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THE JOURNAL OF

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AND THE

British Empire Radio Union

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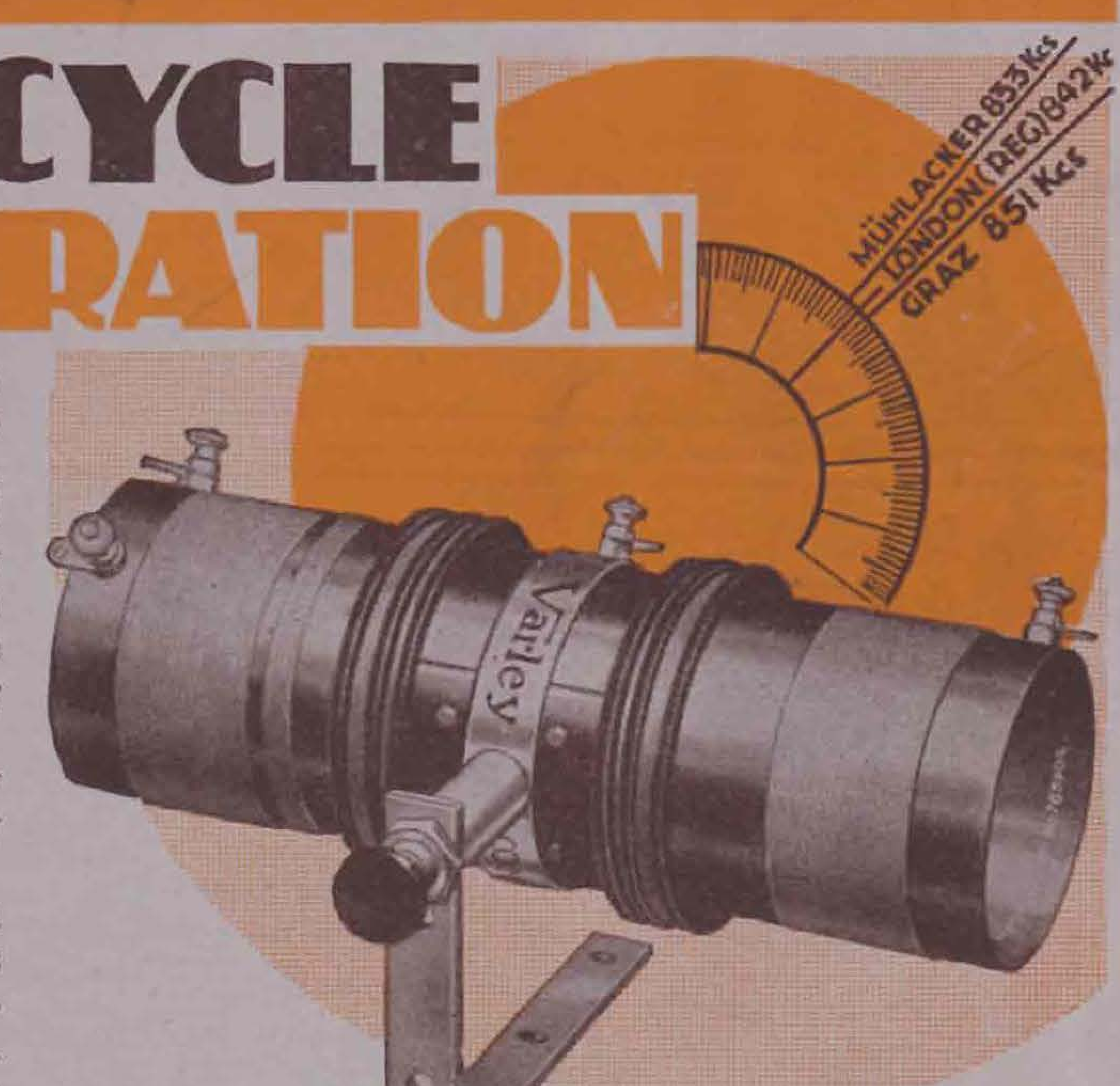

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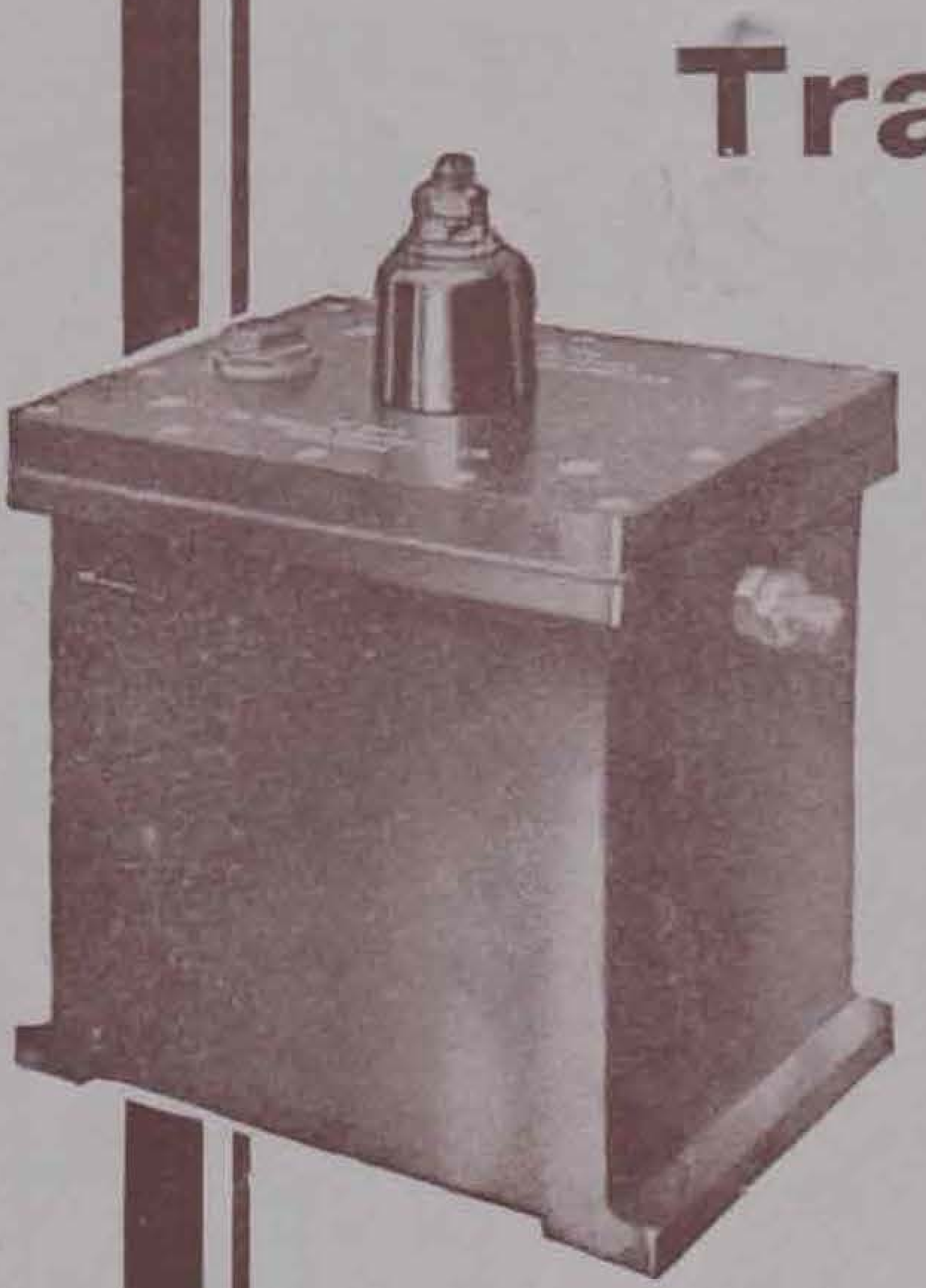

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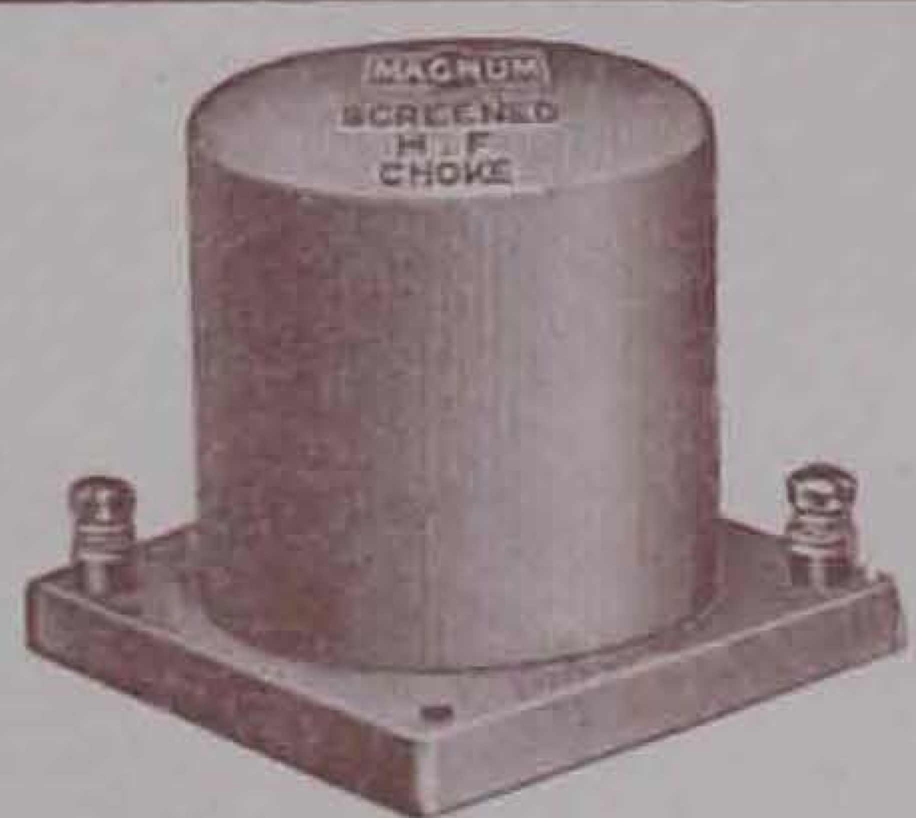

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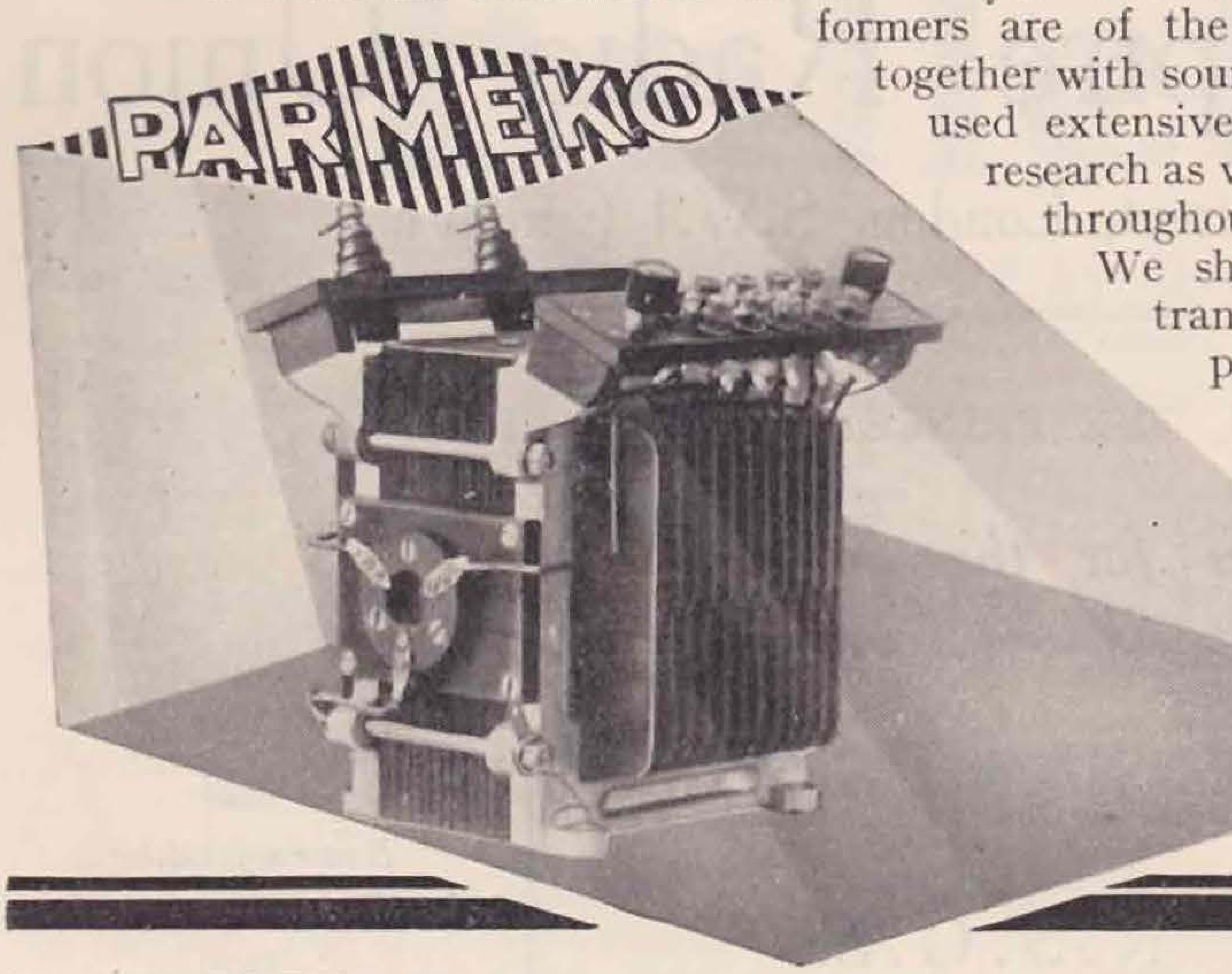

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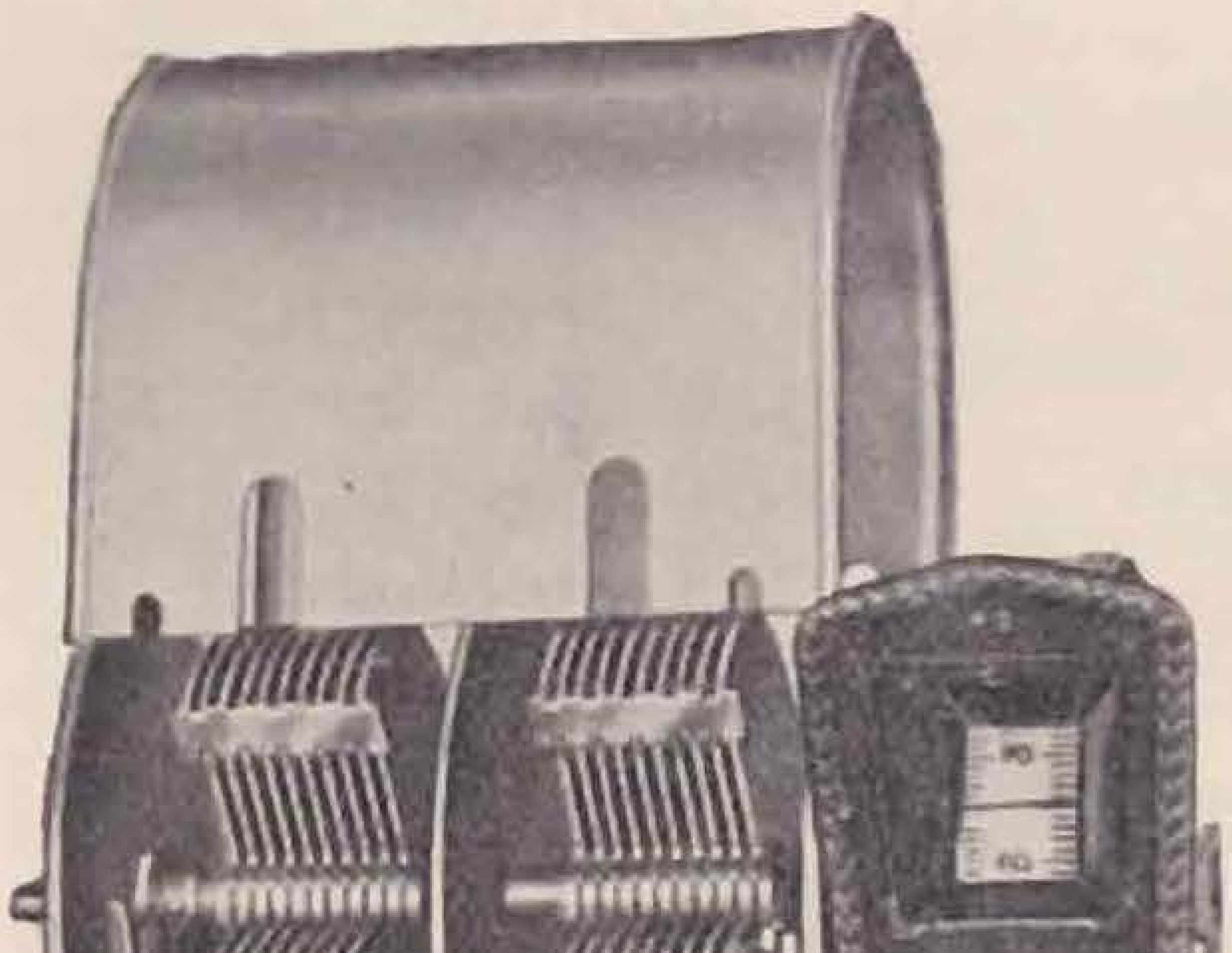

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T & R
Bulletin

The only Wireless Journal Published by Amateur Radio Experimenters in Great Britain

JULY, 1931. Vol. 7. No. 1

The 1.7 Megacycle Band.

An editorial is not an easy matter to prepare, even when its contents are of no particular moment. But when it becomes necessary to write upon a subject of paramount importance, the difficulties are increased tenfold.

In glancing through our list of home members, our first impression is that a very large number are inactive, but that impression would be incorrect, because, as an individual, we know only the active calls on the bands upon which we are usually operating.

Those who for years have used 7 and 14 megacycles exclusively have no idea of the activity on 1.7 M.C., and, conversely, most of our lower frequency exponents would have difficulty in naming half a dozen active calls to be heard on the higher frequency bands.

Very roughly, we can summarise 1931 operating conditions, as they effect Great Britain, into four groups of individuals, viz. :—

(1) The exclusive DX group who seldom work off the 14 M.C. band, but who are occasionally heard on 7 M.C. when conditions on that band are good.

(2) The exclusive European group who keep on 7 M.C. until they have exhausted the possible list of local countries worked.

(3) The exclusive 1.7 M.C. group who rarely, if ever, have used the higher frequencies.

(4) The " wanderers," mostly DX workers, who go down tò 3.5 or 1.7 M.C. during the week-ends.

To attempt to give the percentage of each group seems futile, but we hazard a guess that approximately 40 per cent. of the present active British licence-holders fall into Group (3), whilst a further 10 per cent. fall into Group (4). It is to this large body of members that our editorial is primarily addressed.

To put things plainly, the position as we see it to-day is that the British Government have given us the use of the 1.7 M.C. band when practically the whole of the rest of Europe is debarred. The band is our nearest to broadcasting and, in consideration of the yearly increase in the number of European broadcasting stations, is it not conceivable, therefore, that some attempt may be made at Madrid to extend the present European Broadcast Band ?

The answer is assuredly " Yes." How, then, and by what means are we Britishers to retain our privileges ?

First, we suggest that every user of the 1.7 M.C. band should immediately take steps to see that he is operating *strictly* in accordance with the terms of his licence. There are many well-known members amongst us who have, in ignorance, we believe, assumed that their trans-

(*Continued on page* 16.)

Electron Oscillations and their Application to Ultra-high Frequency Communication.

[*Lecture given before the Radio Society of Great Britain, March* 25, 1931, *by* E. C. S. MEGAW, *B.Sc., D.I.C.* (*by permission of the General Electric Co., Ltd.*)]

I AM going to talk to you this evening about electron oscillations in valves and their application to wireless communication on wavelengths below the limit of the ordinary " reaction " valve oscillator. This subject is a new one in the sense that it has been mainly confined in the past to physical and electro-technical laboratories and that little has been written about it, and still less done, in this country. It is an old one, however, in the sense that its fundamental phenomenon was discovered, in Germany, some eleven years ago and that a hundred or two of scientific papers dealing with it—the majority of them in German—have appeared since then. I think I can best introduce the subject by giving you an outline of the discovery on which it is founded.

In a gas-free three-electrode valve a current of electrons flows from the filament to the anode if the anode is positively charged, but no current flows if it is negatively charged. If the grid of a valve is positive while the anode is negative, current will flow to the grid, but none to the anode so long as the vacuum is good. If the valve contains gas, some of the gas molecules will be disintegrated into positive and negative ions by colliding electrons on their way to the grid. Of these the positive ions will be attracted to the negative anode thus causing a current in the opposite direction to the anode current in a normally-operated valve. As the magnitude of this positive ion current depends on the amount of gas in the valve, it gives a useful indication of the " goodness " of the vacuum.

Towards the end of 1919 two German physicists, Barkhausen and Kurz, noticed some peculiar effects when making vacuum tests on transmitting valves with positive grid voltages. In one case, they observed an anode current in the opposite direction to that for positive ions when the anode was about 100 volts negative and the grid several hundred volts positive. This could only be explained by negative electrons reaching the anode in spite of the opposing field due to the negative anode voltage and positive grid voltage. At the same time a hot-wire ammeter in the anode lead gave a reading of several amperes, although the D.C. anode current only amounted to milli-amps. Barkhausen and Kurz decided that these effects were due to electrons which were attracted to the positive grid and shot past the grid wires into the retarding field in the grid-anode space, where they were slowed up and eventually reversed their direction, returning to the positive grid, where some again missed the wires and repeated the reversal of direction in the grid filament space. These electrons swinging past the grid, between filament and anode caused the grid potential to oscillate about its mean value at a frequency which depended on the grid and anode (D.C.) voltages and the dimensions of the valve electrodes. This oscillating voltage was the cause of the extra current in the hot-wire ammeter and the unexpected D.C. anode current was due to the overshooting of some of the oscillating electrons.

Barkhausen and Kurz calculated the frequency of oscillation of the electrons by making various simplifying assumptions, and they also measured the wavelength by measuring the distance between adjacent nodes on a Lecher wire system ; that is, two parallel wires short-circuited at one end and coupled to the electron oscillator. They got quite good agreement between the measured value (about 1 metre) and the wavelength corresponding to the calculated frequency, and they also found that the wavelength varied approximately as 1/ (the square root of the grid voltage), as was indicated by their calculation.

The type of circuit used by Barkhausen and Kurz and by many later experimenters is shown in Fig. 1. A pair of parallel wires is connected at one end to the grid and anode of the valve and a short-circuiting bridge is moved along it. Barkhausen and Kurz found that the strength of the oscillations varied as the distance of the bridge from the valve was varied, but that the wavelength was practically unchanged, and they came to the conclusion that these oscillations were solely due to electron movements and that the external circuit was simply a means of getting the oscillating energy out of the valve. The shortest wavelength they obtained was about 43 cm., with a small transmitting valve, but they estimated that it should be possible to produce waves down to about 10 cm. with small receiving valves.

The distinction between electron oscillations and reaction oscillations should now be fairly clear. The reaction oscillator depends fundamentally on the anode current following changes in the grid voltage without any appreciable time-lag, so that the voltage variations across an impedance in the anode circuit may always be in the opposite direction to variations of grid voltage. When the frequency becomes very high the time taken by electrons to go from filament to anode is no longer negligible compared with the time period of the oscillations and the phase relations in the circuit are upset so that there is a limiting frequency above which the reaction oscillator cannot work. This frequency depends on the dimensions of the electrodes and the voltages used and for small transmitting valves with anode voltages of several hundred it corresponds to a wavelength of the order of 1 metre. The shortest wavelength produced by a reaction oscillator, so far as I am aware, is 60 cm. produced by Yagi with a pair of Japanese receiving valves. Since this is well inside the upper limit of the electron oscillator, it is now possible to produce a continuous range of undamped oscillations up to the frequency limit of the latter which corresponds to a wavelength of a few centimetres with existing valves.

The electron oscillator, in contrast to the reaction, depends for its operation on the inertia of the electrons being important at the operating frequency which is, in fact, determined by the electron

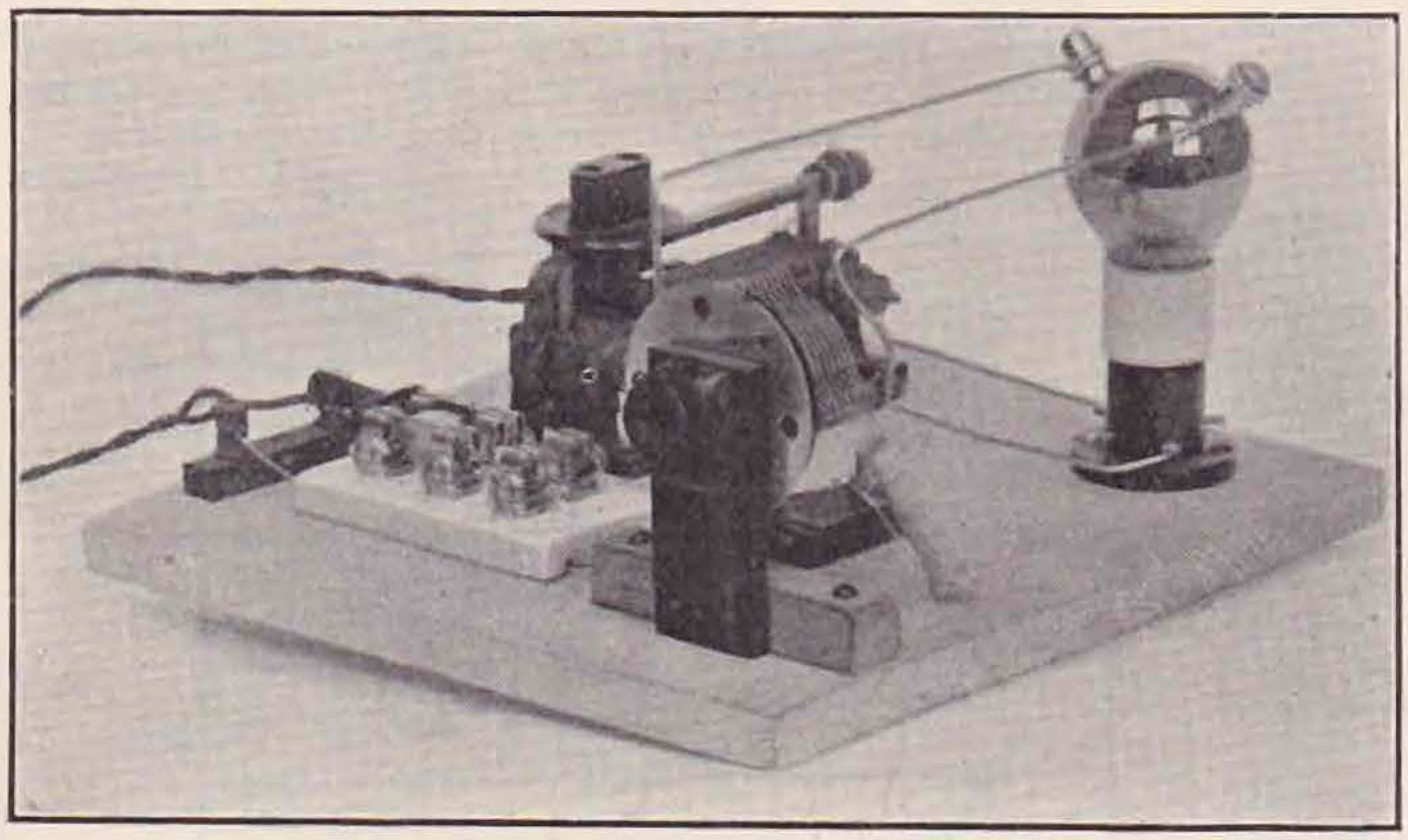
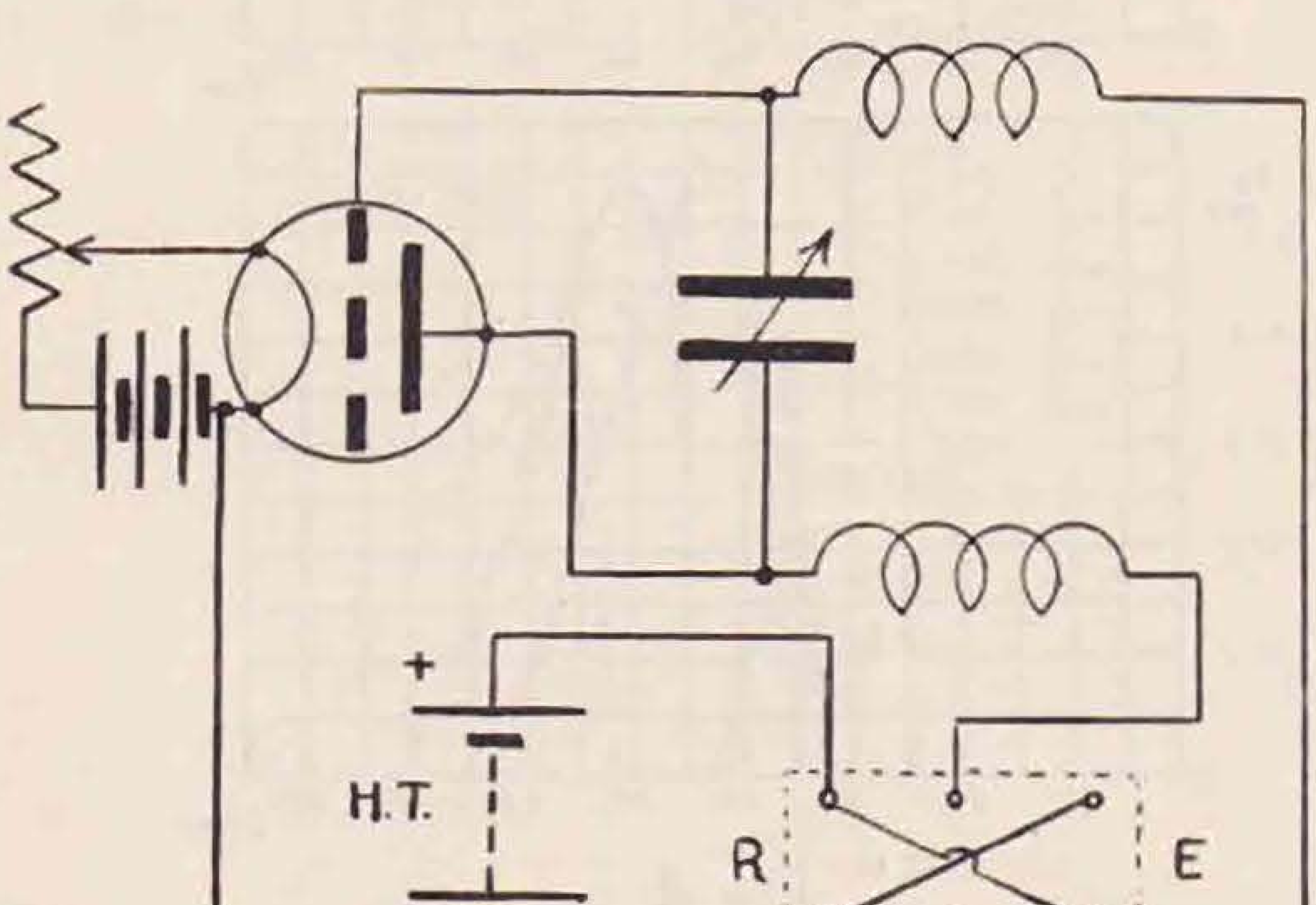


Fig. 1. "Lecher Wire" oscillator with variable condenser bridge. The H.T. can be applied either to (i) the anode, giving ordinary reaction oscillations of one or two metres wavelength, or (ii) the grid, giving electron oscillations of 40 to 80 centimetres wavelength.

The circuit is shown below. When the switch is in the "R" position, reaction oscillations are produced, and when in the "E" position, electron oscillations.



dynamics of the valve, so that the effect which causes the failure of one type of oscillation makes the second possible.

I shall now give you a short account of some of the more important experimental researches which have been carried out on electron oscillations since the original work of Barkhausen and Kurz. It would be impossible to deal with all the work that has been done on account of its quantity and of the highly technical nature of some of it, but I shall attempt to give you an outline of the experiments which have contributed most to the understanding and use of this recent addition to radio frequency technique.

Some of the earliest work on the subject after Barkhausen and Kurz's original researches, was carried out in this country by Gill and Morrell at Oxford. Their apparatus was very similar to that of Barkhausen and Kurz, and consisted of a 25-watt Marconi-Osram valve type M.T.5, the grid and anode of which were connected to a parallel wire system of variable length. Their results confirmed the law of Barkhausen and Kurz for the relation between grid voltage and wavelength, *i.e.*, $\lambda^2 Eg$=constant, but they subsequently discovered that oscillations could be produced whose wavelength was decided by the external circuit and was practically independent of the voltages applied to the valve.

At about the same time Scheibe, in Germany, made experiments with valves of various grid and anode diameters and produced oscillations between 30 and 300 cm. wavelength. He also confirmed the Barkhausen and Kurz results but, unlike Gill and Morrell, he decided that the wavelength was independent of the tuning of the external circuit, which only affected the oscillation strength. Scheibe later used two-valve electron oscillator circuits, one with the two valves connected at the centre of the parallel wire oscillation circuit, and another with one valve connected at each end of the parallel wires. He found this a great improvement and reported that he obtained 5 to 7 times the oscillatory power obtainable from a single-valve circuit, and that the filament temperature could also be reduced. During these experiments he observed oscillations whose wavelength was much shorter than the approximate calculated value, and found that the frequency ratio of these to the normal longer-wave oscillations was between 1.3 and 2.0, so that they could not be harmonics. It was concluded that they must be due to the electrons oscillating in some different manner.

Other early workers were Zacek, who produced oscillations of 100 cm. wavelength with a grid voltage of only 6.5 and zero anode volts, and Sahanek, who found experimentally that the anode diameter should be between twice and five times the grid diameter to produce oscillations.

Much important work was done in the laboratories of Prof. Romanoff at Moscow. Grechowa carried out extensive tests, using the same type of circuit as Gill and Morrell and Scheibe, and found that for low-grid voltages the filament temperature had a great effect on the wavelength, which effect was reduced at medium-grid voltages, while at large-grid voltages the wavelength became independent of small changes in either grid or filament voltage. At the higher voltages a shorter wave which was not exactly a second harmonic was observed as in Scheibe's experiments. Various multi-valve circuits were developed later in one of which the valves were connected at half-wavelength intervals along a Lecher wire system. The valve lives were in all cases very short.

Kapzow and Gwosdower, working in the same laboratory, found that two types of ocillations could be obtained,

(1) oscillations whose wavelength was determined by the electrode dimensions, and potentials—as found by Barkhausen and Kurz; and
(2) oscillations whose wavelength depends only on the external circuit, which they called "Gill-Morrell," or simply "G-M" oscillations.

The researches of Hollmann, at Darmstadt, extended over a number of years, have probably contributed more to the literature of the subject than those of any other worker. I shall therefore deal with his methods and results in some detail, as they are typical of much of the work that has been done, and also introduce new data and new ideas.

His general results can best be stated by quoting from the summary to one of his own papers :—

"In the Barkhausen and Kurz retarding field of a triode, four different types of oscillation can occur :—

(1) Oscillation whose frequency increases with field strength. Wavelength can be calculated from the potentials and electrodes dimensions on the assumption that the electrons vibrate about the grid—'*Barkhausen and Kurz Oscillations.*'
(2) If an oscillatory circuit is connected to the electrodes, alternating field are superimposed on the steady ones. These tend to increase the frequency and a building up process takes place, the final state of which is the natural frequency of the oscillatory circuit—'*G-M Oscillations.*'
(3) With close-mesh grid, the electrons may swing only across the grid anode space—'"*higher*" *B-K Oscillations.*'
(4) From these last '"*higher*" *G-M Oscillations*' may be produced by the use of a '½-wave' tuned electrode system."

The circuit used by Hollmann in the experiments that led to these conclusions is the familiar one of Fig. 1. The wavelength of the oscillations was measured on a separate Lecher wire system loosely coupled to the electron oscillator. A crystal detector and galvanometer were used to indicate the current in the movable bridge on the "wavemeter" Lecher system.

In the oscillator the bridge was formed by two fixed condensers joined by a thermo-couple ammeter.

The first tests consisted of moving this bridge along the wires from the valve end, so gradually increasing the dimensions of the oscillatory circuit connected to the electrodes, and noting the change produced in the wavelength, intensity of oscillation, and anode current. Typical results are shown in Fig. 2. As the bridge distance d is increased, the anode current suddenly increases and then falls off gradually. Measurements of the wavelength show that the oscillator frequency is suddenly increased at the point at which Ia increases and then gradually returns to its original value. The curve of oscillation intensity shows a sudden increase at the same point, and its maximum coincides with the maximum of Ia. This is repeated as d is continuously increased.

To start with, we have, according to Hollmann, pure B-K oscillations in the region marked A and then a sudden transition to G-M oscillations in the B region; here wavelength is independent of grid and anode volts and depends only on the constants of the circuit, *i.e.*, wavelength is approximately proportional to d as indicated by the dotted straight line. With various values of Eg and Ea, similar curves are obtained, wavelength decreasing with Eg and increasing with Ea. With increasing negative Ea, Ia decreases and its maximum is displaced towards shorter wavelength. If Ea is

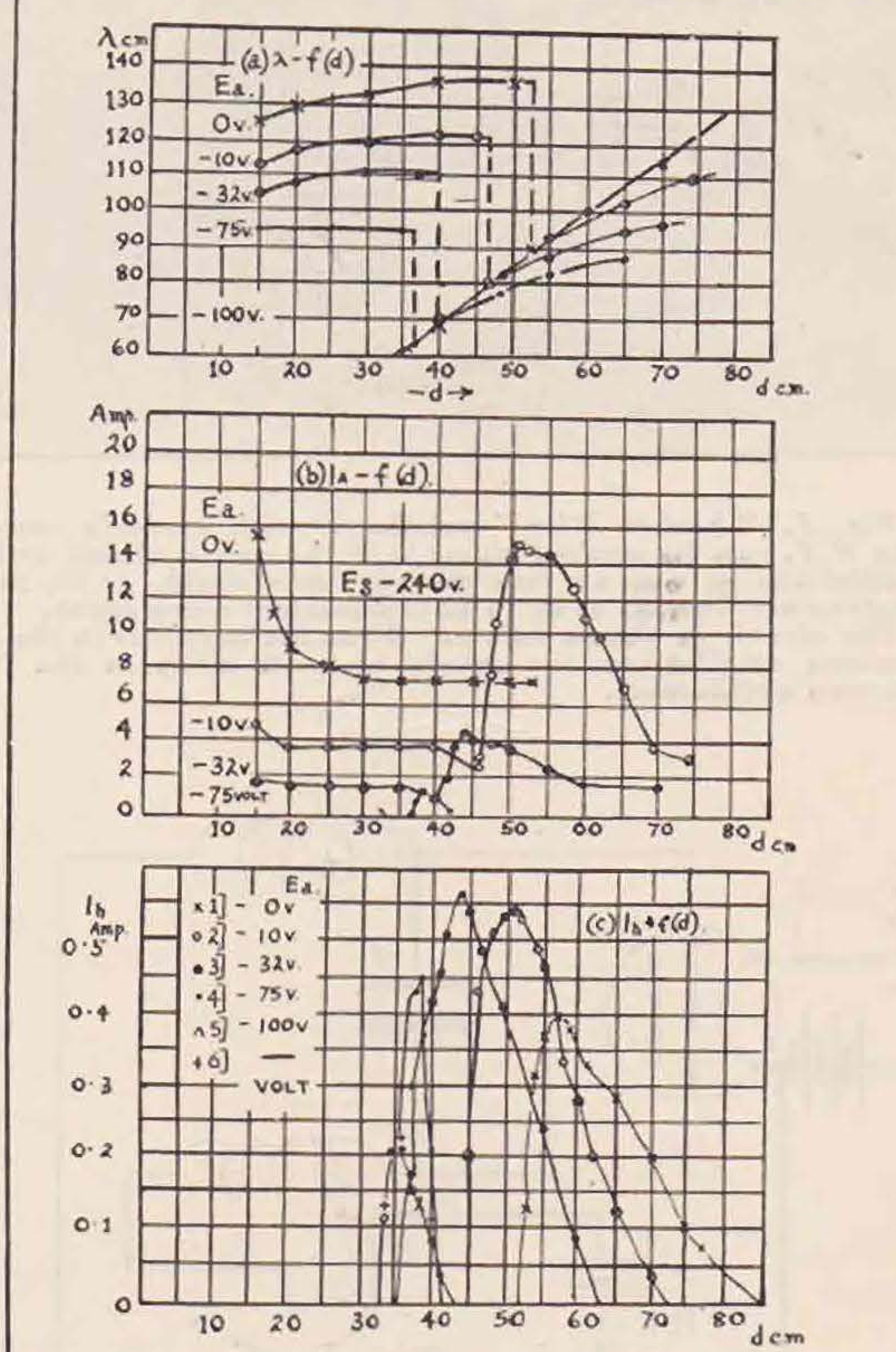


FIG. 2.

—100V. or more, Ia is zero. The oscillation strength (I_H) is maximum with the anode slightly negative, *e.g.*, in this case (for a Schott transmitting valve) —32V., for Eg=240V. and d=44 cm. I_H is then 0.6A. at 78 cm. wavelength.

Careful measurements with Lecher wire "wavemeter" show, according to Hollmann's interpretation, that the transition from B-K to G-M oscillations is not discontinuous, though the change in Ia is. Plots of detector deflection in the transition region show the simultaneous presence of both oscillations. I shall return later to the discussion of this interesting result, for which there is an alternative, and, I think, a more probable explanation (Fig. 3).

Hollmann offers an ingenious explanation of the sudden transition from B-K to G-M oscillations: With a small oscillatory circuit (*i.e.*, small *d*) whose natural frequency is much above the electron oscillation frequency, there is practically no alternating voltage at the electrodes, and we have pure B-K oscillations. As the length of the oscillatory circuit is increased towards resonance, the alternating voltage increases rapidly. This, according to a simplified calculation of Hollmann, causes an *increase* in the electron oscillation frequency which causes a further increase in alternating voltage. Thus, an unstable state is reached which is only stabilised when the electron oscillation frequency coincides with the circuit frequency, as any further increase of electron frequency would

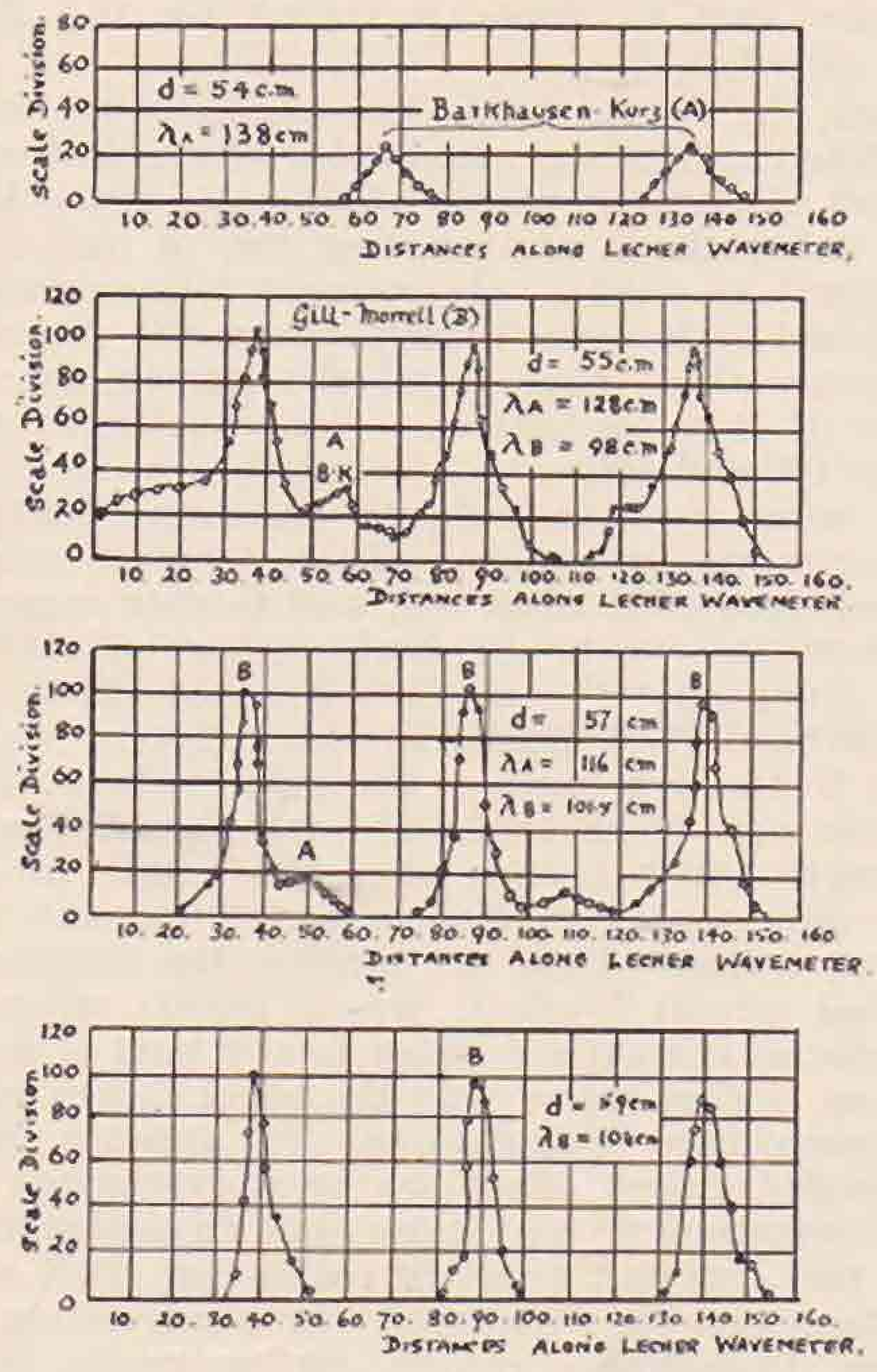


Fig. 3.

then *reduce* the alternating voltage. If resonance is approached in the other direction, *i.e.*, the natural frequency of the circuit is increased from a frequency lower than that of the B-K oscillation, there is no instability since the increase of alternating voltage as resonance is approached causes the electron oscillation frequency to increase, *i.e.*, to go further away from that of the tuned circuit.

Hollmann found that the production of the "shorter B-K" oscillations depended on the pitch of the grid spiral; with 6 turns/cm. only the "long" wave was produced, with 12 turns/cm. the "short" waves appear at 260V., and with 22 turns/cm. the "short" waves appear at 150V. and both "long" and "short" are present up to 180V. Like previous workers, Hollmann found that the frequency ratio was not 2.0 and the "short" wave was therefore not a harmonic. He explains the higher frequency oscillations as being due to the fact that some of the electrons, on returning from the anode, do not pass through the grid a second time, but oscillate in the grid-anode space. As the grid pitch is reduced, the chance of electrons doing this is greatly increased, until eventually none pass back to the grid-filament space and the higher frequency oscillations alone are present.

"Higher frequency G-M" oscillations were produced by attaching parallel wires to the anode and grid, inside the valve, along which capacity bridges could be moved. The frequency of these oscillations was determined by the distance apart of the capacity bridges. The shortest wave produced was 15-20 cm., with a 1.1 cm. diameter anode, 0.3 cm. diameter grid and Eg = 360V.

Among other recent German researches those of Kohl, who produced 30 cm. oscillations with a tuned circuit inside the valve, of Wechsung, who used A.C. potentials on the electrodes instead of D.C. and a variable condenser between the electrodes for tuning, and of Wundt, who showed that B-K oscillations could be produced by a triode with flat-plate electrodes, though this was previously thought impossible—all these are worthy of mention, as, indeed, are many more which, for the sake of reasonable brevity, must be excluded.

Three other workers must, however, be mentioned. The first is Strutt of Eindhoven, who, in a recent paper, presented a particularly lucid set of conclusions, resulting from experiments on a standard Philips triode, which are worth quoting:—

(1) If Eg is increased with Ef constant, a series of oscillations appear at voltages which form a geometric series.
(2) In each of these oscillation regions, the wavelength is constant, regarded as a function of grid voltage. Examples of wavelength measured (for successive increasing values of Eg): 120, 45, 17 and 17 cms. (again).
(3) With increase in Ef oscillation regions move to higher voltages, the relation of (1) still holding.
(4) Increase of Ef with constant Eg decreases wavelength.
(5) Variations of the length of the Lecher wire system coupled to the triode give the usual coupled circuit phenomena, *i.e.*:—
  (*a*) loose coupling:—small variations in intensity: no variation in wavelength.
  (*b*) medium coupling:—large variations in intensity: discontinuous change in wavelength.
  (*c*) tight coupling:—large variations in intensity: "Ziehen" loop.
(6) These three conditions occur in the first and second oscillation regions, but in the third and fourth only (*a*) occurs.
(7) The oscillatory current in the bridge of the oscillator was more than 100mA. at 120 cm. and more than 10mA. at 17 cm. wavelength, with a heavy load which the triode carries for several hours.

Potapenko, in Moscow, has also investigated the various ranges of wavelength which are produced at different grid voltages and filament temperatures and has shown that under certain conditions the wavelength may be much shorter than that given by the B-K formula. He has called these shorter waves "dwarf waves" and the shortest measured wavelength is of the order of 3.5 cm.

The oscillator originated by Pierret and used also by Gutton and Beauvais in France is of particular interest as it uses a different oscillatory circuit to the usual parallel wires, though the fundamental principles of its operation are exactly the same. The oscillatory circuit in this case is simply a straight wire of appropriate length, which also serves as an antenna (see Fig. 4). This is exactly analogous to coupling a linear radiator aerial to an ordinary reaction oscillator by tapping one end of the aerial on to a point on the tuning inductance. Using French T.M.C. valves, Pierret and others have produced stable oscillations on wavelengths between 10 and 200 cm. with this circuit.

The possibility of replacing the retarding field of the anode in a triode electron oscillator by a magnetic field of suitable direction and intensity has been suggested and demonstrated by several workers.

Yagi, in Japan, used a simple cylindrical diode with an axial magnetic field, and found that when the anode was positively charged oscillations were produced for a range of values of the magnetic field slightly less than that required to cut off the anode current. A Lecher wire tuning system connected to anode and filamant was used. As the anode voltage was raised the wavelength went down and the oscillations became much stronger. The wavelength was practically independent of filament temperature. For short waves the anode diameter had to be small and it was found that the tube must be accurately centred in the magnetic field for maximum output. The wavelengths obtained were from 12 to 150 cm. A great improvement in output was obtained by splitting the anode lengthwise into two or four segments and bringing leads from each segment out of the valve. In the two-segment case the two anode leads were brought near the filament lead at a point outside the valve and then joined together to one wire of a Lecher system. The other Lecher wire went to one end of the filament. The D.C. supply circuits were completed through chokes.

Okabe, also in Japan, continued the experiments with split-anode magnetrons and obtained wavelengths down to 3.16 cm. For this he used an anode 0.3 cm. in diameter and 0.5 cm. long, with an anode voltage of 1,500 and a magnetic field of high intensity. He estimated that the shortest wavelength that it was practically possible to produce in this way was about 1 cm. These oscillations appeared to be internal and to be little affected in wavelength by the tuned circuit, but Okabe discovered another type of magnetron oscillation whose wavelength was decided mainly by the external tuned circuit. He compared this to the G-M oscillations of Hollmann, but in the magnetron case the wavelength of the G-M oscillations was longer, instead of shorter, than the internal oscillations. It is possible that these larger wave oscillations were due to negative resistance effects produced by the internal oscillations which existed at the same time.

It should be noted that these ultra-short wave magnetron oscillations are quite different from those of Hull and Elder, which depend on alternations of the magnetic field and are practicable at long wavelengths. In the same laboratory where Hull introduced the original magnetron (that of the G.E. Co., of America), researches have recently been made on the split-anode magnetron for ultra-short waves, and one model has given an output of 10 watts at 80 cm. wavelength, while a water-cooled tube has been designed for 1 KW. output at 1 metre.

Not only is it possible to replace the retarding electrostatic field of the anode in an electron oscillator by a magnetic field, but both anode and magnetic field may be omitted, leaving a diode, whose anode is of grid-form, which can produce oscillations for certain values of grid closeness and voltage. Hollmann has produced oscillations in this way and has shown that they behave in the same way as those produced by the B-K triode circuit.

Gerber, in Switzerland, has made some very interesting experiments with diodes whose electrodes consisted of straight parallel filaments, one acting as the hot cathode and another (or, in one case, two others) as anode. He connected these diodes to the usual Lecher wire tuning system and obtained oscillations which showed all the known characteristics of B-K oscillations. The wavelength was between 100 and 400 cm. Low capacity valve-voltmeters were used to indicate maximum output and Lecher wire resonance. Three separate ranges of wavelength were observed, and Gerber suggests that these are due to different electron oscillation orbits, comparing the oscillating space charge to air vibrations in a pipe and the different wavelengths to the overtones of the pipe. These overtones are not to be confused with the change of wavelength which occurs when the length of the Lecher wire tuning system is varied through the resonant value. This is simply the ordinary "coupled circuit" effect, which occurs when a tuned circuit is tightly coupled to any kind of oscillator and Gerber shows that the effect agrees with his approximate calculations. It appears that this coupled circuit effect has been overlooked by several investigators and it provides an explanation of the two different types of oscillation, B-K and G-M, described by Hollmann. It is interesting to compare Hollmann's results for a triode with those of Gerber for a diode. In the first case the wavelength increases as d is increased, changing suddenly to a shorter wavelength, at which point the oscillation strength suddenly increases, falling away gradually with increasing d, while the wavelength increases to its original value, and the cycle is repeated as d is still further increased. In the case of Gerber's diodes, the wavelength falls gradually with increasing d, while the oscillation intensity increases to a maximum, suddenly falling away at a point at which the wavelength suddenly rises, to decrease again with further increase of d. This is just the reverse of what occurred in Hollmann's case. These results point to the conclusion that in the triode case, with the tuned circuit between grid and anode, the external circuit is effectively in series with, or inductively coupled to, the internal oscillating space charge, while in the diode case the external circuit is effectively in parallel with, or capacitatively coupled to, the oscillating space charge. Returning to the curves of Fig. 3 in which Hollmann has apparently shown the presence of two oscillations of different wavelength (the B-K and G-M) by Lecher wire measurements the apparent difficulty, on the coupled circuit theory, arises of a coupled circuit system oscillating at two frequencies simultaneously. This, however, is readily explained by the fact that the electron oscillations are not confined to a single frequency, but, due to mechanical and electrical asymmetries, spread over a band of frequencies. Thus, it is quite possible for one part of the band to oscillate at one of the possible coupling frequencies, while another part oscillates at the second possible frequency.

With other phases of experimental work on electron oscillators such as the use of double grid valves, of special valves for push-pull circuits, or of special circuits for producing harmonics, I cannot attempt to deal in a short paper, but it may be of interest to say something about electron oscillations in water-cooled transmitting valves observed in the G.E.C. Research Laboratories at Wembley. The occurrence of these oscillations was first observed while the grid of a large transmitting valve was being bombarded on the pump. For this operation the grid is raised to a high positive potential with the anode earthed or disconnected. These are just the conditions under which electron oscillations can be produced. In one case of a 100-KW. valve, type CAT.10, the electron oscillations were so intense that measuring instruments at some distance from the valve were burnt out when a resonance occurred in the connecting leads.

I have recently made some tests with a 20-KW. valve using grid voltages up to about 1,000 and anode voltages from zero to —500. At first the usual parallel wire tuning system connected to grid and anode was used, but it was found that equally good results were obtained with a linear oscillator of adjustable length connected to the grid. Maximum oscillation strength was obtained with a grid voltage of about 750 and zero anode volts. Negative anode voltage gradually decreased the oscillation strength, and the oscillator worked satisfactorily with the anode completely disconnected. Wavelengths of from 80 to 120 cm. were obtained and the B-K law λ^2Eg=constant, was approximately fulfilled. It was easy to trace out the voltage distribution on the oscillator rod by means of small lamps. The most satisfactory way of doing this was to connect a small metal plate, a few square cm. in area, to one terminal of the lamp, while the other was in contact with the oscillator rod. The capacity current into the metal plate was sufficient to light the lamp. It was not possible to light a neon lamp with the voltage produced. With an input of about 1 KW. lamps were lit to a brilliancy corresponding to about 5 watts of low-frequency power, while the energy radiated was probably several times this amount. The efficiency in this case was thus of the order of a per cent. or two, but with other types of electron oscillator, particularly the magnetron type, it can be a good deal higher. It is interesting to note that the valve used for these tests had effectively four straight filaments, parallel to the axis of the grid and anode, forming a square prism of about 1 cm. side.

The theoretical analysis of the mechanism of electron oscillations has been attempted by many investigators since the original work of Barkhausen and Kurz, and in some cases quite conflicting conclusions have been reached. The simple analysis made by B. and K. based on the idea of electrons oscillating about the grid involved simplifying assumptions so drastic that it is quite remarkable that they derived a law (λ^2Eg=constant), which has been so amply confirmed by many experiments. They did not explain why the electrons oscillated in step so as to produce an oscillating potential of definite phase between the electrodes, instead of vibrating with all possible phases, at random. The effect of the external tuned circuit was also not dealt with, and it was even supposed to be negligible. The effect of the emission current and the anode bias voltage were also left to be considered by later investigators.

It will be realised that the problem is a very complicated one when all the factors are considered, the difficulty being in the first place one of mathematical analysis, and in the second of interpreting the mathematical results in physical terms. There is still considerable difference of opinion as to how some of the results should be interpreted, but I think a general summary might fairly be put as follows :—

(1) If electrons are accelerated from an emitting cathode to a positively charged electrode under certain conditions, some of them which do not strike the positive electrode will describe closed orbits or oscillations whose time-period is determined by the electrode geometry and the inter-electrode potential difference. There are, in general, several possible families of electron orbits, corresponding to different frequency ranges. For a given electrode geometry the particular type of orbit is decided by the P.D.

(2) If a small alternating potential exists between the electrodes, the electron oscillations commencing at one part of the cycle will be built up while those commencing at other parts of the cycle will be damped down, thus causing " in-step " oscillations of the space charge about its mean value.

(3) If there is no alternating potential (*i.e.*, no external tuned circuit) there can be no phase-sorting, and therefore no detectable oscillations. But in practice the valve electrodes and their connecting leads inevitably form a tuned circuit for some frequency, in which small oscillations may be built up. The so-called " pure " B-K oscillations, independent of any external circuit, thus appear to be a myth.

(4) The effect on the oscillations produced in a tuned circuit connected to the electrodes by varying its natural frequency is that which would be produced in a secondary tuned circuit coupled to an oscillator.

(5) Under conditions of emission saturation (*i.e.*, when all the emitted electrons go to the positive electrode), no oscillations can be produced. The oscillation frequency varies with changes in emission in the same direction.

(6) The conditions for producing oscillations can be fulfilled (*a*) in a diode whose anode

is a poor electron collector, (*b*) in a cylindrical diode with an axial magnetic field, and (*c*) in a triode where the grid is the positive electrode and the anode is a control electrode for the retarding field: and also in more complicated structures with more than three electrodes.

(7) The oscillations may alternatively be considered as the result of a negative resistance which has been shown theoretically to occur in the equivalent circuit of a valve under certain conditions of mean potential and superimposed alternation. There is quite a separate negative resistance effect which occurs as a result of rectification of the alternating voltage and is shown by a kink in the static characteristic. By means of this secondary oscillations can be maintained in any oscillatory circuit of sufficiently low resistance connected in series with the supply to the positive electrode.

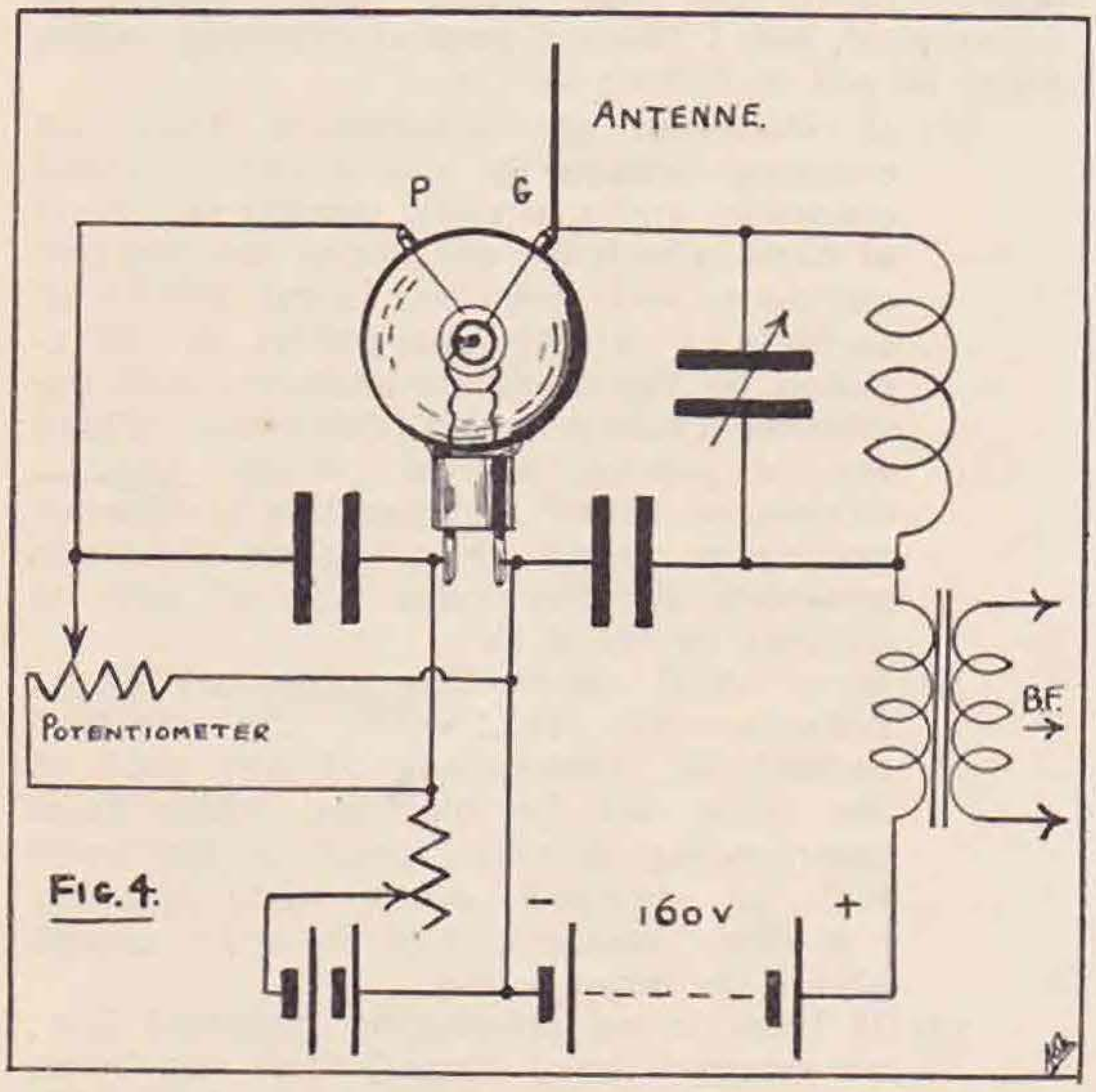


FIG. 4.

The possibility of applying electron oscillations to ultra-short wave communications occurred to their discoverers, and Barkhausen and Kurz succeeded in sending both telegraph and telephone signals over distances of a fraction of a mile. An electron oscillator similar to the transmitter, with telephones in the anode circuit and antennæ connected to grid and anode, was used for reception.

Much development work has since been done with a view to using electron oscillators for practical communication, particularly in Japan, France and Germany.

In Japan, Yagi used magnetron oscillators for investigating the polar diagrams of radiation from beam aerials at wavelengths of the order of a metre of two. More recently, Uda has obtained good telephone communication at 10 km. and telegraphy up to 30 km. along a "line of visibility," using directional aerials. Two receiving type tubes were used in parallel in the transmitter, with a few hundred volts on the grids. These transmitters used Lecher wire oscillating circuits (as in the laboratory experiments), with single or double antennæ attached to them.

In France the Pierret circuit already mentioned (with a straight oscillator wire attached to the grid) has been generally used both for transmission and reception. With an oscillator of this type with 250 volts on the grid of a TMC valve, Beauvais has succeeded in signalling a maximum distance of 38 km. from the top of the Eiffel Tower, using very efficient reflectors at both ends and a wavelength of about 17 cm. In all these tests the transmitter was modulated at audio frequency or fed with audio frequency A.C., as there is no question of using beat reception, first because the oscillations are not entirely confined to a single frequency, and, secondly, on account of frequency variations.

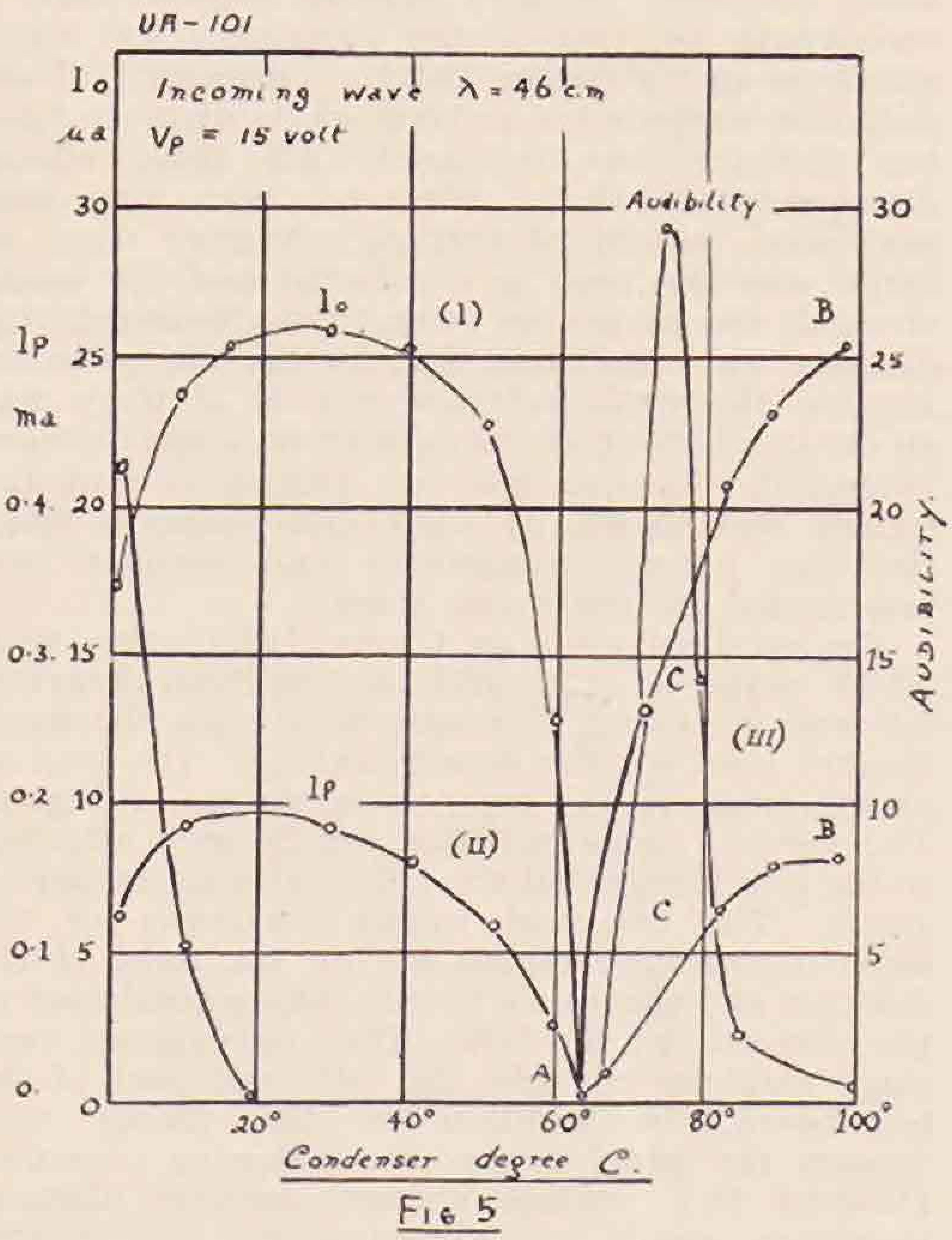
The receiver used by Beauvais is of some interest (see Fig. 4). A vertical $\frac{1}{4}\lambda$ aerial is attached to the grid and the H.T. supply is connected to the grid *via* a tuned circuit, which is made to oscillate by means of the "dynatron kink" in the grid characteristic and so provide super-regeneration by interrupting the electron oscillations at a lower radio frequency (in this case 3 to 15 mC.). The super-regeneration is controlled by the variable condenser of this circuit and fine adjustment of the wavelength by adjustment of the anode voltage by means of a potentiometer across the filament battery. The transformer connecting the oscillator to the low-frequency amplifier is in the grid circuit, though it is usually best placed in the anode circuit, where the D.C. current is much lower.

In Uda's receiver a parallel wire tuning system is used with a variable condenser bridge at one end, by which tuning is effected. The optimum strength and frequency of oscillation are found by adjustment of H.T. and anode voltages by potentiometers. No super-regeneration is used.

The variation of signal strength, oscillation intensity and anode current with the tuning capacity for a receiver of this kind are shown in Fig. 5, taken from Okabe's paper.

In the transmitter modulation is best effected in the anode circuit, and if a suitable bias is used a good depth of modulation can be obtained with little distortion. The modulating voltage required is quite small. If the microphone is replaced by an audio oscillator, satisfactory telegraphy can be obtained by keying in the oscillator circuit. Alternatively, the oscillator H.T. may be keyed.

I have recently made some experiments in the G.E.C. Research Laboratories with simple electron oscillators for transmission and reception, and some of this apparatus will be demonstrated at the end of the lecture. Both the Lecher wire and Pierret circuits have been used with similar results. For test purposes it has been found quite convenient to run the transmitter off A.C. mains, while the receiver is operated from batteries. No distance tests have been made, but signals have been transmitted through heavy screening up to 50 yards or so in the Laboratories. The receiver used a DEQ valve for the oscillating detector in a circuit similar to that used by Beauvais, except that the transformer is in the anode circuit and that the point of tapping the grid on to the "oscillator-aerial" is adjustable so that the optimum coupling may be obtained. This feature can also be used in the transmitter.



The principal features of the waves of 5 to 100 cm. produced by electron oscillators are (1) the practical necessity of having a visibility line between transmitter and receiver owing to the absence of reflected rays from the upper atmosphere, and (2) the practical possibility of confining the transmission to a very narrow beam and greatly improving the reception by the use of directional aerials and reflectors. Parabolic reflectors with the antenna at the focus have been used with marked effect as well as various types of directive arrays. Yagi has introduced a new kind of directive array consisting of a row of vertical wires spaced about .34λ and placed in the direction of transmission. If these wires are made a little less than λ/2 in length (optimum = about .44λ), the system acts as a " wave director " and if the length is a little more than λ/2, it acts as a " wave reflector." A wave director of this kind used with a parabolic reflector forms a most effective directional system.

Waves of this length are entirely free from atmospherics and interference from electrical machinery. It has been shown theoretically and experimentally that their transmission is not appreciably affected by fog down to about 5 cm.

Electron oscillations have found important applications in physical, chemical and biological research, and I need hardly stress their possibilities in the field of ultra-high frequency radio. They have already been used as aids to marine and aerial navigation, and their possible use for television has been discussed. They provide a means of short-range communication, telegraphic or telephonic, in many ways ideal. Here is a field in which the members of this Society who have exhausted the technical possibilities of the now commercial short-wave range may well find new worlds to conquer.

APPENDIX I.

Account of Demonstration.

The oscillator shown in Fig. 1 was first used to demonstrate the difference between reaction and electron oscillations. It consists simply of a TMC valve with a pair of parallel wires connected to grid and anode. The wires are bridged at the " free " ends by a 100μμF variable condenser, by means of which the oscillatory circuit may be tuned. The battery supplies are fed through chokes to the condenser terminals. The wavelength was measured by means of the Lecher wires shown in Fig. 6 and with 200 volts H.T. was found to be about 2 metres for reaction and 44 cm. for electron oscillations.

Various directional effects of ultra-short waves were demonstrated with the " micro-transmitter " of Fig.7, which uses the very simple Pierret arrangement with a straight wire oscillator-radiator connected to the grid. The length of this wire is adjusted to give the best radiation at a given grid voltage and is usually just under ¼ wavelength. This transmitter was fed with 50-cycle A.C. so as to produce a conveniently audible signal in the receiver without further modulation.

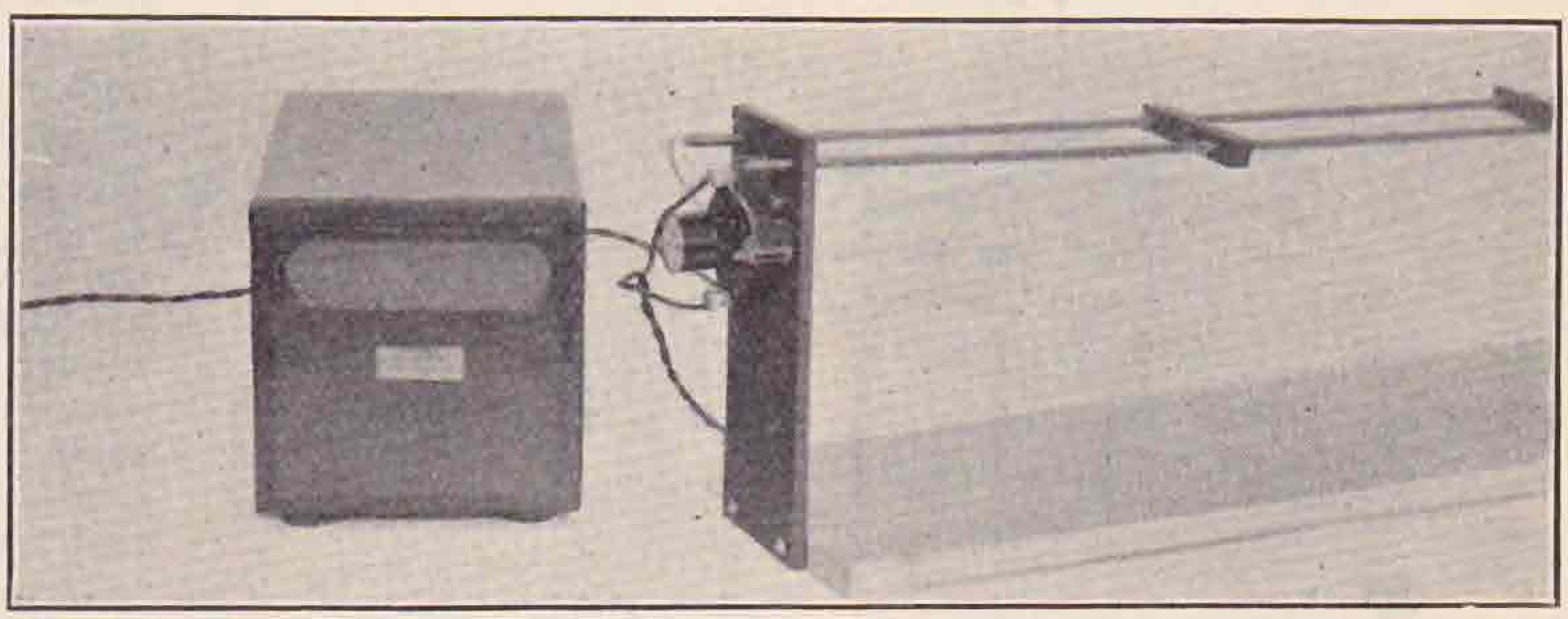


Fig. 6. Lecher wires for wavelength measurement, showing thermo-couple and galvanometer.

The polarisation of these waves was shown by using a receiver with a fixed vertical aerial (Fig. 8) and rotating the transmitter in a vertical plane parallel to the receiver aerial. The signal strength showed a clear minimum when the transmitting aerial was horizontal and increased to a maximum value as the aerial was turned into the vertical position.

The fundamental principle of " beam " aerial arrays was illustrated by means of a " reflector " wire about ½ wavelength (20 cms.) long, which was held at the centre (voltage node) and moved about in the neighbourhood of the transmitting

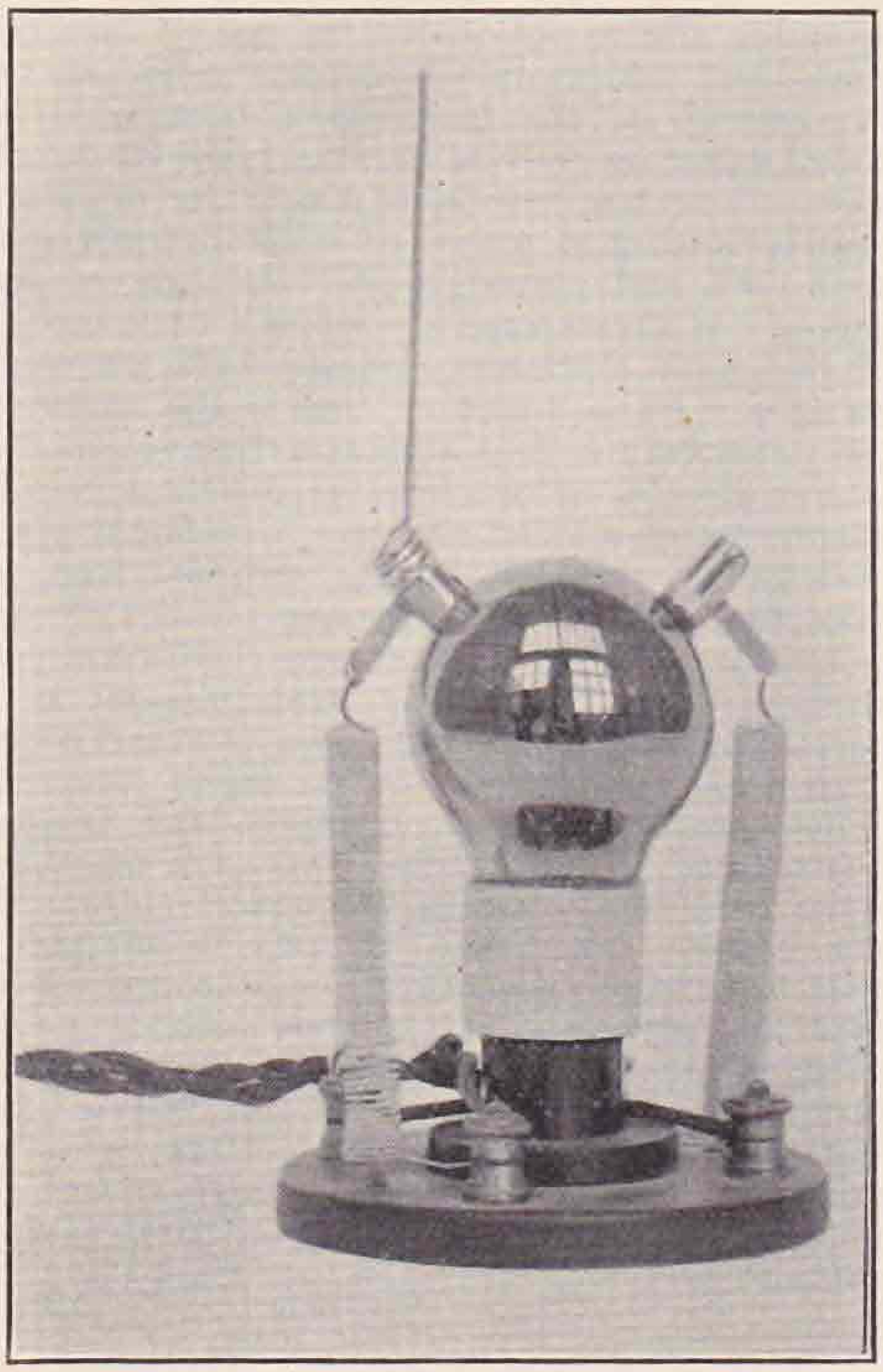
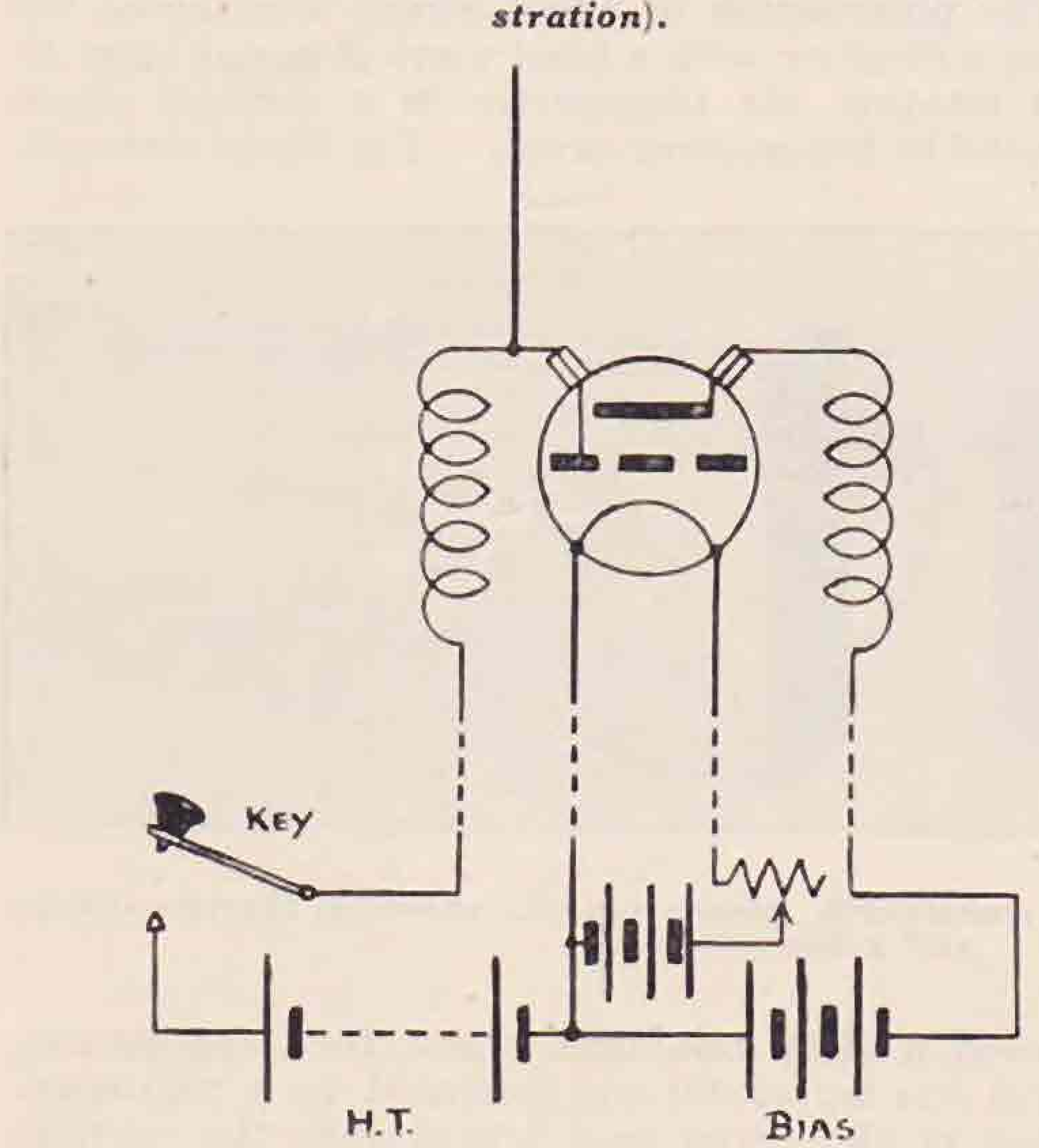


Fig. 7. The "Pierret" oscillator with linear oscillator-radiator attached to the grid (oscillator used for directional experiments in demonstration).



aerial. When it was held vertically behind the vertical transmitting aerial and gradually moved away from it a signal maximum occurred when the distance between radiator and reflector was about ¼ wavelength and weaker maxima at half-wave intervals. A wire slightly shorter than ½ wavelength *in front* of the radiator acted alternately as an "absorber" and a "director" of the radiation towards the receiver as its distance from the radiator was increased. All these effects disappeared if the "reflector" wire was held horizontal instead of vertical. A large sheet of metal was also used as a reflector and the signal strength was maximum when the radiator-reflector distance was about half that for the wire reflector because the sheet reflector acts as if there was an electrical image of the radiator an equal distance behind it. The straight-line propagation of the signals was shown by their disappearance when the line joining transmitter and receiver was interrupted by the metal sheet.

The received used an Osram DEQ valve with 30-60 volts on the grid as oscillator-detector, followed by two L.F. stages to operate the loud-speaker used for the demonstration. The general arrangement of the receiver is shown in Fig. 8. The vertical aerial-oscillator can be seen attached to the grid terminal of the DEQ valve in the photograph. The coil and tuning condenser of the super-regenerative circuit are on the right of the detector and the anode circuit tuning condenser of the detector to the left. The conventional two-stage amplifier occupies the left-hand part of the base-board. In addition to the tuning condensers the panel carries the following controls: Detector H.T. voltage control, detector filament resistance, anode bias potentiometer and volume control across the grid of the first amplifier. The procedure in tuning is as follows:—

(1) Connect an "aerial-oscillator" wire about ¾ wavelength (or 1¼ wavelengths) long (one ½ wavelength projecting above the panel) to the grid, a small fraction of a wavelength from one end, and connect the lead from the "super-regenerating" circuit at a voltage node, *i.e.*, about ¼ or ¾ wavelength from the free end.

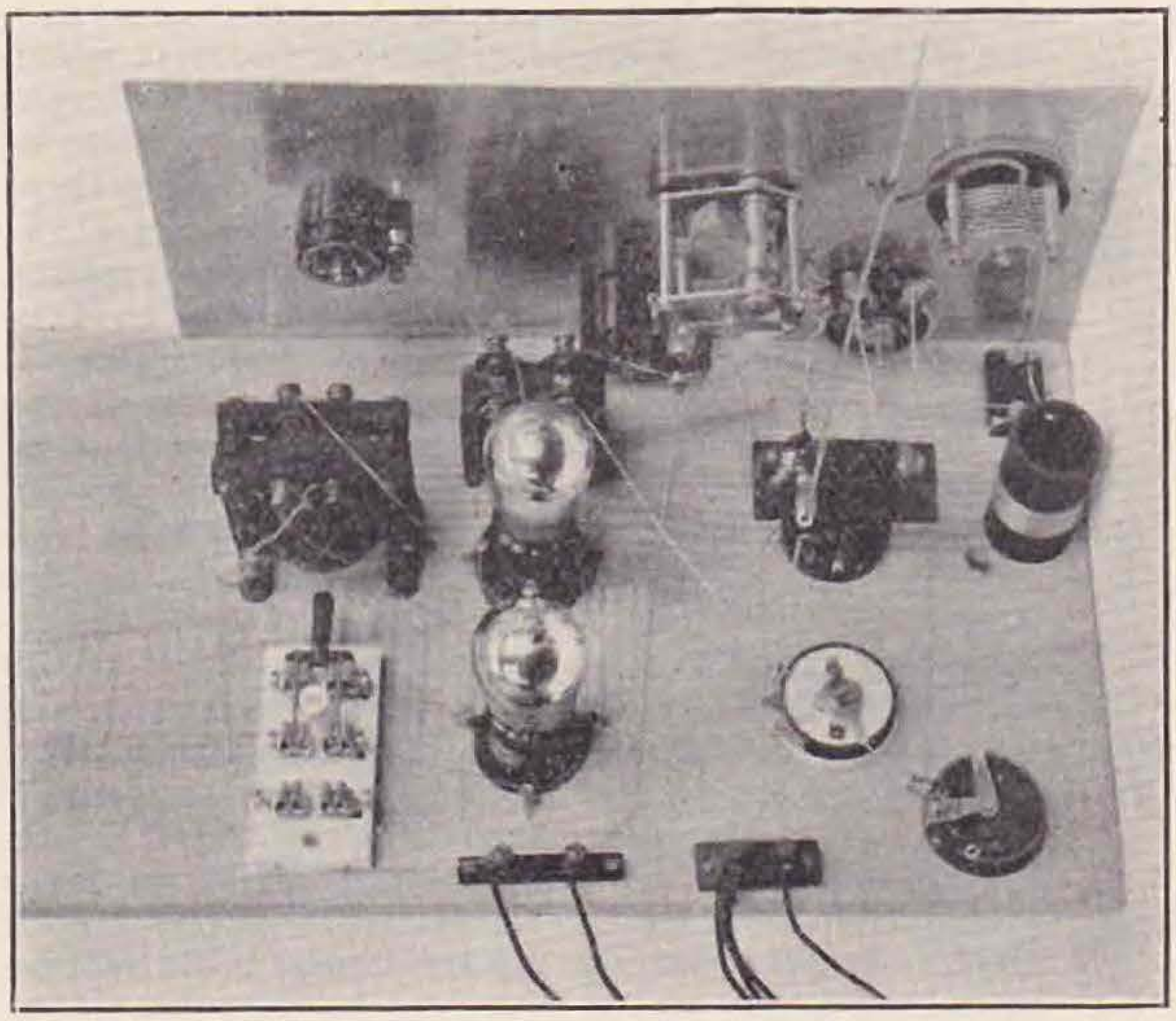
(2) Adjust H.T. volts, anode bias and filament temperature to give oscillation at about the required wavelength. The super-regeneraing circuit can be shorted out during these adjustments.

(3) The anode tuning condenser is then adjusted so as to tune the anode circuit to either the fundamental or a sub-harmonic of the oscillation frequency, which will cause a sudden increase in oscillation strength and sensitivity. The oscillation strength should then be readjusted for optimum rectification by means of the filament resistance or anode bias.

(4) If a satisfactory adjustment cannot be obtained the point of attachment of the aerial-oscillator to the grid should be altered. In general, the nearer this point is to the end of the aerial the greater the sensitivity and the more difficult the adjustment of the receiver, and *vice versa*.

(5) The super-regenerating circuit is next brought into action and suitable values of inductance and capacity must be found, so that this circuit oscillates due to the

" dynatron kink " in the grid characteristic of the oscillating detector. A readjustment of the detector voltages may also be necessary. When oscillation occurs there is a definite increase in background noise (which ceases if L_1 C_1 is shorted out),



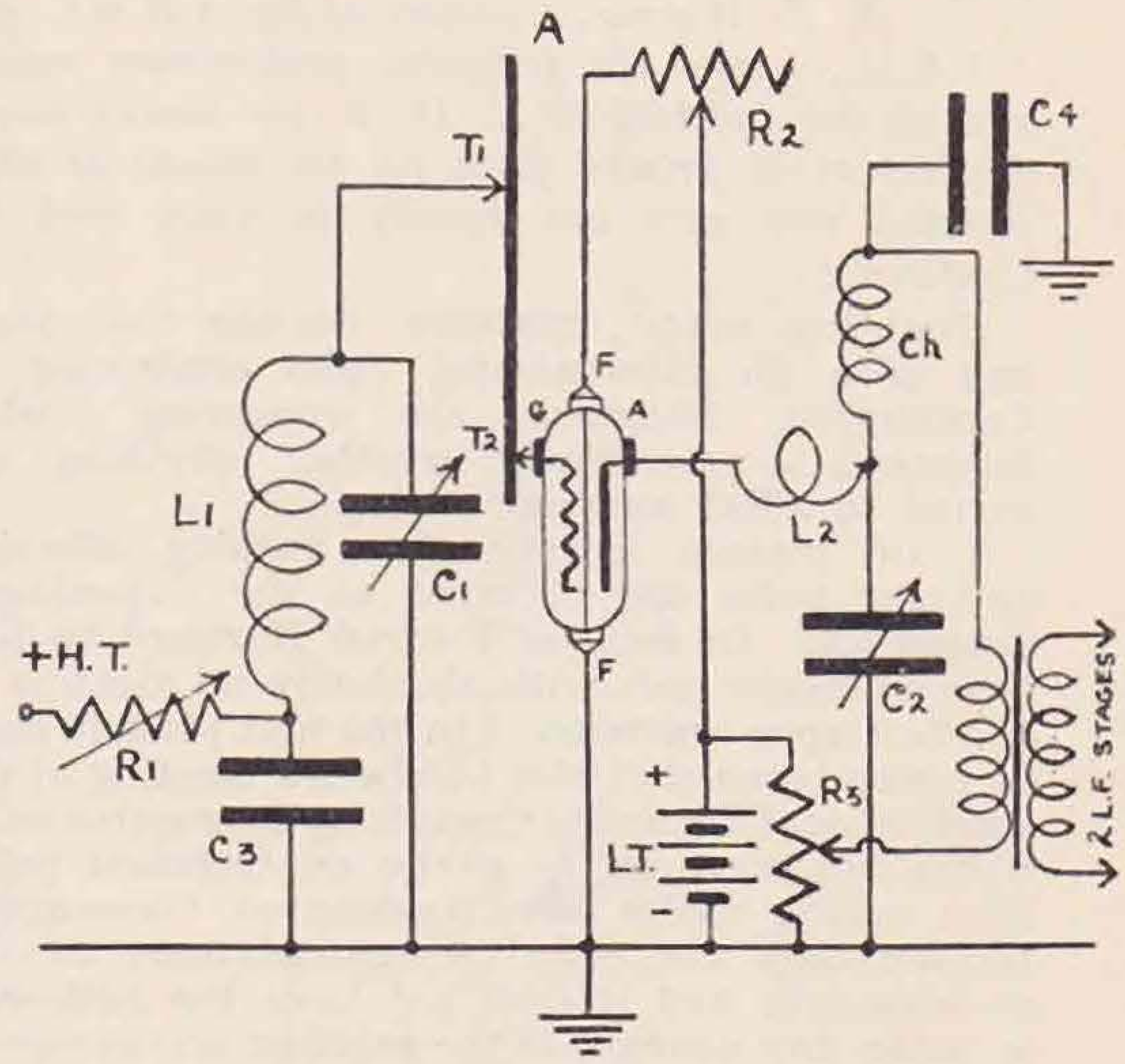


Fig. 8. Electron oscillation receiver, with DEQ valve as oscillating detector. The circuit is shown at the side.
A—Oscillator-antenna, λ/2, 2λ/2, 3λ/2, etc., long.
T_1—Nodal tap, " n " λ/4 from end.
T_2—Coupling tap between oscillatory circuit and valve (c.f. single feeder Hertz antenna).
L_1C_1—Tuned circuit for super-regenerative interrupting (quenching) frequency (plug-in coils suitable).
L_2C_2—Anode tuned circuit, L_2 being a few cms. of wire (say λ/4), and C_2 about 100 mfds.

R_1—Detector H.T. voltage control (1,000 to 10,000 ohms to carry 20 m/As).
R_2—Filament resistance (CRITICAL—oscillation control).
R_3—Anode bias control.
C_3 and C_4—By-pass condensers.
Ch—Choke.
H.T. volts—30 to 60 for λ=40 to 60 cms.

the signal strength increases very con-considerably and the tuning becomes flatter. This " auto super-regenerative " circuit is rather more tricky to adjust than one using an entirely separate " quenching " oscillator, but it is capable of giving quite as good results.

It is quite possible for super-regenerative effects to be produced unintentionally when L_1 C_1 is shorted out, since dynatron oscillations can be produced in various connecting leads and beats between several such oscillations can produce a weird assortment of howls and hisses in the receiver.

These troubles can be overcome by altering the length and disposition of the offending leads and by the judicious use of chokes and by-pass condensers.

A demonstration of telephony was not given at the lecture as it was not possible to arrange this in the available time, but the identical apparatus has been used for telephony tests in the G.E.C. Research Laboratories with some success. Modulation is carried out in the anode circuit of the transmitter and the adjustment of the receiver is the same as for modulated telegraphy.

APPENDIX II.

References for general reading :
(1) Smith-Rose and McPetrie: Experimental Wireless, Vol. 6, pp. 523 and 605 (Oct. and Nov., 1929).
(2) Pierret : L'Onde Electrique, Vol. 8, p. 373 (1929).
(3) Hollmann : Proc. I.R.E., Vol. 17, p. 229 (1929).
(4) Hollmann : Jahrbuch der Drahtl. Teleg. und Teleph., Vol. 35, pp. 21 and 76 (Jan. and Feb., 1930).

STRAYS.

The Citroen expedition into Central Asia has just reached Kabul, Afghanistan. The station has been heard by F8BU and works on 36 and 23 metres with the call FPCF.

* * *

G5LC, of 130, Walton Road, East Molesey, Surrey, has just started up with C.C. on 7135 K.C., and with a self-excited set on 14 M.C. The station is QRP and would appreciate reports of signals and also complete WX report (barometer, etc.).

VK3BB, W. F. Brown, 19, Mackay Crescent, South Warrnambool, Victoria, Australia, is on both 7 and 14 M.C. every night, and would like QSO's with G stations or reports on his signals, which will be acknowledged at once. He uses a T.P.T.G. transmitter for both frequencies, with crystal-control on 7 M.C. He is the youngest transmitter in Australia, being only 16 years old.

C.C.I.R., 1931.

Copenhagen.

At the end of the C.C.I.R. Conference, held in Copenhagen at the beginning of June, Major K. B. Warner, secretary of the A.R.R.L. and I.A.R.U., issued the following preliminary report, and we are indebted to E. D. R. for having issued this report in printed form for the benefit of other societies who were not directly in touch with the Conference.

Doubtless many amateurs, hearing that there has been an international radio conference at Copenhagen, Denmark, are wondering "what happened"—particularly whether anything occurred to affect amateur radio.

I am pleased to say that nothing affecting amateur radio has occurred at the Copenhagen conference. In fact, as I wired Hartford to-day, the conference ends with absolutely no mention of or effect upon amateurs. In the first place it must be remembered that this has been a meeting of the International Technical Consulting Committee only, whose functions are to advise on technical problems arising under the Washington Convention. Its decisions are only recommendations to the governments, and it does not have the authority to make any changes in the existing arrangements prescribing our frequency bands, the authority to each government to stipulate our power, etc. The questions which were studied here were technical in character, relating to many phases of commercial radio, but they have not concerned amateur radio. To give an idea of the field of the C.C.I.R., it may be said that the problems discussed at Copenhagen concerned such things as arrangements to connect marine radio telephony with the land nets, a revision of The Hague tolerance table for commercial services, the control of harmonics, comparison of frequency standards between nations, calibration of frequency meters, information to be published by Berne, the suppression of arc spacing waves, single side-band transmission, and other things of much the same sort, to a total of 25 questions. Many of these questions had the possibility of developing an angle which would affect amateur radio, possibly adversely, and that is why I have been here. The decisions adopted, however, as I have said above, are without effect upon us. Some of the data which have been submitted in the study of the different questions may prove quite useful and valuable to us as amateurs, and I hope that in due course these may find their way to the light of day in *QST*, *OZ* and other amateur periodicals. One question considered here did threaten for a while to take on a complexion unfavourable to the amateur—when it was proposed to engage in a study of the needs of the various kinds of services for frequencies, what frequencies were best suited to each service, and so on. Many nations were opposed to discussing this, however, since the C.C.I.R. cannot engage in allocation, and it was eventually determined to convert the question into a study of the technical factors affecting the performance of frequencies in various parts of the spectrum, but without respect to the needs of various services.

Thus ends the second meeting of the C.C.I.R. Before the next one is held there will be a large international conference at Madrid—in the fall of 1932. At this meeting the frequency table will be examined anew, and it may well be that important changes will occur then. The Madrid meeting, in short, will have the authority to change the assignment of bands to services, and the whole future course of amateur radio will again be at stake. For that reason I would like to take this opportunity to urge upon the amateur societies of the world that they make it their special business, in the intervening year, to establish friendly contact with the radio administrations of their respective countries, and endeavour to give them an appreciation of the value of amateur radio, an understanding of what it is all about. If each of our societies will make this effort in its own country, it will go a very long way towards creating, at Madrid, that recognition of the usefulness and importance of amateur radio which will be essential if we are there to preserve our necessary place in the sun.

Book Review.

High Frequency Alternating Currents. By K. McIlwain and J. G. Brainerd. 510 pages and 226 illustrations and diagrams. Price 30s. net. Published by Chapman & Hall, Ltd., London.

The authors of this book have chosen their material and presented it with the needs of the senior or graduate student in mind, and the reader should have a good knowledge of the Calculus, differential equations, and the theory underlying the use of complex numbers.

The book represents a sound course in high-frequency circuit theory and calculation as applied to both transmission and reception, and each chapter is concluded with a short bibliography which will be useful to any reader desiring more exhaustive treatment of a particular section.

Eleven tables are given, a particularly useful one being the current, voltage amd power ratios versus decibels from 0.1 to 100DB.

In addition to chapters on Resonance Phenomena, Coupled Circuits, Valves, and Amplification, comprehensive treatment is given of modulation and detection (inaptly termed "demodulation"), electric wave filters, production of H.F. waves, transmission lines, electro-magnetic waves, reflection and refraction and electro-mechanical systems; a few other problems are dealt with in appendices.

Students and designers concerned with circuits working at frequencies above commercial power frequencies, and who are well equipped mathematically, will find this book of great interest and value. T. P. A.

Please give page 24 a few minutes' thought.

The Design and Operation of a Crystal Controlled Transmitter.

By D. W. Heightman (A.M.I.E.T. (G6DH).

BEFORE proceeding with the construction of a crystal controlled transmitter the writer recently carried out some experimental work so as to be able to summarise the chief points in the design of such a transmitter. The following article on this work may, therefore, be useful to those using, or contemplating the use, of crystal control.

H.T. supply voltages were somewhat restricted (250 v. for the crystal oscillator and frequency doublers and 500 v. for the power amplifier) so that experiments were directed with a view to obtaining a comparatively high output with the low voltages available. It was found that from a single frequency doubler (hereafter referred to as F.D.) with 250 v. H.T. ample grid swing could be obtained to drive a pair of LS5 valves in push-pull well into grid current. In view of this fact push-pull F.D.'s were not tried.

The components are referred to by the numbering of Fig. 1 (unless otherwise stated).

(1) *L/C Ratios.*—Since in a crystal controlled transmitter constancy of the output frequency does not depend on L/C ratios we can choose the values of L and C to give maximum efficiency. In the crystal oscillator (hereafter abbreviated C.O.) and F.D. stages we are aiming at obtaining maximum grid swing for the following stages, so that obviously we require tuned circuits of high dynamic resistance $\left(\frac{\omega^2 L^2}{R} \text{ or } \frac{L}{RC}\right.$ is to be as high as possible$\left.\right)$ and therefore high L/C ratio in the anode circuits of these stages. Owing to the greater losses at high radio frequencies it is difficult to design a tuned circuit with a resonant impedance of much over 50,000 ohms at 7 M.C., and at 14 M.C. it becomes more like 25,000 ohms, so that great care should be paid to making the tuned circuits as low-loss as possible. As will be seen under (6) it is also desirable to have a high L/C ratio in the power amplifier stage (abbreviated P.A.).

A convenient value for the tuning condensers C_1, C_2, C_3, C_4, and C_5 was found to be .00015 mfds. Suitable values for the inductances are as follows :— L_1 (17 micro. H.), 16 turns : L_2 (6 micro. H.), 8 turns : L_3 (3 micro. H.), 5 turns ; L_4 for 7 M.C. (6 micro. H.), 8 turns : L_4 for 14 M.C. (3 micro. H.) 5 turns : L_5 for 7 M.C. (6 micro. H.), 11 turns : L_5 for 14 M.C. (3 micro: H.), 7 turns. All the coils are 8 cm. in diameter, the C.O. and F.D. coils of No. 18 S.W.G. copper wire (turns spaced .3 cm.), and the P.A. coils No. 10 S.W.G. (turns spaced 1 cm.).

To measure approximately the voltage across the C.O. tuned circuit, etc., the circuit shown in Fig. 2 was set up. V_2 was arranged so that it could be used either as a peak voltmeter or as a F.D. When used as a voltmeter the anode connection to V was disconnected at X, leaving only the grid and filament connected, so that V^2 acted as a diode across L_1 C_1. With the filament of V^2 switched off, the C.O. was adjusted for maximum R.F. current as indicated by the H.W. ammeter A_1. The filament of V_2 was then lighted and grid current was indicated on the milliameter $M.A._2$ (reading 0-1 ma.) : by adjusting the bias to V_2 so that there was no grid current, i.e., so that $M.A._2$ just read zero, then the value of the peak R.F. voltage across L_1C_1 equalled the grid bias value. With 250 v. H.T. on the C.O. the peak R.F. voltage across the C.O. tuned circuit was 150 v. (off load). Similar or somewhat greater values of voltage appeared across the F.D. circuits.

(2) *Valves.*—Valves with characteristics similar to those of the LS5 type (i.e., A.C. resistance 6,000 ohms, amplification factor 6) were found to be most suitable in the C.O. and P.A. stages. In the F.D. stages valves with a higher amplification factor were better. The LS5B gave good results

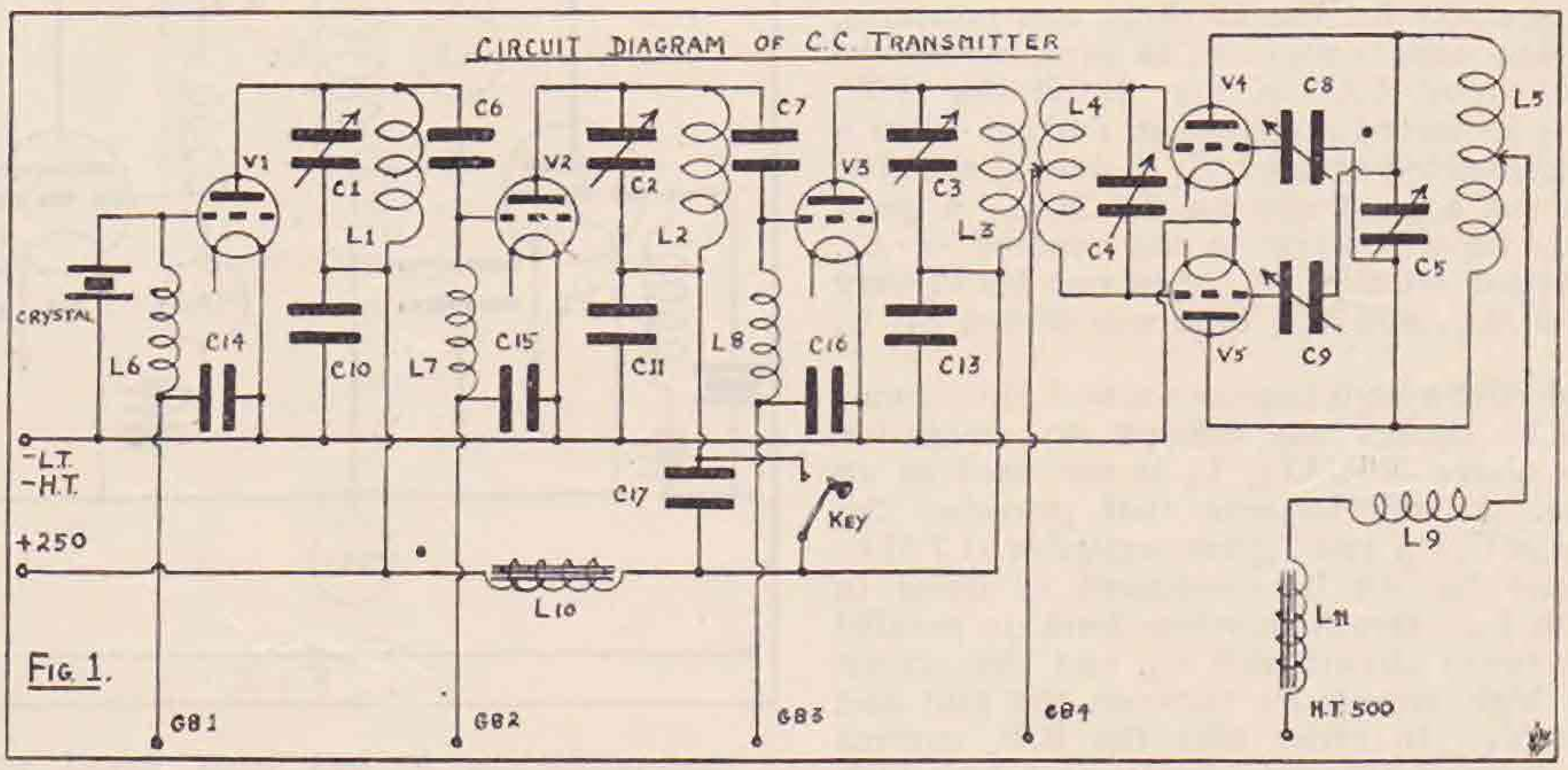


FIG. 1.

(25,000 ohms A.C. resistance, amplification factor 20). Probably the efficiency could have been increased by the use of more modern valves (which have a higher mutual conductance) but as more than enough grid swing could be obtained to drive the P.A. stage with existing valves the newer valves were not tried.

(3) *Coupling Stages.* (*a*) C.O.-F.D.-F.D.—The capacitive method was found to be the best for coupling these stages, and it certainly is the simplest. With the biasing scheme described under (4) the impedance of the coupling condensers (C_6 and C_7) should be negligible to the frequency in use—.01 mfds. is a handy value.

(*b*) F.D.-P.A.—In order to provide a suitable push-pull grid feed for the P.A. the coupling shown in Fig. 1 (where L_4 is the coupling coil) was tried and proved to be extremely good. The transmitter is arranged so that it is a simple matter to couple L_4 either to L_3 or L_2 according to the desired output frequency. By adjusting the centre tap to L_4 the grid feed to the push-pull valves can be balanced. The coupling between L_4 and L_3 (or L_2) is loose—approximately 10 cm.—and by varying this coupling a useful control of the output (and the input) of the transmitter is provided.

(4) *Applying Grid Bias.*—L_6 and L_7 should have a high impedance at 3.5 M.C. In order to find a good type of choke for use in these two positions, several chokes were connected, in turn, across the C.O. tuned circuit L_1C_1 of Fig. 2. If the H.W. ammeter A_1 indicated a change in current when a choke was connected across L_1C_1 it showed that the choke was not a good one for 3.5 M.C. A good choke made no difference to the reading of A_1. The Trix broadcast type of choke was found very good for 3.5 M.C. and this type was chosen for L_6 and L_7.

L_8 should offer a high impedance to 7 M.C. Since efficient R.F. chokes are difficult to design for frequencies above 3.5 M.C., L_8 is not used as an R.F. choke. It will be seen that provided the impedances of C_7 C_{11} and C_{16} are negligible at 7 M.C. (as they are) L_8 can be considered as being in parallel with L_2. It will therefore form (in parallel with L_2) a tuned circuit with C_2, and this circuit provides a high impedance between the grid and filament of V_3. In order that the R.F. current through L_8 is small, this inductance can have a high value. In practice 60 turns of No. 22 D.S.C. on a 2 cm. test tube are satisfactory.

It was noted that several amateurs used resistances, either in series with, or in place of, the R.F. chokes for applying bias. In order to test whether the efficiency was increased by the use of these resistances the experimental circuit of Fig. 2 was again used. V_2 was used as a F.D. and the H.W. ammeter A_1 showed whether the output from the F.D. increased or decreased. When bias was applied through a resistance only, the output was found to be considerably reduced, and when a choke and resistance were used the output was not as great as when the choke was used alone.

The grid bias to the P.A. can be well applied through the coil L_4.

With 250 v. H.T. on the C.O. and F.D.'s the following are suitable values of grid bias :—C.O.—30 v. ; F.D.'s—70 v., and with 500 v. on the P.A.—70 v. The values of bias on the F.D.'s and P.A. depend, of course, to some extent on the values of the grid input R.F. voltages and the best values of bias are most easily determined by experiment, adjustments being made to the bias to give maximum output from each stage.

(5) *The P.A.*—Since only low H.T. voltages were available the writer concentrated on the push-pull type of P.A. Besides giving nearly double the output, this type of P.A. was found to offer several advantages over the single valve type. The R.F. choke L_9 (200 turns 2 cm. diam.) does away with the necessity of having to find by experiment the exact electrical centre of the anode circuit and also simplifies neutralisation. C_8 and C_9 are neutralising condensers of a very good low loss type, their capacity being approximately equal to the valve G-P. capacities. These condensers should be carefully adjusted so that the P.A. will not self-oscillate when the grid and plate circuits are tuned to the operating frequency (the C.O. and F.D. circuits being switched off). Although the P.A. is

EXPERIMENTAL CIRCUIT.

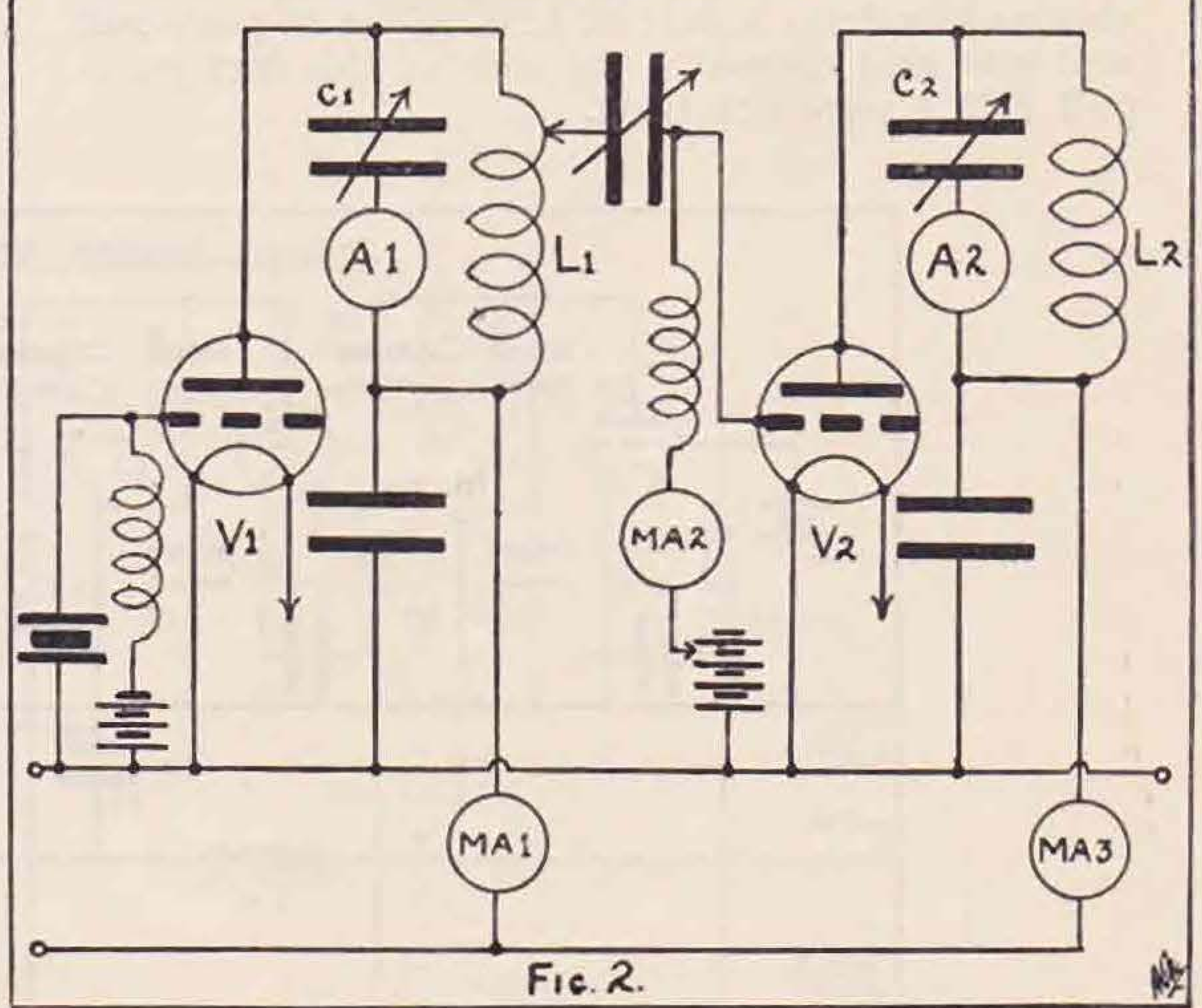


Fig. 2.

non-oscillating it has been found possible, by running the valves into grid current, to obtain a greater output than a similar self-excited push-pull transmitter. It is not, of course, operated as a linear amplifier, the valves being biased rather highly and given a greater grid swing than would be required for linear operation.

In order to obtain a rough idea of the R.F. output and efficiency of the P.A. several vacuum type electric lamps can be connected in turn across two or so turns of the P.A. anode circuit and adjustments be made for maximum illumination, until a lamp is found which lights with the same brilliance from the transmitter as it does when connected to the electric supply mains for which it was designed. The output of the transmitter can then be assumed to be approximately that of the lamp. In the writer's case, with an input of 35-40 watts, it was found possible to light a 20-watt lamp to full brilliance—the output from the transmitter was therefore 20 watts and the efficiency approximately 50 per cent.

The advantages of anode tap were investigated but were found to be nil, this, no doubt, being due to the fact that the effect of the valve capacities is very considerable at high radio frequencies and it is better to have the valves shunted across the whole of the tuned circuits.

(6) *Coupling the Antenna.*—To obtain maximum power output from a valve to its load it is, of course, necessary that the load impedance bears a definite relationship to the valve A.C. resistance. The relationship between these two factors depends to some extent on the operating conditions—if the valve is operated as a linear amplifier it is a simple matter to calculate the correct load, but when it is operated over the curved part of its characteristic and the grid input voltage is not sinusoidal (as is generally the case in a transmitter) calculation becomes difficult. It is, however, very simple to find by experiment the best conditions for maximum power output.

If we make the tuned circuit of the P.A. stage as low as possible ($\frac{\omega^2L^2}{R}$ or $\frac{L}{RC}$ to be great, therefore high L/C ratio) the dynamic resistance of this circuit will be considerably greater than that required for maximum output from usual valves (say of 6,000 ohms A.C. resistance) also the power lost, due to resistance in the tuned circuit will be small. By tapping the antenna on the inductance we decrease the dynamic resistance of the circuit by an amount depending on the position of the tap, and thus have an adjustment of the effective load in the anode circuit of the valve (or valves). In practice it is a simple matter to vary the position of the tap until maximum antenna current is indicated, under which condition we shall be obtaining maximum power transference from the valves to the antenna. In the case of an inductively-coupled antenna the same remarks apply, only with this type the degree of coupling between the antenna and transmitter coils provides the impedance adjustment. The degree of coupling between the antenna (or feeder) and the transmitter will, of course, depend on the impedance of the particular antenna in use and the characteristics of the P.A. valves.

The antenna can be coupled to one side of the push-pull P.A. (obviously it does not matter which side is chosen). One or two amateurs have queried the above; they say that if the antenna is only coupled to one side it would appear that the other side is not delivering power to the antenna, but it must not be overlooked that the two sides of the circuit are extremely tightly coupled and any load connected on one side has power delivered to it from both sides. From the point of view of obtaining absolute balance between the two sides it would be interesting to try the split coupling coil arrangement or the Doublet Antenna ("Q.S.T.," Dec., 1930).

(7) *Keying.*—Keying can be very satisfactorily carried out by breaking the H.T. positive to the first F.D. as shown in Fig. 1. This method has two advantages—(1) elimination of spacer; (2) key is in a low-powered circuit. The choke L_{10} (20 H.) and the condenser C_{17} (.5 mfd.) prevent key clicks. Apparently a click is radiated every time the current in a circuit is changed rapidly, so that it will probably be found necessary to insert a choke (L_{11} = 20 H.) in the H.T. lead to the P.A. as the current in this circuit changes when keying. With an input of 40 watts to the P.A. it has been found impossible to detect any interference on two sensitive B.C.L. sets whose antennæ run within 5 yards of the transmitter. The note is always reported clear-cut with this keying system.

(8) *Tuning.*—The whole transmitter can be tuned up by the use of only two meters, *i.e.*, a H.W. ammeter and an anode current milliameter (with jacks provided for reading the anode currents to the various stages), although it is very useful to have meters in all the stages. R.F. ammeters in the tuned circuits of the C.O. and F.D's are helpful in indicating resonance and in adjusting for maximum output in these circuits.

Assuming that the C.O. is oscillating, the C.O. tuning condenser C_1 is adjusted so that the anode current to the first F.D. (which F.D. is at present not tuned) reaches a maximum. C_2 is now varied so as to reduce the anode current to the F.D. to a minimum—at this point, if a R.F. ammeter is included in the F.D. tuned circuit, maximum R.F. current will be indicated, also the anode current of the second F.D. will be approximately maximum. C_3 is now adjusted for minimum anode current to the second F.D. (or maximum R.F. current in C_3L_3). The circuit C_4L_4 is tuned to resonance with C_3L_3 and the P.A. anode current should reach a maximum when this circuit is fully in tune. C_5 is then varied so as to reduce the anode current to the P.A.—antenna current should now be indicated and C_5 be adjusted to give maximum antenna current, also the antenna coupling (or tap) should be adjusted for maximum current (on the H.W. antenna ammeter). Using LS5 valves in the P.A. stage the anode current to this stage should be about 80 ma. on load. Finally the G.B. and tuning to each of the stages can be finely adjusted for maximum output conditions. When it is desired to operate the transmitter on 7 M.C. the second F.D. is disconnected and L_4 is coupled to L_2.

Strays.

We have been asked why the graphs in G6OT's article in the last issue on the design of smoothing chokes were reproduced full page size, one suggestion being that we were short of material to fill! It was perhaps not made clear in the article that they were true curves for the particular iron in question. They were meant to be used and not merely to be looked at. The article gave us, therefore, complete details for the design of smoothing chokes, and we doubt if such information has ever been placed before members in such an easy and yet comprehensive way. We are much indebted to G6OT for the trouble he went to in the preparation of the graphs which had necessarily to be done with extreme accuracy.

* * *

G5XD says all G's travelling in Norway this summer should communicate with Radio LA1G, Voksenlia per Oslo, Norway, with a view to meeting the LA gang.

* * *

Mr. W. E. F. Corsham, G2UV, says he has received the *Nautilus*, WSEA, on June 8, at 2125 G.M.T., QSA4, R4. He did not appear to be working to the published schedule. Incidentally, G2UV is now on the air again after many years absence, and works on 7 and 14 M.C. any day.

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Screening Apparatus.

NOW that screening is being employed more and more in receivers of all kinds, we should like to draw the attention of members to "Magnum" products. Messrs. Burne-Jones and Co., of Magnum House, 296, Borough High Street, London, S.E.1, who are now manufacturing all kinds of aluminium screening apparatus, are in a position to make any sort of metal screen for radio purposes to design, if their standard articles are not exactly what is required. We have recently had an opportunity of examining some of their stock goods and can thoroughly recommend them. They are well made and finished with a dull surface by sand-blasting. This type of finish prevents that tarnishing and discolouration which affects the polished metal. As a guide, typical prices are: Screening box with lid 9½" by 5½" by 8¼", 7s. 6d.; coil screen, 3s. 6d.; upright screen, 10" by 6", with hole for s.g. valve, and three terminals, 2s. The makers also turn out full chassis for various published circuits. Members would be well advised to ask Messrs. Burne-Jones & Co. for anything in aluminium or copper they may require.

* * *

The General Electric Co., Ltd., is shortly putting on the market two new Osram screen-grid valves, the S21 and the S22.

The S21 (filament 2 volts, .1 amp.) has an amplification factor of 220 and an impedance of 200,000 ohms. The S22 (filament 2 volts, .2 amp.) has an amplification factor of 350 with an impedance of 200,000 ohms. It will be seen that the former is intended for use in two-stage H.F. amplifiers (where a valve with a higher "mutual" might prove unstable), and the latter for use in single H.F. stages, where a high gain is required. The measured grid-anode leakage capacity is approximately .006 mmfd. of the S21. The anode volts of both types should be 150 (maximum).

* * *

In the report of Messrs. Varley's Delayed Action Switch on page 363 of the last issue, the price was erroneously given as 2s. 6d.; this should have been 12s. 6d., and we desire to tender our apologies to Messrs. Varley for any inconvenience caused.

The 1·7 Megacycle Band.—(*Continued from page* 1).

oceanic permit gave them the right to use high power on this frequency. These permits are, as their name implies, issued by the G.P.O. to members of the R.S.G.B., who desire to carry out trans-oceanic experiments on the higher frequencies—(3, 5, 7 and 14 megacycles). An occasional old member, here and there, may possess some special permit for the use of higher power on the 1.7 M.C. band, but, in general, this is a 10-watt band only. We trust that this hint will be heeded.

Second, what of the nature of our transmissions? In London, an abuse of the terms of a licence is seldom encountered, but, unfortunately, a condition exists in certain parts of the country which, we feel, must stop immediately. Cases have come to our notice in which amateurs, usually non-members of R.S.G.B., are flagrantly and wilfully breaking every rule governing the granting of an experimental licence. Without mincing matters, we refer to those who are regularly broadcasting programmes of music for the benefit of their patrons, usually their customers. These pseudo-amateurs use no Morse code, give regular programmes at set times and, we believe, keep no log of their transmissions.

Third, we wish again to warn our members against working with unlicensed British stations. We are aware of instances in which artificial-aerial licence holders have used their stations not only for simple speech transmissions but also for the broadcasting of lengthy programmes. Faked calls, generally employing an "E" in the group, or call signs purloined from some inactive member, are still on the air. Our advice to members is that they should refuse to work these stations.

Full radiating permits are now granted by the G.P.O. to every genuine experimenter, and there remains therefore, no excuse for anyone to carry out illicit transmissions.

The time has arrived when action must be taken to restore law and order, for we are certain that if such practices as those mentioned are continued, the vast majority of genuine experimenters will be penalised for the misdemeanours of the few.

Council are fully alive to the existing state of affairs, and are taking every possible step towards removing the canker. Wherefore, we appeal to the membership at large to keep the 1.7 M.C. band clean for genuine experiment. We are sure that it will pay.

In concluding this editorial, we desire again to emphasise the fact that this Society will *not* handle QSL cards for unlicensed British stations. Furthermore, we wish to warn our members that serious action will be taken against anyone who can be proved to be harbouring the whereabouts of unlicensed stations.

J. C.

Social Notes.

The important thing in "Social Notes" this month is the Convention.

It is very possible that we shall have a still greater number of provincial "Hams" up this year, and so, therefore, will any of the London fellows who will be willing to give accommodation during the Convention period to those who will be coming to London drop me a line and let me know the number they will be prepared to look after. Also will those who are anticipating coming to London also write and let me know, so that I can then make the necessary arrangements.

You may probably think I am starting to talk about Convention very early, but I want to make certain that everyone is going to be comfortable, and the sooner I know, the greater chance I have of doing this, and making the 1931 Convention the best yet.

C. H. B.

London Jottings.

It is rumoured that :—

G5NC has been heard sending at only 30 w. p.m. . . . Several hams have therefore consigned their automatic recorders to the dust heap.

* * *

G2LZ, in a moment of weakness, closed down for five whole minutes on a recent Sunday.

* * *

G6SG has at last worn out the Stein Song record . . . or did some public benefactor tread on it ?

* * *

Woodford is now definitely in Essex. . . . G6TX occasionally says so over the air.

* * *

G5UM now sends dashes (*sic*) as well as dots.

* * *

G2ZN mistook a flight of pigeons across the sun for spots, and promptly dismantled his 2 M.C. transmitter.

TOPSNUS.

Calibration Services.

A Calibration Service will be transmitted from G2NM, Mr. Marcuse's station at Sonning-on-Thames, Berkshire, on 3,583.13 K.C., according to the following schedule :—

At 11.00 every Sunday (Telephony).

At 23.00 every Sunday and Thursday (Morse). Times are G.M.T. or B.S.T., as in force. The frequency has been checked and approved by the Post Office.

Strays.

Mr. S. F. Sharpe, BERS14, is now an operator of VU2ZW at Signals Section, R.A.F., Ambala, Punjab, India, the call being issued to Mr. R. G. Hart. Skeds with G, especially in the Devon district, are requested.

* * *

Mr. Mayer, late of K4KD, desires to thank all British Stations who have worked him or reported on his signals during his stay in Porto Rico. Mr. Mayer is now back in the States, and hopes to be on the air soon as a W9.

* * *

G5RV calls all members of 8A (QRP) on 7 M.C., telephony, at 11.00 (BST) every Sunday, and gives out news of interest to the Group. Anyone hearing these transmissions is requested to send a QSL report, which will be acknowledged.

"T. & R. Bulletin."

JAN. 1931

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Contact Bureau Notes.

By H. C. Page (G6PA).

OWING, presumably, to the call of the open air at this time of year, there has been hardly any material received at C.B. which can be used for publication. In fact the month has been chiefly noted for the lack of correspondence. The Group Managers' reports are already overdue, and I can only suppose that they, in turn, have been held up by the reports from their groups. While on the subject of reports, I would like to draw attention to a point that many of you have may missed. I think it probably accounts for the frequent lateness of them. When, for instance, you are asked to forward your report by the 20th of each month, this does not mean that you should start writing it then, or even send it off then. It means that the report must be at its destination by that date. For preference it should be in the post on the 18th or on the 19th at the very latest. Please bear this in mind when you send off your next report. It will help matters considerably if everyone reports on time, or better still, just before time.

Our 28 M.C. band does not seem to be behaving itself at all well. The only report received this month from abroad comes from VU2FX, who says that the hot weather has had a very detrimental effect on experimental work. He points out, however, that the detrimental effect is on the operators, and not necessarily on the 28 M.C. band! VU2FX is re-building, and hopes to be resuming work again quite soon. VU2PN is active too, but has now had his call changed to VU2GD. There are no reports to date from the VS stations, or from the YI men. Presumably they, too, have not anything of note to report on.

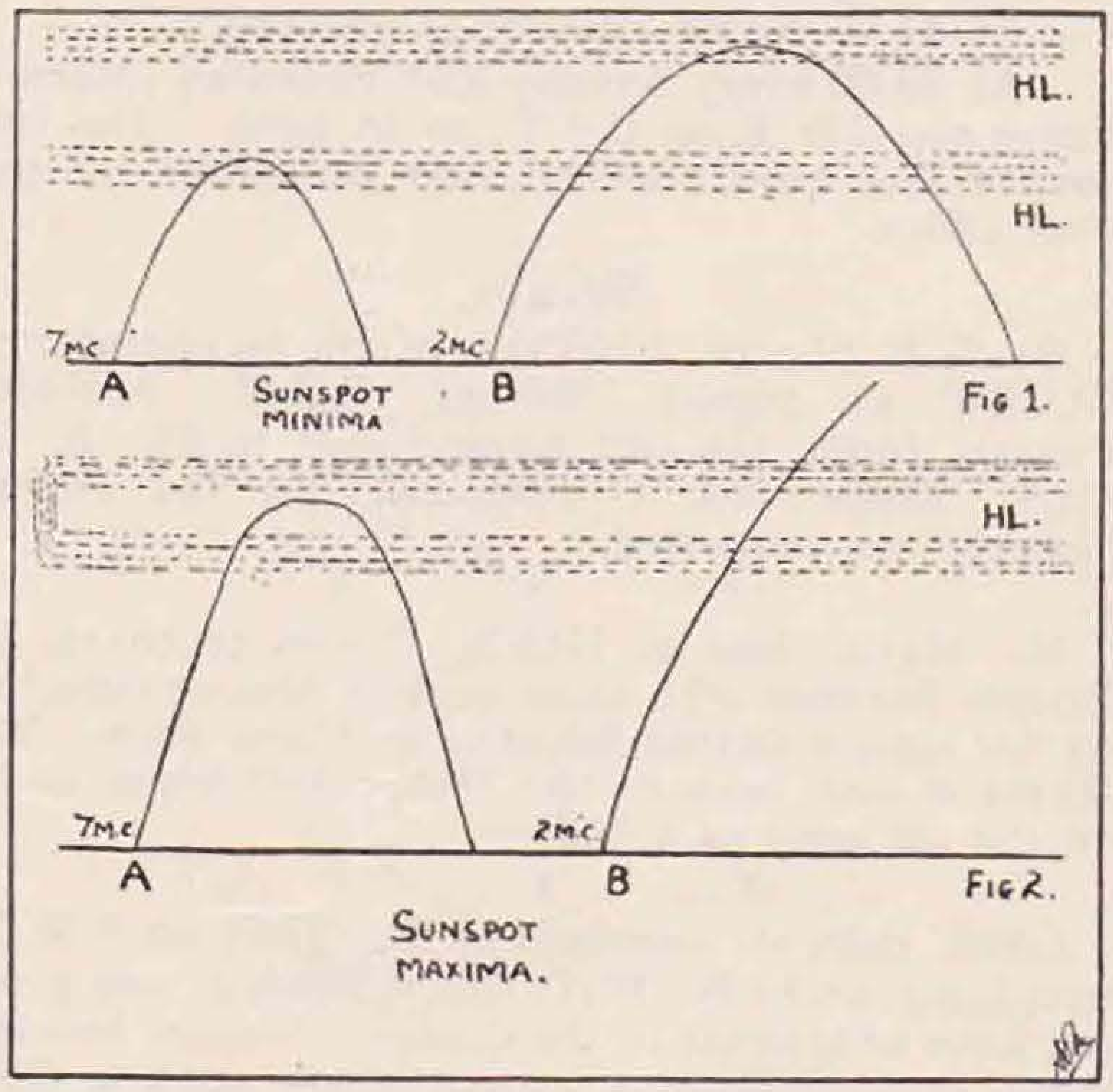
It would be interesting to know how many of you noticed anything unusual just before, or after the earthquake which affected so many parts of the country this month. At this station an unusually heavy amount of atmospheric disturbance was noticed. There were long drawn-out crashes at quite frequent intervals, but little importance is attributed to this. G6QO reported, via the 1.75 M.C. band, that on the previous evening he experienced a very heavy electrical storm, sparks two inches long jumping across the aerial earthing switch, when it was not switched to earth. The reports from the groups working on fading, etc., have not yet come to hand, so it is useless to speculate as to their findings.

In the May issue of the Bulletin I appealed for material suitable for publication in C.B. Notes. So far I have not received a single letter in response to this appeal. Surely there must be some of you who have been doing experimental work of general interest on differing lines from that being done by the organised groups.

G2ZN forwards the usual sunspot report for the month. He was only able to make two observations —one on the 24th of the month, and one on the 25th. On the 25th there was absolutely nothing to be seen, but on the 24th there were three very small spots about half-way between south and east, on the edge of the circle. He says that BRS530 has been very helpful in forwarding him a most complete log of conditions on nearly all bands for the month.

G2ZN remarks that results are extremely conflicting .On the 24th, BRS530 reported mainly good conditions on the high frequencies, with mixed conditions on 2 M.C. On the 25th, there were no spots visible, but he reported 2 M.C. conditions mainly poor, while the higher frequencies were good to excellent. For the remainder of the month no observations were made, and it is therefore useless to give particulars from BRS530's log, beyond saying that conditions fell off on all bands immediately after the foregoing.

No doubt many people have wondered why conditions should be opposite on the high and low frequencies, speaking generally. G2ZN forwards an explanation, for what it is worth. I give it in



full, so that there may be no possibility of any misunderstanding.

Suggested Explanation of the Behaviour of High and Low Frequency Propagation during periods of Sunspot Maxima and Minima.

The diagram in Fig. 1 shows a period of sunspot minima. " A " is a 7 M.C. transmitter and " B " a 2 M.C. one, whilst two distinct Heaviside layers are shown. (In passing let it be noted that this has experimental support.)

Consider the behaviour of the 7 M.C. transmitter. These frequencies are refracted more easily than lower. Therefore on reaching the first layer the waves are soon refracted back to earth resulting, in a short skip. On the other hand, the 2 M.C. waves are not nearly so easily refracted and are only partially bent back to earth by the first layer. The second layer, however, completes the refraction and bends the wave back to earth, resulting in a long skip. We have thus shown that a sunspot minima gives little DX on 7 M.C. but good on 2 M.C.

Now take the case of a sunspot maxima. The effect of the spots have been to pull the layers bodily upwards, in fact to merge them into one. Our 7 M.C. transmitter as before is at "A." The propagation therefrom once again is easily refracted, and as the Heaviside Layer is much higher the skip is correspondingly longer. In other words, DX is good. The 2 M.C. waves, however, as previously, are not so easily refracted, and in fact are not bent back to earth at all. In this case there is no other layer to complete the refraction, and conditions on these frequencies are bad.

It will be seen, therefore, that this hypothesis accounts for known phenoemena without introducing anything altogether incompatible with experimental evidence. It is not difficult to imagine intermediate stages between Figs. 1 and 2. In such a case one might get conditions good on low and high frequencies together.

Group Reports.

28 M.C. Work.

G6VP, Group Manager.

Although no active work seems to have been done by anyone in the British Isles, it is pleasing to note the attention that the next projected tests are receiving.

It has been suggested that these should be held during the early autumn this year ; and whilst this would be interesting from many points of view and meets with the approval of quite a number of our senior Stations, there are amongst the dissentients our very oldest and more experienced ones.

I am in close touch with Monsieur Allard, of French repute, and it appears that our confrères over in France wish to co-operate with us and hold tests in conjunction with ours. The French amateurs are very keen and active even at the moment, and many contacts and reports of more or less long distance reception are to hand.

Our Australian cousins are also very busy on this frequency. Mr. de Cure (VK3WL) writes me a long letter of the work and the number of Australian stations regularly operating.

VK3BQ and VK3WL are on 28 M.C. every Sunday from 23.00 till 02.00 G.M.T., and it is mentioned that this time has produced many VK-ZL and VK-W contacts. The Australians are very convinced of the importance of either sunset or sunrise at either of the stations in contact, and whilst this has been known with reference to the lower frequencies, I do not think it has been definitely proved out as regards 28 M.C.

Although I do not know of any authenticated reports of reception of VK signals in the British Isles, there is no doubt that the Australians and New Zealanders have been heard by other European countries.

G5SY, of Group 1B, reports that most of his members are "hibernating," that is, are marking time till the late autumn. He himself has changed his QRA and hopes that his results on 28 M.C. will tally with those he is now obtaining on 14 M.C. He was very shielded at the old address but now has got an ideal location. G6LL is very emphatic about the tests and thinks that January has always produced the best results. The desire of this Group seems to be that we should hold two tests or one test divided up ; part, perhaps, in the late autumn and the other part at the season which has proved itself, viz., January.

Group 1C.—G6WN's have been chiefly occupied with the transmitter. A 7 M.C. crystal and new chokes have had a wonderful effect on the output. G6VP has also been rebuilding and will shortly be on the air with a very low impedance valve, viz., an LS6A. Whether it is the very low self-capacity of these valves or not, it is a fact that they will stand relatively very high inputs with quite reasonable efficiency.

QRP Work.

G2VV, Group Manager.

This section of C.B. continues to grow and this month we have another new group, 8E, whilst still another, 8F, is at present being formed by G2TJ. This means that there will be six Groups by next month, and it will be a real struggle for the Blank 3-Watt Trophy this year, with 36 members taking part.

Group 8B.—G2VV reports conditions decidedly bad on all bands but 14 M.C. seems to be fairly good after about 22.00 for DX. 7 M.C. dead all day until about 18.00 when stations come in rather weak, and by 23.00 QRM is so bad that a QSA5 QSO is almost impossible. After six months of trying out various aerials, he has proved the 33 feet with feeder tapped 11 feet along (not 11 inches as stated in the June BULLETIN), to be the most efficient for DX and local work at his QRA. Below are results obtained with various aerials tried and input at all times 5 watts maximum.

Current fed, 66 feet good on 7 M.C., but no good on 14 M.C.

Current fed, 66 feet with 15 feet feeders, very poor.

Voltage fed, 69.5 feet good on 7 M.C. ; good for locals only on 14 M.C.

Voltage fed, with 33 feet top and any length feeder tapped as above, fair to good on 7 M.C. and excellent for all 14 M.G.C. work.

G5CM has done little work as he is disgusted with conditions. On 1.75 his results are good but even they are not so good as a month ago. Uses same outfit and aerial as G.C. 2ANU hopes soon to be on the air and already has put up the 33 feet V.F. Says his RX has many "blind spots" and asks for "cures." He was listening just before the earth tremors in June and says 1.75 was amazingly good at the time. He later felt the room shake !

Group C.—G.C. G5PH has rebuilt TX, using a 7 M.C. crystal, and 150 volts to a B.T.H. B4 and 300 volts at 15 mills to a LS6A as PA. Is using split coupling aerial coil and ½-wave Zepp, getting

.4 in both feeders. G2TK reports conditions very bad on all bands and gets poor results with his QRP. G2WS finds same and although does not get many contacts is receiving good reports. G2AV is devoting time to aerial tests on both 7 and 14 M.C. and has little else to report except conditions bad. (8B will welcome full details on your aerial tests.—G.M.)

Group 8D.—G. C. G5MR finds that by earthing the other end of his aerial coil he gets better results on 7 M.C. but no improvement on 14 M.C., and asks why this is so? Is working 3 watt fone on 7 M.C. with good results. On May 17 he noticed a distinct improvement on 7 M.C. but since then conditions very bad and QRN also troublesome. Finds 20.00 the best time for G stations on 7 M.C. In order that the notes will not be so out of date he asks all members not to send in notes until the 5th of each month. G6BU has been troubled by a changing note and found a faulty resistance in his filter circuit to be the cause. Has cured key clicks with 10 ohm resistance across the key but does not like the spacer wave caused by this. He puts forward an interesting theory about a TX valve working on the correct part of its oscillating curve and wants to know if it would be correct to plot the curve of his TX valve on load? G5LX is troubled with QRM from passing automobiles and is trying to find a cure for it. He is testing C.C., using 4 watts to a PM6D and an A.O.G. G5QY, although indisposed for some time has done some wonderful QRP DX, using a T.P.T.G. and 66 foot current fed with 5 watts. Reports conditions getting worse! He sends some interesting views on A.O.G. systems. Says "the antenna consists of a single wire at least half of the working wave in length; it may be any number of half-waves long and is tapped straight on to the tank circuit of TX. As little of the aerial as possible should be indoors and carefully insulated at the lead-in point which is sure to be near the point of maximum voltage. In an unscreened locality it will have to be longer than 21 M. to resonate on 7 M.C., and *vice versa*. 2AGN reports FAIR conditions! He noticed an extraordinary improvement on 14 M.C. on May 19, and asks if others noticed the same. (This seems near the 17th, when the G.C. noticed improved conditions.—G.M.) Has developed an interesting crystal holder, details of which he is sending to the BULLETIN.

Group 8E.—G.C. EI7D has now got the group together and sends in the first report. He, like everyone, complains of very poor conditions. Using a T.P.T.G. with 5 watts to a DE5. G5XM is on 7 and 14 M.C., using a 2-volt power valve in the TX and 120 volts H.T. His TX is also T.P.T.G. He finds an A.O.G. 65 feet in length best for a steady note but C.F. aerials seem to give more of a wobbly effect. He uses a spark coil and an L.T. battery for getting H.T.!! G2OC finds conditions very bad. Is using a T.P.T.G. with a P.M.4. and a V.F. aerial. All power from A.C. mains. G5DI is using a parallel-fed Hartley and a Marconi aerial system. His valve is an LS5. 2AOX has just changed his QRA and is now testing a new O-V-2 RX with a 66-foot aerial and an earth 8 yards long!

Television.

G5CV, Group Manager.

Group 11A.—No reports have been received this month and so it is presumed that the stations have been inactive. The most outstanding event during the last month was undoubtedly the televising of the Derby from Epsom. In view of the many difficulties involved at the transmitting end, the reception at G5CV was considered very good. The QRM from telegraph wires carrying Press messages was considerable at first, but was later almost eliminated. G5CV has been trying to modulate an arc from the output of the television amplifier by means of a 25 : 1 transformer, but owing to the low current carrying capacity of the latter, only ¾ amp. was available for the arc. No visual modulation was noticed, but of course the sound was clearly audible.

Antenna Group.

G2OP, Group Manager.

Last month I described a system which worked on several bands, but unfortunately the dimensions were such that not many of us have the necessary

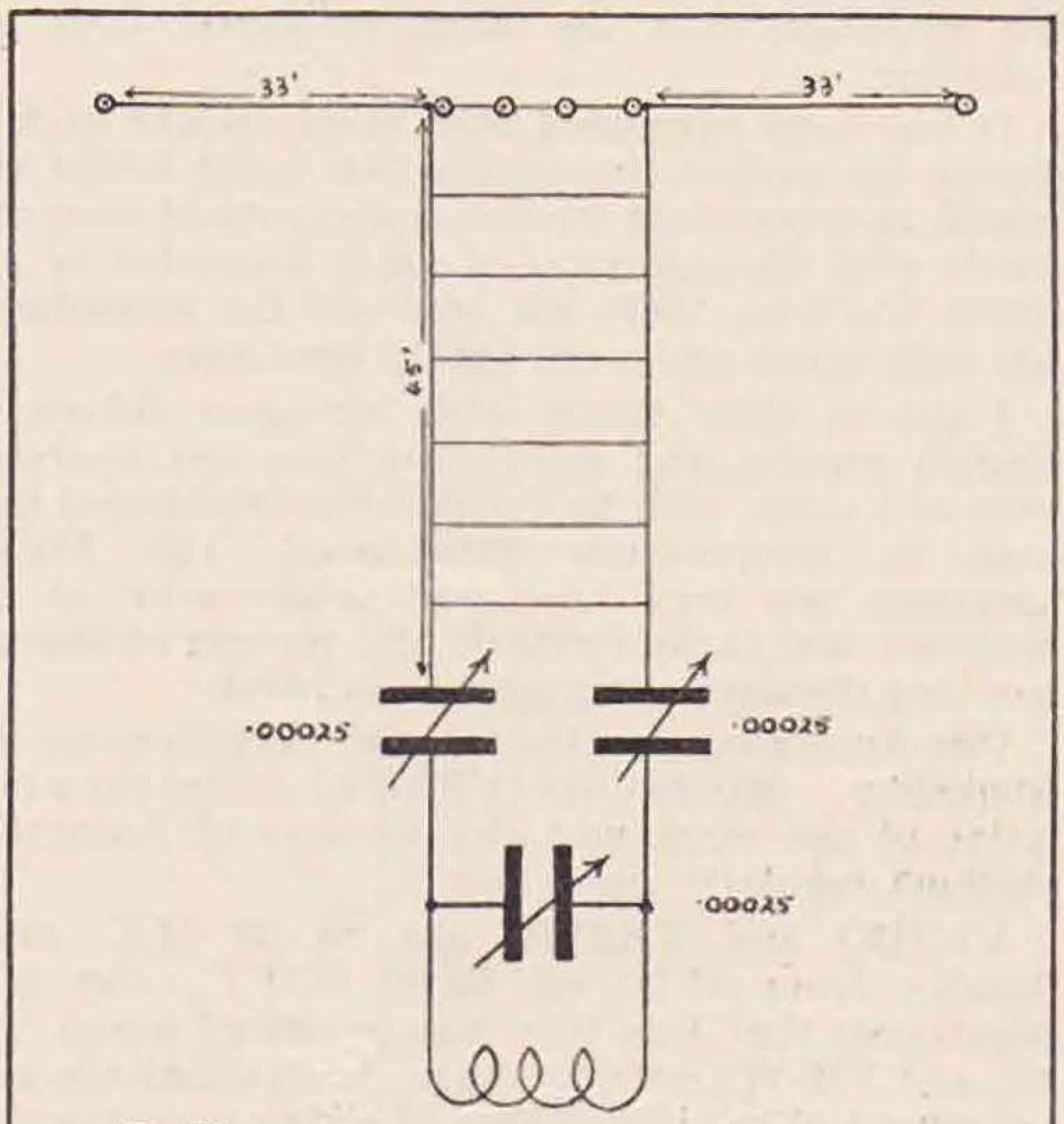


FIG. 3.

space to accommodate it. The one I am about to describe is a current-fed affair which will also work on 80, 40, 20 and 10 metres. There is also a voltage-fed edition, but I much prefer the current-fed one as one can insert thermo-coupled ammeters and actually see what is happening. Besides this, most of us like to see a needle move majestically to the other end of the scale. I have not yet erected this particular one at my own station, but have had experience with it at G2GW's, and while one cannot expect it to be ultra-efficient on all bands, it certainly worked well.

Figure 3 explains itself, but under certain circumstances it may be necessary to make the two top pieces a few inches longer. The feeders must be 45ft., and if it is found that space does not allow of these coming straight and tight into the station, they should be tied back and secured so that they look like the right-hand portion of the letter K.

Continued at foot of col. 2, next page.

EMPIRE CALLS HEARD.

Calls Heard Lists will, in future, contain only British Empire calls (including Great Britain) and those of British ships at sea and British Expeditions.

BERS25, Aden, British Arabia, during May.
14 M.C. : ei7c, ei8d, g2ay, g2by, g2cj, g2cx, g2dh, g2gf, g2gm, g2ju, g2ol, g2op, g2ow, g2pa, g2rg, g2rv, g2un, g2ux, g2vz, g2wv, g2zp, g2zw, g5bd, g5bj, g5dd, g5la, g5ml, g5ni, g5pj, g5qv, g5uy, g5wf, g5yk, g6dh, g6fo, g6fx, g6gd, g6gg, g6hp, g6ll, g6mn, g6nf, g6qb, g6rg, g6rp, g6rw, g6sp, g6un, g6us, g6vp, g6wn, g6wy, g6xj, g6xn, g6yk, g6yl, su1aa, su1aq, su1ch, ve1dr, vo2gp, vp2pa, vq3msn, vq4crf, vs6ae, vs7gt, vu2ah, vu2cs, yi1cd, yi1rm, yi6ht, zc1s, zc6jm.

* * *

J. R. Witty, G5WQ.
Suez to Perim, May 5-9.—14 M.C. : g2bi, g2by, g2ma, g2oi, g2pa, g2xu, g2zp, g5bj, g5ml, g5vb, g6mn, g6nf, g6rg, g6sc, g6vp, g6wn, g6yl. *Perim to Socotra, May* 10-12.—14 M.C. : g2ao, g2by, g2op, g2ow, g2ra, g2rv, g2vp, g2vz, g2wq, g5bd, g5bj, g5dd, gi5du, g5lw, g5qf, g5sy, g5vm, g6bb, g6bs, g6bt, g6bu, g6cl, g6co, g6dh, g6gs, g6ot, g6py, g6qb, g6rb, g6uj, g6ut, g6vp, g6wt, g6xn, g6yk, g6yl, g6zs. *Socotra to Penang, May* 12-22.—14 M.C. : Nil. 7 M.C. : g2bm, g2qb, g2qv, g2ts, g5fa, g5fc, g6bs, g6ot, g6qa, g6ty, g6wy. *Socotra to Suez, June* 10-14.—14 M.C. : g2ay, g2cj, g2dz, g2fn, g2gf, g2gm, g2ma, g2pa, g2rv, g2tk, g2yd, g5bd, g5bj, g5mu, gi5nj, g5pl, g5sr, g5vl, g5vm, g5yg, g6ot, g6rb, g6vp, g6wy, g6xq, g6yk. 7 M.C. : g2bm, g2gm, g2kb, g2qb, g2qh, g2vz, g5az, g5ok, g6kp, g6yq, g6zr.

* * *

G. B. Wild, BERS59, at Cairo.
g2ao, g2bi, g2fn, g2gm, g5bj, g5la, g5ml, g5pl, g5vl, g5vm, g6dp, g6fo, g6lk, g6mn, g6no, g6ot, g6qb, g6rb, g6wt.

* * *

By G6YL, Miss B. Dunn, Felton, Northumberland, May, 1931, 14 *M.C. band.*—fn2c, su1aa, su1aq, su1ch, v1yb, ve1ab, ve1br, ve1bv, ve1dm, ve1dr, ve2al, ve2ar, ve2bb, ve2bo, ve2ca, ve3bf, ve3bm, ve3da, ve3df, ve4bq, ve5aw, vo8an, vo8k, vo8mc, vo8z, vs6ae, vs7gt, vu2ah, yi1cd, yi1rm, yi6ht, xyi6kr, zc1s, zc6jm, ap6jm.

New Members.

Corporates—Great Britain.

G. C. Turner (G5IH), Causton Road, Cranbrook, Kent.
F. S. Mizen (2ADC), 28, Brunel Road, Bridgewater Road, Bristol.
S. J. Mulvay (BRS562), 242, Leith Walk, Leith, Scotland.
L. C. Heddon (BRS563), 31, Medhurst Road, Bow, E.3.
N. Cooknell (BRS564), 34, Woodbine Terrace, Blyth, Northumberland.
T. C. Clark (BRS565), 135, Westward Road, S. Chingford, E.4.
E. Huffington (BRS566), Butchers House, Garton-on-the-Wolds, near Driffield, Yorks.
W. H. Stanton (BRS567), 31, Broad Street, Hanley, N. Staffs.
R. F. Loomes (BRS568), 14, Nursery Close, Wickham Road, Shirley, Croydon.
W. G. Pyke (BRS569), "Keswick," Brunswick Road, Kingston Hill, Surrey.

Corporates—Dominion and Foreign.

Werner Niederer (HB9N), Dufourstrasse 41, St. Gallen, Switzerland.
L. Alons (PA0F), Aalsterweg 90D, Eindhoven, Holland.
C. S. Taylor (VE1BV), Stewiacke, Nova Scotia, Canada.
G. A. Awcock (VE2AA) c/o Canadian Celanese, Ltd., Drummondville PQ. Canada.
A. E. T. Payne (VK3PP), "Scotsburn," Toorak Road, Toorak, Melbourne, Australia.
E. L. Nissen (VK4XN), Condamine Street, Dalby, Queensland, Australia.
R. Mills (YI1RM), R.A.F. W.T. Station, Sulaimania.
C. W. Morrison (ZL2DB), 27, Monro Street, Seatoun, Wellington, N.Z.
W. M. Gurney (BERS68), Barclays Bank (D. C. & O.), Burutu, S. Nigeria.
F. R. M. Robertson (BERS69), Roma Estate, Jelebu, Negri Sembilan, F.M.S.
J. W. D. Trongove (BERS70), 17, Batu Road, Kuala Lumpur, F.M.S.
F. H. Smart (BERS71), Sapele, Nigeria, W. Africa.

Stray.

Mr. H. Freeman, of 121, Kingsway, W.C.2, has been appointed to receive annual subscriptions for certain American radio publications (for list, see Exchange and Mart columns), and we trust that this facility will be of use to those of our members who are, or who anticipate being, subscribers to these periodicals.

W.B.E. Certificates.

Certificates have been issued to :
VK3PP—A. E. T. Payne, VK3WL—J. de Cure.

Contact Bureau Notes—*Continued from previous page.*

The natural frequency is about 7.1 M.C., and parallel tuning is used on 3.5 M.C., 7 M.C., and 28 M.C., while series tuning is used on 14 M.C. Actually, what is happening is that on 3.5 M.C. it becomes a half-wave aerial with all but the two top pieces folded back on itself. For this reason we get high readings and a certain amount of cancellation, but nevertheless it works, and works well on this band. On 7 M.C., which is its fundamental frequency, it is the ordinary current fed, while on 14 M.C. it becomes two voltage-fed Hertz operated on its second harmonic, and on 28 M.C. it is still two voltage-fed Hertz operated on its fourth harmonic.

I have been asked what is the best to use on 1.7 M.C. Obviously the above will not work, and for this band I am at first inclined to say—anything ; or perhaps I should more accurately say—whatever is most convenient to put up. I have very little experience on this band, and I am sure that those interested could not do better than get into touch with G5UM.

Next month I hope to deal with an efficient matched-impedance feed system with which I and several others have had most excellent results.

Stray.

Mr. A. E. Marven, of 12, Alfred Road, Burwood, E.13, Victoria, Australia, writes to say that he would like to correspond with amateurs between the ages of 17 and 28 in England and other parts of the world.

Empire B.E.R.U. News.

B.E.R.U. Representatives.

Australia.—H. R. Carter (VK2HC), Yarraman North, Quirindi, N.S.W.

B.W. Indies, Bahamas, Bermuda, and British Guiana.—H. B. Trasler, No. 2 Mess, Pointe à Pierre, Trinidad, B.W.I.

Canada.—C. J. Dawes (VE2BB), Main Street, St. Anne de Bellevue, Quebec.

Ceylon and South India.—G. H. Jolliffe (VS7GJ), Frocester Estate, Govinna, Ceylon.

Egypt and Sudan.—H. Mohrstadt (SU1AQ), No. 1 Co. Egypt Signals, Polygon, Cairo.

Hong Kong.—P. J. O'Brien (VS6AE), 12, Kent Road, Kowloon Tong, Hong Kong.

Iraq.—H. W. Hamblin (YI6HT), Wireless Section, R.A.F., Shaibah, Basra, Iraq.

Irish Free State.—Col. M. J. C. Dennis (EI2B), Fortgranite, Baltinglass, Co. Wicklow.

Kenya, Uganda and Tanganyika.—H. W. Cox (VQ4CRF), Box 572 Nairobi, Kenya.

Malaya.—G. W. Salt (VS2AF), Glenmarie Estate, Batu Tiga, Selangor, Malay States.

Newfoundland.—Rev. W. P. Stoyles (VO8MC), Mount Cashel Home, St. John's East.

New Zealand. — D. W. Buchanan (ZL3AR), 74, Willis Street, Ashburton; and C. W. Parton (ZL3CP), 69, Hackthorne Road, Cashmere Hills, Christchurch.

Nigeria.—Capt. G. C. Wilmot (FN2C), 1st Battalion Nigeria Regiment, Zaria, Nigeria.

South Africa.—W. H. Heathcote (ZT6X), 3, North Avenue, Bezuidenhout Valley, Johannesburg.

South Rhodesia.—S. Emptage (ZE1JG), Salcombe, Plumtree, Southern Rhodesia.

BRITISH ARABIA.

By BERS25, No. 8 (B) Sqd., R.A.F., Aden.

Conditions have been getting gradually worse of late, and although four hours of steady listening has been put in each day, results have been disappointing. The best times for listening have been from 1700—2300 G.M.T. with a peak from 1800—2000 G.M.T. A peculiar echo effect has been noticed on many stations recently—a phenomenon that has not been experienced before, and it would be interesting to know what has caused this.

AUSTRALIA.

By VK2HC.

(Via VK5HG and VK6CB, ZL3AQ and ZL3AR).

There is nothing to report on 28 M.C.; several are still operating but without success. The 14 M.C. band is very dead, only the W stations, and an occasional J are heard. Conditions are very erratic, but some good QSO's have been made on freak days. Our old reliable 7 M.C. band is falling off rapidly, very little good DX, and then only from W. and Pacific stations. Activity on 3.5 M.C. is increasing; good contacts are held locally and with New Zealand. Considering the present financial difficulties the divisional councils and secretaries are to be commended on their excellent work, and present W.I.A. membership totals 700; the traffic channels are doing excellent work, but owing to adverse conditions the Link stations will have a hard job for the next few months.

CEYLON.

By VS7GJ.

The only report received is from VS7GT, a comparatively new member to our transmitting squad, and one who is doing excellent work under most difficult circumstances. Mr. G. H. Todd is situated well in the heart of the jungle to the north of the island, and reports that conditions on the 7 M.C. band this month have been consistently bad owing to heavy QRN.

VS7GJ has done practically nothing this month, due to overpowering QRN on both the 7 and 14 M.C. bands. Conditions during the inter-monsoon periods are generally very bad for DX working.

IRAQ.

By XY16KR (Via G5RQ).

Until June 6 XYI6KR was QRT, but reception was carried on. Conditions have been unsettled with bad fading here in North-east Iraq from 0400 to 1600 G.M.T. 7 and 14 M.C. bands are quiet and there have been no inter YI QSO's lately as skip sets in early. YI1CD is at Sularmania and is active, but no other YI's have been heard here. WX conditions very bad. Does anybody know the QRA's of YI1RM and YI6AG?

IRISH FREE STATE.

By EI2B.

In spite of the alleged summer weather which we are experiencing there seems to be a slump in the activity of EI stations, and I have only received reports from EI7C and EI7D this month. Conditions on both 1.75 and 3.5 M.C. are almost hopeless at present on account of QRN, but 7 M.C. is about normal for the time of year with a fade-out of G, and all Western Europe at about 2300 G.M.T., after which some American stations begin to come in. 14 M.C. has deteriorated, the afternoons being practically "dead." After dark, however, a good many W. and S. American stations come in fairly well, although, from the absence of serious QRM on this band, it would seem that these are chiefly "big noises" and that QRP has little chance at present.

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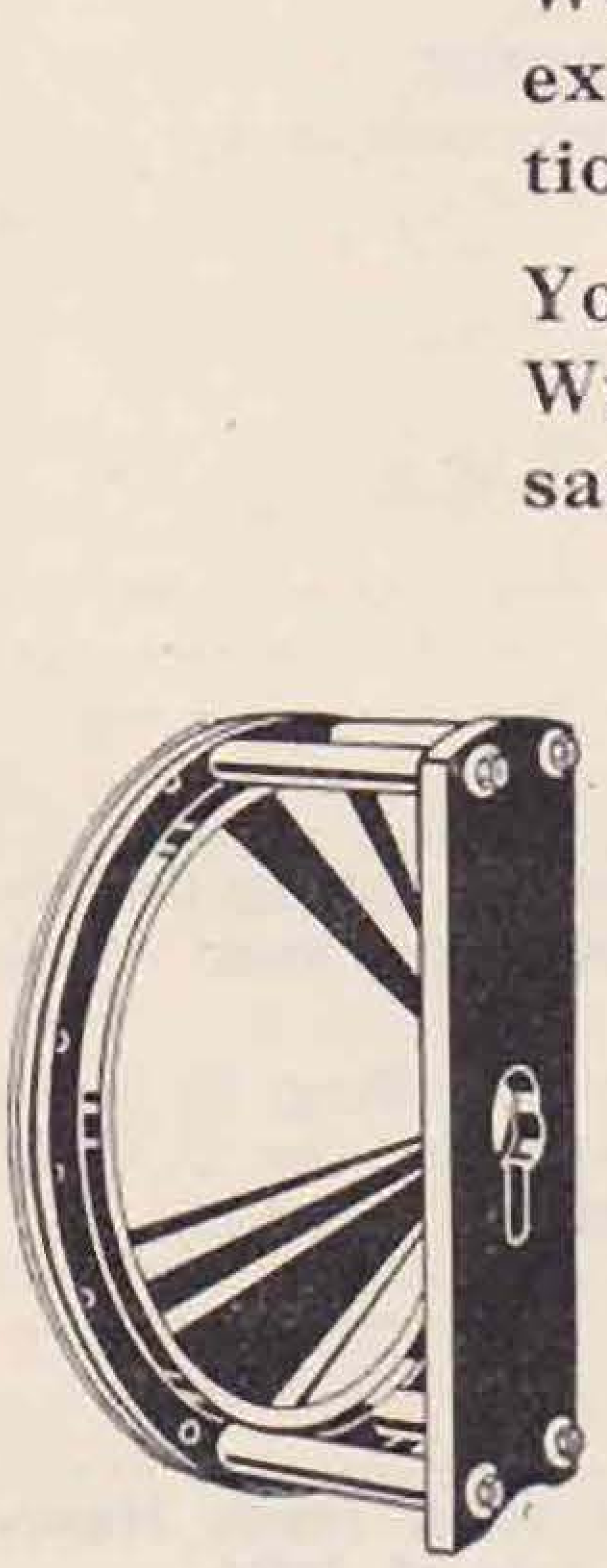

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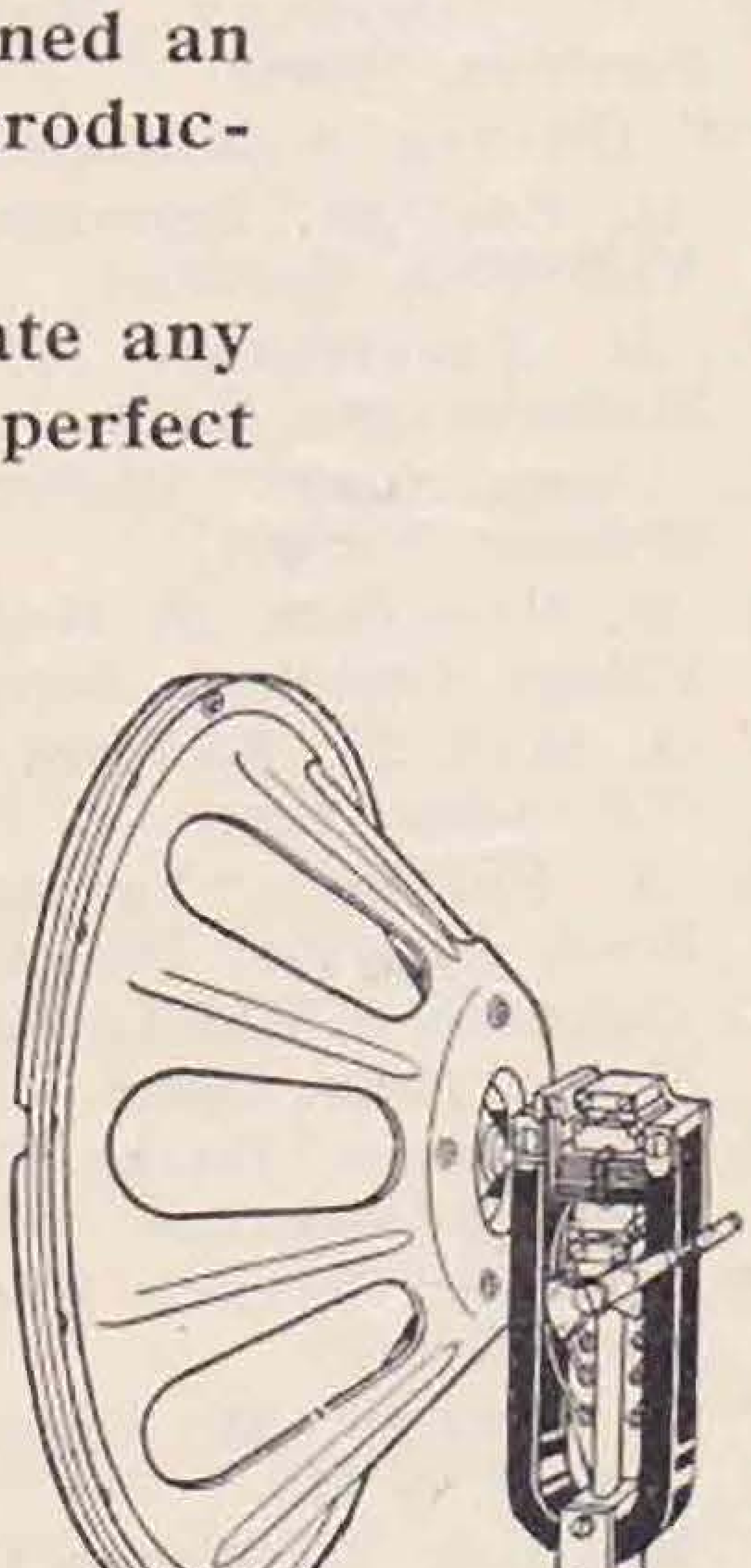

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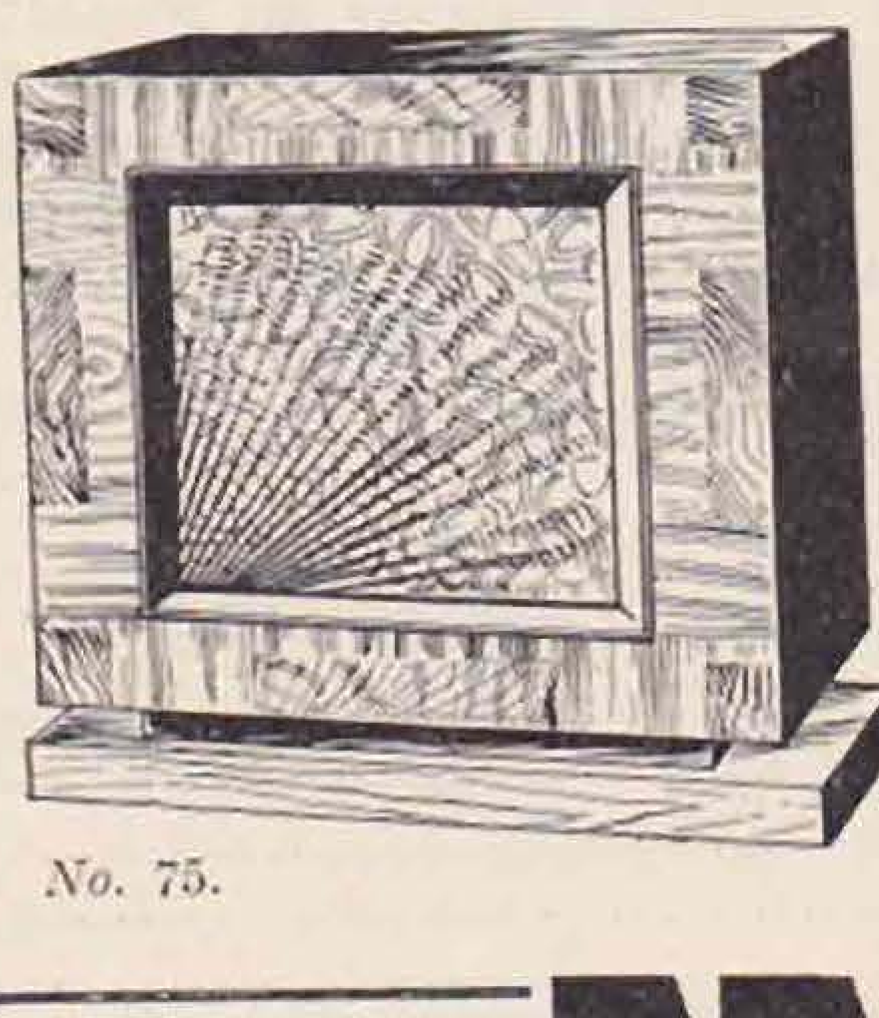

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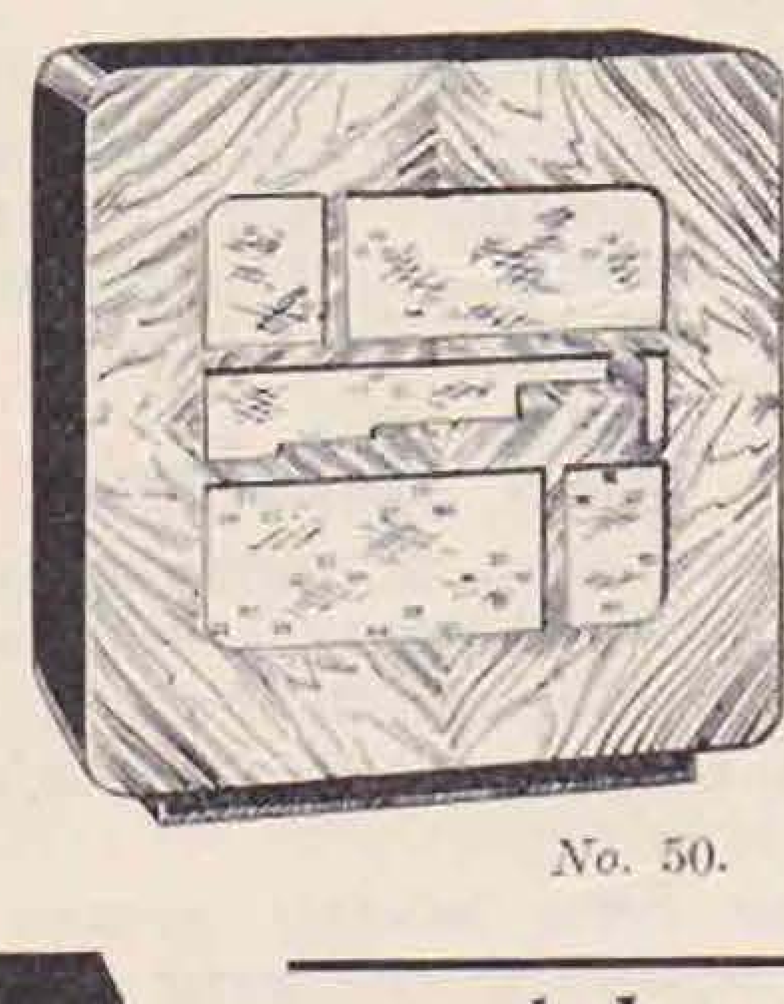

No. 50.

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QRA Section.

Manager: M. W. PILPEL (G6PP).

Three countries, the prefixes of which were not changed from the old I.A.R.U. intermediates, have now come into line with the Washington regulations. They are Nigeria (FN) now ZD, Palestine (AP) now ZC, and Jamaica (NJ) now VP.

New QRA's.

G2CJ.—S. TOWNSEND, 115, Earlham Road, Norwich.

G2OD.—E. J. SIMMONDS, Barclay's Bank House, Ascot, Berks.

G2WK.—W. A. HAYES, "Moyallon," 96, Crescent Road, Reading, Berks.

G2WL.—A. J. WILSON, 35, Langside Road, Govanhill, Glasgow.

G5GD.—D. G. SAINSBURY, Bishampton, near Pershore, Worcs.

GI5GV.—W. GRAHAM, 5, Ratcliffe Street, Belfast.

G5IG.—G. O. KOLLIEN, Berryknowe, Blackhall, Midlothian, Scotland.

G5JT.—R. H. FARRINGTON, 15, West Street, Sittingbourne, Kent.

G5LC.—L. COOPER, 130, Walton Road, East Molesey, Surrey.

G5RS.—E. W. RAWLINGS, 20, Hedgeway, Onslow Village, Guildford, Surrey.

G5VS.—V. A. SIMS, 29, Rochford Avenue, Westcliff-on-Sea, Essex.

G6FN.—S. A. FRENCH, "Valetta," Alnwickhill Road, Liberton, Midlothian, Scotland.

G6GG.—G. GOLDING, 5, Elm Cottages, Elm Road, Shoeburyness, Essex.

G6SH.—S. I. HOBSON, Intake Dairy, Leicester Avenue, Doncaster.

2AHB.—P. VARNEY, Beverley, Upper Hale, Farnham, Surrey.

2AOZ.—P. R. SOLDER, 35, Torrington Gardens, London, N.11.

2BJD.—F. M. CAINE, 75, Warren Drive, Wallasey, Cheshire.

2BMN.—E. WILLIAMS, 14, Wall Street, Ebbw Vale, Mon.

The following are cancelled: 2ACK, 2AUT.

Ex CT1BL's address in Brazil was given erroneously in the January "BULL." It should have read C. J. MUMFORD, c/o The Western Telegraph Company, Fortaleza, Ceara, Brazil.

QSL Section.

The summer slump in radio activity does not seem to have affected the QSL section to any great extent and the H.Q. staff are still battling with thousands of cards weekly, although the staff is depleted by holidays.

There have been several moans lately from transmitters regarding the very poor return that they get for their cards. The whole subject has been threshed out more than once in these columns, and it seems that the only thing that can be done is to ask every transmitter to play the game and send a card to every man who sends one to him, even if he does not care for cards sufficiently to send one on his own initiative for every QSO.

English County Representation.

IN accordance with the decision made recently by Council a nomination form is appended for the use of home members of the Society desirous of nominating persons within their county to serve as County Representative for the year 1931-1932.

Nominations may be made by any corporate member who was resident in an English county on July 15, 1931, but such nomination shall only be made on behalf of a person living in the county in which the nominee is resident on the above date.

Nomination forms must be returned to Headquarters not later than July 25, 1931.

For the purposes of representation London will be divided as at present into four areas, viz., North, South, East and West. The postal address shall decide into which district a London member shall be located. The county of Middlesex shall be considered as being within the West London district.

NOMINATION FORM.
ENGLISH COUNTIES REPRESENTATION,
1931-1932.

To the Hon. Secretary,
R.S.G.B.,
53, Victoria Street,
London, S.W.1.

I wish to nominate..
....
of ....
....
....
Call Sign............as Representative for the County of.................................for the year commencing September 25, 1931.

I have ascertained that he is willing to serve under the conditions as laid down in the T. & R. BULLETIN for June, 1931 (Pages 351 and 352).

Signed ....
Address ....
Call Sign ....

NOTE.—This nomination form must reach Headquarters not later than July 25, 1931.

ELECTION OF COUNTRY REPRESENTATIVE.

The nomination of Representatives for Scotland, Northern Ireland and Wales must be made on the attached form and must reach Headquarters not later than **July 25, 1931.** The clauses governing such nominations shall be similar to those covering the English County Representatives.

COUNTRY REPRESENTATIVES.

The Hon. Secretary,
R.S.G.B.,
53, Victoria Street, London, S.W.1.

I wish to nominate..
....
of ....
....
....
Call Sign..................as Representative of.........
...........................for the year commencing September 25, 1931. I have ascertained that he is willing to serve if elected.

Signed ....
Address ....
Call Sign ....

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Inside Measurements for Radio :
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Headquarters Society:—BRITISH EMPIRE RADIO UNION,
53, VICTORIA STREET, LONDON, S.W.1.

APPLICATION FORM.

The Hon. Secretary,

Sir,—I beg to make application to be enrolled as a member, and shall be obliged if you will submit my name to your Council. I agree, if elected, to act and abide by the Rules of the Society as expressed in its Articles of Association and By-laws.

Signature...

Name in full (please use Block Letters) ....

Address (to which all communications may be sent) ....

Nationality.. Age (if under 21)...................................

Call Sign..

NOTE.—*Members not having Call Signs are allotted B.R.S. (British Receiving Station) Numbers, which are used for identification purposes only.*

Proposed by............................. Seconded by..............................

NOTES.—*Applicants who do not know any member may accompany their forms by references in writing by persons to whom they are known. Such persons should be householders, and should state profession and length of acquaintance with applicant.*
The Council reserve the right to refuse any application without reason.

UNDERTAKING TO BE SIGNED BY APPLICANT.

I, the undersigned, agree that in the event of my election to membership of the INCORPORATED RADIO SOCIETY OF GREAT BRITAIN, I will abide by and observe the Rules, Regulations and Articles of Association of the Society, and that in the event of my resignation from the Society given under my hand in writing, I shall, after the payment of all arrears which may be due by me at that period, be free from this obligation. I further agree to observe strictly the terms of any licence issued to me by the responsible authorities to operate transmission or receiving apparatus.

Witness my hand this..................day of................. (*signed*)..

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Corporate Members resident outside British Isles ...	**0**	**12**	**6**	**,, ,,**
Non-Corporate Members—Associates	**0**	**10**	**0**	**,, ,,**

Associate Members are not eligible to vote or receive individual notices of the Society.
Certificates of Membership and copy of the Articles of Association are issued to all members upon election.

NO ENTRANCE FEE.

A copy of the Articles of Association may be inspected at the Headquarters of the Society, 53, Victoria Street, London, S.W.1, by applicants upon request.

FOR OFFICE USE ONLY.

Approved by Council.. Subscription due...................................

Correspondence.

The Editor does not hold himself responsible for opinions expressed by correspondents. All correspondence must be accompanied by the writer's name and address, though not necessarily for publication.

To the Editor of T. & R. BULLETIN.

DEAR SIR,—As the only two members of the R.S.G.B. to attend the D.A.S.D. Convention at Hamburg on May 22 to 26, we feel that we should record in the BULLETIN our appreciation of the manner in which we were entertained by all those "Hams" with whom we carried on many pleasant conversations in English, German, French, Morse, and "Q" code.

There were about 70 members of D.A.S.D. present, representing all parts of Germany, and from Sweden, Jugoslavia, Switzerland, France, and Austria.

The four days Convention programme combined business and pleasure in a delightful manner, and we were very much impressed with the enthusiasm shown by everybody.

Our most sincere thanks and 73's to D.A.S.D.

Yours faithfully,
STANLEY HIGSON (G2RV).
BRIAN C. CHRISTIAN (G5XD).

Earthquakes and Radio Signals.

The Editor, T. & R. BULLETIN.

DEAR SIR,—I have followed this subject up with some interest for a considerable time now and am in total agreement with the section formed to tackle this problem that these disturbances have a very marked effect on radio signals. In fact, I will go further and give it as my considered opinion that the effects on radio that we call "good days" are undoubtedly due to some disturbance of the earth's surface in either a local or a remote part of the world, and am of the opinion that the chief business of the Society should be to tackle the question of wireless and the effects of the elements on the signals transmitted by the stations of the Society. Those members who take the trouble after a particularly good night or day's work to read the papers will invariably find that somewhere a disturbance of the earth's surface has occurred.

Two instances that can be quoted of our own local disturbances are those of the Manchester district and the all-England disturbance during May. The first I was somewhat unfortunate to miss, from a radio point of view, being at that time somewhere close to Manchester *en route* for Aberdeen, but a talk I had with G6IZ at Aberdeen confirmed the point that unusual conditions had set in during that night. The all-England found me at the key, and those who worked their stations that night will agree that conditions were very abnormal. Seldom have I found QRM so fierce from the U.S.A. side, and I think that we should make a determined attempt to tackle the matter. I personally am convinced that the whole of the source of freak transmissions may be traced to this source. As regards suggestions, I submit the following :—

(1) Every station of the Society should transmit his local weather conditions during a test call for BRS and station information, and should give it on every QSO and ask for same from his contact.

(2) A special prefix should be used by the amateur organisation to denote an unusual occurrence on radio, such as :—

(a) Test de G2UV Z. Z. Z. denoting earthquake conditions.

(b) Test de G2UV C1 C1 C1 conditions bad.
C2 C2 C2 conditions fair.
C3 C3 C3 conditions good.
C4 C4 C4 conditions very good.

This would, of course, refer to listening conditions only, not QRN or QRM. A station suffering from storm, flood or earthquake conditions could signal Z1, Z2 or Z3, so that G2UV, having an earthquake in the vicinity, would signal : Test de G2UV, Z3, Z3, C4, C4. That is, earthquake in vicinity, conditions good ; but I really think it time that we added a separate code for urgency that would enable us to help via radio other stations that might need the stand-by of the Society. If a special call such as "Z," especially if used several times, was brought into use and a request made that all amateur stations were to cease transmission (except those in vicinity), we should be ready for any possible emergency ; admittedly this seems remote, but it may be of use one day.

In the meantime tackle that earthquake dope. It's the goods.—Yours,

W. E. F. CORSHAM (G2UV).

To the Editor of T. & R. BULLETIN.

DEAR SIR,—You will no doubt recollect that a few months ago I appealed to members, through the T. & R. BULLETIN, for subscriptions towards a testimonial to be presented to G2NM at the 1931 Convention.

I regret to say that the response to the appeal has not been as great as was anticipated, but feel that this was due solely to the fact that the Convention was at that time many months ahead, and although members intended to forward subscriptions at a later date, the matter subsequently escaped their memory.

Therefore, may I appeal once more to all members of our Society who appreciate what our past President has done for us to forward their subscriptions to me at the above address not later than September 5, 1931, so that we can make the gift an appropriate one ?

Yours sincerely,
M. W. PILPEL (G6PP).

One Watt DX.

At 22.30 G.M.T. on May 25, W2CXC replied to a test call by G5VL on 14 M.C. G5VL was receiving his signals at QSA5 R6 fairly steady on 0-V-2, and was greatly surprised when the American said that his input was only 1 watt. A QSL card received subsequently confirmed this, and gave details of transmitter used, which was a T.P.T.G. employing a '12A valve with 200 volts on the plate feeding a Zepp aerial. W2CXC is a portable station owned by A. D. Smith, Junr., 1,180, Dean Street, Brooklyn, N.Y., and we wish to offer him our heartiest congratulations on accomplishing this splendid low power DX. We hope that he will let us know if he is successful in working any other Europeans with 1 watt.

NOTES & NEWS FROM THE BRITISH ISLES.

DISTRICT No. 2.

Representative: T. Woodcock (G600), "Santos," 8, George Street, Bridlington.

There is little of note to report this month apart from the fact that G6NG and myself (G600) visited the Nottingham and District Conventionette and had a jolly good time both there and later visiting the various stations and drawing a comparison with No. 2 District stations. Will members of No. 2 District see that more use is made of the 3.5 M.C. band by those licensed to use same?

DISTRICT No. 4.

Representative: J. Lees (G2IO), 17, Trevose Gardens, Sherwood, Nottingham.

The second annual conventionette of No. 4 District was held in Nottingham on June 20, at which 32 members attended. Details appear elsewhere in this issue of the Bulletin. It is pleasing to record a large increase in BRS members, and we welcome BRS511, 521, 538, 545, 548, 549 and 550. The monthly meetings will be continued throughout the summer in Nottingham on the second Saturday in each month, time and place as usual.

DISTRICT No. 8.

Representative: R. C. Neale (G6GZ), Farnborough Road, Farnborough, Hants.

Conditions still continue favourable, particularly on 14 M.C. Heavy QRN has been frequent on 7 and 3.5 M.C., although this is to be expected this time of the year. 14 M.C. band has been favoured the past month and many excellent QSOs reported. G2BI has worked Hong Kong with quite low input. 1.7 M.C. is quite active considering it is summer time and most people expected to be outdoors on Sundays. The somewhat extraordinary conditions on this band the past few months seem to be at last declining, much to everybody's disgust. The Channel Isle folk are receiving the American broadcasting at good strength and consistency, but seem to hear very few Gs on the air: this applies to all bands. The following report active: G2BI, G2WK, G2GG, BRS343, BRS157, G6GZ, G6BU, 2AHD, 2BCS, G6NZ.

DISTRICT No. 10.

Representative: S. Buckingham, 19, Oakleigh Road, Whetstone, N.20.

The letter budget is increasing and now takes over a month to circulate. BRS404 has started television experiments and wants to get in touch with others interested. Congratulations to G5SL on getting another new member. G2WV has now collected the necessary cards to claim W.B.E. and W.A.C., and so the shack of another 10-watt station will soon possess the coveted certificates. All stations are working on their usual bands but nothing outstanding to report. It is proposed to start monthly meetings at the beginning of September and we are promised good support.

DISTRICT No. 12.

Representative: T. A. St. Johnston (G6UT), 28, Douglas Road, Chingford, E.4. Telephone: Silverthorn 1557.

Despite the bad weather on Sunday, June 7, members took part in a field-day. The following took active part:—G2NU, G2ZN, G2QW, G6FY, G6LL, G6TX, G6HY, G6SG, G6CW, and G6UT. The fixed station was G6HY, at Hoddesdon; the two portable stations, G6TX and G6SG, took refuge in a spacious barn at Gilston, Herts. One car party went astray and, after a fruitless search, made for Hoddesdon, when communication was very soon established. The 1.75 M.C. band was employed and a number of local stations were worked. H.T. was obtained from M.G.s which took their supply from accumulators on the cars. A report has since been received from a BRS at Southend. Owing to the success of the outing another field-day has been arranged for Sunday, August 16. All those wishing to take part should notify the D.R., and offers of cars will be greatly appreciated. The next monthly meeting will be held at Chingford on Tuesday, July 28.

DISTRICT No. 13.

Representative: H. V. Wilkins (G6WN), "Hills-View," 81, Studland Road, Hanwell, W.7.

It is with regret that we have this month learnt of the death of Mrs. Smith, wife of G6VP, who passed away on May 29. We offer our heartfelt sympathies to Mr. Smith and family in their bereavement and we shall miss one who entertained the many visitors to this station.

The area hamfest proved quite a success with eighteen present including W2TT and ex-SU8WY, and a very pleasant evening was spent.

Our congratulations to G2OL and G6XN in being placed first and third in the QRP tests. It is gratifying to see this district is creeping to the fore.

Of the thirty-two reports from G stations during B.E.R.W., six came from this area. I am sorry these were not well up in the list but hope next time to see some at the top.

The last area "get-together" saw eleven members and three visitors present and the next will be at G6WN on Wednesday, July 22, at 7.30 p.m.

You will find a nomination form in this issue for the purpose of naming your representative for the coming year. It is your task to think this matter over carefully to decide who shall be your agent. For my part I am quite prepared to take office again should you wish it.

Reports are few this month but no doubt this is due to the better weather.

G6WN has succeeded in obtaining an R2-3 report from U.S.A. when using 1.05 watts input. This was effected on QRP from QRO.

DISTRICT 14 CONVENTIONETTE.

The first District 14 conventionette has come and gone, and one cannot but think that it has marked progress for the R.S.G.B. in this part of Britain.

A whole day was devoted to this real amateur gathering, proceedings starting at 10 a.m. at the Queen's Hotel, Newport, when members started to arrive from all parts by various modes of transport, and a total of 35 were present. A few station visits to G6FO and G2QI were made for the early arrivals.

Then followed the lunch, after which Mr. J. Clarricoats (G6CL) spoke in reply to a toast to the

R.S.G.B. given by Mr. H. Harding (G2HH) (D.R.). " Clarry " mentioned that headquarters had been puzzled for a long time as to the best way to give Monmouthshire the support it needed and to foster the amateur spirit he (G6CL) knew to exist here. Then at the end of the summer of 1930 came the formation of the Monmouthshire Transmitters' Society, whose only rules were that members belong to R.S.G.B. and abide by the term of any licences held, and whose main object was to keep the R.S.G.B. members in and around Monmouthshire together and to further the work of the R.S.G.B. This gave H.Q. the lead, and in the 1930 Convention they made Monmouthshire a separate district. Since then the record of the M.T.S. has been very satisfactory with its monthly meetings, letter budgets, well-operated stations, etc., and now this fine conventionette. He hoped that they would continue their past record. Mr. Clarricoats then went on to describe the progress made by the R.S.G.B. in general and made particular mention of the B.E.R.U. and of the wonderful way the R.S.G.B. was spreading in the provinces and foreign parts. His little " Black Book," which is a thermometer of R.S.G.B. affairs, showed him that things were going up and up and up! He assured the meeting that H.Q. were doing all in their power as far as international affairs were concerned, and mentioned that he and Mr. K. B. Warner had discussed international interests before Mr. Warner attended Copenhagen.

With regard to calibration services, Mr. Clarricoats then described the position, and assured us that an early start would be made with the 7 M.C. service. He pointed out that there were no favourites in the eyes of Council, and that any member desiring high power or any other special permit would receive fair treatment, and mentioned that the D.R. was expected to append remarks to all such applications. Further, he emphasised that Empire link stations were not favoured stations, and that anyone who could prove his ability to attend to this duty could become an Empire link station.

Mr. A. Forsyth (G6FO) then proposed a toast to the visitors, and Mr. H. B. Old (G2VQ), provincial D.R. on Council, replied, in which he mentioned that " Clarry " usually said all there was to say! Nevertheless, Mr. Old gave us a very interesting talk, in which he particularly outlined the progress of B.E.R.U.

The meeting then adjourned to another room, where Mr. D. Briggs (G2QI) opened a discussion on the use of the 1.75 M.C. band. This discussion was very lively indeed, and many interesting and amusing arguments took place. Everyone thoroughly enjoyed this part of the proceedings.

Tea was then served and the meeting became informal when various groups discussed many things of interest to amateurs.

As G6CL and one or two others had to leave by train the whole gathering went to the station with them and gave them a good send off. Those who remained then broke up into parties and visits were made to the stations of G6FO, G2QI, G2XX and G2PA. Altogether an FB day.

Mr. Harding (G2HH) was chairman, supported by G6CL, G2VQ, G2IO, G2OP, G6FO and G2QI.

G2HH wishes to thank all those in his district who helped to make the meeting an unqualified success.

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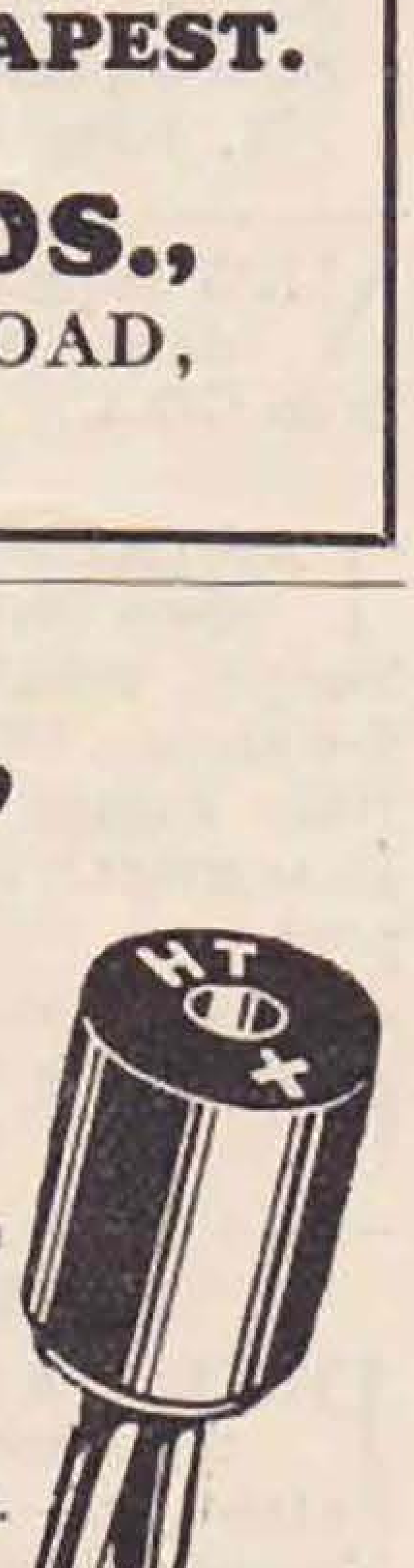

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SCOTLAND.

Representative : J. Wyllie (G5YG), 31, Lubnaig Road, Newlands, Glasgow.

The May-June period has clearly evidenced the onset of summer activities other than radio, so I shall on this occasion make these notes brief and conserve valuable space. I am indebted to G2OL for correcting my impression that G5YG contact with CR9CN was a first " G " contact. There are at least three prior claims. G2MA has during the past fortnight worked Hawaii, and I shall be obliged for information as to whether this is a first " G " contact. G6RG has been busy in connection with the Prince of Wales' birthday relay, and G6IZ has been fortunate in receiving India's message. Mr. French (G6FN) continues his popular Morse classes in " D " District, but otherwise there is nothing of note to report.

WALES.

By G5PH, 144a, Cwm Road, Bonymaen, Swansea.

There does not seem to be much activity in the district although some stations have been converting to C.C., and the air in consequence should be a much pleasanter place for all of us.

G2AV, 2BPM, G5OC and G5PH are all active, but G6XB, our new district member, is still rather busy after his move to give much time to radio.

G5PH having rebuilt his transmitter to CO, PA finds this a great improvement over the old harmonic type control, and is now hoping for better conditions so that he can test out the new gear.

European Notes.

We should like to draw attention to LA2K, who is taking part in the Norwegian Scientific Greenland Expedition this summer. He will be using a 15-watt transmitter and operating under the call sign XLA2K on the 14 M.C. band for QSOs with amateurs during the period July 20 to September 12. His principal working hours will be around 17.00 G.M.T., and reports will be welcomed by the N.R.R.L.

The sixth annual Convention of the D.A.S.D. was held on May 23-26, at Hamburg, and was a great success. Nearly ninety amateurs gathered together, and the D.A.S.D. were pleased to welcome several foreign amateurs. During the Convention some very interesting lectures were given, and one, by M. Vantler, on the broadcast experiments carried out on 7 metres in Berlin, must be mentioned.

A lecture on screen-grid transmitters was given by H. Reifenberg, together with one on wave metres by H. Evertz. These lectures, together with a most elaborate and remarkable exhibition of the apparatus used by the Hamburg amateurs, awakened much interest and many very interesting discussions.

The meeting was concluded by an excursion to Heligoland Island. The D.A.S.D. wish, through this medium, to thank again all those societies and amateurs who kindly thought of them at that time.

Major K. B. Warner paid a visit to Berlin after having again successfully represented the interests of the amateurs at Copenhagen. The D.A.S.D. expresses again its sincere thanks to him for his gallant fight.

We understand that the attitude of the German postal authorities towards the amateur is becoming considerably more friendly, and it is hoped that the situation of German transmitters will soon improve.

The situation of amateurs in Switzerland is also improving a great deal, licences being granted in almost all cases of application. An official broadcast now takes place in Switzerland every Monday from 21.15 to 21.30 G.M.T. on 3.5 M.C. This broadcast is similar to that given by the A.R.R.L. and will be given from AB9H. The 3.5 M.C. band is greatly in use in Switzerland, especially on Monday evenings ; during the past winter relays around the country have been carried out regularly on Mondays.

Notice to Contributors.

The Editor is pleased to have manuscripts submitted to him for publication, but would remind contributors that, owing to lack of space, a delay often elapses between the receipt of the MS. and the date of its appearance in these pages. All matter intended for publication should be written on one side of the paper only and preferably typewritten (double spaced). Diagrams should always be shown on separate *sheets. Rough sketches can be re-drawn by our draughtsmen. Photographs, if any, should not be smaller than ¼-plate as otherwise the reproduction will be poor.*

After publication, authors may, if they so desire, purchase from the Society any blocks used in their articles at the following prices :—Half-tone, 1s. *per block ; Line,* 6d. *per block (post free). Application should be made after the appearance of the article in question.*

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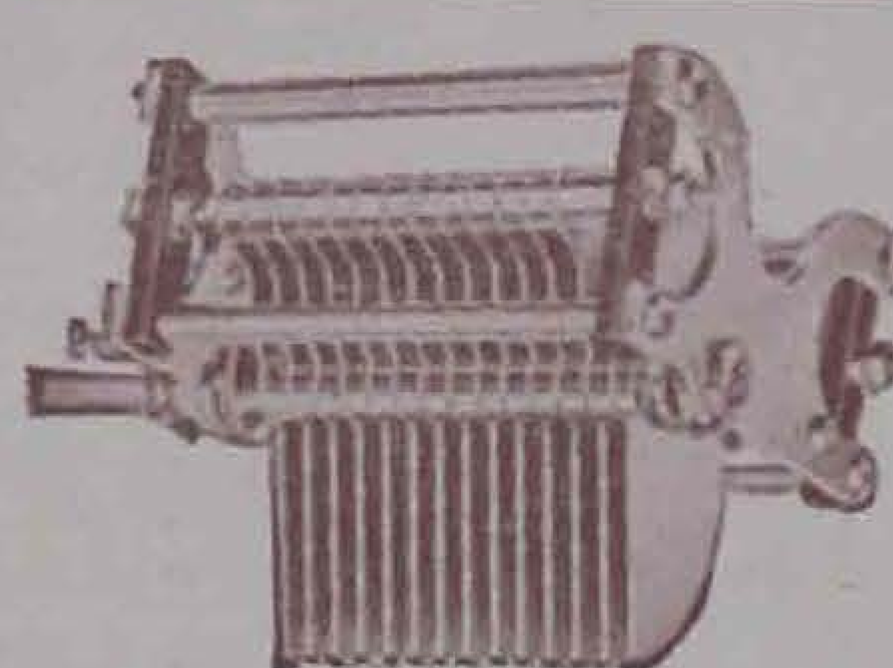

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TYPE S.W.2B.

Type S.W.2B. is a medium power transmitting valve designed for operation on wavelengths down to 15 metres at a maximum continuous anode dissipation of 200 watts. When working at 15 metres the input power should not exceed 240 watts at 2,000 volts.

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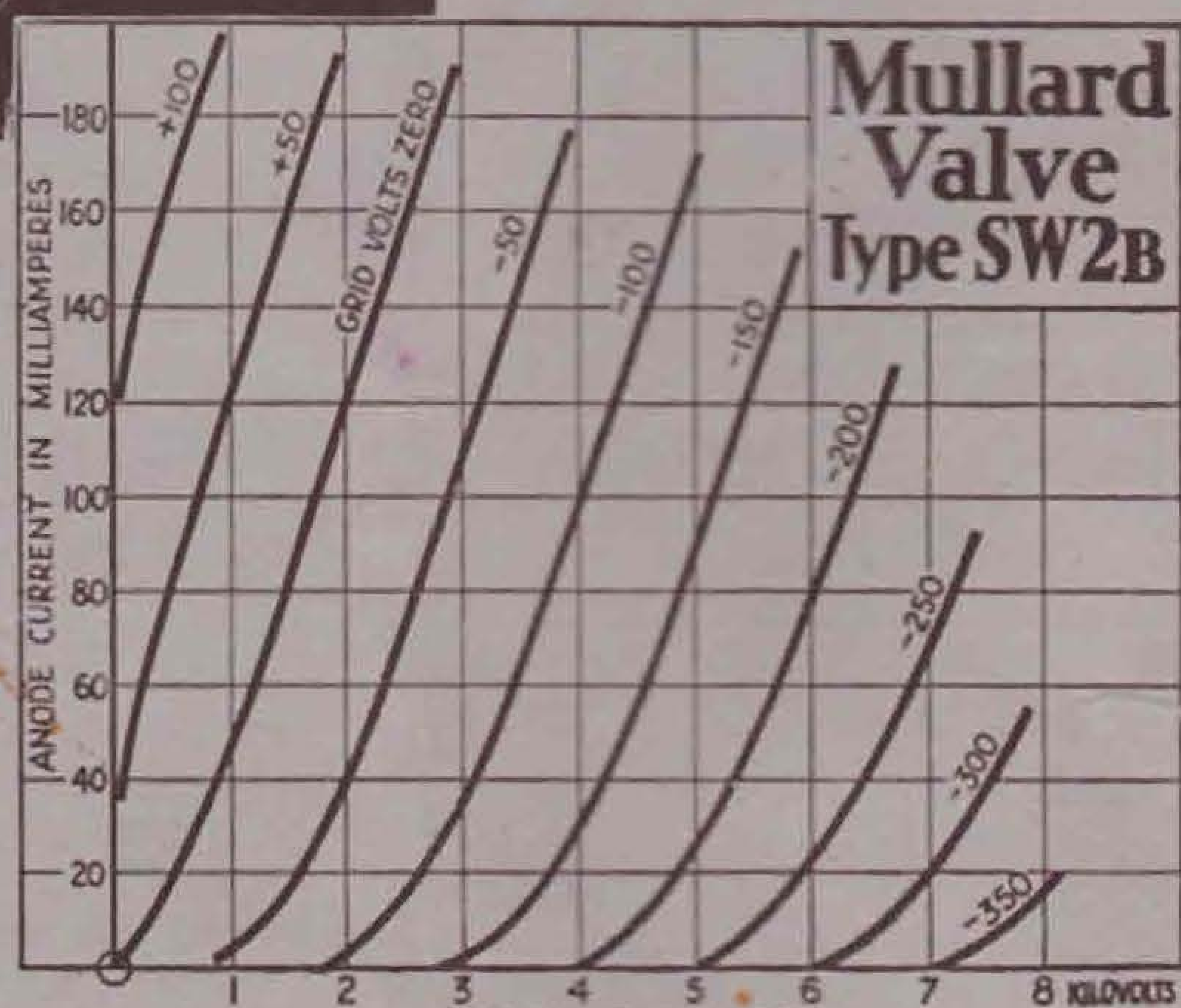

OPERATING DATA & CHARACTERISTICS.

Filament Voltage	12.0 volts.
Filament Current	5.5 amps.
Max. Anode Voltage	3,000 volts.
Max. Anode Dissipation ... (Continuous operation)	200 watts.
Total Emission	450 mA.
Amplification Factor	20
Impedance	12,500 ohms.
PRICE	**£11 : 10 : 0**

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