Vol. 4 APRIL 1931 No. 38 25 CENTS MONTHLY

TELEVISION

FIRST TELE-CINE BROADCAST

TELEVISION

TELEVISION PRESS, LTD.

Editorial, Advertisement and Publishing Offices:
505, CECIL CHAMBERS, STRAND, LONDON, W.C.2.
Telephone: TEMPLE BAR 8169

SUBSCRIPTION RATE:
7/6 PER ANNUM, POST FREE.
AMERICAN RATE:
$2.50 PER ANNUM. POST FREE.

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TELEVISION

THE OFFICIAL ORGAN OF THE TELEVISION SOCIETY

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VOL. IV] APRIL 1931 [No. 38

THIS MONTH'S CAUSERIE

PROGRESS in television is maintained step by step. The goal, in the opinion of many, may yet be far off, but not even the most caustic critics will deny that the progress is sustained and unmistakable.

* * * * *

Let the reader refer back to past issues of TELEVISION and he shall find report of definite discovery, not only in one direction but in many. No need to catalogue them, but the latest, the portable transmitter, is immediately capped by advancement in a different field, the cinema.

* * * * *

The success of the big screen at the London Coliseum and in places of equal immensity abroad is well known to our readers. Now it is our pleasure to report the first transmission of an ordinary film in the ordinary daily broadcast programme from the Baird Studios through the B.B.C. station at Brookman's Park.

* * * * *

The film—by a happy coincidence—one of that inimitable comedian and irrepressible publicist, Charles Chaplin, was transmitted with unqualified success under conditions which are related more fully by Sydney A. Moseley on another page.

As regards the portable transmitter, at the time of writing, this ingenious contrivance has been further developed so that it is possible to move the whole bag of tricks from place to place. Indeed, by the time this issue of the Magazine appears on the bookstalls, there is every hope that, for the first time in history, a portable television transmitter will have entered the portals of the British Broadcasting Corporation.

* * * * *

Report comes from America of "new television systems." Some of these are manifestly written by those who are unfriendly to Mr. Baird and obviously "the wish is father to the thought." It is a curious fact that seldom do the writers say they have actually *seen* these inventions; it is all hearsay.

* * * * *

If and when a new system does arrive and we have proof that it has arrived, readers of this magazine may rest assured that the fullest and entirely unbiased details will be given. It is not the intention however, of the management of this paper to spread rumours—we desire to deal with facts.

* * * * *

And, as a postscript, may we remind our friends and supporters that March 31st was the anniversary of the first dual broadcast by wireless of sound and vision.

The Capacimeter

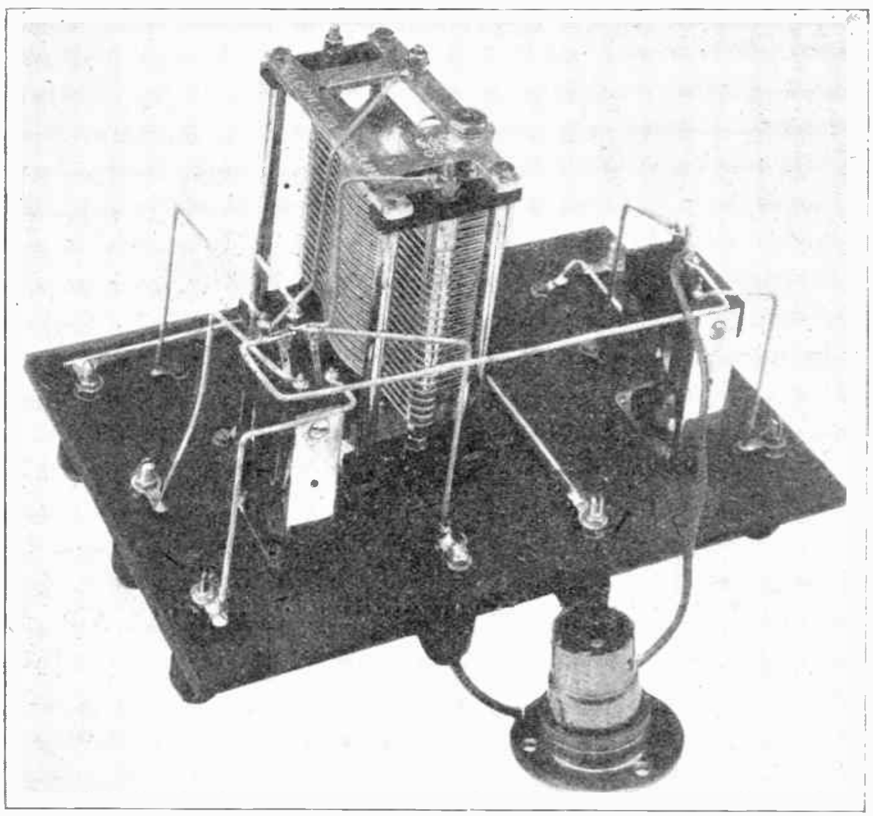
A Tester for Measuring Capacities and Resistances

PART II.

Designed and Described

By *William J. Richardson*

PRESSURE on editorial space prevented me from completing the description of the Capacimeter and readers will no doubt recall that we left off at the point where everything was in readiness for wiring. There are not many leads to be accommodated and a reference to Fig. 1 and the accompanying photographic illustration will enable you to carry out the small amount of work entailed. Make neat right-angled bends in your wires and see that every connection is well soldered. Also remember that no lead must foul the variable condenser moving plates when they are turned through their 180 degrees.



By using this illustration in conjunction with the wiring diagram no difficulty will be experienced in connecting the few necessary wires in an efficient manner.

The Accommodating Box

For the neon lampholder a pair of flex leads should be joined to the batten holder screws and the free ends soldered at the points indicated in Fig. 1. Leave about a foot of flex spare, for the lamp has to be seated inside the box lid. A special oak box was made up according to my specifications by Messrs. Clarion Radio Furniture, and readers are advised to get in touch with this firm for this item. It has a ve deep lid and is supplied complete with a carrying handle to facilitate transport when desired. To pass the pair of flex wires through the panel cut two small nicks in the left-hand top panel edge and also in the wooden side battens which hold the panel.

Then screw the batten lampholder to the left-hand side of the lid as close to the lid-top as possible. To clear the wires small ebonite distance pieces should hold the metal flange of the lampholder about $\frac{1}{16}$th inch away from the wood, as seen in an accompanying illustration. Furthermore, the deep lid enables you to house the substandard fixed condensers, grid leaks, and headphones, small clips being suitable for carrying this into effect in the case of the first two items.

A Calibration Curve

Having completed the construction and checked all the wiring, steps should be taken to put the instrument into commission. Messrs. Sydney S. Bird will supply you with accurate capacity figures for condenser settings of, say, every 20 degrees and a calibration curve must then be drawn on squared paper with great care. To ensure the greatest accuracy make your graph on the largest sheet of paper that towards you, a note can be heard in the 'phones. The particular frequency of this note will depend on the setting of the variable condenser C_1 (refer to Fig. 3 which is the schematic diagram of the Capacimeter reproduced from last month's article) and you will notice that every setting of C_1 gives you a different note.

Capacity Measurements

If the capacity of the condenser you desire to test

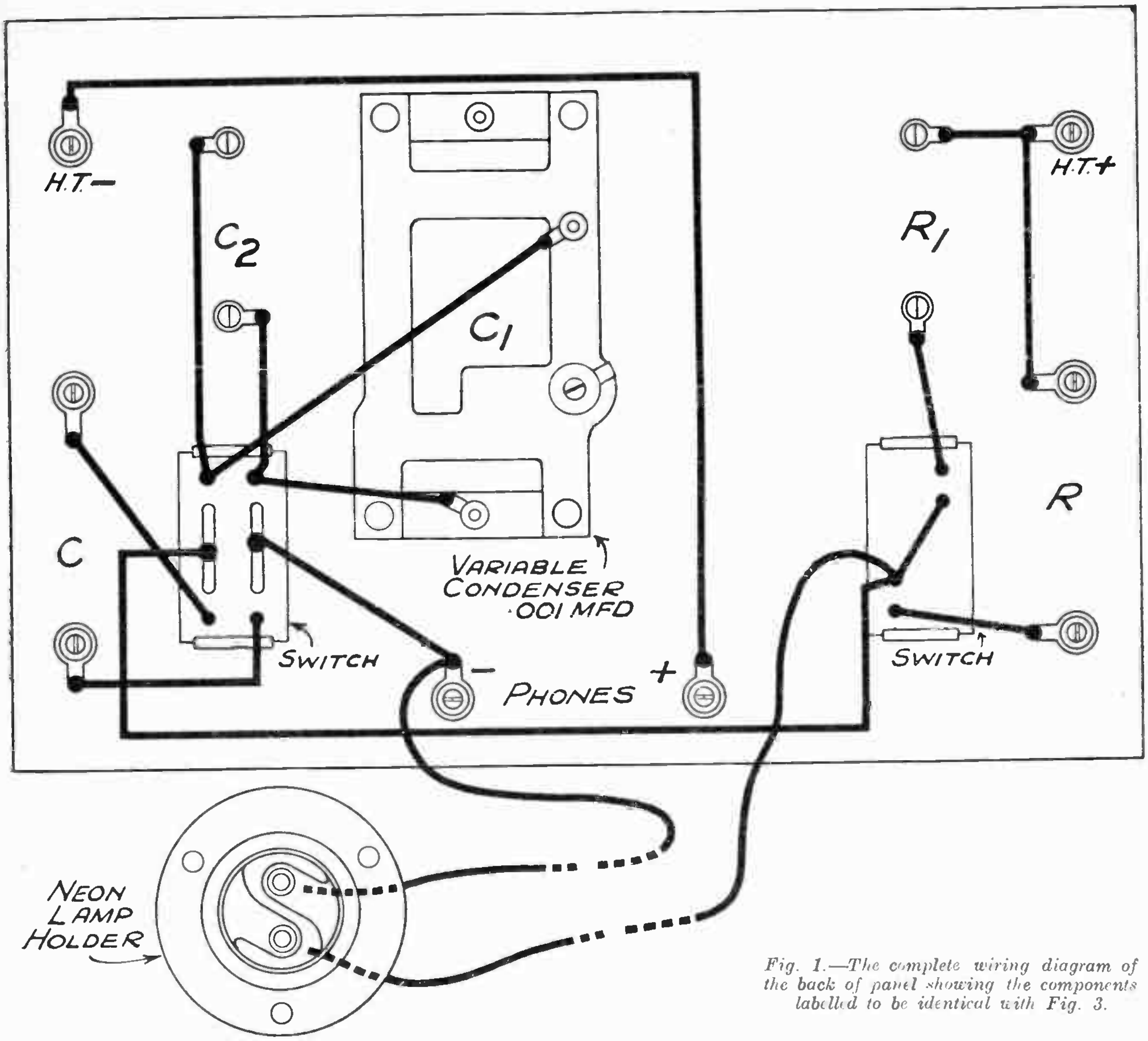


Fig. 1.—The complete wiring diagram of the back of panel showing the components labelled to be identical with Fig. 3.

you can find. Fig. 2 gives you an idea of what the actual curve will look like.

Now with the neon lamp in its holder and one of the grid leaks inserted into the pair of clips on the left of the panel, connect a 100-volt supply across the appropriate H.T. terminals. Since the current taken by this instrument is so minute—less than a milli-ampere—a dry battery will serve for this purpose. Finally join the pair of headphones to the terminals provided and with both of the switch levers pulled is known to be less than ·001 mfd., join it across the pair of black terminals on the right of the panel keeping the length of the connecting leads to the barest minimum. Move the double pole change-over switch lever to the position away from you and listen to the pitch of the note heard. Now move the switch lever over to its previous position and adjust the variable condenser until the pitch of the note heard is identical to that heard with the unknown capacity. Rapidly move the switch to and fro until you are quite sure there is no change in note frequency, adjusting the variable condenser dial with extreme care in this operation. No difficulty will be presented in judging the same "musical" note, and after a little practice great accuracy will be possible.

From the formula given last week and calling C the capacity required and C_1 the capacity as found from the calibration curve, we have :—

$$P = KCR$$

and $$P = KC_1R$$

but P and R are the same in both cases, therefore $C = C_1$.

Sub-standards

In order to measure condenser capacities above the value of ·001 mfd. it is necessary to calibrate the fixed sub-standard condensers. These represent the C_2 of Fig. 3 and the three Dubilier condensers I recommended in the list of components will meet the case. Having found their true capacities in the manner just described, they must be placed in parallel with the C_1 variable condenser, either individually or collectively, by pushing the terminal shanks home into the clips on the right of the panel. Then when identical notes are heard in conjunction with a condenser of unknown capacity we have :—

$$C = (C_1 + C_2).$$

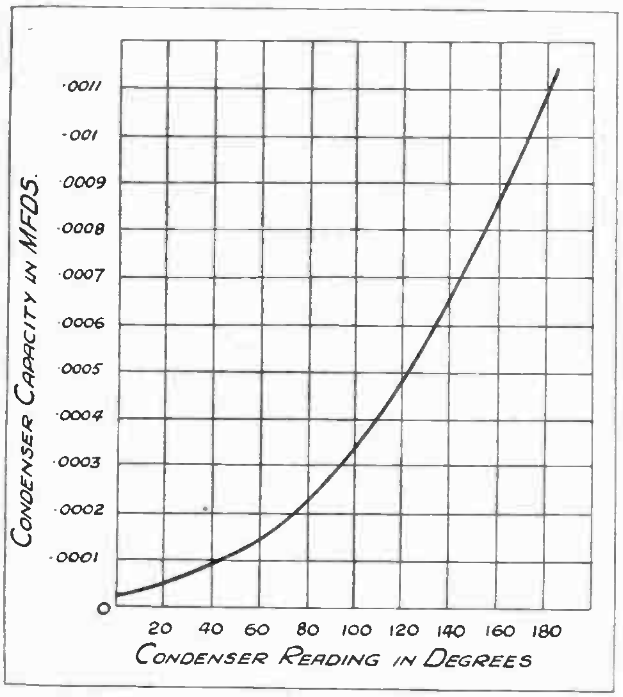


Fig. 2.—Plot out carefully the calibration curve for the variable condenser used in the Capacimeter.

Condensers of Large Capacity

If you take a condenser of large capacity, say 1 or 2 mfd., and join it across the pair of black terminals, the current pulsations are of such low frequency that they can be seen and counted as flashes in the neon lamp. To carry out capacity measurements in these cases it will be necessary to calibrate other intermediate sub-standard condensers in the manner just described, and these in turn become the C_2 condensers which may be joined to the pair of clips.

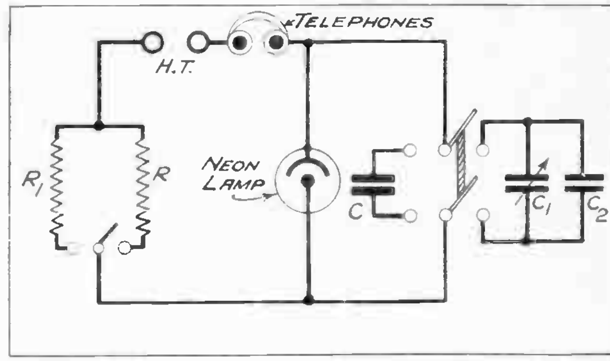


Fig. 3.—The theoretical diagram for the tester is shown here so that you can find exactly how the condensers and resistance are referred to.

To ensure the "note" is identical with known and unknown capacities, check by counting the neon flashes with the aid of a reliable watch and arrange for the same number of flashes per minute, then, as before, the unknown condenser capacity is the sum of the capacities C_1 and C_2.

Resistance Measurement

For the purpose of making resistance measurements you must obtain a resistance, say a grid leak, which has been calibrated accurately from some outside source. This should not be difficult, and when available let this resistance be accommodated in the R_1 position and the unknown resistance joined across the pair of red terminals.

Pull both switch levers towards you and listen to the pitch of the note for a given setting of the variable condenser C_1. Then move the single pole switch lever to the position away from you and adjust C_1 rapidly until a note of the same pitch is heard. This reading must be checked up three or four times, and furthermore you must remember that it may be necessary to add one or more sub-standard condensers in order to arrive at this condition.

Now call C_a the capacity registered with the unknown resistance R in circuit and C_b the capacity registered for the same pitch note with the known resistance R_1 in circuit, and we have from our formula :—

$$P = KC_aR$$

and $$P = KC_bR_1.$$

Then $$C_aR = C_bR_1$$

and $$R = R_1\frac{C_b}{C_a}$$

and the resistance we require is easily calculated.

The accuracy obtained with these measurements is wholly a matter of practice, and once you have made a few tests to become thoroughly acquainted with the handling of the Capacimeter, everything will be straightforward.

An Advantage

One advantage of the instrument arises from the fact that the frequency of the note heard in the 'phones does not in any way enter into the calculations. You merely judge notes of identical pitch, and in this way rule out possible discrepancies which might arise if the note frequency had to be determined.

Do not forget that this tester is handy for certain work over and above that just described. Continuity in coils, resistances, etc., may be proved by inserting the component in series with, say, one of the H.T. leads from the battery, and if a note is not heard in the headphones then a break is present. Defective

Note how the neon lamp has been accommodated on the left-hand side of the lid. Be careful to ensure that the flexible leads do not get jammed when the lid is closed.

grid leaks are rapidly tested, and also, for example, a poor variable condenser whose fixed and moving plates touch at one or more points.

If one is undertaking tests in this manner it will be found particularly convenient to have a pair of testing handles, such as the Eelex testing prods, in series with that section of the circuit which is broken. Then with the headphones on, it is possible to make investigations inside a wireless receiver, listening for the absence or presence of the "neon note" as the case may be.

This simple modification extends considerably the field of uses embraced by the tester, and it is quite conceivable that other suggestions will occur to the experimenter. Apart from this aspect, however, the prime object of construction, namely, capacity and resistance measurements, is splendidly catered for.

Owing to the simplicity of the construction and the cheapness of the complete instrument, I am sure many readers will make up the Capacimeter and bear out my remarks as to its undoubted utility.

Television Lecture before Royal Society of Arts.

Describing it as the "biggest advance in television made in recent years," Mr. W. G. W. Mitchell, B.Sc., referred to the Baird "Big Screen" (demonstrated during last summer at the London Coliseum) in a lecture before the Royal Society of Arts on February 25th.

The lecture, the subject of which was "Developments in Television," enjoyed the presidency of Sir Ambrose Fleming, who personally added some interesting comments on present-day television. Sir Ambrose expressed it as his opinion that one of the latest Baird achievements, the "modulated arc," also represented a big step forward.

In the course of his lecture Mr. Mitchell reviewed, in some detail, the various modern systems of television, and also exhibited several commercial types of television receivers, including the Baird "Televisor."

T. H. B.

Lectures for April

Forthcoming lectures on television by Mr. J. J. Denton, A.M.I.E.E. :—

April 1st, at 8 p.m.—Norwich Science Gossip Club, Norwich. (Postponed from March 25th.)

April 23rd, at 8 p.m.—Folkestone Natural History Society, Folkestone (Public Library).

Course of Lectures on Television.

Owing to the success of the short course of lectures on television now completed at the Borough Polytechnic Institute, S.E., the Principal has requested the lecturer, Mr. J. J. Denton, A.M.I.E.E., to repeat the course of six lectures commencing on May 28th next (Thursday) and ending on July 2nd. Particulars can be had on application to the Principal, the Borough Polytechnic Institute, Borough Road, S.E.1.

The First Tele-Cine Broadcast

By Sydney A. Moseley

IT is my privilege to record one more milestone in the progress of television. This time it is no less than the broadcast of a film from the Baird studios through Brookman's Park, in the ordinary television programmes.

Let me tell in as simple terms as possible what actually occurred, in order that there can be no misunderstanding when the inevitable claims from America pour in. On Friday, March 6th, at the midnight transmission, a piece of test film was transmitted at the end of the programme. No public announcement was made of this test, so that in the circumstances it would not have been surprising if little or no attention had been paid to it. But the number of letters that reached the Baird Company after the transmission showed the enormous interest that had been aroused.

I do not think I am betraying any secret when I say that the B.B.C. engineer in charge of the transmissions at Savoy Hill himself rang up and informed the Baird engineer how successful he thought the transmission had been.

Encouraged by this success, a more formal transmission was given on Monday, March 9th, when a piece of an old Charlie Chaplin film was shown at the 11 a.m. transmission.

Readers will naturally want to know what special technical considerations this needed. First of all, let me make it clear that no special film was used. A film-renting company was asked in the ordinary way to lend the Baird Company a film, and from three that were sent, two were used. The film was transmitted through the tele-cinema projector, which has been in the Baird laboratories for the past three or four years.

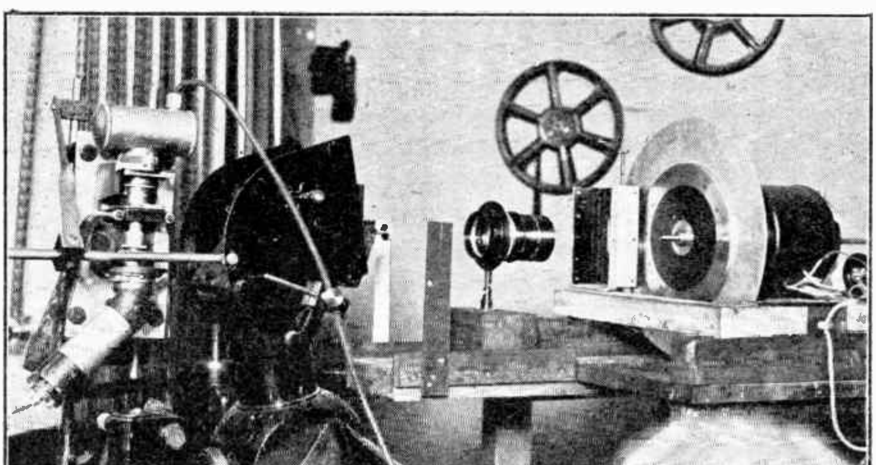
This projector, however, is, of course, an improvement on that hitherto used for experimental purposes.

The projector is situated in one little room and from there a landline couples it up with the ordinary television transmitter. Reports received from various parts of the country are unanimously in praise of the innovation.

My own criticism is this: Since these films were recorded for ordinary cinema apparatus and no special consideration was given to the needs of television broadcasting, there are far too many background scenes which do not come out any too clearly on the television receiver.

Take the case of the Charlie Chaplin film. When he was chasing or being chased by his inevitable, implacable foe round the park seat, this was clearly seen, together with Charlie's inimitable methods of "downing" those who have the misfortune to cross him, and, of course, when there was a "close-up" this was far better still. Charlie's every action was clearly portrayed, but when one was asked to look at a church steeple, for instance, miles in the background, it became quite evident that this part of the film would be of no use for television production at its present stage.

But to quote from one or two letters received, will



A glimpse of the original experimental tele-cinema projector used by Mr. Baird when he gave his first land-line demonstration of a talking film in August, 1929 tell more than I can in the space at my command. For instance :—

Lord Ampthill writes : "The short television film came through almost, if not quite, as clearly as the rest of the programme. A most promising experiment and should be repeated. It undoubtedly has great possibilities."

E. Lamb (Worthing) : "The boxing film was truly an astounding advance in television. Please accept my heartiest congratulations."

W. McDonald (Worthing) : "I have witnessed one of the biggest strides in the science of television, namely the tele-ciné film. I was thrilled at the first part of the programme, but when the boxing match appeared I became spellbound. Every little detail stood out on the screen and was quite equal in purity to a cinema film."

L. J. Swan (Southall) : "Your experiment in transmitting a cinematograph film was a great success."

H. W. Franklin (Grays) : "For a film transmission I should consider this reception very fine. The close-up picture of "Charlie" was very clear and as good as many direct pictures I have received. Oh, how I long for all-day transmissions!"

Mr. H. H. Awcock (Canonbury) : "We all thought that the introduction of the film was a happy thought. We received this quite well, both contestants and referee being clearly outlined and defined, every movement, feint and attack could be followed with ease, and we were genuinely sorry that we only had about five minutes of it. Please send over more of this."

Mr. Albert Kay (Rochdale) : "It was with the greatest of pleasure that I witnessed your tele-ciné transmission last night, the wealth of detail being greatly evident, such as the ropes of the ring and the action of the referee in separating the boxers from a clinch, being clearly shown."

Mr. F. G. R. Palmer (Sunderland) : "I hope that in future, you will be able to transmit cinematograph pictures once or twice a week for the full half hour."

Mr. W. B. Weber (Bristol) : "The film was the most steady of the programme, and though so small, I found you could view same much better from, say, 3 to 4 feet distance against, say, $1\frac{1}{4}$ to 2 feet necessary to view a large picture from programme proper."

Mr. A. B. Crawford (Acton) : "I received this excellently. If just an ordinary, interested wireless fan, such as myself, can get results, it speaks volumes for Baird television."

Mr. J. H. Sparks (Guildford) : "Without a doubt these films would be a greater interest to the public than the usual head and shoulders, as there is more idea of movement, and we hope you will continue with them."

Mr. H. R. Moore (Bishop's Stortford) : "The audience I had was extremely appreciative and much impressed, and hoped you would give us some more films in your future transmissions."

The above are only a few of the letters received, but it will be seen that a new source of entertainment by television has been discovered, and no doubt, this will be developed post-haste. At the same time it must not be forgotten that television proper is likely to prove more attractive in the long run. Far better to see events first-hand as they occur than to see them second-hand through a film.

The position, therefore, is intensely interesting. Which will get there first? Will the progress of television proper—by which I mean the televising of objects at first-hand—proceed at such a rate as to make the use of the film unnecessary? I hope so. But at the same time it is obvious that no alternative or secondary medium can be ignored. If cinema production is to offer immediate means of entertainment then, of course, it must be used, what time the harder work of television images first-hand goes on. I venture to say that never in the history of this much-debated science has the situation been so fraught with piquant possibilities. Let me repeat: Tele-cinema was, in the first instance, regarded by Mr. Baird as a retrograde step. When I first saw a demonstration in the laboratories some years ago I agreed with Mr. Baird that it was not half so interesting as seeing the image which was actually there—in the flesh. But I have to confess that the technical progress of tele-cinema has been so rapid that there may be no alternative but to offer the public films in their homes as well as images first-hand.

Without saying too much, I would hazard a guess that Mr. Baird may spring a surprise on the world of science in this connection before many moons have passed, and may again alter the situation.

The Television Society

ON Wednesday, March 11th, 1931, at 7 p.m., the Third Annual General Meeting of Members was held at University College, London.

Following the reading of the Minutes of the previous Annual General Meeting, the Annual Report of the Council was read. Its adoption was proposed by Mr. R. W. Corkling, seconded by Mr. P. C. Philpot, and carried unanimously.

The following gentlemen were unanimously elected as Officers and Council for the ensuring year:—

President: Professor Sir Ambrose Fleming, M.A., D.Sc., F.R.S.; 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.: Hon. Fellow: John Logie Baird.

Council: Professor Cheshire, C.B.E., A.R.C.S., F.I.P., J. J. Denton, Esq., A.M.I.E.E., Wm. C. Keay, Esq., Lord Angus Kennedy, Admiral Mark Kerr, C.B., M.V.O., T. M. C. Lance, Esq., E. G. Lewin, Esq., M.Sc., A.Inst.P., 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.

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

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

The Chairman, Dr. Tierney, then called upon Professor Appleton, M.A., D.Sc., F.R.S., to address the meeting. Confining his remarks to the effect of the Heaviside layer in television, Professor Appleton requested members to observe the "echo" images at times noticeable in television reception, and described the phenomenon by aid of lantern slides and blackboard diagrams. He invited the co-operation of members, and stated that the following details are required:—

1. Distance of receiving station from transmitter and wave-length of transmission.

2. Whether "echo" images are observed during day-time as well as at night.

3. Nature of "echo"; whether positive or negative.

4. How displaced and by what fraction of scanning strip.

5. Information as to fading of main or subsidiary images.

Members able to take part in this work should communicate with the Lecture Secretary.

A very hearty vote of thanks was accorded to Professor Appleton.

Mr. T. M. C. Lance then outlined proposals for the forthcoming exhibition of members' work to be held at University College on April 15th, 1931, from 2.30 to 9 p.m.

Having suggested test experiments, Mr. Lance concluded by calling on all members to assist in making the exhibition a success.

Mr. Bridgewater made known the fact that the transmitting station, G2TV, at Kingsbury, N.W.9, will be operating on about 50 metres from 4.45 to 5.45 p.m. for the benefit of members able to take part in "echo" research, thanks to the courtesy of the Baird Company.

Proceedings, and particulars with conditions of membership, can be had on application to the Hon. Secretaries, Television Society, 4, Duke Street, Adelphi, W.C.2.

J. DENTON, A.M.I.E.E.,
Hon. Sec. (Members).

The South London and District Radio Transmitters' Society.

At an enthusiastic and well-attended meeting of amateur transmitters, recently convened in South London, it was unanimously decided that a Society should be formed to further the aims and interests of radio amateurs generally, and those resident in or near London especially.

It is hoped to enlist the support of every interested amateur, whether he be a member of the R.S.G.B. or otherwise, and thus consolidate the initial success of the movement.

All preliminaries have been arranged, and a confirmatory meeting will be held on Thursday, 9th April, at 7.35 p.m., at the Greyhound Hotel, Kirkdale, Sydenham, S.E.

For full particulars as to times and places of future meetings, etc., please communicate with the Hon. Secretary, at 25, The Gardens, East Dulwich, S.E.22, or with the Assistant Secretary, Mr. Arthur H. Bird, at 35, Bellwood Road, Waverley Park, Nunhead, S.E.15.

When writing, kindly mention this Journal.

Inertia in Gas Filled Photo-Electric Cells

By *Dr. Fritz Schröter and Günther Lubszynski**

THE independent discharge current of gas-filled photo-electric cells which is controllable by light, has, in the case of the Elster and Geiter cell, two particular voltages when the illumination remains constant. We have the saturation voltage E_s and the ionising voltage E_i. The relations are shown in Fig. 2 in which a curve is reproduced showing the characteristic curve of the behaviour of ionised gas particles. This curve was obtained from a cell having a hydrated potassium cathode and filled with a neon-helium combination constituting about 30 per cent. helium. The pressure was in the order of 1 mm. The explanation of this typical characteristic is somewhat as follows. In the region where E_a is less than E_i there is no ionisation, thus the electrons liberated by the light follow the characteristic of saturation. Here we have a special case in which the space discharge law is obeyed and with a homogeneous field we apply Rutherford's law of distance which is

$$I_{max} = \frac{9\mu}{32\pi a^3} E_a^2 \qquad (1)$$

where μ represents negative ion motion and a the distance between the electrodes.

We may refer now to Hertz's rudimentary nomenclature of "Expulsion Velocity" of electrons in rare gases for a clearer conception of the course of events which transpire under these conditions.

For we are dealing here with an identical form of discharge mechanism under the influence of a small field, thus obtaining similar results. In the region where E_a is greater than E_r, which is greater than E_i, E_r being the resonance potential, the following formula is valid for the computation of the maximum current:

$$I_{max} = \frac{\lambda}{2\pi a^3} \sqrt{\frac{2e}{m}} \cdot E_a^{\frac{3}{2}} \qquad (2)$$

(Here λ denotes the amplitude of the electron a, as before, the distance between electrodes, and e/m = charge/mass of the electrons.)

Now this formula differs only from that given by Rutherford in the inception of the numerical factor which is associated with the motion of the ions. Even the Rutherford formula contains the $E_a^{\frac{3}{2}}$ law, provided one expresses μ as the expulsion velocity.

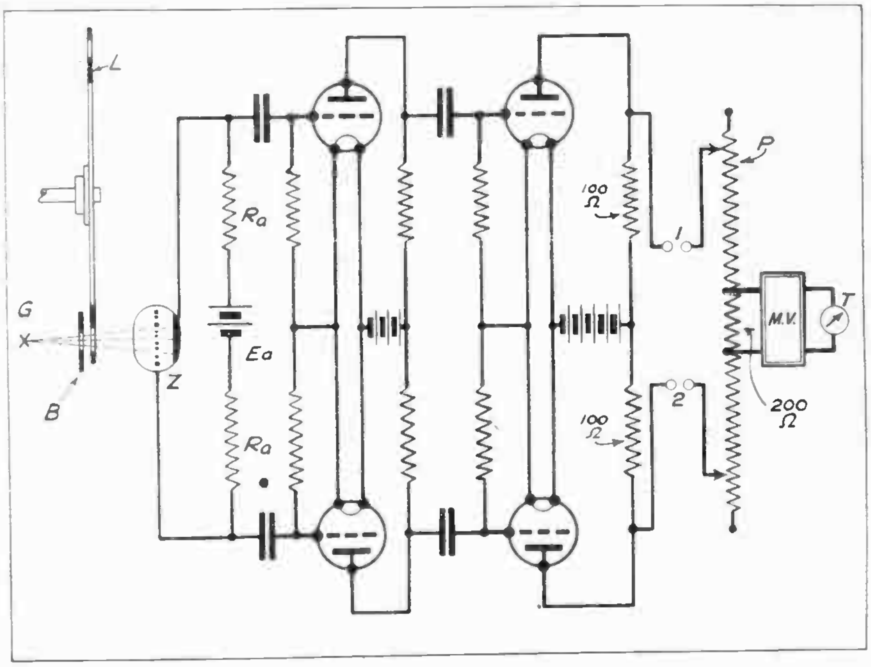


Fig. 1.—Diagram of the apparatus employed for the tests referred to in the text. L is a perforated disc, P a potentiometer. MV the amplifier and T the thermo voltmeter.

* Reprinted from Physikalische Zeitschrift, 1930, No. 20.

The value of the term denoting distance between the electrodes is recognisable in both formulæ. In the case of gas-filled cells saturation will assuredly ensue in the working region even if the initial potential is low and the more so the nearer together the electrodes.

It can be observed in the curve represented in Fig. 2 that the greater the value of E_a, so becomes correspondingly greater the slope of the curve, this, of course, being the case after complete ionisation has set in and the value of the potential has risen above that of E_i. Furthermore, the amount of ionisation in the cell is of such value that the ionisation current exceeds by far that brought about by the stream of electrons alone.

Now, the pure photo-electronic current is of far greater importance for the purpose of amplification, for it is the primary photo-electric effect which is suitable only for technical purposes. It must be borne in mind, however, that sufficient signal strength should reach the amplifier to enable amplification to take

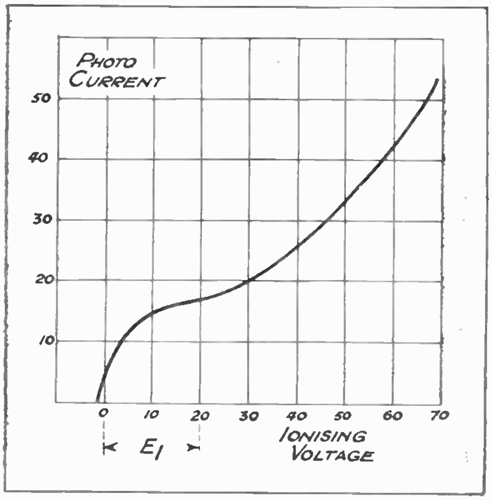


Fig. 2. Showing the behaviour of ionised gas particles (Neon-helium at 1 mm. pressure.)

place over the mush level. There are limits to this possibility and in the first case care must be exercised that the voltage is not high enough to produce breakdown owing to the increasing slope of the curve.

This has been dealt with by Townsend who has discussed at length the threshold values of the photo-electric cell, under which values the cell will not break down. Secondly, there is a certain recombination type of inertia caused by intermittent illumination which serves to limit the use of the photo-electric cell to frequencies confined to smaller bands. This has led to employment of cells as sound generators such as Schaeffer's Light Siren and also as a method of transmitting pictures and for sound reproduction on talking films.

It has been found in electro-optical experiment that it is most expedient to choose a value of E_a about 30 to 40 volts below the glow voltage E_z, which brings about pure discharge. These difficulties can be overcome by the employment of special amplification technique and thus the value of E_a can be readily adjusted to give optimum results. The Klangfilm method introduces specially designed amplifiers and another method is to produce intermittent illumination by interrupting the light frequency which acts as a modulator of illumination intensity. Then S_{max} must be much smaller than ω where ω is the interruption frequency. Of course, an interrupter disc provided with holes is employed to this end as in the case of picture telegraphy.

So far as television scanning is concerned the conditions are unfortunately not so simple, as an

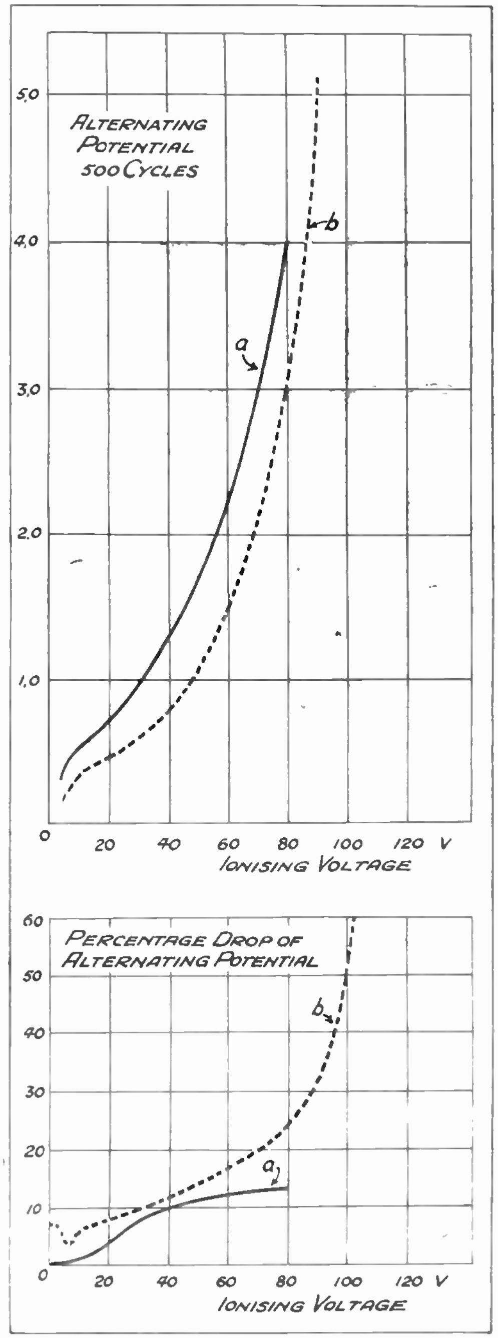


Fig. 3. Curve for potassium cell filled with neon 1.44 mm. pressure.

interrupter disc of so high an interruption frequency is not practicable for too high frequencies, also owing to the weakening of the illumination the value of E_a has to be raised so high as to be on the point of discharge if good results are to be obtained. Besides this the inertia due to recombination makes itself very apparent. This is liable to spoil results for the transmission factor becomes variable for different modulation frequencies. Clearly, then, the vital factor, when television comes into consideration, is that the inertia due to occluded gases in the cell must be reduced to a minimum.

With this in view, the Telefunken have investigated this important problem under the direction of F. Michelssen, who has worked with the Light Siren apparatus. The data given here has come to hand from work carried out in the laboratories of the State Radio Company, Ltd., in the applied wireless section. The apparatus schematically represented in Fig. 1 is a measure of the frequency characteristics of amplifiers and transmitting gear, including cables, land-lines, and wireless transmission, for frequencies of 50 to 10,000 cycles. Measurement of the alternating current is effected by employing a rare gas photo-electric cell in conjunction with an interrupter disc of known speed. Now if the value of E_a is kept constant and also the filament current of the glow lamp G, which provides the source of illumination, and also if all other things are kept constant and thus the sensitivity of the photo-electric cell, then the alternating current introduced by the disposition is independent of the cycle of illumination and darkness.

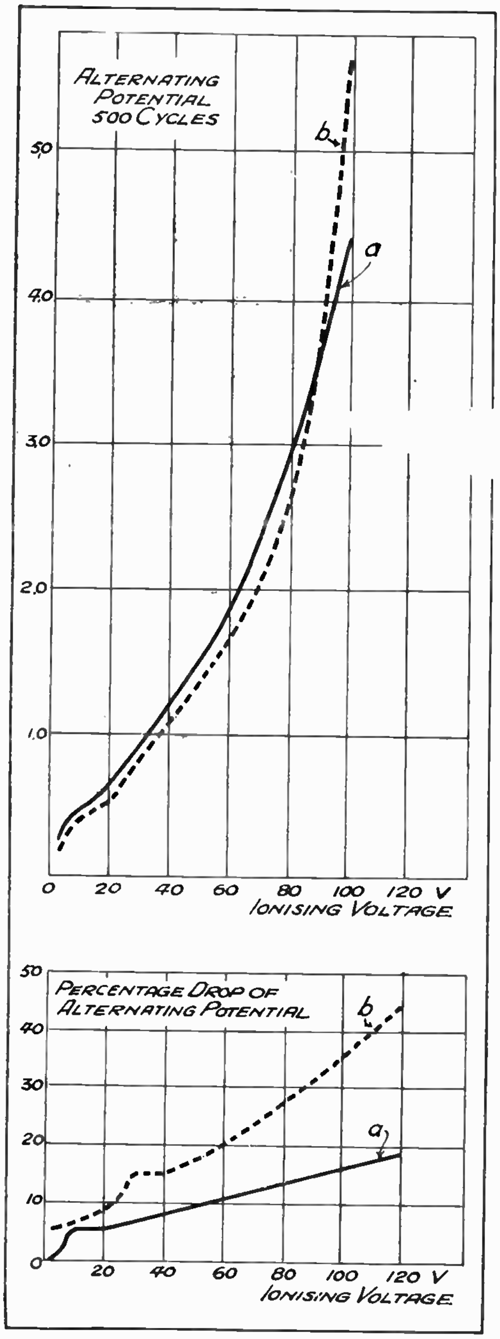


Fig. 4. Curve for potassium cell filled with helium 1.8 mm. pressure.

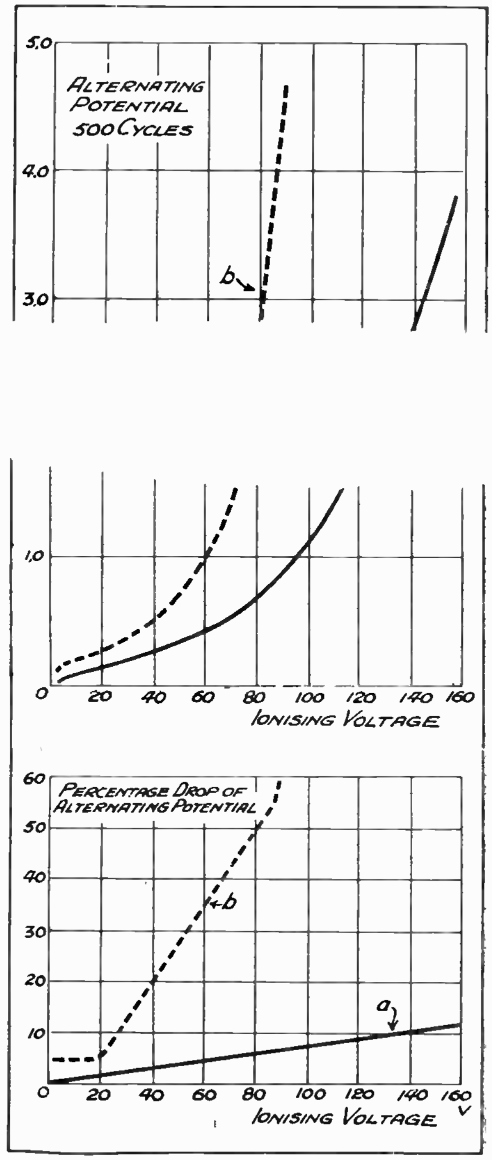


Fig. 5. Curve for potassium cell filled with helium 1.8 mm. pressure.

We then have symmetrical amplification of all cycles from 50 to 10,000. The two resistances R_a effect a special coupling resistance so that the following valves are being operated in accordance with the push-pull amplification principle. The alternating current is passed through the series coupled condensers. The value of R_a is chosen so small (about 20,000 ohms) that the effect of the wattless component is parallel (value $\frac{1}{2\pi v C_r}$) of the photo-electric cell is hardly noticeable even up to frequencies of 10,000 cycles per second. It was observed that the deviation from the normal between frequencies of 50 to 10,000 cycles was as low as 3 per cent.

If the variation in the frequency of illumination is measured in this arrangement by virtue of the voltage drop across the output resistance, then on increasing the value of E_a over the value of 12 volts a decrease is observed in the value of the output amplitude on increasing the rate of interruption. The percentage amplitude decrease varies directly with the value of E_a. To investigate this the contacts 1 and 2 in Fig. 1 were introduced, which brought the output to a potentiometer and thereby connected it with an amplification meter MV. P had the value of 200 ohms and connections were such that a Weston thermo voltmeter was included in the circuit. The potentiometer served to vary the resultant amplification of the complete amplifier. Thus it was ensured that the Weston thermo voltmeter read a known proportion of the total amplification.

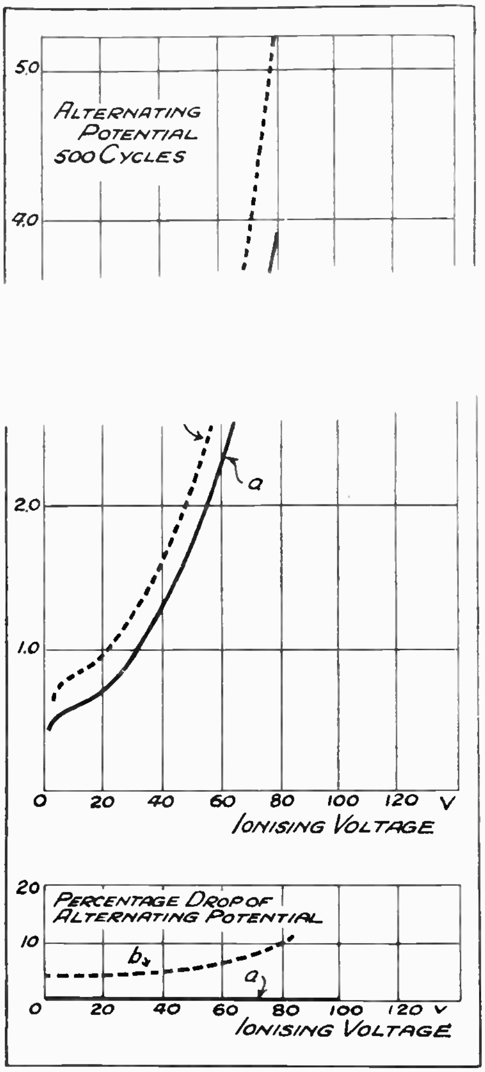


Fig. 6. Curve for potassium cell filled with argon 1.14 mm. pressure.

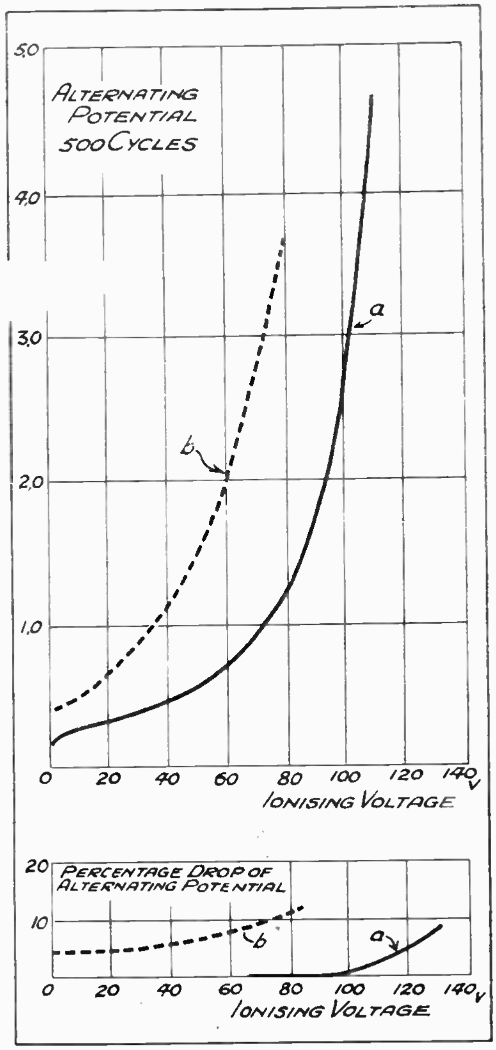


Fig. 7. Curve for potassium cell filled with argon 1.27 mm. pressure.

In the Figs. 3 to 7 curves are plotted with E_a as abscisse and the alternating input as ordinates. No particular irregularity was observable with cells dealing with frequencies from 50 to 500 cycles. The standard value of the input voltage was 2×10^{-4} volts and the loading resistance R_a was $2 \times 20,000$ ohms. Thus the effective photo-electric current was 5×10^{-9} amperes.

The conclusion was drawn that for frequencies from 500 to 10,000 cycles we have

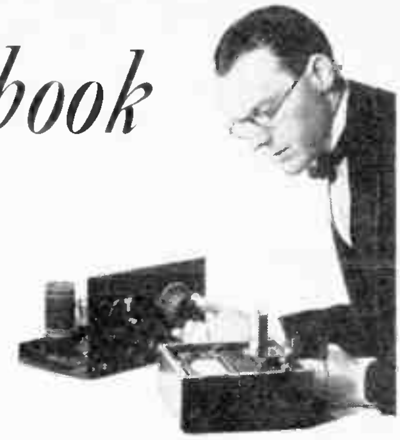
$$d = 100 \frac{A_{e1} - A_{e2}}{A_{e1}}$$

where A_{e1} = alternating input at 500 cycles.
A_{e2} = alternating input at 10,000 cycles.
d = percentage decrease in input voltage at various cycles.

Measurements were carried out by increasing E_a gradually until the E_z value was reached, that is, of course, the value at which the cell begins to glow. These curves denoted by "a" are curves taken before the discharge glow, and "b" denotes the state of affairs after the cell begins to glow. After use the glow voltage became smaller in value.

(To be continued.)

From My Notebook



By *H. J. Barton Chapple*
Wh.Sch., B.Sc.(Hons.), A.C.G.I.,
D.I.C., A.M.I.E.E.

A Giant Osram Water-cooled Valve

FOR many months past the Research Laboratories of the General Electric Co., Ltd., in conjunction with the M.O. Valve Co., Ltd., have been engaged on the design of a new type of water-cooled valve capable of handling an output of no less than 100 kilowatts.

I understand that this is the first water-cooled valve of its size entirely designed, developed and manufactured in England, and its success is a striking tribute to the skill and ingenuity of British radio engineers and valve manufacturers. That it is a giant among valves is revealed by comparing a few of its dimensions with a standard wireless receiving valve, with which all owners of wireless sets are familiar :—

The size of the giant Osram water-cooled valve can be gathered by a comparison with the 30" rule placed alongside

Filament volts, 31·5 volts.
Filament current, 226 amps.
Anode voltage, 18,000 volts.
Length, 3 ft. 6 in.
Diameter of anode, 4 in.
Approximate weight, 18–20 lbs.

The anode of the valve is a solid copper tube and is kept cool in operation by a jacket through which water circulates at a rate of approximately 500 gallons per hour. The glass parts of the valve are directly fused on to the metal parts and this part of the construction follows the same lines as in the smaller water-cooled valves. A new departure in valve construction is that the filament leads, owing to the heavy currents they have to carry, are water cooled.

It is, of course, impossible to forecast what the future of wireless communication may hold in store in the way of further development, but we all hope that the day is not far distant when the needs of television by radio will necessitate the employment of high powers such as can be handled by this new design.

Another Use for Neon Lamps

It is surprising how that versatile product, the neon lamp, keeps cropping up in various spheres. "Televiewers" are familiar with its use in connection with the receiving end of the vision apparatus, but how many know that experiments have been conducted so as to employ the light from the neon for plant culture ?

According to the latest reports, by the careful use of electric light, it is possible to promote the growth of plant life. Already some remarkable results have been achieved by exposing seeds to the rays of a 75 or 100 watt Argenta lamp. In three or four days, seedlings were raised out of a quantity of cucumber seed, developing into hardy and thriving plants. The exposure of plants to a deep red neon light also promoted growth to a remarkable degree, ensuring a very fine green foliage due to an abundant formation of chlorophyll. A very striking fact was that where electric light had been used, there was a total absence of fungus growths, particularly at the base of the seedlings. Furthermore, in addition to flowers being found to benefit from an exposure to artificial light, strawberry plants exposed to rays from neon lamps developed fruits of very high quality.

Listeners in the States

In the British Isles we naturally pride ourselves on the total number of wireless licences which have been issued up to date, 3,521,019 being the total given in January 1931.

This enormous figure is proof of the popularity of wireless and I give as a basis of comparison with the latest returns issued by the United States Board of Trade which states that there are 13,478,000 listeners in the United States. Another notable feature furnished in the same return is that the number of radio sets is proportional to the number of motor-cars. The states of New York, California, and Illinois, show the largest number of receivers, while Nevada is at the other end of the list.

Speaking of wireless reception reminds me also there are to be two more stations in Europe which will add to the number already on the ether. At Bogorodnosja, Russia, a radio station is being built which will have a power of 100 kilowatts and will relay chiefly the programmes from the Moscow transmitter. In addition, transmissions from Western France will be supplemented by those from a high powered transmitter which is shortly to be erected at Le Havre.

The Photo-electric Cell's Varied Duties

Daily we find that photo-electric cells are more and more undertaking industrial tasks which before relied upon more complicated methods. For example, I have just garnered the information that there is a new steel mill which relies on the "electric eye" to open and close its fourteen soaking pit covers.

Before rolling, steel ingots soak for several hours at a very high temperature in covered pits. Overhead cranes continually open and close these pits, putting in huge cold ingots or removing hot ones. In the older mills the crane operator had to wait for a workman on the floor to uncover the pit, but in this instance he has merely to flash a light on suitably positioned cells high on the wall and the soaking pit cover obediently slides back or closes as the case may be. The illumination in the shed will not operate the cells, since they are set for a certain minimum illumination.

Another case which I came across was in the adjusting of the black velvet curtains which frame the picture screen at the cinema theatres. The outer border of a moving picture on the screen changes with the size of the films—the news reel may be a foot wider than the preceding drama. A pair of photo-electric cells are so arranged at the edge of the screen that should the picture suddenly enlarge both receive light and this sets in motion mechanism to draw the curtains aside just the correct amount. The reverse operation takes place if the picture size reduces.

Interference

It is a rather deplorable fact that, especially in large towns, the enjoyment of radio and television programmes is often marred by interference. This interference may be caused by (*a*) atmospheric conditions, which are beyond control; (*b*) electrical or mechanical devices.

The interference caused by apparatus mentioned in (*b*) may be either eliminated or considerably reduced once the cause of interference has been brought to light.

Naturally the detection of the cause of interference is the most important step towards rendering reception free from interference. As a rule the actual cause can only be detected by an expert, but every set owner can make a few simple tests in order to get some idea of the nature of interference.

If your set has an aerial and earth, detach both of them from the set and interconnect the aerial and earthing terminals or sockets of the set by means of a short piece of wire. If the interference becomes inaudible, or at any rate less pronounced, it is quite possible that the interference is not caused in the receiving set but outside. Even if the interference enters your set via the mains and not via the aerial, interconnecting the aerial and earth terminals or sockets will often result in a considerable decrease of interference. If, after the aerial has been detached, the interference is still heard in the same way, there is the possibility of the receiving set being defective. Now loosen the earth connection, but leave the aerial connected. If the interference enters via the aerial it will decrease, but that entering via the mains will increase. It is advisable, when making these tests, not to tune the set to a transmitter.

If the interference is caused outside the set, switch off all electrical apparatus (lamps, electric iron, stove, etc.). If the interference continues, there is every possibility that your electrical installation is not the cause.

Possible Causes

Electrical apparatus in the immediate vicinity that may cause interference can be summarised briefly as below:—

(1) Warming-cushions and electric irons containing a temperature regulator.

(2) H.F. massage apparatus (violet ray).

(3) Electric motors, as used in vacuum-cleaners, sewing-machines, washing-machines, hair-dryers, fans, and other household apparatus.

(4) Electric bells and buzzers.

The interference caused by most of the above-mentioned apparatus may be remedied by using a suitable interference filter, and readers are referred to Messrs. Dubilier Condenser Co. (1925), Ltd., who specialise in this particular product. Then again trouble can accrue from faulty apparatus, such as:—

(1) Loose or soldered contacts in switches, wall-sockets and fuses.

(2) Lamps which are loose in their holders.

(3) Loose contacts in distributing-boxes.

(4) Loose contact of a live wire with the metal frame of electrical apparatus, such as stoves and electric irons.

Any defects in electrical apparatus or installations should be immediately repaired, when detected, as apart from the fact that they cause radio-interference they may also cause fire or electric shocks.

Valve Price Reduction

The General Electric Co., Ltd., inform us that the Power Amplifying Osram Valve, Type D.A. 60, has been reduced in price from £7 to £5 10s. This valve is strongly recommended for use in the output stage of public address and talking picture amplifiers of moderate size.

Useful Hints for the Experimenter

By *V. Dumert.*

THE television experimenter is often handicapped in his work by a lack of knowledge of certain phenomena which belong more strictly to the realm of physics, but whose applications are extremely useful. It is intended here to outline the effects associated with a few of these which have been established by the study of light, and also to describe apparatus by which, it is hoped, they may be harnessed in the service of further experimental work.

One of the simplest and most accurate methods of comparing the speed of motors involves the use of the stroboscope. This was dealt with in the January issue of TELEVISION, but the salient points will be outlined again because the principle is a very important one and so frequently misunderstood. A source of constant frequency supply is required, and the experimenter fortunate enough to have access to A.C. mains will find them ideal for the purpose.

Like the cinematograph, the stroboscope depends for its success on the time lag associated with the human eye, by which an optical illusion can be produced.

Mounting the Disc

A disc such as a circular piece of cardboard three or four inches in diameter is covered with a number of black spots arranged equidistant from each other around the circumference of a circle concentric with the disc. The latter is mounted coaxially with the motor or exploring device whose speed we require to know, and illuminated by focussing upon it the light from a neon lamp flashing at a constant frequency. It will be observed that at certain definite speeds of rotation of the disc the black spots will appear to be stationary. This will be understood from the following explanation.

Suppose in the first instance that the disc has only one spot, and that it is illuminated for a very short period of time once every second. Provided this period is short enough, as it will be in the case of our neon lamp flashes, whose duration does not very much exceed one hundredth part of a second, then the disc will appear to the eye to be stationary during the flash. The shorter the time taken by the flash, the clearer and sharper will become this stationary picture of the disc. As the disc begins to rotate from its position of rest a number of stationary spots appear round the circumference.

Movement not Seen

This number diminishes as the disc gathers speed, at the same time becoming more and more distinct, until a speed is reached at which only one very clearly defined spot is visible. The disc is now making one complete revolution every second, and this causes the spot to take up exactly the same position every time the neon lamp flashes. During the dark interval between each flash the spot is moving round the circle, but this movement we do not see.

Now suppose the speed of the disc to increase slowly from one revolution a second. Each time the spot is lit up by a flash it has not only travelled once round since the last flash, but has also had time to go a little farther. This gives to our eye the picture of a single spot moving slowly round in the direction in which the disc itself is revolving. Similarly, if the velocity

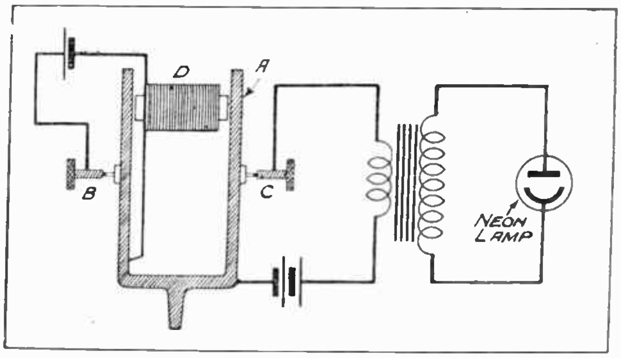


Fig. 1.—One method of obtaining a fixed number of pulses per second for feeding a neon lamp.

of the disc decreased slowly from one revolution a second, we should see the spot slowly moving in the opposite direction.

A Fundamental Speed

Now let us imagine our disc to travel through one complete revolution every two seconds. In one second only half a turn has been completed, and the spot receives a flash when it is half-way round. Consequently, two spots now appear, at opposite ends of a diameter of the circle. In the same way we can see that if the disc took three seconds for a complete turn, then three spots, equally spaced round the circle, would become visible; four spots would appear if the disc took four seconds to go round, and so on.

The speed of the disc at which the number of stationary spots appearing before the eye is precisely the same as the actual number of spots painted on the disc is known as the fundamental speed, and is one revolution per second in the case we have studied. The other stroboscopic speeds each make a number of stationary spots appear which is a multiple of the actual number, and these speeds are themselves sub-multiples of the fundamental.

Expressed Algebraically

If we examine a disc with more than one spot we observe that when the disc is now revolving with its fundamental velocity, each spot must move from the position which it occupies during one particular flash, so that it arrives in time to receive the next flash at the position which was filled by its immediate next-door neighbour during the first flash. If the number of spots on the disc is n, and the lamp is flashing once a second, the time taken for one complete turn is n seconds. But if the lamp is giving out flashes more often than once a second—let us say p times a second—then the interval between successive flashes is $\frac{1}{p}$ seconds. To maintain the fundamental frequency the disc must now take $\frac{n}{p}$ seconds to complete a revolution.

Expressing the matter algebraically, if we let N represent the number of revolutions per second and n^1 is the number of spots on the stroboscopic illusion (as distinct from n, the actual number of spots painted on the disc), then

$$N = \frac{p}{n^1}$$

where $n^1 = n$ for the fundamental frequency.

As was the case with the discs with a single spot, we can increase n^1 to $2n$, $3n$, $4n$, etc., providing we decrease N at the same time by dividing it by 2, 3, 4, etc. The spots, however, are the most clearly defined at the fundamental frequency.

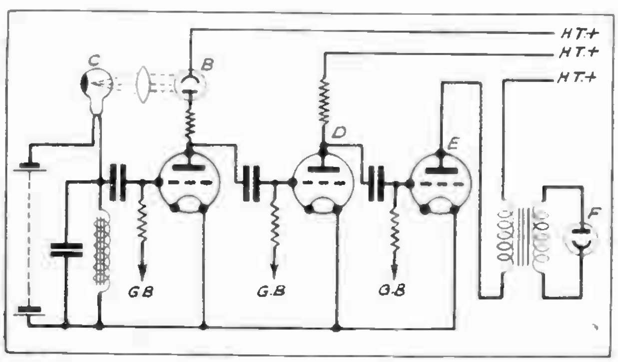


Fig. 2.—When a range of frequencies is desired the scheme shown here may be tried.

A Source of Supply

To cite an example, eight stationary spots on a rotating disc lit up by a lamp flashing forty times a second show us that the velocity of revolution of the disc is $\frac{40}{8} = 5$ turns per second.

The stroboscopic method of rotational speed measurement is capable of being accurate to within 1 part in 5,000.

Fig. 1 illustrates a method of obtaining a fixed number of pulses a second that is suitable for feeding a neon lamp. The prongs of a 50-cycle tuning fork A serve as armatures to the contacts B and C, the make and break of which is effected by the energising coil D, whose field attracts the prongs when the contact B is made, only to release them again in consequence of B being broken by the attraction. With a rigidly mounted fork and clean contacts, bright flashes of short duration and constant frequency have been obtained.

Obtaining a Frequency Range

A means for providing the neon lamp with a range of frequencies is suggested in Fig. 2. The first valve of a 3-stage low frequency amplifier has a photo-electric cell C connected across its input grid circuit and a neon lamp B inserted in the output plate circuit of the first valve. If the grid bias is correctly adjusted, it should be possible to control the light falling from the neon lamp on to the photo-electric cell in such a way as to produce a negative bias at the grid of the valve.

The decrease in the current through B consequently produced would be immediately followed by a corresponding lowering in intensity of the light falling on C, and thus the normal potential of the grid of the valve would be restored. The current in B would then rise again, and the cycle commence once more. The amplifying valves D and E are necessary in order to obtain the required degree of brilliancy for the neon lamp F. With suitable values of inductance and capacity frequencies ranging from 50 to 6,000 cycles per second could thus be obtained.

Light Polarisation

It is generally supposed that for the production of polarisation of light, expensive apparatus is necessary. It is true that great accuracy can be obtained with apparatus which is complicated, but the following method, although very simple, is capable of producing fair results.

The two essential parts of every polariscope are the polariser and the analyser. Light is normally assumed to cause particles of the ether, which is the medium through which it is supposed to be carried, to vibrate in any direction so long as that direction is at right angles to the one in which the light in travelling. When light has passed through a polariser this vibration is confined to one direction only. As the analyser produces precisely the same effect on light, we can see that a polarised beam of light from a polariser will only pass unaltered through an analyser if the direction of vibration produced by the latter is the same as that already caused by the polariser.

If the analyser be rotated, the plane of polarisation of the emerging light will turn with it, and less and less light will get through. Finally, when the analyser is at right angles to its former position, it can only allow light to pass that will produce vibrations at an angle of 90 degrees to those already possessed by the light; in other words, no light can get through at all in this position.

Operation

The polariser seen in Fig. 3 is a plate of glass about ¼ in. by 6 in. by 6 in. which has been coated on one side with lamp black by being held over a smoking oil flame. Fourteen pieces of thin, flat glass, each measuring 4 in. by 3 in., which have been pressed firmly together and held in position by strips of paper glued round the edges, form the analyser. The light is produced from a piece of ground glass plate mounted in front of an ordinary 40 watt electric lamp.

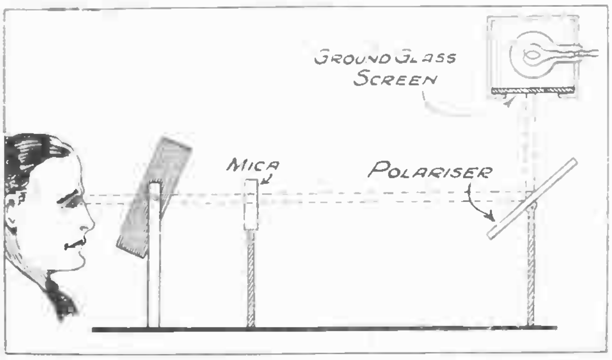
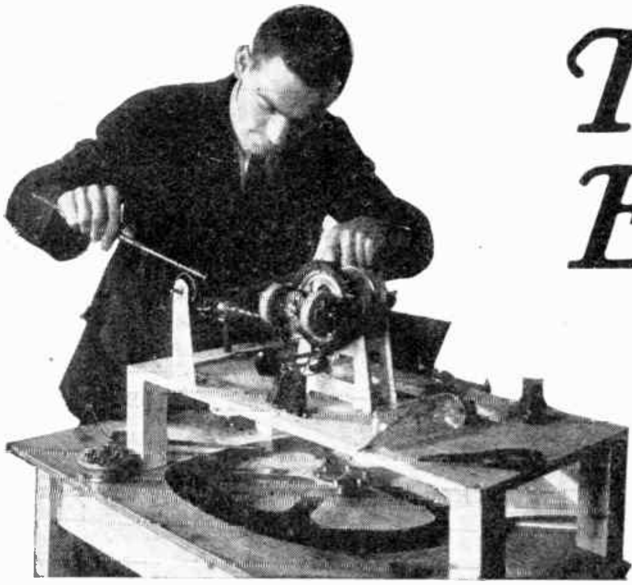


Fig. 3.—Details of a simple polariser which is very inexpensive.

To operate the polariscope the polariser is set up at such an angle as will enable it to reflect an image of the ground glass plate, the light falling on it having at the same time a uniform white tint. The analyser, 4 feet away, can be set up in one position so that this image seen through it does not appear different. As we would expect, a rotation of the analyser through 90 degrees from this position, around the axis of the apparatus, prevents nearly all the light from getting through.

Brilliant Colours

A piece of mica interposed at the proper angle a few inches from the analyser, and between it and the polariser, will produce in the field of view some very beautiful colours, which, however, can be made entirely to disappear by a rotation of the analyser through a further 90 degrees. Still more brilliant colours are formed if a thin plate of yellow prussiate of potash is used in place of the mica, while a powerful magnetic field cutting the beam of light between polariser and analyser would provide another means of producing extinction.



The Enthusiast Sees it Through

THAT the contributors to these columns are enthusiastic followers of television has been proved continually by the prompt manner in which they have responded to our invitations to voice their opinions and give helpful details of their apparatus and reception for the benefit of others. Now there is yet another request we have to make. At present, as is the case with everything in the beginning, the facilities for looking-in are not accorded to everyone. Invite your friends, therefore, to bring their friends and see the television transmissions you receive in your home, encourage them to write down their impressions—the impressions of people who are unbiased in either direction — and send them in to the magazine. In this way you will be able to widen the field of enthusiasts and promote interest of quite a different character. Also do not omit to keep us regularly posted with your own work and experiences, supplementing your remarks with rough pencilled sketches and photographs where possible. Thank you.

A Stroboscope for D.C. Mains

Mr. O'Brien, of 41, Cartwright Street, E.1, has sent us along a note on the use of the stroboscopic effect in conjunction with D.C. mains. Readers will notice that Mr. O'Brien has made use of the principle which Mr. William J. Richardson has ingeniously incorporated in his "Capacimeter," described both in last month's and this month's issue. It serves to prove how invaluable is the neon lamp for television working and, no doubt, experimenters will find the suggestions quite helpful in their work.

"An article in the January issue of TELEVISION led me to consider the best way of using the stroboscopic effect to ascertain the correct speed of the disc on a home-made television receiver working from D.C. mains.

"The motor was 'the first one that could be secured,' and much time was spent during those valuable half-hours at midnight trying to get the necessary 750 revolutions per minute.

"At first a Veeder Revolution Counter was rigged up and the number of revolutions for periods of five minutes was taken at different values of resistance in series with the motor, but the counter loaded the motor as much as the disc itself, and no reliable results were obtained.

"It is a well-known property of the neon lamp that it will flash at a certain definite frequency if it is connected in series with a resistance shunted by a condenser with a suitable value of D.C. volts applied to the circuit. The time T, in seconds, between flashes, is proportional to $R \times C$,

where R = resistance in ohms.
and C = capacity in farads.

"It was found by experiment that if $T = \frac{1}{50}$ secs., i.e., the lamp flashed at a frequency of 50 per second, very good results were obtained. This differs from Mr. Campbell's case of A.C. 50 cycle mains in that the mains give 100 flashes per second.

"It is interesting to note that if C is expressed in microfarads, *i.e.*, $N \times 10^{-6}$ farads, where N = number of microfarads, and R is expressed in megohms, *i.e.*, $M \times 10^6$ ohms, where M = number of megohms, then the product CR is obtained easily by multiplying the number of microfarads by the number of megohms, as 10^{-6} cancels with 10^6.

"Several values of R and C were tried, and it was found that a 2 megohm resistance in parallel with a ·01 mfd. condenser gave a fairly bright glow in a 'beehive' neon lamp, with a frequency of 50 flashes per second.

"These are values which are often at hand, and it is possible fairly easily to find a suitable grid leak resistance and a fixed condenser of the required size in the 'junk box.'

"Actually a Dubilier ·01 mfd. mica condenser (type 620) was fitted with grid leak clips from another condenser, and a Dubilier 2 meg. grid leak placed in the clips. This makes a very neat job and can be fitted permanently to the baseboard of the vision apparatus together with a batten holder for the neon lamp, so placed that the lamp throws a light on the disc. This is a matter for adjustment to suit the existing conditions on the television receiver, and will, no doubt, differ for everyone. It is advisable to turn off the other lights in the room in order to make the most of the neon glow when using the stroboscope.

"The number of spokes is very simply calculated. With the help of Mr. Campbell's article, which the reader is advised to study carefully, we see that the angular velocity of the disc is 4,500 degrees per second, therefore the disc moves through 4,500 ÷ 50 in $\frac{1}{50}$ second. This gives a 90 degrees spacing for the spokes, *i.e.*, 4 spokes, drawn, say, with Indian ink on a circular piece of thin white card, are necessary.

"A useful formula for calculating rapidly the number of spokes for any given conditions of flash frequency or revolutions of the disc is:—

$F = R \times N$ where F = frequency of flash.
R = revs. per second.
N = number of spokes.

and so, for any suitable combination of condenser and resistance for the neon circuit, it is easy to find the required number of spokes."

An Apprentice Contributes his Quota

Although handicapped by lack of funds, since he is still an apprentice, Mr. W. G. Rowell, of Wall, Northumberland, is an enthusiastic television experimenter. With home-made apparatus constructed from cardboard and old scrap material, he has obtained results which are quite creditable. Naturally, he is using every endeavour to effect improvements, and we wish him success in his efforts. He writes as follows:—

"I am forwarding you a brief account of my television experiments, which I hope will be interesting for some of your readers. The apparatus I am using is entirely home-made, and as mains are not available, I have rigged up a 6-volt motor.

"As I had an old dynamo, I thought the best plan was to use it, after a little repair, and it runs at a fairly steady speed. Synchronism is maintained by hand, a resistance bringing the motor up to speed, and a push-button, which short-circuits the resistance, is used for holding the images. The scanning disc is made of cardboard, 17 in. diameter, the square apertures being punched through. Starting with a radius of 8 in. and spaced 12 degrees apart, the holes are one-fortieth of an inch square. The neon is a standard Beehive 100 volt, which is worked from 200 volts high tension and connected in the plate circuit of the last valve. Images are viewed through a cardboard viewing tunnel with two lenses. The wireless receiver is a four-valve S.G. Det., R.C. and transformer, the transformer being a Ferranti A.F.5.

"The results I obtained with the first few transmissions were not encouraging, but after a while better results accrued by using more G.B. Up to the present, all my images are negative ones, but movements are easily observed. Changing the wires on the transformer does not alter image polarity, so I am going to alter the set, making the first L.F. stage transformer coupled, and hope for better results. On Friday night, February 27th, I obtained the best results so far. I tried to pick up the Berlin transmissions on Saturday morning, but the results were poor, due to lack of signal strength. I should be pleased, in the same way as other experimenters, if better times for transmissions could be obtained, since sitting up till midnight for only half-an-hour's enjoyment is miserable.

"Being my first letter to you, let me thank you for the television magazine which has been of great assistance to me. Readers may think my apparatus crude, but my wages as an apprentice do not allow greater elaboration."

Television for the Experimenter

(*Abstract of talk given by Mr. J. C. Emerson, B.Sc., before the Golder's Green and Hendon Radio and Scientific Society, 26th February*, 1931).

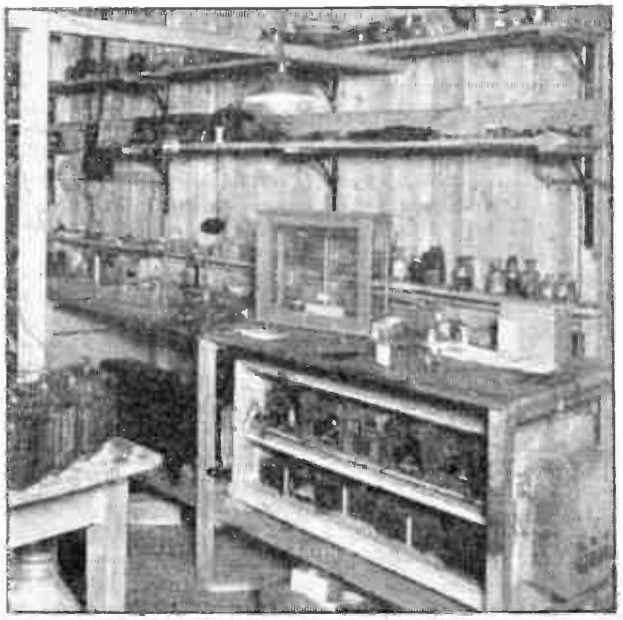
This talk is intended to summarise briefly the work which has been done by television experimenters in the past and to show that at the present time there is every opportunity for the amateur to participate in the development of this absorbing new science.

Television began to receive serious consideration on the discovery of the light sensitive properties

Gramophone records are the "foundation" of the mirror drum receiver mentioned by Mr. Hewel in our correspondence columns. Note the Baird "Televisor" on the left.

of selenium and the essential principle of light scanning was introduced at an early stage. This idea is still the foundation of all modern systems and consists of exploring the object to be transmitted in small elements taken in turn. At the receiving end the image is built up by reproducing each element in intensity and position as it is examined. This involves a knowledge at the receiving end of the position of the scanning mechanism at the distant end, which is most satisfactorily accomplished by motors run in synchronism. No successful alternative to this method has been produced but a scheme interesting from the theoretical standpoint is that, due to Fournier d'Albe, of allotting to each element a tuned reed vibrating only when its own particular frequency is transmitted by illumination of the corresponding element at the distant end.

There are two types of scanning, firstly, that in which the illumination is present over the whole area and selection is made as to which beam is observed, e.g., Nipkow disc, and secondly, that in which a fixed



It has often been emphasized in these columns that the sciences of physics and chemistry are essential in the development of television. This corner of a room in the Baird laboratories bears out these remarks.

narrow beam is reflected or refracted by the mechanism so as to travel over the viewing screen, e.g., Weiller drum, Jenkin's prism, etc. The choice of scanning mechanism is, therefore, dependent on the type of light source employed.

A problem encountered with cathode ray apparatus is to obtain constant speed of motion of the light beam, and the peculiar characteristics of the neon lamp may be usefully employed for this purpose.

The most popular and easily obtainable light source is the neon lamp, and a possible future development is the introduction of a control grid to modulate the main current. Other light modulation methods depend on the Kerr and Faraday effects with polarised light, or on the use of the Duddell and Einthoven oscillograph movements.

Baird has recently developed an arc as light source and although details are not available, a marked advance in reception generally is anticipated as a result of this invention.

Incandescent filaments have not been used so far in positions requiring modulation, although certain possibilities seem worth experimenting upon.

The Baird "Televisor" is well known to most of us, and requires no description.

The Jenkins receiver, used in America, is another commercial product, and uses a neon light source and drum scanning, the principle of light conduction by quartz rods being ingeniously employed.

The author employs drum scanning with a double spiral rotating at 1,500 r.p.m. for receiving Baird transmissions. An auxiliary drum driven by chain gearing allows the two turns of the spiral to be viewed alternately.

The Baird apparatus is the only one which employs automatic synchronising. Two methods are known: the relay method (electrical commutation) is not too successful and subject to hunting, and the toothed-wheel method (magnetic commutation) is widely adopted and gives steady results if sufficient power is available. The use of a separate valve for synchronising is an improvement and experiments are recommended on separate amplification of the synchronising signal using a microphone amplifier.

At the present moment television is broadcast in England from 11 a.m. to 11.30 a.m. on weekdays, and from 12 to 12.30 midnight on Tuesdays and Fridays. These hours do not encourage the amateur, but much better service is expected shortly from stations abroad, and the new Baird short-wave transmitter. It is probably worth while at present to build a motor-driven commutator, giving the effect of a blank picture such as has been used for demonstration in connection with this talk. This will enable scanning arrangements to be checked and synchronising accomplished.

There is a great deal of experimental work required on both of these subjects, and also on light sources. Regarding the latter, the construction of Kerr cells, polarisers, and of oscillograph type movements for the production of a modulated beam of light should not be beyond the scope of the wireless enthusiast. Motors can be cheaply and easily obtained, and the author believes that in a very short time television, as an experimental science for amateurs, will be even more popular than wireless, more especially as the latter science is commencing to feel a lack of new material.

West Sussex Enthusiasts Please Note

In writing to us from Orchard Cottage, Storrington, Sussex, Mr. J. Morford asks us to put him in touch with any other television enthusiasts who happen to reside in his district, namely West Sussex. We are, therefore, passing on the appeal through the medium of this series in the hope that any reader in that locality will immediately get in touch with Mr. Morford with a view to exchanging ideas. In sending us a few details of his apparatus, Mr. Morford writes as follows:—

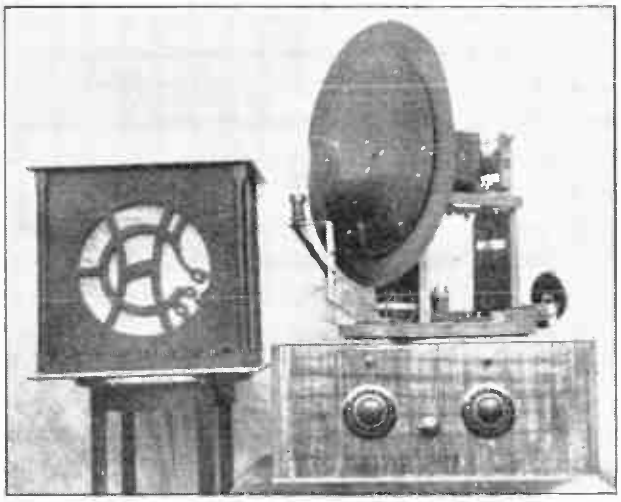
"I have recently fixed up a television apparatus at the above address, and am getting quite fair results. The distance from the London Regional transmitter is approximately sixty miles. The following particulars may be of interest to you:—

"Receiving set: One S.G. (P.M. 16) followed by anode bend detector (P.M. 6.D.), then three R.C. stages (L. 610, P. 610, and two parallel fed P 625 A's).

"The aerial used is of the squirrel cage type. The output circuit is connected in series with the coils and neon; 350 volt H.T. (accumulators) being used. The 'Televisor' is made up principally from Baird standard components, a 6-volt motor being used. One small 'gadget' I employ may be of interest to you. The set output is shunted by a *very* small condenser (approximately .00001 mfd.) in series with a pair of headphones; this is of great assistance in making tuning adjustments when the 'Televisor' is working.

"The actual image received is good (atmospheric conditions permitting), plenty of detail showing up.

"Wishing your very excellent paper every success."



A good view of Mr. H. E. Christie's apparatus with which he has been able to achieve such good results in Portsmouth.

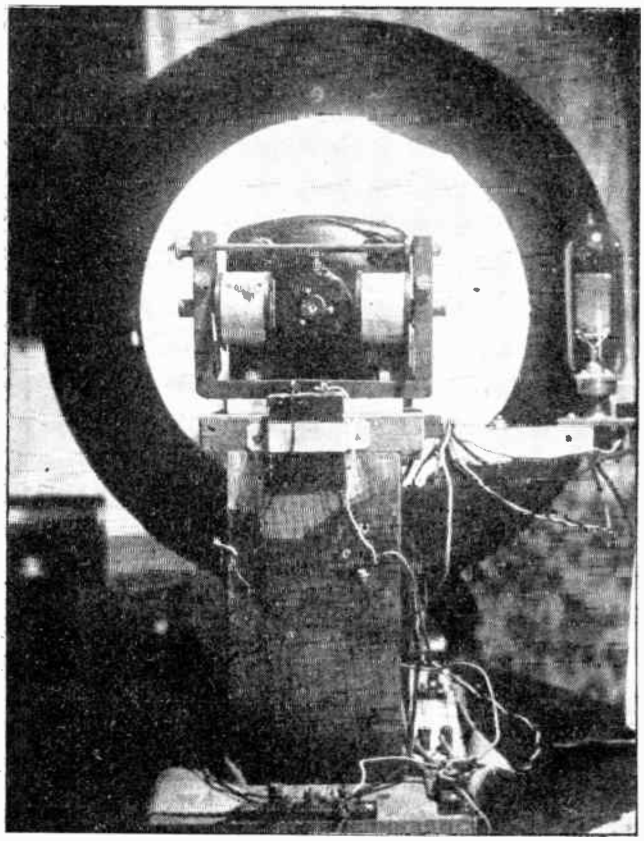
A Year's Progress

To be able to say that he has not missed one midnight transmission and has included several of the morning programmes in his past year's work in connection with television, is surely a matter for congratulation to Mr. H. E. Christie, of 94, Suffolk Road, Milton, Portsmouth. In sending us details of his year's progress he points out that it would now be difficult to improve upon his reception in Southsea, bearing in mind, of course, the question of apparatus cost. We extend our best wishes for continued success to Mr. Christie and are sure our readers will take further heart when they read of what can be done when the spirit moves.

"It was in the April issue of TELEVISION, 1930, that you published my first results of television. Since that date I have not missed *one* midnight transmission and have included several of the morning programmes.

"There have been transmissions when, owing to atmospherics, it has been a little trying to make a picture, on the other hand it is great credit to the Baird Co. that of the midnight transmissions only once have they failed to work the half-hour allotted to television.

"It will be taken for granted that I have improved my results after all these runs. I have no difficulty now in producing a picture that is worth 'looking into.' The permanent wave of the lady artists comes over very well. I judge the quality of my picture by this.

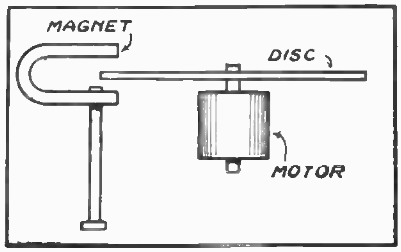


After considerable experiment Mr. Christie has included a fixed magnet system for synchronising and moves the disc on the shaft for framing.

"The circuits and different combinations of valve couplings that I have experimented with are too numerous to detail here, but out of them all I have built a special set which I think it would be difficult to improve upon for reception in Southsea, not forgetting the expense side of the apparatus required.

"The set has a screened grid valve connected to a grid leak detector on to a PM4 through an AF5 transformer on to a P625 valve through another AF5 transformer. The neon lamp and the synchronising coils are in series with the plate of the P625 and are supplied with 500 volts. This gives a definite pull on the synchronising system and the picture can usually be held throughout the half-hour run. I, like most experimenters, worked for a long time with various devices for keeping the picture in the 'gate' not having facilities for building the moving magnet system which seemed to be essential for framing. I eventually decided to fit a fixed magnet system and hoped the picture would always fall in the 'gate.' Of course, it did not do so and some means had to be found for correcting or framing the picture. This was accomplished by slotting the three securing holes in the disc so that it could be moved round in relation to the 30-toothed wheel of the synchronising device. If the picture is not framed correctly at the commencement of the run it is just half-a-minute's work to stop the motor, loosen the three wing screws, move the disc round a fraction of an inch, and after tightening up start the run again. It is seldom I have to make two adjustments now. This method is very crude as compared with the Baird device, but it is within the scope of the amateur workshop. If the idea is not clear I shall be pleased to give fuller details.

Bare details of the speed control idea employed by Mr. Jenkins.



"The audible side of the Baird transmissions is received on a set with 'push-pull' output to a moving coil loud-speaker; this set is really too large for the time of night and also emphasises the fact that '. . . we are now closing down until 11 a.m. to-morrow.'

"I am enclosing three prints of my apparatus and I hope I am not too late for the April issue because it is, as I have stated, just twelve months since you published my first results.

"And now, Mr. Editor, for your last twelve issues I thank you."

A Club for Weston-super-Mare?

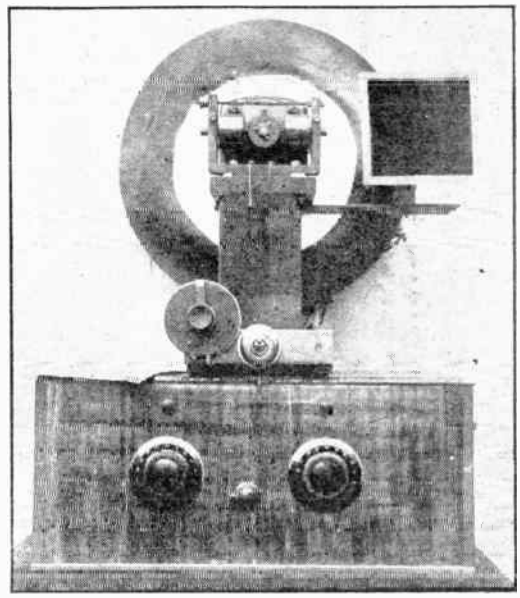
Mr. E. Jenkins, of 127, Moorland Road, Weston-super-Mare, is anxious to get in touch with any readers in his district with a view to forming a club. This is an excellent suggestion and we hope that anyone reading this paragraph will immediately write to Mr. Jenkins and in this way come together so as to foster the spirit of television and make it more widely known. Mr. Jenkins sends along a suggestion for regulating the speed of the television disc and we have pleasure in passing on this information so that others can try out the scheme.

"I am pleased to say I have been a reader of TELEVISION since No. 1 issue, and have followed with interest reports from readers on the results they have obtained. It is six months since I have experimented in the reception of television and I received fairly good images with a very simple machine of my own making consisting of a small universal motor "Polar Cub," beehive neon and a 12-inch 30-hole disc. After trying several methods of speed control I used with great success a very powerful horseshoe magnet mounted on a convenient rod and bracket the disc running between the poles as shown. Maximum speed is obtained when the poles are just clear of the disc and when the poles are covering each side of the disc a powerful braking effect is obtained. By slowly rotating the magnet to or from the disc a fine variation of speed is obtained without jumping. I can recommend this method for a beginning, having held the whole half hour's transmission with just an occasional up and down motion of the image.

"The receiver used was a straight Det. and 2 L.F. transformer coupled to a super-power valve, 200 volts H.T. These results were obtained in Bristol during last autumn and since coming to reside at Weston-super-Mare, I find the Brookman's Park transmissions subject to fading on sound broadcasts, and I am constructing a new set and vision apparatus being anxious to see what results can be obtained here.

"I am connected with the wireless trade in Weston and have not met anyone interested in television sufficiently to own a home-made or commercial 'Televisor.'

"Perhaps a club could be formed here, and I should be glad if any of your readers who reside in this district would get in touch with me.



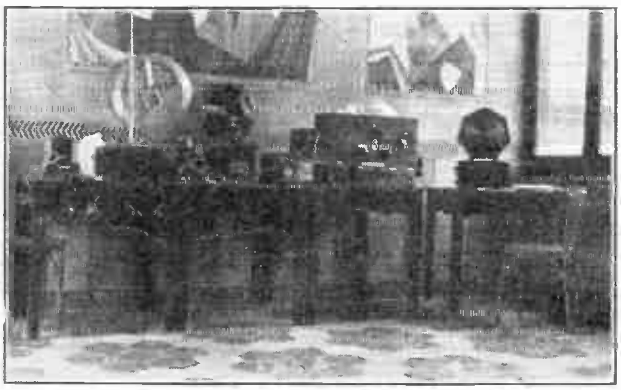
Another view of the vision apparatus and wireless receiver referred to on the opposite page.

"Like most of your readers I can only find praise for your journal, but a month is just a bit too long to wait for the next issue and the transmissions are too short. Wishing your paper every success."

Reception of Baird Television in Rome

By *R. Bocchi*

FOR some time past, having taken considerable interest in the theory and principles of television, I have, as a supplement to this, been following very keenly the practical experiments carried out in this field by a promising young engineer friend of mine in Rome, one Dr. Carlo Bonanome. This engineer with diligent application has evolved an interesting television receiver on the lines and system of our illustrious pioneer, Mr. John L. Baird. For those who are also attracted by the possibility of seeing at a distance, a short account of this week's reception in Rome of the experimental television transmissions, which as everyone doubtless knows are radiated by the "Brookman's Park twins," the Regional on the wavelength of 356·3 transmitting the "image" whilst the National transmitter propagates the "sound" inherent to it on 261·3 metres, these stations being linked with the studios of the Baird Television Company at 133 Long Acre, London, for the period of half an hour (I would it were more!) every Tuesday and Friday night from 12 midnight to 12.30 a.m. G.M.T., may possibly interest them. Therefore a further improvement having been effected in my friend's apparatus it enables me to tell of my experiences



A comprehensive view of the television apparatus constructed and installed by Dr. Carlo Bonanome.

of reception on Tuesday and Friday nights of this week (*i.e.*, February 24th and 27th).

Artists in Character Make-up

On Tuesday night no sooner had the last vibrations of Big Ben died away, with the voice of London bidding the world good-night, than immediately, as usual, came the synchronising signal from the Baird studios, and in went the switches controlling the television motor (which serves to spin the perforated disc at its 750 revolutions per minute), and the neon lamp. A few moments passed and then the transmission proper began with the result that no sooner was the synchronising of the receiving apparatus definitely established than the whirling pinkish white line bands, created by the rotation of the perforated disc before the neon lamp, resolved themselves into the image of a young lady singing to piano accompaniment plainly audible in the second wireless receiver, utilised on this particular evening for the reception of sound.

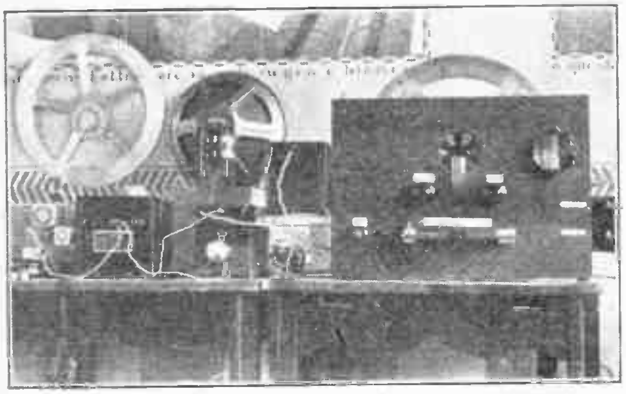
This item was followed by a gentleman singing "Ridi Pagliaccio" (from Leoncavallo's opera, "i Pagliacci"), also with piano accompaniment. The image at the moment of its greatest clarity showed the singer dressed with the frilled collar of the clown which is in keeping with his song. The best item received in this transmission (the image signal on 356·3 metres coming in with excellent strength and quite undistorted by any static) was a really very good rendering by violin and piano of "Svenson's Romance." The image of the violinist was very clear indeed, and all his movements were quite sharply defined.

A Sense of Completeness

Just before the conclusion of the programme some block-letters were passed before the photo-electric cells at the studio, but, unfortunately, I was not able to see these well as at this particular period the reproduction in the vision apparatus was disturbed and distorted by "fading" and the untimely intervention of static discharges.

Friday night's reception may be said to have been equally successful, except for the fact that I noted rather more disturbance from the two prime nuisances already mentioned. Again I beheld the picture of a young lady singing, turning her head from side to side, while raising her hand to her face and head, as also the putting on and taking off of a hat, and her movement was perfectly clear. Next a gentleman spoke. This time in the case of the block letters transmitted I was able to distinctly read the words "Carter" and "Saxophonist," which passage of letters was immediately followed by a gentleman playing the saxophone, which incidentally brought this programme to a close.

Here it is interesting to mention that for the sake of experiment on the Friday night the sound receiver was eliminated. This absence of the second wireless receiver stressed, most acutely, its necessity, and I formed the opinion that, whilst we have in wireless become accustomed to hearing without seeing, where seeing only is concerned, hearing is of primary importance; as otherwise, there is provoked most deeply the sense of something vital missing, which in hearing only, as in wireless up to now, is by no means so pronounced. I therefore consider that in television reception the use of two receivers is absolutely essential, one for the image, and one for the sound.



Extreme care has been given to the vision apparatus seen on the right of this photograph.

Certainly with such an installation in use the fact of seeing as well as hearing gives one an enormous sense of completeness even as matters are now with television in its present stage. After all, I suppose that this is only natural, as being able to see as well as hear means that we have at our command the use of our two most intellectually important senses, which assuredly hold first and second place where all five are concerned.

Contrary Factors

In a way, seeing the great number of wireless enthusiasts of the experimenting and home-constructing type in existence, it is a little surprising that there is not more general interest in television (in fact, generally speaking, in this part of the world I have found that image transmission by the Fultograph process seems universally to be accepted as the system meaning television), and more attempts made on the home-constructing of vision apparatus which, with the exception of the arrangement of automatic synchronising (which is a little tricky though of paramount importance), are by no means so very difficult to assemble.

As far as I can see the two most contrary factors are: (1) the inconvenient hour of transmission (here, for instance, reception takes place at 1 to 1.30 a.m., being Central European time); (2) the necessity of having two wireless receivers, one for the image and one for the sound wave. In England or close to the transmitter the question should become simplified, for, if within range, only a crystal set with a pair of headphones would be necessary for the sound part of the programme, thus doing away with the extra valve set. Further, being close to the transmitter means that valve receivers need not function at the utmost sensitivity, and thus the disadvantages of "fading" and "static" interference are greatly reduced or eliminated altogether.

Sensitive Wireless Receivers

Situated far away, as one is in Rome, it is impossible to avoid this type of trouble, and the would-be "televiewer" and hearer must perforce put up with these hideous annoyances, for the receivers must be sensitive to the utmost, in order to get strength of image and sound. This means that if there is fading present the image in the apparatus duplicates or fades away, and if there is static too, then over it will appear darting white flashes, ills which, I am afraid for the present, have no cure.

Nevertheless I think it safe to predict that it is now only a matter of time, a year or two, and the Baird "Televisor" will become to the public as indispensable as the wireless receiver is to-day in the modern home. When this is the case it will be a pleasure for those who are trying to look-in to-day to remember they were amongst the first in the field of this wonderful outcome of modern science.

Measure Your Signal Volts

PART II.

The Simple Construction of a Valve Voltmeter

By *D. R. Campbell*

IN last month's TELEVISION the theoretical aspect of the valve voltmeter was discussed, and now we must turn our attention to the construction of an actual instrument, the theoretical circuit of which is given in Fig. 1. Broadly speaking, the instrument is an anode bend rectifier, the resistance R_2 being arranged so as to secure an automatic increase in grid bias as the anode current rises, this action giving the instrument a considerably wider range than if it was omitted. The switch S_2 short circuits the resistance R_2 when it is required to use a more sensitive range. S_1 is the "on" and "off" filament switch. The reader who did not peruse last month's article is advised to do so, for fuller details of this circuit. The terminal marked "meter" plays no part in the instrument used as a valve voltmeter, and is only included so that the microammeter may be conveniently used for other purposes without disconnecting any of the wiring.

Panel Assembly

The construction of the instrument is extremely simple. The ebonite panel should first be marked

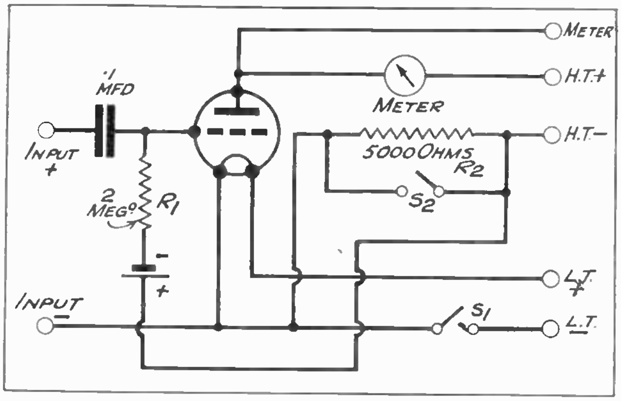
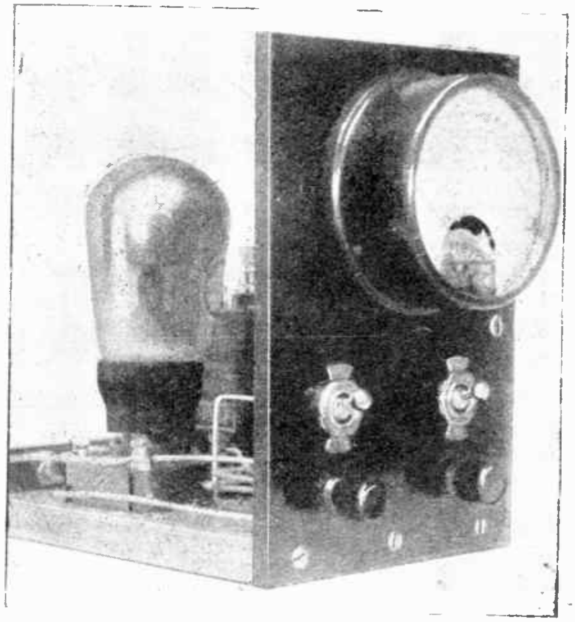


Fig. 1.—Examine the theoretical circuit carefully before undertaking any constructional work.

out and drilled as in Fig. 2. As the meter is of the projection type only two holes have to be drilled to take the terminal shanks at the back. Do not forget while drilling operations are being done that the terminal strip will also require five holes $\frac{5}{8}''$ each between centres. When fitting the switches S_1 and S_2 it will be found that an engraved name-plate inscribed "on" and "off" is supplied. As this inscription is not suitable for S_2 it is suggested that the plate is reversed and, as the other side is plain, it may be more appropriately marked.

The general layout and wiring can be seen clearly



The front of panel is quite symmetrical, while the meter has a good open scale.

from the photographs of the instrument, studied in conjunction with the diagram Fig. 3. In wiring up it is advisable to commence with the input leads first, owing to their position under the switches, the rest of the wiring following from the baseboard upwards.

Components

A list of components as used in the instrument illustrated is appended, and although substitutes of similar quality may be used, it must be pointed out that it may not be possible to fit them into the given dimensions.

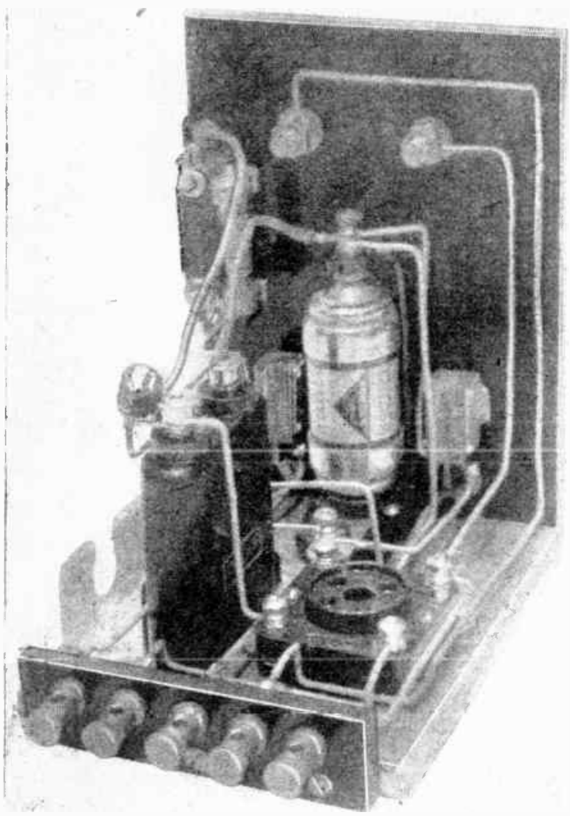
One ebonite panel, 6" by 4" by $\frac{1}{4}''$ (Trelleborg Ebonite Works, Ltd.).
One ebonite strip, $3\frac{1}{2}''$ by 1" by $\frac{1}{4}''$ (Trelleborg Ebonite Works, Ltd.).
One 0/500 microammeter, Model 301 (Weston Electrical Instrument Co.).
One anti-phonic valve holder (Formo, Ltd.).

One 5,000 ohm wire bound resistance and holder (Varley, Ltd.).

One ·1 mfd. mica condenser (Dubilier Condenser Co. (1925), Ltd.).

One 2-meg. grid leak and holder (Dubilier Condenser Co. (1925), Ltd.).

One $4\frac{1}{2}$ volt grid bias battery (Siemens)



Used in conjunction with Fig. 3, this photograph will help you to position all the leads.

Two insulated terminals, Type R (Belling and Lee Ltd.).

Two midget wander plugs (Belling and Lee, Ltd.).

Two Toggle on/off switches (A. F. Bulgin and Co., Ltd.).

One G.B. battery clip, No. 2 (A. F. Bulgin and Co., Ltd.).

Five small telephone terminals.

Wooden baseboard, $4\frac{1}{2}''$ by $4''$ by $\frac{3}{8}''$, Glazite and flex wire.

The choice of valve may be considered separately. A high amplification factor is of prime importance for sensitivity, and with this object in view the following list is suggested :—

Maker.	2 volt.	4 volt.	6 volt.
MULLARD	PM1A	PM3A	—
COSSOR	210 RC	410 RC	610 RC
MARCONI-OSRAM	H 210	H 410	H 610
MAZDA	H 210	—	H 610

It is for the constructor to make his own choice of valve, but the writer uses a Marconi H 610.

Refer to the Characteristics

Having decided on the valve to be used, if possible take the characteristic grid volts/anode current curves. Apart from giving accurate information concerning the valve, the set of curves will come in useful when choosing a similar valve, should it at any time be necessary to replace the original one. In addition, it is advisable occasionally to check up the valve to ascertain that it is up to its original standard of performance. If the valve characteristics have been taken it will be necessary to refer to the curves to ascertain the correct high tension voltage for a given grid bias to work at the most sensitive

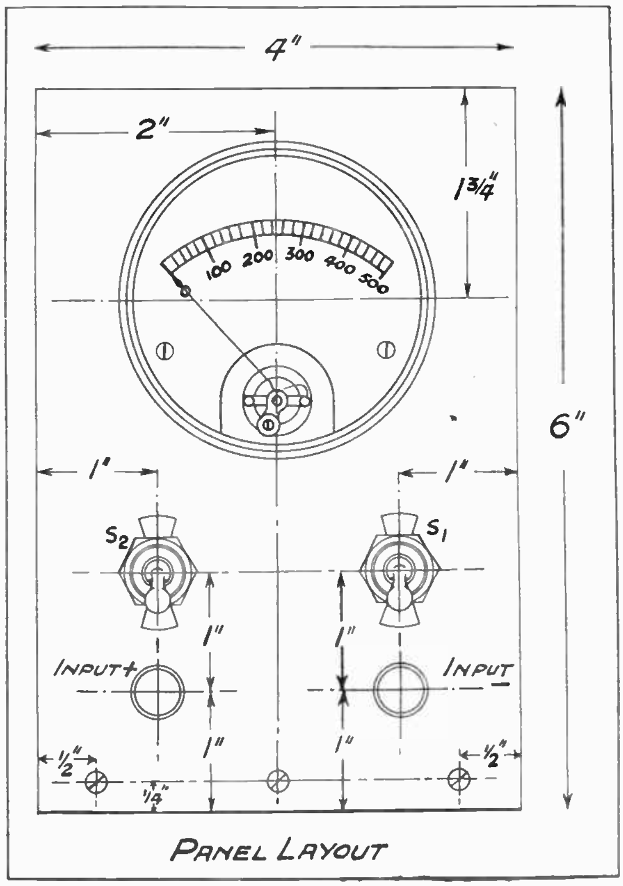


Fig. 2.—Complete details for marking out the panel prior to drilling operations.

part of the curve. If, however, it has not been possible to obtain the valve characteristics this information can be gleaned from the maker's curves included in the valve carton.

Place the valve in its holder and adjust the grid bias to −3 volts. Switch on the filament, and starting at, say, 60 volts high tension, zero plate current should be recorded. Gradually increase the voltage, probably to about 130, when the meter will indicate about 20 microamperes. The above operations should be carried out with the switch S_2 closed.

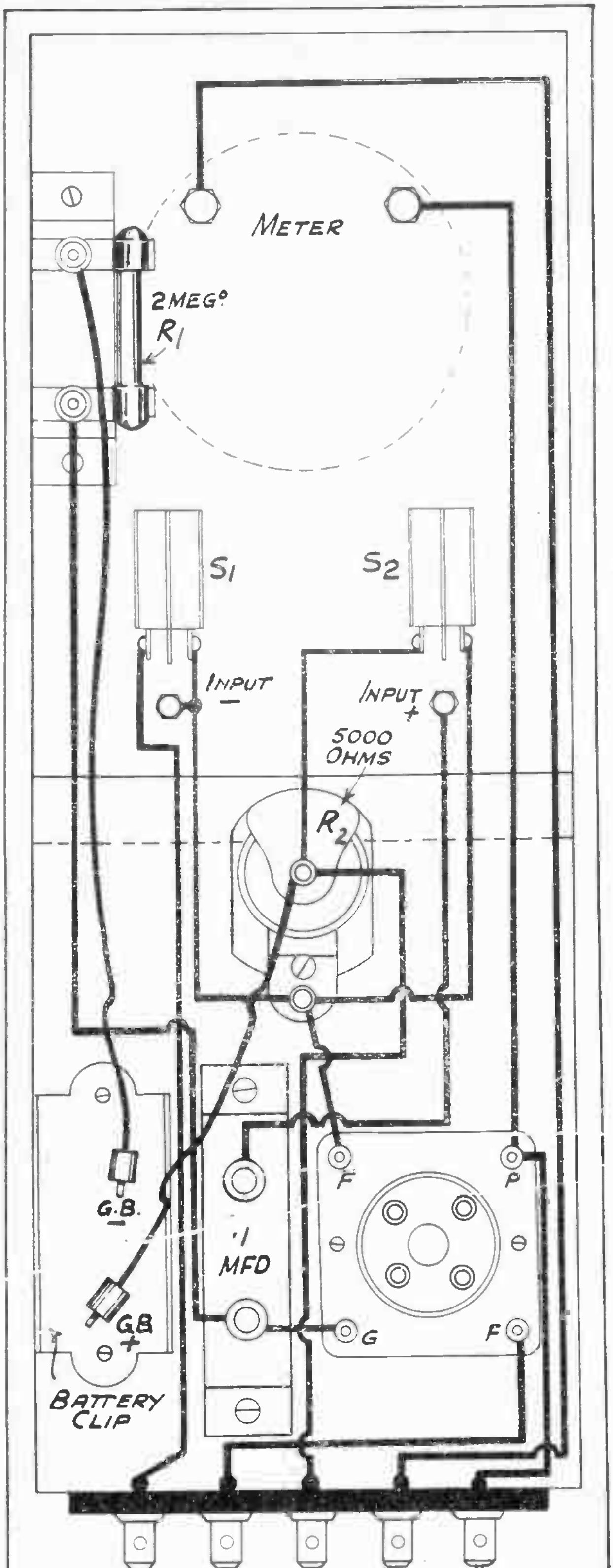


Fig. 3.—Neat and compact, little difficulty will be experienced in wiring if this diagram is followed carefully.

At this stage the input terminals may be connected across the grid to filament of a low-frequency valve in a radio receiver, and as a station is tuned-in gradually the meter needle will at once respond to the signal swinging in time with the louder passages of the music or speech. Do not connect the instrument across a valve of your receiver when it is fully tuned-in to commence with, as considerable voltages are developed which might easily result in an overload. Gradually increase the signal strength until a generous scale reading is obtained. Open switch S_2, bringing in the automatic bias resistance when the reading will drop to about half the previous one. Considerable increase in signal strength will now be required to obtain the original deflection.

At this stage the instrument can be used to compare signal strengths, but the results cannot be

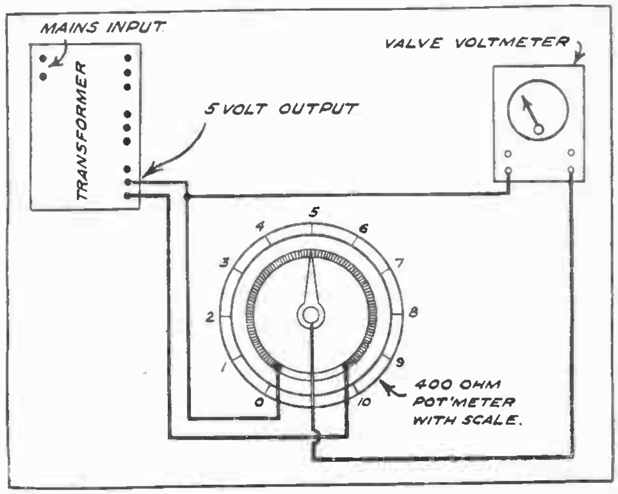


Fig. 4.—When calibrating the valve voltmeter access to an A.C. source is provided by a suitable step-down mains transformer.

expressed in any definite units, and for a wider application calibration is necessary.

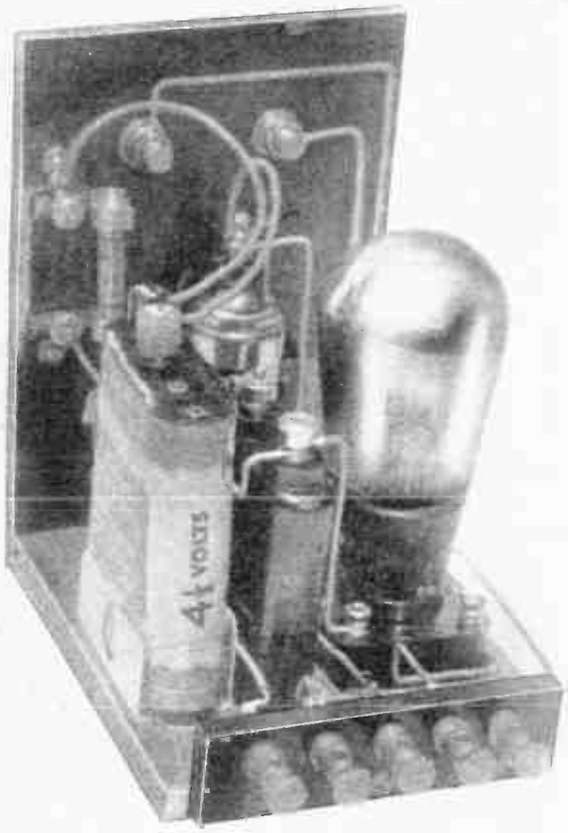
Calibrating the Instrument

The two ranges of the instrument are approximately 2·4 and 3·9 volts A.C., using a Marconi H 610 valve and grid-bias —3 volts, H.T. 145 volts, and correspondingly higher or lower ranges can be obtained according to the valve and working voltages chosen.

To calibrate, a known source of A.C. voltage must be available, the most convenient being that from the 5-volt winding of the usual "all-mains" transformer. This winding is generally used for heating the rectifier valve, and is always centre tapped, which gives a useful 2·5 volts for the more sensitive range of the instrument.

Take a resistance such as a filament rheostat of the common circular wire-wound type of a value not less than 5 ohms, or a potentiometer. Suitably mount the resistance with a piece of card conveniently attached, and marked off into ten equal parts of the linear length of the actual resistance element.

Connect the resistance across an outer and the centre tap of the 5-volt winding of the transformer, as in Fig. 4. Now the difference in voltage across any of the ten equal parts is ·1 of the voltage across



A rear view of the completed instrument showing valve and G.B. battery in position.

the whole, which in this case is 2·5, so one has ten different voltage tappings of ·25 volts each.

Plotting Curves

A calibration curve is obtained by plotting A.C. volts input against anode current. Before making the calibration note carefully the voltage across the filament, the high tension and grid bias volts, as the calibration will hold good only at these values. While plotting the 2·5 volt range it is convenient to alternatively open and close the switch S_2 at each tapping of the calibrating resistance and draw the two curves simultaneously. For the completion of the high range curve the resistance is connected across the outer terminals of the transformer winding which will give ·5 volt per tapping, the switch S_2 remaining open. Finer calibration may be obtained by dividing the resistance into a greater number of parts.

It need hardly be stressed that the valve should be used only in the instrument, and for no other purpose if it is to retain its characteristics and the instrument its calibration.

Working Hints

In most radio receivers higher voltages than 5 are present, and though valve voltmeters may be made to indicate any voltage, under suitable conditions, it will be found more convenient to have the two calibrations suggested, and when one wishes to measure higher voltages, to use externally a tapped resistance in a similar manner as when calibrating the instrument, the total value of which must at least be comparable with that already in the circuit. Unfortunately, variable resistances in the form of volume controls have tapered resistances, and therefore unless specially calibrated are not suitable.

Either metal or wood may be used to house the instrument, according to the constructor's tastes and capabilities.

Some of the many uses of the valve voltmeter have already been outlined in last month's article, and it is suggested this should be generally referred to.

As a guide to the strength of the signal necessary for the satisfactory reception of television by radio a signal voltage of ·4 volts is required across the grid filament of the first valve, in the type of low-frequency amplifier so ably described by Mr. William J. Richardson in an article on low-frequency amplifiers for television in this magazine of March, 1930.

Attention to the High Tension

PART IV.

By *H. J. Barton Chapple*,

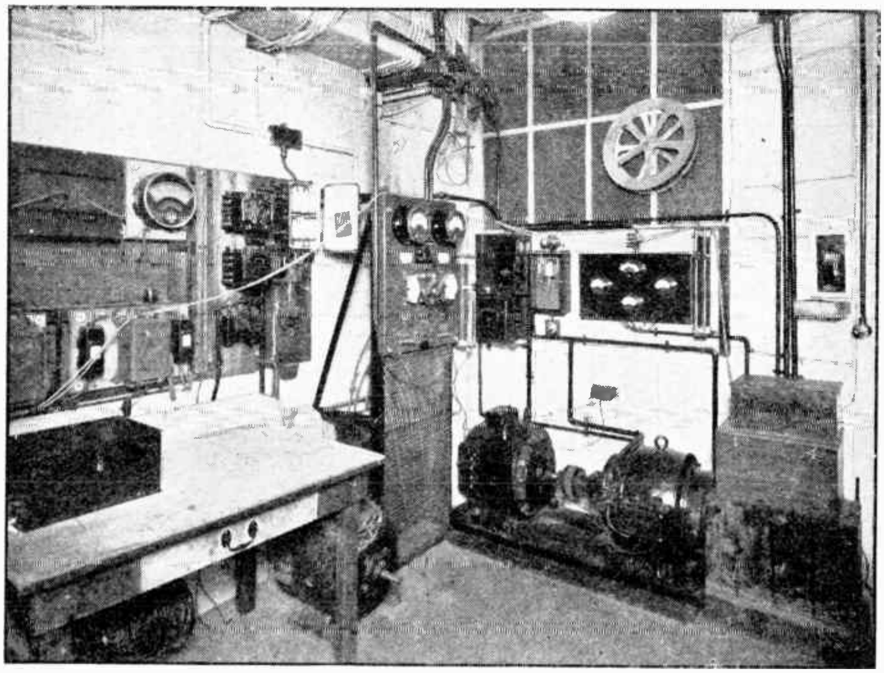
Wh. Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

HAVING satisfactorily disposed of the questions arising from the use of D.C. mains, we can now pursue our investigations to embrace the A.C. side. Here we meet a voltage or current which alternates or pulsates from a maximum positive value through zero to a maximum negative value and back again (see *A* of Fig. 1). The frequency with which this effect takes place is, at the moment, not standardised in this country and may vary from 25 to 100 cycles per second according to the particular locality in which one happens to reside.

A One Way Device

In its natural form we, of course, realise that an alternating current supply is useless for working in conjunction with wireless receivers, either for aural or television purposes, and the first step towards rendering the supply suitable is to "rectify" it. Put simply, this means that the negative half of our cycle of changes has either to be rendered inoperative or reversed so that the resultant current, although it may not be regular or smooth, is at least unidirectional.

We carry this into effect by using apparatus which has a non-return action, that is, allows current to flow in one direction but bars its passage in the opposite direction. When used in the simplest manner the effect of the half-wave rectification is to produce the condition shown at *B* in Fig. 1. In addition, however, it is possible to interconnect the "one-way traffic devices" so that the positive and negative effects are combined, and we are left with full-wave rectification as at *C* in Fig. 1. Generally speaking, the full-wave rectification is the better method to use, and we must now investigate the ways and means employed to bring about rectification generally.



Motor generating plant in the Baird laboratories. These machines furnish a 4,000-volt and 2,000-volt D.C. supply and a 230-volt A.C. supply.

Types of Rectifiers

There are really four types of rectifiers which can be used: thermionic valve, metal rectifier, electrolytic rectifier and gas rectifier, and as far as the over-all process is concerned the principle is the same. Turning to Fig. 2, we have a mains transformer whose primary is joined to the alternating current supply, while the extremities *A* and *B* of the secondary winding pass to the anodes of a pair of *two* electrode valves. The filaments of these valves can be fed from a special filament winding on the same transformer, as indicated, and the centre taps *C* and *D* on these two secondary windings connect to a fixed condenser.

Considering the action, we find that during one half of the voltage cycle the end of the secondary winding marked *A* is made positive, *C* is zero, and *B* is negative. A stream of electrons, that is a thermionic current, therefore passes from the valve anode to C, and since these electrons are negative in character they impart a negative charge to the top plate of the fixed condenser. Similarly, during the second

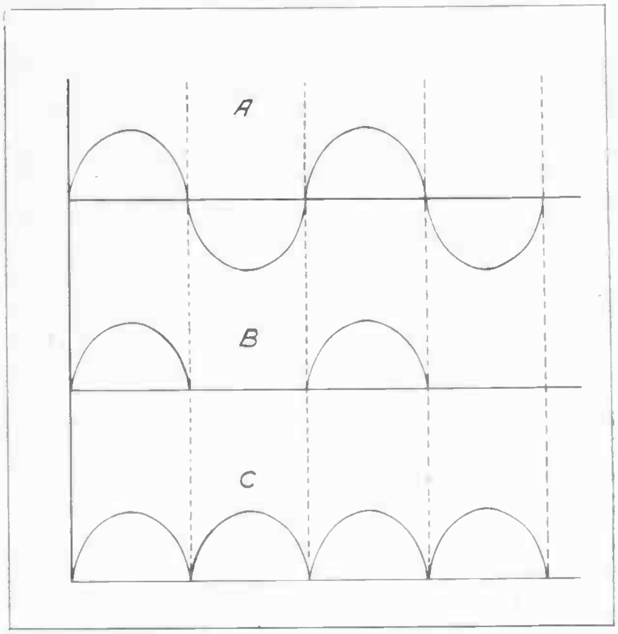
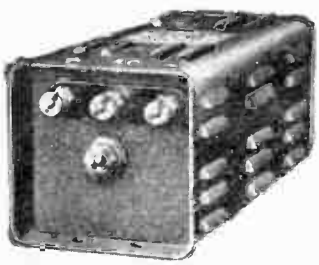


Fig. 1. Indicating alternating current at A with a half wave rectification curve at B and a full-wave rectification curve at C.

half of the cycle B is now positive, and electrons flow from the second valve to C and impart an identical charge to the same end of the condenser. Since this cyclical process continues indefinitely while alternating current is fed into the transformer primary winding, we have a condition created whereby the top end of the fixed condenser is maintained at a negative potential. By induction the opposite condenser plates are made positive, and we are thus presented with a unidirectional voltage. This will require "smoothing" to eliminate any form of hum or ripple, but, as we see, the process is a particularly



A sample of the Westinghouse metal rectifier of the H.T. 7 type

simple one and finds considerable application for television purposes.

Modern Rectifying Valves

In the case illustrated two separate diode valves are featured but modern rectifying valve practice is to incorporate these within one glass bulb, the full wave rectifying valve consisting of a single filament and two anodes. The theory of operation is identical but the valve is more convenient in this form. One of the accompanying illustrations shows a typical Mullard valve of this type—a D.W.30—and this valve is capable of giving an output of 120 milliamperes D.C. with a maximum output voltage of 500 R.M.S. This is admirably adapted for television purposes; in fact, is in excess of normal requirements, and in a future article I shall explain fully how to construct eliminator units, using the latest full-wave rectifying valves.

A Metal Rectifier

Of late there is another form of rectifier which has come into popular use, namely, the Westinghouse metal rectifier. This has many advantages, being

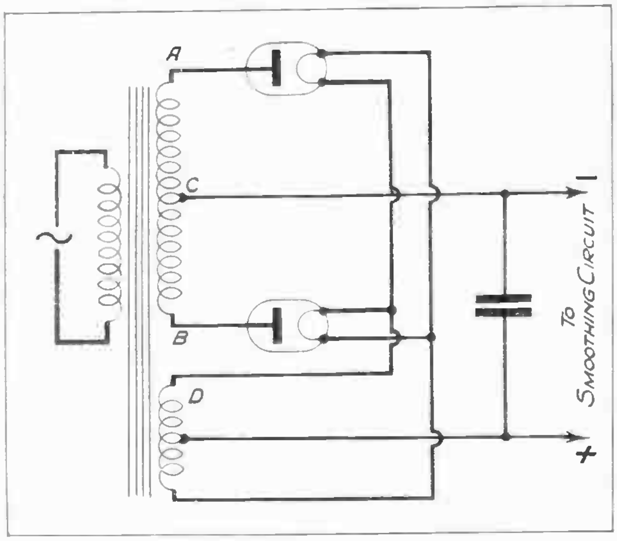


Fig. 2. Diagrammatically illustrating how full wave rectification takes place with a pair of two electrode thermionic valves.

compact with no moving parts requiring maintenance. Essentially it is an electronic device depending for its operation on electronic action at a permanent junction between copper and copper oxide. No chemical action takes place during the process of rectification, and, moreover, it has quite a high efficiency—between 50 per cent. and 60 per cent.

The construction of the unit is shown diagrammatically in Fig. 3, every unit being assembled on steel bolts with the number of discs in series and parallel connections varied to suit the voltage and current output required. This rectifier is virtually a cold electronic valve, and depends for its action as a rectifier on the fact that the ratio of the resistance from copper to oxide coating is very high compared with the resistance from oxide coating to copper. The ratio between these two resistances is of the order of 1,000.

Three Methods

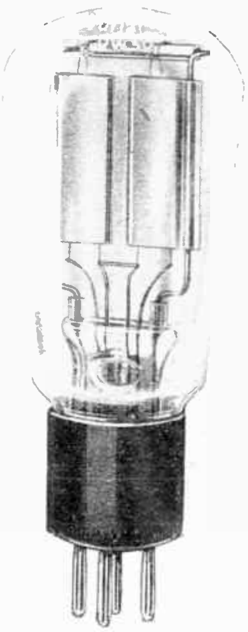
In practice there are three methods of obtaining full-wave rectification, these being known respectively as :—

(*a*) The centre tap.

(*b*) The bridge.

(*c*) The voltage doubler.

These are illustrated in Fig. 4 (*a*), (*b*) and (*c*), corresponding with the method lettering just given. It will be seen that the "centre tap" connections are really identical with that shown in Fig. 2 for the thermionic valve rectifier, and the same explanation holds good. In actual practice the "bridge" connection (*b*) has the principal advantage over the "centre tap" method (*a*) in that the voltage across the secondary winding of the transformer is approximately equal to the D.C. output required from the rectifier, whereas with (*a*) the voltage across the transformer secondary winding has to be double that of the rectified D.C. output.



Modern types of full-wave thermionic valve rectifiers consist of a double plate and a single filament brought out to the four pins of a standard valve base. Here we see a Mullard D.W. 30 rectifier, which is most efficient.

Other Rectifiers

Before turning our attention to a more detailed consideration of the practical means employed for building up H.T. eliminator units incorporating both the thermionic valve and the dry metal rectifiers, mention must be made of two other processes which have been used to attain the same ends.

First of all there is the electrolytic rectifier which depends upon a chemical change taking place during its action. Unfortunately, in many cases frequent cleaning and a replacement of the electrolyte is necessary. Furthermore, there is a distinct tendency towards a polarisation E.M.F., and this may lead to instability with a distortion of the output wave form. Of course, the output current has to be smoothed so that this should not materially affect the final supply, but even so the electrolytic method has not proved so popular as the two I have mentioned previously.

Not Well Known

The fourth type called the gas discharge rectifier is not very well known and depends for its action on a glow discharge in an inert gas. Electrodes are so shaped and positioned in a housing bulb that the striking voltage of the discharge is very much greater in one direction than the other. The resultant rectified wave form is not of "regular" shape, and this is liable to introduce smoothing difficulties with a possibility of oscillation. In addition, the life of these rectifiers is an uncertain quantity and this may account for their somewhat waning popularity in this country.

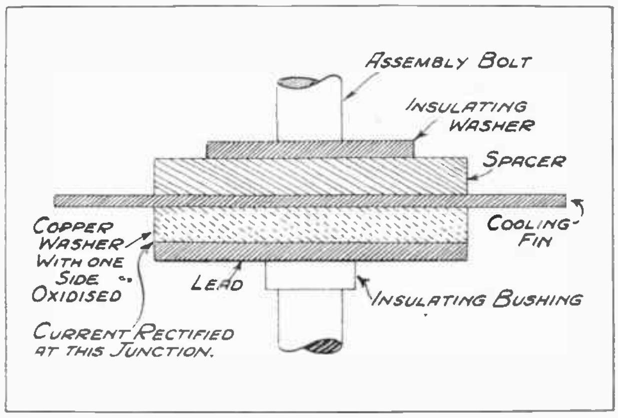


Fig. 3.—The Westinghouse dry metal rectifier unit is built up in sections on steel bolts such as the one illustrated above.

In any case, bearing in mind the definite requirements of television, I do not propose to describe constructional units incorporating these last two types, but shall confine my remarks to the valve and dry rectifier units with due emphasis being laid on the best type of smoothing circuits to include in the units themselves.

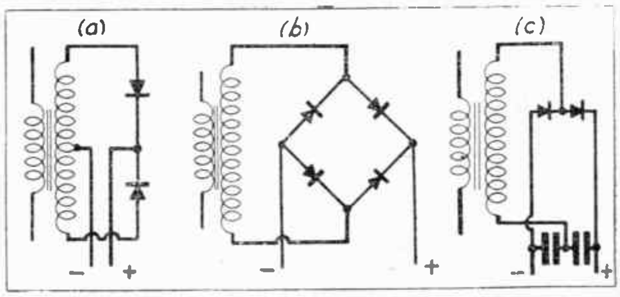


Fig. 4.—Three methods of obtaining full-wave rectification with the dry metal unit.

In considering the design of H.T. eliminators for use in conjunction with vision apparatus, it is essential to ensure that they operate efficiently, economically, and reliably. Upon the proper functioning of this portion of the "accessories" will depend the efficiency of the results obtained from the image point of view. Bearing this in mind, one can sum up that the most desirable features of the complete rectifying apparatus should follow somewhat on the lines of absolute dependability under all conditions of service with high efficiency and absence of moving parts which are liable to get out of order together with maintenance costs brought down to the barest minimum.

TRADE NOTES OF THE MONTH

REPORTS ON APPARATUS TESTED

Mullard Loudspeaker Model M

THE Mullard Orgola Junior Speaker, Model M, which we have recently tested is a cabinet-type instrument with a balanced armature movement, the armature being supported in the field of a powerful permanent magnet in such a manner that its whole mass is free to vibrate. The vibrations are transmitted to a large cone diaphragm through a driving rod, the anchoring of the armature and the method of attaching the driving rod rendering lateral movement of the driving unit or of the diaphragm impossible.

We were particularly impressed with the performance of this speaker, it being capable of handling large volume and, since the winding of the speech coil was capable of carrying a current of 25 milliamperes with safety, it was possible to join the instrument directly in the anode circuit of a super-power valve without risk of damage. Another point of interest was that the location of the speech coil is such that the direction of the anode current in the windings is immaterial.

There was a marked absence of resonance or boominess and at the price of £3 15s. we can confidently recommend this Mullard product to the attention of our readers.

Trelleborg Ebonite

The Trelleborg Ebonite Works, Limited, furnished us with a sample of their Ebonite Panels, mahoganite finish, for test purposes. According to the makers, this is guaranteed to be genuine ebonite and they furnish a N.P.L. report to bear out this statement. According to these figures Trelleborg Ebonite has an electric strength of 120,000 volts per millimeter, a specific gravity of 1·198, an infinite resistivity, a power factor of ·005, zero surface leakage, and an ash content of 1·57 per cent. From these figures it is at once seen that the ebonite in question is of the highest quality and our own tests showed that the material was satisfactory in every respect.

We were impressed with the excellent way in which it could be machined, drilled, engraved, etc., and since for all television purposes insulation is of prime importance, we can unhesitatingly recommend this product to all readers of our journal.

"Radio"

Among the sporting events which command nation-wide spontaneous enthusiasm, the Boat Race can justifiably claim a high place. It is beyond doubt a national event of universal interest.

Broadcasting has made it possible for millions to participate in the thrills of the struggle between the rival crews, and it has proved one of the most consistently successful outside broadcasts ever undertaken by the B.B.C.

Everyone will be interested to read an authoritative article—"Behind the Scenes at the Boat Race Broadcast"—published in the March issue of *Radio*, obtainable through Marconiphone radio dealers.

This issue is also particularly rich in items of interest dealing with other sporting events on the air during the month—notably, the Grand National and the F.A. Cup Semi-Finals.

Improvements in the Marconiphone Pick-up

A new model of the Marconiphone Pick-up—known as the No. 10—is now being supplied in place of the original model.

Fundamentally, the instrument is unchanged, and the new model has exactly the same electrical characteristics and performance as the original product.

The price—3 guineas—is unaltered. This new model "10" has, however, a greatly improved moulded base, which is larger and more robust than its predecessor. In place of the ordinary screw terminals, the new instrument is fitted with quick grip spring terminals, which are at once neater in appearance and much more convenient in use.

Cossor Two-Valve All-Mains Set

Amongst the many specialities of Messrs. A. C. Cossor, Ltd., is a Two-Valve, All-Electric Receiving Set. This is designed for use on an alternating current supply only, and we were particularly impressed with a model of this receiver which we tested very thoroughly. It is housed in a well-finished oak cabinet with the controls readily accessible, while very complete working instructions are supplied with the instrument.

In this particular case the receiving aerial was only about six miles from the Brookman's Park station and, after making the necessary connections, inserting valves, etc., as specified, we switched on. After the few seconds lapse, which is necessary when employing valves of the indirectly heated cathode type, we tuned in the local, and were amazed at the volume secured even when the reaction control was set at zero. Both on long and short waves we were able to tune in stations with ease, it being possible to listen to at least half a dozen of these with absolute comfort. Quality of reproduction was of the first order when used with a first-class loud-speaker.

The selectivity control on the left-hand side of the set, adequately fulfilled its purpose in enabling easy separation of the two Brookman's Park transmissions to take place within six miles of the station.

Provision is also made for the use of an electrical pick-up, it being necessary only to join this component to two terminals found inside the set close to the back of the cabinet. The mains plug is arranged to fit either a light- or wall-socket, a feature which is advantageous. According to the makers' claims this two-valve receiver is designed for the B.B.C. Regional broadcasting scheme, but, with efficient aerial equipment available, other transmissions can be tuned in, as we have stated.

For an all-mains receiver of moderate price, namely, £11 10s., we can assure readers that this product of Messrs. A. C. Cossor, Ltd., is one which merits their closest attention.

Guarantees with N & K Loudspeakers

Messrs. A. Brodersen, of 11, Northampton Square, E.C.1, sole distributors of the original N. & K. Inductor, inform us that in future they will issue a certificate of guarantee available for twelve months for every N. & K. speaker distributed by them.

If any mechanical defect should occur during that period a replacement will be made upon production of the certificate to the dealer who effected the sale.

Purchasers are requested to ensure that they obtain a certificate, and that the red and green licence marks are attached to the speaker, which on no account must be removed. Replacement cannot be effected unless these conditions are conformed with.

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, *505, Cecil Chambers, Strand, W.C.2, and must be accompanied by the writer's name and address.*

TELEVISION RECEPTION IN BERLIN.

To the Editor of TELEVISION.

DEAR SIR,—I trust the enclosed information will prove of interest to your readers as being indicative of the work that is being undertaken in Berlin. Since February 16th the transmissions from G2TV, the short-wave station of Baird Television, Ltd., have been badly interfered with by another station relaying the broadcast programme of Huisen, Holland, on a frequency of 6,024 kilocycles (or just below 50 metres). This short-wave station (or better, the sixth harmonic of the real frequency of Huisen, that is 1,004 kilocycles) has also been observed by other German listeners. It would appear advantageous if it was possible for G2TV's frequency, which is about 6,025 kilocycles, to be raised about 20 kilocycles in order to avoid this interference.

I might also add that television transmissions from Schenectady, New York, U.S.A., take place on Tuesday and Friday at 14.00–15.00 G.M.T. on a frequency of 17,300 kilocycles or 17.34 metres. This station, W2XAW, transmits on the German R.P.Z. standard. The televised objects are a diamond-shaped rectangle, a vertical black bar, an arrow-like figure pointing downwards, the station's call letters and human faces. I have received this station several times in the last three weeks, with varying quality, of course, but very often echo-free images both clear and distinct are seen, and I have written to the G.E.C. giving details of my reception. The transmissions are in the nature of special wave-propagation tests and are officially received by Telefunken, and the R.P.Z. at Beelitz (near Berlin) with the usual disc vision apparatus. I have also been able to see images on the screen of my mirror-drum vision apparatus, two photographs of which are enclosed.

Yours faithfully,

HORST HEWEL.

Landhausstr. 13, Berlin-Wilmersdorf,
Germany.
February 28th, 1931.

BIRTHDAY WISHES.

To the Editor of TELEVISION.

DEAR SIR,—Hearty congratulations to yourself and all connected with TELEVISION on that Journal attaining the age of three years.

I have followed its development since the first number of March, 1928, and I have carefully preserved all my copies since.

I consider its present form hard to beat because it caters for the beginner in the world of science as well as the advanced experimenter. The numerous educative and inspiring articles to be found in its pages are of great value, both for present reading and future reference.

I would suggest that every subscriber to TELEVISION should display a copy of the journal in his workroom or radio den so that the attention of visitors may be drawn to it. This is what I am doing. I have already made two subscribers in N.S.W., Australia, just by sending along a copy to a friend, and shall hope to make others.

Lastly, with reference to the letter of your correspondent, Mr. H. E. Jones, and his suggestion as to "Queries and Answers," I agree if it will not displace other more interesting matter.

Yours faithfully,

ARTHUR H. BIRD (F.T.S.).

Radio Experimental Station G.6A.Q.,
35, Bellwood Road, Waverley Park,
Nunhead, London, S.E.15.
February 28th, 1931.

THE QUERIES COLUMN.

To the Editor of TELEVISION.

DEAR SIR,—I have just received this month's copy of TELEVISION, and notice one of your readers asks for a queries column. I should appreciate this greatly, and in addition I am sure my friends would. I hope you can see your way clear to include it soon. I must say your paper gets gradually better and I always look forward to it. I keep lending my copies to friends to interest them, and am glad to avail myself of your offer to send copies to my friends.

Yours faithfully,

H. E. SMART.

"Domus," The Avenue, Weddington, Nuneaton.
March 2nd, 1931.

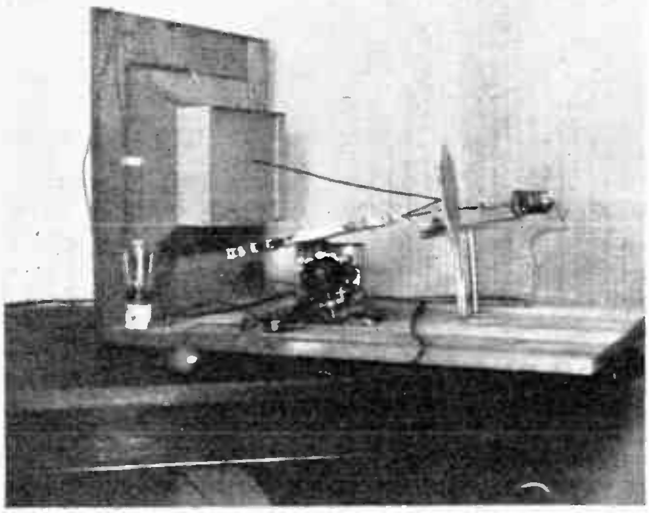
OUR BIRTHDAY AND A STORY.

To the Editor of TELEVISION.

DEAR SIR,—In wishing you many happy returns for the third birthday of TELEVISION, I will tell you a short story :—

When Mr. Baird first started his television experiments and patented his schemes, I was a regular reader of " —— " which at the time was waging an anti-television campaign consisting of articles by Dr. ——, Sir ——, and others. As is usual with most regular readers, I found myself thinking with the paper and actually felt that television was impossible. However, one evening at the local Institute, one of my fellow-students brought a copy of No. 1 TELEVISION with him. I looked through it, and decided to buy a copy for myself. I did, and later I found that my Physics lecturer also had a copy and had made the selenium cell described in it, and that I had to test it for him. Well, I have had TELEVISION ever since, discontinued the "——" and now read a wireless paper that is not anti-television. (Curtain, with loud cheers).

The query-corner suggested by Mr. W. E. Jones



An interior view of Mr. Horst Hewel's home-made mirror drum vision apparatus. The ink line indicates the path of the light beam.

should certainly be "installed," preferably separate from the "Letters to the Editor."

Wishing the Journal a long and even more successful life.

Yours faithfully,
J. S. GOLDSTEIN,
Assoc. I.W.T., A.M. Tel. S., etc.

48, Rectory Road, London, N.16.
March 3rd, 1931.

THAT FARNSWORTH CLAIM

To the Editor of TELEVISION.

DEAR SIR,—The paragraph ("The Farnsworth Claim") in the March issue of TELEVISION was by no means the least important, and I am sure your readers would be interested to know that Mr. Farnsworth's claim is not quite as original as he would have us believe.

On page 438 of the "Phys-Zeit." for 1922 there is a suggested method by Busch for determining the velocity of an electron. In this arrangement a rotating magnetic field is employed to control the path of electrons emitted from a heated cathode in a Braun tube. The electrodes are accelerated by an anode and pass through a hole in the same. They then come under the influence of a rotating magnetic field produced in the same manner as in the case of the induction motor. The cone of swiftly-moving electrons is bent into a spiral by this field, and finally the electrons come to a focus on a luminescent screen, producing a well-defined point of light when everything is correctly adjusted. The accelerating potential is in the neighbourhood of 400 volts.

On page 386 of the November, 1930, issue of "Radio Industries" there is an outline of the Farnsworth system.

The electrons are emitted by the cathode and are accelerated by an anode. They then enter an equipotential space beyond in exactly the same manner as in the Busch system. They are bent into a spiral formation and focused on to a collector. With the exception of the different method of producing the electrons—for the electrons in this case are liberated by photoelectric action—the whole system resembles in every detail that of the Busch method. I should, therefore, be more inclined to term the Farnsworth system the Busch system, for although this was originally devised for determining the value of $\frac{e}{m}$ and also the velocity of the electrons, it appears that it can be readily adapted to a television scanning device. The method of reproducing embodies the use of an ordinary Braun tube which is for some reason or other termed an oscillite, but I am at a loss to distinguish any radical difference in the so-called oscillite and the cathode ray tubes as first suggested in England by Campbell-Swinton.

It is stated in the second magazine which I have quoted that it is possible to use an amplifier which has a constant frequency characteristic approximately flat to 600 kilocycles. It is a pity that we do not know more about this interesting amplifier.

I think, therefore, that your correspondent has done well to show this fallacy, and I feel certain there are many other readers besides myself who welcome the paragraph.

Yours faithfully,
D. WHATTAM.

13, Gray's Inn Square, W.C. 1.

JUST A FEW OF THE

GO-AHEAD
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BAIRD
TELEVISION

Is YOUR dealer among these?

If not—

Please send us his name and address!

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BAGSHOT (Surrey)	LINDFIELD'S GARAGE	
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CHELMSFORD	G. KENNINGTON (CHELMSFORD), LTD.	Victor Lane
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GRAVESEND	PRICE'S STORES	38, Harmer Street
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HORLEY	S. A. COUTTS (RADIO HOUSE)	Victoria Road
HOUNSLOW	KINGSLEY RADIO STORES	99, Kingsley Road
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KNEBWORTH	E. S. HEAP	London Road

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EAST SHEEN	BRITISH RADIO & TELEVISION, LTD.	422, Upper Richmond Road
EDGWARE ROAD	MR. SINGER	307, Edgware Road
FOREST HILL	KIRKDALE ELECTRIC CO.	
FULHAM PALACE ROAD	ECONOMIC	24, Fulham Palace Road
GOLDER'S GREEN	L. M. RADIO SERVICE, LTD.	74, Golder's Green Road
HAMMERSMITH	W. H. OATES	195, Hammersmith Road
HENDON	S. G. THAINE	192, Brent Street
HENDON CENTRAL	ROLAND RADIO	3, Queen's Parade
HERNE HILL	RAY'S WIRELESS SERVICE	23, Norwood Road
HOLLOWAY	PUGH BROS.	95, Holloway Road
ISLINGTON	HIGHBURY ENGINEERING WORKS	287, Upper Street
LEE	A. BEDFORD & SONS	11, High Road
LEE GREEN	LITTLEWOODS	19, Burnt Ash Road.
NORTH FINCHLEY	E. A. BALL & CO., LTD.	10, Woodhouse Parade
NORWOOD JUNCTION	C. P. H. NUTTER	245, Selhurst Road
PALMER'S GREEN	PALMER'S GREEN RADIO SERVICE	
PECKHAM RYE	W. M. WILLIAMSON	184, Peckham Rye
TOTTENHAM	B. HOGBEN	272, High Road

MAIDENHEAD	EAST BERKS ACCUMULATOR SERVICE	100, Queen Street
MARLOW	C. DRYE	10, High Street
MARGATE	WALKER & SONS	1 2, Marine Terrace
NEWBURY	EDWARDS & GODDING, LTD.	Market Place
OXFORD	HEADINGTON WIRELESS DEPOT	Headington
OXFORD	F. F. C. KING	235, Banbury Road
READING	F. GALE & SONS	133, Friar Street
SEVENOAKS	STRANGE & SONS	139, High Street
SOUTHALL	LAYTON & CO.	10, South Road
STAINES	V. & D. KEALE	Kingston Road
SUNBURY COMMON	J. SPIGHT	3, Station Road
TEDDINGTON	J. H. ELLIOTT	22, High Street
TWICKENHAM	C. MARGRAVE	34, London Road
UXBRIDGE	WILLIS & SONS	278, High Street
WALTON-ON-THAMES	H. N. BULLEY	18, High Street
WELLING	WELLING RADIO STORES	3, The Parade
WEMBLEY	MELODY HOUSE (J. C. MILLS)	50a, Ealing Road
WEST DRAYTON	SPRATLEY BROS.	Station Road
WEST WICKHAM	W. F. ROGERS	1, Central Parade
WEYBRIDGE	F. W. FARROW	42, High Street
WINDSOR	S. A. SURPLICE	27, Sheet Street

Printed by HAZELL, WATSON & VINEY, LTD., 52, Long Acre, London, W.C.2, and published for the Proprietors, TELEVISION PRESS, LTD., 505, Cecil Chambers, London, W.C.2, by THE ALDINE PUBLISHING CO., LTD., Crown Court, Chancery Lane, London, W.C.2. Address for advertisements, "TELEVISION" ADVERTISEMENT DEPT., 505, Cecil Chambers, London, W.C.2. Sole Agents for America, THE INTERNATIONAL NEWS COMPANY, LTD., 131, Varick Street, New York, U.S.A. Registered for transmission by Canadian Magazine Post. Entered as Second Class Matter, March 15, 1929, at the Post Office at Boston, Mass., under the Act of March 3, 1879 (Sec. 397, P.L. and R.)