Vol. 3 APRIL 1930 No. 26 25 CENTS MONTHLY

TELEVISION

THE DUAL PROGRAMMES

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SYDNEY A. MOSELEY

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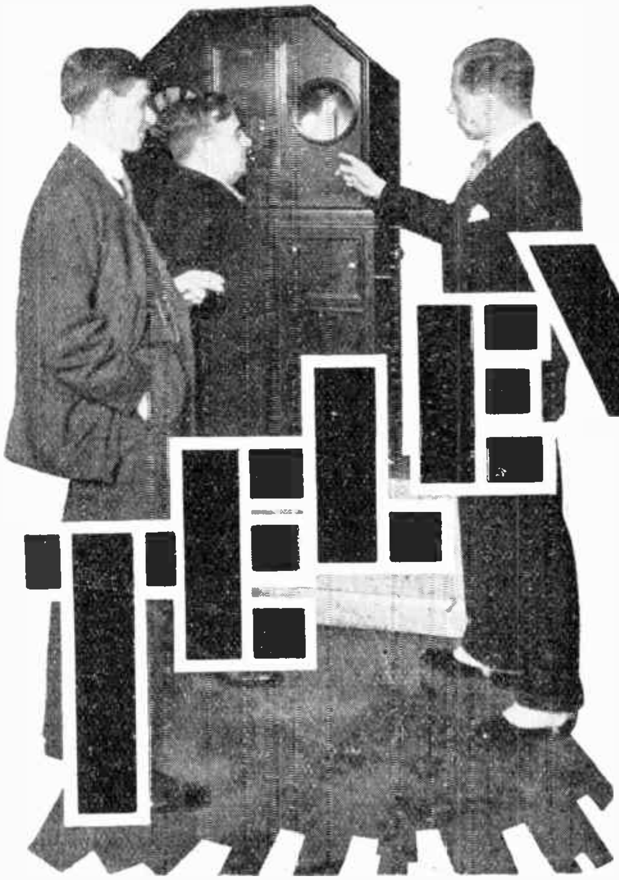
Front View of the Baird "Televisor" Receiver, which is now on the market, price £26 5s.
A = Synchronising Control; B = Phasing Control; C = Viewing Tunnel.



TELEVISION

THE
OFFICIAL ORGAN OF
THE TELEVISION SOCIETY

SYDNEY A. MOSELEY, *Managing Editor*

A. DINSDALE, A.M.I.R.E., *Editor*

Consultants { C. TIERNEY, D.Sc., F.R.M.S.
W. J. JARRARD, B.Sc., A.R.C.S., A.I.C.

VOL. III] APRIL 1930 [No. 26

EDITORIAL

EVER since this magazine was founded, it has been our privilege to record historic dates in the development of television in this country. The last date of importance was September 30th, 1929, when a regular service of experimental television broadcasts was inaugurated by arrangement with the B.B.C. But these broadcasts, although representing a step forward, did not go far enough. True, they gave the engineers and other experts concerned opportunity for overcoming some of the many difficulties which are necessarily associated with the establishment of a new public service, and the development of new technique.

In order to establish a television broadcasting service which will satisfy the public, however, it is not sufficient that they should be enabled only to see; they must be able simultaneously to hear as well, otherwise the situation is just as unsatisfactory as in the case of sound broadcasting, where it is frequently a definite handicap to the listener not to be able to *see* what is happening before the microphone.

It is, therefore, with considerable satisfaction that we are able this month to record the inauguration, on March 31st, by Sir Ambrose Fleming, of simultaneous sound and sight broadcasting, through the medium of the " B.B.C. twins " at Brookman's Park. This development is in accordance with the P.M.G.'s promise made to the Baird Company last September, that as soon as the second Brookman's Park transmitter was ready it would be placed at their disposal for this purpose. The original television broadcasts were sent out from the longer wave transmitter; for the past few weeks they have been sent out from the second, or National Programme transmitter on 261 metres. The television signals will continue to be sent out on this transmitter, whilst the accompanying music and speech will be radiated from the Regional Transmitter on 356 metres.

WANTED—YOUR REPORTS, PLEASE!

We learn from the Baird Company that there is a great and growing demand for the new Baird "Televisor" Receivers, and that deliveries are proceeding, in strict rotation, as rapidly as possible. Many of our readers are now in possession of these instruments. A large number have also constructed their own receivers. We extend a hearty invitation to one and all to send in to us details of the manner, and with what success they are receiving the new dual transmissions.

An ever-increasing number of reports is already coming in; we want more of them, and to this end we intend to devote more space month by month to the publication of the best accounts. Photographs and diagrams of amateur-built apparatus are also welcome, and the best of these will be published.

We welcome this opportunity of reminding those of our readers who do not yet possess a television receiver, but who do possess a broadcast receiver and live within range of the Regional Transmitter, that they can listen into, and enjoy the *sound* part of the dual transmissions. Your criticism of this part of the programme will also be welcome, but in criticising do not forget that the programme you are listening to is designed on the assumption that *you can also see!* This is an important point.

IN THIS ISSUE.—

Some months ago we issued a questionnaire card which we asked our readers to fill up and return. We have already commented on the fact that whilst roughly half of our correspondents asked for more *technical* articles, the remainder requested articles of a more popular character. As we pointed out, it is impossible to please everybody all the time. In this issue, however, the technically-minded reader will find plenty to please him.

First and foremost, we are able to publish, exclusively, a full report of Sir Ambrose Fleming's Presidential Address before the Television Society on "The Relation of Government to Invention." His extremely comprehensive and lucid review of the subject is recognised as the product of a master mind, a mind which is also a vast storehouse of intimate experience over a very long period.

His conclusions, however, are sufficiently disturbing to make one furiously to think. Sir Ambrose, obviously, has but little respect for patent protection as at present constituted and administered. He has even less respect for the ability of governments, or government departments, to dabble in any way with any science or art which involves the continual evolution of new inventions. It is not an inherent characteristic of such organisations to be progressive. They are admirably fitted to handle such unprogressive matters as the delivery of our letters; but in such a field as, for example, communications, which continually calls for new ideas and inventions, they are hopelessly unsuited. Such an indictment, coming from such an authoritative and progressive source, will undoubtedly give rise to much misgiving in the public mind. If ultimately it leads to an outcry against existing conditions, and to their revision, Sir Ambrose will unquestionably have performed a valuable public service, comparable only in importance with that which he performed when he made the suggestion which led to the establishment of the National Physical Laboratory in this country, the Reichsanstalt in Germany, and the Bureau of Standards in America.

Since the invention of the electric telegraph, all forms of electrical communication have been definitely hampered in this country, and not assisted by governmental control. It would be a thousand pities if the latest form of electrical communication, television, were to share a similar fate.

In our February issue we reprinted from *Nature* Sir Ambrose Fleming's article on *The Waveband Theory of Wireless Transmission.* This gave rise to considerable correspondence in the pages of *Nature*, and in this issue of TELEVISION Sir Ambrose rounds off the discussion with a further article on the subject. In this connection, although everybody knows that Sir Ambrose is the inventor of the Fleming Valve, which made broadcasting possible, it is not so well known that in the early days of wireless he invented the Fleming Cymometer for the purpose of measuring wave-lengths. This instrument is the prototype of our modern wavemeter, without which no broadcasting station can keep to its assigned wave-length.

In the October, 1929, issue of TELEVISION, the writer of these lines, in describing the television exhibits at the Berlin radio exhibition, recorded an interview which he had with Dr. Schroeter, of the Telefunken Company, and the collaborator of Dr. Karolus, of Leipzic University. In the course of this interview, Dr. Schroeter promised us a contribution on the problems of television. In this issue we publish the first part of a long article which he has, in accordance with that promise, sent us. The concluding portion will appear in our May issue. Readers will be interested to note that in Germany the same problems have been encountered as have been met with in this country, and investigated and overcome in much the same way.

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A NEW FEATURE.

Commencing with this issue, we are introducing a new popular feature. Under the heading of "Personalities of the Month" we shall publish every month the photographs of those who are listed to take part in the television broadcasts during the ensuing month. We recommend our readers to keep these reproductions so that they can be compared with the images seen on their "televisor" screens.

The Wave-Band Theory of Wireless Transmission

By *Sir Ambrose Fleming*, F.R.S.

THE article published by me under the above title in *Nature* of January 18th last and reproduced in the February issue of TELEVISION (p. 600), gave rise to a great deal of discussion in the pages of *Nature*. Some very eminent physicists have expressed their views on the subject, two in letters published in *Nature* of February 22nd, and two others in private letters to the writer. Other correspondents in *Nature* and in other journals have endeavoured to show that I was quite wrong in my opinions about the current wave-band theory, and in fact guilty of the great sin of wireless heresy.

When a controversial matter is thrown down for discussion, a contributor who is not very opinionated will at least endeavour to appreciate the point of view of one who differs from him, and he will try to find out the reason for that difference without hastily assuming that the heresy arises entirely from ignorance or serious mental incapacity on the part of the heretic. The first thing to be done is to ascertain the facts of the case and, if possible, to be agreed about them, before we argue about explanations or theories.

One outcome of the orthodox wave-band theory appears to be the opinion that broadcast music, vocal or instrumental, is better heard by a wireless receiver in correct relative intensity or loudness of high or shrill musical notes compared with low notes when the receiver is not too selective. The reason given is that the receiver must be capable of taking in the whole width of the wave-band.

Selective Receivers Condemned

I find by enquiry that dealers in wireless receivers *do* as a matter of fact sometimes suggest to their customers that they should, for the above reason, not buy a very highly selective receiver.

The above stated opinion as to the advantages of a not very selective receiver appears to be held sufficiently widely to make it impossible to neglect it, and in what follows I shall endeavour to account for it consistently with my already expressed opinion that the assumed wave-band is an effect due to the receiver and does not exist in the spaces between the transmitter and receivers.

If we assume that a certain broadcast station is sending out a carrier wave of frequency n and that it is modulated steadily by an acoustic frequency m we must first consider then what grounds are there for assuming that this single modulated wave at once divides itself into two actual unmodulated waves of frequencies $n+m$ and $n-m$? None of the correspondents in *Nature* or elsewhere appear to me to have given an answer to this question which is entirely satisfactory.

Suppose an organ pipe was sounding a pure steady note of frequency n, and that by some valve in the air supply pipe the amplitude or loudness of this continuous air wave was modulated so as to fluctuate the sound wave regularly in amplitude with a constant frequency of modulation m. Have we any reasons whatever for believing that this wave would at once divide itself into two unmodulated sound waves of frequency $n+m$ and $n-m$ which are separately propagated through the air? I think not. If not for air waves why for ether waves should this resolution take place?

What Happens?

If then the modulated carrier wave is propagated as a single modulated wave and not as two unmodulated waves we may next proceed to enquire what happens when this modulated wave falls upon the aerial of a wireless receiver.

This receiver, however complicated, is only in effect a single oscillatory circuit having inductance, capacity, and perhaps resistance, and the impact on it of the feeble electromagnetic impulses of the arriving wave sets up electric currents in this receiving circuit which are caused to give evidence of themselves by some kind of instrument, loud-speaker, micro-ammeter, etc.

Suppose, then, that a modulated electric wave falls on this circuit. It has to set up oscillations of a definite frequency, say n modulated to an acoustic frequency m. That means to say that the resulting oscillations have to fluctuate rapidly in amplitude whilst keeping the same periodic time.

We know that if the bob of a pendulum is gently tapped with a feather at intervals exactly equal to the natural periodic time of the pendulum, oscillations will quickly be set up of that period which will reach a certain amplitude. If, however, the amplitude of the oscillations had also to be varied periodically whilst keeping to the same frequency, assuming that the pendulum is isochronous, it would be very difficult or perhaps impossible to do this in such a manner that the pendulum oscillations should be an exact copy of the blows of the feather in amplitude as well as frequency.

The pendulum may not be, so to speak, nimble enough to follow the vagaries of the feather in amplitude as well as frequency. The pendulum can be set in vibration at its own rate of oscillation with a certain final constant amplitude very easily, but it is not always easy to make rapid changes of amplitude. The pendulum possesses a certain tendency to persist in the state of motion in which it finds itself.

An Analogy

To complete the analogy with the circuit of a wireless receiver we must suppose the pendulum to vibrate in a slightly viscous fluid, the viscosity or stickiness of which can be varied even down to zero. This corresponds to the resistance of the receiver circuits or to other causes which create energy losses.

In the first place, suppose this frictional resistance to be entirely absent. Then the pendulum when set in vibration with one amplitude and frequency persists, and if the bob has mass enough it will not be very quick to take up changes of amplitude. In an extreme case, that is with almost complete absence of frictional resistance and a certain ratio of pliability or capability of being displaced to inertia, the pendulum will be "stiff" and tend to persist very much in its state of motion at the moment and the oscillations will not die away rapidly or take up changes of amplitude quickly. At the same time it would require very exact "timing" in the blows of the feather to get up any appreciable oscillations, and blows not quite in time with its natural period would be ineffective. This corresponds to the state of a very selective wireless receiver which is only responsive to electric waves of the exact or very nearly exact frequency to which the receiver is tuned.

It has, however, the defect that it should reproduce the high notes with rather diminished intensity relatively to the low notes. Whether this is actually the case is a question of test by those who have good musical ears and musical knowledge. What is required is such dispassionate opinion by musical experts and not merely opinions of wireless experts who may quite unintentionally "listen-in" with their minds attuned to some particular theory of wireless transmission.

Suppose, then, on the other hand, we set our pendulum vibrating in a very slightly viscous fluid. This tends to dissipate energy and by itself, therefore, to damp out vibrations which have once been set going with a particular amplitude and frequency.

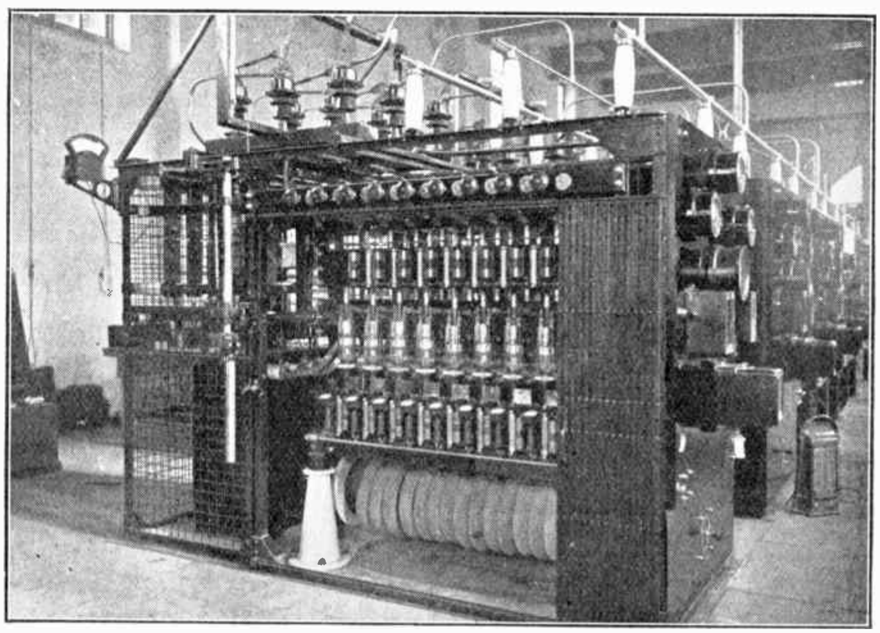
If then we desire to make changes of amplitude the pendulum is in this last case always fairly ready to start afresh and build up again a new state with a new amplitude and the same or very nearly the same frequency. On the other hand here again we have a counter-quality. Such a receiver with slight resistivity equivalent to a pendulum in slightly viscous medium would respond to impulses of frequency somewhat differing, on either side, from that frequency or tuning which gives the maximum current. The effect of resistance is to make the resonance curve more rounded, and hence to enable waves of a somewhat different frequency to that which produces the maximum current to create currents of nearly the same strength in the circuit.

This, then, implies that the receiver can be set in oscillation by transmitters sending out carrier waves of a frequency differing somewhat from that which it is desired to receive. Resistance, therefore, is an advantage in some ways but a disadvantage in others, and we are on the horns of a dilemma.

It is necessary to remember that the carrier frequency is always very much greater than the modulation frequency when the latter is constant. Thus for a carrier wave frequency, say, of 800,000, the highest note of the orchestra is only about 4,000 frequency. But in broadcast music the modulation is not for long constant in frequency but is jumping about rapidly in amplitude and frequency. Hence to prevent these varying modulations from overlapping each other and making confusion we must make them die away quickly the moment the driving force causing them is removed. That is done in the ordinary receiver by the resistance of the circuits and that implies a certain rounded top to the resonance curve.

Hence, when in ordinary language it is said that "the receiver must be able to take in the whole width of the wave-band," what is really implied is that there must be sufficient resistance to quench out the modulation oscillations as soon as they are no longer

(*Continued on page 61.*)



A bank of High-Power Amplifying Valves at Rugby. Sir Ambrose Fleming's original invention of the thermionic valve made these possible to-day.

The Story of Electrical Communications

by

Lt. Col. CHETWODE CRAWLEY, M.I.E.E.
(*Chief Inspector of Wireless Telegraphy, G.P.O.*)

PART XV.

WIRELESS TELEPHONY (I)

AS we have already seen, wireless telephony became a commercial possibility as soon as de Forest, in 1907, added a third electrode to Fleming's valve, as this piece of apparatus was then capable of being used as a really efficient transmitter and receiver of continuous wireless waves. But we must go much further back for the birth of wireless telephony from the experimental point of view. Indeed, no sooner had Bell produced his telephone, than efforts were made to get rid of the connecting wires. The method of induction was tried just as it was tried in telegraphy without wires, and in this country William Preece used induction for telephony, just as he did before for telegraphy; in fact, one of his installations was in use between the Skerries and Cemlyn until quite recently. But these induction arrangements for telephony were only of practical use, like those for telegraphy, for short distance communication.

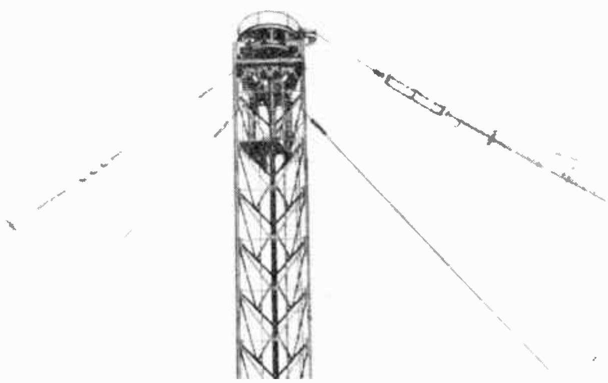
The Pioneers

Marconi, in 1896, was the first to show that Hertzian waves could be used for telegraphy, and it was clear to all that they could be similarly used for telephony if it were possible to produce them as a continuous stream. R. A. Fessenden, of America, was the first to achieve substantial success in producing continuous waves, and in 1900 he used an alternator for transmitting wireless telephone messages in Maryland over a distance of one mile.

By 1906 he had greatly increased the range of working, and, as already mentioned, he even spanned the Atlantic, wireless conversations between two of his stations in America being overheard at a station which he had erected at Machrinanish, in Scotland. In the same year he demonstrated the practicability of linking up the wireless telephone circuit to land lines, and in the following year he showed the possibility of talking and listening by wireless in the same way as by line telephony, that is, without having to switch over from the sending to the receiving instruments.

Many others were, of course, working along similar lines, notably Lee de Forest in America, Valdemar Poulsen in Denmark, and Guiseppe Vanni, in Italy; but Fessenden was the most successful of the early pioneers in the practical application of wireless telephony.

By 1908 Fessenden was working a practical wireless telephone circuit, with alternator transmission, between Brant Rock and New York, a distance of 400 miles; de Forest had fitted the United States Navy with telephone sets, using arc transmission, and obtained good communication between ships up to 50 miles; Poulsen was demonstrating telephony,



Top of one of the 800 ft. masts supporting the wireless telephone aerial at the Rugby Station.

with arc transmission, over distances of 300 miles; and the British, French, Italian and Japanese navies were trying out various systems.

All these early efforts were made with alternator or arc transmission, and magnetic or electrolytic reception, and it was not until the use of the three electrode valve, first as a receiver and later as a transmitter,

The Machine Room at the Tetney Beam Station.

became established that wireless telephony began to emerge from the experimental stage.

The first outstanding success was obtained by Vanni, who spoke between Rome and Tripoli, a distance of 600 miles, in 1912; but longe-range telephone tests became a dead letter in Europe as soon as war broke out in 1914, and all available experience was directed towards the development of small sets, especially in connection with aircraft. This was due to the fact that the use of wireless telegraphy in aeroplanes entailed the pilot or observer being a trained telegraphist and acting as such in addition to his other duties. Pilots and observers had plenty of other work to do, and the advantage of having a simple telephone set which could be used with little technical knowledge was apparent.

It was in the summer of 1915 that wireless speech from an aeroplane was received for the first time in this country, and there is little doubt but that our Air Force was the leading pioneer in this method of communication with aircraft. One of the first successful demonstrations of wireless telephone working with aircraft in France was given to the late Lord Kitchener at St. Omer. The messages unfortunately were heard as far away as Lowestoft, and further experiments were prohibited for quite a long time, as it was feared that the Germans might obtain some valuable information by reading our messages. By the end of the war it was normal practice for aeroplanes to communicate by wireless telephony with ground stations up to fifty miles, and with each other up to five miles.

During the early stages of the war more time could be devoted in the United States than in Europe to the development of long-range working, and by 1915 the American Telephone and Telegraph Company decided to attempt communication across the Atlantic. With this end in view they used a large number of small valves in parallel for transmitting from the naval station at Arlington, and succeeded in transmitting speech to the Eiffel Tower station in Paris on the 23rd of October, 1915. This experiment was the starting point of commercial wireless telephony over great distances; that is to say, that for the first time the results obtained were such as to show that commercial long-range working might become a practical proposition.

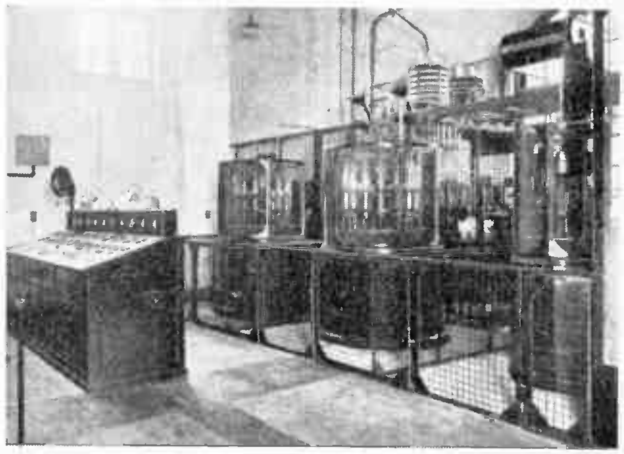
The Transatlantic Circuit

The war continued to delay any spectacular advance in long-distance communication, but in 1923 the Company again made tests across the Atlantic, this time to England, with such marked success that the Postmaster-General decided to co-operate with the Company and with the International Western Electric Company in developing a transatlantic wireless telephone circuit.

The greatest troubles at the outset arose from fading and atmospherics, and for three years daily observations and tests were carried on, both in this country and in America. At last, on the 7th of February, 1926, two-way conversation was held for the first time between England and the United States of America.

This was the greatest advance that had been made in telephonic communication since Bell, on the 10th of March, 1876, made his famous first speech by line telephony in Boston from one room to another, "Mr. Watson, come here; I want you." Bell's somewhat abrupt speech was equalled by England's epoch-making opening remark across the Atlantic, "Hullo, New York; who is that speaking?" but was surpassed by America's laconic reply, "Bailey."

Exactly eleven months later, on the 7th of January,

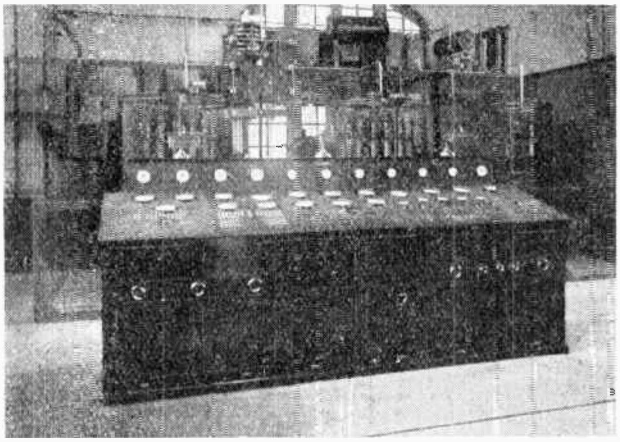


The wireless telephone transmitter at Rugby with Control Table in left foreground.

1927, the transatlantic wireless telephone service was opened to the public. Mr. W. Gifford, President of the American Telephone and Telegraph Company, opened the service by speaking from New York, and

Sir Evelyn Murray, the Secretary of the Post Office, by replying from London. Both speeches were more expansive, but less technically illuminating, than those of eleven months before.

The telephone channel from England to America was by underground cable to the Rugby wireless station, thence by wireless to Hulton, Maine, a distance of 3000 miles, and from there by open and underground lines to New York. The reverse channel was from New York by underground lines to Rocky Point wireless station, thence by wireless to Wroughton, in Wiltshire, and on to London by underground lines.



The Transatlantic Telephone Control Panel at the Rugby Station.

Later a receiving station was erected at Cupar, in Fifeshire, and another has since been erected at Baldock, in Hertfordshire. The transmitter at Rugby consisted of a 200 kw. valve set, with an aerial supported on masts 820 feet high, and the wave used was about 5000 metres.

The service developed so rapidly that at the end of the first year an additional channel, using short waves, was opened, and two more, also using short waves, followed. For some months now the service has been available throughout the whole of the day and night.

The minimum charge at first was £15 for a three minutes' conversation, but this has since been reduced to £9, and it is now possible for nearly all countries in Europe to hold telephone conversations via the Rugby transatlantic circuit with any part of the United States and the chief towns in Canada, Mexico and Cuba; in fact, it was calculated some months ago that this service was available to more than 200 million persons.

The Rugby service was the first long-distance commercial wireless telephone service in the world, but several others are now in operation, notably those between Germany, France, Spain and the Argentine, between Spain and the United States, and between Holland and Java.

It will be noticed that we have confined ourselves solely to the growth of long-range commercial services, but this does not mean that all advance was due to professional workers; far from it. As soon as the war was over the amateurs, as we have already seen, got busy on short waves, and they did not confine their energy to telegraphy where they made such astounding advances. They were soon on the trail of telephony, and long before the Rugby service was opened, amateurs were talking to one another from one side of the world to the other; and their experiences were of great value to the professional workers who were developing commercial services. But we must not lose sight of the fact that to speak over long distances at odd times under certain conditions is a very different proposition from establishing commercial communication; in fact we have seen that it was twenty years from the time when Fessenden's voice in America was heard in Scotland, before a commercial service was in operation between the two countries.

The Waveband Theory.

(*Concluded from page* 58.)

wanted. But as already stated this also involves the possibility or liability to pick up also carrier waves of a frequency which is not wanted. There may, therefore, be a background of noise due to the vagrant waves which the not-very-selective receiver is able to pick up.

The upshot of the whole thing is then that the receiver itself is responsible for the so-called wavebands. We cannot handle or investigate the ether without the aid of some receiver and it is therefore difficult to devise any crucial experiment which will enable us to examine the structure of the arriving wave before it reaches the receiver.

The same is very much the case with the endeavour to determine the exact nature of a ray of white light. The prism resolves it into a spectrum of rays of many frequencies, but can we say these rays previously exist, mixed up together in the incident white light?

The question then arises: Is it possible to construct a wireless receiver which is very highly selective and has a very sharp resonance curve and yet can follow with extreme nimbleness the most rapid variations in the amplitude of the carrier wave or modulations required to reproduce music very perfectly? The answer is it not only *can* be done but it *has been done*, and the writer has had the opportunity of seeing it and testing it in practice.

I venture in conclusion to sum up the whole discussion by saying that as the outcome of my original article in *Nature*, and of the discussion resulting, there is now a very large degree of assent to my original contention that the effect which traverses space between the broadcast transmitter and the receivers is a single modulated wave of one frequency but of varying modulation or amplitude. In addition, I think that there is a recognition that it follows that the door is not closed to further progress. It is not, then, necessary to state that there is a limit to selectivity, but that selectivity of a high degree can be combined with the most rapid response to quick or very quick changes in modulation by certain means, and that implies a great advance in our powers of reception both for music, speech, and television as well.

Experimental Television Apparatus

By *A. A. Waters*

PART XII

IN the previous article of this series a few words were included on the subject of a suitable radio receiver and amplifier for use in television experiments. In this concluding article I have included photographs of these, and for those of my readers who are prepared to go to the expense of such a set and amplifier I will add a few words on the constructional side.

It will be noticed from the photographs that both the set and its associated amplifier are built in separate metal boxes which enclose them completely, and are entirely separate from each other. This construction has the advantage of leaving either free for separate use, and also provides the complete electrical screening which is so desirable in apparatus of this kind. The box used for the set is made from 20 gauge sheet tin, of such dimensions that the base board of the Ferranti S.G. IV, receiver will fit comfortably within.

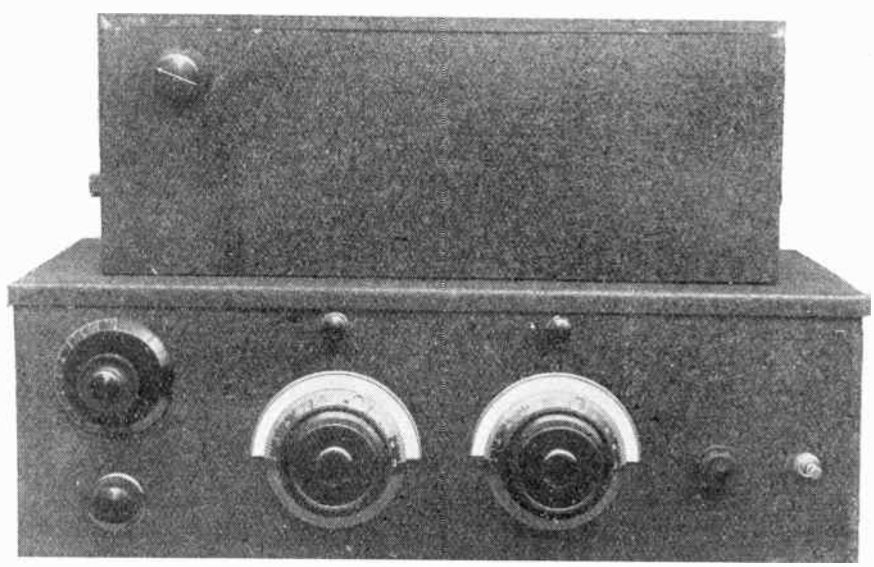
It is open to some doubt whether tin, or more correctly tinned iron, is an ideal material for the screening case of a radio receiver, since it may be argued that the presence of iron in the neighbourhood of tuning coils will detract from their efficiency. This effect does undoubtedly exist, but provided that ample room is allowed to space these coils well away from the walls of the box, the loss of efficiency so caused is usually negligible. In the case of the Ferranti circuit under discussion no loss of efficiency could be aurally detected on placing the finished set into its case, except possibly a slight flattening of tuning on the lower wavelengths.

The cheapness of tin is a factor of importance in experimental work where alterations may often be required after a piece of apparatus is thought to be completed. Moreover the use of tinned iron provides electro-magnetic screening in addition to the electrostatic screening provided by boxes of copper or aluminium.

In the case of a set which may be used in close proximity to electric motors or to phonic wheel synchronising apparatus (which necessitates the presence of strong magnetic fields) good magnetic screening is of considerable value, and may easily offset a slight loss of efficiency.

However, those who wish to use the set for long-distance broadcast reception might be well advised to construct the case from sheet copper, the cost of which might well be as much as three pounds. If copper is used it will be desirable to employ a heavier gauge of material, 18 gauge being the thinnest I can recommend. This is necessary owing to the softer nature of the metal as compared with tinned iron. It is interesting to note in passing that for the best screening reasonably obtainable, copper-plated iron is the material to employ.

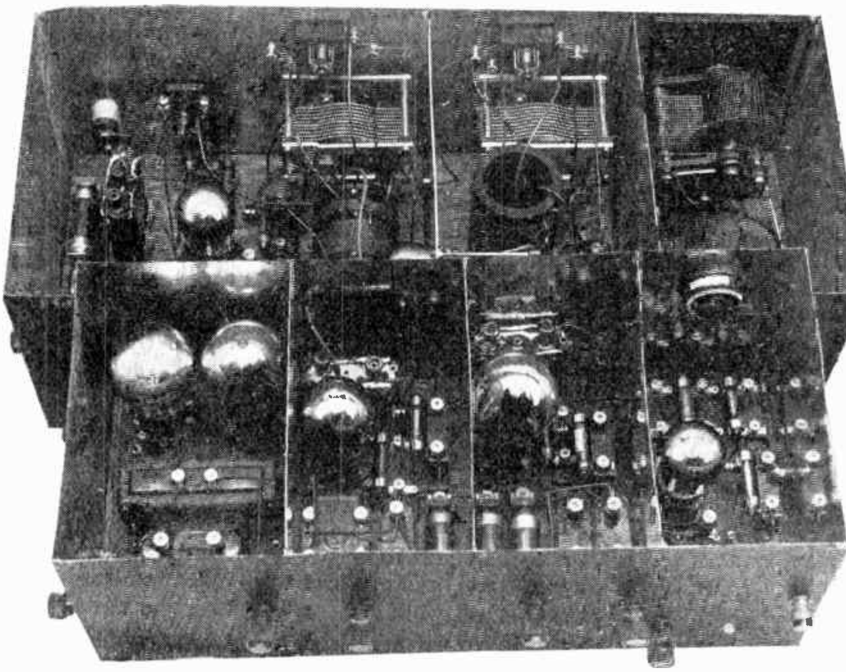
The metal set case is divided up into three compartments by means of metal partitions, which slide on runners fixed to the walls of the case. This construction permits of the partitions being placed in position after the set has been dropped into place within the box, and of their easy removal for fault finding, adjustment, or alteration. The tiresome business of



The wireless receiver and amplifier described in this article. The amplifier is mounted on top of the receiver, and both are enclosed in metal cases.

getting at components deeply seated in narrow compartments is thus avoided. It is important, however, that these partitions shall be a good sliding fit in the runners, since any intermittent electrical contact at these points will result in crackling noises, and possibly in indifferent screening and consequent instability.

Slots are provided in the bottom edges of the partitions to clear the inter-stage wiring, which is kept flush with the base board for this purpose. If this is carefully done, it should be possible to remove all partitions without unsoldering any of the wiring. In this connection it may be mentioned that the use of glazite or similar insulated wire cannot be recommended since the covering is not stout enough to resist chafing against the sharp edges of the metal case, and short-circuits may result. I recommend the use of bare wire protected by good quality sistoflex.



Interior of the amplifier (front) and wireless receiver (back). The layout of the components is clearly visible.

The first compartment of the set is devoted to a wave trap, which has proved invaluable for the reception of other stations in a locality badly swamped by the London transmitters. The natural selectivity of this set is sufficient for most purposes, and the wave trap might be omitted when the set is to be used at distances greater than about 15 miles from a regional station. It is well worth while including the wave trap in a screened compartment of the set, both from the point of view of neatness and compactness, and because the efficiency of this component is seriously impaired by inter-action between it and other tuned circuits of the receiver.

The inductance used for this wave trap is a Dimic low loss coil, a 35 turn coil being suitable. A ·001 mF variable condenser is shown in the photograph, but a smaller capacity can be used if available, ·0002 or ·0003 mF being sufficient. Since this condenser is in the aerial circuit it is necessary to insulate its spindle from the metal box by means of suitable bushings. A good arrangement would be to support this and the other variable condensers on brackets fixed to the base board, so that they would form part of the set when removed from the case and could be permanently wired in position before the set is placed in its cabinet. Clearance holes would then be required in the metal case to accommodate their spindles.

The construction of the rest of the set can easily be followed from the Ferranti pamphlet, but it must be borne in mind that the S.G. and detector stage only are required, the whole of the L.F. side being omitted. The layout of the first two stages can be identical however.

The terminals are shown mounted on the back of the metal box, and must be insulated therefrom. If the well known Belling Lee moulded terminals are employed it will be found that by drilling a 5/16 inch hole and using a single 5/16 inch by 1/8 inch ebonite bush, the terminals will be adequately insulated.

An alternative construction would be to mount the terminals on an ebonite strip attached to the back of the baseboard, when the set can be wired without making it inseparable from its cabinet, in which case, of course, a suitable clearance slot is required in the back of the case. This arrangement was not adopted, however, in the set photographed, since it was feared that the efficiency of the screening would suffer from having so large a slot in the screening box. The L.T. negative, H.T. negative, and earth terminals are not insulated from the case, but are made a good electrical connection to it, and an internal connection is made between the L.T. negative and the case, thus making it common to the earthed line of the set. It is necessary to provide an additional terminal to those shown in the Ferranti pamphlet to serve as an output connection to feed the L.F. amplifier, this terminal being taken via the first R.C. coupling condenser of ·01mF to the detector anode.

It is thought undesirable to use common or external grid bias batteries owing to the risk of interaction between stages being incurred, and hence a four volt pocket lamp battery is included within the set to provide bias for the S.G. and detector valves.

Turning now to the amplifier, this is also constructed on similar lines to the set proper, the metal box in this case being 16 inches long, 8 inches wide and 8 inches deep inside measurements. Three removable partitions are provided between the four stages of the amplifier, thus enabling most of the wiring to be completed before the amplifier is placed in its cabinet. The layout of the components should be sufficiently obvious from the photograph of the inside, and the circuit values were given in a circuit diagram published in my last month's article.

A 500,000 ohm potentiometer is used as an amplification control, and is connected in the output circuit of the first amplifying stage. This is the earliest point in the circuit at which it can be situated; its inclusion in the coupling between the detector and first L.F. stage is inadvisable because the adjustment of this control is apt to affect the high frequency side of the set and the output load, and hence the performance of the detector. It is important to remember that the rotor of this potentiometer is not at earth potential, and requires insulation from the metal case.

In the amplifier photographed a convenient method of obtaining grid bias is adopted in the case of the first valve, and could be extended to the following stages if desired. This consists in the use of a two volt valve operated from the six volt supply which feeds the other valves via a suitable resistor connected in its negative filament lead. If the valve is of the 2 volt 100mA class, such as the DEH 210 shown, two resistors each of 20 ohms can be used in series.

If the grid return lead be taken to the middle point of these two resistors, then a negative grid bias of two volts is automatically obtained. These two resistors can be clearly seen in the photograph, those used being replaceable resistors made by the Dubilier Condenser Co., and which fit the standard grid leak holders of this company It is best to make these resistors interchangeable to enable various valves to be used in the stage if desired. This biasing arrangement was not adopted for the later stages of the amplifier shown since it was desired to employ six volt valve in these positions. Hence separate grid bias batteries will be seen mounted in the second and third compartments of the amplifier. The bias for the power stage is connected externally owing to the bulk of the batteries required in this position. Two PX 650's or P 625 A's have been found sufficient to constitute the power stage for most purposes, and are used in parallel, since in my experience the use of push-pull is nor advisable for television purposes.

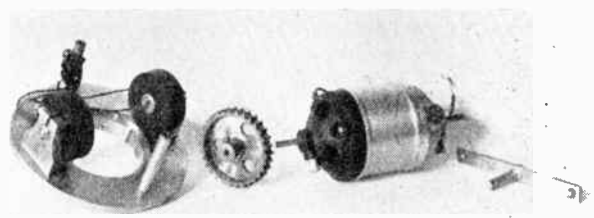
The earth, negative H.T. and L.T. terminals of this amplifier are common to the case, as also is one of the output terminals. The other output terminal is taken to the power valve anodes through 2 mF condensers, which should be of high quality since they are subjected to considerable strain in this position. Nothing less than 500 volt A.C. test can be regarded as good enough for this work if a breakdown is to be avoided.

For reasons which were explained in detail last month, transformer coupling is adopted between the third stage and the power valves,and if this system is employed an R.I. Hypermu transformer will be found a good choice, a ratio of 3/1 being suitable. This transformer was adopted after tests on a number of well-known makes, and gave appreciably the best results, probably owing to the high damping of its secondary winding, which is obtained by the use of nickel wire. A transformer having marked resonance even at very high audible frequencies is particularly objectionable for television purposes.

A really quiet source of H.T. is most necessary for a low frequency amplifier comprising more than three stages, and hence large dry batteries have usually been employed in working the set described above. The heavy duty Siemens 50 volt batteries have given excellent service in this position over a period of more than six months, proving a very economical source of current in view of the entire absence of trouble associated with this form of supply.

In concluding this series of constructional articles it is interesting to notice how closely much of the apparatus which we have evolved from inadequate data corresponds to that which the Baird Company are now offering to the public. Our experience goes to show that the quality of the disc employed is probably the deciding factor in the excellence of the results obtained from our apparatus, and I would emphasize that no amount of trouble taken over this part of the apparatus will be wasted.

It is a matter of the greatest difficulty to construct a really first class disc by hand, and now that machine divided discs can be purchased from the Baird Co. for £2 2s., the experimenter who wishes to be certain of success might do worse than obtain one of these.



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

Reasonable care in the choice and adjustment of the amplifier used is the only other vital factor which should be watched in receiving the Baird transmissions, and those who are prepared to follow the general lines laid down in this article should not meet with failure on that account.

Since the apparatus described in these articles constitutes, when added together, a complete television receiver, I should always be interested to hear from any constructor who has made use of all or part of the information which I have put forward, and to offer any suggestions or advice in my power in order to help him to achieve success in the fascinating field of television experiment.

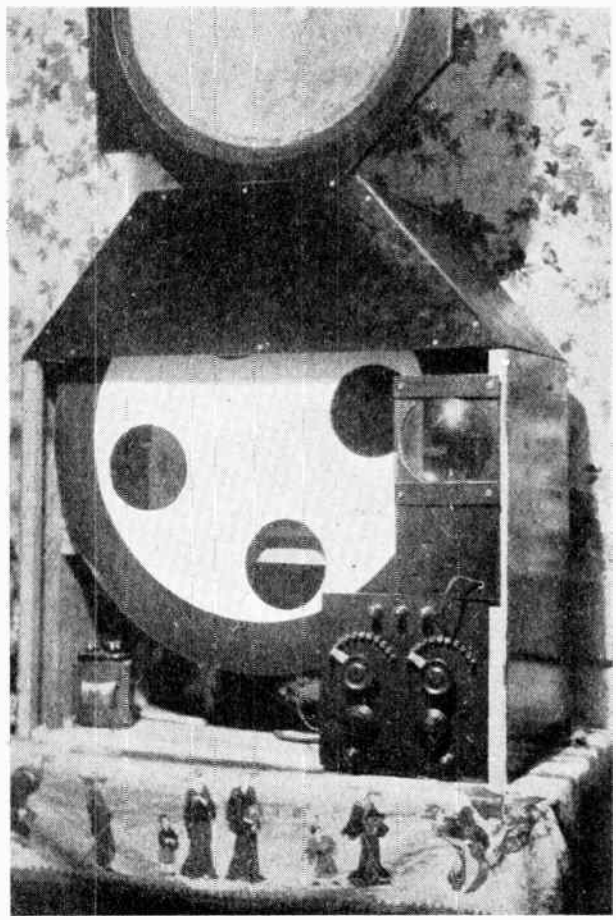
How the Amateur is Receiving Television

UP-TO-DATE amateur television receivers have more than justified themselves by the success of their efforts. The most interesting report during the past month is that of Messrs. E. J. and J. W. Holmes, twins, who live at Ashville Road, Leytonstone. It is a well-known joke of the B.B.C. to sing "Hello! twins" when they announce a birthday, but these twins have taken a very delicate revenge on the B.B.C., for with almost impossible apparatus they not only get a good image but receive it consistently. As all good twins should do, each thinks almost the same thoughts as the other, and listening to their verbal report on their reception was a most lively business, for one was constantly giving running comments and amplifications on the remarks of the other.

However, to get down to business, their mains supply is 150 volts D.C., and by the time this has passed through their very simple smoothing apparatus, *i.e.*, the secondary of a transformer, with about a 6 m.f. condenser, their voltage has dropped to somewhere in the neighbourhood of 130. This supplies an anode-bend detector with three stages of resistance capacity coupling, two valves in the last stage being in parallel. None of them are costly valves, those used being a Cossor 410 H.F. as detector, followed by a Tritron R.C.; then a Tritron power followed by an O.K. valve running in conjunction with a Dario super-power. The O.K. valve was purchased for about eighteen-pence, but like many cheap things, when one is lucky, it does the job.

The neon lamp used is a simple commercial type which is carefully focussed to get a nice flat field of illumination. According to a milliameter reading when the neon is in circuit, there is not more than 4 milliamps. passing in the output circuit, but this figure goes up to 12 milliamps. when a loud-speaker is being used. The "televisor" is decidedly homemade. The disc is nothing more substantial than a piece of white-faced grey cardboard, .022 of an inch in thickness. The holes in this were made with an ordinary fret-work drill, filed chisel-shaped on the end and used as a chisel to cut square holes. The positioning of the holes was done by the very simple process of dividing up the circumference of the disc into 30 equal portions, then circles were drawn one-tenth of an inch apart. The holes were positioned more or less by eye; the only guide being the points where the concentric circles cut the radii. The motor driving this disc is a universal model, intended to drive a domestic sewing machine, and was purchased for a little over £1. The synchronising gear consists of two ordinary early-type filament rheostats inserted in the mains. A lens is used to view the received image.

With this very simple and primitive gear in operation they have seen many of the midnight transmissions of television, and had not been long in the Baird offices—where they turned up to report progress—before they recognised one of the typists as a person whom they had seen smoking a cigarette the previous night by television. A few minutes afterwards they recognised another amateur performer who had appeared. They also recognised another typist who



The Televisor constructed by Messrs. E. J. and J. W. Holmes.

had done a little " business " with a mirror before the " televisor." With regard to the male character whom they had seen, they not only saw him wearing a monocle, but saw the shine on the glass. Their considered opinion is that if anyone gets a good three-valve set they should be able to receive anything that may be sent over, and receive it, be it noted, with good detail and all the half-tones.

Incidentally, these twins are both under twenty, and suffer from the same disability which another amateur receiver of television has had to face, namely, a serious shortage of pocket-money. This problem is further complicated for them by the fact that their parents do not view their television experiments with approval. " They say," remarked E. J. and J. W. in chorus, " we spend far too much money playing about with television, but, so far as we are able, we are going on with our experiments."

TELEVISION, and in fact every televisionist, wishes these two lads every success. The photograph of their home-made " televisor," is published on this page.

A strange phenomenon, something like an " image echo " has been observed by Mr. H. Hewel, of Berlin, whose reports of television reception have already been published. Writing of this in February, he says :

" During a time of 3 or 4 seconds the image 'faded over' into another image 10–20 elements higher. When the *original image* (fully synchronised of course and standing still !) faded *down* to a large degree *another* image faded *on* at the same time, showing the same picture (head or letters, etc.) *twice*, one *in* the frame and one 10–20 elements *higher*. Sometimes *during* the time *two* pictures were to be seen, one above the other, phase shifted 180 *degrees* (*negative picture*) for a few moments !

The phenomenon was *not* due to lack of synchronism in my rotating disc. It was like 'fading over' two gramophone records with a potentiometer (for instance in talking films !).

In transmission of music and speech over the 261 m. transmitter there is the same effect to be *heard* (at least here in Berlin). Sounds seem to come out of a bottle or the like for a few seconds time, and have an echo. After that they become clear again."

So far, no satisfactory solution of this has been offered, but it almost suggests that Mr. Hewel is getting two receptions of the same signal ; one direct and the other the long way round from London to Berlin. Here is a nice little problem for a mathematical enthusiast to work out. Does the amount of image displacement represent the time difference between the two journeys that the signal can make ?

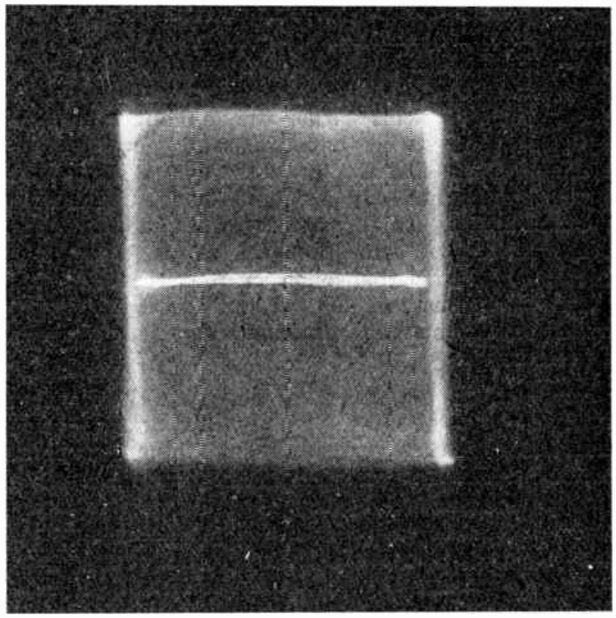
At the same time, Mr. Hewel continues to receive the television transmissions although the short wave station—261 m.—does not provide as good a signal in Berlin.

Mr. W. L. Wraight, an associate of the Television Society, writes from Funchal, Madeira, to report reception, and says :

" Between the short intervals of static, the images have been quite clearly seen, and the announcement headings would undoubtedly be clearly readable were it not for the static."

Apparently things at Funchal, Madeira, are far from ideal, for Mr. Wraight mentions among other difficulties a variable mains supply of 230 v. D.C., spark interference from ships and static.

His receiver works from 40 to 4,000 metres, and has a screen grid, H.F., leaky grid detector and two transformer coupled valves. These, of course, will



The fluorescent screen of the German experimenter Manfred von Ardenne's new cathode-ray tube for television, showing a line traced by the ray. The tube is described elsewhere in this issue.

be replaced later, although at present they are doing remarkably well.

The disc in the " televisor " is made of tin, 20 ins. in diameter, and is driven by a 220 volt D.C. motor of G.E.C. manufacture, with a 500 ohm resistance in the mains, fitted with a micrometer adjustment as synchronising gear. A toothed-wheel synchronising device is being built to replace this. For reception under difficulties, Mr. Wraight seems to be doing very well.

These reports are the outstanding events of the month. Other amateurs whose reception reports have already been mentioned continue to improve on their results, and are finding television reception a most absorbing hobby.

W. C. F.

Television for the Beginner

PART IV

By *John W. Woodford*

LAST month we went back to the transmitting end of our television system and commenced to examine the necessary apparatus in detail. The necessity for this was emphasised and we finished off with a query as to the shape of the disc hole. I pointed out that for the most economical use of a given area the square hole is best suited, but there is another aspect of the problem which must be considered in conjunction with this, namely, the available kilocycle sideband of the broadcasting station.

Intimate Detail.

Naturally, the smaller the width of this band the smaller will be the amount of intimate detail which can be received in the resultant image, or, alternatively, the extent or magnitude of the scene which can be handled adequately is kept within somewhat narrow limits. Now we know that at present the transmissions going out through the B.B.C. station at Brookman's Park must be within the nine kilocycle sideband as, unfortunately, this allocation to every broadcasting station was laid down before the popularity of television had manifested itself.

That being so, and until such time as the powers that be give special consideration to television broadcasts, it was necessary to study the problem carefully and find out the most efficient way of utilising the available broadcasting channel.

Graduated Exploration.

The Baird Company did this with their characteristic thoroughness, and the result is the Baird Graduated Exploration. Instead of the thirty holes in the disc being square only twenty-four take this shape, while the first three holes and the last three holes are rectangular, the long side of the rectangle being in a radial direction. For a given picture width, therefore, the size of the twenty-four square holes is slightly smaller than would be the case if the whole thirty were square. (See Fig. 1.)

The resultant picture is one with more detail over about the inner two-thirds than on the outside. In other words, the detail is concentrated in that section of the picture where it is generally most needed, this being especially the case with head-and-shoulder subjects. In this way the most efficient use is made of the waveband.

Another point to note in passing is that the picture ratio, that is, height to width in the case of the Baird vertical scanning, is seven to three. Here again the ratio was established only after careful consideration had been given to the type of subjects which were likely to be televised.

Using a Gate.

If you refer to Fig. 1 of last month's instalment you will notice that a "gate" or mask is shown positioned between the disc and the lens. Actually this portion of the apparatus is mounted as close as possible to the face of the revolving disc and consists of two metal shutters held in a vertical framework. One is arranged to move up and the other down, and obviously the distance between the bottom edge of the top shutter and the top edge of the bottom shutter will govern the "height" or length of the light area on the screen.

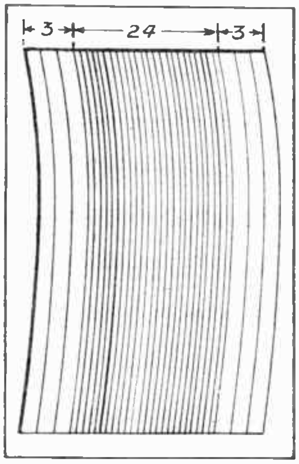


Fig. 1.—Illustrating the effect of the Baird graduated scanning disc.

Under present working conditions this gate is very carefully adjusted so that one small area of light just leaves the screen at the top a moment before another appears at the bottom. The gate depth is, therefore, slightly less than the distance between two adjacent holes in the scanning disc. A condition is thus established that for a very small fraction of a second between the end of one light spot scan and the beginning of the next there is no illumination on the screen or subject at all.

The reason for this may appear puzzling at first sight, but the mystery (if one can use such a term in this connection) will be unravelled when we come to consider the question of automatic synchronising.

Reducing Flicker.

With our fixed light source and revolving perforated disc we have a resultant light area on the screen of definite shape. Although actually described by travelling light spots which trace thirty light strips side by side one after the other, the rapidity of the process (750 complete explorations in one minute) practically annuls any flicker, and to all intents and purposes one has the impression of a floodlighted area.

You will have noticed a similar sort of thing in your own homes if the electric lamps are lit from an alternating current supply. No flickering can be seen and yet the light is varying continuously at a rate depending upon the supply frequency.

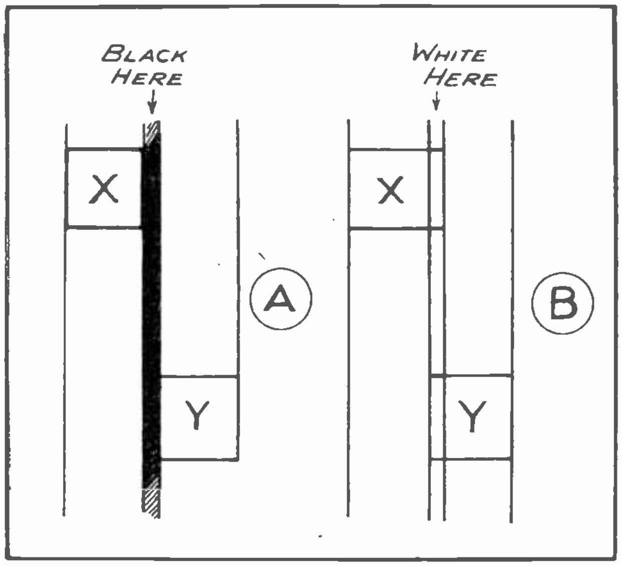


Fig. 2.—Showing the effect of underlap and overlap.

Accurate Hole Positioning.

Of course the holes in the scanning disc must be very accurately positioned otherwise lines will appear on the screen, that is, the junctions between the individual light tracks become visible. Let me illustrate what I mean. Turning to Fig. 2A, we see that two squares, X and Y, are shown. These represent the disc holes, each pair of lines being the light track made during a portion of the sweep. The track made by the inner edge of hole Y does not coincide with the track made by the outer edge of hole X. In other words, there is underlapping and the result is a black line on the screen, the actual width of the line depending upon the amount of underlap present in the disc.

With Fig. 2B we have another condition represented, namely, overlap, and it is easy to see that this will produce a narrow white line on the screen. Obviously, it is essential to have the holes carefully marked off on the disc and thus reduce the "lines" to the barest possible minimum or, better still, make them disappear entirely.

Turning Light into Electricity.

This scheme is very interesting, you will say, and it is easy to grasp exactly what happens so far, but where is the purpose underlying the ingenious arrangement? The travelling light spot will certainly illuminate the scene or object it is desired to televise, but what is the next step in the process? It is at this juncture that we make the acquaintance of one of the most important links in the television chain. We must learn something of the apparatus which enables us to turn light into electricity, for it can then be handled in a more straightforward manner.

No doubt you have seen articles and references in this journal to a substance called selenium. Now the history of television is really linked up with the history of selenium and may be said to date from the discovery of the light-sensitive properties of that element.

Selenium.

Selenium is a metal and has an enormous resistance to electricity. This property made it useful in the construction of high resistances used in telegraph working. Many years ago an operator at a cable terminal station noticed that his instrument behaved in an erratic manner every time the rays of sunlight touched the selenium resistance. The phenomenon was investigated and the light-sensitive properties of selenium were disclosed. If connected up in a circuit and exposed to light an electric current will flow in the circuit of which it forms a part. On shielding the selenium from the light rays, however, the current flow will cease. In addition, it was also found that the strength of the current flow was dependent upon the amount of light to which the selenium was exposed.

The scientists of those early days were quick to perceive that in the selenium cell they had a means for providing vision by telegraphy. A great number of devices were invented and many of them to a certain extent were perfectly feasible schemes except for one point, and that was that selenium was much too slow in its action. For over forty years television remained at a standstill, the "time lag," as the sluggishness of selenium was called, proving a fatal barrier.

Overcoming Time Lag.

Luckily, however, a discovery made by Hertz in 1888 led to the construction of what are now known as photo-electric cells. These cells turn light into electricity, and although only a minute current flows they possess the great advantage that they are instantaneous in action, and television demands this high standard. The smaller current response is easily made good by suitable valve amplifiers and these cells are now used in several different forms. One particular type is illustrated in an accompanying photograph and can be compared in construction with the selenium cells, which are also illustrated. The exact function of these special "television eyes" will be dealt with next month.

A photo-electric cell as manufactured by the G.E.C.

Electrical Conductors

By *W. F. F. Shearcroft*, B.Sc. (Hons.), A.I.C.

Fellow of the Television Society

It must have been somewhat of a surprise, in the days when only electrostatic charges of electricity could be manufactured by clumsy friction machines, to the man who discovered that the charge would leak away from along various materials. It was an enormous advance when the invention of the battery and the production of a current along metallic wires became an accomplished fact. To-day, static charges occupy a very inferior place in the practice of the science of electricity, and its transference from one place to another is one of our main considerations.

Experiment has divided matter into conductors and non-conductors, a division which, in reality, is a gradation; for conduction is a matter more or less of conditions, and all known substances will conduct to a certain extent. In practice we use some form of metal as a conductor, because metals as a group offer less resistance to the passage of a current than other materials.

Under any given conditions the conductivity of the metals varies within wide limits, as is shown by the figures in Table I.

TABLE I.

Metal.	Conductivity at 18° C.
Copper (drawn)	$5{\cdot}62 \times 10^5$
Gold	$4{\cdot}2 \times 10^5$
Silver	$6{\cdot}06 \times 10^5$
Aluminium	$3{\cdot}3 \times 10^5$
Zinc	$1{\cdot}6 \times 10^5$
Platinum	$8{\cdot}62 \times 10^4$
Iron	$7{\cdot}1 \times 10^4$
Mercury	$1{\cdot}06 \times 10^4$
Bismuth	$8{\cdot}3 \times 10^3$

For the majority of metals the resistance, which we consider as the reciprocal of the conductivity, decreases with pressure. Lithium, calcium, strontium, antimony and bismuth increase their resistance with increase of pressure, while the values for cæsium pass through a minimum. This change is an appreciable one, amounting in the case of potassium, for example, to an increase of 78 per cent. over the measured range.

Tension produces an increase of resistance in practically all cases, and on melting a metal the resistance increases or decreases in the same sense as does the density.

The resistance of a metal depends very largely on how it is treated in the process of manufacturing the actual conducting material, for example, the specific resistance of wrought iron at 18° C. is $13{\cdot}9 \times 10^{-6}$, the value for steel being $19{\cdot}9 \times 10^{-6}$.

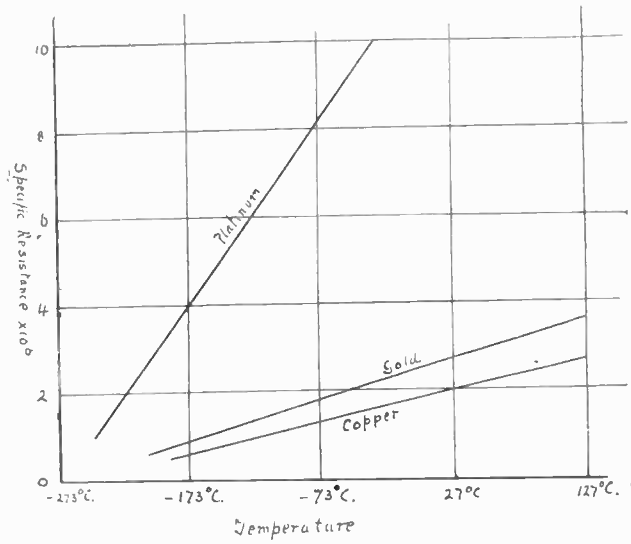


Fig. 1.—Curves showing how the electrical resistance of metals varies with absolute temperature.

Resistance varies considerably with temperature, being very roughly proportional to the absolute temperature. This is shown for a few metals in the curves in Fig. 1.

As the temperature is lowered to the region of absolute zero a remarkable phenomenon appears in the case of certain metals. At a critical temperature the resistance suddenly sinks to practically zero. This state of *super-conductivity* has been found for the following metals :—

Metal.	Characteristic Temperature in Degrees Absolute.
Iridium..	3·41°
Tin	3·78°
Mercury	4·19°
Thallium	2·3°
Lead	7·2°

Fig. 2 gives a curve showing the resistance of mercury at very low temperatures.

This very remarkable behaviour leads to equally surprising results. A conductor without resistance means a current without driving force. Thus it was found that in a lead circuit in a state of super-conduction an induced current fell by less than 1 per cent. per hour, and so we have a current flowing

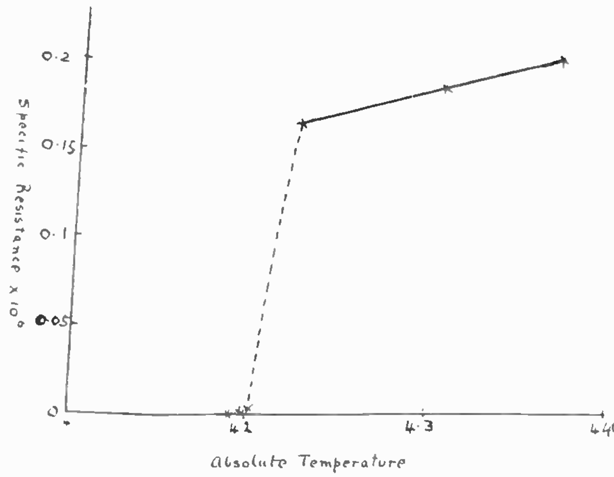


Fig. 2.—Curve showing the resistance of mercury at very low temperatures.

for several days without any applied electromotive force!

It seems strange that for this very common occurrence of conduction of electricity through solid conductors, we have no adequate theory. The idea that it can be explained by the migrations of electrons through a wire will not hold in the sweet simplicity of the picture it provides. Conduction, with many another simple phenomonon, still awaits explanation. It is certainly not analogous to thermal conduction, for which there is nothing similar to super-conduction.

The conductivity of any system is described by Ohm's Law, which states: "Other things being equal, the potential difference between two points on a wire, at constant temperature; carrying a current is proportional to the current."

For practical purposes copper is the metal most used for the conduction of electricity. Its tenacity and ductility permit us to make wires of it of varying thickness, and considerable strength. It is very little affected by the atmosphere, and thus can be used bare, for laying a line for conduction. It has a high value for its conductivity.

Copper seems to have been known since the Neolithic age, and a *copper age* followed the *stone age*. It occurs free in many places; the largest deposits occurring on the shores of Lake Superior, where masses weighing about 400 cwt. have been found. Copper compounds, from which the metal can be obtained, are also widely distributed, the best known being the oxide in the form of *cuprite*, the sulphide known as *copper glance* or *copper pyrites*, and the basic carbonate, *malachite*.

From its ores copper is obtained by methods which depend largely on the nature of the ore and local conditions. In outline the process consists of roasting the ore to produce copper oxide. Washing the ore to free it from impurities may precede this process.

The oxide is then reduced to the crude metal by further treatment, usually in a blast furnace and some form of converter. The crude product is refined by an electrolytic process. Plates of the crude metal are made the anode of an electrolytic cell, passing into solution when the current flows, and being deposited on the cathode in a very high state of purity—99·8 per cent. of copper being obtained.

For electrical purposes such a high state of purity is essential, for minute traces of impurity may seriously effect the conductivity.

Copper has a reddish-brown colour by reflected light, but thin layers are green by transmitted light. The metal can be obtained as octahedral crystals. Near its melting point it may be ground into a powder, and it is brittle also if heated and cooled slowly; rapid cooling give the usual flexible, ductile and malleable product.

Dry air has no effect on copper, but in the presence of water and carbon dioxide, a covering of a green basic carbonate called *verdigris* is formed. A list of constants is given below:—

Symbol	Cu.
Atomic Weight	63·57.
Density	8·93.
Tenacity—Cast	1·2–1·9 dynes/cm².
,, Rolled	2·0–2·5 ,,
,, Hard-drawn wire	4·0–4·6 ,,
,, Annealed wire	2·8–3·1 ,,
Melting point	1083° C.
Boiling point	2310° C.
Thermal conductivity	$K = 0{\cdot}918$.
Coefficient of expansion	$16{\cdot}7 \times 10^{-6}$.
Specific heat	0·091 (at 0° C.).
Latent heat of fusion	43 cals.
Specific resistance—	
Drawn	$1{\cdot}78 \times 10^{-6}$ } at 18° C.
Annealed	$1{\cdot}59 \times 10^{-6}$ } at 18° C.
Thermal coefficient of resistance	$42{\cdot}8 \times 10^{-4}$.

WIRE RESISTANCE FOR COPPER.

S.W.G.	Diameter.		Ohms per metre.	Safe current.
	Mm.	Inch.		
				Amps.
12	2·64	0·104	0·0032	15·0
16	1·63	0·064	0·0083	6·8
20	0·914	0·036	0·0260	2·6
24	0·559	0·022	0·070	1·1
28	0·376	0·0148	0·155	0·5
32	0·274	0·0108	0·293	0·3
36	0·193	0·0076	0·590	0·15
40	0·122	0·0048	1·48	0·06
46	0·061	0·0024	5·90	0·02

Reproduction and Amplification in Television Receivers*

By *Dr. Fritz Schröter*

IN the following paper physical relations will be dealt with which are of importance for the sharpness of reproduction in modern televisors. In part the deduced relations apply in principle for all registering electro-optical transformations (sound-film, photo-telegraphy, and special forms of photo-telephony). Whilst, however, in the distant signalling of pictures within a fixed period of time, scanning speed and screen can be adapted to the greatest claims made on the reproduction of the original, in the selection of these dimensions in television freedom does not exist, because for the creation of a constant retina impression a minimum number (n) of transmissions of the entire picture surface per second is necessary, and the degree of image analysis is limited by the permissible frequency band width, by amplifier difficulties and by the physiologically-based claims on the brightness of the receiver vision-field.

We adopt here as a basis the principle of every modern picture transmission: the scanning device breaks up the subject into temporary light alterations which produce in the photo-cells corresponding fluctuations of the transmitting current. These are re-converted by the light relay of the receiver into proportional brightness values, for the accurate composition of which into the distant picture the picture-point distributor, running synchronously and in phase with the scanning device, is responsible. Through which special optical means the relative movement

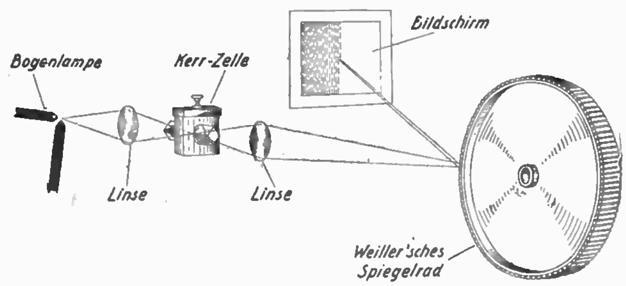


Fig. 2.—Television receiver employing Kerr cell and Weiller mirror-wheel.

of light spots (or light gap) and picture surface is obtained is of no importance here.

For this purpose, for example, the well-known Nipkow perforated spiral discs, as per Fig. 1, or the likewise two-dimensional decomposing Weiller mirror-wheels[1] as per Fig. 2 may be used. The common characteristic of all such apparatus with uniform movement (v) is the finite of the size aperture or light-spot vertically and parallel to the running direction, and therefore its finite aperture speed (Auflaufzeit) in relation to a fixed mathematical point in the picture.

For simplicity's sake we will first assume that the time constants of the transmission mediums are to be neglected, and that in the whole chain of conversion and controlling processes between the varying light effects in the photo-cell and the lighting up of the light relay, no non-lineal amplitude distortions occur. Therefore all energy transformers are practically free from inertia, and the second differential quotients of the controlling functions disappear.

Fig. 3 shows a picture-field of height q and width l shown as a "point screen," as it can be clearly conceived that a square light-spot, for example, moving in the direction v_1 draws parallel adjoining lines over the surface. Such a rectilinear decomposition is

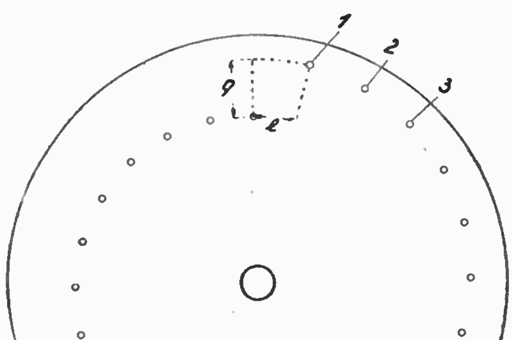


Fig. 1.—Perforated Nipkow Disc.

* Communication from the laboratory of the Telefunken-Gesellschaft für drahtlose Telegraphie m.b.H. Reproduced as a supplement of the "Elektrischen Nachrichten-technik," Berlin, 1929.

[1] See Korn-Glatzel: Handbook of Phototelegraphy, Berlin, 1911, p. 446. The Weiller wheel, after the surmounting of important mechanical and optical difficulties, is now used in the televisor of A. Karolus.

exactly producible by means of the mirror-wheel device shown in Fig. 2, with the application of a square diaphragm before the source of light. The Nipkow disc, on the contrary, delivers arc lines; if,

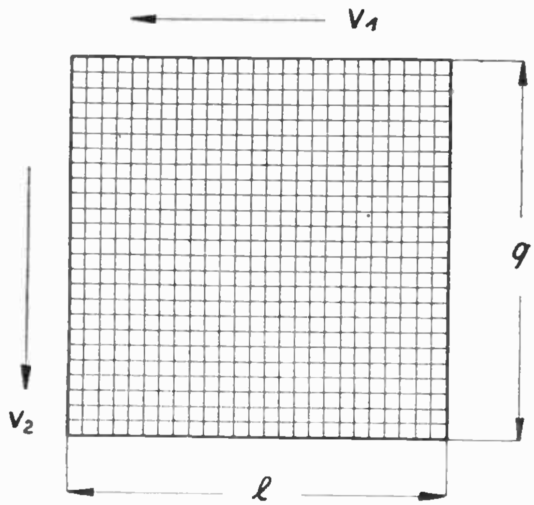


Fig 3.—Point Screen.

however, the radius is great in proportion to q and l, the bending of the path and the distortion relatively to Fig. 3 become unnoticeable. k lines may fall out over the entire height q. The square surface element of the screen then has the side length $f=q/k$. The light-spot speed for n pictures per second is given by

$$v=v_1=n\ k\ l,$$

the transverse speed is the number of the picture lines scanned in $1s$.

$$v_2=n\ q=n\ k\ f.$$

v_1 is assumed to be completely constant, that is, the synchronised picture decomposers are free from oscillations.

I. Still Pictures.

1. *Sharpness of the contours.* As shown in Fig. 4, at the transmitter the light-spot travels with the speed v from a black area to a white one. The vary-

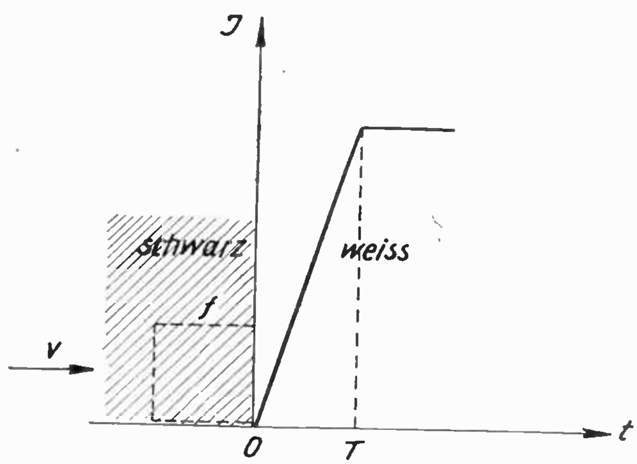


Fig 4.—Current increase caused in the photo-electric cell by a sharp contour.

ing transmission is assumed to be completely sharp, so that the brightness jump $d\,H/d\,t=\infty$. In consequence of the finite movement f of the light-spot the illumination increases however, which illumination, on passing over to white, arises by reflection on the photo-cell, not jerkily but gradually and rectilineally, until the light-spot lies completely on the bright zone, that is to say, has moved to the right across f relatively to the shaded initial position. The "transition period" appertaining hereto we call T. From the time point $t=T$ onwards no further alteration takes place. Therefore:

$$T=f/v\doteq q/n\,k^2\,l.$$

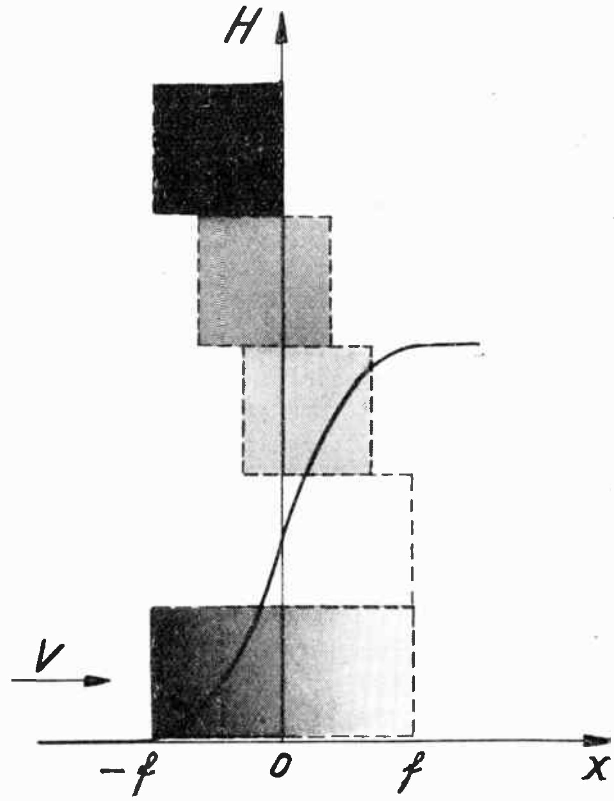


Fig. 5.—Reproduction of a sharp contour in the receiver.

The photo-current is supposed to follow the varying light values proportionally. Fig. 4 therefore represents the current increase in the photo-cell for which the following relations hold good:

(a) $I=O$ for $t\leq O$,

(b) $I=it$ for $O<t<T$, if i is the photo-current intensity for $t=I$,

(c) $I=iT$ for $t\geq T$.

The momentary brightness H_m produced by the light relay of the receiver is, according to supposition, proportional to the momentary value I of the photo-current, therefore $H_m=C\ I$, if C signifies the proportionality factor of the conversion of current into light. The photometric impression of a certain spot of the received picture covered by the controlled light-spot exercised on the eye can, according to the Talbot law, which is doubtlessly valid for such short periods,[2] be represented by the time-integral of the variable brightness. The viewing apparatus therefore perceives its assumed mean value over the visibility period of the place or spot concerned. Fig. 4 corre-

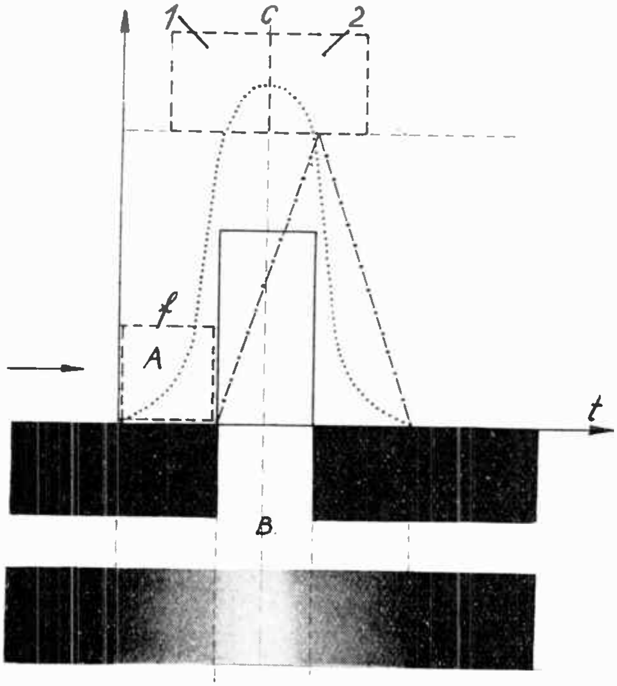


Fig. 6—Reproduction of a strip, or line.

sponds therefore to the phenomenologically shown course of the transition zone in Fig. 5, the shade of which constitutes itself as an integral effect from the momentary values of the brightness in the various positions of the aperture or light-spot. This shade extends to the double width of the surface element.

The calculation of the H curve in Fig. 5 can be effected in two ways. In principle the method indicated in the next section for the case of periodically variable brightness can also be used for the deduction of the blurring of sharp edges in the received picture. If the inconstant transition spot or place is represented as a Fourier-integral, one calculates for the important harmonics the amplitude dampings resulting from the finite aperture, and superimposes the obtained brightness courses. However, the want of sharpness of the reproduction of such bright-dark jumps by the receiver is more simply and clearly shown by the following consideration: if, as hitherto assumed, the apertures of the decomposing discs on both sides are exactly in phase, then the co-ordinates of the aperture edges $x_1=O$, $x_2=-f$ in Fig. 5 correspond to the time-point $t=O$ in Fig. 4 and the co-ordinates $x_1=f$, $x_2=O$ correspond to the time-point $t=T$.

For a place in the received picture which lies in the negative area of the X-axis at a distance $/x/</f/$ from the H-axis lighting up by the light relay only takes place during one part of the transition period T. If the aperture meets the place mentioned in the time-point τ, taken on the zero line of Fig. 4, there results there the photometric brightness

$$H=C\ i \int t\ dt=\frac{C\ i}{2}(T-\tau)^2. \qquad (1)$$

For all places situated within the interval f on the positive side of the H-axis of Fig. 5 which may enter in the time-point τ in the aperture, increasing illumination is occurring from τ to T; after this their illumination remains constant at the maximum value $C\ i\ T$, so that we get:

$$H=C\ i \int_{\tau}^{T} t\ dt+C\ i\ \tau T$$
$$=\frac{C\ i}{2}(T^2-\tau^2+2\tau T). \qquad (2)$$

If we insert in the formulæ (1) and (2) different values for τ, for example, $-T$, $-T2$, O, $T/2$, T, and write for $C\ i\ T^2$ the maximum amount of the illumination H_s, there follows for the parts of the received picture corresponding to the selected time-points the following distribution registered in Fig. 5 which characterises the non-sharp course of the reproduction of sudden changes in contrast in the original:

Point in the received picture field, $x=$	$-f$	$-f/2$	0	$f/2$	f
Illumination for the eye, $H_s \times$	0	1/8	1/2	7/8	1

The application of this method of consideration in the question of the sharpness of reproduction of a bright strip of the thickness of a picture element (f) gives a fading zone of the width $3\ f$ (Fig. 6). The solid line represents the variable brightness distribution in the original, the dash-made curve the rise and fall of

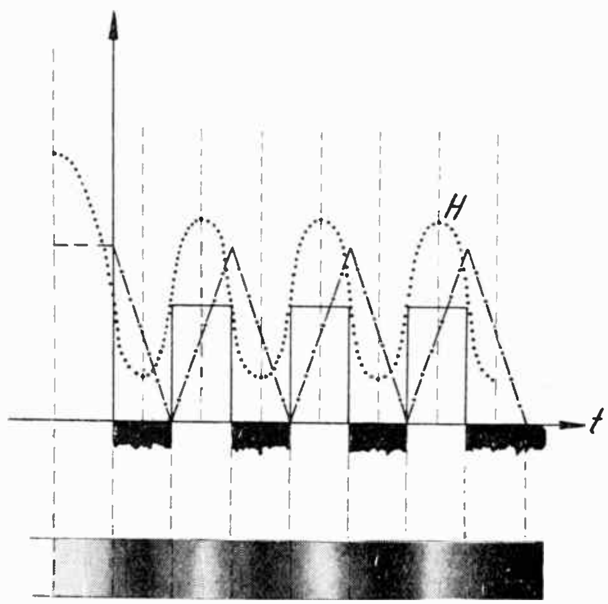


Fig. 7.—Reproduction of a line screen.

[2] Geiger-Scheel: Manual of Physics, xix., p. 487. Chapter "Photometry," by E. Brodhun.

the photo-current, and the dotted curve the blurred reproduction of the receiving apparatus. In the centre line $B\,C$ the illumination intensity is the integral over the transition period of the light aperture from position 1 to position 2. As the photo-current during this time passes through its maximum values ($\geq 1/2$), the brightness maximum lies in $B\,C$, the amount of which is given by

$$2C\, i \int_{T/2}^{T} t\, dt = C\, i\, T^2\left(1-\tfrac{1}{4}\right) = \frac{3H_s}{4}.$$

Therefore no complete lighting-up takes place (the controlling current of the light relay has not its maximum value during the whole transition).

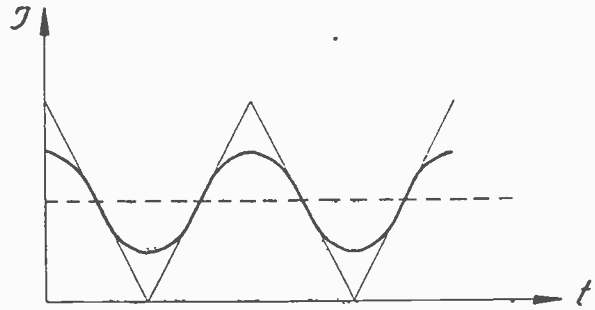


Fig. 8.

A series of black strips of the thickness f is reproduced as in Fig. 7. The co-ordination of the curves is the same as in Fig. 6. The lighting intensity maxima of the reception picture of the amount $3\,H_s/4$ lie in phase with the centre line of the bright strips of the original, the minima of the amount $H_s/4$ in phase with the centre line of the dark strips. Therefore no complete darkening takes place either. These dampings are worthy of note in connection with the question as to which modulation frequencies must be transmitted in television. In view of the overcrowding of the ether the limitation of the frequency band as far as possible suggests itself. In general one calculates as maximum frequency (in Hz) the value

$$\frac{\text{Number of pictures} \times \text{number of the quadrat surface (picture) elements}}{2} = \frac{n \times k^2 \times l}{2\,q},$$

because one regards as the most rapid change which can occur in the scanning, the following on one another of a bright and a dark surface element. The duration of a maximum period number is after this the time for the running through of two-picture-point widths $= 2\,T$.

In this connection, however, it is expressly overlooked that the brightness in the original picture proceeds by jumps according to assumption, the sinusoidal fundamental frequencies $v_m = v/2\,f$ of the line screen in accordance with Fig. 7, therefore, would have to contain an infinite series of harmonics, which, although with altered amplitudes, recur in the zigzag-shaped photo-current curve in accordance with Fig. 8.[3] In reality the appearance of the received picture shows that even in the case of the co-transmission assumed in Fig. 7, of all higher frequencies through a system represented as free from inertia, it cannot be a question either of a sharp reproduction of sudden contrasts or of a complete controlling of the intensity between maximum and minimum. The definition of the picture element as a superficial dimension of the scanning hole or light spot is therefore conceived in its direction of running, more or less arbitrary; the edge sharpness actually obtained would correspond to a coarser screen, especially if the additional action (or effect) in practice of the "in-swing" times (Einschwingzeiten) is taken into consideration. The decisive influence of the finite aperture f and its ratio to the width of the transition zone to be portrayed is still more generally dealt with in the following section. If the rectangular brightness distribution of the original and the zigzag photo-current curve arising in its scanning is represented in Fig. 7 by Fourier series, then these run:

for the rectangular curve:

$$i = \frac{J}{2} + \frac{2J}{\pi} \cdot \left(\sin \omega t + \frac{1}{3}\sin 3\omega t + \frac{1}{5}\sin 5\omega t\ \ldots\right),$$

for the zigzag curve:

$$i = \frac{J}{2} + \frac{4J}{\pi^2} \cdot \left(\sin \omega t - \frac{1}{9}\sin 3\omega t + \frac{1}{25}\sin 5\omega t\ \ldots\right),$$

whence proceeds the characteristic difference in relation to amount and sign of the amplitude of the three harmonics and the insignificance of the further members. As the amplitudes in the receiver side illumination occur squared in consequence of the finite aperture (see following section), it is plain how

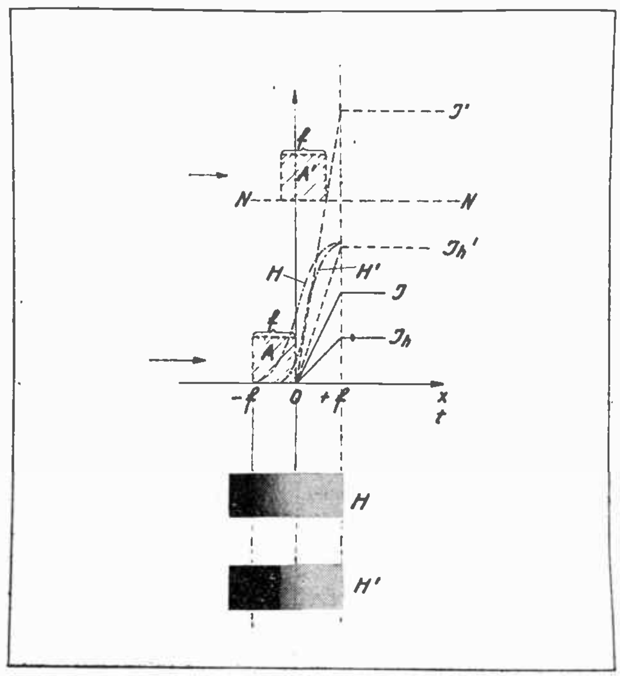


Fig. 9.—Increasing the picture sharpness by applying a controlling amplifier.

[3] Amplitude spectrum of an aperture. See K. Küpfmüller, Zeitschrift f. Techn. Physik, 8, p. 475 (1927).

little the higher frequencies of the fundamental frequency $v_m = v/2f = 1/2T$ contribute in reality to the picture sharpness. We may therefore confine ourselves to the transmission of v_m and may suppress the higher period numbers. This is more convincingly proved in section 3 by consideration of the influence of the aperture on the temporary voltage increase on the entrance grid of the photo-cell amplifier.

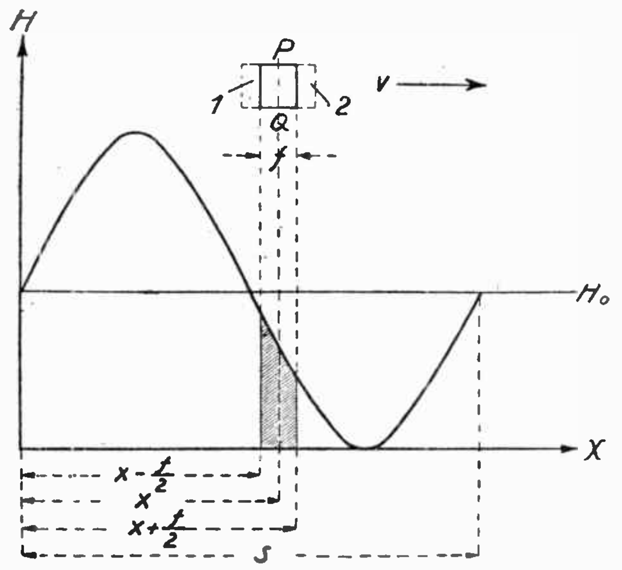


Fig. 10.—Sinusoidal light intensity distribution.

The previous results apply to the case of a threshold-value-free amplifier with rectilinear working range. The blurred edge of the width $2f$ in Fig. 5 can now be narrowed by manipulation at the receiver, which brings about a diminution of its time constants. This is shown in Fig. 9. The maximum amplitude of the current which excites the light relay is assumed to be given in the case *a* by I (solid line), in the case *b*, which corresponds to a pre-amplification three times as large, by I' (dash-made line). In the case *a* working is done without biassing. There thus arises the same lighting up curve H as in Fig. 5. The resulting want of sharpness extends from $x = -f$ to $x = +f$.

In the case *b* let (for example, by negatively biassing the grid of the controlling tube) a threshold value N be introduced for the initial illumination. The light relay then only begins to act at a time point which is characterised by the position A' of the scanning aperture in relation to the H-axis, but attains, however, the final intensity assumed in case *a* at the same moment ($x_1 = f$, $x_2 = O$), provided that the pre-amplification suffices in order to make $I' - N = I$. Consequently we get the steep lighting up curve H'. The comparison of the registered lights and shades shows that the transition zone now appears much sharper and narrower. Moreover, it is acknowledged that all half-tone values which deliver controlling current intensities of less amount than N, must drop out on the receiver side. For example, the half maximum amplitude I_h in the case *a* would be equivalent to $I_h' < N$ in the case *b*, that is to say, a corresponding grey would not be transmitted. In order to reproduce half-tones quantitatively, and simultaneously contours sufficiently sharp, the smallest possible aperture is therefore indispensable.

2. *Damping of periodically changing brightness.*[4] One hole of the transmitter Nipkow disc covers over in the scanning direction (X) the sinusoidal light intensity distribution represented by Fig. 10

$$H_x = H_o \left(1 + \sin \frac{2\pi x}{s}\right)$$

of the period length s. In consequence of the finite aperture f the light quantity

$$H_o \int \left(1 + \sin \frac{2\pi x}{s}\right) d\,x$$

acts on the photo-cell, whereby the integral is to be extended over the aperture limitations. If, for example, the aperture centre is in the line $P\,Q$, then the edges have the co-ordinates $x + f/2$ and $x - f/2$ and the photo current will therefore be proportional to the shaded surface (Fig. 10). That is to say, at the moment where the aperture centre has completed the section x, we get

$$i_x = \text{const}\, f\, H_o \left(1 + \frac{s}{\pi f} \sin \frac{\pi f}{s} \sin \frac{2\pi x}{s}\right) \qquad (3).$$

The transmitting current therefore follows the brightness variations of the scanned picture in the same curve form and frequency. The amplitude of its fluctuation does not, however, attain the value I; it is, on the contrary, multiplied by the damping factor $\frac{s}{\pi f} \sin \frac{\pi f}{s}$, the amount of which depends upon s/f and only converges against I for $s > f$. For $s/f = I$, $1/2$, $1/3$ and so forth, the current alteration disappears and with it the transmission of the corresponding picture frequencies (the mean value over one or

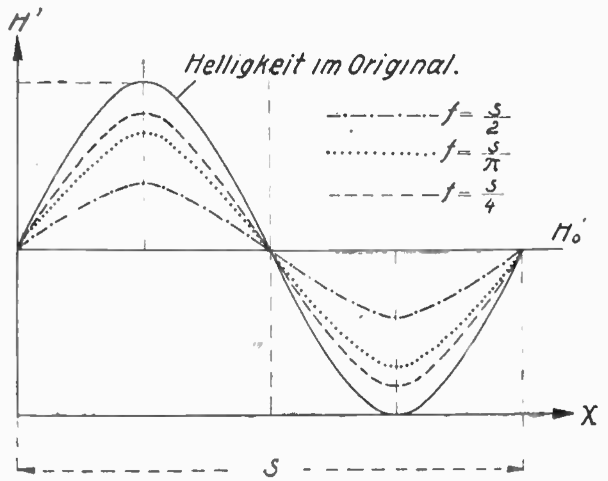


Fig. 11.—Illustrating loss of contrast. (Translation: Degree of brilliancy in the original.)

[4] See J. W. Horton, 4th Annual Convention of the Institute of Radio Engineers, May, 1929, p. 5 and following. Hitherto unpublished calculations of this kind were carried out with special reference to the sound-film independently of the author by K. Küpfmüller (Siemen's Central Laboratry) and Wohlrab (Dissertation, Leipzig, 1929).

several entire periods of the light fluctuation must obviously be zero), and for the ranges $\frac{1}{2} < \frac{s}{f} < 1$, $\frac{1}{4} < \frac{s}{f} < \frac{1}{3}$, and so forth, $\sin\frac{\pi f}{s}$ becomes negative; that is to say, the alteration of the brightness at the point of the aperture centre is in counter-phase to the simultaneous alteration of the photo current.

For the building up of the received picture the Talbot law and complete linearity of the controlling of the light relay (for example, incandescent lamp) must apply. If the photo current fluctuates in accordance with (3), then, assuming equal phase running of both perforated discs, and coinciding apertures, the brightness resulting along the line PQ will be an integral effect, which is made up from the momentary values of the light intensity of the portraying aperture in the transition from position 1 to position 2. Inserting a new constant for the conversion of the photo current into light, we can therefore express the brightness perceived on the receiver side in PQ by

$$H_x^1 = \text{const}' f H_o \int_{x-f/2}^{x+f/2} \left(1 + \frac{s}{\pi f} \sin\frac{\pi f}{s} \sin\frac{2\pi x}{s}\right) dx$$
$$= \text{const}' f^2 H_o \left[1 + \left(\frac{s}{\pi f} \sin\frac{\pi f}{s}\right)^2 \sin\frac{2\pi x}{s}\right]. \qquad (4)$$

We obtain accordingly in the received picture a sinusoidal brightness distribution of the same frequency and phase as in the transmitted picture. As the factor $\frac{s}{\pi f} \sin\frac{\pi f}{s}$ occurs in the square a reversal of phase, as it may occur in the photo current according to the foregoing, is not possible for any value of s/f. Fig. 11 shows the resulting loss of contrast, assuming various values for f/s; for comparison the completely controlled brightness distribution is registered in the original (solid line) with correct phase. The formula (4) contains (to which reference shall only be made here) the transmission characteristic $e^b = \varphi(s/f)$ of all the intensity periods given in the scanning by the pictorial configuration.

The sharpness of the reproduction transversely to the direction of movement of the aperture or light spot is a function of the number of lines k. This is shown very plainly by Figs. 12 to 14, of which 12 is the original, 13 and 14 the received pictures with 40 or 75 lines photographically produced by means of a Kerr cell. If, however, the eye itself acts as the receiving organ, and if the transmission speed is of the necessary order for continuous sight impressions, a new experience is disclosed, that is, the disproportion between longitudinal sharpness ($v_1 \parallel$ picture line) and transverse sharpness ($v_2 \perp$ picture line). The usefulness of an increase of k appears trifling so long as the transitions and contours in the running direction of the light spot do not also become correspondingly more marked. In this connection it must be remembered that in the transverse decomposition each brightness jump (contrast) from line to line is reproduced with undiminished sharpness in the receiver, as neither the size of the aperture nor the time constants of the electric transmission exercise an influence thereon. The increase of the line number k would therefore have worked out less strikingly in Fig. 14, if the light spot had possessed in the scanning direction the same expansion as in the case of Fig. 13. In reality it was narrowed in the ratio k_1/k_2.

If the Figs. 13 and 14, set side by side, are considered from a greater distance then the disproportion greatly noticed in the normal method of vision seems to be lessened. The televised pictures received to-day require such physiological aids (prevention of the right accommodation of the eye and so forth) in order to have a satisfactory effect. This method is, of course, only justified for objects which our sense of vision, by virtue of long experience, permits of seizing pictorially from a minimum of detail, as, for example, the human countenance. We will revert later to psychological points.

(To be continued.)

Fig. 12.—Original.

Fig. 13.—Reproduced through a coarse screen.

Fig. 14.—Reproduced through a finer screen.

Sydney A. Moseley on The Dual Transmission

WELL, the die has been cast and the first commercial televisors are now in full use in all parts of the country. It is too early yet to judge the results. Indeed, it would be like judging the telephone in its early stages, when *The Times* did not think it of sufficient importance to give it a mention!

A good many of my friends have been literally staying up all day and all night in order to get early results. So far, one or two notes that have reached me have been encouraging. Mr. Miller, of the *Wireless Trader*, appears to be getting some good pictures; while Mr. Haines, of the *Wireless World*, tells me that he has had what really are to him "very interesting results." Mr. Bernard Jones, editor of *Amateur Wireless*, who in some strange way got well ahead of TELEVISION and others in obtaining results, is full of the exciting and interesting times they have had in the office with the Baird Commercial Televisor.

My friend, Norman Edwards, on the other hand, is going slow, for the moment. He is going to subject his televisor to a series of thorough tests. I am hoping by the time this appears in print that Mr. Edwards may have achieved good results.

However, I regard these experiments more or less in the nature of a preliminary canter. The great day, March 31st, will go down on the calendar as having seen the beginning of television service proper in this country. For the benefit of posterity I append the official programme. Also I am printing the photographs in this issue of a number of eminent artists who participated in this historical transmission.

Well, then, for five mornings in the week and two nights we shall be seeing as well as hearing sopranos, tenors, baritones, comedians, and occasionally a speaker.

Lookers-in must remember that it is not the intention of the Baird Company to put over a fulsome programme. The object is to enable lookers-in so to adjust their sets that they are able to see a singer or speaker as clearly as conditions permit. Obviously, at first, one will have to make allowances for those who are unaccustomed to tuning-in.

So for the moment there will probably be three items per transmission, allowing on an average ten minutes for each artist, which is enough. On the other hand, as things progress it might be possible to add to these items or, what is more important, if the public interest is such as one has reason to expect, the B.B.C. will undoubtedly continue to help, as they are doing at present, by extending the time placed at the disposal of the Baird Company.

I am afraid I must warn readers against accepting some of the unauthorised statements that appear from time to time in the public press. It would almost seem as if we have not altogether disposed of those little groups of foreign rivals who desire to place as many obstacles in the road of the progress of the British Company as they have in the past.

Listeners should only accept official statements issued either by the B.B.C. or the Baird Company. It is not much use accepting such statements as "an official of the B.B.C." or "The Baird Company." I write this because, apparently, a news agency has been led to circulate an unauthorised news item which was wrong in many details.

(*Continued on page* 81.)

Personalities *of*

The Personalities pictured below will appear in

KEEP THESE PAGES

Miss Annie Croft, appearing March 31st.

R. C. Sherriff, Author of "Journey's End," appearing March 31st.

Bobby Howes, appearing April 2nd.

Miss Mamie Watson, appearing April 11th.

the Month

Television Programmes during the Month of April

FOR COMPARISON

Miss Cicely Courtneidge, appearing April 3rd.

George Metaxa, appearing April 17th.

Lupino Lane, appearing April 1st.

Miss Désirée Ellinger, appearing April 1st.

More Personalities

Appearing in Television Programmes during the month of April

Jack Hulbert, appearing April 3rd.

Miss Gracie Fields, appearing March 31st.

Miss Peggy Wood, appearing April 17th.

De Groot, appearing April 15th.

Sydney A. Moseley.

(*Concluded from page 77.*)

As reported in the *Daily Mail* on March 13th, speech was transmitted on 2LO's old wavelength of 356 metres, while the new National transmitter, on 261 metres, broadcast the television part of the arrangements.

During these programmes those with ordinary receiving sets will be able to hear all that happens, while those who have the apparatus for receiving television will also see the faces and movements of those before the microphone.

If everything goes well, our senses will be doubled for broadcasting purposes.

The programme started at 11 a.m. from the television studio in London and was as follows :—

1. Introduction by Mr. Sydney Moseley .. 11.00 a.m.
2. Sir Ambrose Fleming, inventor of the thermionic valve .. .. .. 11.02 a.m.
3. Announcement .. .. .. 11.07 a.m.
4. Miss Annie Croft .. .. .. 11.08 a.m.
5. Miss Gracie Fields .. .. .. 11.16 a.m.
6. Mr. R. C. Sherriff (author of "Journey's End") .. .. 11.24 a.m.
7. Closing announcement.

Lord Ampthill and Sir Edward Manville also hoped to make their appearances before the screen-microphone.

And now a word about the artists who were "billed" to appear in the first transmission on March 31st.

You do not need to be told anything about the man who opened the proceedings.

Professor Sir Ambrose Fleming is the "Grand Old Man" of wireless, without whom such a ceremony would have been incomplete. Sir Ambrose has been unswerving in his belief in Mr. Baird's invention, a belief which the ceremony in which he took part more than justifies him.

Miss Annie Croft is, of course, the well-known musical comedy star, who usually appears with her husband, Mr. Rex Sharland.

Then Miss Gracie Fields is another idol on the lighter side, while Mr. Sherriff, of course, is the well-known author of "Journey's End." He tells me that he was anxious to know whether those who know his play were disappointed after seeing him ; whether the image that had been conjured up of him was in any wise different from the actuality !

Television, then, is in full blast. I expect from now on an army of amateurs co-operating with Mr. Baird, as they did in the early days of wireless broadcasting. Some of my prophecies in the past have been near the mark. I venture to make one more prophecy, viz., that before the end of the year television will have made such progress as to equal the remarkable strides made in aural broadcasting as soon as the public were allowed to take part.

I went to the Selfridge show and saw television demonstrated to many hundreds of excited lookers-in. There could be no doubt about the interest that was roused.

Mr. Wragge of Selfridges, who was responsible for the demonstration at that end, tells me there could be no doubt that television has caught the popular imagination. He emphasises, however, that from a commercial standpoint it is vitally necessary for the time of transmissions to be extended. He thinks that before commercial television can have a fair chance it must be put in the programmes hours.

Coming from such an authority, this point is of the utmost importance, and no doubt it will be the subject of discussion later on with the B.B.C.

Meanwhile, Mr. Wragge testifies to the success of the first commercial televisor ever placed on the open market.

Peto-Scott and Television

The name Peto-Scott has become a household one wherever wireless matters are discussed. The seeds of the business sown at the beginning of broadcasting in this country have grown with it. As new methods of construction have come to the fore, the Peto-Scott Company has always been identified with the progressives.

In 1919 the work of a keen wireless experimenter and model maker laid the foundations upon which the business was to be built. From then on he devoted his undivided attention to the development of what now seems to us to have been strangely crude apparatus, but this apparatus, consisting of a few tuning coils, condensers and valve detector units, gave place as time went on to the most intricate efficient receiver parts known to modern broadcasting. For ten years the Peto-Scott Company has specialised in the supplying of kits of parts for all well-known radio sets, particulars of which are given in the leading technical papers.

It was a natural sequence, therefore, that when television should leave the laboratory as a practical proposition the Peto-Scott Company should be identified with the new science. Many of our readers will recall the Peto-Scott advertisement appearing in the very first issue of the TELEVISION magazine, published just over two years ago. It took the form of a statement that they would look after and foster the construction of television receivers. Advertising only those components which they had tested thoroughly and could recommend, they made a genuine effort to bring their reputation in radio matters to the television field. The complete resources of their extensive workshops were placed at the disposal of those wishing special components to be constructed to given specifications.

Elsewhere in this issue the current advertisement of the Peto-Scott Company will be found, and it is significant that they are already in a position to supply complete kits of Baird branded components which, when assembled, are suitable for picking up the present television broadcasts from the B.B.C.

The Company maintains an up-to-date test room which is at the service of customers. Ten years of experience gained in satisfying the home constructor is a valuable asset of any firm entering the important field which television is now opening up.

The Proceedings *of* The Television Society

Presidential Address Delivered at the Second Annual General Meeting, at University College, Gower Street, W.C.1, on March 18th, 1930.

By *Sir Ambrose Fleming*, M.A., D.Sc., F.R.S.

WHEN the request reached me to give an address to this Society at its second annual general meeting, my first thought was that this would require some technical discussion of matters connected with the main interests of this Society, viz., television. But a little further consideration made it clear that the occasion might perhaps be better employed in dealing with a larger question, namely, the relation of Governments, and especially our own British Government, to invention generally.

We had it forcibly impressed upon us as a nation, at the outset of the Great War in 1914, that our easy-going British habit of indifference to serious pursuits, and especially to scientific investigation and research, constituted a national danger of a very serious kind.

We had been very much accustoned to regard scientific research into the phenomena of nature as a more or less harmless hobby, interesting to a few old fogies, but not of importance to the bulk of the nation whose attention was mostly centred round more important matters such as sport, horse-racing, amusement or threatricals, when not engaged in the main purpose of life, which was considered to be the making of money.

Hence although the British mind is, I believe, endowed with an unusual share of originality, and highly gifted British investigators and men of science had opened up continually new fields of investigation of a very important character, the cultivation of these fields had been left too much to other nations, particularly Germany, the United States, France and Italy, and they accordingly reaped where we had sown.

The subject of scientific investigation has, moreover, two sides to it, and appeals to two distinct classes of mind.

There is first, the purely scientific investigator who has no other object except to probe the inner nature of phenomena and the laws or uniformities connecting them. This pursuit appeals to those of a philosophic cast of mind who are most concerned to know the *why* and *wherefore* of observed things. The pure scientist is very perfectly represented by our beloved Faraday, prince of experimentalists. For 40 or 50 years he went every day to his laboratory with a fresh question to put to Nature and never rested, until he obtained an answer ; but he never seemed to care to pursue the subject into its utilitarian consequences, and he left it to others to develop the applications of his famous discoveries.

Faraday Centenary

In the autumn of next year (1931) we shall celebrate with suitable impressiveness the centenary of his epoch-making discovery of elecrto-magnetic induction and of induced currents, which gave us the dynamo, the transformer and the induction coil at the hands of his followers.

Then on the other hand there are those who are more attracted by applications of scientific knowledge, or often what amount to new discoveries, the importance of which rests on their technical uses. These originate in minds of the engineering and constructive type, who desire not so much to know the reasons of things as to make use of them for increasing the convenience or comfort of life or diminishing labour.

In the charter of the Institution of Civil Engineers an engineer is defined as one who applies the great forces or energies of Nature for the use and benefit of mankind. Now in this technical side of the subject to which we shall direct our attention to-night there are in nearly all cases two well-marked stages of progress. There is first a novel idea or some new device, apparatus or effect which is often stumbled upon unexpectedly or evolved empirically by the unconscious cerebration of genius.

If this occurs to a mind of the constructive variety the first stage will be to apply it to some technical or useful purpose, and carry it out practically in a rudimentary manner.

These two sides to a subject are extremely well illustrated in the initiation and growth of wireless telegraphy. Maxwell's profound investigations in 1864 into the propagation of electric force through space had led him to the idea of an electro-magnetic wave, and he inferred that the undulations called light were a special variety of these electric waves.

It was not until eight years after Maxwell's death that Hertz in Germany succeeded practically in producing Maxwell's waves and set all the scientific world busy in investigating their properties. Again, it was not until just after Hertz's death in 1894 that the idea arose in several minds of utilising these waves for telegraphy.

To Marconi belongs the credit of first evolving a simple yet effective combination of apparatus for this purpose. His important technical invention was that of the aerial wire and earth plate which at once translated the operations out of the regime of experiments with Hertzian waves into that of practical telegraphy over distances reckoned in miles.

But now, as just remarked, there are two stages in the evolution of a new technical application of scientific knowledge.

There is the first stage, already described, in which the inventor discloses the new appliance or method and achieves his first early practical and perhaps rudimentary success. Then comes a second and generally much more prolonged and costly stage in which the new technical advance has to be brought to such perfection as to make it a real use to the world.

This generally requires a very considerable expenditure of money.

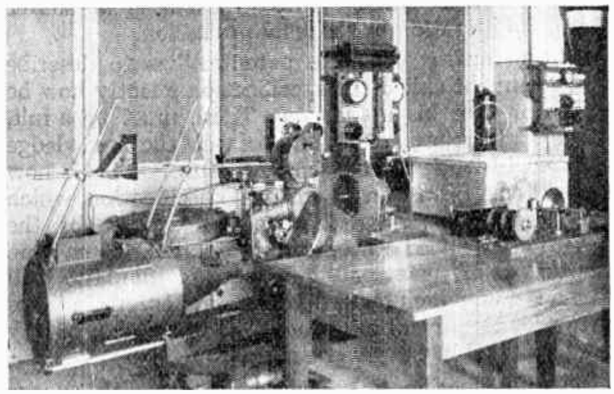
Two Characteristic Stages

These two stages of a technical invention have been characteristic of all the leading electrical achievements of the nineteenth and twentieth centuries—viz., of electric telegraphy, electric telephony, electric lighting, public electric supply, and electric traction, also of wireless telegraphy, and wireless broadcasting, and no doubt will be of television also. In each of these there has been a more or less prolonged period of preparatory expenditure without return before the profitable commercial stage was reached.

In order to safeguard the interests of those who thus finance a new technical art to bring it to practical perfection, it is necessary to have some period of protection or monopoly to prevent the fruits of this expenditure being appropriated by other persons who have not shared in the preliminary outlay, and this in all civilized countries takes the form of patent protection.

The manner in which this grew up is very briefly as follows:

In the former days of absolute monarchy the Sovereigns of England claimed far greater power than they have now to control the commerce and occupations of their subjects. They claimed, amongst other things, the power to bestow on favourites or those who purchased their favour by advances in cash, the sole right to import certain articles or sell them in their kingdom. For instance, the right to import



Teletalkie transmitter as used by the American Baird Television Corporation.

or sell salt, coal, iron, silk, gold thread, etc., were formerly granted by the Crown to certain persons in return for money payments or services, to the great grievance of the general public. Queen Elizabeth and James I. were great offenders in this respect, and matters came to a crisis in the twenty-first year of James I.'s reign, when Parliament abolished all these rights of the Crown to grant monopolies, but reserved one thing to it—viz., the right to grant the privelege of working or making any *new manner of manufacture* to the first and true inventor of this manufactured article. The document making this grant was called a patent, and was formerly issued and stamped with the great Seal of England.

In order that this grant of a patent may be valid it must comply with certain conditions.

In the first place, the manufacture must possess *novelty*. The Act declares that it must be for a *new* manufacture. Hence a patent cannot be valid for something already known or done.

In the second place it must have *utility*. A patent cannot be granted for a mere scientific idea or principle. It must be for something which has concrete use. It may be a small use, and that term covers articles or manufactures intended to please or make some improvement in what has been done indifferently before.

In the third place it must be for some manner of *manufacture*. Now that term in the course of time has been greatly extended. It is now held to cover not only making a new thing but making a new useful application of an old thing or a new combination of old things.

This question came up in the case of James Watt's invention of the separate condenser for a steam engine.

Before his time the steam was condensed in the cylinder of the engine by a jet of water, and the result was a prime mover so extremely wasteful of heat that it was of very little use. Watt's separate condensation effected a great improvement and it was allowed to be patented as a new manner of manufacture. There are countless cases of articles actually not new in themselves but for which a new use has been found which is held to be a new manner of manufacture and to be a patentable invention. These so-called "user" patents are a great source of fruitful litigation to the legal profession.

In the fourth place the patentee has to describe in a document called the specification exactly how he makes or uses his invention. There must be a full, frank and honest disclosure of all the knowledge required to work the new manufacture. This is now given in the form of a provisional specification, which must disclose in general terms the nature of the invention but need not enter into details. Then, nine months after, the patentee has to file the full specification, which must describe or "ascertain" the nature of the invention so as to be intelligible to any person skilled in the art concerned.

The full specification must conclude with one or more claims setting out especially what thing, process, manufacture, or combination is claimed as the invention. If the full specification contains anything essential which is not foreshadowed in the provisional, the patent is invalid. This was the case with the Edison phonograph. If the claims contain anything not adequately described in the complete specification the patent is invalid. Much patent litigation has turned upon the question whether the patentee has properly "ascertained" or described his invention, and any keeping back of essential points is fatal to a patent.

I remember hearing of a case in which a workman in a factory made a very important improvement in a certain process, and his employer determined to have it patented. So he sent the workman to his patent agent to draft the specification. When in due course this specification was printed and made public the employer was struck with the fact that it did not describe the same process the workman had disclosed to him privately. So he sent for the workman and said: "How is this? This specification describes something quite different from what you told me as to your improvement" The workman replied, "Well, you see, I was not going to be such a fool as to tell that patent chap exactly how I did it, because then he would have been able to do it himself, so I stuffed him up with another story." This frank and honest admission, of course, made waste paper of the patent, and the employer's disgust at the loss of his expenditure on fees may be better imagined than described.

Before the war the Germans were great adepts in the art of taking out chemical patents in Great Britain in which, though apparently all essential information was disclosed, some little item necessary for practical working on a large scale was carefully concealed.

Lastly we have to mention a necessary obligation on the part of a patentee, and that is to pay all the Government fees at the proper dates, without which the patent lapses. A British patent now runs for 16 years and the Government fees amount to about £140, exclusive of any fees paid to the patent agent for drafting and filing the specification.

The provisional specification is not made public until after the complete specification is sealed, so that if further consideration during the nine months' grace shows the invention to be of little use the complete specification need not be filed. The Government fee for the provisional specification is only £1, and hundreds of these are applied for but not completed. Under some conditions, where the inventor has not received sufficient reward, the British patent may be extended beyond 16 years.

Having now reviewed all that the patentee has to do on his side, let us see what it is that he gets from the Government in return for his fees and trouble. The answer is "precious little." All he gains is the right to bring a legal action against infringers at his own expense. The Government guarantee him no absolute rights, nor do they give him any warrant as to the correctness of the subject matter of his patent. There is, however, a certain search by the Patent Office Examiners, who notify the patentee of any possible anticipation of his invention.

If he finds his invention being carried out by others in an unauthorised way he can bring an action for infringement if he has the money and cares to risk it in litigation. Even if he is successful in his action his opponent may file his petition in bankruptcy and leave

German Amateur's Original Idea. In the receiver pictured above the scanning disc is strengthened between two gramophone records. A gramophone motor is used to drive the disc, and he receives television images quite successfully. The wireless receiver and amplifier are seen in the background.

the patentee to pay his own expenses. Moreover, the Government itself may infringe the monopoly they themselves have granted, and as they have the almost unlimited purse of the taxpayer to fall back on it is very difficult to succeed against the Crown in an action for the infringement of a patent brought by a private citizen. Hence the whole affair is a very one-sided matter. If on the other hand an inventor does not apply for patents but decides to keep his invention secret, someone else may rediscover and patent it, and the first inventor may then be in the position of having to pay royalties for making his own invention.

In past times patents were granted for any impossible machine, such as perpetual motion, and it is difficult to defend the mortality of a government which takes fees from citizens for granting a

The Baird "Televisor" Receiver on view at Selfridges recently. Demonstrations of the instrument were also given.

monopoly for the sole manufacture of that which cannot be manufactured.

The same applies to many specifications where there is some radical scientific defect not apparent until the invention begins to be worked, e.g., Garland and Gibb's Transformer patent.

Leaving the subject of patent protection, let us consider briefly the question of the relation of Government to scientific and industrial research.

Before the Great War of 1914, the greater part of the scientific research in Great Britain was conducted directly by professors, amateurs, assistants and students in the universities and technical institutions. Much was done in private institutions, such as the Royal Institution, London, which has been the birthplace of some of the greatest discoveries made by the mind of man. Very important work had also been carried out by private individuals such as Joule, de la Rue, Spottiswoode, Huggins and Crookes, not attached to any institution or college.

Some technical researches (but mostly kept private) were carried out by manufacturers for their own benefit.

The outbreak of the Great War showed us the lamentable and dangerous degree to which we had become dependent on other nations and countries, not only for our food supplies, meat and wheat, but for such articles as fine chemicals, rare metals, dyes, optical glass, arc-light carbons, explosives, and alloy steels. All these articles were the result of laborious scientific research conducted, not haphazard by individuals, but by highly organised team work assisted by ample funds.

The Royal Society of London for many years had a small grant of a few thousand pounds which had to be dispensed in a parsimonious manner in small grants. On July 28th, 1915, the Privy Council appointed a committee called the Committee for Scientific and Industrial Research, and they in turn appointed an Advisory Council and various Standing Committees on special subjects. Long previously to that date various isolated attempts had been made to organise scientific research on a national basis. Eminent men from time to time had given the nation serious warnings of the danger of neglecting it. When, however, the great period of electrical invention began, about the middle of last century, the chief idea of the Government seemed to be to meddle with it and throttle it by premature or unnecessary legislation.

When electric lighting first began and public electric supply from central generating stations was originated and attempts made to put it in practice under the Electric Lighting Act of 1882, it was clear to me that it would be necessary to have some national institution to test and certify electric measuring instruments.

Accordingly I presented and read a paper to "The Society of Telegraph Engineers and Electricians" in November, 1885, entitled: "On the necessity for a national standardising laboratory for electrical instruments," in which I advocated certain proposals. That paper was, I am afraid, very soon forgotten, but a large number of eminent electrical engineers took part in the discussion and entirely approved the idea. This paper was read and published long before there was any National Physical Laboratory in England or Reichsanstalt in Germany. A committee was formed of members of the Society to further this scheme, and, as a result, in 1889 the Board of Trade established a small electric laboratory in Richmond Terrace, Whitehall, for this purpose, with Major P. Cardew as its first director. In the paper mentioned I pointed out that one function of such a national laboratory would be to conduct researches in pure science which need too prolonged or too much continuous work to be carried out by any private effort.

The subject continued to attract attention, and soon after my paper was read an institution was created in Germany, called the Reichsanstalt, for such national scientific research; and other similar establishments were set up in France, called the Central Laboratory of Electricity, and the Bureau of Standards in Washington, U.S.A.

The subject was brought before the British Association in 1896 by Sir Douglas Galton, then President. A year or two later the Chancellor of the Exchequer appointed a Treasury Committee under the chairmanship of the late Lord Rayleigh to advise as the matter, and the result was the formation of the National Physical Laboratory at Teddington, which was opened by His Majesty King George V, then Prince of Wales. In his address to the Prince and audience, Lord Rayleigh referred to my pioneer paper to the Society of Telegraph Engineers.

The control of all these scattered institutions or endowments of scientific research has now passed into the hands of the Government Department of Scientific and Industrial Research, who make each year a report on their achievements and results. This department is administered by an Advisory Council, of which Sir W. H. McCormick, F.R.S., is Administrative Chairman and Dr. F. E. Smith, C.B., the present Secretary; and there are some ten eminent scientific men associated with them on the Council. They are also assisted by a number of assessors representing various Government departments and private interests.

The work of the Department is for the most part conducted by numerous special committees and research boards appointed for the purpose of dealing with special subjects and classes of research.

The Department has funds, placed under its control by Parliament, which are dispensed in the upkeep and management of establishments such as the National Physical Laboratory, the Chemical Research Laboratory, the British Museum Laboratory, the Geological Survey and Museum and other institutions, as well as in grants to research workers and students. It has under its control a fund of a million sterling, and its total annual expenditure last year was rather over half a million sterling. Grants can be obtained for individual workers for special researches when recommended by responsible persons.

In addition, the Department assists some 24 Boards of Research established and maintained by the private enterprise of associated firms in special trades to solve scientific problems involved in successful commercial work. Such research associations exist in connection with the electrical, textile, leather, linen, rubber, oil, cutlery, silk, and metalurgical trades.

The work of this important Government department in the last fifteen years has been to weld into one coherent whole and strengthen the work of numerous isolated scientific organisations, we have not yet reached quite that degree of consolidated action which marks the research work of many powerful corporations in the United States, but we have done a good deal to organise a disconnected multitude of independent workers into a scientific army, with its general staff, intelligence department, and regimental organisations. Nevertheless, when all is said and done, it remains an indisputable fact that no number of second or third rate minds, however organic may be their relation, are equal to one man of genius.

There is, it is true, much systematic research which can be conducted by team work provided the necessary money and guidance is forthcoming. It is here that the great and wealthy corporations of America do so well.

Take for instance the discovery of that remarkable alloy, permalloy, which has been the means of increasing the speed of signalling through submarine cables to ten times its former maximum value. It had been pointed out by an English mathematician, Mr. Oliver Heaviside, that a great improvement could be affected in telephonic and telegraphic transmission by increasing the inductance of the line, and it was known that this could be done to a moderate extent by winding over or whipping the cable with iron wire, just as the handle of a bat is whipped with string.

Iron has, however, a very low magnetic permeability for small magnetising forces such as exist round cables carrying telephone or telegraph electric currents. Hence began a search for a better material than iron.

It was known that the alloys of nickel and iron had very peculiar magnetic properties, and the result was to instigate a careful examination of nickel iron alloys, and after prolonged experiment in the research laboratories of the American Telephone and Telegraph Company, associated with the Western Electric Company of the United States, it was found by Elmer and Arnold that an alloy of about 21 per cent. of iron and 79 per cent. of nickel had, when subjected to a particular heat treatment, an enormously greater magnetic permeability than iron for small magnetising forces. It has also extremely small hysteresis losses, Hence it is almost an ideal material for "loading" submarine telegraph and telephone cables, and thus increasing their inductance. This has resulted in such important improvements in their performance that all unloaded cables are now antiquated and out of date.

Here, then, we have another case in which the scientific suggestion made by a British scientist ignored in his own country only received its practical development in the United States.

Great interest was shown by the public in the recent Television demonstrations at Selfridges, as is evidenced by this photograph of people lining up.

Now this leads us to consider the important question why this should be.

Telegraphy also had its beginning in Great Britain. Cooke and Wheatstone laid down in 1837, between Euston station and Camden Town, one of the first electric telegraph lines, and their 5-needle telegraph preceded the invention of the printing telegraph by Morse.

In the course of the next 30 years, electric telegraphy with wires was conducted in England by several separate electric Telegraph Companies, and these would no doubt before long have amalgamated into one single corporation, as happened in America. But about 1867 the idea arose in Great Britain that there would be some disadvantage to the public if another so-called monopoly arose. The public distribution of gas had been to a great extent carried on by gas companies, and there was a strong feeling that these necessary public supplies or services should not be a source of profit to individual shareholders but should be managed by the State for the benefit of all. It had become clear that some control, of essential public services in which there could not from the nature of things be competition, was necessary.

If your butcher supplies you with bad meat or your baker with bread not to your taste you can try different butchers or bakers until you are suited. But if a Gas Company supplies you with a gas poor in lighting or heating power you cannot change your gas Company because there is only one supply Company in your district.

Parliament was, therefore, compelled to institute some control of the quality of the gas as regards light and heat and also as regards price by connecting together dividends and gas price so that in proportion as Gas Companies' dividends exceed a certain limit the price of the gas has to be lowered. This then initiated the State Control of essential public services which could only be non-competitive from the nature of the service.

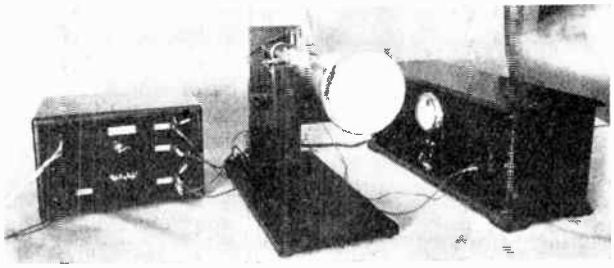
Hence, when electric telegraphy gave indications of becoming a public service, in order to prevent the upgrowth of another so-called monopoly, Parliament created a still greater State monopoly by passing the Telegraph Acts of 1868 and 1869, by which they purchased for ten millions sterling the plant and business of the Telegraph Companies, and put the whole business under the control of the General Post Office.

The Acts of Parliament were so skillfully drafted that when, seven years later, the speaking telephone was invented, and ten years later telephone exchanges began to be established, the Government was able to claim that the telephone was a telegraph within the meaning of the Acts. Nay, more, when wireless telegraphy and telephony were invented the control of them also was brought under the same Acts of Parliament.

Whilst it is obvious that in essential public services in which there cannot be competition by different suppliers there must be some State Control exercised as to quality and price to protect the customer or consumer, nevertheless when the Government itself becomes the supplier the necessity arises for some control over the controller.

In our representative form of popular Government the actual administration, or the putting into practice of agreed or accepted principles is largely in the hands of permanent officials, and there are many who think that we have already gone too far in this direction and that there is a risk of official autocracy overriding the true and best interests of the public, of which it ought really to be only the servant and not the master.

This now raises a large and difficult question whether it is to the ultimate advantage of the nation that highly technical industries involving continual invention should be managed by Government departments. Without entering into questions which are properly political, it may be said that there is a large and perhaps increasing body of opinion that certain universal requirements should not be conducted for private profit. Hence the demand that not only post-office service but telegraphs, telephones, broadcasting and perhaps railways, coal



The new cathode-ray television receiver developed by the German experimenter, Manfred von Ardenne, and described on another page of this issue.

mines and several other things should be "nationalized," to use a current term.

This may not be unreasonable for operations which remain fairly constant; but for electrical inventions there is no finality, and fresh advances are continually being made and demanded. A Government management is a much more rigid and inflexible thing than private control. Its operations are limited by rules, regulations and red tape. Personal promotion is slow, and goes by seniority rather than ability. A young man who showed great initiative would be apt rather to be snubbed by his seniors than promoted over their heads. Want of ability, or even bad mistakes, would not always be a reason for terminating an appointment, and no Government department cares to take risks in its operations, but prefers a slow but sure method of going to work. It is, therefore, generally much behind the times in its operations.

This is all very well in certain simple and settled undertakings like letter collection and delivery or pensions or savings bank business, but in a highly technical and continually changing art like electro-communication generally, where constant invention, improvements, new ideas and long views ahead are necessary, it is a serious question whether Government control is that which conduces to the greatest efficiency and benefit.

The argument in favour of it is that this so-called "nationalization" prevents the growth of powerful monopolies in the matter of essential public services. But it only does so by creating a far greater monopoly under bureaucratic control, which can never afterwards be broken down. This can never have the alert, progressive and far-seeing policy which must be a condition of the success of such public service run by private effort. Nevertheless, some Government control is always necessary, as in the case of railways and gas or electric supply undertakings, to protect the public interests. In every one of the electrical industries there are many unsolved experimental problems, and the inventive genius is necessary for their solution.

Let me indicate, in conclusion, one or two of these as far as television is concerned. The neon tube as a receiver has the disadvantage that it affords a surface of relatively small area on which the varying glow takes place by which the scanning disc at the receiving end builds up the image.

The Kerr Cell.

There is, however, another way in which a varying electric potential can cause a corresponding variation in the illumination of a field of light, and that is by a Kerr cell. It was found by Dr. Kerr, half a century ago, that in certain liquids an electric stress causes a double refraction. One of the most effective materials is nitro-benzol. The arrangements are shown in the slide exhibited. The fluctuating potential produced by the transmission system, whether by wireless or by wires, causes an electric strain in a cell placed between two crossed Nicol prisms; and this can be used to fluctuate proportionately the brightness of a field of light which can be scanned by a Nipkow special disc.

I think some arrangement of this kind might give quite a large field of light sufficient to contain a reproduction of a full-length human figure. It would have the advantage of being a field of white light or of any other colour.

Another thing I am anxious to have tried on a fairly large scale is the method I suggested in my lecture on television at the Imperial College of Science in January last. It is to form an image of a large scene by means of a large concave mirror, or lens, and then to treat this image as an object to be scanned. It seems to me the only way in which scenes or objects of large areas, such as a cricket or football match or a procession can be "televised." I have certain ideas as to how this could be done, which will be explained later on.

It is perfectly clear that television will not fulfil that which the public expect of it until we can do more than televise a single human face or something of the same size. I am strongly of opinion that we have not yet reached the final or best form of television detector in the neon tube. It has certain advantages in its colour for human face television but for many other things it would be better to have a field of white light.

What is required is some form of light-valve which is capable of being actuated by an electrric current of a few microamperes which would control the illumination of a perfectly white surface by white light so that the brightness of that surface would respond instantly and without lag to change in the current and be proportional to it. There are great possibilities for invention under this head. It does not follow that only the possession of very elaborate or costly apparatus is necessary for the making of great advances.

When we look back at the history of invention in connection with wireless telegraphy and telephony, we see how very much of it is due to the work of the amateur, and comparatively little to the highly favoured Government official.

Marconi himself was an amateur, and carried out his early experiments with the most rudimentary apparatus—but he had ideas.

When the Government brought wireless telegraphy under its control by the Wireless Telegraph Act in 1904, it left the amateur with little or no right to meddle with the creation of electric waves except in one little corner of the ether esteemed to be of not much practical use. But the amateur with ideas did a good deal to discover the extreme importance and value of short waves for transmission over long distances. It was an amateur who discovered the first crystal detector, and others who added to their number. It was an amateur who invented the speaking telephone, viz., Alexander Graham Bell, at one time a student in this College; and it was an amateur, John Logie Baird, who first gave us practical television.

This Society is chiefly composed of amateurs who investigate and invent for the love and excitement of achievement. Military historians speak of certain battles as "soldiers' battles," because they were won not mainly by the strategy of the general staff, or commanders-in-chief, but by the dogged persistence and pluck of the unknown soldier.

So there are inventive victories and conquests waiting to be made, and which may be made, not by the highly placed Government official, but by the unknown yet capable amateur.

Second Annual Report of the Council

for the Year ending 31st December, 1929.

(Approved by Council, 26.2.30.)

In presenting their second annual report the Council are able to state that substantial progress has been made by the Society during the year under review.

ORGANISATION.—An important step has been taken to strengthen the organisation and management of the Society's affairs, and early in the year the Society's Solicitors were instructed to take the necessary steps for the Society's Incorporation. The legal formalities have been carefully considered, stage by stage, by the Council, who have acted throughout with the one desire to see the Society firmly established as an independent scientific body.

MEMBERSHIP.—Progress in membership is indicated by the following figures:—January 1st, 1929: Fellows 115, Associates 192, Students 18—Total 325; December 31st, 1929: Fellows 215, Associates 295, Students 67—Total 577. The Council deeply regret to have to record the death of one of their members, Dr Wm. Martin, after a long and painful illness, and also the loss the Society has sustained by death of the following members:—C. H. N. Alderson (A.1929), E. J. Baker (A.1928), Lieut.-Col. E. J. de Salis (F.1928).

A printed "List of Members" was issued to all members in December. It is intended to revise and issue a new list annually.

GROUP CENTRES.—The organising of local group centres outside the London area has involved the hon. officers in much preliminary work. One of the secretaries (Mr. J. J. Denton) and the hon. treasurer (Mr. Wm. C. Keay) have devoted themselves untiringly to the task, by personal visits and in the giving of lectures and demonstrations, with the object of supporting interest locally. In several cases the Headquarter's organisation has been substantially assisted by the local members, and as a result the following groups are now established and regular meetings are being held:—

Hastings: Secretary, H. G. Nye, Esq., 9, Stockleigh Road, St. Leonards-on-Sea.

Southend: Secretary, R. I. Cowley, Esq., 99, Eastwood Boulevard, Westcliffe-on-Sea.

Leeds: Secretary, H. Wolfson, Esq., "The Dingle," Grove Lane, Headingley, Leeds.

Birmingham: Secretary, F. L. Farmer, Esq., 472, Bordesley Green, Birmingham.

The formation of local group centres is also contemplated in the following districts:—Liverpool, Manchester, Rochdale, Sheffield, Derby, Wigan, Newcastle. The Council wishes to place on record its appreciation of the valuable services rendered by the members who have consented to act as local secretaries, and on their efforts, much of the future success of these developments must depend.

LECTURES AND MEETINGS.—The following is a list of the lectures and meetings which have been held during the year:—

January 1st: Lecture and demonstration. J. J. Denton, A.M.I.E.E. (secretary). Subject: "Television Research."

February 5th: Lecture (with experiments). Ronald R. Poole, B.Sc. Subject: "Methods of Light Modulation in Television Receivers."

March 5th: Annual General Meeting and First Annual Exhibition of Members' Apparatus.

April 9th: Lecture. J. C. Rennie, B.Sc., M.I.E.E. Subject: "Some Notes on Exploring." Informal discussion on "Selenium Cells," opened by H. S. Ryland, F.O.S.

May 7th: Lecture and demonstration. Capt. R. Wilson and Mr. A. A. Waters. Subject: "Some Practical Considerations in the Building of Television Apparatus." Informal discussion, entitled: "A Quantitative Analysis of Television," opened by J. H. Owen Harries, A.M.I.R.E.

October 1st: Lecture. H. S. Ryland, F.O.S. Subject: "Talking Films."

November 5th: Lecture and demonstration. F. Langford Smith, B.Sc., B.Eng. Subject: "Amplification and Television."

December 3rd: Lecture. E. G. Lewin, B.Sc., A.Inst.P. Subject: "Television, some Suggested Schemes."

Commencing with the October meeting, it has been the practice to discuss the subject of each lecture at the next meeting following. Such informal discussions are found to be invaluable by the members and attendances at lectures and discussions have been good.

All the above meetings were held at The Engineers' Club, London, W.1.

Papers presented at the ordinary meetings with reports of the discussions arising therefrom, have appeared in the official organ of the Society, TELEVISION, and reprints have been issued separately for circulation to the Fellows. The Council's thanks are expressed and hereby conveyed to the Editor and Publishers of TELEVISION for their courtesy.

The thanks of the Society are also due to the following firms who have kindly loaned instruments and apparatus for the use of the Society at its lectures and demonstrations:—

Baird Television Development Co., Ltd.
The General Electric Co., Ltd.
The Edison Swan Electric Co., Ltd. (Radio Division).
Philips Lamps, Ltd.

SUMMER MEETINGS.—Summer Meetings were arranged, and took the form of visits to the research laboratories of the General Electric Co., Ltd., Wembley, and to Messrs. British Talking Pictures, Ltd., Wembley. Parties of 30 members took part in two separate visits on June 26th and July 31st. The visits were greatly appreciated by those who took part in them.

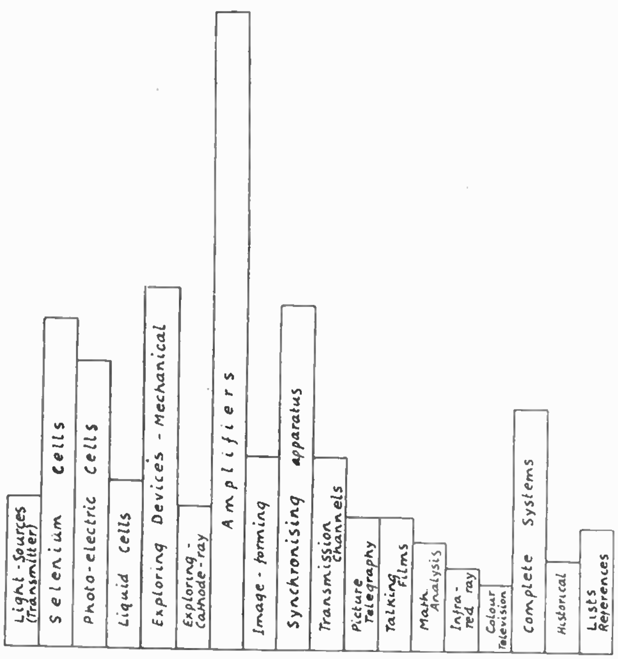
GENERAL.—The Council have appointed Messrs. J. C. Rennie, J. J. Denton, and W. G. W. Mitchell to serve on a committee of the British Engineering Standards Association dealing with radio and television nomenclature.

Considerable progress has been made with the work of compiling the "Index of Literature," although this has proved a much heavier task than was contemplated. Correspondence hereon should be addressed to the lecture secretary (Mr. Mitchell).

An analysis of the 76 questionnaire forms recently returned by members shows that 24 members receive British television transmissions regularly, some with considerable success. Most members report that they have had to overcome initial difficulties in their synchronising gear; nearly all urge the necessity for better and more frequent facilities in the experimental transmissions as at present arranged.

A chart showing the comparative interest in the different branches of the subjects studied is appended.

The Council have learned with much satisfaction of the formation during the year of the French, German and Belgian Television Societies, and also of the International Television Institute (Brussels).



Comparative Interest Chart constructed from the Replies to the recent Questionnaire circulated to members. Data based on the reports made by 76 members. Vertical scale in ordinary units.

Liaison has already been established with each of these Societies, and mutual co-operation is expected to result.

Signed on behalf of the Council.

CLARENCE TIERNEY, *Chairman of the Executive.*

THE TELEVISION SOCIETY.

Annual General Meeting, March 18th, At University College, London.

AGENDA.

Business Meeting: Dr. Clarence Tierney, F.R.M.S. (Chairman)

Apologies for absence received from Capt. Wilson, Capt. Tuke, Col. L'Estrange Malone, Herr Lehmann (German Television Society), Prof. Gheudo (International Television Institute).

Minutes last General Meeting were read and signed.

Annual Report of the Council was presented by the Chairman.

Balance Sheet was presented by the Hon. Treasurer.

Adoption of Report and Balance Sheet: Proposer, Mr. G. P. Barnard; seconder, Mr. A. M. Nance.

Election of Officers and Council (proposed by the Chairman):—

As President: Professor Sir Ambrose Fleming, M.A., D.Sc., F.R.S.; as Past President: The late Lord Haldane of Cloan, F.R.S., K.T., O.M., P.C.; as Vice-Presidents: Sir Philip Gibbs, Lord Angus Kennedy, Col. C. L. Malone, F.R.Ae.S., M.P., Professor Magnus Maclean, M.A., D.Sc., LL.D., Alderman W. T. Patrick, J.P., and Sir John Samuel, LL.D.; as Hon. Fellow: John Logie Baird.

As Council: T. W. Bartlett, Esq., Professor Cheshire, C.B.E., A.R.C.S., F.I.P., J. J. Denton, Esq., A.M.I.E.E., Alfred Dinsdale, Esq., A.M.I.R.E., Wm. C. Keay, Esq., Lord Angus Kennedy, Admiral Mark Kerr, C.B., M.V.O., T. M. C. Lance, Esq., W. G. W. Mitchell, Esq., B.Sc., Professor Magnus Maclean, M.A., D.Sc., LL.D., Ronald R. Poole, Esq., B.Sc., J. C. Rennie, Esq., B.Sc., M.I.E.E., E. Phillips, Esq., Sir John Samuel, K.B.E., D.L., Dr. Clarence Tierney, D.Sc., F.R.M.S., Capt. B. S. Tuke, Lieut.-Col. J. Robert Yelf, P.A.S.I., and Capt. Randolph Wilson.

As Hon. Treasurer: Wm. C. Keay, Esq.

As Hon. Secretaries: J. J. Denton, Esq., A.M.I.E.E., and W. G. W. Mitchell, Esq., B.Sc.

Vote of thanks to the Officers and Council for their services during the year: Proposed by Col. G. F. H. McDonald, O.B.E.; seconded by Mr. D. C. Philpot.

Presidential Address at 6.30 p.m. in the Botanical Theatre: "The Relation of Governments to Invention."

Vote of Thanks: Proposer, Admiral Mark Kerr, C.B., M.V.O.; seconder, LI. B. Atkinson, Esq.

We Test a Baird "Televisor" Receiver

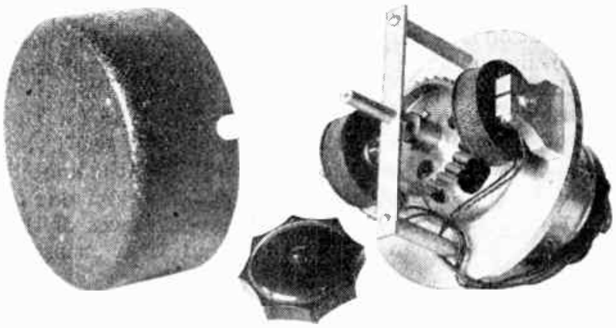
WE could not help expressing extreme satisfaction at having received one of the first Commercial Baird Televisors, and although there has not been sufficient time to give a complete report in this issue of all our tests, we felt that readers would welcome our impressions of the instrument itself, as well as hearing about the initial results.

A well-illustrated and interesting brochure accompanied the apparatus, and we first of all perused this carefully to see what information and working instructions were given. Dr. Tierney deals with the origin and progress of television in the first seven pages and after that the essential parts of the "Televisor" are briefly described.

We take exception to one paragraph in this second section which reads: "Isochronism or 'phasing' is obtained by rotating the synchronising gear around the centre of the motor shaft." Surely isochronism is one of the conditions which have to be satisfied before synchronism is possible, and corresponds to identical speeds, while phasing describes the moving of the image right or left so that it is not split vertically after the synchronising mechanism "holds" the picture. Obviously, the term meant here is "framing," and the process intended by the paragraph quoted is that of moving the picture vertically up or down so that it takes up a central position in the image aperture.

Fairly complete information is given for connecting the "Televisor" to the wireless receiver, various alternatives being illustrated and explained, but there is a dearth of material dealing with the wireless set itself.

The accompanying photographs give a very good impression of what the complete apparatus looks like, and it will be noticed that it differs considerably from the wooden cabinet models which were proposed originally for commercial use. The machine stands on four metal legs, the whole of the working parts being enclosed in a metal case finished in crystalline black enamel. Two control knobs appear on the front, that on the left being for a fine adjustment of motor speed while the knob in the centre is for "framing" the image.



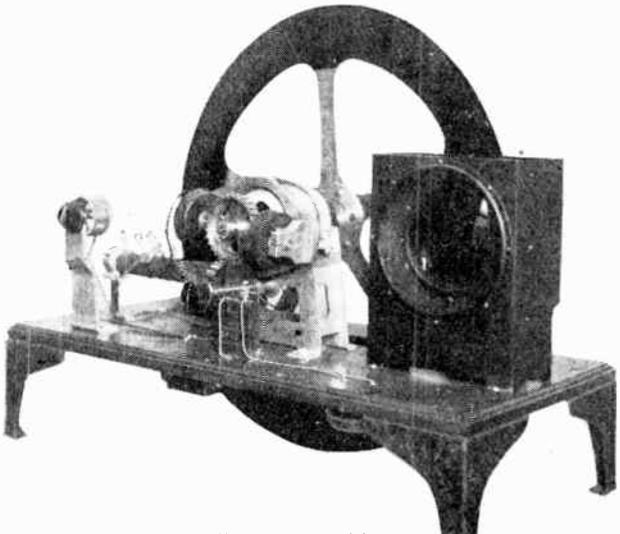
Cover of synchronising gear, adjusting knob, and the synchronising gear itself.

At the back of the apparatus are two sliding covers, one of which when raised exposes the neon lamp and the other a small terminal board. The top four terminals are marked "coils" and "lamp" respectively and it is possible to join these in series and thus series-operate the neon and synchronising coils, or alternatively each may be operated by a separate feed from the wireless receiver. Connections are also brought out to this same terminal board for adjusting the taps on the series resistance mounted on the baseboard so as to step down the house supply voltage to the required value for driving the motor. The motor is of a universal type, that is to say, it will run on either alternating current or direct current.

Undoubtedly the workmanship of the assembled machine is excellent, the 20-inch disc being arranged for graduated exploration to give concentrated detail over the centre of the image where it is most required.

For our tests we used an anode bend detector followed by a three stage resistance capacity coupled amplifier almost identical to the amplifier described by William J. Richardson in our March issue. With the coils and neon in series and a supply voltage of

(*Continued on page* 93.)



The Baird "Televisor" Receiver with cover removed.

Receiving a Television Image

What One Sees when Tuning-in

By *W. C. Fox*

NOW that television receivers are being sold, it is as well to describe what one sees when tuning-in. While it is nice to know how much in the way of area or size of object one can see, such information is of very little help when one is faced with a working televisor and has to bring its motor into synchronism.

Just a knob to turn, says the catalogue, or the expert, to bring the motor into step, and there you are. Quite so, but when one tries to " turn the knob " a number of strange things may happen, and one is definitely *not* there if the various appearances of the receiving screen are not known and their message understood.

From this it must not be assumed that synchronising a Baird " Televisor " receiver is a difficult or tricky matter. It is not, but if one does not know what is likely to be seen during synchronising, the process may be quite troublesome—as troublesome as tuning a wireless receiver to a distant station would be to a person who knew nothing about the controls or what they did.

Suppose one has a correctly designed and properly connected television receiver where everything is going as it should, and is waiting for the image transmission to come along so that the motor can be synchronised.

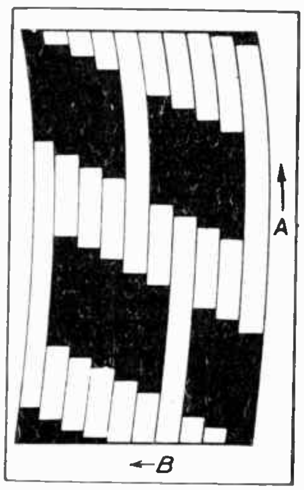


Fig. 1.—Appearance of television screen with motor running too fast. This is for a 10-hole disc. 30 holes would give three times as many black check patches.

The field of vision is covered with a uniform pink glow with faint black lines splitting it up into a series of parallel strips. Presently a series of black patches appear, travelling upwards and across. It is the image, but as the motor is running far too fast it is distorted and carried upwards in the direction of rotation of the disc. This state of affairs is represented diagrammatically in Fig. 1. As the motor speed is reduced the speed of the black patches gets slower, and one can begin to see the detail of the image. At about one and a half times the correct motor speed the image, while not travelling upwards in the direction of arrow A, Fig. 1, will be travelling in the direction of arrow B. As the speed approaches the correct figure, the movement of the image across the screen in the direction B will become slower, but increase in the direction A until, when close on synchronism, its movement B-way will be very slow indeed, while in the direction A it will be approximately that of the speed of rotation, each particular image seeming to jump upwards. When the motor speed is correct, of course, the image is stationary before the viewing aperture, but one may have secured correct speed adjustment at a point where transmitting and receiving disc are not in step, and, as a result, one has the image split, as in Fig. 2, the person's face appearing behind the back of his head. This is corrected by allowing the motor speed to increase or decrease slightly, and watching until the image being received is properly centred.

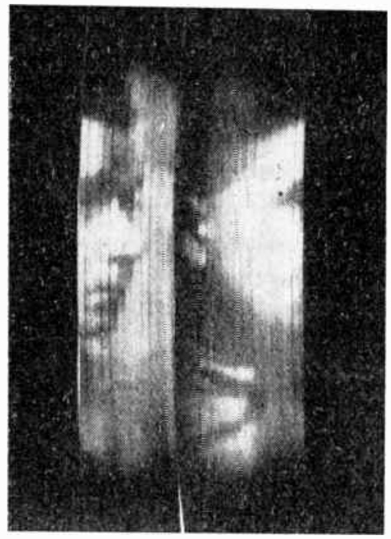


Fig. 2.

There is, however, still another form of displacement of the received image, due to the transmitting and receiving disc being out of step. In this case a man's feet would appear above his head in much the same way as an incorrectly adjusted camera film misplaces things. This is corrected by rotating the motor body about its spindle, and is usually referred to as " phasing."

All this may seem very complicated, but when one has seen it once or twice it becomes very simple, and is in some ways like tuning a wireless set by picking up the howl of a station, bringing it to the silent point and then adjusting reaction for the best results.

So much for a motor running too fast. If on the other hand it is running too slow, the black patches will appear to be travelling down and across in the reverse directions of the arrows in Fig. 1. When a receiving motor is running at a quarter the correct speed, *four small* images will be seen, and, if the motor can be held at that speed, will be quite stationary. At half speed *two* complete images will be seen side by side. From this point to the correct speed one gets the exact reverse image movement as described above for a fast motor.

There are, now, several faults in assembly of motor and disc which can upset the image. If the disc is placed the wrong way round on the motor spindle the image will be reversed, as one will quickly realise if a clock face or letters are being shown. On the other hand, should the motor be running the wrong way, the image will be upside down, while if the motor is running the wrong way and the disc is on backwards,

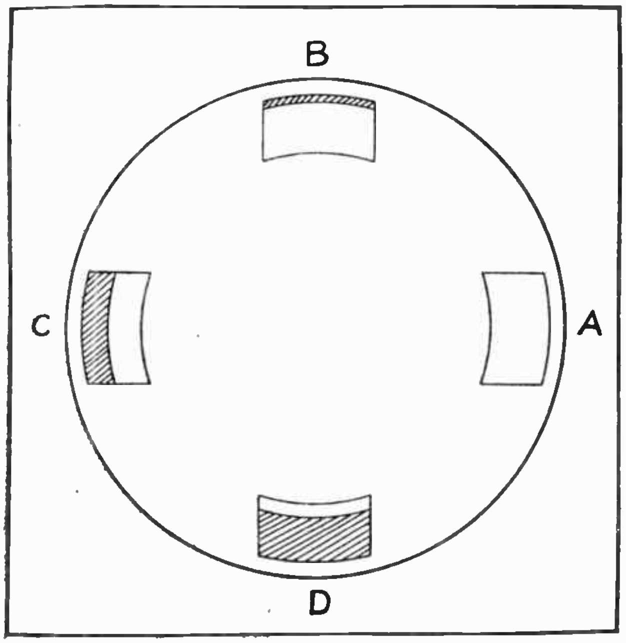


Fig. 3.—Diagram showing four usual positions in which television image can be viewed.

the image will be upside down and reversed, i.e., as though one were looking at a lantern slide upside down and the wrong way round. In addition to these little faults, there is the question of where one should view the image. Fig. 3 shows four possible and convenient positions in which to view an image.

"A" is the position favoured in England and used for the Baird transmissions. "B" is the standard position in Germany. If one is receiving an image correctly at A and views it at the B position, it will be seen lying face down and one quarter displaced. At C, it will be upside down and one-half of the picture will be before the other in the same way, except for being upside down, as shown in Fig. 2. At D, the image will be face up and three-quarters displaced.

There is now the question of attempting to receive, say, a 30-hole transmission with a 45-hole disc. Under certain combinations of circumstances it can be done, but the image will not remain correctly framed. In the case mentioned—30 and 45—if the motor speeds are correctly in step and the spacing of the holes in both discs are about the same, the received image will travel to the left continuously, and no adjustment of motor speed will stop it; therefore, make sure you are using the right disc for the transmission you wish to receive.

We Test a "Televisor."

(Concluded from page 91.)

about 350 volts we received extremely good images, it being possible easily to distinguish quite small details. It takes only a little time to get thoroughly acquainted with the manipulation of the synchronising by adjusting the motor speed control, but once this has been mastered the picture holds very steady. In the output stage we used in turn a P625, an LS5A and an LS6A valve. Naturally, the last-named valve gave the best results and held the picture quite steady, but the others were very satisfactory. All this talk about using three or four large valves in parallel of the output stage of the amplifier is ridiculous.

The separate synchronising feed was also tried and its benefits appreciated, but the extra H.T. current consumption hardly seemed warranted. Further tests are in hand and we shall keep our readers well informed of these; in the meantime we can thoroughly recommend the Baird "Televisor" to them. It opens up avenues of experiment which will give full rein to the ingenuity of the amateur, especially as far as the wireless receiver itself is concerned.

Television Society Notes of the Month

The annual exhibition of members' apparatus will be held this year on Wednesday, April 9th, at University College, London, from 3 p.m. to 9 p.m.

A silver challenge cup, presented to the Society by Capt. B. S. Tuke, will be awarded annually for the best exhibit in relation to Television shown by a member of the Society at the annual exhibition. Entries to be made immediately on the special form (EX3) obtainable from the secretary.

Offers of suitable exhibits from non-members of the Society, bearing on the subjects of Television, Picture Telegraphy, or Talking Films, will be carefully considered if particulars are sent as soon as possible to the secretary.

The sixth meeting of the session will take place on Tuesday, April 1st, 1930, at 8 p.m., at the Engineers' Club, Coventry Street, Piccadilly Circus, London, W., when a lecture on "Photo-electric Cells and their Applications" will be given by Dr. T. H. Harrison, B.Sc., A. Inst. P., followed by informal discussion at 7 p.m. (members only) on Mr. Barnard's paper on "The Photoconductivity of Selenium and other substances" (February meeting).

J. J. DENTON, A.M.I.E.E.,
W. G. W. MITCHELL, B.Sc.,
Joint Hon. Secretaries.

About Scanning Discs

By *George C. Cato*

Associate of the Television Society

IT has been pointed out, rightly, that cardboard is not a satisfactory material for the construction of scanning discs, as it is impossible to obtain holes in it with a sufficiently sharp edge. Cartridge paper has been suggested for cheap experimental discs, but it is not rigid, and is satisfactory only at rather high speeds, and as quite a lot of useful experimental work may be done at low speeds it is necessary to obtain rigid scanning discs which are cheap and easily made. A combination of cardboard and cartridge paper has been found satisfactory, and the construction of such discs will be described. The cartridge paper is used for making the accurate disc which controls the light, and it is supported by a cardboard disc with similarly placed but larger holes. The cardboard used should be of good quality and as thin as is consistent with reasonable rigidity. The white cardboard obtainable from stationers is very satisfactory in this respect.

Before proceeding with the description, however, one or two technical points in connection with scanning discs, a knowledge of which is useful, will be explained insofar as they apply to the construction of a standard aluminium disc. It will then be a simple matter to apply the principles to any other case which may arise.

There are three fundamental quantities upon which the nature of a scanning disc depends :

(1) The disc ratio ;

(2) The size of the holes in the disc ;

(3) The radius of the circle on which the outermost hole lies.

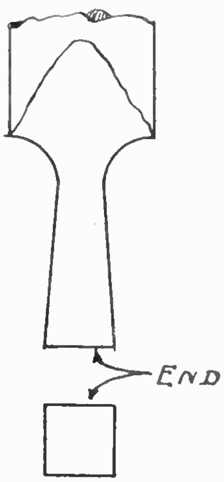


Fig. 1.

These three quantities are not independent ; when the magnitude of any two of them has been settled, the third is automatically determined. It then becomes a matter of deciding which two can be most conveniently used as the independent determining factors. Now the disc ratio, *i.e.*, the ratio of the arc of the outermost circle between two consecutive radii to the radial distance between the outermost and innermost holes, determines absolutely the shape of the picture, and is therefore the most important factor. For a standard disc this ratio has already been settled for us by the Baird Company, and is the ratio 7 : 3, so that only one of the other two factors is entirely within our control. Obviously the most convenient one for us to be able to choose is the size of the holes, for drills are made only in certain definite sizes, whereas we can set our compasses to any radius which follows from the choice.

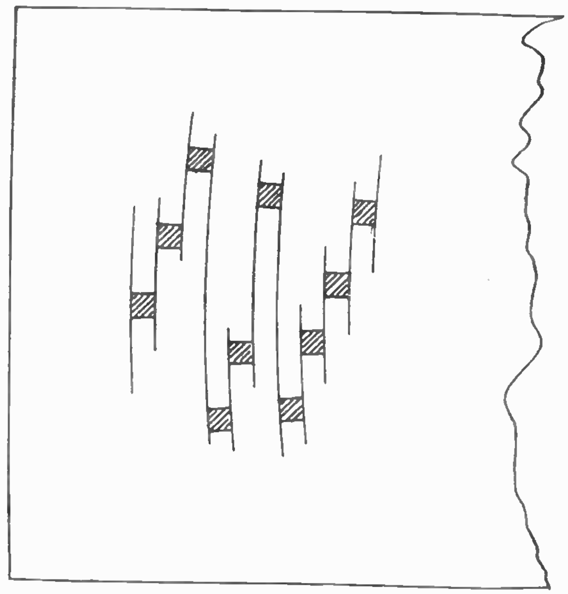


Fig. 2.

Let us suppose, then, that we are to use a 1 mm. drill. Thirty holes of this size give a picture breadth of 3 cms. from which a height of 7 cms. follows (from the disc ratio). Now the angle between successive radii of a 30-hole disc is 12°, so that if r be the radius of the outermost circle we have

$$\frac{7}{r} = \text{circular measure of } 12^\circ$$

$$= 0{\cdot}2094 \text{ radians,}$$

whence $r = \frac{7}{{\cdot}2094}$

$$= 33{\cdot}5 \text{ cms.}$$

or about 13·2 in. The disc itself would therefore need to be of about 14 in. radius.

Now if we had decided to choose the radius of the outermost circle instead of the size of the holes, we would have chosen a round number, say, 30 cms. This, together with a disc ratio of 7 : 3, gives us a hole of ·9 m.m. diameter, and one might quite conceivably have difficulty in obtaining a drill to bore a hole this size ! And similarly for any other round numbers of the radius, the corresponding drills required will in general have inconvenient diameters. It is therefore better to choose the drill and work out the corresponding radius from it.

In the paper discs about to be described the holes are made by means of a punch, and as it is just as easy to punch square holes as round ones (and incidentally easier to make the punch) we may as well have square holes, since they are more efficient. A suitable punch may be made from a $1\frac{1}{4}$-in. wire nail the tip of the nail being filed off and the end made absolutely flat. The end is then filed down till it is about $\frac{1}{25}$ in. square, and slightly less than this for a short distance from the end, so that it does not burr the hole as it passes through (Fig. 1). One side of the head of the nail should also be filed off parallel to an edge of the square end, to serve as a means of ensuring that the nail is always used in the same relative position.

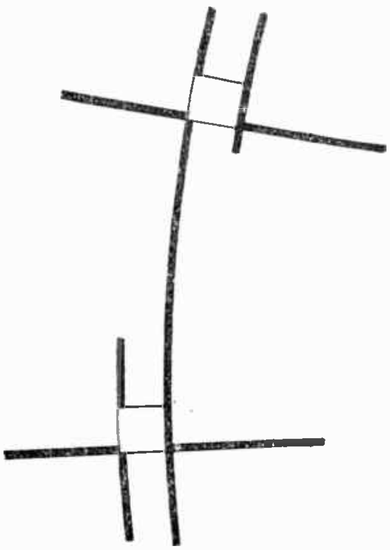


Fig. 3.

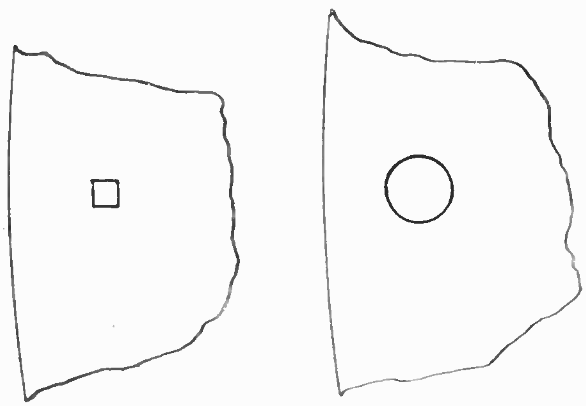
Having made the punch it is necessary to find out what distance thirty holes made by it will fill in. Take a strip of paper about 12 in. long and 2 in. or 3 in. broad, and with centre near one end draw an arc of a circle of about 10 in. radius near the other. Punch a hole with the outer edge on this arc. With the same centre as before set the compasses to the inner edge of the hole and draw another arc. Punch another hole with the outer edge on this arc and a short distance along from the first hole. Set the compasses to the inner edge of this hole, draw another arc and punch another hole, and so on. If ten holes are punched in this manner (see Fig. 2) the radial distance between the outer edge of the outer hole and the inner edge of the inner hole divided by ten gives the breadth of each hole, or multiplied by three gives the breadth of the picture, from which the other quantities connected with the disc can be calculated as previously described. When punching the holes the paper should be backed by a block of lead to ensure a clean edge.

A detail, careful attention to which is essential if a really accurate disc is to be obtained, is the fact that pencil lines have a certain finite thickness, and it should be ensured, by means of a powerful magnifying glass, that the edge of the punch always coincides with the same part of the guiding lines, say the outside edge, before punching the holes. Reference to Fig. 3, which is an enlarged view of two successive holes with the associated construction lines, will make this clear. Note which parts of the lines are cut away with the holes.

A test strip like Fig. 2 having been made with this point in mind, its accuracy should be checked by fixing the strip with a drawing pin at the centre of the arcs and marking through each of the holes in a row on to a piece of paper with a *sharp* pencil. That is, the first hole is marked through, the strip is turned about the drawing pin till the second hole comes alongside the mark of the first hole, and the second hole marked through, and so on. This will show whether the holes are too close together or too far apart, radially, and a second test strip should be made with any alterations in the geometrical construction indicated by the check on the first strip.

This procedure of making test strips and checking them should be continued until proficiency has been acquired in correctly positioning the holes relative to the construction lines and in drawing the succeeding construction lines. To do this a set of beam compasses, if available, will be found extremely useful, for, not only are they very accurate, but after a little experiment it will soon be found how many turns of the adjusting screw are necessary to draw the point in the required distance for successive arcs, thus saving a lot of trouble. After this practice in marking out and making holes no difficulty will be experienced in constructing an accurate paper disc.

Having made your paper disc, cut out a cardboard disc of the same diameter, and fix the two discs together by means of a drawing pin through their centres, the point of the drawing pin being upwards and the paper disc on top. Keep the discs firmly together with one hand and mark the holes through on to the cardboard disc. Remove the paper disc



A Hole in the Paper Disc and— The Corresponding Hole in the Cardboard Disc

Fig. 1.

and, roughly finding the centres of the holes marked through, draw small circles of about $\frac{3}{16}$ in. diameter to act as guides to a larger punch consisting of a 3-in. wire nail with the tip filed off flat. The holes should be punched through into the *end grain* of a block of wood and a fairly neat edge should result.

Now fix the discs together again with the drawing pin, this time with the paper disc beneath, and make sure that the two sets of holes are in register and that no cardboard comes up to the edge of any of the holes in the paper disc. The two discs may now be pasted together, one or two holes at a time, commencing with the innermost hole (if it is possible to do such a thing as paste holes together !). When the material round each of the holes has been pasted together the edges of the discs should also be joined. No other part of the discs should be fixed—only the material round each hole and the edges—otherwise it will be found practically impossible to get the discs concentric and the two sets of holes in register.

After the paste has dried the disc may be blackened with Indian ink. Discs made in this manner are inclined to curl with variations in temperature, and when not in use should be removed from their mountings and kept under a heavy book. They will, however, usually remain flat for the duration of an experiment. Three of these discs were made at a cost of about one shilling, the most expensive item in their manufacture being the ink to blacken them.

In conclusion a useful hint for mounting discs might be mentioned. If you are to mount a disc on a face plate of, say, 2 in. radius, draw a number of concentric circles on the disc with radii decreasing from about $2\frac{1}{4}$ in. to $1\frac{3}{4}$ in. by intervals of about $\frac{1}{16}$ in. The job of getting the face plate in its correct position will then present no difficulty.

A German Amateur's Results

The following extracts are taken from a letter and reports received by the Baird International Television, Ltd., from Mr. Horst Hewel, of Berlin. These results were obtained on home-made apparatus, but he has now been presented with one of the new Baird "Televisor" receivers, and we look forward with interest to receiving his reports of its performance.—Ed.

THE German people (e.g., Dr. Möller of Fernseh A.G., were somewhat blaming me for the *fact* that I received the London Television Transmissions better (in quality) than our Berlin Radio "Movies." In the meantime, the quality of the Berlin Transmissions is becoming really better because the land line disturbances (from RPZ at Tenyrellrof to Transmitter at Witzleben) are now eliminated, and the Movie Transmitter is placed in one of the Broadcast Transmitter rooms. The programme is also enlarged, e.g., a sketch, in which is shown the morning of an average business man (shaving, taking breakfast, quarrelling with "wifie," going to office by a taxi); a very fine scene, in which is seen a street, with tramway, bicycles, autos., etc. The taxi has the number IA38866.

In No. 3 of "Fernschen" one of the R.P.Z. people comments on the article "How Amateurs are Receiving Television" (*Television*, Feb. 1930), and is somewhat enraged over the justified criticism (and joy!) of Mr. W. C. Fox and the "Berlin Amateur!"

In your experimental transmissions you also use landline from studio to Savoy Hill. I guess that's no *special* cable laid for the experiments, and its *going*. Why isn't it possible here?

Enclosed you will find the Reception Results of the last three weeks.

I have constructed an exploring disc with an outside diameter of 490 mm., weighing only 90 grammes. The old disc (cardboard) weighs about 130 grammes; material, 1.5 mm. Pertinax (black Bakelite paper) with 6 large holes (110 mm.) to make the disc lighter and plain during rotation.

Reception results and Programmes of Experimental Television transmissions over 2LO on 261 metres (National Programme Transmitter).

February 22nd.—00.00—00.30 GMT.

Card.

Photo (Prince of Wales).

Mr. ? climbing up a cord, and shading his eyes with his hands.

Cartooning:

1. Head of a Policeman.
2. Head of Prisoner (?) with cap.
3. Head of a girl.
4. Glass of beer (?) The cartoonist tried to drink out the beer (?), and finally poured it out (!)

This programme's reception was demonstrated by me to Dr. Alfred Gradenwitz. Reception conditions were very fine. The quality of images on this wavelength (261 metres) was the same as that of the *best* images received on 356 metres. In my opinion the broadcast transmitter had only a small percentage of modulation (at times). I have a 0–1 milliammeter in the Diode Rectifier Circuit showing relative intensity of signals. In this case the reading on this instrument (intensity of carrier wave) was quite high, but the image impulses to be seen in the "Televisor" were faint. There were no "double images" or "echoes" as described in my previous letter.

Feb. 26th.—00.00–00.30 GMT.

Card with letters (Baird Television Process). Intensity weak. (Weak modulation).

? (Clock ?). Weak intensity.

Mr. ? with a black hat. (Intensity better).

Mr. ? At about 00.15 G.M.T. I observed the "*echo-images*" again. Two overlapping images (e.g., two heads to be seen *at the same time* for periods of some ten seconds. The two heads were moving together; the hair of one head was in the mouth of the other head. A new form of Siamese twins! Sometimes the images were negative. Due to these echoes, I couldn't recognise much of the transmitted objects for a long time.

The clock, with hands pointing to half past twelve, which was shown at the end of this transmission period, was well recognisable again. Echoes none. Signal intensity very steady.

Roman ciphers on the dial, isn't it? The small white dot on top of image, just in the middle (15–16 line of picture beneath the synchronising line, is of great help to get the image into the right phase. If no object is before the transmitter's eye, one is able to and the correctly framed picture only with the aid of the small dot, which must be exactly in the middle. Why do you not transmit this spot always?

Conditions were: Signal strength medium. Statics: Sometimes very heavy. Fading: Small.

March 1st.—00.00–00.30 G.M.T.

I observed only a part of this transmission, because the rheostat of my driving motor suddenly had a short-circuit, which was to be repaired during the first fifteen minutes of the Transmission period.

Mr. ? with low, black hat.

Another gentleman with mustachios.

At 00.23, heavy "echoes" and negative images.

At 00.26, when no object was before the transmitter I observed a three-fold image (of the synchronising lines). The tone of the television impulses in my loud speaker distinctly altered during this period. Each synchronising strip (of the three strips visible 10–15 elements apart) was also continuously altering its blackness (or strength).

At 00.27: Clock showing 12.24, was set to 12.27 (by hand).

March 5th.—00.00–00.30 G.M.T.

Programme:

Photo (Prince of Wales).

Clock, showing four minutes past twelve.

Mr. Shaw (?) doing the usual stuff. ('Phoning, fastening black mustachios over his mouth; putting on the helmet of a policeman; fastening long white mustachios; putting on a black eye-mask; smoking a cigarette). Another head appears in the frame (with the black mask). Mr. Shaw leaning back seriously. The beginning and the end of this transmission very steady. Good quality images. In the middle part of the broadcast, the modulation of transmitter was quite low. I also made adjustments in this time, and therefore missed a part of the programme.

Static level: Low.

No "echo images" at all.

March 8th. 00.00–00.30 G.M.T.

Programme: Card: Baird Television Process.

(Sometimes "echoes." Double images for long periods.

Clock showing five minutes past twelve. The hands are moved by a person many times round the dial but finally set back to five past twelve.

Lesson on Shaving. I don't put the brush into my mouth while shaving. I guess the boy had no soap on the brush). After that the "teacher" was wiping his face dry. Then he put on the "Bobby" helmet, and twirled his mustachios.

At 00.25 (about), during the transmission of the "Bobby," quality of image was bad. No half tones. Especially the helmet very much distorted.

Modulation: Low.

Fading: Medium.

Statics: Medium.

March 12th, 00.00–00.30 GMT.

Due to oscillating receivers in the neighbourhood and heavy "echoes," it was possible for me to see only the following items:

Clock (five minutes past twelve.)

A gentleman trying on a crown of laurels. Till 00.20 there were heavy "echoes." I also saw this gentleman a few minutes before, but couldn't distinguish much. From 00.20 (about), reception was very good (in details), and without an "echo." The gentleman's hand was very clear, each finger to be seen.

Clock five minutes past twelve.

A human hand turns the hand of the clock (minute hand) backwards to 27 minutes past twelve.

After that "regulation," echoes were again appearing. (Upper side of "fading on" rectangle goes just through centre of "original" dial.)

Signal strength: Good (Quite steady). Statics: Small.

In my opinion, automatic synchronisation wouldn't be of great help to me in my reception at least on 261 metres, for the "echoes" and the Fading will promptly bring the disc out of phase, while with the aid of Manual synchronisation I am able to hold the image, when signal strength (and synchroniser current) are small. My fingers have just one year's experience in synchronising. They have never failed. But that's only a theoretical argument. I hope that experience with Baird's synchronising system will prove the contrary.

LECTURE TO KENSINGTON RADIO SOCIETY

On Thursday, March 13th, Mr. H. de A. Donisthorpe, of the General Electric Company, Ltd., gave an exceedingly interesting lecture to the members and friends of the Kensington Radio Society. The Kensington Radio Society is one of the few such societies that have survived, and Mr. Donisthorpe was the first president.

The lecture, "Radio: Past, Present, and Future," traced the progress of radio from its earliest days, when a coherer was used for reception, up to the present day, with some prophecies regarding the future. The future was symbolised to some extent by a demonstration of the latest Baird television receiver.

A New Cathode-Ray Tube for Television

By *Dr. Albert Neuburger*

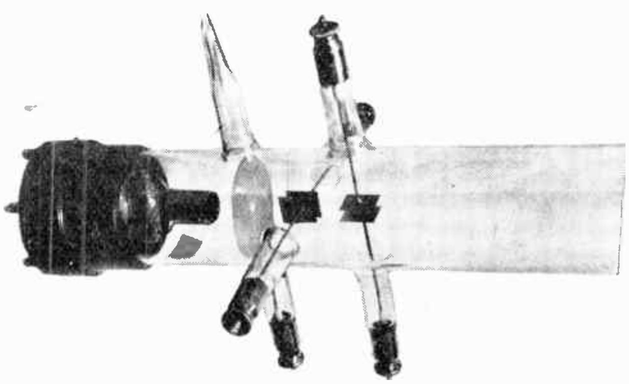
FROM time to time attempts have been made to use a cathode-ray tube for television purposes. It appears on the surface to have several advantages, viz., there are no moving parts, it will appear to permit of a greater number of scanning lines, and high amplification of the incoming signals is rendered unnecessary. From time to time articles have appeared in TELEVISION describing various attempts which have been made to employ the cathode-ray tube.

One of the latest experimenters to investigate this field is the German Radio Engineer, Manfred von Ardenne. One of the first requirements for television purposes is that the cathode-ray tube employed must possess a high degree of intrinsic brilliancy. Up to the present this requirement has usually been met by increasing the voltage employed to operate the tube.

The new type of tube which has been evolved by von Ardenne is of the incandescent cathode type, and operates at a potential of about 300 volts, which can be supplied by a simple mains unit. A considerable increase in brilliancy results from the use of a high emission cathode, and every dissipation of the cathode-ray beam is avoided. It is concentrated electrostatically by means of a "Wehnelt cylinder." In operation the beam is convergent throughout its entire length, despite the fact that the distance from the anode to the fluorescent screen is 40 centimetres.

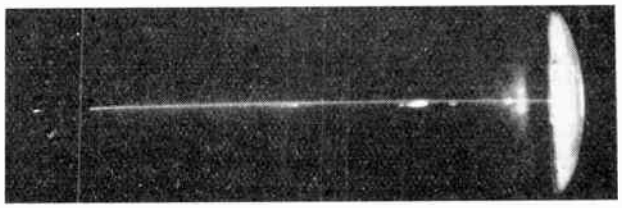
The tube is filled with an inert and rare gas at low pressure.

Having overcome the dispersion of the beam by means of electrostatic concentration, the next problem was to raise the efficiency of the fluorescent screen. Von Ardenne claims that the best results were obtained with green fluorescence, because green is a colour to which the eyes are sensitive and does not cause fatigue even if looked at for a considerable period.



The electrodes of a cathode-ray tube. That developed by von Ardenne has two circular diaphragms instead of one as shown above.

In the case of cathode-ray tubes used for television purposes it is necessary for the luminescence to be persistent, and much experimental work had to be carried out in order to find a way of causing the luminescence to persist. Finally, a fluorescent material was chosen, containing a certain amount of silicate of zinc, which gave good results.



Track of cathode-ray from cathode to fluorescent screen.

The received images must have a minimum size of 7 by 7 centimetres, and the brightness of these images should be equal, if possible, to that of a cinematograph screen. Measurements of the von Ardenne fluorescent screen show that the degree of brilliance obtained even allows of magnification of the size of the pictures. The brilliance of each point amounted to six Hefner candles, which means that if the receiving screen has an area of 25 square centimetres the brilliance of six Hefner candles signifies a light intensity of 240 Hefner candles per square metre, which is more than twice the usual intensity of illumination on the projection screens of large cinematograph theatres. It is, therefore, possible to observe the pictures in full daylight.

The control of the cathode-ray beam can be achieved in several ways. The ray as it leaves the cathode is somewhat divergent, therefore it is caused to pass through an anode diaphragm. Behind this first diaphragm the speed of the electrons is augmented by a second diaphragm. The voltage of the first anode is 200 volts and that of the second anode 2,200 volts. The cathode-ray leaves the second anode with a high constant velocity. The ray can be deflected without varying its velocity.

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.

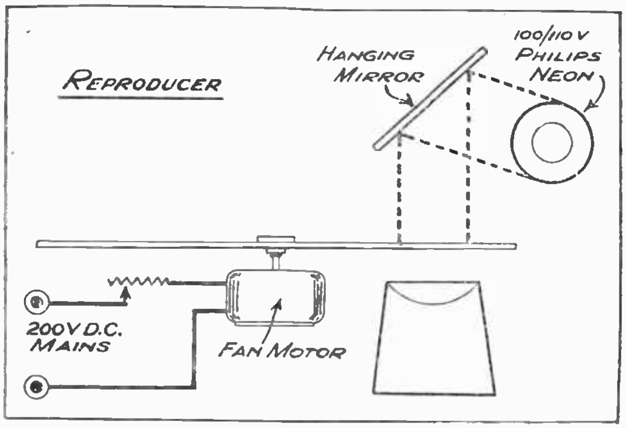
NEON LAMPS.

To the Editor of TELEVISION.

DEAR SIR,—In the March issue of your magazine I noticed a letter from Mr. W. F. Neal, advocating the use of an Osglim type neon lamp for television. I also have experimented with this lamp, and the following tip for removing the brass cap may be of use to your readers.

Remove the solder from both contact points with a hot soldering iron. This will free the connecting wires and leave two small holes giving access to the inside of the cap. The cap is then entirely filled with methylated spirit by means of a fountain pen filler inserted in one of the small holes. The other hole serves as an air vent. After allowing the lamp to stand in an inverted position for a few minutes, the cap may be lifted off without damage. After removing the resistance, the *same cap* may be replaced with Chatterton's compound as advised by Mr. Neal.

For those readers who can obtain the necessary chemicals, or who have access to a chemical laboratory, I would suggest the following method of silvering the bulb, which is a great improvement on sticking foil on to the glass.



An arrangement suggested by a reader for the use, for television purposes, of an ordinary beehive type neon tube. The use of a mirror distributes evenly, he claims, the light of the neon.

Concentrated ammonia solution is added slowly and with constant stirring, to 300 ml. of a 5 per cent. solution of silver nitrate, until the black precipitate, which at first forms, is dissolved. The solution should not smell of ammonia, and should not be heated. A few drops of formalin (38 per cent. formaldehyde) are then added and after thorough mixing the neon lamp is immediately inverted in the mixture, so that the glass part is almost covered.

After standing for an hour, the lamp will be covered with a film of metallic silver, and should be removed from the solution and carefully washed. After drying in a warm place, the silver film may be protected with cellulose varnish. The required rectangular opening is then obtained by scraping off the silver with a knife.

This method gives an almost perfect internal reflection, and is a great aid in obtaining adequate illumination.

Wishing your paper every success,

Yours faithfully,

G. A. CHESTER.

Duke Street,
Princes Risboro, Bucks.
March 16th, 1930.

NAME OF A NAME!

To the Editor of TELEVISION.

DEAR SIR,—Mr. Shered's criticism of "Gravideorad" is mildly interesting, but is he apposite? I assume from your request for a composite name for the triple combination stated, you wanted a catchy, comprehensive trade-name. Therefore, brevity is of primary importance. To wit, "Oxo," which is unpleasantly suggestive of that banality "What Oh!" but is a trade-name *par excellence*, as it has proved itself in many ways. Yet Mr. Shered wants "only five letters and one syllable more"!! As to "proportion and untrue syncopated balance," "Radiograph-osc-ope" sounds like a "gallumphing" giraffe or octoped. At least "Gravideorad" trips off the tongue with a crisp celerity compatible with the characteristics of the three things it covers.

I take it the main idea was that television should be incorporated with gramophone and so-called radio as secondaries; in as brief a title as possible. Yet radio is really inadmissible, and "wireless" is incorrect in many senses other than land-lines. We could hardly accept "Wavio," whereas the two former serve the purposes of concise expression and convenience, even if not justifiable on the grounds of absolute accuracy. If my premises are accepted axiomatically, then I think "Gravideorad" is not too bad. Obviously it comprises video—to see, as the main central feature (which, incidentally, is not a "spun-out word," it is the bare word itself); the abbreviations of gramophone and radio may be "hideous" but they answer their purpose effectively, despite their crudity. Now, does "Radiographoscope" work out as well?

Radio in itself is a misnomer, but let that pass. Nothing is *written*, so the "grapho" is wholly extraneous and meaningless as regards the combination under condensation into a name. The "scope" is a poor and obscure equivalent for all that is implied by Television, since *skopein* merely means to view or observe; not the vivid portrayal of the living, moving object, as understood by the modern acceptance of the word Television; and which "video"—I see!! succinctly conveys.

Evidently the composite title "Gravideorad" is not intended to be taken as a new word in an etymological sense, but to serve as—well! shall we say a self-explanatory trade portmanteau-cognomen.

We are all entitled to our own opinions, and therefore Mr. Shered to his; but the weight they carry depends on relevancy rather than academic erudition.

Yours impartially,

AUDI ALTERAM PARTEM.

Mill House,
Runhall, Norwich, Norfolk.

WAVE-BAND THEORY.

To the Editor of TELEVISION.

DEAR SIR,—With regard to the valuable discussion on the wave-band theory of wireless transmission, it is perhaps not amiss to recall, for the benefit of the readers, that a slightly damped wave-meter, when applied to the determination of the frequency of a strongly modulated wave, shows a response at three frequencies, that of the carrier wave, that of the lower, and of the upper side-band. The decomposition of a modulated wave into three high-frequency waves may, therefore, be said to have a physical basis.

As pointed out by Barkhausen the three waves can be shown in the case of a 50 cycle current which is being interrupted (completely modulated) five times per second, say. An ordinary technical frequency meter will show a deflection at 50, at 45, and at 55 cycles, the first one having about twice the width of each of the last two.

I am reading your magazine with great interest.

Yours respectfully,

RICHARD RUEDY, Dr. Sc.

Toronto, 42, Maitland Street.
March 3rd, 1930.

READERS' RESULTS.

To the Editor of TELEVISION.

DEAR SIR,—I am writing to you in the hope that it may be of interest to some of your readers to know the results that can be obtained with a comparatively small radio receiver coupled to a home-made televisor.

Using a three-valve set of my own design I have succeeded in obtaining an image sufficiently clear to enable one to clearly distinguish between the different persons being televised, and read easily the lettering held before the televisor.

The receiver used consisted of an anode-bend detector, followed by an R.C.C. stage, which was in turn coupled to the final stage by means of a transformer (the transformer used was an old type, and was probably the cause of a certain lack of half-tones in the received image). The valves used were P.M.5x, P.M.6, P.M.6, respectively.

The anode voltage of the detector valve was 120 v., and of the two L.F. valves 240 v., this H.T. supply was obtained from D.C. mains.

The receiver was coupled to the neon by means of the usual output filter.

I think this demonstrates that an elaborate radio receiver, with super-power valves and so forth, is not essential for passable television results.

Wishing your journal every success,

Yours truly,

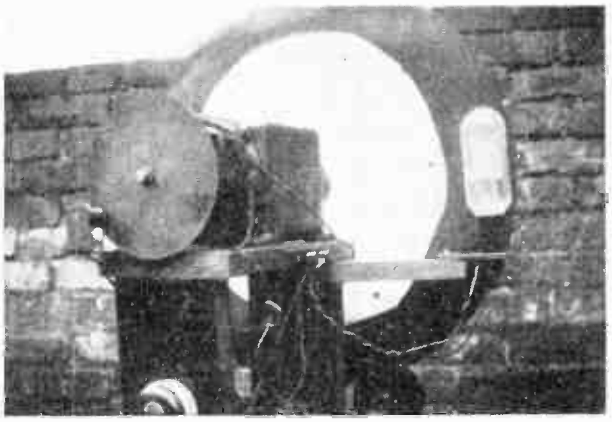
G. E. MARCUS.

48, Bethune Road,
London, N. 16.
March 10th, 1930.

To the Editor of TELEVISION.

DEAR SIR,—I have been an interested reader of TELEVISION for many months and I am now able to report that I obtained good reproduction of the subjects transmitted by the Baird Company, from Brookman's Park, on Friday, March 14th, 1930.

The receiver has been constructed by myself and Mr. J. W. Clarke, of Claremont Road, Portsmouth, who is another keen experimenter.



Mr. Christie's Receiver.

Synchronising gear is not yet fitted, but excellent results in holding the picture have been obtained by two very simple devices which are quite easy to make and fit.

It should first be stated that the motor is a very well-built machine, it is compound wound, but it has been found to give very steady running as a series motor only. It was found that the motor would revolve a 20-inch disc at approximately 800 r.p.m. A single wire resistance was inserted in series and another fine control single wire resistance was fitted to the front of the televisor. With these medium and fine controls, it was possible to get, and almost hold the picture in the viewing aperture. It just wanted something to "brake" the disc at a moment when the picture was tending to rise. Mechanical braking to obtain just the desired result is out of the question. An eddy current drag seemed to be what was required. It was the work of an hour to make up a trial eddy current brake device, and on the next television evening which was, as I have stated, Friday, 14th March, it was found possible to adjust the motor, and with "just a touch" of the eddy current brake at the moment when the picture was tending to rise we were able to hold the picture continuously.

To many of your readers the mere mention of "eddy current brake" will be sufficient for them to make and fit this piece of apparatus.

The brake fitted by the writer was made from two ordinary electric bell bobbins and cores and a sheet-copper disc 6 inches in diameter. The copper disc was fitted to the outer end of the motor and a bobbin mounted in a sheet-iron yoke was fitted on each side of the copper disc. The bobbins were fed from the 8-volt motor supply and a variable resistance of about 60 ohms was connected in series. With this resistance it is possible to always have a slight brake effect on, and to add or reduce according to the tendency of the picture to rise or fall.

I have enclosed some snaps and the films of my televisor, and the eddy current brake can be clearly seen.

You may think it of sufficient interest to publish these ideas for the benefit of other amateurs who find the proper synchronising gear difficult to make.

The scanning disc being used at present is made of paper and was constructed from particulars given in TELEVISION by Mr. A. A. Waters. The disc has round holes only; this, of course, robs the picture of brilliance, but is helpful to amateurs for obtaining their first results.

Thanking you for the excellent articles which have appeared in TELEVISION and hoping it will soon be possible to issue as a bi-weekly.

I remain, yours faithfully,

H. E. CHRISTIE.

94, Suffolk Road,
Milton, Portsmouth.

March 17th, 1930.

To the Editor of TELEVISION.

DEAR SIR,—Just these few words to inform you that a fortnight ago I succeeded for the first time in seeing the experimental television transmission on 261 metres. Since then I am regularly seeing in to the night transmissions. It took only about three hours to build an experimental television receiver, the motor and neon being mounted on empty cigar boxes. Synchronising is maintained with a variable resistance in the motor circuit, the power for which is supplied by a 6-volt accumulator. The scanning disc was made of thin black cardboard and punched with square holes, the accuracy being such that I don't want to have any better. I am using a three-valve straight receiver with one low-frequency stage only, but I think an extra stage of amplification will give brighter pictures.

It is extremely difficult to maintain correct synchronism under ordinary conditions, but last Friday night (the 14th of March) I saw about 60 per cent. of the transmission. The first five minutes I could not see anything, surely due to nothing being placed before your apparatus. The "next" object I saw was the head-and-shoulder picture of a man in smoking dress, busy with his necktie. Another picture showed a human hand. But then the next image showed a really very beautiful young lady; her dark hair had a well made permanent wave. When she turned her face to the right this was easily seen. Of course, the face was small, only half an inch in height, but I could not move to get a magnifying glass, which my two friends attending my demonstration cried for, since my left hand manipulated the reaction control in order to equalise for fading effects, and my right hand had to maintain synchronism. Thus my two friends and I had to rest satisfied with our hearts performing something like a stepping dance. Fading made an end to this condition. Then at intervals I caught faces of male and female human beings, and near the end of the transmission our beauty again appeared. The last weak picture seemed to be a watch.

You see that it is possible to follow the television transmissions over here in Copenhagen.

With the hope for extended night transmissions, and the best wishes for your success,

I remain, yours truly,

WALTER CHRISTENSEN,
Student at Polytechnical University.

124, Aagade, Copenhagen, Denmark.

March 16th, 1930.

To the Editor of TELEVISION.

DEAR SIR,—Having constructed polarisers and analysers to the instructions given in Mr. H. Wolfson's most excellent article in the last issue of your paper I am somewhat dissappointed by the results of experiments with a Kerr cell, also to Mr. Wolfson's directions.

The polarisers as such work splendidly, consisting as they do of a pile of 23 plates. (I assume that an error has crept into the article where a pile of three plates is suggested). Plates of mica, grains of sand, sugar, etc., give beautiful colours when viewed through the piles.

I have endeavoured to rotate the plane of polarisation with a Kerr cell consisting of a glass container $1\frac{1}{2}$ in. square, and containing nitro-benzene, and polished aluminium plates 1 in. wide and spaced $\frac{1}{8}$ in. apart. With a potential of 120 volts (D.C.) applied to the plates not the slightest rotation is obtained.

The nitro-benzene was purchased from Messrs. Griffin & Tatlock, and I cannot imagine that I have been sold an inferior brand of chemical by a firm of such repute.

Incidentally, the fluid is a partial conductor (the cell described passing 2 or 3 milliamps at 120 volts), and has the appearance of whisky or ginger wine and a very strong smell of almond oil.

Other electrodes have been tried, viz., tinfoil and iron, always with the same negative result. I should not be surprised to learn that 120 volts is a very moderate figure for the applied voltage (I have heard of 600 volts being used), but I should expect at least *some* result.

I would deem it a great favour if you could make some suggestions as to the possible causes of my failure to obtain the desired result. I should like to know what rotation I can expect with the application of one or two hundred volts, etc.

In passing, may I express my sincere appreciation of the very excellent nature of the articles and general get-up of TELEVISION. I have been taking TELEVISION now for many months, and intend to do so so long as the expenditure of 6d. per month remains a possibility. I have found the publication most instructive. It has enabled me to obtain very satisfactory practical results.

Using a 20-in. disc and a letter "I" Osglim neon and suitable optical system I have received *consistent* results with a total H.T. consumption (neon + receiver) of 14 milliamps, the motion of sitters being clearly visible, clock face, and capital letters being particularly clear.

I must apologise for taking up your valuable time, but once I get going on television I am hard to stop. Wishing TELEVISION every success.

I remain, yours truly,

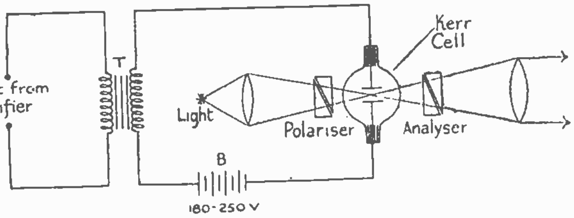
H. M. RIDDLE.

19, Bermeston Road,
Catford, S.E.6.

To the Editor of TELEVISION.

DEAR SIR,—I am indebted to Mr. Riddle for pointing out the printer's error in my article in the March issue of TELEVISION. The figure should read 30 plates and not 3, as stated.

It is extremely difficult to furnish an explanation of the non-working of the Kerr cell, but a few suggestions may be of use to your readers. The efficiency of the pile of plates polariser is much lower than that of a Nicol prism arrangement, and the apparatus should be tested by replacing the Kerr by a cell containing a strong sugar solution, say three parts sugar and one part water. The polariser and analyser should be placed so that no light gets through, and the cell then inserted. Light should



now be able to pass through. An improved optical arrangement might also improve matters, and this is suggested in the figure below. Electrodes of aluminium or silver will answer quite well, but the spacing between these should be $\frac{1}{16}$th–$\frac{1}{8}$ in. The cell should be arranged so that the light does not pass through more than $\frac{1}{2}$ in. of nitro-benzene, which might conveniently be redistilled. The probable source of error is that the applied potential is too low, as a minimum potential of about 180 volts is stated to be required before the effect is manifested.

The circuit shown is self-explanatory, the battery B in the cell circuit being used to supply this starting potential. With this circuit the polarisers should be arranged to extinguish light when no input is being applied to the transformer, T, and signals from an average L.F. amplifier working on broadcast or records will suffice to rotate the plane of polarisation, so allowing light to pass.

The Kerr effect has not been at all thoroughly investigated, and much useful work could be done in the way of providing data of the starting potential, etc., and its variation with the distance between the electrodes.

I hope to be in a position, in a few months, to publish some data of this sort, but at the moment am busy on other problems.

I am, Sir, yours faithfully,

H. WOLFSON.

"The Dingle,"
Grove Lane,
Headingley, Leeds.

March 19th, 1930.

To the Editor of TELEVISION.

DEAR SIR,—*Re* Mr. G. F. La Presti's letter in the March issue of TELEVISION, I will suggest a scheme to overcome the difficulty which he has pointed out.

Personally, I see no reason why the receiving disc should not be used to scan the observer as well as to build up the image being received.

To accomplish this, I propose that a neon tube be constructed with a "plate" of fine wire gauze, so that a source of infra-red rays can be placed behind this tube, and directed through the wire mesh and scanning disc on to the "looker-in" at the same time as the image is being built up by the disc and special neon tube.

I am suggesting this scheme assuming that the infra-red rays will pass through the glowing tube and also that the dual-receivers and transmitters could be run in dead synchronism with each other.

I hope I have made my suggestion quite clear, even if the system would be unpracticable. Wishing TELEVISION even greater success,

I am, yours truly,

GORDON E. CARDEN.

13, Athelstan Road,
Folkestone,

March 19th, 1930.

To the Editor of TELEVISION.

DEAR SIRS,—I should like to report to you that I have been having very successful results from the television broadcasts.

The apparatus in use very closely follows the articles of Mr. A. A. Waters, which are exceedingly practical and of the utmost help.

From the very first effort at reception, the whole programme was received quite distinctly, and I would offer respectfully my thanks to Mr. A. A. Waters, as this was largely due to following his constructional articles.

I have at present no synchronising device other than an external hand belt brake, but I am proceeding with the synchronising device from the details of Mr. Waters in the January issue of your journal.

Wishing your journal every success, and assuring you of an enthusiatic reader,

Yours faithfully,

E. C. PERKINS.

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. 323041, granted to F. A. LINDEMANN. A photo-electric cell and amplifying valve are arranged adjacent to, but separate from, one another within the same cover, connections from the photo-cell to the grid and plate of the valve being made internally. Fig. 1 shows the arrangement and connections.

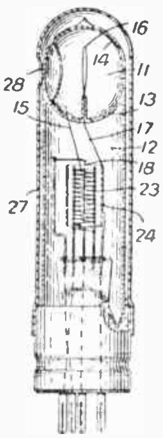
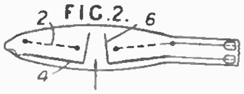


Fig. 1.

Patent No. 323605, granted to GEFFCKEN, H., and RICHTER, H. In this Specification the carrier for light-sensitive material is described as consisting of a network of such fine mesh that the material is drawn into it by surface tension and capillary attraction. A copper network may be supported by a metal sheet, a glass plate, or the wall of the cell. The light-sensitive material is poured into the cell and shaken on to the network, excess being poured out subsequently. The cathode 4, in Fig. 2, and a tungsten or molybdenum anode 2, are of annular shape, and a funnel-shaped extension 6 of the cathode support may be provided. This allows the light to pass through the cell and prevents diffused, reflected light from reaching the sensitive layer.

FIG. 2.



Patent No. 322776, granted to BAIRD, J. L., and TELEVISION, LTD., relates to transmitters for colour television. Either three differently coloured lamps 2, 3, 4 in Fig. 3, acting in succession, throw a moving spot of light on to the object through scanning spirals 6, 7, 8, which are respectively individual to them, the lamps being switched on in succession by a commutator, *or* the object being transmitted may be illuminated as a whole by coloured lamps 10, 11, 12 of Fig. 4, when these lamps are exposed in succession through a slot 14 in the disc. The object is then scanned by spirals 19, 20, 21 working in conjunction with light-sensitive cells 16, 17, 18. Or, again, a single lamp emitting red, blue and green rays, such as a neon and mercury-vapour lamp, may be exposed through three colour screens mounted in the scanning disc and coming successively into action. Colour filters and density filters for use in the above methods are particularised in the Patent Specification.

Patent No. 322822, granted to BAIRD, J. L., and TELEVISION, LTD. In order to obtain a relatively large image in a television receiver, a number of lamps are mounted on two or more spirals on a disc, cylinder or cone, which is rotated at a speed equal to or a multiple of the speed of the transmitting exploring device. In Fig. 5 a double spiral of lamps 28 are attached to the disc 26, which rotates at double the speed of the transmitting disc. By means of pulleys 50, 52 and belt 48 this disc is made to rotate at double the speed of the two-segment commutator 46 and slip rings 42, 44 on the shaft 45. The outer spiral of lamps has a common lead 36 connected to a slip ring 32, the inner having a common lead 38 connected to a slip ring 30, while the pairs of lamps on a common radius have their free electrodes attached to the same segment of a commutator 34. The slip rings 42, 44 on the half-speed shaft 45 are joined to the two segments respectively of the commutator 46 on that shaft, and also to the two slip rings 30, 32 on the shaft 25 through appropriate brushes. The receiver is fed with modulated current through leads 58, 62 connected to brushes 60, 64 respectively bearing on commutators 46 and 34 respectively. Thus the commutator 46 feeds the outer spiral and the inner spiral of lamps successively by connecting the common leads 36, 38 in turn to the lead 58, while the other input lead 62 is connected to the appropriate lamp by the commutator 34.

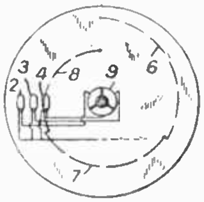


Fig. 3.

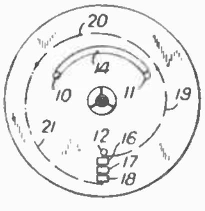


Fig. 4.

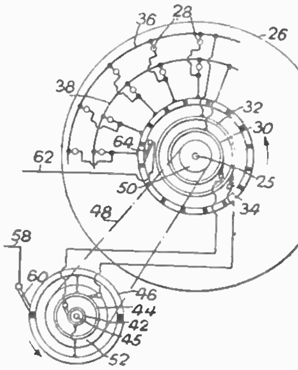


Fig. 5.

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