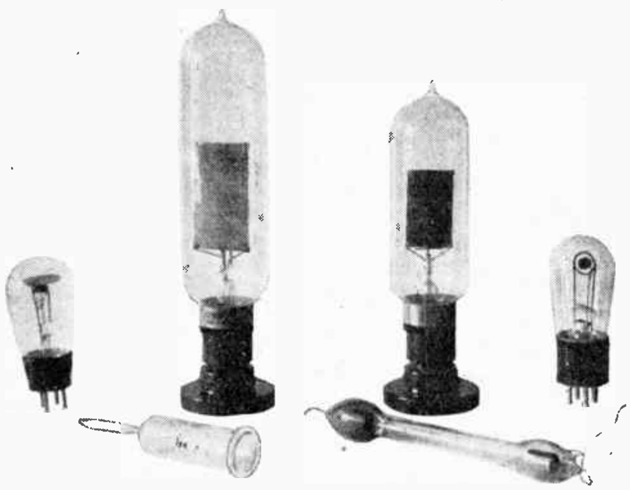


Parts of the Baird "Televisor" receiver. Left to right : synchronising electro-magnets, cogwheel, and motor.

This, of course, is based on the assumption of vertical scanning, which is the method employed by the Baird Company for their present transmissions. The disc should be light, and is preferably made from thin sheet aluminium, about 32 S.W.G. being suitable. For normal working a disc diameter of 20 inches will be found to meet most needs, and the apparatus will then not be bulky.

We next come to the motor, which is a very important item in the receiving kit. First and foremost, it must be a reliable machine, capable of running at a constant speed for long periods at a stretch without adjustments of any sort. As will be explained later, this lightens the load on the automatic synchronising mechanism which, after all, is only meant to be a form of speed control within certain limits. The normal running speed is 750 revolutions per minute, corresponding to $12\frac{1}{2}$ pictures per second, and your machine must therefore be capable of developing this speed with a margin to spare when equipped with the disc on its shaft and the synchronising mechanism is working.

Hard-and-fast rules need not be laid down as to the type of motor one should employ, but what is known as a "universal" motor is admirably adapted to the purpose in hand. As its name implies, it will run on either direct current or alternating current.



A few of the various types of neon tube which have functioned from time to time in television work.

If your house mains are direct current then an ordinary shunt motor can be used and speed control becomes quite an easy matter. For those dwellings without an electrical supply laid on, a motor deriving its power from a 6 to 12 volt accumulator supply must be pressed into service. Above all be sure and employ a machine which exhibits no tendency to indulge in sudden speed changes or this will be fatal to the work in hand.

The variable resistance used to vary the speed of the motor can be in the form of a rheostat. It is wise not to have a definite "off" position, otherwise you are liable to unconsciously move the contact arm to this position when your hand is operating the control knob but your eyes are on the image. The motor speed will at once start to drop, and you will have to start resolving the image all over again. If a wire-wound resistance is used, endeavour to obtain one whose resistance shows little alteration with changes of temperature. If not, the motor speed is liable to be continually altering as the resistance wire warms up with the passage of current.

Magnification.

Coming to the lens assembly for magnifying the image, this is largely a question of taste if you are making up your own apparatus. It is not wise to attempt to magnify the image to any great extent, say two or three times at the outside. This may be undertaken with a single lens or a combination of one single and one double lens. This last-named arrangement is used in the commercial Baird machine, and functions very satisfactorily.

The automatic synchronising mechanism is a subject unto itself, and cannot be dismissed summarily in one or two paragraphs. The commercial success of the Baird system is attributable in a large measure to this ingenious device, and later on in this series I shall describe fully the means adopted for ensuring that the motors both at the transmitting and the receiving ends run at the same speed.

A good idea of what the actual mechanism looks like can be gained from an examination of one of the accompanying photographs. The universal motor will be noticed on the right, and is seen to be quite a small affair. This can be compared with the motor shown in a second photograph, which illustrates a 6-volt type used in one of the earlier portable "televisors" employed for certain demonstration purposes.

The Neon Lamp.

It is fairly obvious that if we are to see an image there must be a light source at the receiving end, and for this purpose we require a neon lamp. There are certain types of these lamps with which you are sure to be familiar. The beehive or spiral pattern so useful for domestic purposes, especially night-lights, the shaped letter patterns which glow in shop windows and make excellent advertisement signs, etc., all fill a special need.

For television work the standard Osglim type will serve quite well, but what is termed a flat plate neon is best suited for the purpose we have in hand. A few of the various patterns which have functioned at various times in television work are shown in an accompanying group photograph, and the flat plate type is conspicuous in the centre.

At the back of your mind I am sure you are querying why this special type of lamp should be necessary for television work. Why not use an ordinary electric lamp such as we employ for lighting our home? The candle-power is ample and, above all, they are cheaper than those of the neon class.

Unfortunately they suffer from the same sort of defect which we found ruled selenium out of court, namely, sluggishness in action. Snap down the lighting switch in your own room and notice that a fraction of time elapses before your lamp assumes full brilliancy. The same thing occurs when you switch off, and although the "time lag" between current establishment and final brilliancy is small, it is sufficient to make this form of lamp entirely unsuitable for television work.

Just think of the number of light variations which take place at the transmitting end when scanning our object with the light spot. These are transposed into electrical effects, and at the receiving end we have to reconvert these rapid changes (several thousand per second) into light changes with identical rapidity. Why, our metal filament lamp would simply assume practically a mean brilliancy and remain there, and all our efforts to reconstruct vision images would be frustrated.

(*Concluded on page 176.*)

Reproduction and Amplification in Television Receivers

By *Dr. Fritz Schröter*

(Continued from April issue)

THE line screening occurring in Figs. 13 and 14 (the optical causes of which appear complicated in the consideration of the collaboration of transmitting and receiving discs) one endeavours to make as little noticeable as possible by slight overlapping of the picture lines. In addition, there is given to the aperture or light spot a special form, for example that of a rectangle or triangle, the height of which is greater than the line breadth. However, the desired object should be obtainable even without overlapping by the minutely accurate joining up to one another of the light point paths and the completely homogeneous brightness in the aperture or diaphragm shape.

3. *Time constants of the amplifier.* The neglect of time constants shall now be abolished for that place

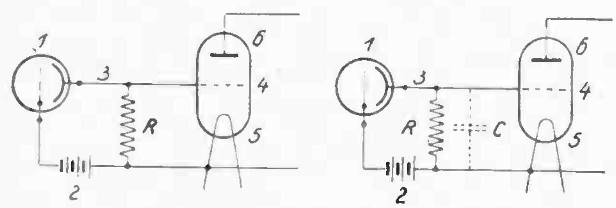


Fig. 15.—Connections between photo-electric cell and first stage of the amplifier.

at which the disturbing influence of the wiring capacity on the transmission characteristic of the frequency band makes itself particularly effective. This is the entrance grid of the photo-cell amplifier. Fig. 15 (left) shows the normal connection between the photo cell 1 and the first valve, which is represented by grid 4, cathode 5 and anode 6; 2 denotes the high tension battery, 3 the grid lead. The coupling resistance is R. The coupling with the further valves is without importance for what follows. We confine ourselves to the case of non-intermittent light and of pure continuous voltage in the circuit of the cell, which consequently yields a continuous current, i, proportional to the intensity of the light falling on the photo-cell. In this connection the grid 4 shall be so far negatively biassed that no grid current flows.

The ideal case of a purely ohmic load of the cell acting as a generator is now not realisable in reality, for the unavoidable capacity between grid 4 and filament 5, between the electrodes of the photo-cell and the connecting conductors represents a C connected parallel to R of an amount not to be neglected. We have therefore to reckon with conditions as indicated in the right-hand portion of Fig. 15. So long now as the hole of the transmitter scanning disc crosses a completely dark place, no fall of voltage is present at the extremities of R. In the transition from bright to dark ($p=O$ in Fig. 4) current begins to flow in the cell I which during the time $T=f/v$ rises to its maximum value I' and has the intensity $I'\,t/T$ at any chosen moment $t<T$. Of this current a part, i, flows through R, producing the controlling voltage $R\,i$. the rest via the capacity C which in the time $\mathrm{d}\,t$ receives the load:

$$\mathrm{d}\,Q=\left(\frac{I't}{T}-i\right)\mathrm{d}\,t=R\,C\,\mathrm{d}\,i$$

as $R\,\mathrm{d}\,i=\mathrm{d}\,V$. The integration for i is:

$$i=\frac{I't}{T}\left[1-\frac{R\,C}{t}\left(1-e^{\frac{-t}{RC}}\right)\right] \qquad (5).$$

In the time $t=T$ (duration of the complete aperture transition) i has therefore increased to:

$$i=I'\left[1-\frac{RC}{T}\left(1-e^{\frac{-T}{RC}}\right)\right],$$

that is to say, only to a fraction of its final value assumed in Fig. 4.

When $R\,C=10^{-5}$s.

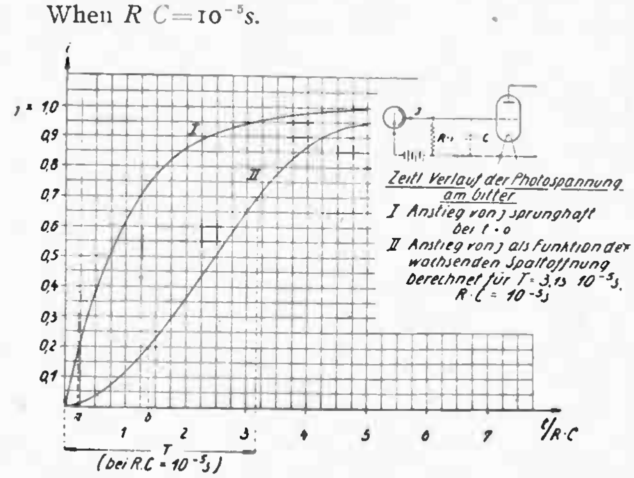


Fig. 16.—(Translation: Time curve of the photo-electric voltage on grid. I. Increase of j in steps when t=0. II. Increase of j as a function of the increasing aperture size.)

If we insert for R and C amounts in accordance with practice, for example, $R=5\times10^5\ \Omega$ and $C=2\times10^{11}\ F$ (for very short leads) then $RC=10^{-5}s$. The hole of the Nipkow disc is assumed to be q/k mm. square. Its running speed is (neglecting the bending or curving) $v=nkl$. If we assume $n=16/s$, $k=50$, $q=50$ mm., $l=40$ mm., that is, $f=l$ mm., then $T=f/v=q/n\ k^2l=3{,}13\ 10^5s$. If we now assume t from O, then after $\frac{1}{4}\times10^{-5}s$ duration $t/RC=1/4$ and so forth, and in the curves of Fig. 16 one division corresponds to the time unit $10^{-5}s$. One receives the values for i in the curve II then from the following table:

Time-point $t=10^{-5}s\times$
$i=1\ 10^{-4}\times$

1/4	1/3	1/2	1	2	3
96	169	352	1184	3648	6528

Curve II therefore represents the course of the current increase and consequently the increase of the controlling voltage Ri on the grid of the first valve of the photo-cell amplifier and characterises the delay arising through the joint action of finite aperture and harmful capacity. The curve I serves for comparison, which curve corresponds to the suppositious case that the photo current would attain its maximum in steps at the moment of the commencement of illumination, whereby the known function:

$$i=I'\left(1-e^{\frac{-t}{RC}}\right)$$

would have to be inserted.

If one compares the increase of the grid voltage Ri in the ideal case of Fig. 4, where it possesses its maximum value already at the end of the transition period P, with the actual course in accordance with Fig. 16, curve II, then confirmation is given of the conclusion drawn in Fig. 1, that the transmission of higher harmonics of the fundamental frequency $v_m=v/2f$ plays no rôle, for these harmonics are absent in the grid voltage curve already, apart from the damping of their amplitudes by the finite aperture on the receiver side. The harmful capacity C of the photo-cell amplifier wiring acts in practice as a sufficient short-circuit for those higher frequencies.

The curve II can be calculated in the manner described for all possible values of RC. From the time-point T on, then, the further course becomes identical with that of the correspondingly drawn curve I, as the aperture when $t=T$ has completely reached the bright zone, that is to say, the photo current has attained its maximum.

From (5) the decisive influence of R becomes more visible. As C is given by the applied means, R cannot be chosen of any size desired. In the following table are given the fractions of the maximum grid voltage which are received for the various values of RC/T at the end of the transition period. In order to utilise as fully as possible for controlling purposes the photo current released in the cell, the stipulation $RC<T$ should be fulfilled.

$RC/T=$	3	2	1	1/2	1/3	1/4
$IR\times$	0,15	0,21	0,37	0,57	0,68	0,76

This acknowledgment or admission is in agreement with the conclusions regarding the limit values of R, which proceed from the consideration of the vectorial branching of the photo current over the resistances R and $I/\omega C$. The adaptation of R to the internal cell-resistance (order of size in television, for example, $10^{11}\Omega$) is, in view of the parallel connections of the capacitive resistance $I/\omega C$ for the ω-values given by f and v, quite unthinkable, as C cannot be made as small as desired. For a known C, R on the one hand is to be chosen so small that the stipulation $RC<T$ is fulfilled, on the other hand so large that $R>I/\omega C$ remains; therefore

$$T>RC>I/\omega.$$

It is seen immediately herefrom that the fluctuations of ω entailed by the variation of the brightness must produce a transmission depending greatly on frequency through the amplifier. This points to the indispensability, increasing with the fineness of the degree of scanning, of a carrier frequency method for the picture current amplification.

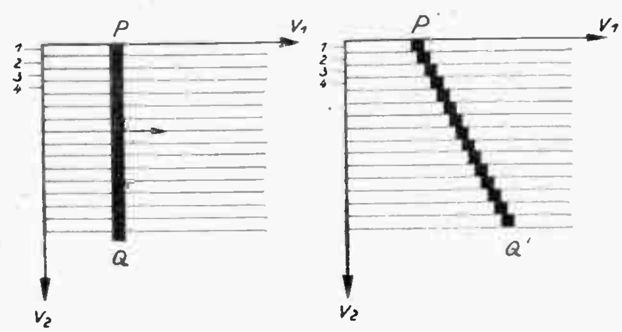


Fig. 17.—Illustrating movement in the scanning direction.

II. Movable Pictures.

1. *Geometrical laws.* We consider here with reference to Fig. 3 only such longitudinal movements ($\parallel v_1$) and transverse movements ($\perp v_1$) of the object to be transmitted in the picture field, whose speed components c_1 or c_2 do not disappear relatively to v_1 or v_2. However, values of c_1, which as to their order of size agree with the running speed v_1 of the aperture or light spot, may remain unconsidered owing to lack of real importance for the applications of television. Only the case $c_1 \leqslant v_1$ is of practical interest. The picture line of the length l is assumed as rectilineal and $v_1 \perp v_2$. The constant frequency of the picture signal (wireless wave) may be neglected in the following.

Fig. 17 gives an example for the movement distortion[5] in the transmission of a stroke PQ displaced in the picture field in the scanning direction, which stroke PQ is represented in the left part of the drawing.[6] At any moment PQ undergoes a parallel movement proceeding with constant speed in the direction of the arrow, which after less than I/ns may again cease.

(To be continued.)

[5] See Proc. Television Society, R. R. Poole, *Television*, Vol. 2, No. 16.

[6] The thickening or thinning of a transverse line appearing during the displacement of the same as per Fig. 17 is neglected here as a less striking phenomenon.

The Proceedings *of* The Television Society

Report of Meeting held on Tuesday, May 6th, at University College, London

Summary of Lecture on

"Liquid Photo-electric Cells"

By *R. Neville-Gray*

THE informal discussion for members only was held prior to the formal meeting, the subject being the programme of the next session. At the formal meeting, which commenced at 8 p.m., Mr. R. Neville-Gray read a paper entitled "Liquid Photo-electric Cells." Unfortunately exceptionally heavy demands on space make it impossible to reproduce the whole paper in the customary manner.

Dealing with the early history of liquid photo-electric cells Mr. Neville-Gray said that it was observed by Arrhenius in 1887 that some silver halides when exposed to light conducted electricity better than when it was not illuminated. The maximum effect was observed in the region of the spectrum in which the absorption was greatest.

Previous to this, Becquerel observed that if two identical silver plates be coated with a halide, and immersed in dilute sulphuric acid as an electrolyte, and one plate illuminated while the other plate is kept dark, a measurable current could be obtained.

This phenomenon, known as the Becquerel effect, is by no means confined to the silver-silver halide system. Becquerel's results were unnecessarily complicated by the use of sulphuric acid, which is liable to cause secondary polarisation. Others following him obtained very variable results, some obtaining what they called a positive effect and others a negative effect, while a few, including Tucker, obtained both. Tucker found that the photo potential gradually reaches a maximum, then drops back to its original value when the light is removed. The exposed plate was positively charged with respect to the unexposed one, but after a time varying from a few minutes to a few hours this positive current died away and was replaced by an apparently strong but negative current.

Becquerel observed that the photo potential was not always in the same direction. If the silver iodide layer was not too thick the potential was always positive, but when the coating reached a critical thickness there appeared a negative light effect which was only temporary and was ordinarily followed by a positive effect. In 1929 Vauselow and Shephard investigated this very closely. They first studied the effect of the variation of the thickness of the silver halogen and found, incidentally, that the different methods of preparing the electrodes gave different shaped curves. This explains to a large extent the varying results obtained by the numerous investigators.

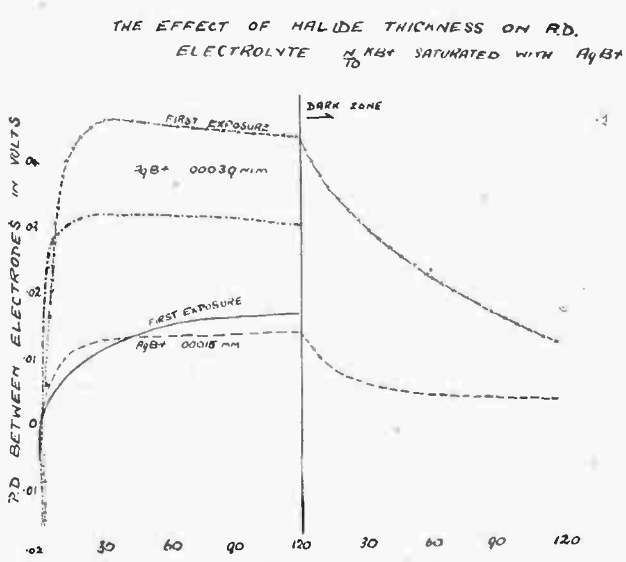


Fig. 1.

Vauselow and Shephard's Apparatus

This may be conveniently classified under three headings :—

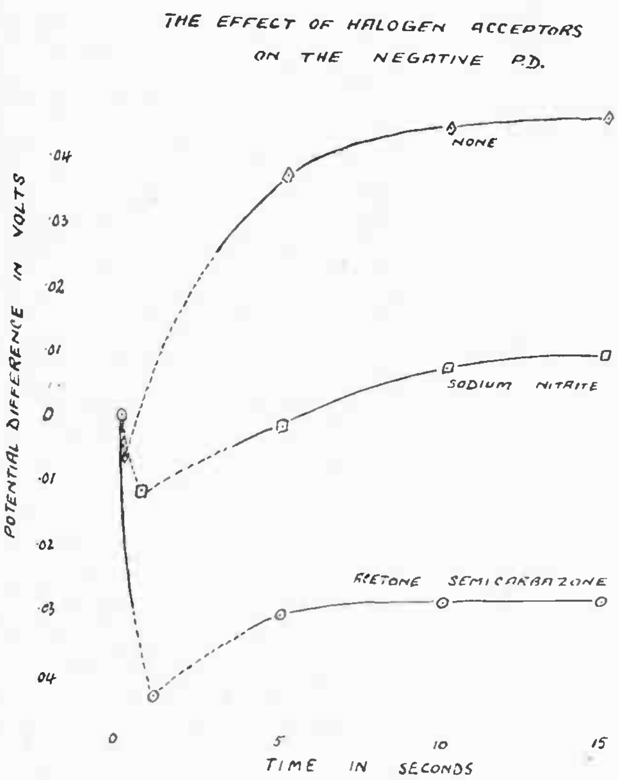


Fig. 2.

1. The optical system, consisting of a mercury vapour lamp, a quartz-windowed water cell (to exclude heat from the photo cell), and a shutter for exposure.

2. A photo cell with quartz window immersed in a thermostat, the electrolyte being stirred during the experiment.

3. The vacuum tube voltmeter for measuring the variations of the potential difference. By its use accurate E.M.F./Time curves after the first five seconds' exposure may be obtained. The grid current of the voltmeter is so remarkably small that it does not produce sufficient polarisation in the photo cell to interfere with the results. To study the effect during the first second an oscillograph is essential. The energy of the light reaching the electrode, of which only a part is photo-chemically active, was measured by a Moll thermopile and high sensitivity galvanometer calibrated against a radiation standard.

The Electrodes

Various methods have been tried of depositing silver bromide on the polished silver electrodes and each method gave rather differently shaped photo-potential time curves. The method eventually selected was that of joining the two electrodes together and immersing them, together with a platinum sheet, in a solution of hydrobromic acid and potassium bromide. The electrodes were made the anode, and the platinum sheet the cathode, the silver bromide being formed electro-chemically.

Details were than given by the lecturer concerning the manipulation of the vacuum tube voltmeter.

The Effect of Thickness of Silver Bromide Layer of the Photo-potential

The lecturer said that in the case of some electrodes the negative effect was observed at the very beginning of the exposure (see Fig. 1). It could not be measured by the vacuum tube voltmeter because the effect was practically inertialess. It was followed by the positive effect which persisted.

The negative effect was observed after successive exposures of .001 second, although the curves obtained for the initial negative effect differed somewhat from those obtained for the subsequent exposures.

On darkening the illuminated electrode the potential difference drops, the time being apparently a linear function of the thickness of the silver bromide layer when the electrolyte has a constant composition.

The various thicknesses were obtained by varying the length of time of deposition and the strength of the electrolyte. A thickness of .0005 mm. appeared to give the maximum effect.

It was assumed that the positive and negative effect occurred simultaneously, and also that the positive effect was due to the bromine attacking the silver and so giving a bromine potential. The latter assumption was tested and found correct, and explained the rate of fall of the positive potential when the incident light was removed, as being due to bromine diffusion.

If bromine could be prevented from reaching the electrode the negative effect should be favoured and the positive suppressed. This was verified by having a halogen acceptor present in the electrolyte. This is a chemical which combines with the halogen as soon as it is formed. Fig. 3 shows the effect of different halogen acceptors, and it should be noted that when they are present the time required to reach a maximum is greater than when they are absent. The time may be prolonged to 1.3 seconds. When halogen acceptors were absent the time to reach a maximum negative potential was about 0.06 second, as shown by an oscillograph. The conditions were favourable for the negative effect, the electrode film being .0004 mm. in thickness, while the electrolyte varied from normal to .000001 normal in different experiments.

The Effect of Variation of Photo-cell Electrolyte

Fig. 3 shows how different negative potentials were obtained with different electrolytes when the silver bromide was a constant thickness on the electrode.

It should be noted that with electrolytes other than KBr, greater negative potentials may be obtained, and that silver acetate gives a maximum negative effect in the shortest time.

The intermittency of incident light is of particular interest from a television point of view—the effect if studied under conditions favourable for the production of a negative effect, i.e. AgBr .0004 mm. thick on the electrode and an electrodlyte of 0.02 normal $AgnO_3$. It has been shown that the negative effect was observable after several successive exposures of 0.001 second. Using a Nipkow disc to interrupt the incident light, and obtaining a curve by the aid of an ocsillograph, it was found that the total negative effect was approximately the same for a continuous illumination as for high frequency interruptions. Unfortunately there seemed to be no data available under those conditions when the negative effect was increased by the use of a halogen acceptor. When the electrodes were both kept in darkness, and the electrodlyte was illuminated, no potential variation was observed.

The Becquerel Effect in Dye-stuff Solutions

In 1887 Arrhenius also observed that the change of conductivity of silver salts was increased when treated with certain dye-stuffs, and other workers had found that dye-stuffs solutions also showed an increase of conductivity on exposure to light. Goldmann, in 1908, on further investigation of dye solutions, found that the strength of the photo-currents increased with the concentration of the dye solution (Fig. 4), and was also directly proportional to the area of electrode exposed and, within limits, to the intensity of the light.

The strength of the current was found to increase less rapidly with the time and not to reach an absolutely steady maximum.

When the light was cut off the decline of the current did not follow a simple exponential function but, after becoming zero, next became positive. The positive current then slowly fell with time. These results were

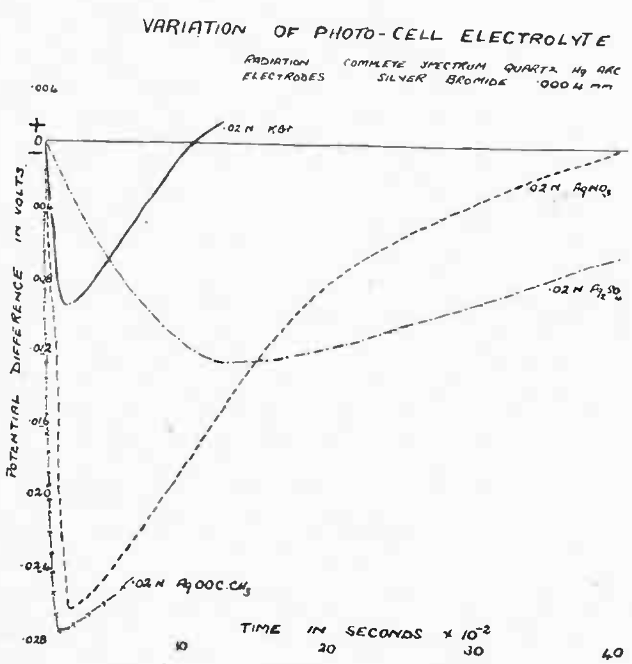


Fig. 3.

obtained by the use of a sensitive galvanometer, a solution of a dye like Eosin or Rhodamin, and electrodes of thinly deposited metal in glass.

Both the negative and positive effect appeared to be compounded of two effects superimposed as in the case of the silver-silver-halide system.

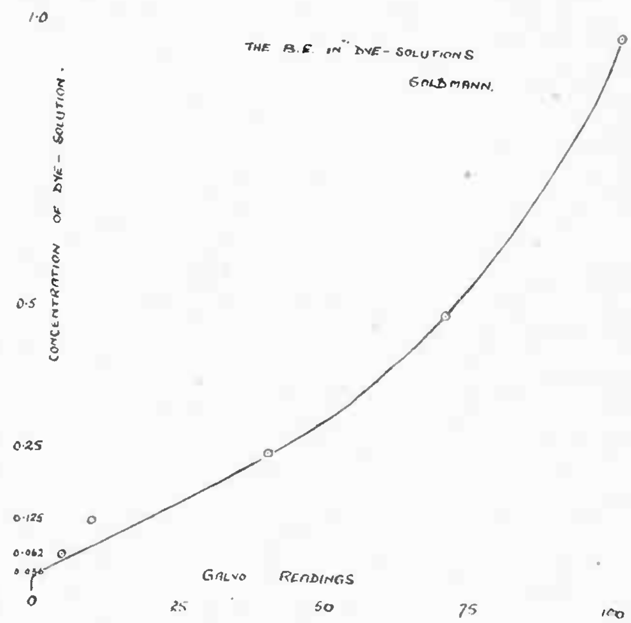


Fig. 4.

After explaining in detail the results obtained by different workers using different chemicals, the reaction formulæ of which were given, the lecturer explained that Goldmann, from a consideration of his experimental results, was led to the conclusion that the Becquerel result in dye-stuffs is a type of Hallwach effect, that is, the seat of the effect is a capillary layer on the electrode. The magnitude of the effect depended on the dark potential, and on the quality of the light.

The lecturer then proceeded to discuss in some detail what relation, if any, held between the structure of the dye-stuff and the photo-electric effect, and referred to the work and theories of Staechlin, Lifschitz and Hooghoudt, Wilderman, Athanasiu, Baur and Svensson.

In his concluding remarks Mr. Neville-Gray stated that the Becquerel effect was not a particular Hallwach effect but a "photo-volta" effect. It consisted of a reversible potential change, the magnitude and direction of which depended on (1) the dark potential, (2) the intensity and wavelength of the incident light, and, above all, on (3) the nature of the ions present in the solution.

The primary cause of the Becquerel effect was a photo-chemical alteration of the electrolyte, the nature of which was not in all cases understood.

Baur's theory of the displacement of an electron from the photo-sensitive molecule was the most plausible, but met with several difficulties.

Impurities produced extraordinary effects and were not additive.

The effect of valency, molecular rearrangement and electro-chemical characteristics on the Becquerel effect had been left open, while phase boundaries had not been considered.

Seen on the Television Screen

(1) Pearl Greene, at present at the Gaiety Theatre. (2) Clifford Millar, tenor, late D'Oyley Carte. (3) Margaret Barrie, well-known Scotch soprano. (4) George Pizzy, baritone. (5) Jack Richards and Winifred Dunk, humorous entertainers. (6) Ben Lawes, entertainer. (7) Brena Quinion, entertainer. (8) Lorraine la Fosse, soprano. (9) Eric Mason, ventriloquist and conjuror.

Baird Studio Topics

By *Harold Bradly*,

Studio Director

WHEN I first became connected with the stage I used to hear a good deal of talk about technique. At first I was rather bewildered, and wondered if I should ever acquire this necessary part of an actor's equipment. As time went on, however, I realised that this so-called technique was purely and simply a matter of combining experience and adaptability. I found that under certain conditions it became necessary to employ special precautions to avoid over-playing or under-playing a particular scene or rôle—to apply a knowledge that instinctively pointed to what was the right thing to do at the right moment.

Technique, as I have said, can hardly be acquired without knowledge or experience, and now that television is with us, and is becoming an established part of our home entertainment, it imposes a new technique upon all television artistes.

It is part of my duty, as studio director, to help and advise all and sundry who are to appear in our television broadcasts, and it has been a great source of pleasure to me to note how keen is the interest taken in television from the purely entertainment point of view, apart from the interest in its scientific marvels.

It is a noticeable fact that most stage folk when being televised invariably raise the head, to all intents and purposes with a view to "putting it over" to the back seat in the gallery. As there happens to be no gallery to consider the effect is rather like a person reclining in a barber's chair, and it only requires a little imagination to visualise a towel being placed round the neck, and to hear the words: "Shave, sir?"

Vocalists are occasionally a source of trouble. There seems to be an inclination to sing with the eyes closed. I presume this is supposed to give a dreamy effect to the melody or the character of the song. From a televisional point of view, however, nothing could be more deadly. It is like looking at a lifeless statue. When, however, the eyes and the features become animated with expression, there is at once a definite interest in the picture.

One very important point artistes should study, and one which gives an additional picture value, is the care of the hair. A charming face, for instance, adorned with a head of fair wavy hair, is something to behold on a "televisor," but if that hair is dull or flat, no matter how well it may suit the individual under ordinary circumstances, there is not that additional interest to observers.

Which leads me to state that every added attraction in one's personality, coupled with facial expression, and movements of the eyes, head and hands, makes up into a much more effective picture as a whole. The result, then, is that the images are less flat in appearance, these essential details giving a quality to the picture which would otherwise be lost.

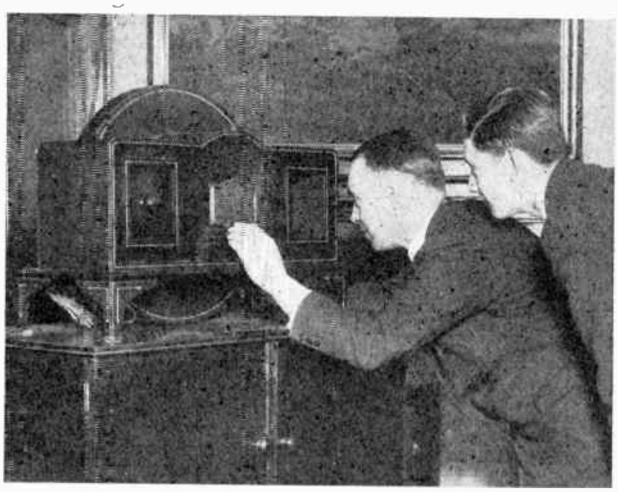
Now, all these points I have raised should not be lightly disregarded by those who are likely to become acquainted with the Baird Studio broadcasts. Little by little, as television expands, so will this technique, in all probability, become more complicated. Thus, armed with the foregoing advice, and a thorough knowledge of television technique, an artiste would claim attention as being in every way a highly desirable subject.

Selling Television

Wireless traders all over the country are taking the greatest interest in television, and infusing their own enthusiasm into their customers. Many of them are writing to us to tell us about the results they are obtaining from the present television broadcasts, and expressing their views thereon.

LONDON

GLASGOW



THE above photograph illustrates the showroom which has been devoted to television by Major W. H. Oates, of 195, Hammersmith Road, London, W. 14. On the left, mounted on the wall, are the two wireless receivers, one for speech and one for vision, openly mounted so that all details can be clearly seen by prospective customers. The loud-speaker can be seen on the wall, and underneath is a built-up kit of parts. To the right, in the centre of the photograph, is the commercial Baird "Televisor," connected up ready for demonstration. Inset is Major Oates himself, who will be met by intending purchasers of television apparatus.

The photograph in the centre of this page depicts an interested group looking in to the "televisor" in the premises of Consulting & Radio Service, Ltd., Glasgow. An article by Capt. Norman Turner, Managing Director of the Company, appears on the opposite page. In an article in the April issue of the *Ulster and Scottish Radio Dealer* Capt. Turner says: "The rightful exploiter of television should be the radio dealer; he possesses the technical knowledge necessary to give service, and should have sufficient creative ability to foster the new art through its baby stage." He complains bitterly of the brevity of the present broadcast facilities, and also demands that television should be broadcast through a more northerly station.

Our third photograph shows "Uncle Tom" Payne, of Payne and Hornsby, Newcastle, demonstrating to an interested group of Newcastle citizens, including the ex-Lord Mayor, Councillor A. W. Lambert (with hands clasped). Mr. Payne also is most anxious for an extension of the hours, and for the transmissions to take place through a northern station.

NEWCASTLE

Getting Acquainted

By *Norman Turner*

Of course, there are more ways of killing a cat than hanging him; but surely no one can grouse at the small aperture in the Baird "Televisor" when it represents such an advance on all the older methods of "Getting Acquainted." Time was when wise folk used to smile at two heads under one earphone and predict but one result; but the limitless possibilities of "looking-in" when you both want to get into a dead central position have to be experienced to be believed.

Mine host, a worthy man, a pioneer, and one who knows he will have to pay, has now installed his "televisor." The stage is set, but what a wait until the curtain rises! Verily a midnight seance, when the tombs open and discharge their ghostly occupants (it *was* a bit ghastly I'll admit), but it was television. We had managed to get a negative picture first, and it was a little difficult to reconcile the death's head we saw with the beautiful lady we knew should appear. Tense excitement while we change over the leads and then the vision appeared—"A lovely apparition sent to be a moment's ornament" and it was only for a moment. A visual crash, and away she went, whirling round until I'm sure she must have been sick; steady again, with a nice synchronous-sounding hum from the toothed wheel, and we get ten minutes perfect television. We bumped our heads quite a lot, did mine host's daughter and I, and I wished I could knock a few years off my age! When she's as old as I am, I suppose television will be a commonplace. The pictures on the wall will be "Vision-screens," and if she is cold she'll tune in the beach at Cap D'Antibes, or if she's too warm she'll follow some Arctic explorer or ski runner in Switzerland.

Captain Norman Turner, Managing Director, Consulting & Radio Service, Ltd., Glasgow.

They'll have to do something with the printed matter they put over, up at Long Acre. We don't get it here at all well. Apparently black letters are used, and we only get a few odd words. I'd like them lower down in the framing; near the bottom of the picture might help.

A policeman's lot may not be a happy one, but the radio engineer of to-day, with the vital interest of new things, has, I believe, the most interesting life of all. That night, after a real dinner—the cocktails themselves almost made television exist where no television was—we foxtrotted to Berlin, fandangoed to Spain, waltzed to the radio-gramophone, and whiled away the time with home-made films of skating among the Alps. By the time we'd finished, the bottled lookers-in—what's the right word, anyway?—saw the real unbottled vision. A thoroughly modern night.

Seriously, though, will someone strike a medal for the enthusiastic televisionist who, with only two miserable half-hours per week in which to indulge his new hobby, religiously stays up late, not only on those two nights, but every other night on the off-chance that Berlin may be transmitting? Let's have some more, and at decent Christian hours when Scots folk won't think you're up to no good arriving home twice a week in the "wee sma' hours." I won't mind if my hosts are like my last one, but can we seriously ask people to become televisionists on the miserable dole we get? We Northerners must get together and harass the authorities for a transmission up our way. If they don't, I warn them I'll start a Home Rule movement and withdraw all the heads of businesses from England—and *then* where would they be without their canny Scots? Let them give us programmes, sound and sight, and the licence figures will go up. We don't mind paying, but we must have value for our money. In the Sunny South you can always get a choice, but here we're confined for perfect service to our one station, and the best programmes always seem to come on the night you are out.

I wonder if the milliameter needle swings much on the transmitter when the Baird announcer is letting off his Oxford—or is it Cambridge?

The Amateur gets to Work

IT is extremely gratifying to be able to report this month that a rapidly increasing number of reports continues to flow into our Editorial Office from amateurs who give details not only of the reception results which they are obtaining, but also of the apparatus which they have constructed specially to receive the television programmes now being broadcast daily by the Baird Company in conjunction with the B.B.C. The number of reports is so great, indeed, that space does not permit us to print them all in full. We give below, therefore, some leading extracts.

Mr. E. H. Traub, of 34, Dartmouth Road, Brondesbury, N.W.2, writes as follows: "I am using a home-made 'Televisor' with a 110 volt A.C. fan motor, Osglim beehive type neon lamp, with tracing paper for an even field of illumination. The disc is home-made out of white cardboard made black with boot polish, and not graduated. Synchronisation is by hand control." At the time of writing, Mr. Traub had evidently only been able to look in to one transmission, but of it he says: "A man was 'sitting' at the time. His features were quite distinct. His eyes could be seen rolling, and his lips moving. Later on he put on a small beard." He goes on to say that he has not yet constructed a second receiver for the sound part of the programme, but concerning the latter he thinks the Baird Company must be using an indifferent microphone, and he does not like the voice of the announcer.

Mr. J. Plymen, of 7, The Fairway, North Wembley, Middlesex, writes that on Friday, April 25th he received an excellent picture during the latter part of the transmission of a lady with bobbed hair. Again on April 28th he saw a man with a moustache very distinctly. In both case all movements were noticeable. He considers his results very good in view of the inexpensive apparatus which he is using. Of this he says: "I used a machine-made disc, a cheap 12 volt motor, and 200 volt Osglim neon silvered on the outside. I have a PM.24a Super Pentode in the last stage with about 260 volts H.T." In conclusion, he says "I hope for extended transmissions in the future."

Praise for the Programmes.

From Hampstead comes a letter from D. G. C. Davis, of 167, Adelaide Road, who has been looking in regularly to the Tuesday and Friday night transmissions for the past two months. He says he really must offer his congratulations to the Baird Company for the number of well-known artistes they have presented in the course of their short existence as entertainment providers.

Mr. Davis is using a motor taken from a discarded vacuum cleaner, which he says works excellently, although, of course, it is running at a fraction of its normal speed. He employs a fan starter as a rough resistance and a sliding resistance built up out of an old electric fire element for fine settings. With this arrangement he can hold the image perfectly stationary for several minutes at a time. An ordinary Osglim neon is employed which he has frosted over and covered with silver foil except for an inch square window, as suggested by several previous correspondents in this journal.

Mr. Davis drilled his own disc, and this he found to be by far the most difficult job in view of his lack of precision instruments for marking out. His wireless receiver is a 5-valve all-mains set comprising two H.F., anode detector with choke coupling to the first L.F., which is in turn transformer-coupled to a Cosmos AC P1 with 250 volts on the anode. He uses a choke-filter output to the neon tube which is first "struck" by a separate feed from the eliminator.

Describing his results, Mr. Davis says: "I am getting quite good quality images with plenty of half-tones, and such small details as the necklace on an artiste's throat and the style of the coiffure are easily picked out. I immediately recognised the announcer when I called at the Baird Studios one morning." In conclusion, he describes a very excellent idea which will commend itself to readers. In order to pick up the speech transmission as well he has built a simple 2-valve set inside his large one.

An Ambitious Combination Set.

Messrs. V. J. Ross and J. W. Turpie, of 15, Barandon Street, North Kensington, W.11, send the photograph which is reproduced herewith. As will be seen, they have constructed a very ambitious cabinet which houses a "Televisor," loud speaker, both wireless sets and all the necessary batteries. The top panel of the cabinet has a viewing tunnel at the right, a loud speaker opening at the left and phasing control in the centre. This control rotates the motor casing and so "frames" the image. Beneath the top facia there is a sloping panel upon which are the motor resistances. In the centre is a tapped resistance, to the left is a 50 ohm rheostat, and to the right a 20 ohm rheostat for course and fine motor speed adjustment.

The speech and television receivers are in the bottom part of the cabinet. The speech receiver is tuned permanently to 356 metres and employs leaky grid rectification to H210, thence to Marconi 1–2·7 transformer to a pentode and finally choke output to speaker. The H.T. is 120 volts, 10 ma. The television receiver also employs leaky grid rectification to H.210; plate resistance 100,000 ohms, coupling condenser 0·1 mfd. to small power valve (P215) with 2 megohm grid leak; then Marconi 1–4 Ideal transformer with 30,000 ohms variable resistance across the secondary. The last valve is a hyper-power valve (impedance 2,700) choke output to change-over and filament switch for neon speaker respectively. H.T. 180 volts distributed by potential divider to the various stages. In the bottom compartment the batteries are situated.

The dual receiver made by Messrs. Ross and Turpie.

The disc is 20 inches in diameter, drilled with round holes 1/30th of an inch in diameter. The motor is a B.T.H. fan motor mounted on two bearings so that the casing can be rotated. The neon lamp is a Philips 100/110 volt commercial type, with the resistence still inside the cap.

Our two correspondents are surprised that such simple and inexpensive apparatus has proved capable of giving such excellent results. They ask us to announce that they contemplate forming a local television club, and would welcome communications from interested readers.

Novel Sychronising Arrangement.

Mr. S. Falloon, of 61, Eltisley Avenue, Cambridge, sends us some interesting particulars of his apparatus, together with details of its cost. He uses a 10 volt ball-bearing motor, a Baird neon lamp, and a Baird graduated scanning disc which he made himself of 1/32nd inch aluminium with the aid of the jig described by Mr. A. A. Waters in the July, 1929, issue of TELEVISION. For synchronising he uses a 30-tooth wheel, but departs from standard by using a single synchronising coil wound round a number of U stampings, the ends of which are filed to shape to match the teeth of the wheel. His pole pieces are thus 90° apart instead of the usual 180°. The synchronising coils are connected in series with the neon lamp to the output of a PM24a. He reports that this unusual synchronising arrangement works quite as well as one of the standard Baird sets.

Mr. Falloon's wireless receiver consists of a screened grid H.F. stage, transformer-coupled to a triode H.F. stage, which is choke-coupled(aperiodic) to a diode; this in turn is transformer-coupled (Hypermite) to the first L.F. stage, which is transformer-coupled (Ferranti AF5) to a PM24a. This combination is supplied from an eliminator which is carrying a 50 per cent. overload.

As to results, our correspondent says "The pictures were reasonably clear and several people were able to identify immediately an artiste who had appeared in a previous transmission. The parting and wave in a person's hair were quite plain and the printed bulletins could be read clearly by a person who normally uses glasses for reading."

We give below Mr. Falloon's list of components and the cost of them.

	£	s.	d.
Ball-bearing motor set of machined parts and material from Queen's Engineering Co., Battersea	2	0	0
Neon Lamp (Baird)	1	5	0
Aluminium Sheet, 21″ x 21″ x 1/32″ ..		3	9
Sync. wheel to own design		14	0
Oddments		5	0
Total	£4	7	9

Another Television Reader Succeeds.

Another reader who has successfully followed out the instructions contained in Mr. Waters' articles is V. E. Ireland, of Wynton Bungalow, Oldhurst, Hunts.

His motor is a discarded $\frac{1}{8}$ H.P. G.E.C. fan motor to which he has fitted ball-bearings. "Owing to the fact that the motor shaft protected slightly at one end end only, it was necessary to build the disc and synchronising unit on a separate shaft running on ball-bearings and having a spring coupling to the motor. I made the disc from 22 S.W.G. aluminium with a jig as described in your journal, while the toothed wheel was made from mild steel, following the articles by Mr. A. A. Waters as closely as possible. The neon lamp is a commercial Osglim with one side frosted by rubbing it with a piece of emery cloth, while a large concave mirror is arranged behind it, the picture being viewed through a large magic lantern condenser and tunnel."

Our correspondent's wireless receiver is a *Wireless World* "Kilo-mag Four" with an Osram PX4 in the output stage. The sound part of the programme is picked up by a simple three valves of his own design.

After overcoming some difficulty due to unsteady running of the motor (prior to fitting ball-bearings) and sparking, no image could be received, only a bright rib of light. This he found to be due to too powerful a signal being applied to the neon, and after further adjustment he was able to receive pictures which were easily recognisable. He adds that he is only 15½ years of age and still at school, so his time is limited to week-ends and some evenings. We congratulate him on his success.

From Loughborough College, Leicestershire, comes a letter from Mr. James F. Driver, M.I.E.E., M.I.Mech.E., Head of the Dept. of Electrical Engineering. He writes as follows: "After a fairly considerable amount of experiment, we are now receiving the Baird Television transmissions most satisfactorily. You will be pleased to learn that quite a number of my electrical students are interesting themselves in television and are building up apparatus." We are looking forward to receiving details of Mr. Driver's apparatus, which is illustrated on this page.

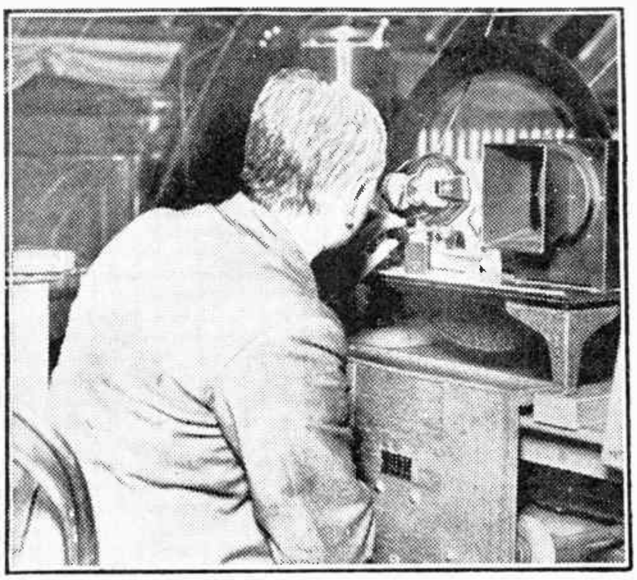
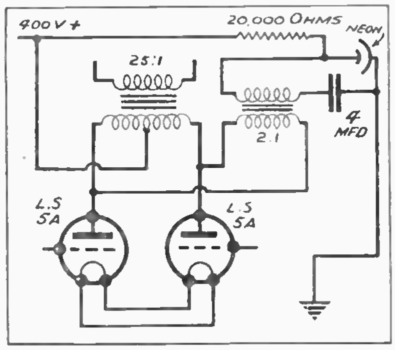


Photo by courtesy of *Leicester Mail.*

Mr. J. F. Driver, head of the Electrical Engineering Department of Loughborough College, looking in to his "televisor."

Mr. E. Norbury, of 172, Terry Road, Coventry, who has been getting very successful results, gives the following particulars of his apparatus. Scanning disc, 20 in. diameter No. 22 S.W.G. aluminium, drilled with 1/30 in. round holes, and run by a 20 volt D.C. ball-bearing motor supplied by a 40 volt transformer from the A.C. mains. He says this arrangement works extremely well, there being very little temperature rise in the motor.



Mr. Norbury's output circuit.

The neon lamp is a commercial Osglim with resistance removed and silvered. This is viewed through frosted glass to give uniform illumination.

The wireless receiver has two S.G., H.F. stages, anode-bend detector which is R.C. coupled to an LS5, which is then transformer-coupled to two LS5a valves working in push-pull. These valves work on their maximum H.T. of 400 volts. "I have often seen in your magazine that push-pull coupling is unsuitable for television work but I can say that I have had most successful results with the arrangement."

"Due to the fact that my output transformer has a step-down ratio of 25 to 1 it is little use for feeding the neon lamp, and I have used an ordinary step-up transformer with a ratio of 2 to 1 connected as shown in the accompanying diagram, and I find that a 2 to 1 ratio gives better results than a 1 to 1 ratio. This may be due to the fact that the Osglim lamp has a higher resistance than the flat plate type. I have not yet fixed up any synchronising gear, and I therefore have to rely on the popular thumb-on-shaft method, at which I am getting quite proficient."

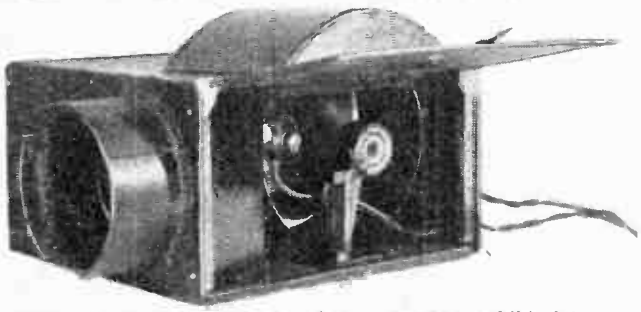
In conclusion, Mr. Norbury looks forward to the time when the transmission hours will be extended and made more convenient.

Another Schoolboy's Ingenuity.

R. E. Kaye, of 153, Longley Croft, Lower Houses, Huddersfield, bought a copy of TELEVISION some months ago, immediately became interested, and determined then and there that he would build a "Televisor." He is only 17, still at school, and suffering from that very common complaint—shortage of pocket money.

First he bought an Osglim neon, and got it to flicker beautifully, using only 180 volts H.T. Then he made a scanning disc from sheet steel "a few thousandths of an inch thick." It is 25 in. in diameter, and drilled with 3/64 in. round holes. "Next came the big difficulty, *i.e.*, means of driving the disc. I certainly could not afford an electric motor, and had I bought one I should have had to drive it from accumulators, not having mains in the house, and this again would have been expensive. A friend suggested using a water motor, but the idea did not seem practical. However, I determined to give it a trial, and constructed a water motor entirely from sheet metal. I am very pleased to say that it is very successful. As I have seen no mention in your columns of this source of power being used before, I think this may interest your readers.

"Synchronising is effected by reducing the force of water until the speed is somewhere near correct, and then using finger and thumb on the spindle. On the night transmissions speed is surprisingly steady, but



"Televidascope" employing drum scanning, exhibited by Mr. R. W. Corkling at the Television Society's 1930 Exhibition.

it varies during the day owing to neighbours drawing water and reducing the pressure.

"My set is quite ordinary. It consists of a leaky grid detector followed by two stages of transformer-coupled L.F. with 200 volts on the last valve. Using this apparatus I have had very fair results on several occasions and I am very pleased with it. I have only two difficulties now: (1) The folks at home seem to have a deep-rooted objection to my staying up for the night transmissions." (Never mind. The wives of we oldsters have similar objections!—ED.) "(2) The 261 metre transmitter fades badly."

Double Images Again.

Mr. W. A. Page, of 28, Britannia Road, Norwich, gives the following particulars of his experiments.

"As a beginning an LS5 was run off a Philips all-mains receiver and a rough disc 12 in. in diameter used with an ordinary spiral neon lamp. As may be imagined, the results were not good but they were sufficient to stimulate a desire for something better. There was too much black and white and the lettering could not be read at all. An old 2 H.F. Det. (anode-bend) and one L.F. (Trans. coupled) was then rigged up and put into service with the old disc, 250 volts being used. The results were very promising and showed up the defects of the disc and a new one was hurriedly marked and cut, but without much improvement. Finally a jig was made as described by your contributor with a very great improvement, and we strongly advise anyone making a disc to make this jig first.

"This set gives enormous volume on the loud speaker and appears to be quite adequate for television. Faces are easily recognisable and the lettering is quite clear. The half-tones are extremely good at times, the face appearing slightly darker than the background, with the ears and eyelids quite distinct. The reception generally, though, is very variable, and it appears as if different methods of transmission are employed.

"At night some very peculiar effects are obtained from the skip effect, two images, one above the other, holding the screen for some minutes, and then a folding effect takes place and one picture results, first the top half predominating and then the bottom. Between the effects splendid images can be seen, but last only a short time. The morning receptions do not give these effects, of course, but are not so good as the night pictures when free from distortion."

Mr. Page suggests that, between items, some definite wording should be placed before the transmitter, in order to assist experimenters to make adjustments. He also hopes that transmisisons, if technically possible, will shortly be arranged from 5XX to give provincials a better chance. He compares the present television broadcasts with the early sound broadcasts, and says "the uncertainty was very exasperating and we find it the same with television. One is tempted to cry out at the end of half an hour: 'Ridiculous to give half an hour! What can you do in the time?' The B.B.C., from a reply received, do not appear disposed to grant any further time, and are even too busy to reply to our further queries. It therefore appears one must turn to the foreign transmissions as was the case with the early broadcasts of music."

Reports from Holland.

From Holland come reports from Mr. M. W. H. de Gorter, of the Dutch Section of the International Amateur Radio Union, and Mr. Van Schie, of Rotterdam. Mr. de Gorter is getting what he describes as splendid results, "I get fully detailed pictures all the time." He also reports double images, "the head of the one being about in the shoulders of the other one. When the original picture faded out and became faint, the other picture became stronger. During fading periods it is often difficult to hold the synchronism."

We take this opportunity of congratulating all our correspondents on the success of their experiments, and thank them for sending us such detailed reports. Those who have not yet written to us are cordially invited to do so, and those who have are invited to keep us posted as to further progress.

STOP PRESS.

Television on a Crystal!

Tests have recently been carried out using a number of different types of detector circuits for receiving television images, but it will no doubt come as a surprise to readers to learn that first-class images have been secured with the almost forgotten crystal detector.

Full details of these interesting experiments will be given to readers next month. Order your copy in advance.

Sydney A. *Moseley* on *Cabbages* and *Kings*

THE dog-days may be upon us but I warn my readers that so far as we are concerned there will be no *seeking* after dog-day topics. The fact is, things are a-humming again and will go on merrily throughout the summer.

* * *

You may have noticed in my recent articles that there has been little of the fireworks to which my readers have long been accustomed. But it has never been my way to fight when one has no real cause. As I say, the television programmes are going over quietly, attracting a great deal of interest from all parts of the country, and for the moment I am content to leave it at that.

An unexpected meeting with my friend and foe, Captain Eckersley, recalled some of the old exciting times, and after a little ragging I went so far as to promise to send him a copy of the book which Mr. Barton Chapple and I have written on Television! So much for that.

* * *

First of all, let me run over as briefly as possible the events of the past few weeks. On March 31st, television came into its own. For the first time in history the dream of putting over sound and sight simultaneously became a reality. Since then regular half-hour transmissions have taken place for five mornings a week and for two nights a week at midnight.

A new photograph of Mr. Moseley.

* * *

Among the artistes who have broadcast have been the following: Annie Croft, Gracie Fields, Mary Mackie, Desirée Ellinger, Mark Daly, Lulu Stanley, Gaye Jukes, Evelyn Mardon, Charles Cardiff, Vera Florence, Leslie Hollwood, Marie Burke, Margaret Barrie, Edward Sydney, Sybil Thorndike, George Clark, Florence Bayfield, Will Gardner, Cyril Smith, Frederick Yule, Elfrida Burgess, Cecile-Maule-Cole, Frederick Wheldon, Barbara Austin, Bransby Williams, Ursula Hughes, Ben Lawes, Dorothy Dickson, Ouida MacDermott, Mamie Watson, Mercia Stotesbury, Gladys Chappelle, Molly Molteno, Neta Underwood, Reginald Stewart, Bret Hayden, Jean Colin, De Groot, Will Gane, Albert Whelan, Zoe Corner, Gwen Stella, Harry Emeric, Joe Leigh, Benita Lydel, Mary Brough, Rosalind Chard, Doreen Monte, Marjorie Lotinga.

Last, but not least, we had the London Marionettes—an experiment which proved astonishingly successful.

* * *

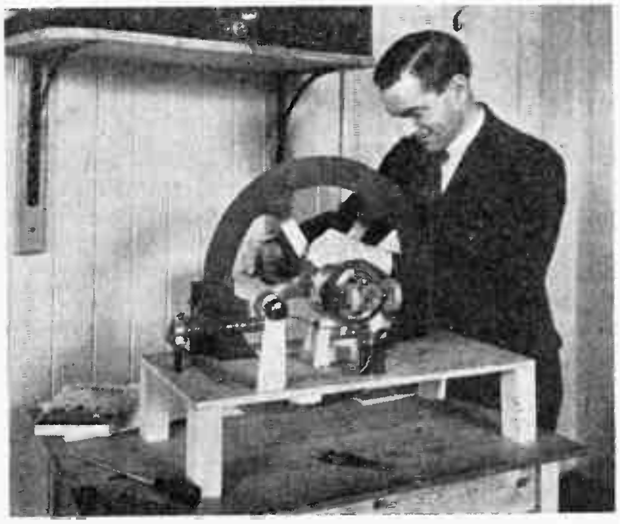
Our contemporary, *Amateur Wireless*, refers to these transmissions in the following terms:

"Many readers have commented on the general very high standard of the television programmes, particularly those which are given round about midnight. Although these transmissions are only of an experimental nature it certainly is a good thing to put over the best talent. Of course, listening to these transmissions leaves one with a feeling of dissatisfaction, because to enjoy them to the full one needs a television receiver to see the artistes.

"What do you think is one of the greatest inducements to lead the average listener to television? In our opinion that eerie, monotonous buzzing heard when one picks up the Baird tests on the speaker is a wonderful advertisement. It makes one long to be handling the "Televisor" controls, and resolving that buzzing into pictures. The speech accompanying the pictures is, too, rather fascinating. One longs to see as well as hear."

So far as I am concerned, however, as Director of Programmes I am far from satisfied. I never am. Yet there is no doubt that, on the whole, the results have been very satisfactory. I judge particularly from the reports sent in by lookers-in. Readers who have had good results have written from as far afield as Austria and Madeira.

As a rule in this age of wonders one becomes very blasé—one soon tires of achievement. But for me, I continue to be as thrilled with the broadcasting of sound as I am with the broadcasting of sight. I can never get over the wonderment that one sits before the transitter in London, and may be heard and *seen* in all parts of the globe. Those of you who have got over this feeling of marvel with regard to sound certainly should try to find means of looking-in. That, I am sure, will give you renewed appetite for the wonders of radio.



An amateur assembling the Baird Kit of Components, referred to on page 178.

* * *

And, by the way, I am wondering whether those of you who take part in the reception of these transmissions have formed any opinions as to which particular items are best suited to television. Of course, I have my own ideas, but I am very anxious to test my ideas with the views of those of you who look in regularly.

I refer, of course, to the "Televisor" point of view. Is the ordinary singer or speaker more interesting to see than, say, the character sketch artiste, the ventriloquist, the pianist or the violinist? I want to emphasise, if you will allow me, that all of you who listen, and more particularly those who look-in, are taking part in pioneer work, and I think it is up to you to co-operate with us as far as possible. Therefore, I want to thank those listeners in the British Isles, as well as those abroad, who have taken the trouble to send in detailed reports. They are most helpful.

No one followed more closely or more sympathetically than I did the earlier stages of aural broadcast, and comparing what was done at the beginning with what is being done now, I realise that we have still a good deal to do in order to reach the same degree of perfection as our sister-science, aural broadcast.

* * *

In the past few years, a wonderful army of amateurs and ordinary listeners have done their best to help, even if sometimes they may embarrass those who are doing their best for us at Savoy Hill. I repeat, I should like similar enthusiasm in regard to television, and, judging from our postbag, we are getting that same sort of help and sympathy as was manifest when broadcasting first began.

* * *

And now for an excellent piece of news. Exclusive to my readers!

On July 14th I shall be co-operating with my friends of the B.B.C. in producing a play entitled "The Man With The Flower in His Mouth." This will be the first officially authorised play given by the B.B.C. by television.

I regard this development as of immense importance. It definitely establishes this country as being the first to broadcast a play by television and it is also of immense credit to the B.B.C. that this transmission is due to their initiative.

It is too early to give you details beyond this interesting but brief announcement, except to say that Mr. Val Gielgud and Mr. Lance Sieveking have been the pioneers in this regard.

I shall tell you more about the play in the next issue of TELEVISION.

* * *

Some kind friend has sent me a "National" portable wireless set. What with this set and television I have had hardly any time to do any work! My "Televisor" keeps me occupied in the morning and late at night, and with the portable which I have put by my bedside I have been up half the night picking up all sorts of stations. Indeed, I spent the week-end in bed regaling myself with the music of the world. It is amazing that in this era of invention my appetite remains as keen as ever. I really do think that the "Televisor" and a portable set can make the very latest thing in modern entertainment.

* * *

Commencing with the next issue, TELEVISION has arranged to publish the television programmes a month in advance. Readers will also be able to obtain full information regarding the artistes in TELEVISION.

* * *

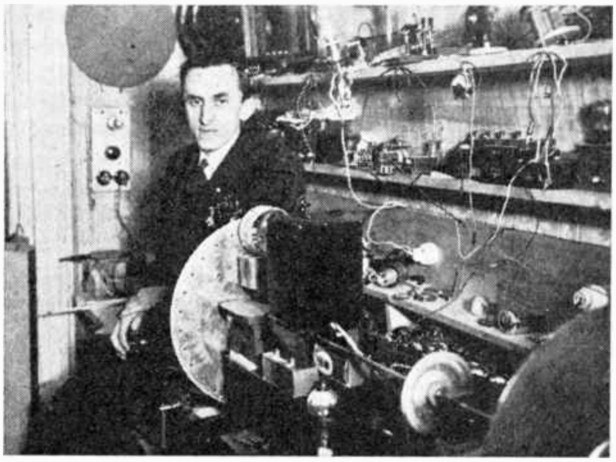
The other day when I gave my talk on the television transmissions from the Baird studio I asked for reports, and several interesting reports have reached me. I will quote one from Mr. Henry H. Lassman, of the East Ham Wireless Supplies, who says, *inter alia*, that he prefers women's faces to men's:

" I find that all male faces are always much darker than the ladies'. I take it that this is due to the ladies' faces being well powdered, and thus more suitable for television purposes."

He thinks, therefore, that men who appear before the "Televisor" should be made up as they do on the stage. As a matter of fact, experiments at the Baird Studios show that this is really not necessary, and some of the best results have been from those who have not made up at all. I quite agree, however, that from the point of view of plays and character studies some make-up should be used in order to give colour to the character being portrayed.

Mr. Lassman, by the by, says that Miss Stotesbury, the violinist, came through splendidly with the exception that her arm sometimes came across her face when playing. He thinks this is due to her being too near the "Televisor." He adds:

" The transmissions of late have been most excellent."



Mr. Mossig, of Vienna, with his home-made television apparatus.

And while I am on this matter I must refer to two other letters that have been kindly sent to us from the B.B.C., as correspondence which was addressed direct to them. One letter comes from Vienna in which the writer says: " I was able to pick up the transmissions at night-time. First a pretty young lady was to be seen, and afterwards a gentleman in evening dress. Both could be well recognised. At the same time the synchronised words and music were produced on a superheterodyne. This excellent reception is rather a proof that television over such a big distance is principally possible, although for the time being the television with primitive apparatus can only be effected by a technician."

The correspondent, Mr. Mossig, encloses some photographs of great interest, one of which is reproduced on this page.

Another letter from Austria also talks about the " pretty lady " who was singing, and describes other details of the transmission. My correspondent adds: " Would you kindly let us have photographs of the televised persons ? "

* * *

Another correspondent who was apparently able to pick up Mary Mackie has asked for her photograph, and it seems to me that these transmissions are in danger of initiating romances.

* * *

Did I mention that Mr. Baird at Boxhill, looking in at a transmission at Long Acre, saw somebody sitting before the " Televisor " furtively snatch a kiss—quite unofficially—from a young lady who was sitting by the transmitter? Both denied the soft impeachment, but Mr. Baird's " Televisor," I am afraid, did not lie.

* * *

I certainly cannot conclude these notes without referring to the very interesting letter from Mr. Henry Hoskins, of Wembley, who had some trouble with his synchronising and found that it was merely due to sticky brushes.

He now writes: " I can hold the picture perfectly steady and only occasionally we need slight readjustment. The last transmission was again excellent, the gold bracelet watch of the last artiste being clearly seen. One could almost count the links. Thanking you very much for the interesting programmes."

* * *

Then there is the all-important question of transmission hours, which several of my correspondents have touched upon. There is no doubt that a good many people, particularly amateurs, find the present arrangement insufficient and inconvenient for their purposes. I quoted in my last month's article the opinion of Mr. Wragge, of Selfridge's, that had television been included in the programmes proper his firm would have sold a very large number of television sets.

Obviously, then, under present conditions the number of sets that are sold is no criterion, and will not answer the question whether television has caught on with the general public. Naturally there will be a limited number of people who are prepared to buy a television set so long as facilities are limited—while, in fact, they are only permitted to look-in for half-an-hour in the morning and two half-hours at midnight. Indeed, nine listeners out of ten are engaged in their daily work when the morning transmissions are put over. But this matter is of such importance that I propose to deal at greater length with it in the next issue of TELEVISION.

Harmonic Analysis

PART I

By *Cyril Sylvester*, A.M.I.E.E., A.M.I.Mech.E.

MOST forms of energy cannot be transferred from one point to another unless they are in the nature of impulses. A stream of running water, for instance, in passing over a weir has not what may be termed a constant value. Above the weir are obstacles which hold back, and release, at indefinite periods of time, quantities of water; these periodic increases and decreases of quantities of water are superimposed upon what should be flow of constant value. The actual flow, then, may be said to take the form of a ripple, or form of wave.

An electrical analogy is the case of the generation of direct or unidirectional currents. In a perfect system of direct current generation the wave form would consist of a perfectly straight line parallel to the time axis; this ideal is never attained in practice because, in all direct current machinery employing a commutator, the current consists of a ripple—often of high frequency—superimposed on the ideal horizontal straight line. This undulatoriness is due to the division of the windings and the continual variation of the reluctance of the magnetic circuit as the armature rotates under the lines of force of the main pole pieces of the machine.

Light, although considered to have a certain velocity, is composed of certain colours which form the spectrum. The colours in any spectrum vary in both quality and quantity according to the variation of the colours from the normal spectrum. The velocity of light is constant but the colours which go to make up a certain kind of light have different frequencies; from this it will be seen that the wave form of the resultant light is the combination of the different frequencies. This may be stated in another way: that the efficiency of light (taking the normal spectrum as 100 per cent.) depends upon the variation in colour quality from the normal spectrum. Wave form, then, may be defined as a line which shows the shape of any phenomena, with irregularities, which is transmitted from one point to another.

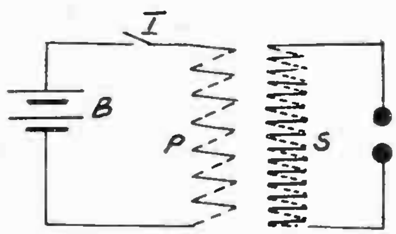


Fig. 1.

Some forms of electrical apparatus depend upon distinct variation for their operation. In an induction coil, such as was used in the early days of wireless telegraphy, current in the primary coil was interrupted before any secondary effects were manifest. This is shown in Fig. 1. The primary coil, *P*, was connected in series with a source of supply, *B*, and an interruptor, *I*. The secondary coil, *S*, was wound with *P* round an iron core; the interruptor was either of electromagnetic design operated by the magnetism of the iron core, or it was of the mercury type by means of which a rotating jet of mercury made contact with a certain vane at each revolution.

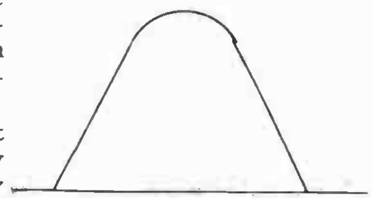


Fig. 2.

The action is that when the primary current is broken by the interruptor, the lines of force in the core commence to fall to zero. In doing so they cut the turns of the secondary coil and so a pressure is induced at the terminals of this coil. The latter produces the corona at the sparking spheres in the form of a brush discharge. The current from the source of supply is a direct or unidirectional one. If this were alternating current no interruptor would be necessary since the effect of alternating current is to reduce the current values to zero twice during each cycle. For the moment, however, we are concerned with alternating currents.

In the case illustrated in Fig. 1 the current will, obviously, have a certain wave form. The ideal is shown in Fig. 2. This shows the current rising from zero to maximum, and falling again to zero; the current rises at exactly the same rate at which it falls, so that maximum efficiency must be obtained. This, however, is not obtained in practice. The shape may be distorted as illustrated in Fig. 3; if this is so, then the efficiency must be decreased, as will be seen from the following considerations.

It will be seen that the maximum value is less than with the ideal wave form; it is also apparent that, since the value on one side is not according to a sine wave (or as close to a sine wave as is possible) it must result in fluctuating current. Here, then, transformer action is taking place which results in the production of an electromotive force which is operating against the applied pressure; in this way the effective pressure is reduced.

The same may be said of alternating currents. The introduction of inductance or capacity in a circuit, unless one neutralises the effect of the other so that resonance is established, must result in distorted wave form with consequent inefficiency. From a television point of view the matter is a complex one, this because we have three sources of energy which, combined, form the basis of reception. We have light, the impulses transmitted through the ether and the rectification apparatus at the televisor.

I have already dealt with light in these columns; I have shown how artificial light can be made to approximate to normal daylight and so bring the wave form as close to the ideal as is possible. With regard to the other factors, apparatus is available by means of which a distorted wave form can be made to assume normal shape; the rectification of the wave of one source may assist in the rectification of the wave of another source; on the other hand, it may result in further distortion of the waves in the other sources. I have carried out experiments and I realise the importance of being able to analyse the particular wave form generated; knowing this, rectification becomes a simple matter. In this short series of articles I hope to explain in simple language how wave form, especially with regard to television, can be analysed by various methods.

To commence, it is necessary to deal with the construction of a pure sine wave and show how variation, termed *harmonics*, alters the form of the wave. In Fig. 4 is illustrated a circle with points, *A* and *B*, on the horizontal line. In the top half of the circle there are, of course, 180 degrees. On the right of the circle is a line, *A—B*, which corresponds to 180 degrees. If we divide the top half of the circle into a number of divisions each of which is 30 degrees (there will be six divisions) and draw lines parallel to the horizontal over *A—B*, and then draw perpendiculars from *A—B* which has also been divided into 30-degree points, the perpendicular lines intersect those of the horizontal at certain points. If a line is drawn through these points we have what is known as a pure sine wave; this is absolutely free from harmonics and it is known as the fundamental. This ideal wave curve is so called because it is obtained by a certain rate of cutting lines of force, equivalent to the swing of a pendulum, which increases in speed from the end to the middle of the swing, decreasing at the same rate after passing the centre. The swing is expressed in physics as simple harmonic motion.

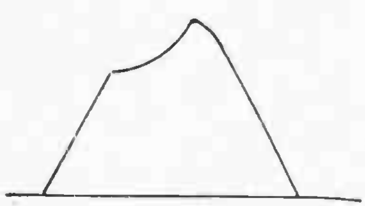


Fig. 3.

The experimenter can illustrate for himself, without the aid of electrical apparatus, how energy can be transmitted from one point to another in wave form. Let him tie a piece of string about twelve feet long to a staple fixed in a wall. If he now holds the other end in such a manner that there is a slight sag in the string between the hand and the wall, and he gives it a shake with an upward movement, a ripple will form in the string and it will pass from the hand to the wall. On reaching the wall the energy (or what is left of it) is returned to the hand in the form of a ripple which may be of smaller magnitude than the one which was transmitted from the hand to the wall. If the hand is kept perfectly rigid this harmonic motion will be maintained until the whole of the energy in the string is expended. If, however, the hand is moved, the wave form will be altered and harmonics will be set up. These, of course, will have the effect of bringing the string to a state of rest in much quicker time than would be the case if the wave were maintained as started.

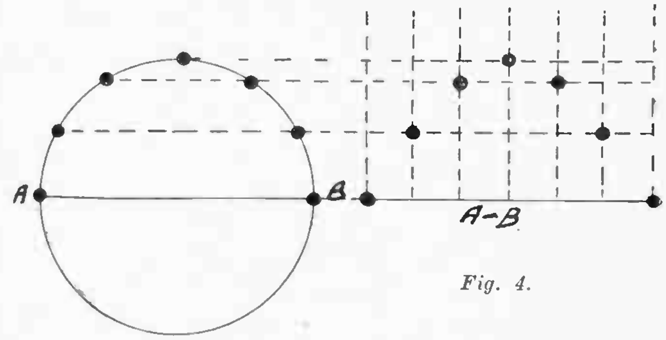


Fig. 4.

Television for the Beginner

(*Continued from page 158.*)

Instantaneous Response.

At the receiving end we must have a form of illumination which will be *instantaneous* in its response to the current variations produced by the television signals. Not only that, but it must be capable of withstanding the "shock" (if one can use such a term) brought about by the speed with which these current changes take place. So far the neon lamp has proved the only good servant, and we shall deal with this again next month as well as the assembling of all the parts mentioned at the beginning of this article.

Ahronheim's Television in Natural Colours

By *Dr. Alfred Gradenwitz*

Several announcements have appeared in the general press recently concerning the new system of colour television designed by the German inventor Ahronheim. Such claims were made in these announcements that we specially commissioned Dr. Gradenwitz to investigate them, and in the following exclusive article he gives such particulars as the inventor is at present at liberty to divulge.

THE problem of colour television was first solved, more than two years ago, by John Logie Baird, and, on similar lines, though much more recently, in the United States, by the Bell Telephone Company.

To Albert Alexander Ahronheim, of Berlin, colour is not an end in itself, but a means calculated to do away with present limitations of television to a narrow wave-band (9,000 cycles).

What is scanned in television, as at present in use, is the variable luminosity of the various picture elements, each luminous intensity being converted into a current impulse transmitted to a distance over a line of conductors, or—as in connection with present television broadcasts—superimposed upon the waves emitted from the antenna of a wireless station.

In exploring the various elements of pictures to be televised, Mr. Ahronheim pays attention only to differences of colour, those of luminosity being disregarded altogether. In doing so, he imitates the painter engaged in rendering colour and nothing but colour, and composing a picture with half-tone effects out of a relatively small number of colour shadings on his palette. Wherever there is a shadow, he simply takes a darker shading of the same colour, or else another colour.

It has thus been found that a painter only requires sixteen to eighteen different colour shadings; with these on his palette he is able to combine even the most delicate hues. This applies to still pictures.

In the case, on the other hand, of moving pictures, with which television is concerned exclusively, experience has shown that an even far smaller number of shadings suffices, twelve different hues being sufficient to secure the most delicate effects of colour.

In transmitting, in the place of luminous intensities, differences of colour only, Mr. Ahronheim then renders, for example, a brighter picture element by a brighter colour rather than by a more intense lighting of the element in question.

His *transmitter* comprises for each of these twelve necessary shadings one oscillating circuit, which only responds to this shading and is entirely insensitive to any other. The *response is invariably the same*, any difference in intensity being eliminated.

Current impulses thus are of constant magnitude, and being always the same, are not affected by any atmospheric trouble, such as fading, etc. All parts of the apparatus are tuned to one another so as to enable any number of current impulses to be given out. Each photo-electric cell yields current impulses of constant (and minimum) intensity, corresponding to one given colour shading.

Inasmuch as Mr. Ahronheim claims that he is not tied to such limitations as apply to present television broadcasts, he is free to choose a much higher number of holes for his Nipkow discs.

The beams of light coming from each picture element, at the transmitting end, are made to strike an *optical analyser*, viz., a liquid prism decomposing them into their spectral components, *i.e.*, ascertaining their colour composition. Each of the twelve portions of the spectrum falls on a photo-electric cell of its own, each of these twelve cells being by a special gas filling, endowed with special sensitiveness to the colour in question. The minimum (and constant) current impulses emanating from the photo-electric cells are properly amplified, care being taken not to interfere with their constant magnitude.

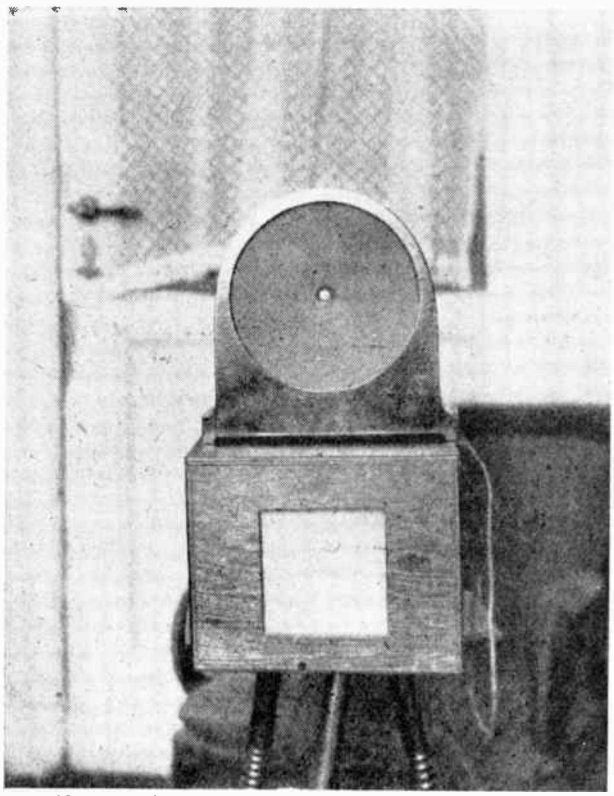
Another Nipkow disc will, until further notice, be used in scanning the various photo-electric cells, though the inventor expects to devise another, purely electrical, arrangement in its stead.

Mr. Ahronheim operating the tungsten lamp of his experimental transmitter.

The waves emanating from the antenna of the wireless transmitting station are modulated with the current impulses from the various photo-electric cells, which, after all, are merely current interruptions.

At the *receiving end* the same process is repeated in an inverse order, current impulses being converted into beams of light of constant intensity which are made to pass through colour filters of exactly the same spectral composition as the corresponding portion of the spectrum. The desired brightness of pictures is obtained by a uniform lighting.

Sound is transmitted in the same way as vision, by first recording its image on a film (as in connection



Ahronheim's experimental loud speaker on top, viewing screen below.

with talkies) and then televising this record just like the visual part of the performance. A possible difference in the orders of magnitude of current impulses corresponding to the visual and acoustic parts respectively is duly balanced.

The twelve photo-electric cells of the transmitter are, for the sake of simplicity, combined in a 12-fold bulb comprising thin glass partitions.

The inventor has so far been able to construct only a rather crude experimental apparatus demonstrating the principle of his scheme, and which merely renders coloured luminous points corresponding to three different shadings. The simultaneous acoustic reproduction was likewise demonstrated to the writer, who satisfied himself of its constant intensity irrespective of pictures transmitted at the same time.

Notes on the Assembled Baird Kit of Components

By William J. Richardson

If you followed last month's instructions carefully I am sure you have assembled the kit of Baird parts and found little difficulty in undertaking the work. Now in connection with the running of the universal motor there are one or two points which must be borne in mind. It is essential for the motor to run at the correct speed, namely, 750 revolutions per minute, and that is why you should be careful to verify that the motor you have acquired is built for a voltage corresponding to your house mains.

A Useful Table.

According to the mains voltage and the type of supply available, so you must join your spade tag (see last month's article) under the appropriate terminal connected in its turn to the Zenite resistance. For your information I append a table which you should copy out and keep by you for reference. The mains voltage is given together with the terminal to which connection has to be made, separate columns being allocated to direct current and alternating current (50 cycles).

Mains Voltage	Terminal	
	D.C.	A.C. (50 cycles)
100	B or C	A
105	C or D	A
110	C or D	A
115	C or D	A or B
120	D or E	A or B
125	D or E	A or B
200	D or E	E or F
210	D or E	E or F
220	C or D	E or F
230	C or D	D or E
240	B or C	C or D
250	A or B	C or D

A Variable Resistance Note.

It must be remembered that the supply voltage sometimes varies, and if any difficulty is experienced in securing a correct motor speed with the terminals specified, you should try those indicated for adjacent voltages. Should you be able to obtain the correct speed by the use of either of the terminals mentioned for each voltage, than it is naturally the better plan to select the one that allows the variable resistance being maintained nearest to the centre point when the final adjustment is obtained. The photograph on page 173 shows the kit of parts in process of assembly by an amateur, and I am convinced that the reader will have found the work most interesting.

Television *on the* South Coast

DEMONSTRATIONS AT SOUTHAMPTON AND BOURNEMOUTH

THROUGH the enterprise of the Baird Television Development Co. Ltd. arrangements have been made to give public demonstrations of television in many different parts of the country. Already several provincial demonstrations have been staged and many thousands have been brought face to face with television for the first time.

Press reports of the Ideal Home Exhibitions at Southampton and Bournemouth, just concluded, bear striking testimony to the pulling power of television. The *Southern Daily Echo* and *Bournemouth Daily Echo,* respectively, are to be congratulated upon the organisation of these two exhibitions.

On April 29th Miss Peggy O'Neill, the well-known actress, visited the exhibition and was "interviewed" by television. The following account from the *Southern Daily Echo* of April 30th describes the event :

"Journalistic history was made in Southampton last night when Miss Peggy O'Neill, the actress, and an *Echo* reporter carried on an interview by television and loud-speakers.

"Miss O'Neill removed her hat, patted her hair and said : 'Television is certainly very fascinating. This is the first time I have been interviewed by television, and it's rather a jolly experience.'"

"A few minutes after I had met Miss O'Neill in the exhibition I saw her again on the 'televisor,' writes Patoc. It was hard to realise that Miss O'Neill was in a different building. We were re-introduced via microphones and loud-speakers.

A section of the queue waiting to see a demonstration at Bournemouth.

"Tell me, what do you think of television ?" I asked.

"Television," came back the answer, "to say the least, it's very wonderful."

"And what a top-hole present a 'televisor' would make—there's a new idea. The Exhibition seems to be full of ideas. I can quite understand why it is so crowded this afternoon."

"But," added Miss O'Neill, as the screen registered ever such a slight frown, "you're all too modest about it. You ought to shout about it all over the place. I'm going to send all my friends along."


Peggy O'Neill (seated) looking-in at Southampton. Behind her is "Miss Television."

Then Miss O'Neill left the transmitting studio in the Royal Victoria Rooms and returned to the exhibition to see Mrs. Lepard televised.

Mrs. Lepard held up Miss O'Neill's pet dog, and he was televised, after which Mr. Lepard entered the studio and gave a diverting exhibition of Leslie Henson "faces."

Miss O'Neill was received at the exhibition by Mr. G. L. Logan, of the Baird Television Co. and was presented with a shower bouquet by Miss Joan Dare, another representative of the company.

Another incident which speaks volumes for television is also recorded :—

The television exhibition yesterday evening produced an unusual incident. One of the engineers was being televised and the usual request was being made for questions to be put to him. A girl surprised him by asking over the two-way communication : "Haven't you been in Glasgow lately ?" The engineer, rather taken a-back, admitted that he had. It was subsequently discovered that the girl, who is employed at one of the stands in the exhibition, saw the same engineer televised at Glasgow not long ago, and though she had never met him actually, she recognised him again—a striking tribute to the powers of television.

Demonstrations of Noctovision were given before the Southampton Master Mariners Club at the close of the Exhibition, some prominent sea captains being present at the luncheon.

Captain J. King, O.B.E., R.D., R.N.R, said that if Noctovision could do one tithe of what was claimed for it in the days of 32-knot ships then it was going a very long way towards eliminating the difficulties with which seamen had to contend. He looked forward with great interest to seeing what could be accomplished in that direction.

Television in the Home.

A Baird "televisor," supplied by an all-mains receiver, installed in a reader's home.

Captain W. V. J. Clarke, D.S.C., added that if the instrument was a safeguard against collision, then shipowners would probably regard it as part and parcel of the equipment of a ship. He did not think that cost would be a determining factor if the apparatus only accomplished what was claimed for it. Captain J. G. Saunders, R.D., R.N.R., "Captain" of the Club, in thanking the speakers said that they had listened with the greatest possible interest to the details of this new invention and they were satisfied that if it could only be developed and perfected it would prove a great boon. Anything which might reduce the bugbear of fog was going to do a great service for the Mercantile Marine.

The Bournemouth Exhibition was opened at the Holdenhurst Road Drill Hall on May 8th. The Exhibition closed on the 17th.

On May 12th Sir Dan Godfrey, Director of the Bournemouth Municipal Orchestra, was televised and those present were delighted with the excellent results. Sir Dan Godfrey first saw a demonstration at the receiving end, where he saw a *Bournemouth Echo* representative, who congratulated him upon the interest he had taken in his tour of the Exhibition. Sir Dan Godfrey afterwards told the *Echo* man that the definition was wonderfully clear. Sir Dan then went into the transmitting cabinet and those at the other end saw how wonderfully clear the facial expressions were. He took the opportunity of making a short speech in support of the advantages of the "Televisor" for business and police identification purposes.

According to press reports, a large number of people visited the exhibition and saw the television demonstrations. Among those particularly interested were Mr. Herbert Russell-Cotes and Mr. Arthur Pamment, manager of the Royal Bath Hotel.

The following reports from the local press are significant :—

"These demonstrations have attracted continual crowds ever since the Exhibition was opened. They take one-and-a-half minutes each, and four people see each demonstration. Yet the men in charge are kept hard at work from the time the Exhibition opens until it closes each day.

"Quite a number of people are under the impression that the television apparatus at the Exhibition is only a receiving set for showing the short B.B.C. television broadcasts which are given daily from London.

"This is not so. In addition to the receiving apparatus, there is a complete transmitting studio, erected near the entrance to the Exhibition, in spite of the many technical difficulties. This transmitting studio is worked all day long so that visitors to the Exhibition can witness this marvellous invention at work any time, not only during the short period each day that the B.B.C. gives to television.

Speaking of the Baird Company's equipment the *Bournemouth Echo* says that :—

"The 'Televisors' are neatly made and easy to understand. They enable you to see faces and things which are transmitted at a speed of 186,000 miles per second and they cost only 25 guineas.

"Visitors heard talks by the engineer, Mr. Vince ; Mr. Logan, of the sales department, and "Miss Television," all of whom had something to say about the apparatus and what it was capable of producing and its cost. Meanwhile the audience actually saw the reproduction of the face of the person talking to them, and noticed clearly any change in the facial expression, or movement of the hand to the face. The movement of the lips actually synchronised with the sounds of the loud-speaker. By telephone the visitor can also talk to the person who is being transmitted. 'It is all very wonderful,' said a lady, 'and I shall want to see it again before the Exhibition closes.'"

Noctovision was also demonstrated.

A Wireless Receiver for Television

By *William J. Richardson*

WE must now proceed to the third and final stage, for it is assumed that the amplifier described in the March issue of *Television* is made and tested and the "televisor" completed, so it is necessary to make up a unit to couple in front of the amplifier to receive and rectify the broadcast television signals. As far as the detector stage is concerned an anode bend rectifier is the best for the work, and this, together with the three stage resistance capacity coupled low frequency amplifier will ensure positive images, which of course is a point that must be watched.

Another factor to which I gave careful consideration was whether a detector unit alone should be described or whether it should be preceded by a stage of high frequency. Anyone within reasonable distance of the Brookman's Park stations will be in a position to apply quite a strong signal to the anode bend rectifier. For the efficient working of this particular arrangement such a point is essential.

A Reserve of Power.

On the other hand, there must be a large number of enthusiasts who find that a detector stage is insufficient, and these will welcome the advantages brought about by the inclusion of a high frequency stage. Furthermore, even those within the service area of the television broadcasts will be on the safe side if they make up the high frequency and detector unit which I propose to describe in detail. It will give a reserve of power which will serve them in good stead.

Turn to Fig. 1 and you will see the theoretical circuit which I finally decided upon as being the best to meet the situation. I have tried it out thoroughly and can assure you it will, together with the amplifier and assembled kit of parts, or alternatively a commercial Baird "Televisor" itself, give a first-class image.

Aerial Coupling.

A special but straightforward coil has been used on the aerial side in order to meet the conditions of selectivity in a simple but effective manner. It is suitable for both long and short waves, a three-spring switch normally bringing about the wave change. Since at present the vision transmissions are on the 261 metre wave-length the long wave section has been shorted out in the wiring. If the constructor should desire to use the set for ordinary broadcast reception then a switch may be mounted very easily on the top of the coil. The connections are shown quite plainly in Fig. 1.

The short wave aerial coil is wound on a rotor so that the coupling between it and the tuned grid coil may be varied at will and give both selectivity and volume control in an efficient manner. A screened grid valve is used and the semi-variable resistance shown as R_1 is included to give a negative bias to the valve when using a 4 volt valve in that position and 6 volt. valves for both the detector and low frequency stages. Should a 6 volt screened grid valve be preferred then this resistance may be omitted or set at zero. The second resistance R_2 proves useful as an addional volume control to be used distinct from or in conjunction with the variable magnetic coupling on the aerial side.

A Fuse Lamp.

In the assembly the valve is mounted horizontally, passing through a screen. Note the inclusion of a fuse lamp as a safety measure. Should the screen grid of the valve happen to fail from faulty construction it is liable to touch the filament or plate. If so, part of the high tension battery would be shorted out and the insertion of the fuse—one of the 60 milliampere class—will ensure its "blowing" under these circumstances and preserve the battery. Note that the 1 mfd. bypass condenser is connected to the battery side of the fuse. If joined on the other

Assembling the components for the receiver described in this article. At right back is Mr. Richardson's famous amplifier, described in our March issue.

side the fuse lamp is liable to fail with the charging current surge which occurs when switching on.

Choke Feeding.

In the anode circuit of the screened grid valve I have arranged to choke feed the magnified signal impulses into the tuned grid circuit of the detector valve. This is a very efficient method as actual practice has demonstrated. Naturally the high frequency choke must be of the high impedance screened grid type, and it is also advisable to " decouple " the circuit in the manner shown with a 600 ohm. resistance and 2 mfd. condenser.

The tuned grid coil is suitable for both long and short waves and a two-spring push-pull switch could be used here. As in the case of the aerial coil, however, points 3 and 4 have been shorted out in the wiring.

Anode Bend Detector.

The anode bend rectification arrangements are no doubt quite familiar to readers, a 400 ohm. potentiometer providing the fine variation of grid voltage so that the optimum working point can be found with ease. In the plate circuit of the detector valve is a standard high frequency choke together with a semi-variable condenser of .0003 to .001 mfd. capacity to act as a capacity bypass to earth. The output + terminal is for connection to the input + terminal of the amplifier as in this way the detector valve will be R.C. coupled to the first low frequency valve.

By using the three-spring push-pull switch both high tension and low tension sources are isolated from the unit, it being borne in mind that the same L.T. and H.T. will be used for both this unit and the low frequency amplifier. One of the accompanying photographs shows the components all assembled ready for screwing to the base-board, while the amplifier itself is seen in the background.

The Components Required.

Elsewhere in tabular form will be found a complete list of all the components used together with the individual manufacturer's names. This will give interested and prospective constructors an opportunity of collecting together all the gear required. If they desire, a start can be made on the layout and construction work, but next month I propose to give full working drawings and photographs showing exactly how the high frequency and detector unit can be wired up, etc. This will be supplemented with working instructions so that constructors will have no difficulty in duplicating the results I have been able to obtain from present television broadcasts.

Bear in mind that although two standard tuning coil products have been specified, constructors can quite easily make up their own or purchase alternatives

(*Continued on page* 184.)

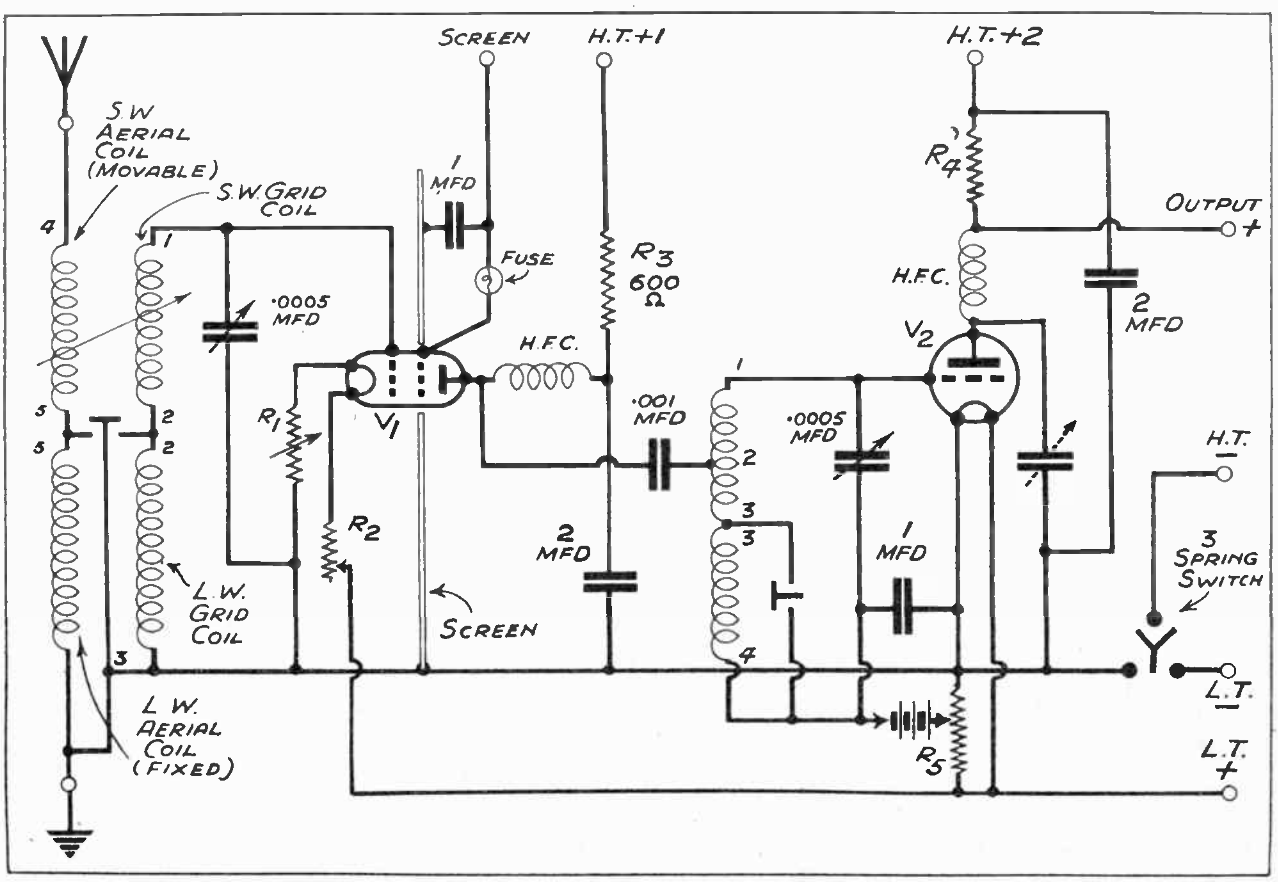


Fig. 1.—Schematic diagram of the circuit employed in the receiver described in this article.

Notes of the Month

Night Television Transmission for Germany

UP to the present television broadcasting in Germany has been limited to two daily half-hour periods from 9 to 9.30 a.m., and from 1 to 1.30 p.m., except on Tuesdays and Thursdays when the morning transmissions have been omitted. The transmissions have taken place from the Witzleben, Berlin transmitter only, which has a power of 1½ kw., and operates on a wavelength of 418 metres (716 kc.).

According to our Berlin Correspondent, the German authorities are now favourably considering a suggestion of the German Television Society that, twice a week to begin with, television should be broadcast at night after the ordinary broadcast programme has come to an end. In addition, it is stated that the high-power transmitter at Koenigswusterhausen is to be used in future for the experimental television broadcasts. As stated in our October, 1929, issue, this desirable station could not at that time be employed because the land lines connecting it with Berlin were unsuitable. New high-efficiency lines have since been installed.

In addition to the experimental broadcasts which have so far been conducted by the German Post Office, another series of experiments is being carried out at the Heinrich Hertz Wave Research Institute, recently opened in Berlin. These experiments, as inferred from Professor Leithaeuser's recent lecture, are mainly concerned with reception, with particular reference to the discovery of suitable glow lamps, synchronizing devices, photo-electric cells for transmission, etc.

Combined Television-Sound Broadcasts in America.

As reported from time to time in the pages of this journal, the Jenkins Television Corporation have been broadcasting silhouette films for some time past. According to recent newspaper reports, an attempt has now been made to transmit simultaneously both speech and actual television, but the attempt does not appear to have been very successful as far as the television end of it was concerned.

Apparently the floodlight system of transmission was employed, instead of the spotlight system used by Baird. According to the reports, the sitter had concentrated on his face a battery of giant lamps, giving a total of 30,000 candlepower. Although no shadows were apparent at the transmitting end, at the receiving end shadows were so pronounced that considerable difficulty was experienced in recognising the person before the transmitter. Double images were frequently observed.

The television signals were transmitted on 139 metres, and the speech was broadcast on three wavelengths simultaneously, 187, 207 and 297 metres.

Jenkins has apparently abandoned his customary method of drum scanning, and in these experiments a 48-hole disc was employed. Scanning was carried out at the rate of 15 pictures per second. The driving motor consisted of two parts, an eddy-current motor for bringing the scanning disc up to speed, and a small synchronous motor to maintain the speed at 900 r.p.m. The A.C. mains appear to have been relied on to preserve synchronism, however.

The Jenkins television receiver (left) shown connected up to a wireless set.

Shorter and Shorter!

Despite the strenuous efforts of the Paris fashion dictators to make the ladies' skirts longer and longer, wireless waves obstinately persist in getting shorter and shorter.

From Germany comes a report that a certain Dr. Esau says 'e saw (sorry !) distinct possibilities in the broadcasting by television of cinema films on wavelengths three to ten feet long. He has been working on these ultra-short waves at a secret station in Saxony, and recently told a Breslau audience that, over short distances, he got good reception by using an aerial only twenty inches long. No interference, he said, was experienced from trams and other static-producing machinery.

"Within a few months the equipment of stations with ultra-short wave apparatus could begin," says Dr. Esau, and adds that "within a few years existing sending stations will only be museum relics."

What has Paris got to say to this new rebel ?

Television by Phone

Efforts are apparently being made in America to bring within the bounds of possibility the dream of those imaginative writers who have foretold the day when we shall be able to *see* the man at the other end of our telephone, as well as talk to him.

Following their recent successful demonstration of two-way television-cum-telephone conversation in New York, the American Telephone and Telegraph Company has applied to the United States Government for gigantic concessions "to enable television to be brought to the masses."

It is stated that the concessionaires would require the right to control four wireless wavelengths and to increase the power used in telephonic transmissions 30 times. If the concessions are granted the A. T. and T. proposes to inaugurate a television service between principal cities to determine whether or not the public will make use of the system. It is estimated that a telephone plus television call will cost thirty times as much as an ordinary telephone call.

At present the A. T. and T. is stated to be concentrating purely on telephonic or telegraphic television over wires, leaving the problem of wireless television to the Radio Corporation of America. At present, it is stated, wireless television is not so far advanced as wire television. With telephonic television it is proposed to send only the head and shoulders of the speakers. By wireless, however, it would be possible to transmit talking pictures (films) over the ether.

Novel Hero-worship

A short-wave amateur in the United States is so fond of the voice of the P.C.J. announcer that he has made a record of it.

He was only using a two-valve set which, however, gave excellent reception on a loud-speaker. The reproduction of the announcement by means of the dictaphone was almost as good as the direct reception.

If this idea catches on Mr. Snowdon will be able to put an entertainment tax on dictaphones.

England's 1,800 Amateur Transmitters

There are 1,800 amateur wireless transmitters in England as compared with the French total of 1,100. France, however, is making rapid headway and soon will reach the British total, if her amateurs develop at the rate shown in last year's return.

A Wireless Receiver for Television.

(*Concluded from page* 182.)

provided they are of reliable make. The same remark applies to all the other components listed.

List of Components.

1 Aerial coil with variable magnetic coupling. (Peto Scott.)
1 Grid coil. (Peto Scott.)
2 ·0005 De Luxe 1930 variable condensers. (Formo.)
1 Binocular H.F. choke, screened grid type. (McMichael.)
1 Standard H.F. choke. (Igranic.)
2 Valve holders—1 Standard and 1 Universal. (Whiteley Boneham.)
1 Three-spring push-pull switch. (Bulgin.)
1 Pair G.B. battery clips type No. 1. (Bulgin.)
1 Formodenser type G. (Formo.)
1 400 ohm base-board potentiometer. (Igranic.)
1 600 ohm decoupling resistance. (Wearite.)
1 Anode resistance with holder. (Varley.)
1 9-Volt G.B. battery. (Pertrix.)
9 Insulated terminals, aerial, earth, L.T.+, L.T.—, H.T.—, H.T.+ 1, H.T.+2, Screen, output +. (Belling Lee.)
1 15 ohm filament rheostat. (Wearite.)
2 2 mfd. fixed condensers. (T.C.C.)
2 1 mfd. fixed condensers. (T.C.C.)
1 ·001 mica condenser. (T.C.C.)
1 30 ohm calibrated resistance. (Burne-Jones.)
1 Fuse lamp and holder. (Bulgin.)
2 Vernier dials. (Formo.)
7 2-ft. lengths glazite wire. (Lewcos.)
2 Wander plugs and 1 S.G. safety connector. (Belling Lee.)
1 Aluminium panel, 16×8×1/16th. (Whiteley Boneham.)
1 Cross Screen, aluminium 8 × 6¼ × 1/16th with two half inch overlaps. (Whiteley Boneham.)
1 Wooden baseboard 16 × 8 × ½.
2 Wooden side battens, 8 × 1¼ × ½.
1 Ebonite terminal strip, 16 × 2 × ¼. (Peto Scott.)

Shadows and Television

By D. R. Campbell

IN our younger days many of us must have read that delightful story of Peter Pan, and his absolute desolation on losing his shadow, followed by his intense joy at regaining it again. Though many have read this fairy tale, how many have ever given a thought to what a different world this would be if suddenly there were no shadows, how changed would be our visual perspective. Perhaps one is inclined to think that colour is more important than shadow in the composition of a picture. Certainly colour makes for prettiness—but shadows give us beauty and solidity. Shadows are always interesting, and ofttimes mysterious. Scientifically, a shadow tells us the height of things, for many years the time, and scientists hope to prove or disprove many things by the aid of the shadow of an eclipse.

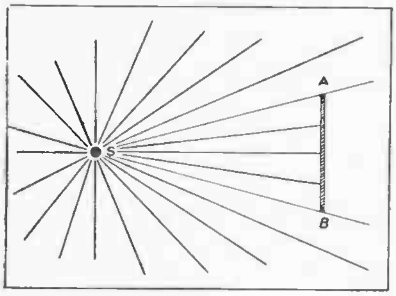


Fig. 1 (*a*)

Shadows are caused by the interception of light by some body or object. In the study of light we find two kinds of shadows, the perfect or umbra, and the partial or penumbra. In Fig. 1 the two kinds are shown. In "A" one has a small source of light area relative to the object casting the shadow. This light area *S* emits rays of light travelling in a straight line in all directions. If the object *AB* is opaque it will intercept any light falling on it, and a total shadow area is formed to the right of *AB*.

In "B" *SS* is a relatively large source of light compared to *AB*, and if we follow the four rays drawn one finds that some of the shadow cast by *AB* is total, area *ABC*, the rest being partial. With a little thought one realizes that a small area of light source gives one sharper or denser shadows. Except by design one rarely gets total shadows. In nature, though, the sun is only a comparatively small area of light, and the amount of light reflected and diffused by clouds, etc., makes shadows nearly in every case partial. In television the source of light is small and brilliant, and if one holds up an object in this area, covered by the travelling spot, a very clean-cut shadow is thrown on the background.

There must be many readers of this magazine who have visited the Baird Company's premises, and seen a demonstration of the reception of the daily transmissions, also the Studio and Control Room, from which these programmes are broadcast, and which are now freely shown to visitors. Those who have seen the studio are generally struck with the simplicity of the apparatus required. For those who have not seen it, a brief description will be given.

The studio, a room of some twelve feet square, draped with curtains, and normally lighted, contains, besides the usual piano and microphone, a simple white background on a frame, like one generally sees in any photographic studio. On one side is an aperture leading into the control room, through which a diverging beam of light is projected on to the white background, all very similar to the beam of light from the operating booth of a movie theatre. It is in this beam of light that the artist or object to be televised is placed. Last, but by no means least, just above the aperture is a not very interesting (to look at) black box in which four little windows are cut, through which one can just see the photo-cells. To visitors this box is generally described as the "vision mike" or "electric eye." The artist to be televised, after taking up his allotted position in the beam of light, is instructed to consider the source of light as the audience, and if they look at the light they will be looking straight out of the receiving "televisor" at whoever is looking in. Fig. 5 shows the layout.

Now, on first consideration, it seems rather odd that one does not get a picture looking down on the subject, considering the position of the cells, such as in Fig. 4. This photograph has been taken with the light camera and model in the positions indicated by the accompanying diagram, which, it will be observed, is similar to the layout of the light source, photo-cells, etc., in the Television Studio. In practice one sees the artist from the angle, as in the photographs in Figs. 2 and 3, for reasons that the writer will endeavour to explain.

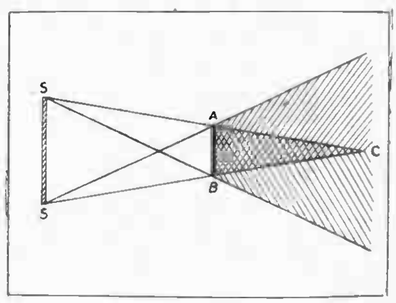
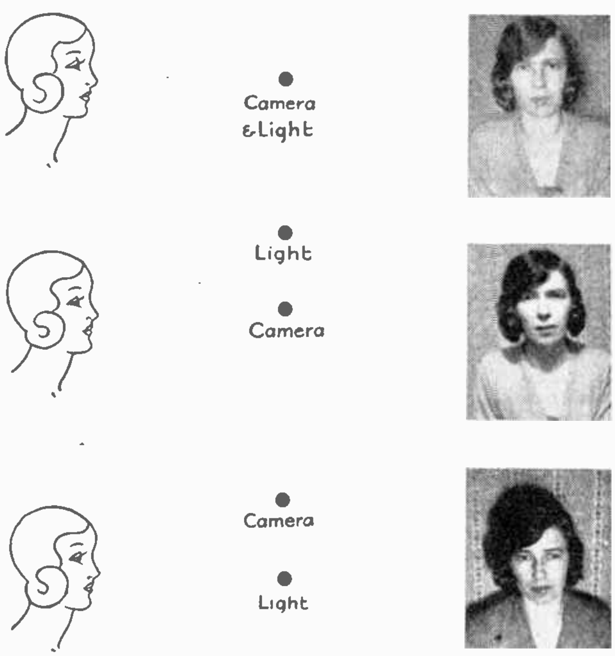


Fig. 1 (*b*)

When one looks at the transmitting end one sees the whole object being televised illuminated, but as TELEVISION readers are aware, at any given instant only a spot of light is illuminating a very small area of the whole, and the photo-cells are only affected by the amount of light reflected from this spot, and are quite incapable of distinguishing in what direction it comes from. At the receiving end one has the neon lamp fluctuating to the changing light falling on the photo-cells at the transmitter. This neon lamp, which now becomes the object televised; inasmuch as it has become a source of changing light intensities, corresponding to the amount of light being reflected on the object televised. One views the neon lamp through a rotating disc, the disc being relatively in the same position to the neon lamp, the origin of the televised image, as the transmitting disc is to the object being televised. Consequently, the televised image is seen as if one viewed the object being televised from the transmitting disc, which is also optically the source of light.

Looking at the photograph in Fig. 2, which is taken from the source of light, one has a picture devoid of shadow, except for a slight one on the right-hand side on the background. This is due to the fact that it is obviously impossible to have the camera and light in exactly the same position. The light in this case is two and a half inches to the left of the camera. If one viewed the object being televised from a point as near as possible to the transmitting source of light, one would get a view of a person televised exactly similar to Fig. 2. Those readers who have actually seen a television image will, however, have noticed that there are shadows such as in Fig. 3. Note where the light



Figs 2, 3 and 4.

was placed to produce this photograph, also how much more generally interesting this picture is compared with Figs. 2 and 4. Quite a lot can be learned by the study of these three pictures if carefully studied in conjunction with the light and camera positions relative to the sitter, great care having been taken to have the same set expressions in the three examples.

At whatever angle one looks at a person in the transmitting beam one never sees shadows on the neck, under the nose and eyebrows, as in Fig. 3, but if one considers where the light was to produce this picture—that is, the cell positions in the Television Studio—one immediately realizes that the cells are responsible. In practice one considers the light source the "eye," and the cells the light source. This reversal of affairs is not, in these early stages of television, very serious, but when the projected spot-light system is considerably extended it will not be too convenient for the art director of television to "light" his artists as is done in the movie or "still" photographic studio, when he cannot directly see the shadows which are so essential for the success of any monochrome picture.

How cells cause shadows is best explained by the analysis of what actually happens, with the aid of Fig. 5, in televising a simple object such as a length of wood placed horizontally in the transmitting beam. In Fig. 5, *AA* is the aperture through which the spot light is projected, *C*1 and *C*2 photo-electric cells in the relative positions to the screen or background *SS'*. Anything placed in the area covered by the spot-light beam *SYZS'* will be televised. The object we are considering is *O*. To our eyes *O* will be brilliantly lighted on the side next to the light, also the screen *SS'*, except for the shadow cast by *O* at *f* to *e*.

Though the eye sees the beam as a whole it must not be forgotten that only a very small area is actually lighted at any instant. Consider the line from *A'* to *S'* to represent this spot of light, travelling upwards As this spot moves up *S'S* from *a* to *b* it is in full view of both cells, *C*1 and *C*2, from *b* to *c* it is out of view from *C*1, and consequently, as the electrical output of *C*1 and *C*2 are in parallel, only half the signal is available.

Continuing its traverse, the spot passing from *c* to *d* is completely eclipsed from *C*1 and *C*2 by *O*, and in consequence the cells record no signal, and at the receiving end there will be a black line. From *d* to *e* only *C*1 responds, from *e* to *f* the light side of *O* is in full view of *C*1 and *C*2, also the area from *f* to *g*. It will be noticed that the visual area of shadow *e* to *f*, though in full view of *C*1 and *C*2, never exists to the electric eye, nor do any other visual shadows, unless caused by an object to the right of the line *YZ*, in which case the object would be out of "cell sight" and therefore would not be televised.

If the reader has followed what happens in this simple case given above he will realize that at the receiving end, instead of seeing just the piece of wood, he will see, from the top, white screen, piece of wood, medium shadow, black shadow, medium again, and white screen. Further, one will realize where the shadows in a television image come from, and how, at the transmitter, we see Fig. 2, but at the receiver Fig.3. To transmit a picture like Fig. 2 numerous cells in different positions are necessary to kill each other's shadows, just as in photography one would use many lights, or one could place the cells as near the light source as possible.

Another form of shadow is caused by the object, which, though being in full view of the cells, may have its surface inclined at such an angle as not to reflect the light directly at the cells, just as a piece of white paper, *PP* in Fig. 5, will appear darker than the background, even if of the same tonal quality.

Colours also will give a shading in the received image which the eye does not see in the original. If one held up the cover of this paper, which to our eyes has three distinct visual luminosities from the red, black and white, to be televised, one might get the red and black one tone, and the white another, or the white and red the same tone and the black the other. The result would be according to the type of cell used. If one used a cell which makes red and black the same tone,

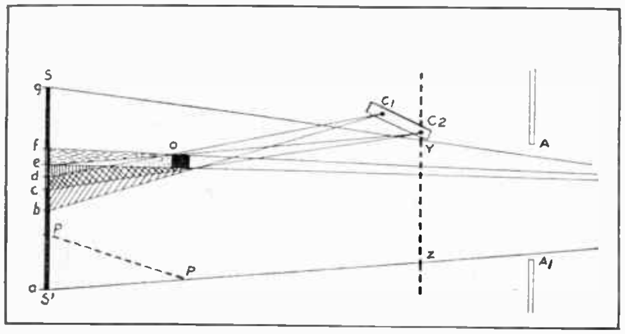


Fig. 5.

it would certainly spoil the "likeness" of the person televised if he had a strong complexion. Bright cheeks would become dark and the face would appear narrower in the televised image. Nowadays the cells used are very sensitive to red, so much so that the lighter shades of red televise as white. This fault is obviously not a drawback in televising the human face. The writer would advise readers to refer to "Faithful Images" by W. F. F. Shearcroft, in last month's TELEVISION, for further consideration of this subject of colour.

Television is like photography inasmuch as some people "take" much better than others. Round, broad faces reproduce best, the thin narrow face worst. The same conditions generally hold good in photography. If one photographs a person with a broad face one can use with good effect a narrow or concentrated lighting, which, if applied to a narrow face, will almost invariably give us a grotesque picture. In television the light surface is "narrow," and in consequence persons with long faces do not make good subjects.

So far, reflectors are not used as in the photographic studio. They would be far from easy to operate, considering there is nothing visible to reflect. It seems that a small lamp, equal in power to the photo-cell, and attached in close proximity to it, would greatly assist in getting the required lighting effects in the television studio, the light from which would play no part in the televising, but only show the human eye of the studio director where the shadows are.

The writer has only dealt with shadows that originate in the studio. Before closing, however, he must mention that there are other kinds of shadows in a television image, which are vaguely termed "electrical." They are caused by a lack or preponderance of certain frequencies from various sources, such as amplifiers and lines, to overloading of valves, and recently on long-distant receptions a ghost effect, apparently caused by the receiving aerial being excited by the direct waves, and also the reflected ones from the Heaviside layer, which though the ear cannot detect it in sound receptions, the eye in vision can—which scientifically adds a very interesting, though hardly pictorial, shadow to a television image.

MORE NOTES

Television at a Reading Store

Television celebrated its arrival in Reading on Thursday, May 15th. The first broadcast messages were made by His Worship the Mayor of Reading, and also the Editor of the *Reading Standard*, Mr. J. E. Archibald.

From the moment of opening, and throughout business hours, both transmission and receiving ends are thronged with people. The artistes who provide the programme include the well-known comedian, Mr. Ben Lawes. Members of the staff visited the micro-phone also and provided entertainment, as well as giving a selling talk.

A feature of the broadcasts were the visits of mannequins who described their frocks to the public. Various pets from the stores pet department showed their pictures on the screen, as well as making amusing noises through the microphone.

The experience of William McIlroy, Limited, at Reading proves the amazing attraction of television in a departmental store to-day.

Television Programmes

The following is a list of newspapers which are regularly publishing the television programmes :—

Birmingham Gazette.	Evening Chronicle.
Bristol Evening News.	Glasgow Herald.
Bristol Observer.	Irish Radio News.
Daily Dispatch.	The Scotsman.
Daily Express.	Sunday Chronicle.
Daily Herald.	Sunday Times.
Daily Mirror.	Western Daily Press.
Daily Sketch.	World's Pictorial News.
Empire News.	Yorkshire Observer.

"His Master's Voice" New Loud-speaker

"His Master's Voice" have just introduced a new moving-coil loud-speaker—No. L.S. 4. This unit has been produced to satisfy the requirements of those owners of "His Master's Voice" Standard Electrical Reproducers who have asked for a separate loud-speaker comparable in quality to the original instrument, in order to extend the facilities of their present equipment. The L.S. 4 is, therefore, designed specially to operate in conjunction with the :—

Electrical Reproducer, Model No. 551.
Automatic Electrical Reproducer, Model No. 15.
Radio-Gramophone, Model No. 520.

The cost of the new loud-speaker is £16. It can be installed at any distance from the main instrument, and for tone and quality and value it is unequalled by any loud-speaker.

Apparatus Tested

A New Mullard Valve

The new Mullard PM256A valve is admirably adapted for television purposes. It possesses the very low impedance of 1400 ohms with a mutual conductance of 2.6 mA/volt. It is capable of handling very large imputs without distortion. When an *anode* voltage of 200 is applied with over 30 volts G.B. the plate current is 30 milliamperes. Adjustments can thus be made for this valve to work in the output stage of an amplifier connected to a "Televisor". This was effected during the course of the tests made and not only did the valve give an undistorted image but the synchronising mechanism functioned satisfactorily with the neon and coils in series in the output circuit. In every way the valve fulfills the specification of the makers and should find an especial application as an output valve for a television amplifier, it being noted that the filament current is only ¼ ampere.

Philips Television Lamp

The Philips neon is made with a three pin base for plugging into an ordinary valveholder. Two of the pins make connection to the positive and negative electrodes, while the third acts as a steadying pin. There are two nickel electrodes, one of which is a plate and the other a wire grid, and it should be noted that the plate (cathode) is always negative and the grid (anode) positive. The overall dimensions are approximately 6½ in. by 2 in.

The cathode measures approximately 1½ in. by 1¾ in. It has insulated backing, thus restricting the luminescence to one side only.

It is claimed that a minimum current of 4 milliamperes is sufficient to cover the plate with light and on test this proved to be the case. Diagrams of connections for using the neon lamp for television purposes are provided and it was carefully tested under working conditions. Although the normal working current was given as 20 milliamperes this was insufficient to give an image of standard brilliancy. Nearly 40 milliamperes was necessary for this and the voltage required was a full 350 volts. The lamp, while quite satisfactory under these conditions, compares unfavourably with the standard G.E.C. flat-plate neon which requires only 20 milliamperes and about 220 volts for normal working. The construction of the lamp was quite rigid and the plate showed no tendency to bend under rough usage.

New Osram P2 Valve

The G.E.C. have just added a new valve known as the P2 to their Osram series. We have subjected a sample to a thorough test and found it to be most efficient. It is a power valve in every sense of the word and fills an undoubted need in the 2-volt class where a moderate H.T. consumption is desired with good quality reproduction. The low impedance and high mutual conductance produce a combination in the P2 which gives results almost equal to that secured from what we now regard as a super-power valve.

Ample output was obtained on test to drive a moving-coil loud-speaker, and a very large input grid swing voltage could be applied without any distortion. The valve is admirably adapted for portable sets where both H.T. and L.T. consumption has to be cut down to the barest limits consistent with efficient working. In order to get sufficient power in the last stage of a television amplifier, however, we found it necessary to use two P2's in parallel.

In every way the new valve is a worthy addition to the Osram range of 2-volt valves. The following are its characteristics :—

Filament Volts	2.0 max.
Filament Current	0.2 amp.
Amplification Factor	6·5
Impedance	2,300 ohms
Mutual Conductance	2.8
Anode Volts	150 max.

The National Portable

Without knowing the price at which the National Portable is to be put on the market I cannot say whether or not it is good value for the money—all I can say in that connection is that, providing the figure is not over 15 guineas, the set is well worth it.

I have now had nine in use for a fortnight, and I must frankly own that I am more than pleased with the results I have been able to obtain with it. I have tested it in London and I have tested it 40 miles out of London, and in each case there was a surprising absence of atmospheric trouble.

Both last Sunday and the previous Sunday I spent several hours picking up foreign stations, and with highly satisfactory results. What pleased me more perhaps than anything else was that I was able to get both Radio Paris and Eiffel Tower at good strength clear of Daventry, but I was not quite so successful in getting rid of London Regional on the short wavelength.

The set is well constructed and simple to manipulate. Consumption is moderate, and batteries and accumulator should have quite a reasonable life.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents. Correspondence should be addressed to the Editor, TELEVISION, 26, Charing Cross Road, W.C.2, and must be accompanied by the writer's name and address.

LOOKER-IN, SCANNER, OR GAZER ?

To the Editor of TELEVISION.

DEAR SIR,—With reference to the article by Mr. John W. Woodford, "Television for the Beginner," Part V., that appeared in the May edition of TELEVISION, I would like to draw attention to the misnomer applied to television fans.

Your contributor refers to a "looker-in"; obviously this cannot be correct. In the case of listening-in we term the individual a "listener," and, whilst it may be good English to say "looker-in," much the same as we use the phrase "looker-on," I am confident that a single word can be found to describe the new art.

I would suggest the name of "scanner" or "gazer," but realise that both these words suffer from a defect, the former because it may become confused with the scanning disc, the latter because it savours of being rude.

It can be said in defence of "scanner" that the word is already associated with television, and by virtue of this fact could allow of no confusion except that already mentioned, whereas "gazer" has been applied to another reputable science, viz., astronomy.

Perhaps your readers will give their opinions on this matter.

Yours faithfully,
C. H. KEELING.

8, Tennison Street, S.E.1.
May 5th, 1930.

NAME OF A NAME !

To the Editor of TELEVISION.

DEAR SIR,—I am indebted to Mr. A. A. Partem for his criticism of my suggestion, but regret that I cannot see its pertinence.

His statement that a trade name is required may be questioned, because to give an apparatus a trade name before it has got any name at all is slightly absurd. In his argument he is both putting the cart before the horse and trying to run before he can walk. It is as futile a process as it would have been if a certain machine had been called a Columbia before it was a gramophone.

I may say that the word radio-graphoscope was chosen on the analogy of radio-gramophone. It is not a word that would be used much, because the apparatus is only a secondary branch of television.

So if Mr. Partem really approves of the unspeakable gravideorad, will he, as a guarantee of good faith, support grandiorad in the place of radio-gramophone ?

"Nothing is written," he brightly declares, "so that grapho is wholly extraneous" (!). It is true that no man by taking thought can add one cubit to his stature, but he can avoid bloomers like that. I advise Mr. Partem to have a try.

I can only conclude that he has been reading a book. I suggest that in future he should digest the same before boring people with it.

I must apologise for wasting your space on a side issue, but if people like Mr. Partem will insist upon turning what was only a suggestion not really designed for publication into a minute discussion I am bound to reply to him.

Yours faithfully,
A. J. C. SHERER.

Dundaff Muir, Camberley, Surrey.

["Mr. Partem" is the correspondent who signed himself "Audi Alteram Partem" in our April issue.—ED.]

THE SIDEBAND THEORY.

To the Editor of TELEVISION.

DEAR SIR,—Mr. Spreadbury's article in the May number of TELEVISION describes a number of interesting experiments which he believes disprove the existence of sidebands. Now such experiments are similar to perpetual-motion devices, by which I mean devices (other than those utilising the transformation of matter into energy) which disprove the law of conservation of energy. All science is inductive; it argues from an experimental basis, and it is quite possible that this law may one day be experimentally disproved. But the law is the basis of all dynamics, and when dynamics is assailed from its foundations it crumbles completely; you cannot use part of the theory to batter to pieces some other part. In plain language, you cannot set up a machine to disprove the law of conservation of energy, and then use an ordinary dynamical proof to explain why the law is untrue.

Now although the sideband theory of modulation is not the basic principle of electrodynamics, it can easily be proved from a few basic principles. I propose to set out the proof, and ask Mr. Spreadbury, or anyone else who has not thought out the matter clearly enough, to point out the clause he disagrees with.

1. The expression $a \cos pt\,(1+M \cos qt)$ is algebraically identical to the expression $a \cos pt + \frac{aM}{2} \cos (p+q)t + \frac{aM}{2} \cos (p-q)t$.

2. When two quantities are adequately represented by algebraically identical expressions they are not distinguishable by any physical process.

3. An ether wave can under certain conditions be adequately represented by the expression $a \cos pt (1 + M \cos qt)$. This we will call a wave of constant frequency and varying amplitude.

4. Follows from (1), (2) and (3). The same ether wave under the same conditions can be adequately represented by the expression $a \cos pt + \frac{aM}{2} \cos (p+q)t + \frac{aM}{2} \cos (p-q)t$.

5. It is a property of the ether that waves as represented above can be superimposed with algebraical addition of their instantaneous amplitudes at all times.

6. Hence the effect of superimposing the waves $a \cos pt$ $\frac{aM}{2} \cos (p+q)t$, $\frac{aM}{2} \cos (p-q)t$ is represented by the expression in 4. This superimposition we can call three waves of constant, though differing, frequencies, and constant amplitudes, or, loosely a carrier and a pair of sidebands.

7. Follows from (2), (4) and (5). Hence a wave of constant frequency and varying amplitude is not distinguishable from a carrier and a pair of sidebands by any physical process.

It remains to explain the results of Mr. Spreadbury's tests, though briefly, for I am afraid I have already trespassed much on your space.

I have repeated his experiment shown in Fig. 1 and found sidebands revealed on an R.F. voltmeter with a tuned circuit when the output valve was kept carefully on a linear part of its curve. I expect Mr. Spreadbury used very weak modulation. I suspect his choke HFC; it should be a simple two-element low-pass filter.

In his second experiment, Fig. 3B shows that the responses from two frequencies spaced at equal distance from x are equal and opposite. Sidebands are equally spaced from the carrier, so that when the carrier is neutralised they will be neutralised too if they have equal amplitude. Incidentally, the reason for his initial failure to cut out sidebands was probably due to these being received with unequal amplitude. Frequency swinging effects are very small.

Yours faithfully,
C. E. G. BAILEY.

Research Laboratory, The Gramophone Co., Ltd., Hayes, Middlesex. *May 6th*, 1930.

RE DEFINITION OF TELEGRAPHY.

To the Editor of TELEVISION.

DEAR SIR,—In the first issue of your journal television was defined as "seeing by telegraphy, either with or without wires," and since its appearance I have waited with the hope of finding in your interesting and helpful explanatory articles some remarks shedding light upon the words "by telegraphy," which qualify "seeing," but to date I have not noticed any.

The presidential address to the Television Society, reported in the current issue of TELEVISION, also reawakened my interest in the above point by referring to the skilful way in which telegraphy was originally defined, such that with the advent of the speaking telephone, and wireless telegraphy, and telephony they came within its meaning.

As this point is again fresh in mind I have taken this opportunity of writing to you with the hope that you could, via the medium of your correspondence column, give a brief explanatory note on the meaning of telegraphy as it applies to the definition of television quoted above.

In conclusion, may I add my best wishes to the many already expressed for the continued success of TELEVISION?

Yours faithfully,
E. J. SEALES.

398, New Cross Road, New Cross, S.E.14.
April 24th, 1930.

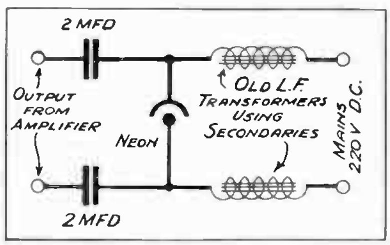
NEON LAMP CONNECTIONS.

To the Editor of TELEVISION.

DEAR SIR,—I noticed in TELEVISION for March, 1930, an article by Mr. W. F. Neal containing a method of connecting a neon lamp to the mains.

Being interested in television but short of cash, I decided to make up his circuit and try to get my neon flickering, so I removed the resistance from one of my Osglim neons.

Having got my circuit as shown below, and connected to our set, which is a 3-valve (screened grid, detector, and pentode), with 100 volts on the plate, I failed to get any flicker at all, although the signal was of *good* strength on our speaker.



Our usual plate current is about 10 m/a (ten milliamperes).

Now the question is: Does the neon need a large current in plate circuit to alter the brilliancy of the lamp, or is it a varying voltage that is necessary?

In short, must I use a set with a large current output, or is it more H.T. voltage I need?

Perhaps you would kindly give me a little data about the characteristics of a neon lamp.

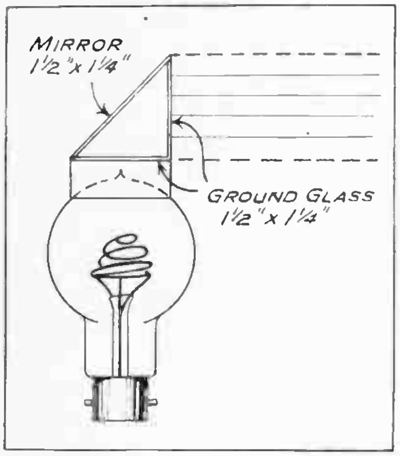
Wishing your paper every success.

Yours faithfully,
H. R. RAWLINGS.

22, Caxton Gardens, Weston Road, Guildford.
May 6th, 1930.

DEAR SIR,—May I suggest a further method of fitting up the Osglim neon tube—commercial beehive type?

The following way has one advantage over that used by Mr. Neal, namely, it gives a much more even illumination with the weaker signals. The bulb can be silvered by the method set out by Mr. G. A. Chester, or by means of silver paper, the resistance being removed. As can be seen from the diagram, the beehive is viewed from the top instead of from the side.



In order to hold the mirror and ground glass screens in position, a card frame is used as shown; the mirror, etc., can also be held by glue as well as the frame.

One essential for good illumination is that the ground glass should be as fine as possible.

Might I also add that unless the top of the tube is at least ¼ inch from the first glass plate it will cause a dark spot on the screen, and spoil the job?

Congratulating you on your excellent journal and wishing it every success.

Yours faithfully,
R. C. BUTLER.

Bridgefoot House, Buntingford, Herts.
April 19th, 1930.

VIEWING LENSES FOR TELEVISION.

To the Editor of TELEVISION.

DEAR SIR,—I have been a reader of your journal since No. 1, but do not remember having seen any scientific treatment of the design of a viewing lens for a "televisor." In view of this, your readers may find the following points of value in designing and positioning of the lens to the best advantage.

A common fault of many lenses or systems used is that in order to observe the image the observer has to be quite near to the axis of the lens, so that only a few persons may view the image at the same time. The image can only be observed within a cone which encloses the image and the periphery of the lens and has its axis coincident with that of the lens. This is shown in Fig. 1.

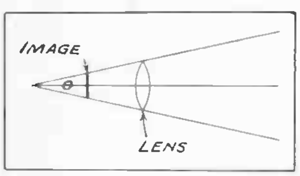


Fig. 1.

The criterion to be used in designing in order to enable the maximum number of persons to view the image simultaneously is to make the apex angle θ of the cnoe as large as possible.

This may be done in two ways:—

1. Increase the diameter of the lens, the image remaining unchanged.

2. Decrease the distance between the image and the lens by decreasing the focal length and distance of the object from the lens. This is shown in Fig. 2, which shows two positions of the image.

Combining these two conditions, we have the general requirement, namely, a lens of large diameter and short focal length, placed at a short distance from the object, *i.e.*, short distance from the scanning disc.

Let the distance of the scanning disc from the lens be u.

Let the magnification produced by the lens be m.

Then it can easily be shown that, for an equi-convex lens:—

$$\frac{(m-1)}{mu} = (\mu-1)\,\frac{8t}{D^2},$$

where t = thickness of lens at centre,
D = diameter of lens,
μ = refractive index of lens material.

The value of m required can be chosen, and then values of D and u to give a large cone angle θ.

Then the equation reduces to $(\mu-1)\,t = K$, where $K = \frac{(m-1)}{mu}\cdot\frac{D^2}{8}$ which is known. t and μ remain to be chosen. t must be chosen so that the ratio t/D is small, in order to reduce distortion of the image by spherical aberration. Hence μ can be found.

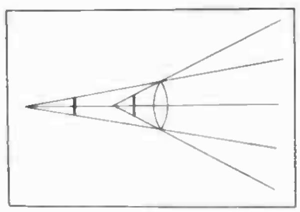


Fig. 2.

It is obvious that if μ is made larger, u can be made correspondingly smaller, thus increasing θ. μ is therefore made as large as possible. This is best obtained by making use of a liquid lens such as that exhibited by the Southend branch of the Television Society last month, which consisted of water trapped between two watch glasses. Here $(\mu-1) = 0{\cdot}33$.

By using glycerine $(\mu-1) = 0{\cdot}47$, and for carbon disulphide $(\mu-1) = 0{\cdot}63$, but the evil smell of the latter limits its use. Trusting that this will be of use to you.

Yours faithfully,
S. G. FOORD
(Stud. Mem. Tel. Soc.).

229, High Road, Willesden Green, N.W.10.

INVENTION

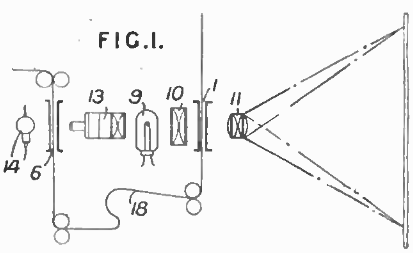
and

DEVELOPMENT

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, W.C.2. Price 1s. each.

Patent No. 323923, granted to GRAMOPHONE CO., LTD., and WHITAKER, A.: *Talking Films.* In this Patent Specification a single source of light is used both for projecting pictures and for reproducing sound from a film on which the pictures and sound are recorded on separate tracks. In the apparatus shown in Fig. 1, the film passes intermittently through the gate (1) of the picture projector, and is drawn at a constant speed through the gate (6) of a sound-reproducing device. By providing optical systems (10), (13), light from a

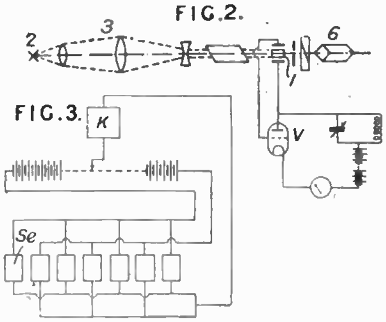
FIG.I.



single lamp (9) is concentrated both on the pictures as they pass through the gate (1) and on the sound record as it passes the gate (6). A picture-projecting system (11) on the one hand and a photo-electric cell (14) on the other are provided as usual. A modification is described in which the sound-reproducing apparatus is arranged below the picture projector, and the lamp is so arranged that whilst it illuminates the pictures directly, light from it is also reflected to the sound-reproducing device by means of prisms. It is also claimed that the device may be applied to systems in which the film is moved through the projector at a uniform speed.

FIG.2.

FIG.3.

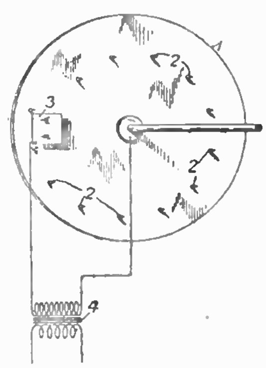


Patent No. 324080, granted to A. HILGER, LTD.: *Maintaining constant speed; measuring frequency.* Flashes of light are generated by means of a piezo-electric crystal (1) in Fig. 2, and used to indicate or effect constancy of speed or else to compare frequencies. Polarized light from a light-source (2) passes through lenses (3) and polarizer (4) and crystal (1), which is excited at its natural frequency by an electric oscillator (V). The flashes of light emerging from an analyser (6) fall on a mirror rotated by the device of which the speed is to be controlled, to draw out the flashes into a band of light and dark patches. Light-sensitive cells (Se) in Fig. 3 are placed in the normal positions of the patches of light and dark, so that any wandering of the patches effect appropriate control through a relay (K). To compare frequencies, two piezo-electric crystals are placed in series between the polarizer and analyser, and electrically excited by the frequencies to be compared, and the beat or difference frequency flashes are observed.

Patent No. 323817, granted to BAIRD, J. L., and TELEVISION, LTD.: *Image-forming.* (Fig. 4). A television receiver comprises a sheet of thin platinum foil (3) which is heated at different points to different temperatures so that it reproduces the picture by glowing. Thus an alternating current modulated by the picture signals may be applied through the transformer (4) to produce an arc between the sheet (3) and the successive points (2), which are carried by the scanning disc (1) passing behind the sheet, or by arms passing in front of it. The sheet is thus differentially heated by the arc. According to the Provisional Specification the heating may be effected by brushes carrying heavy current or by a heated point.

Patent No. 324049, granted to BAIRD, J. L., and TELEVISION, LTD.: *Phonovision.* Television signals are recorded on a gramophone record (1) in Fig. 5, and are

FIG. 4.



picked up by the electrical pick-up (6) and then applied after amplification to a Neon lamp (4). The latter is viewed through a viewing aperture (5) and scanning apertures (3) in the border (2) of the turn-table of the gramophone. Lenses or reflectors may be used instead of simple apertures.

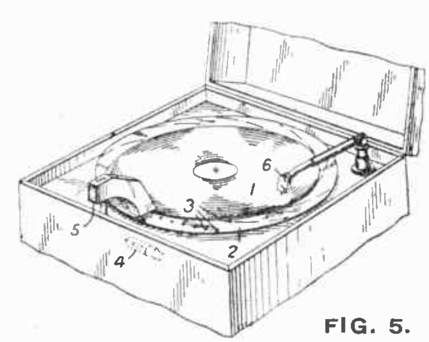


FIG. 5.

TELEVISION IS HERE!

At last the greatest Radio achievement of the era—the Baird Televisor becomes a " home " proposition. Everyone has been eagerly awaiting the advent of this apparatus, at a reasonable price, and its coming heralds the commencement of the greatest radio boom in history.

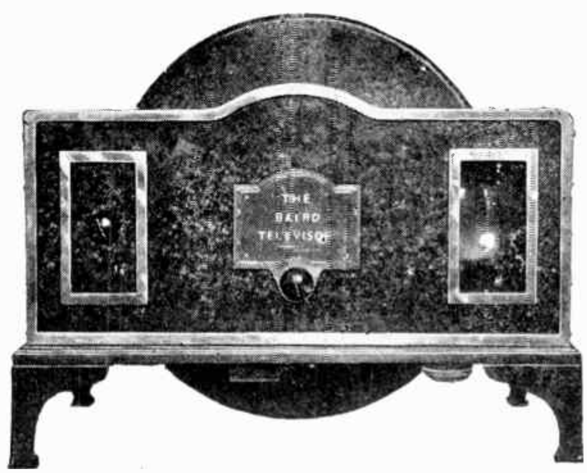
The wonder of ordinary radio is now amplified by the additional wonder of the Baird Televisor. To SEE and HEAR is the expressed desire of everyone interested in radio, and only the Baird Televisor with its actual reproduction of every movement of living things can solve the problem. No laborious building up of " still " pictures can ever be more than experiment of limited interest. The Baird Televisor Home Reception Set *alone* can give permanent satisfaction.

Daily broadcasts both from the National and Regional Stations at Brookman's Park have been a feature since March 31st.

The Baird Television Company has given great thought and care in producing a Kit of Parts bearing the BAIRD brand. This will interest the Home Constructor and Experimenter, and will open up a new wonder to tax his ingenuity. Ample " Service " is arranged for.

Prices for the complete Receiver and Televisor, Televisor only, and Kit of Baird branded parts will be sent on application to :

THE BAIRD TELEVISION DEVELOPMENT COMPANY LTD.
133, Long Acre, London, W.C.2



the birth of a wonderful radio era

The following is a LIST of the PRINCIPAL STOCKISTS of Baird "Televisor" Receivers and Branded Components.

"Aldertons"
8, Bank Parade, **EDGWARE, MIDDLESEX.**

Bannister & Fitton,
27, Milnrow Road, **ROCHDALE.**

Barbrook Bros. & Co.,
St. Peter's Street, **IPSWICH, SUFFOLK.**

Barnsley British Co-Op. Society, Ltd.,
New Street, **BARNSLEY.**

The Battery & Dynamo Co.,
124, North End Road, **LONDON, W.14.**

T. Beadle & Co.,
3/5, Castle Street, **HULL.**

F. T. Bennett,
Rue de Pre, Park Street, **CONTREE MANSELL, GUERNSEY.**

H. Binns, Son & Co., Ltd.,
SUNDERLAND.

"B.N.B." Wireless, Ltd.,
80, Castle Street, **BELFAST, N. IRELAND.**

"B.N.B." Wireless, Ltd.,
65, Renshaw Street, **LIVERPOOL.**

Broadcast Relay Services, Ltd.,
17a, Church Road, **RAMSGATE.**

Brown Bros.,
Great Eastern Street, **LONDON, E.C.2.**

Brown Bros., Ltd.,
86/88, Adam Street, **CARDIFF.**

Fred. Burris & Sons, Ltd.,
7/16, Redcliffe Street, **BRISTOL.**

Chorlton Radio & Cycle Co., Ltd.,
494, Wilbraham Road, **CHORLTON-CUM-HARDY, MANCHESTER.**

Clarith Reproducers, Ltd.,
East Street Mills, **LEEDS.**

Cole Bros., Ltd.,
Church Street, **SHEFFIELD.**

E. K. Cole,
"Ekco" Works, London Road, **LEIGH-ON-SEA, ESSEX.**

Colwyn Charging Works,
OLD COLWYN, NORTH WALES.

Consulting & Radio Service, Ltd.,
47, Hope Street, **GLASGOW.**

J. H. Cook,
49/51, Monks Road, **LINCOLN.**

Frank Crocker,
Wireless Corner, **TORQUAY.**

R. Darbyshire (Wholesale), Ltd.,
2, St. John's Walk, **BLACKPOOL.**

A. J. Dew & Co.,
34, Rathbone Place, Oxford Street, **W.1.**

Downes & Davies,
1/3, Stanley Street, **LIVERPOOL.**

J. Dyson & Co., Ltd.,
5/7, Godwin Street, **BRADFORD**

The East Ham Wireless Supplies,
427, Barking Road, East Ham, **E.6.**

J. J. Eastick & Sons,
Eelex House, 118, Bunhill Row, **LONDON, E.C.1.**

Ecco Radio,
Ecco House, Princes Street, Edgware Road, **N.W.8.**

Economic Lighting Stores,
24, Fulham Palace Road, **W.6.**

Elect Radio Co.,
25, Westbourne Grove, **LONDON, W.**

S. Evans & Sons, Ltd.,
King Street, **MAIDENHEAD.**

F. H. Wireless Co.,
11, Market Row, **GT. YARMOUTH.**

Flinders (Wholesale), Ltd.,
East Stockwell Street, **COLCHESTER, ESSEX.**

A. Franks (Wholesale), Ltd.,
3, South Kings Street, **MANCHESTER.**

Galliers, Ltd.,
167, North Street, **BRIGHTON.**

A. W. Gamage, Ltd.,
Holborn, **LONDON, E.C.1.**

Harrods, Ltd.,
Knightsbridge, **LONDON, S.W.1.**

Henshall Bros.,
89, Lower Hillgate, **STOCKPORT, LANCS.**

Hobday Bros., Ltd.,
Turner Street, **MANCHESTER.**

Henry Hollingdrake & Sons,
STOCKPORT, LANCS.

Lampitt & Elliott,
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