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THE WIRELESS WORLD AND RADIO REVIEW

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EXPERIMENTS IN TELEVISION.

No. 247 [No. 6 Vol. XIV]

TRANSATLANTIC TESTS REPORT.

THE WIRELESS WORLD AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GREAT BRITAIN.

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CONTENTS

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The WIRELESS WORLD AND RADIO REVIEW

HOW MANUFACTURERS CAN HELP.

By The Editor.

WIRELESS is no longer an obscure science understood only by a few highbrows and a thing of mystery to the public. Even before broadcasting started the public had begun to take an inquisitive interest in wireless, and apart from the thousands of amateurs who were then becoming expert, there was a large proportion of the general public who at least knew something of the principles.

The attractions of broadcasting and the publicity which wireless has received as a result, has brought the general public into intimate association with this hitherto mysterious science and so much literature is now available explaining simply the principles of wireless, that the public is almost as well versed in wireless matters now as in the technicalities of motoring, with the difference that wireless is within the scope of the smallest pockets, whereas motoring may still be regarded as a luxury.

The public is being educated to look for the best and to judge products on their technical merits, and in consequence it is already becoming increasingly difficult for low grade apparatus to find a market,

Many manufacturers are fully alive to the present state of affairs and cater for the market accordingly, but we believe that still further progress can be made by the manufactureres which will assist the public to recognise the merits of their products.

We may, as an example, cite the case of valves. Some months back, unless enquiry was made, the laymen had very little to go on as a guide to the properties of the valve he purchased and the ideal conditions for its best performance. Now almost every maker of valves provides with the packing box, details giving the correct filament voltage, current consumption, anode voltage and so on, but if this policy were taken a step further and the public were supplied with valve characteristics for each type of valve, we believe that not only would this information be appreciated by the public, but it would enable justice to be done to each particular type, because we feel sure, that in ignorance of the properties of the valve, many types are being used under conditions which are unsuitable, resulting in disappointment in their performance. There are many other instances which can be cited where additional technical information might be supplied and would be appreciated not only by the experimenter and advanced amateur, but by a very large proportion of the public now reasonably well informed on technical matters.

In our opinion inductance coils should give not only the number of turns, but the inductance and self capacity, within reasonable limits, should be stated on each coil. We realise, of course, that it would be a difficult matter to measure each coil independently, but where identical coils are made in quantity production as at present, values within very reasonable limits can easily be supplied, and we have observed that with Continental manufacturers it is the general practice to do so.

In the case of valves, naturally, individual curves could not be taken for every valve, but an average for valves constructed to the same specification could be supplied

Sooner or later all manufacturers must realise that they are catering for the requirements of a critical and intelligent public and we feel sure that those manufacturers who are the first to realise this fact will reap the benefit in the popularity of their products and the feeling of confidence in the mind of the public which the provision of this technical information will inspire.

SOME NOTES ON

REGENERATIVE RECEIVERS.*

The effects of oscillation in a receiving circuit are discussed, and in particular with reference to the operation of the Armstrong super-regenerative arrangement. The details concerning the setting up and operation of the super-regenerative receiver should prove of great value to those who have experienced difficulty with this type of apparatus.

By E. V. APPLETON, M.A., D.Sc.

MOST wireless experimenters use regeneration or reaction in their sets in some form or other, and it may therefore be of interest to describe one or two tests I have made with a broadcast receiver which is of the reactive type.

The first point I wish to discuss relates to a phenomenon which is shown by all valve receivers, but is particularly evident when reaction is used. It is often noticed that if the reaction coupling of a set is adjusted so as to give marked amplification, a rustling noise is heard in the presence of the carrier wave from a broadcasting station. The noise is similar to that experienced if the carrier wave is absent and the reaction is increased just past oscillation point. I have not seen this liveliness on the part of the set satisfactorily explained, but, so far as I can see, it means that the carrier wave from the broadcasting station is really making the set much more sensitive to spark and atmospheric waves of similar and neighbouring frequency by a kind of heterodyne action. We thus must come to the conclusion that the broadcasting station helps its enemies in that, if it were not there, the interfering noise would hardly be heard at all. It is a simple matter to show theoretically how the strength of the signal received from a very weak spark wave is increased by the presence of another oscillation of neighbouring frequency, and this increase in sensitivity appears to be the explanation of the rustle. In support of this we may note that in cases where the broadcast carrier wave fades the rustling noise and spark and other interference fade too, following the carrier wave in intensity.

From theoretical considerations we may deduce that the stronger the carrier wave (within certain limits) the bigger the amplification it produces for a given weak spark signal of neighbouring frequency, and we therefore ask ourselves whether it is not possible to use a heterodyne method to make our set more sensitive for telephony in a similar fashion. In doing so we must, of course, be careful to make the heterodyne have the same frequency as that of the carrier wave to prevent annoyance to other people.

We are thus led to try the reception of radiotelephony by the heterodyne method, and the simplest scheme for doing this is by means of the auto-heterodyne circuit. Two years ago† I showed how it was possible for a powerful transmitter to control the frequency of a receiving oscillator of small power, and it was found that the range of receiver tuning over which this was possible was proportional to the strength of the incoming signal and inversely proportional to the magnitude of the self-oscillation in the circuit. Thus in my set I find that the carrier wave from London will control the frequency of my receiving set over a large range of my fine tuning condenser, and I often work with the reaction increased so much that the set, in the absence of the carrier wave, would oscillate very freely on its own. The set, however, is so stable and constant that it will remain "locked" by the carrier wave from the first news bulletin to the dance music. (The set was made by Messrs. Pye & Co., and Marconi-Osram D.E.3 triodes are used with it.)

It is, however, possible to increase the reaction too much, resulting in loss of signal strength. In this case the oscillation produced by the set in the presence of the carrier wave has been made greater than the value normally required for optimum heterodyne

*An abridged account of a lecture delivered before the Cambridge University Wireless Society.

†The automatic synchronization of Triode Oscillators, Proc. Camb., Phil. Soc., Aug. 1922.

when ordinary continuous wave signals are being received. The value of the controlled heterodyne oscillation necessary for optimum signals depends on what I call the rectifier-characteristic of the detector valve or crystal. This is a very interesting characteristic which is easily obtained, but which I have not seen mentioned in any of the books. By using a low frequency alternating current and potentiometer for alternating electromotive forces we can find the relation between the change in mean anode current and the amplitude of the applied grid potential (or in the case of the crystal the relation between the current through the crystal and the alternating voltage applied to it). An example of this type of characteristic relation is shown in Fig. 1. We may easily show that the set having this detector-characteristic is most sensitive for the reception of continuous wave signals when the local oscillation is adjusted to conditions represented by the steep part of the detector-characteristic curve indicated by the point Z. Thus for optimum reception in this case we must arrange that the amplitude of the oscillation impressed on the grid of the detector valve by the local oscillation should be 2·75 volts, while for optimum reception in the case of radio-telephony the self-heterodyne controlled by the carrier wave should reach the same value.

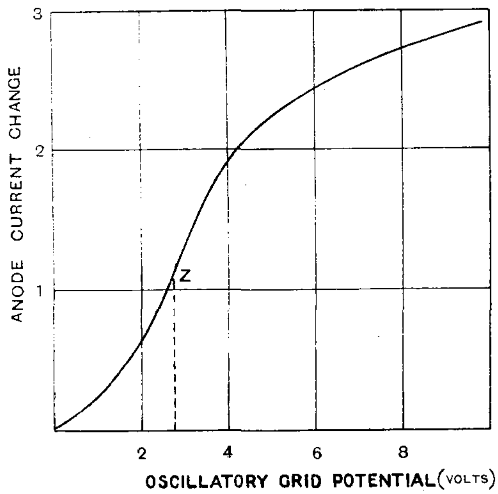


Fig. 1.

Further sensitivity than this does not appear possible in a simple regenerative circuit, but E. H. Armstrong, to whom we are indebted for many of the important advances in receiver technique, has, in his super-regenerative receiver, shown us how the sensitivity of a set can be still further increased by the presence of a heterodyne oscillation of frequency quite different from that of the receiver. I have made some

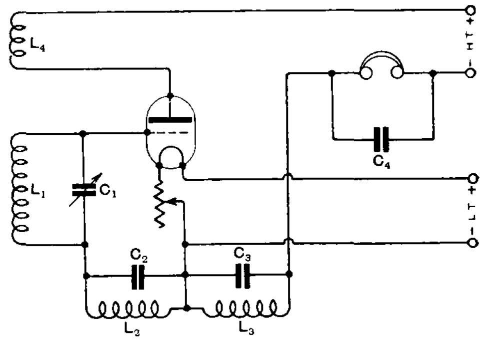


Fig. 2.

experiments with this type of circuit, and perhaps one or two notes on them may be of interest.

I think that the failure of many experimenters to get good results with the original Armstrong circuits is due to the complicated nature of these circuits. These circuits are all two-valve assemblies, and are difficult to operate. The best plan, therefore, seems to be to try out first the simplest type of Armstrong circuit, which is a one-valve circuit, and to study its peculiarities before connecting on the second valve. Moreover, the circuit I wish to discuss is a fundamental one in that it illustrates with the least amount of complication the new principle in super-regenerative reception.

The fundamental Armstrong circuit is shown in Fig. 2.

It is seen to consist of a high frequency circuit L_1C_1 tuned to the wave of the incoming signal (which may be received on either loop or aerial), connected on the one hand to the grid *via* the usual grid condenser and leak, and on the other hand through a lower frequency circuit L_2C_2 to the filament. In the anode circuit we have a reaction coil L_4 giving us high-frequency coupling with the L_1C_1 circuit. In the same circuit there is also a lower frequency circuit L_3C_3 identical with L_2C_2. Both of these lower frequency circuits (L_2C_2 and L_3C_3) are tuned to a very high wavelength (*e.g.*, 15,000 to 30,000 metres corresponding to a frequency of 10,000 to 20,000). After such a circuit is fixed up it is best to test the various parts, and the following procedure is recommended. Short circuit the coils L_2 and L_3, and test if the set will work as an ordinary retroactive receiver. To do this the high frequency coupling between the coils L_1 and L_4 is increased until a click or sudden liveliness is heard in the telephones. The set is then oscillating with its fundamental frequency corresponding to the high frequency L_1C_1 circuit. If this does not happen the reaction coil should be reversed. If still no success, the filament current and anode voltage should be increased slightly. The reaction coil should be such that the set oscillates easily with a coupling very much smaller than the maximum amount possible with the set. As will be seen later, this is necessary, as it is essential to be able to increase the high frequency coupling well past the oscillation point when the set is functioning as a super-regenerative receiver.

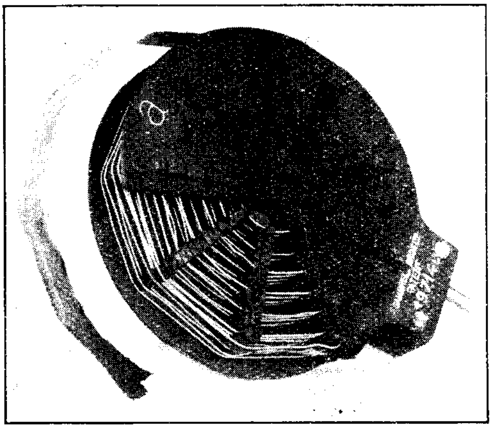
If the set works all right as a simple receiver the short-circuits on the coils L_2 and L_3 should be taken off and the high-frequency coupling loosened. On coupling the coils L_2 and L_3 together a high-pitched whistle should be heard in the telephones. If this is not heard the coupling between the lower frequency coils should be reversed. If all is well we can now proceed to study the results obtained with different values of high and lower frequency coupling. At this point it cannot be too strongly emphasised that success with Armstrong circuits of this kind is almost wholly dependent on the correct relation between these two couplings. The experienced experimenter will see at the outset that we are trying to make one valve oscillate at two frequencies with the circuit shown in Fig. 1. One frequency is the one corresponding to L_1C_1, and the other corresponding to L_2C_2 or L_3C_3. On experimenting we find this view confirmed, for we find that the oscillations interact, and, as it were, tend to prevent one another. For example, if we make the high frequency coupling between L_1 and L_4 very close we may find it impossible to make the valve oscillate with the lower frequency and give the high-pitched whistle if L_2 and L_3 have only medium coupling. On the other hand, and here is the secret of super-regeneration, if the lower frequency coupling is fairly tight we can push the high frequency coupling well past the oscillation point if the whistle is present without free oscillations of the normal type developing.

I have noticed that one or two writers on Armstrong circuits advise a fixed close coupling between the lower frequency circuits, but personally I have always found that the best results were obtained when I was able to adjust both high and lower frequency couplings within a wide range, and so adjust both for optimum signals.

In adjusting the couplings the experimenter should, if possible, work on buzzer signals without outside aerial so as not to interfere with neighbouring listeners-in. The high frequency coupling should be loosened and the lower frequency coupling made fairly tight so that the high-pitched whistle is heard. The signal should then be tuned in and the high frequency coupling increased. The signal will be found to increase enormously in intensity until at a certain value of coupling a loud click occurs accompanied by the cessation of the Armstrong whistle and of the loud signal. In this case it is obvious that the high frequency coupling has been carried too far, and it should be loosened again, so that the whistle starts. At the second attempt the high frequency coupling can be increased very nearly, but not quite, to the critical value, and the loud signal maintained. The receiver is then functioning as a super-regenerative circuit.

NEW SHORT WAVE INDUCTANCES.

Minimum capacity between turns is an important detail in inductance coil construction for short wave reception. A particularly interesting method of spacing is seen in this new type Gambrell



coil, designed for use on wavelengths from 50 to 150 metres. A good feature is that the turns are air spaced, which reduces dielectric loss to a very low value.

AN ACCOUNT OF SOME EXPERIMENTS IN TELEVISION.

A good deal of popular interest has been aroused by experiments in Television recently conducted by Mr. Baird. The following article describes some early apparatus used by him, and results obtained.

By John L. Baird.

The recent publication in *The Wireless World and Radio Review* of two articles dealing with the problem of Television is in itself an indication of the public interest in this subject at the present time.

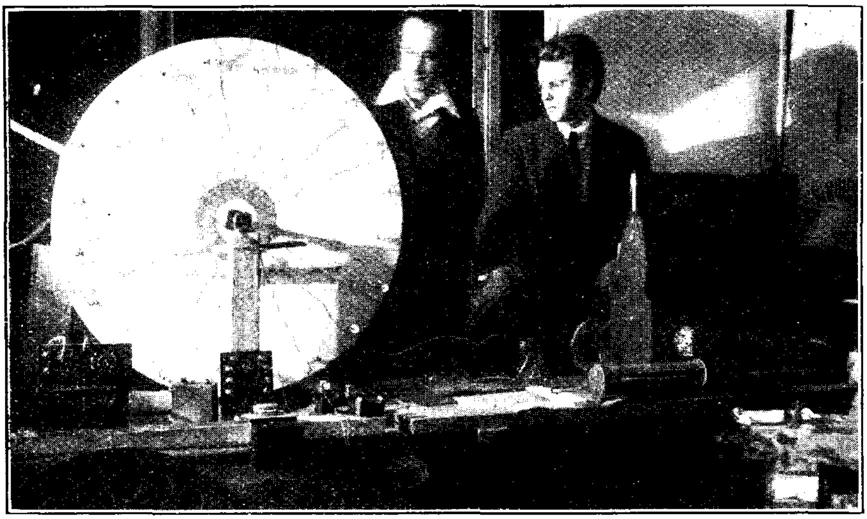
The article by Mr. Nicholas Langer describes the work conducted by an investigator on the continent, whilst Mr. A. A. Campbell Swinton described before the Radio Society of Great Britain his own views as to a likely direction in which a solution of the problem might be sought.

In view, then, of the general interest in Television, I believe it may be of value to readers of *The Wireless World and Radio Review* to have some account of experiments which I conducted some time ago.

I propose in this article to confine myself entirely to a description of my earlier experiments, the apparatus described being one of the first constructed and capable of transmitting only crude outline images. Since the date of these experiments considerable advance has been made. I am now engaged on apparatus capable of giving a certain amount of detail; considerable modifications have been made, the large revolving discs and lamps described below having been dispensed with.

By reference to the accompanying photographs and sketch the principle of the mechanism employed in the model can be readily followed.

In the transmitter an image of the object to be transmitted is focussed on a disc rotating at a speed of approximately 200 r.p.m. This disc is perforated by a series of holes staggered around the circumference. In the experimental apparatus described four sets of five holes were thus arranged; in proximity to this disc revolved a serrated disc at some 2,000 r.p.m., and on the other side of this and in line with the focussed



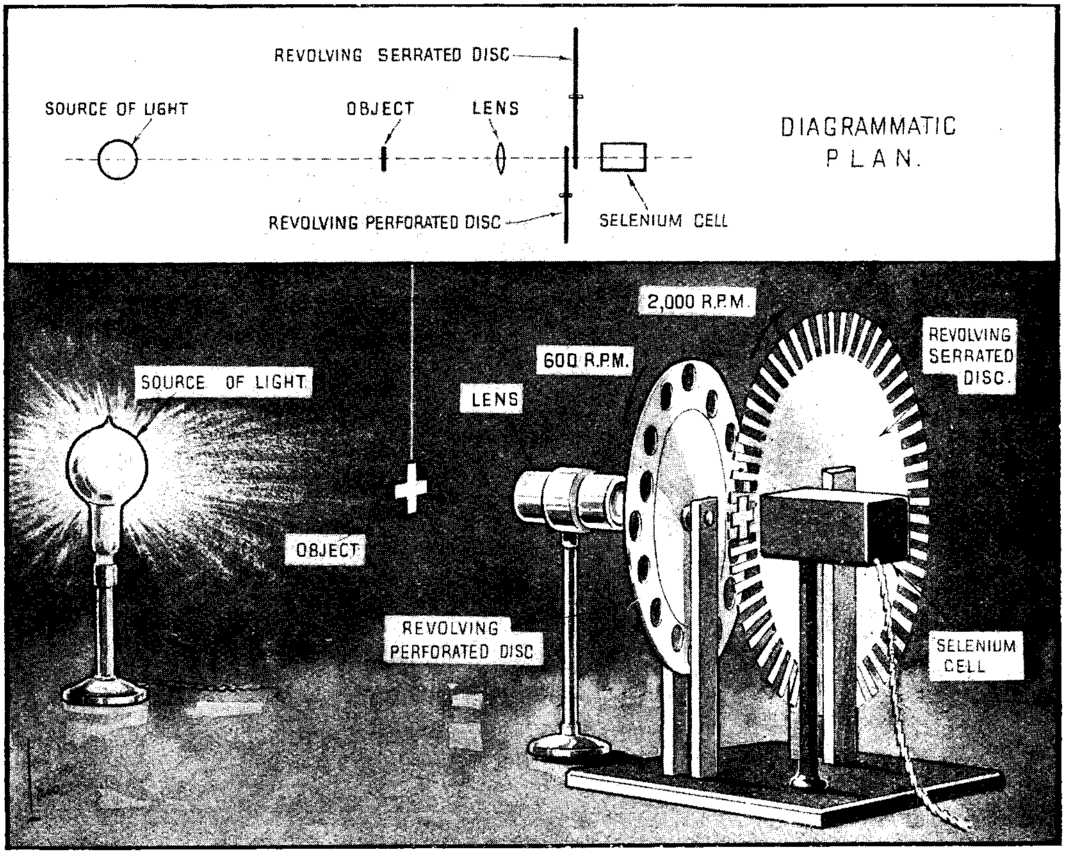
Mr. John L. Baird (right) with the receiving apparatus. The image appears on the disc when the latter is rotated.

image of the object to be transmitted, there was a single selenium cell connected to a valve amplifier.

In operation the procedure of the mechanism is as follows: The image focussed on the disc controls the illumination; as this disc rotates the holes allow light from each part of the image in succession to fall on the cell, the light flashes are interrupted by the edge of the serrated disc at a very high frequency before reaching the cell.

Selenium is instantaneous in its response to light, that is to say, the instant light falls on it, it *begins* to change its resistance. Time, however, is required for this effect to reach its maximum, and this property of selenium known as its " chemical inertia," or " time lag," is fatal to any system which depends simply upon passing the image over a selenium cell, as in passing along a light strip of the image, the resistance is very much lower at the end of the strip than at the beginning, and again in passing along a dark strip the resistance increases as the strip is traversed.

The use of the rapidly revolving serrated disc overcomes this, as the actual resistance of the cell at any instant is not of consequence —it is the pulsations which are transmitted.



A sketch which illustrates the principle of operation and the disposition of the parts.

To make the matter clearer it might be said that light was turned into sound. Loud for the high lights, low for darker areas and complete silence for darkness.

The apparatus used for the visible detection of these impulses as a picture replica of the original image is in the model illustrated on a principle similar to that employed at the transmitter.

A revolving disc is here employed where lamps are arranged in the same staggered formation as on the disc of the transmitter, and these lamps are joined to a commutator at the centre of the disc. This disc is run in synchronism with the transmitting disc, and the image is reproduced by the flashing in and out of the lamps, continuity of vision making the whole image appear simultaneously.

A machine somewhat similar to that described was shown to representatives of the press at the beginning of this year, outlines of moving objects being transmitted.

The system described above, in common with other systems advocated at present, consists essentially of a method of rapid telegraphy, the transmitter being actuated by light. It is possible that at some future date means may be discovered of sending out energy from a point A, bringing it to bear on an object at a distant point B, and causing the object to radiate from its surface energy which, penetrating intermediate obstacles, can be brought to a focus at A, rendering it visible. This would be radio vision in a very different sense.

A photograph showing the transmitting apparatus, comprising the perforated disc, the disc with serrated edge and the selenium cell.

VALVE TESTS.

THE MARCONI-OSRAM R. 5-VOLT.

In the previous issue we reviewed the new "DEV" and "DEQ" types. Continuing with our tests, we deal this week with the "R. 5-v.," a valve which is very popular among those who do not favour dull emitters owing to battery charging difficulties. It is hoped in the near future to describe, for the benefit of our readers, tests carried out on all the standard types of valves which are on the market. A perusal of these tests will guide the reader in the selection of valves for particular requirements.

IN spite of the many dull emitting filament valves now on the market, it is a fact that many of the "old brigade" of wireless enthusiasts still operate one or other of the well-known "R" types. Many experimenters of to-day gained their first knowledge during the War, when the "R" valve was manufactured in tens of thousands and the number of valves of this type still being sold proves that some workers, at least, are faithful to the old love.

The "R. 5-volt" is a modified form of the R, and the object of such modification is, we are told, with the double object of retaining the characteristics of the latter, but at the same time embodying constructional improvements.

The whole electrode system has been redesigned, with the result that the valve has

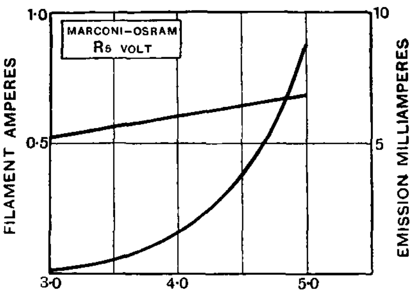


Fig. 1.

a lower impedance, and the filament has been lengthened, being now V shaped, the additional springing reducing the liability of its sagging on to the grid.

The normal filament voltage has been increased to 5, and from Fig. 1, which gives the filament characteristics, we find the current on the sample tested was 0·68 ampere, giving the quite ample emission of 8·8 milliamperes.

Fig. 2 shows two anode current, grid voltage characteristics at 40 and 80 volts respectively.

The magnification factor varies from 8 to 9·7 as the anode potential was raised from 30 to 100, as can be seen from curve A, Fig. 3.

The result of the re-design is well shown by

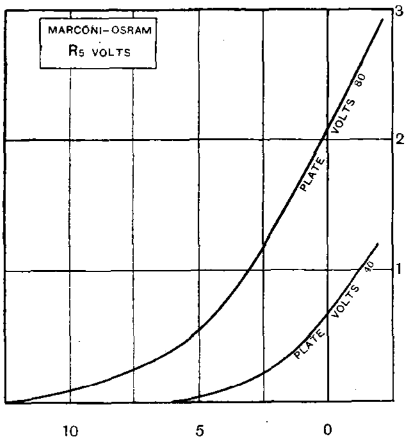


Fig. 2.

curve B, Fig. 3, which represents plate impedance as a function of plate voltage for at a plate potential of 100 the impedance is but a fraction over 20,000 ohms.

In view of the foregoing data, the valve was expected to give satisfactory service as

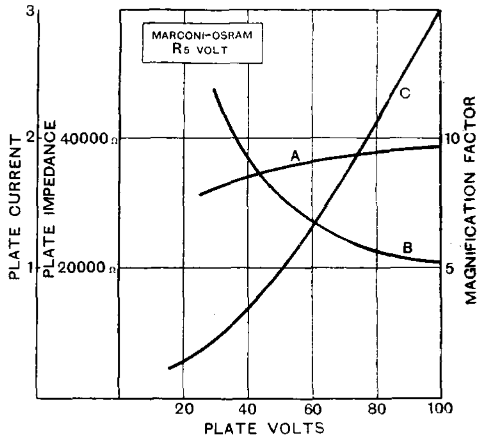


Fig. 3.

a general purpose valve, which prediction was found, on test, to be accurate.

As a high frequency amplifier and as a detector good results were obtained with an anode potential of 42. For low frequency work we increased this potential to 80 and gave the grid a negative bias of 2 volts.

We are inclined to think that valve noises are slightly less pronounced in this tube.

If the user is prepared to stand for the extra filament consumption, the valve is one that can be recommended for general use and it should be remembered that having a somewhat longer filament, the life should be proportionately increased.

The Radio Society of Great Britain.

Transmitter and Relay Section.

Mr. E. J. Simmonds **(2 OD)**, one of the few amateur transmitters who regularly communicate across the Atlantic, opened an instructive discussion on April 25th last.

Considering that Mr. Simmonds has effected two-way communication with no fewer than fifty-one American and Canadian amateurs, his remarks on the erection of an efficient transmitting plant were of the greatest practical interest. His aerial, screened by several large trees, is of the six-wire cage type, a system he strongly recommended as providing the best distribution of current. A tuned grid, or reversed feed-back, circuit is used, and has been found the most reliable after prolonged experiment. To test for sharpness of tuning the speaker recommended the use of a Neon tube and loop aerial, a practice giving much useful information concerning different types of modulation.

Speaking of the series condenser in the aerial circuit when working below the fundamental wave-length, Mr. Simmonds alluded to the interesting theory of Dr. Eccles, that in such cases radiation proceeds upwards, rebounding from the Heaviside layer. Some discussion afterwards centred on the position of the nodal point and its effect on radiation, Mr. F. L. Hogg **(2 SH)**, Mr. H. Andrewes **(2 TA)**, and others taking part.

THE TRANSATLANTIC TESTS.

REPORT OF RECEPTIONS OF EUROPEAN SIGNALS BY AMERICAN AND CANADIAN STATIONS.

By Philip R. Coursey, B.Sc., F.Inst.P., A.M.I.E.E.

THE report on the results of the main part of this season's Transatlantic Tests has at last been received from the American Radio Relay League. This time the officials of the A.R.R.L. have been experiencing similar conditions to those which obtained on this side a year ago—*viz.*, large quantities of reception reports to sort out, examine and check up with the codes and schedules of the transmitters. This work must have been complicated by their having schedules and code lists from at least three countries, instead of merely from one, as was the case when we were receiving test signals from America at the end of 1922.

While the total number of European transmitters who entered for the tests this season was probably less than the number of American and Canadian amateurs who sent signals to us in the 1922-3 Tests, the number of 5-letter code words was considerably greater. On this occasion the A.R.R.L. requested that instead of allocating

PART I.

Call.	December										January									
	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10
2 FN	..	..	..	..	..	..	..	..	×	×	..	..	×	×	..	..	..	..	×	×
2 FQ	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2 FU	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×
2 IN	..	..	..	..	..	..	..	..	..	..	..	×	×	..	..	..	..	..	..	..
2 KF	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..
2 KW	..	..	..	..	..	..	..	..	×	..	..	×	..	..	..	..	×	..	..	..
2 NM	..	..	..	..	..	..	×	×	..	×	×	×	×	×	..	×	..	..	..	..
2 OD		..	..	..	..	..	×	×	..	..	..	×	×	..	..	..	×	..	..	..
2 ON	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
2 SH* (see note below)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2 SZ	×	×	×	×	×	×	×	×	×	×	×	..	×	×	×	×	×	×	×	×
5 AT	..	..	×	×	×	..	×	×	×	×	×	×	×	×	×	×	×	×	×	×
5 BV	..	..	..	..	..	×	×	×	..	..	..	..	..	..	..	..	..	..	..	..
5 KO	..	..	..	..	..	..	×	..	..	..	..	..	..	×	..	..	×	..	..	..
5 LC	..	..	..	×	..	..	×	..	..	..	..	..	..	×	..	×	..	..	..	..
5 NN	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	×	×	..	×
5 PU	..	..	..	×	..	..	×	×	×	..	×	×	..	..	..	..	..	..	..	×
6 NI	..	×	×	×	×	×	..	×	×	..	..	..	×	..	..	×	..	..	..	..
6 XX	..	×	×	×	×	..	×	×	..	..	×	×	×	×	×	×	×	×	×	×
6 YA	..	×	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8 AB	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
8 AE′	..	..	×	..	×	..	×	..	×	..	×	..	..	..	..	..	×	..	×	..
8 ARA	..	..	..	..	..	..	..	..	×	..	..	..	..	..	×	..	..	..	..	..
8 AZ	..	..	..	..	..	..	..	..	×	×	×	..	×	..	×	×	..	..	..	..
8 BE′	..	..	..	×	×	..	×	..	×	..	×	..	×	..	×	..	×	..	×	×
8 BF	×	..	×	..	×	..	×	..	×	..	×	×	×	..	×	×	×	×	×	..
8 BM	..	..	..	..	..	..	..	..	×	×	×	×	..	×	×	..	×	..	..	..
8 CD	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
8 CF	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×
8 CS	..	..	..	..	..	..	..	..	..	..	..	×	×	..	×	×	×	..	..	×
8 CT	..	..	×	..	×	..	..	..	×	..	×	..	..	..	..	×	..	×	×	..
8 CZ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..
8 JL	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8 LY	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
PA 9	..	×	×	×	×	×	×	..	×	×	×	..	..	×	×	..	×	×	×	×
PCII	..	×	..	×	×	×	×	×	..	..	..	×	×	×	×	×	×	..	..	..
PA0DV	..	×	..	×	..	..	..	..	×	×	×	×	..	..	..	..	..	×	..	..
PAR 14	..	..	..	..	..	..	..	..	..	..	×	..	×	..	×	×	..	..	..	..
NAB 2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..
PA0US	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	×	..	..

* These call letters are included in the ARRL report of stations heard, but no reception dates are given. They were also included in the daily reception reports received by radio from the United States.

one code word to each station for use during the whole of the Test periods (as was done in 1922), the word for each station should be changed every night. This was accordingly done, with the result that for the British Test entrants alone something like 1,000 different code words, each consisting of an arbitrary 5-letter group, had to be prepared. The list of these code words, with their allocations to the various transmitters on different nights, was posted to the A.R.R.L. before the commencement of the Tests to provide a means of checking up and verifying the reported reception.

During the Test transmission reports were received every third day via the Marconi Wireless Service through Carnarvon, setting out the signals which were heard. Supplementary reports were also received through N1XW, *via* G2KF and other British stations, using the shorter wavelengths in the neighbourhood of 100 metres. These reports merely indicated what stations had been received, without giving any indication of how often they had been heard, or on which nights. The reports as received day by day were re-transmitted by G6XX each night for the information of those who were taking part in the Tests.

The main report as now received from the A.R.R.L. consists of two parts. The first reproduced here as Part I sets out the different days on which the various stations were heard, while Part II gives details of the signals reported by the various American and Canadian listening stations.

PART II.

INDIVIDUAL RECEPTION TESTS.

Reported by—

1 BDT, Sheldon S. Heap, 132, Atlantic Avenue, Atlantic, Mass.
2 FN, 2 FU, 2 IN, 2 KW, 2 SZ, 5 AT, 5 BY, 5 KO, 5 LC, 5 NN, 5 PU, 6 NI, 6 XX, 6 YA, 8 AB, 8 AÉ, 8 AZ, 8 BF, 8 BM, 8 CS, 2 NM, 8 CT, 8 LY, PA 9, PAR14, NAB2, 8 CZ.

1 ANA, R. B. Bourne, c/o Radiocorp, Chatham, Mass.
2 FN, 2 FQ, 2 KF, 2 KW, 2 NM, 2 SZ, 5 AT, 5 NN, 5 BV, 5 PU, 6 NI, 6 XX, 8 AB, 8 AÉ, 8 AZ, 8 BÉ, 8 BF, 8 BM, 8 CF, 8 CS, 8 CT, PA 9, PCII, PAR 14, NAB 2.

3 II, E. M. Scattergood, Jr., Lodges Lane and Penorth Road, Cynwyd, Pa.
2 SZ, 8 AB, 8 BF, PA 9.

9 TS, A. Johanssen, 2203W 11th Street, Chicago, Ill.
8 AB.

A. A. Learned, 76 Camp Street, Providence, R.I.
2 NM, 2 SZ, 5 AT, 5 LC, 5 PU, 6 XX, 8 AB, 8 AÉ, 8 BÉ, 8 BF, PA0DV.

Canadian 1 AF, J. L. Fenderson, Jacquet River, N.B.
2 NM, 2 SZ, 5 AT, 5 KO, 6 NI, 6 XX, 8 AB, 8 AÉ, 8 AZ, 8 BÉ, 8 BF, 8 BM, 8 CF, 8 CS, 8 CZ, PA 9, PA0DV, NAB 2, PA0US.

Canadian 1 BQ, A. W. Greig, 40 Seaforth Street, Halifax, N.S.
2 KF, 2 OD, 2 SZ, 5 BV, 5 KO, 6 YA, 8 AB, 8 AÉ, 8 ARA, 8 BF, PA 9, PCII, PA0DV.

Canadian 1 DD, Major W. C. Barrett, 14 Sinclair Street, Dartmouth, N.S.
2 KF, 2 OD. 2 SZ, 5 BV, 5 KO, 8 AB, 8 AÉ, 8 ARA, 8 BF, PA 9, PCII, PA0DV.

9 CD, F. J. Marco, 5723 Winthrope Avenue, Chicago, Ill.
8 AB.

9 COL, Quentin Swigart 836 Avenue A, Galesburg, Ill.
8 AB.

9 DES, Wm. Moore, 108 E. Third Street, Carey, Kansas.
8 BF.

Canadian 9 AL, A. H. K. Russell, 234, Westmount Drive, Toronto, Ont., Canada.
8 AB, PCII, PA0DV.

Canadian 9 BL, F. G. O'Brian, Nova Scotia Tech. College, Halifax, N.B.
8 AB, 8 BF, PCII.

Canadian 1 AR, J. J. Fassett, Pleasant Street, Dartmouth, N.S.
8 AB, 8 BF, PA 9.

Canadian 1 DF, C. C. Curran, 124 Edward Street, Halifax, N.S.
6 XX, PAR 14.

Canadian 3 WX, R. C. Hunt, 595 Sandwich Street, Sandwich, Ont.
8 AB.

Canadian 3 OJ, H. E. Taylor, 557 Gladstone Avenue, Toronto, Ont.
8 BF.

Canadian 3 HT, H. Richardson, 92 E. Avenue, N. Hamilton, Ont.
8 BF.

Canadian 3 JL, F. G. Paterson, Agincourt, Ont.
8 BF.

1 AMQ, R. W. Cushman, Brook Road, Sharon, Mass.
6 XX, 8 BM.

1 ZE, I. Vermilya, Matapoisett, Mass.
8 AB.

1 BIS, H. V. Coates, 34 Williams Street, New London, Conn.
6 YA, 8 AB, 8 BF.

1 VA, E. Nuttall, 20 Arnold Street, Methuen, Mass.
8 AB, 8 BF, PCII.

1 AWE, N. H. Miller, 25 Phillips Street, Providence, R.I.
2 SZ, 6 XX.

1 CZ, E. J. Gallagher, 16 Appleton Street, Atlantic, Mass.
2SZ, 5 AT, 6 XX, 8 AB, PA 9.

1 AUF, B. T. Warnock, 34 Shackford Street, Eastport, Me.
2 SZ, 6 XX.

1 CMP, W. E. Jackson, 32 Clarence Avenue, Bridgewater, Mass.
8 AB.

1 BBP, W. R. Courtois, 126 Fourth Street, Leominster, Mass.
8 AB.

1 BBM, B. W. Bates, North Harwich, Mass.
5 AT, 6 XX.

1 BFA, C. W. Radoslovich, 16 Perth Street, Arlington, Mass.
6 XX.

1 AOL, V. A. Hendrickson, Bouton Street, Spring dale, Conn.
8 AB, PA 9.

1 CAZ, J. N. Langdon, Charlestown Road, Claremont Junction, N.H.
2 SZ, 6 XX, PA0DV.

1 BCF, L. G. Cushing, South Duxbury, Mass.
2 FN, 2 NM, 2 SZ, 5 AT, 5 BV, 5 LC, 5 PU, 6 NI, 8 AÉ, 8 AZ, 8 BÉ, 8 BF, 8 BM, 8 CS, 8 CT, PA 9, PAR 14.

1 RV, C. G. Ricker, Willow Street, South Hamilton Mass.
5 AT, 6 XX, 8 AB.

1 AYN, R. W. Rafuse, 38 Lincoln Street, Norwood, Mass.
5 AT, 6 YA, 8 BÉ.

1 AJK, L. A. Harlow, 3 Mayflower Street, Plymouth, Mass.
5 AT, 6 XX, 8 AÉ, 8 BÉ.

1 SN, W. E. A. Dodge, 23 Sargent Avenue, Beverley, Mass.
5 LC, 6 XX.

1 CKP, G. H. Pinney, 84 Prospect Street, So. Manchester, Conn.
8 AB.

1 BVL, R. S. Briggs, 393 Ashmount Street, Dorchester, Mass.
2 FN, 5 AT, 6 XX, 6 YA, 8 BÉ, 8 BF.

1 AKZ, A. Hurnanen, 62 A Street, Gardner, Mass.
2 SZ, 5 AT, 6 XX.

1 RR, E. G. Cavalini, 305 Court Street, Plymouth, Mass.
2 ON, 2 SZ, 5 AT, 6 XX, 8 AB, 8 BF, 8 CS.

1 AAC, E. H. Gibbs, 362 Franklin Street, Framingham, Mass.
2 SZ, 6 NI, 8 BÉ, 8 BF.

1 BDU, B. H. Chace, 39 Chester Avenue, Winthorp, Mass.
2 SZ, 5 AT, 5 PU, 6 XX, 8 AÉ, PA 9.

1 CTP, N. L. Monser, 11 Forest Avenue, Auburn, Me.
2 SZ, 5 LC, 8 AÉ.

1 AUR, H. G. Riley, Livermore Falls, Me.
2 SZ, 5 AT, 6 XX, 8 AÉ, 8 BÉ.

1 AUC, C. W. Sprague, 11 Oak Street, Bar Harbour, Me.
2 SZ, 5 AT, 6 XX, 8 AZ, 8 BF, 8 BM.

1 AQY, W. P. Libby, Jr., 259 Court Street, Plymouth, Mass.
2 SZ, 5 PU, 6 XX, 8 AZ, 8 BÉ, PAR 14.

1 BQK,, C. S. Mason, 10 Parkman Street, Westboro, Mass.
8 AB.

1 GG, R. H. Sproul, Box 131, South Hamilton, Mass.
2 SZ, 5 AT, 6 XX.

2 AJF, J. Van Riper, 117 Lafayette Avenue, Pasaic, N.J.
2 SZ, 6 XX, 8 AB, 8 BF, 8 BM, PA 9.

2 CLA, L. J. Dunn, 480 E. Nineteenth Street, Brooklyn, N.Y.
8 AB.

2 CPD, R. A. Donnelly, Crescent Avenue, Brielle, N.J.
8 AB.

2 CGK, C. E. Goodwin, 78 Mount Hermon Bay, Ocean Grove, N.J.
8 AB.

2 CYH, T. W. J. Byron, 1 Frear Avenue, Troy, N.Y.
5 AT.

2 CWR, F. H. Mardon, 1309 West Farms Road, New York City.
5 AT.

2 CRO, J. J. Escobar, 40 Fourth Street, Ridgefield Park, N.J.
2 SZ.

2 NP, N. B. Foote, 275 Clinton Avenue, Brooklyn, N.Y.
2 SZ, 8 AB, 8 BF.

2 BIS, M. H. Hammerly, 1 Bronxville Road, Bronxville, N.Y.
8 AB, 8 AZ, 8 BF.

2 AZL, L. Calkins, 197 Stevens Avenue, Ridgewood, N.J.
8 AB.

2 APY, A. B. Church, 4 Van Courtlandt Park Avenue, Yonkers, N.Y.
5 AT, 6 XX.

2 BSC, D. H. Doscher, Locust Avenue, Glen Head, Oyster Bay, N.Y.
2 SZ, 5 AT, 8 AB, 8 BF, PA 9.

2 CEG, H. A. Chinn, 210 W. 102nd Street, New York City.
8 AB, 8 BF, PCII.

2 BYS, L. P. Davis, Jr., 18 Lake Avenue, Yonkers, N.Y.
8 AB.

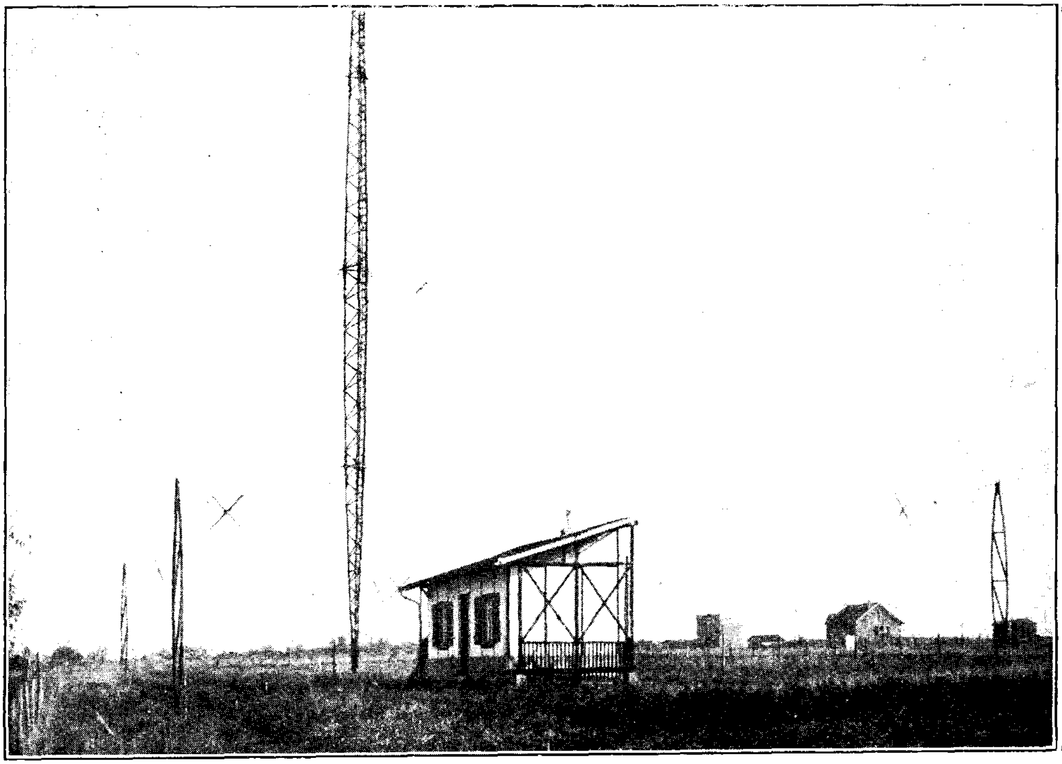
2 CXB, J. R. Finchers, 12 St. Charles Place, Brooklyn, N.Y.
8 AB, 8 BF, PA 9.

2 BKJ, D. W. Dana, 14, Edgewater Avenue, Grantwood, N.J.
8 AB.

2 RP, J. A. Lynd, 2101-15th Street, Troy, N.Y.
6 YA.

2 CMR, R. Silberstein, 315 Central Park W., New York City.
8 AB, PA 9.

(To be concluded.)



The station building, aerial and counterpoise at French **8 AÉ.** *The masts are of wood and that which carries the aerial is* 115 *feet high.*

FRENCH 8 AÉ.

A SUCCESSFUL TRANSATLANTIC STATION OF INTERESTING DESIGN.

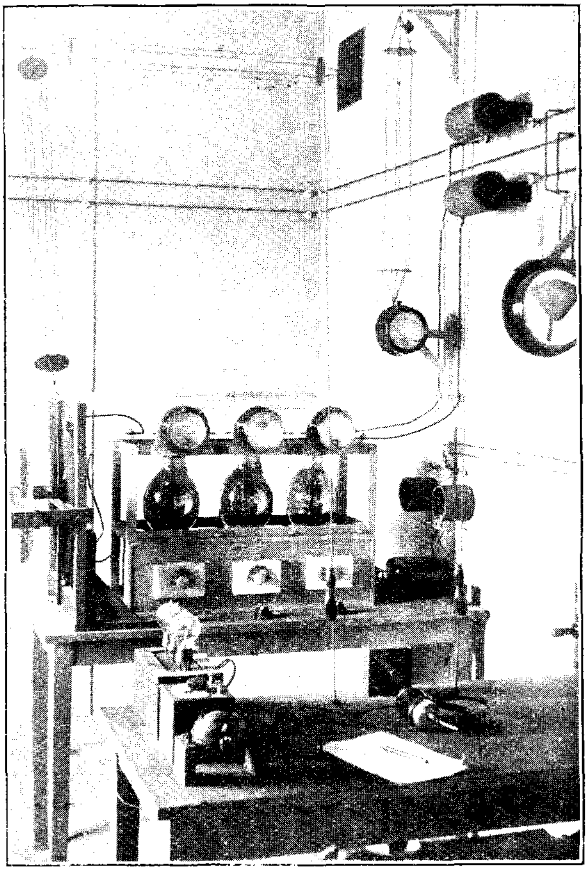
AMONGST the transmitting stations which took part in the recent transatlantic tests, **8 AE**, the station installed by *La T.S.F. Moderne* at Rueil, near Paris, played a conspicuous part. This station undertakes certain regular transmissions on behalf of the journal and this prevented it from taking part more frequently in the transatlantic transmissions.

The first aerial installed was a "T" or rather a "Y" aerial. This antenna, however, did not permit of transmissions on wavelengths below 200 metres, and was therefore discarded and replaced by an eight-wire cage supported between the top of the mast and the station building. One of the masts, which was demolished as the result of an accident, has never been re-erected because it was found unnecessary.

The mast is of wood and has a lattice construction. It is located 80 ft. from the station building and is 115 ft. high. The cage aerial is 90 ft. long, about 3 ft. in diameter and is constructed of bare copper wire 15/19 S.W.G. A counterpoise is employed consisting of cages similar to the aerial cage but of four wires and 45 ft. long, about 3 ft. in diameter and arranged at a height of 13 ft. above the ground. Originally four counterpoises were employed, but experience showed that it was better to use only two counterpoises for wavelengths of 200 to 180 metres and only one for wavelengths of 170 to 150 metres.

The earth connection consists of four strands of four wires buried at a depth of 2 ft. precisely underneath the four counterpoises. The earth is only employed for reception. In addition the negative pole of the high tension dynamo is connected to earth for safety. Inside the station building the aerial and counterpoise connections are carried by means of small six-wire cages 4 ins. in diameter, as shown in the accompanying photograph.

Local power mains supply the current for the station at 220 volts two-phase, and this is used for filament heating on the one hand and for high tension to the valve plates on the other. Until recently a "Ferrix" 250-watt 220 volts to 15 volts transformer was used for filament heating. This transformer has two primary connections and three secondary connections, and provides for easy control of the secondary potential used in conjunction with a filament rheostat. The transformer is seen in the photograph on the operating table. Two choke coils placed in series between the transformer and the mains, prevent high frequency leakage.



The components can be easily identified. The layout is particularly neat. The use of choke coils in the power leads is an interesting though essential feature, whilst the caged aerial and counterpoise leads is a bid for extreme efficiency.

Unfortunately, the set is fed from a long supply lead, with the result that a variation from 10 to 20 volts is a frequent occurrence, resulting in distressing irregularity in the emission. This necessitated the substitution of an independent battery for filament heating, consisting of ten cells of 120 ampere hour capacity.

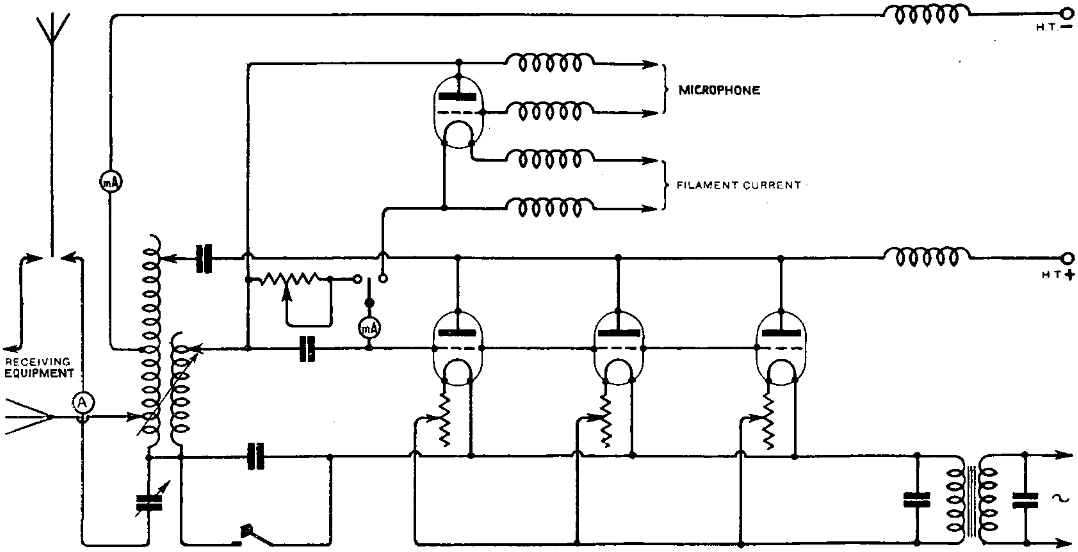
A Heiser dynamo is now installed and supplies 2,000 volt continuous current to the plates of the valves, the maximum current output being 500 milliamperes. The output from this dynamo can also be adjusted to 500 volts if required. The machine is independently excited by means of a Drouard converter.

Each valve is controlled by a filament resistance. The plate and grid circuit inductances are shown to the left of the table, which carries the transmitting valves. The plate inductance is constructed of 12 turns of copper ribbon, spaced 8 mm., the mean diameter of the coil being 300 mm. The copper strip is 15 mm. wide and 0.5 mm. thick. The grid inductance is an ordinary basket coil wound with 15 turns having a mean diameter of 200 mm. The turns are spaced by means of insulating pegs, and tappings are provided so that 5, 10, or 15 turns can be included. Of three clips provided on the plate circuit inductance, the first connects to the counterpoise and adjusts the number of turns between the aerial and the counterpoise and consequently the aerial wavelength. The second clip connected to the plate serves to tune the plate circuit, and thirdly, the negative terminal of the high tension dynamo is brought to a clip since it is necessary that it should be connected exactly at the nodal point.

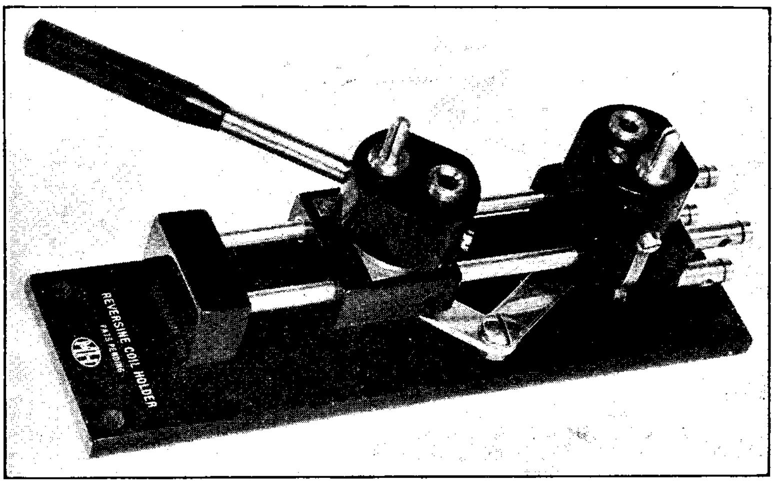
It will be noticed that the positive of the plate potential is only connected to the plates so that it is possible to touch any other part of the circuit without picking up high voltage direct current.

Aerial tuning is easily obtained by means of a variable condenser. The grid condenser is an air dielectric variable, and is shunted by a variable resistance of 1,000 to 8,000 ohms. The transmitting key at the same time that it controls the transmitter operates a little buzzer which serves as a guide to the regularity of the operating.

The results which have been obtained have been decidedly satisfactory, while the maximum output has never been employed. The regular transmissions are made with 100 watts delivered to the aerial and this gives readable signals throughout France, and at very considerable distances beyond.



The circuit used at French **8 AÉ.**



An ingenious arrangement for providing uniform variable coupling. The feature of the design is that the sliding coil holder is automatically caused to revolve as it is moved away from the fixed coil holder and a position of zero or reversed inductive coupling can easily be obtained with a comparatively small movement.

PRIMARY BATTERIES

SPECIALLY DESIGNED FOR DULL EMITTER VALVES.

NOW that dull emitters are becoming more popular with reduced prices, the amateur appears to be in need of a primary battery capable of giving with a reliable degree of certainty the necessary continuous supply of current to operate his valves.

The writer has explored the possibility of utilising well-known forms of wet batteries for this purpose, but without success, and it was therefore decided to carry out a few experiments, with the object of producing a battery suitable for experimenters' needs. By that it is intended to convey that the type of cell to be described is not necessarily ideal in its present form of development and therefore suitable for general use.

It was considered that any new form of wet battery should have, if possible, the following features, *i.e.*, it should be capable of giving continuously a comparatively heavy current for long periods without polarisation—that it should be cheap to make up and maintain.

The simplest form of cell having these properties consists of a worn-out Leclanché porous pot, a straight-sided 3 -lb. marmalade pot and a tubular zinc element. A small modification is required to the porous pot and this is effected by carefully chipping away the black sealing compound at the top. A portion of the enclosed loose carbon is then removed to a depth of 1½ ins., leaving, of course, the carbon plate intact. The top of the porous pot should now be painted with bitumastic solution, or equal, to a depth of 1¾ ins outside and down to the loose carbon inside.

A zinc element is now required, and is so dimensioned as to practically line the inside of the jar. Ironmongers sell sheet zinc which is quite suitable for this purpose at 5d. or 6d. per lb. It is not really necessary to amalgamate the zinc. It is understood, of course, that any connection which is soldered to the zinc should be painted over with the solution already mentioned to prevent corrosion. Similarly, the top edge of the outer jar should be painted to prevent creeping of the liquid.

To put the cell into use, it only remains to pour a saturated solution of salammoniac into the outer jar and a weak solution of copper sulphate into the porous pot, and which should not more than thoroughly moisten the loose material. When this latter operation has been effected, a thin layer of copper sulphate crystals should be placed around the carbon plate upon the already moistened loose carbon. It must be mentioned that the level of the salammoniac solution in the outer jar should be kept just above the bottom edge of the black band at the top of the porous pot.

This simple form of cell will give 0·25 amp. at about 1·1 volts with ease and without polarisation.

Occasionally, a few crystals of copper sulphate should be dropped inside the porous pot by way of replenishment, and, at fairly lengthy periods, the salammoniac solution will require strengthening.

During the first day or two there may be a little diffusion of the copper sulphate, but this is of no importance.

Intending constructors should note that all materials used in connection with this battery are common and comparatively cheap. Sheet zinc and copper sulphate can readily be obtained for 5d. or 6d. per lb.; salammoniac, however, seems to vary considerably, and the ordinary commercial quality will be satisfactory.

The foregoing instructions are, it is hoped, clear, and no difficulty should be experienced if they are adhered to. Owing to non-portability, cells should be fitted to some convenient cupboard, and well insulated leads run to the experimenter's table, terminating with a socket which can easily be plugged for use.

The author is experimenting with an improved form of wet cell, and hopes to be able to give brief particulars of this in some future issue of this Journal.

C. E. W

SUBSTITUTING ALTERNATING CURRENT FOR ACCUMULATORS AND DRY BATTERIES.

The following article is based on the author's talk before a recent informal meeting of the Radio Society of Great Britain when he opened a discussion on this interesting subject.

By L. F. FOGARTY, A.M.I.E.E.

THE substitution of accumulators and dry batteries by a supply of energy taken from the mains has always presented an interesting problem to experimenters. Every user of an accumulator is conscious of its low efficiency and the inconvenience of regular charging, to say nothing of the frequent damage to furnishings through the accidental spilling of the acid electrolyte.

It is fairly safe to say that the popularity and more extended use of radio receiving apparatus would be greatly increased if practical and economical methods were devised for operating them direct from the supply mains.

I propose to outline briefly some of the work which has been done in this direction with alternating current.

Briefly, the problem consists of rectifying the alternating current, and subsequently smoothing it, by means of appropriate electrical circuits, comprising inductances and condensers. The rectification may be obtained by means of mechanical, magnetic, chemical, or thermionic devices, all of which have some distinctive advantages or disadvantages.

All rectifiers produce a pulsating unidirectional current, which may be smoothed out by means of a series of inductances and condensers, shown in Fig. 1. It can be shown by calculation that a certain advantage is to be obtained by utilising a number of small condensers and inductances, suitably connected, rather than one large one, but in practice it is more general to utilise a single inductance, comprising two windings, on a common closed magnetic circuit core, these two windings being shunted by two capacities of suitable value.

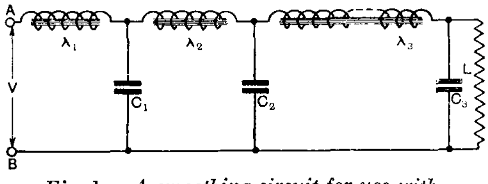


Fig. 1. A smoothing circuit for use with rectified A.C.

Doubt has been expressed as to the utility of the condenser C_1, but I am of the opinion that it is useful, because most rectifiers have a fairly high impedance, and in consequence the variations in potential are considerable in the absence of a condenser connected at C_1.

The condensers C_1 and C_2 are of the paper type, employed in large numbers for telephony. Two microfarads are usually sufficient with a rectifier and smoother intended for a supply of energy to a set comprising one or two valves. The inductance coil consists of two equal windings, well insulated from each other, and each having a value of 8 to 10 henries. The closed magnetic circuit is built up of laminated strips, or stampings, having dimensions approximately equal to those used in the larger kinds of intervalve transformers.

The connections to the windings are made in such a way that the magnetic flux, due to the currents in each winding, adds together, otherwise

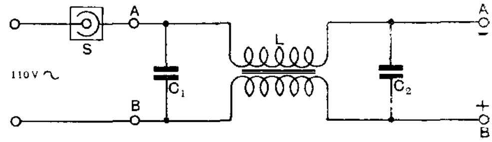


Fig. 2. A simple rectifier circuit providing half-wave rectification.

if the current passes through the coils in the opposite manner, the resultant magnetic flux would be zero. Mechanical and vibratory rectifiers have been tried for this purpose and found unsuitable, as it is almost impossible to completely eliminate sparking at the brushes or vibrating contacts. On the other hand, the electrolytic rectifier has given quite good results. I demonstrated a four-valve receiver, operated on rectified alternating current, derived from an electrolytic rectifier about a year ago.

It would appear that for very small amounts of energy the electrolytic rectifier preserves its value indefinitely, which is more than can be said for it when it is called upon to deal with twenty to thirty watts and upwards.

For our purpose it is only necessary to utilise something of the order of 10 milliamperes at 100 volts; that is to say, about 1 watt. The simplest possible arrangement is that shown in Fig. 2, where the rectifier allows one half wave of the complete alternating current supply to pass, so that the rectified supply takes the form of Fig. 3.

A much superior method is to utilise both half waves of the cycle in the well-known way shown in Fig. 4. With such an arrangement, operating at no load, and on the supposition that the valves are 100 per cent. efficient, it is possible to show that the direct current voltage available is twice the peak voltage at the terminals of the secondary S. For example: If the secondary gives 100 volts R.M.S. value, the peak value will be

$$100 \times \sqrt{2} = 141 \text{ volts,}$$

but as the direct current voltage is double this

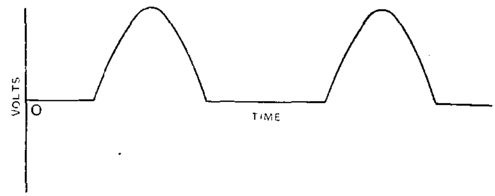


Fig. 3. *Wave form of rectified supply.*

value, the pressure existing between the points A and B will be 282 volts. This may be verified.

The arrangement shown in Fig. 4 comprises a transformer whose principle function is to isolate the supply mains from the wireless set. The secondary is connected to two valves, each comprising an aluminium wire and a lead plate immersed in a solution of sodium phosphate.

It will be seen that the valves are connected in opposition to each other and to the same end of the secondary. One valve will therefore allow the positive half waves to pass, and the other will allow the negative half waves to pass. These pulsating voltages will charge up the condensers C_1 and C_2 to the peak value, and therefore we

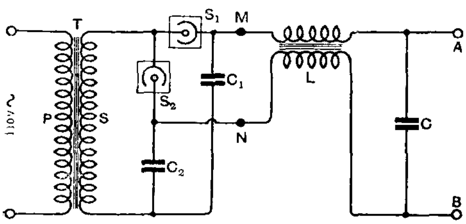


Fig. 4. *A circuit providing for full-wave rectification.*

shall have available between the points M and N twice the maximum voltage, providing always that the insulation of the condensers is sufficiently good to enable them to retain their charge for a period of time equal to that required by the alternating current to pass through the complete period. A voltmeter of the moving coil type connected across the points A and B will read about 250 volts with a rectifier of the kind described, connected up in the manner shown and with a secondary arranged to give about 100 volts output.

It is well known that two-electrode thermionic valves may be used in exactly the same way, except that it is necessary to make provision for a filament heating circuit. Valves have the disadvantage of a high internal resistance and their life is limited. On the other hand, they make a rather neater arrangement than the electrolytic valve, and do not require attention or chemical electrolytes.

The necessity of providing for filament heating calls for a slight alteration in the arrangements, and these are shown in Fig. 5, although, of course, this can be simplified where half wave rectification is sufficient for the purpose in view.

Although the majority of listeners to broadcast programmes might be prepared to put up with the inconvenience of dry batteries which require renewal every two or three months, there are but few who fail to complain at the troubles brought about by the necessity of having filament accumulators recharged every few days.

I expect that most of us have experienced the annoyance of finding our accumulator running down just at the moment when we were particularly

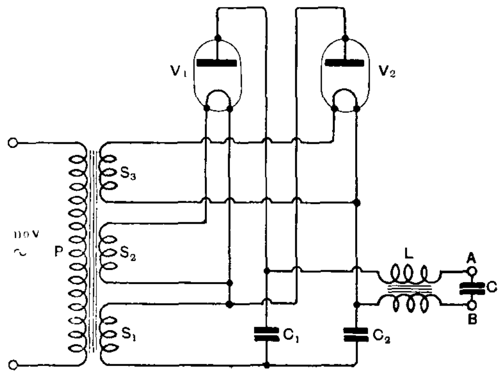


Fig. 5. *A circuit] where provision is made for filament heating from the supply mains.*

desirous of hearing some special transmission, or demonstrating the unique advantage of our pet circuit to an admiring circle of friends. This trouble has perhaps been somewhat minimised by the introduction of dull emitter valves operated from a large dry cell; nevertheless, this arrangement cannot be regarded as an entirely satisfactory solution, such as would result from the operation of a set entirely from the supply mains.

The disturbance produced by heating the filaments of receiving valves with alternating current may be classified under two headings. Firstly, the varying voltage introduced into the filament plate and the filament grid circuits. Secondly, the low thermal inertia of the filament.

From the diagram, Fig. 6, we can see that the common point of the grid plate circuit is connected

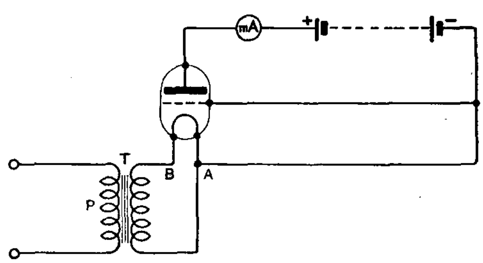


Fig. 6. *A circuit using unrectified A.C. for filament heating.*

to the "A" extremity of the filament, which we shall suppose to be operated at 4·3 R.M.S. volts. The potential difference, therefore, between the "B" extremity of the filament and the plate will vary from 80 minus 4·3 volts to 80 plus 4·3 volts; that is to say, from 74 to 86 volts during one complete cycle of the alternating current. This in turn produces a variation in the plate current, in addition to which we have a further disturbance, due to the fact that the grid is alternatively connected to the positive and then to the negative end of the filament.

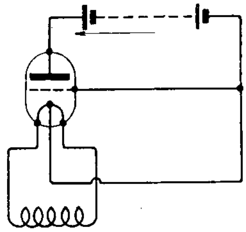


Fig. 7. A circuit due to R. Barthelemy.

R. Barthelemy patented in the year 1919 the circuit shown in Fig. 7, with a view to overcoming the above-mentioned difficulty. The diagram shows that the grid was connected to the middle point of the filament is such a way that when one half of the filament is positive in respect of the common point of connection between the plate and filament, the other half would be negative.

On the assumption that the characteristic curve of the valve is a straight line, and that the position of the grid and plate is quite symmetrical in respect of the middle point of the filament, it would follow that the electron emission, and therefore the plate current, would remain steady and undisturbed by the alternating voltage applied at the terminals of the filament.

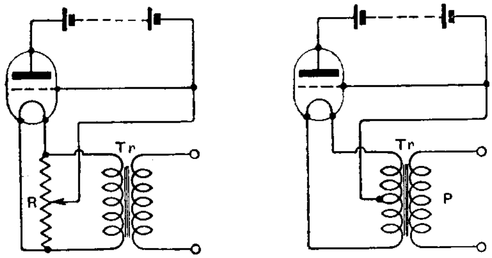


Fig. 8. Two alternative methods of obtaining the same result as the circuit of Fig. 7.

The same result can be obtained by either of the two methods shown in Fig. 8, which dispenses with the necessity of utilising a special valve with a connection to its middle point.

Although this arrangement overcame to a considerable extent the defects arising from an intermittent electron emission, it did not overcome the defects arising out of the low thermal inertia of the general run of filaments, and in consequence receiving apparatus utilising the features described were still troubled with circuit noises when used for reception.

Although with a valve connected in the manner shown in Fig. 9, and using reaction it was easily possible to set up oscillations, there was a point just before the oscillating stage where violent noises were produced in the telephones. Even when the reaction coil was moved to a point where the coupling with the grid coil was insignificant, there was still a good deal of distortion present, both in the reception of speech and of music.

It was, however, significant that the distortion appeared in the main to be modulated with a periodicity corresponding to that of the alternating current supply. All attempts to eliminate this trouble by means of filter circuits proved unsuccessful, until it was realised that the trouble was due to distortion in the radio frequency circuit.

A great deal of experimental work has been done, particularly in France, in an attempt to discover means of overcoming this particular difficulty.

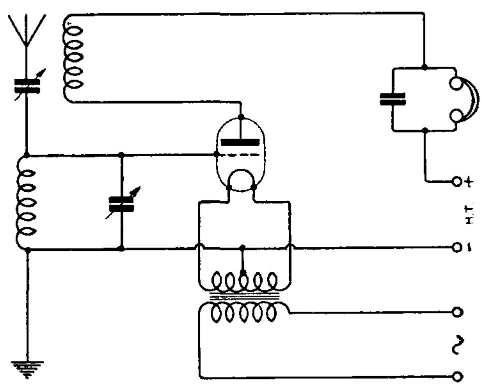


Fig. 9. A possible but unsatisfactory arrangement discussed in this article.

The explanation put forward by R. Barthelemy appears to me to be the simplest and most reasonable, and briefly it is as follows :—

It is well known that when a receiver is on the verge of oscillation, it suffices to slightly increase the filament temperature to provoke oscillation. Whenever, therefore, we use a reaction coil and feed alternating current to the filament so that its temperature varies slightly as a function of time, we have the conditions roughly set out in Fig. 10, where each increase in filament temperature produces high frequency oscillations. It is easily possible to adjust the degree of reaction so that the oscillations are produced at the moment of maximum heating, and cease when the temperature is lowest. On the basis of this reasoning it is not difficult to see that we can produce trains of interrupted oscillations, and a telephone included in the circuit will give evidence of the effect by producing a beat each time the oscillations are interrupted; that is to say, with a frequency of double that of the alternating current supply.

It is possible to carry this line of argument a stage further, because the voltage of the alternating current mains does not remain rigorously constant, so that in addition to the variations due to the normal alternating current cycle we may have complications due to a variation in the voltage of the supply, with the result that the conditions shown in Fig. 11 are produced.

This diagram shows that the oscillations start as soon as a certain degree of filament temperature is attained, and cease whenever the temperature falls below that value. There are therefore intervals t_1, t_2, t_3, when the oscillations are no longer a function of the frequency of the supply, but become of longer or shorter period owing to variations in the voltage available. For this reason the distortion and other noises heard in the telephone during reception appear very irregular.

If we loosen the coupling of the reaction coil so as to get well away from the oscillation point we can minimise the distortion, but some will still remain, due entirely to variation in filament temperature, for the degree of amplification is very sensitive to filament temperature, and will be greatest at those instants when the main's voltage is greatest, as compared to the amplification at periods when the supply voltage is at a minimum. It is possible to overcome this particular difficulty by dispensing entirely with reaction, but it is then necessary to use a larger number of valves, when we replace our original difficulty by others. Various methods of overcoming the lack of thermal inertia have been attempted. They comprise the use of high frequency current for filament heating, or alternatively valves with several symmetrical filaments operated on two or three phase supplies. All these arrangements involve additional complications, which render them unsuitable for adoption in the great majority of cases.

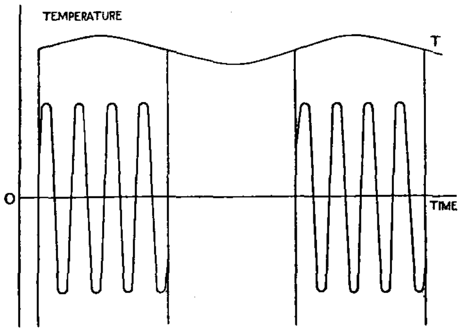


Fig. 10.

Some few years ago the firm of Ducretet introduced a valve which, whilst similar to the ordinary Type R, was equipped with a much thicker filament, taking about 2½ amperes at 2·3 volts, of which only about 1·6 volts were available at the terminals of the filament, the remainder being absorbed by the resistance of the various internal connections. This feature of low voltage drop in the filament is not a disadvantage, as the degree of amplification is thereby increased.

With these thick filament valves the characteristic distortion and noise, when near the oscillation point, is almost eliminated, and would not in any case be audible when the reception is made with a loud speaker, although a slight trace could be heard with sensitive headphones. These valves have another advantage in that their durability greatly exceeds that of the ordinary valves, and the life may amount to several thousand hours. A heavier current at a low voltage does not constitute a drawback, as the lamp, being operated from alternating current, it is easily possible to provide a suitable winding on the transformer for that purpose. Fig. 12 gives some idea of the characteristic curve of one of these special valves with a plate voltage of 160. It will be seen that, apart from considerable amplifying power, the valve has a high internal impedance, which is of considerable interest when it is desired to use these valves with any form of rectifier having poor regulation, or, in other words, which have a high voltage drop, and can therefore only give a limited output, as, for example, two-electrode valves or chemical rectifiers. The particular feature referred to must be kept in mind in designing transformers and other apparatus used for the purpose of supplying energy to them.

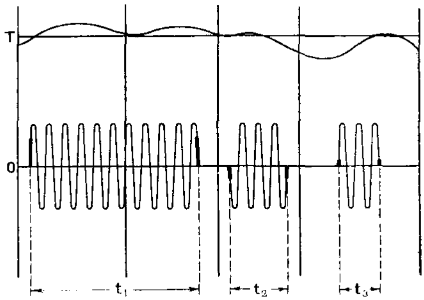


Fig. 11.

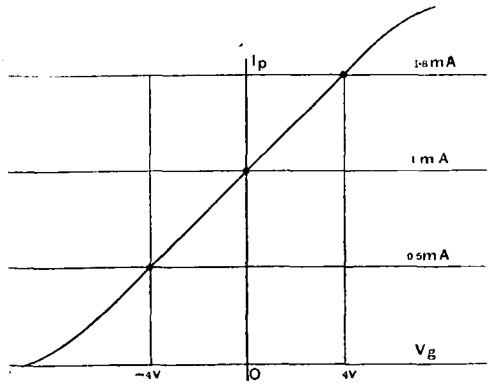


Fig. 12. *Characteristic curve of a specially designed valve employing a heavy filament.*

It is possible to say a good deal more on this subject, particularly in regard to the design of receiving sets and amplifiers operating with rectified current from the A.C. supply.

PATENTS AND ABSTRACTS

Means for Eliminating Disturbing Electrical Oscillations.*

It has already been proposed to employ for this purpose an additional coupled circuit. Thus a detector circuit subject to undesired oscillations received from an aerial through the ordinary coupled circuit may be freed from these oscillations by the employment of an additional coupled circuit, which is highly damped, and which is out of tune with the desired frequency, while the ordinary coupling circuit is slightly damped and only slightly out of tune. According to this invention, the ordinary coupled circuit and the additional circuit are not coupled directly to the detector circuit or to an amplifier preceding the detector circuit, but by means of a reactionless coupling through a three-electrode valve.

A diagram of the invention is shown in Fig. 1. A is the aerial circuit, and S the ordinary coupled circuit, which is

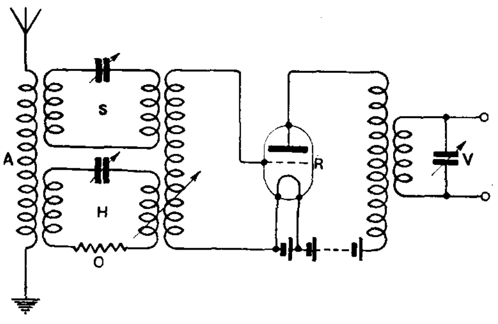


Fig. 1.

slightly detuned from the waves it is desired to receive, and is of low damping. H is a coupled circuit, which is much out of tune with the desired waves, and includes an ohmic resistance O, so that this circuit is of high damping. V is the input circuit of the high frequency amplifier. The two circuits H, S, are coupled to the circuit V through a valve R, so that it is not the high frequency amplifier circuit, but the grid circuit of the valve R which is thereby de-coupled.

* British Patent No. 206,838, by Gesellschaft für Drahtlose Telegraphie.

Variable Condensers.

Instead of separating the plates of a variable condenser with spacing washers it

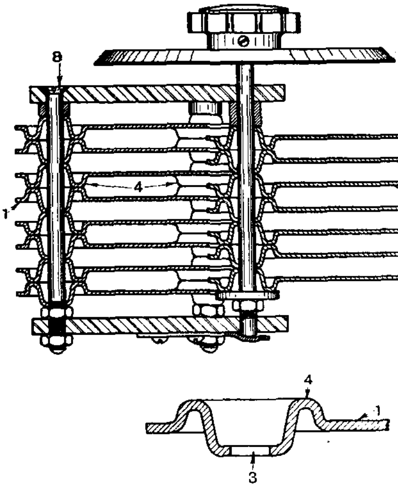


Fig. 2.

is proposed* to construct the condenser of specially prepared plates, as shown in Fig. 2. The condenser is built up of two sets of substantially semi-circular plates, a stationary set 1 and a rotating set 2, the plates of the two sets being interleaved and relatively movable. All the plates are identical with one another.

* British Patent No. 212,205, by the British Thomson Houston Co.

It will be seen that the plates are pressed to provide an opening 3 to receive the securing rod 8 or the centre spindle, and portions 4 which extend the same amount from both sides of the plate. This construction permits quick assembly and accurate spacing of the plates is assured.

Improvements in Valves.

No doubt many readers will have wondered why valves are not provided with more than one filament. A patent* has been taken out covering the use of an additional filament or filaments in close proximity to the usual one, so that in the event of one filament being broken, the second or remaining filament may be brought into use. An arrangement is described for switching in the desired filament. It is pointed out that in the event of the emission obtainable from one filament being insufficient, the other filaments may be connected in parallel to increase the emission.

Crystal Detectors.

To reduce the difficulty of finding sensitive spots on a crystal detector of the ordinary wire contact type, and the liability of the adjustment to be easily upset by vibration or shock, it is proposed† to construct the detector as indicated in the sketches of Figs. 3A and 3B. Fig. 3A is a vertical cross-section, and Fig. 3B an end view.

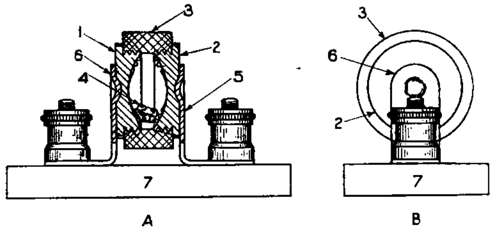


Fig. 3.

The contacts 1 and 2 are concave, or dished, and roughened on their inner surfaces, and threaded to engage the internally threaded spacing ring of insulating material 3. The contacts and spacing ring are mounted between the metal supports 6, fastened to the base 7.

In operation it is only necessary to turn the assembly between the metal supports so as to cause the crystal 4 to roll or turn until a position of the desired sensitiveness is found.

* British Patent No. 211,940, by G. E. Stubbs, E. S. Brown and F. Warner.

† British Patent No. 212,076, by M. Billington.

Inductance Coils.

To reduce dead end effects it is proposed* to construct an inductance in sections, each section being divided into two elements. The sections need not be equal, but the elements of each section are approximately equal. Connections are taken from the ends of the sections and elements to the contacts of a switch to connect up the elements in the following consecutive arrangements.

First, to connect the two elements of the first section in series assisting one another, and to connect the two elements of each remaining section in parallel and opposing one another. Secondly, to connect the four elements of the first two sections in series assisting one another, and to connect the two elements of each remaining section in parallel and opposing one another. And so on for any number of sections.

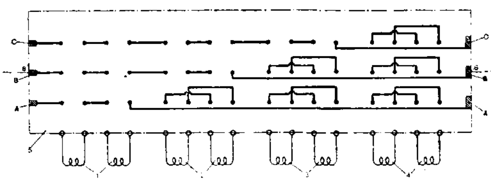


Fig. 4.

One arrangement is sketched in Fig. 4, where 5 is a barrel switch, carrying contacts represented by black dots, rotatable on an axis 6. The coils 1, 2, 3 and 4, are connected to contact springs; AA, BB, and CC, indicate the lead connections from the inductance. The contacts are connected by the wires as shown. It will be seen that when the first row of contacts press against the contact springs, coils 1 are connected in series and the remainder in parallel; as the switch is turned to another position more coils are connected in series, as may be readily seen from the sketch.

* British Patent No. 211,553, by H. P. T. Lefroy.

REPORT OF THE PROCEEDINGS OF THE

PRELIMINARY CONFERENCE FOR AN INTERNATIONAL AGREEMENT ON WIRELESS TELEPHONY.

(GENEVA : APRIL, 1924).

THE Conference was formally opened in the Salon of the Palais Eynard, Geneva, on Tuesday, April 22nd, 1924, and was attended by official representatives of thirty-nine wireless telegraphy and telephony companies, societies, stations and administrations in seven countries.

M. Mussard, Minister of Education of the Republic of Geneva, welcomed the delegates on behalf of the Republic. He reminded them of the great Wireless Telephony Exhibition to be held at Geneva at the end of May, 1924, and said that this Exhibition was eagerly awaited by those interested in the subject.

In the name of the Geneva Government, he welcomed the Conference, and expressed the hope that it would find means of facilitating the more general and even more successful use of wireless telephony throughout the world.

M. Maurice Rambert, President of the Swiss Radio-Electric Society, and delegate of the Romande Radiophone Society (stations of Geneva and Lausanne), explained the aims of the Preliminary Conference.

Wireless telephony was one of the most marvellous inventions of our time, because, quite apart from its own utility, it had established proof that the ether could be used as a vehicle for other agents of nature than light. It is probably the first step in a real scientific revolution, since we had now at our command a means of communication which enabled us to encircle the earth seven times in one second.

Wireless telephony had necessarily developed very quickly, but now, in order that its development might proceed, it had become necessary to take certain steps, because on their way through the ether the Hertzian waves met with numerous obstacles. Some of these obstacles were due to natural causes and were difficult to remove, but the majority of them arose from wireless telegraphy itself.

In fact, in all countries the telegraphic administrations had been slow to grasp the new invention. Moreover, the celebrated experiments of Signor Marconi had shown them what part they could play, and they were little disposed to yield a place to the intruder which had had the audacity to come poaching on their preserved ground. It could be asserted that 80 per cent. of the crackling, whistling and howling which interfered with the reception of wireless telephony was due to powerful damped wave transmissions. Among the latter the most undesirable were undoubtedly those of ships which came precisely in the range of short waves that appeared to give the most interesting results in wireless telephony. Morse is, in fact, the real *bête-noir* of the listener-in, and it appeared to the organisers of the Conference to be desirable that a Preliminary Conference should be called at the earliest moment to discuss practical means of arriving at an understanding in the general interest. It was also thought that Geneva, which tends to become a centre of internationalism, was best fitted for this first interchange of ideas, and the readiness with which replies came from everywhere to the invitations proved that the organisers were not mistaken. On behalf of the organisers of the Conference, M. Rambert invited those present to discuss the question of the regulation of wavelengths and to formulate resolutions to give expression to the conclusions arrived at, and proposed that M. J. R. G. Isbrucker, engineer of the Bell Telephone Manufacturing Company, and delegate of the Netherlands Radio Telephony Association, of the Netherlands Scientific Society for Radio Research, and of the Vas Diaz Press News Radio Station in Amsterdam, be elected President of the Conference.

M. Isbrucker, having been elected unanimously, took the chair, and thanked the Conference for the honour conferred upon them. He traced the evolution of wireless telephony, pointing out that telegraphy was the parent of telephony.

When wavelengths were originally allotted internationally, no one foresaw the rapid introduction of wireless telephony on a vast scale, and therefore telegraphy was at present greatly interfering with the good reception of telephony.

M. Isbrucker felt that the present Conference would prove to be the first step towards the solution of the great question of wavelengths, and congratulated the organisers on their initiative.

M. Haas, Director of the Communications Section of the League of Nations, announced that the special sub-committee elected by the Communications Section of the League of Nations to study the question of wireless telegraphy had also come to the conclusion that it was necessary to call an interstate conference to revise the London Convention of 1912 in many respects. The present rapid spread of wireless telephony made it desirable that this should also appear on the agenda, and therefore the League of Nations would be pleased to receive the suggestions and wishes of the Preliminary Conference, which represented specialist opinion. In this way a practical link would be set up between private endeavours and the always slower official ones.

One after another, M. Edmonds (representative of *The Wireless World and Radio Review*, London), M. Saggiori (President of the

Padua Radio Club and Delegate of the Radio Societa Lombarda), M. Pitlik (Commissioner of the Ministry of Commerce of the Republic of Czecho Slovakia and delegate of the Radioslavia Company), M. Kreuz (delegate of the Sudwestdeutscher Rundfunkdienst Aktien Gesellschaft, Frankfort Station), M. Scholze (Engineer delegate of the Radio Section of the Reichenberg Fair), explained the position, the progress and the difficulties of wireless telephony and broadcasting in their respective countries, and agreed that difficulties could only be overcome by international agreement. The resolutions of the Conference would be very useful in creating public opinion with a view to inducing the governments to move in the matter.

M. Reut, President of the Geneva Section of the Swiss Radio Club, presented a proposal which might serve as a basis for discussion, and earnestly pleaded the rights of amateurs, whose experimental work had done so much for the progress of wireless telephony.

An interesting and vigorous discussion followed, in which M. Chaponnière (representative of the Marconi Company), M. Rambal (Vice-President of the Swiss Radio Club), Dr. Merz (Director of *La Radio*, Berne), and others took part, and eventually the following resolution was accepted unanimously :—

> The Preliminary Conference for an International Agreement on Wireless Telephony met in Geneva, April 22nd and 23rd, 1924.
>
> Realising that the London Convention of 1912 and the Washington Agreement of 1920 no longer suffice, and contain important deficiencies in view of the present spread of wireless telegraphy—
>
> Expresses the desire that a new interstate conference should be called in the near future to remedy these deficiencies and to give to wireless telephony the opportunity to develop as freely as possible in the interests of world-wide popular culture and general education, and recommends—
>
> (1) That certain ranges of wavelengths be exclusively reserved for wireless telephony transmission, and that these be rigidly differentiated from the ranges allotted to wireless telegraphy.
>
> (2) That in view of the important contribution by amateurs to the development and progress of wireless telephony, their rights be taken into consideration and certain ranges be reserved for their experimentation.
>
> (3) That the use of non-continuous damped waves be reserved exclusively for marine danger signals and for time signals.
>
> Requests the League of Nations and the Universal Telegraph Union to do all in their power to hasten the meeting of the necessary Conference—if possible world-wide, if not at least European.
>
> Urges all radio organisations to interest public opinion on the subject, and to address petitions to their governments requesting them to intervene in Geneva and in Berne to bring about the Conference.

M. Rambert promised the Conference that the resolution should be conveyed to the Communications Section of the League of Nations, whose delegate (M. Haas) was present, and whose Sub-Committee on Wireless Telegraphy had already been instructed to consider the possibilities of calling an interstate conference on wireless telegraphy.

The resolution should also be conveyed to the Universal Telegraph Union in Berne with the suggestion that it should take some step or other in the same direction.

On the other hand, there had recently been formed in Paris an International Jurist Committee with the object of studying the questions raised by wireless in connection with public and private rights. This committee, which will carry on activities in all countries, has already a Swiss section with several members, of whom M. Pittard and M. Edmond Privat figured in the organisers of the Conference. This committee will be called upon to play an important part in the solution of the question just discussed by the Conference. There was also the International Federation of Amateurs, which incorporated a large number of radio societies. A proposal had now been put forward by M. Privat, one of the members of the Swiss Committee on the Regulation of Wavelengths, that an international organisation of broadcasting stations should be formed to exchange time tables and to protect common interests.

In the discussion on this question M. Privat, M. Kreuz (delegate of the Frankfort Station), several engineers, viz., Messrs. Chaponnière, Stromboli, Leonello Boni, Rambal, Scholze and others, took part. At the conclusion of the discussion the following resolution was passed :—

> The Conference commissions its officers to form a provisional executive committee to carry on the work for an International Agreement on Wireless Telephony, and to keep in touch with transmitting stations, companies and radio magazines, with a centre at Geneva, the seat of the League of Nations.

M. Isbrucker, in the chair, notified the Conference that the next question on the agenda was that of an auxiliary language for international broadcasting, and summarised the need for such a language.

An interesting discussion took place, when many speakers supported the proposal for the adoption of Esperanto.

M. Leonello Boni, President of the Italian Radio-Communications Society, and Colonel Hilfiker, Chief of Staff of the Engineering Section of the Swiss Army, neither of whom had had any previous acquaintance with the language, remarked that the delegates speaking Esperanto were evidently able to use the language quite fluently and freely in discussion, and they approved of the more regular and general use of Esperanto for the purposes of wireless telephony.

M. Edmonds explained that he could foresee some difficulty in arranging the regular transmission in Esperanto from Great Britain for the benefit of listeners-in abroad, owing to the necessity of maintaining programmes for those whose licence fees contributed towards the cost of broadcasting.

Letters were read from radio organisations in Czecho Slovakia, France, Germany, Great Britain and Italy, who were unable to send delegates, but who approved the idea of regular transmission in Esperanto of news, etc.

After some further discussion the following resolution was passed unanimously :—

The Preliminary Conference for an International Agreement on Wireless Telephony, met in Geneva, April 22nd and 23rd, 1924.

Realising that wireless telephony carries the human voice across all frontiers and meets the obstacle of the diversity of tongues—

Considers the auxiliary use of an international language urgently necessary for such broadcasting as is destined for other countries.

Congratulates the broadcasting stations which have already commenced broadcasting in Esperanto, both in Europe and America, or which have arranged for the transmission of lessons in that language, and

Recommends to all broadcasting stations that they arrange for regular broadcasting in Esperanto at least once a week at a fixed hour on an agreed day, and so far as possible arrange for the transmission of Esperanto lessons because the language has been shown to be easy to learn, clearly audible, and has already spread to a considerable extent among listeners-in of all countries.

An interesting and instructive discussion took place on the question of the compilation of an international technical dictionary for wireless telephony.

At the conclusion of the discussion the following resolution was moved by M. Privat, seconded by M. Edmonds, and carried unanimously :—

> The Conference recognises the work already done by the Internacia Radio Asocio, whose President is M. Corret in Paris, and requests that body to hasten the preparation of the technical vocabulary for wireless telegraphy and telephony in agreement with the Esperantist Academy.

M. Grenkamp, a Polish member of the public present, asked for permission to complain to the Conference that in several states, including Poland, decrees forbade absolutely all private use of wireless telephony even for mere private listening-in. He himself, until his visit to Geneva, had never even seen an ordinary receiving set.

At the request of M. Grenkamp, the Conference carried the following final resolution with acclamation :—

> The Conference expresses the desire that the several states which still forbid the use of wireless telephony should reconsider their decisions and permit amateur receiving apparatus.

CORRESPONDENCE.

Galvanometer Tests with Crystal Sets.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I note that Mr. H. E. Adshead, in your issue of March 12th, makes use of the No. 375 Weston Galvanometer but fails to get an aerial reading when using it in the telephone circuit of a crystal receiver. It may be of interest to state that I habitually use one of these excellent little instruments in the way he mentions as a means of determining the exact tuning point of crystal detector sets, also for comparing the relative values of crystal combinations of various types as I find this method far more reliable than using the telephones alone.

As I am situated only about one mile from **6 BM**, I am able to obtain perhaps rather phenomenal results, using a small and well screened single-wire aerial only 40 feet long and approximately 32 feet high.

The power wave from **6 BM** causes a steady deflection of about 10 degrees on the instrument scale and with 8,000 ohm Sullivan headset in series of approximately 8·5 degrees.

It is most interesting to study the modulation effects whilst wearing the telephones and watching the needle at the same time. Sopranos and cornets exercise the greatest effects, about 2·5°, as do also certain notes at the opposite end of the scale, notably kettle-drums. Some notes which are almost beyond the range of audibility in the 'phones cause a great amount of perturbation on the part of the needle, whilst other notes which strike the ear as being either harsh or shrill, as the case may be, apparently have little or no effect on the steady deflection produced by the carrier wave.

The instrument in question is rated at 20-25 micro-amperes for each scale deflection (1 mm.) and has a resistance of approximately 30 ohms, so I think the readings to be fairly satisfactory for such a short and low aerial. With a two-crystal combination with which I am at present experimenting I can get even higher readings under favourable conditions. Improvements in tuning and in detector efficiency may thus be resolved into measurable quantities. Personally I have learnt much about crystals in this way.

PERCIVAL J. PARMITER.

Bournemouth.

April 19th, 1924.

(*Editorial Note.—Fuller reference to this interesting subject was made in the article in our last issue, by Mr. F. M. Colebrook, B.Sc., in which the same method of determining the best tuning points in crystal receivers was recommended.*)

A New Dual Circuit.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In the issue of *The Wireless World and Radio Review* of November 7th, 1923, particulars were given of a dual circuit, accompanied by theoretical and practical diagrams, by James Strachan, F.Inst.P.

I have built this set and find that the circuit is much to be recommended, as after a little practice, all broadcasting stations can be tuned in easily. I am situated 20 miles from the local broadcasting station, and can cut it out without difficulty when tuning in any other distant station. I find on the wiring diagram, however, that the leads to the coil C should be reversed.

I repeat that anyone wishing to build a one-valve set to get all stations with good results should try this circuit, using the best components only. I have every confidence in recommending it.

E. ROWELL.

Wall-on-Tyne,
Northumberland.

A SIMPLE DIRECT-READING SET FOR MEASURING CAPACITY.

THE recent description of capacity measuring brought to mind a simple adaptation, by the writer, of the Wheatstone bridge, which was used for many years for measuring condensers.

THE APPARATUS.

The set consisted of two condensers *B*, of any value from 0·001 to 0·01 mfd. These should be as nearly equal as possible, but to balance the circuit when working, a small variable condenser *C*, is shunted across one of them. *X* is the capacity to be measured. *S* is the standard variable condenser, on which the values of *X* are read directly. *P* is a pair of headphones.

The set is connected to the make and break of a small buzzer, to which is connected a battery and switch.

BALANCING THE SET.

To balance the set, switch on the buzzer, when a hum will be heard in the telephones. The standard *S*, should be placed at 0°, and condenser *X* removed. Then, by moving the condenser *C* in or out, the hum in the telephones will die away. When this happens, the set is balanced, and ready to measure the condenser connected at *X*.

If the condenser *C* does not balance out, it should be connected to the other fixed value condenser.

MEASURING.

Now, by connecting up the condenser *X*, and turning the handle of the variable *S*, the hum in the telephones will gradually disappear. A little practice will enable the pointer to be adjusted to the centre of the space where there is no sound heard. The value on the scale of *S* is then the value of the capacity of *X*. This, of course, only applies to condensers of capacity under the maximum value of *S*.

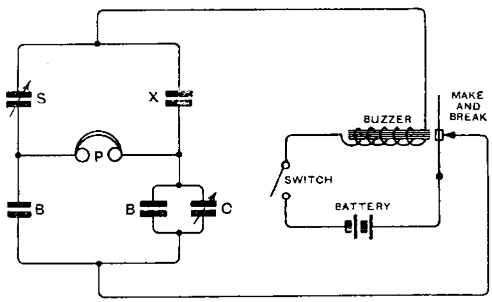
INCREASING THE RANGE.

The range of the set may be increased by measuring any block condenser at *X*, and then connecting it to the terminals of *S*. As many of these may be used as required to balance out the value of *X*. Also a switch may be used to connect extra condensers in parallel with *S* as required. The value of *X* in this case will be the values of *S* and the extra condensers used, added together.

A short circuit at *X* will be recognised by the loud hum heard in the telephones.

PRINCIPLE OF WORKING.

When the potential from the buzzer is applied to *X S* and *B B*, the current takes a path through *X S*, and down through *B B* back to the buzzer. Since the telephones are joined across the centre of the circuits, as in a Wheatstone bridge, the current flowing when the set is balanced is the same at both ends of the telephones. Consequently no difference of potential is set up across them and the buzz practically disappears. When the set is unbalanced, more current flows through one side than through the other, which causes a buzz in the telephones. The strength of the signal heard indicates the amount of variation in the capacity of *X* and *S*.



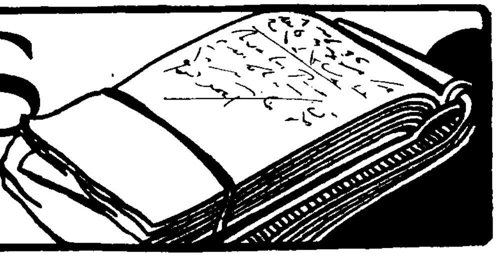
This method is quite accurate enough for ordinary purposes, and the sensitivity depends on the value of the voltage applied from the make and break of the buzzer.

It is possible that even when balanced a slight hum will be heard, due to leakage, but this will not affect the working.

To measure very small condensers it will probably be better to connect some known condenser of medium size in parallel with it, measuring the two together. By taking away the known value the difference will be the result required.

R. G. H. C.

NOTES & CLUB NEWS



A press campaign has been opened in Switzerland against the widespread interference which is seriously affecting broadcast reception.

* * *

A broadcasting station is being erected in Copenhagen to operate on a power of one kilowatt.

* * * *

Wireless is included in the trades to which boy recruits in the Royal Air Force are to be apprenticed.

Radiola Changes its Name.

"Radiola" transmissions, as such, have now ceased, the well-known 1,780 metre station being re-named "Radio Paris." A number of provincial stations controlled by the same company will be known as "Radio Nice," "Radio Marseille," "Radio Bordeaux," etc.

New Time Signal Service.

A new high-power wireless station has been completed at Saigon, French Indo-China, which will work direct with Bordeaux, a distance of 6,000 miles. It is proposed to organise this new station for a full daily programme of time signals on the same lines as the Eiffel Tower service; at present rhythmic (or vernier) signals only are being transmitted daily. We learn from "The Radio Service Bulletin" that it has been reported that this station is part of a network of stations in Europe, America and the Far East, which shall eventually form part of the Saigon-Bordeaux system. Fifteen such stations are contemplated in Indo-China, fifteen in Europe, and two in America.

Lyngby's Ten Kilowatts.

A Copenhagen correspondent, Mr. V. A. Ramsing (**7 KA**), suggests that the transmissions from Lyngby should be easily heard in England, considering the power employed. Lyngby uses a Poulsen arc transmitter of 10 kilowatts, and has been heard in Scotland. In addition to the daily programmes between 8.30 and 9.45 p.m., the station transmits a concert between 8 and 9 p.m. on Sundays, on the same wavelength, viz., 2,400 metres.

S.O.S. ?

A mysterious transmission of the S.O.S. call on 120 metres is reported by Mr. D. B. Knock (**6 XG**).

While DX recording at 10.55 p.m. on April 25th, Mr. Knock was surprised to hear the distress call on this low wavelength. The signal was C.W., at times very strong, but with marked periods of fading, and the note sounded slightly like rectified A.C., as the C.W. was not quite pure. The call terminated with a long dash. Did any other reader intercept the call ?

Danish Amateur Seeks Tests.

Mr. Borge Jorgensen (**7 BJ**), of Brandes Allé 8, Copenhagen, V, states that he would be glad to arrange tests with British amateur transmitters.

Cinema Broadcasting Experiment.

A successful broadcasting experiment in connection with two well-known London cinemas was carried out on Monday, April 28th.

Music played by a band of 25 performers to a film at the Shepherd's Bush Pavilion was broadcast from **2 LO** and received on a loud speaker at the Shaftesbury Pavilion, where it accompanied the same film from start to finish. It is believed that this is the first occasion on which a single orchestra has accompanied the same film in different theatres.

Frame Reception of High Power Stations.

The advent of broadcasting and many other transmissions on comparatively short wavelengths has probably diminished the number of amateurs who make a practice of intercepting the long distance stations operating on "five-figure" wavelengths.

It is interesting, therefore, to receive a report from a Dutch experimenter, Mr. Robert Wunder, who regularly receives the following high-power stations:—Peking **XYZ** (16,150 metres), Saigon, French Indo-China, **HZE** (15,700 metres), Malabar, Dutch E. Indies (7,500, 13,500 and 15,600 metres), Monte-Grande, Argentina, **LPZ** (12,500 and 16,600 metres) and also Hawaii, **KGI** and **KIE** (16,300 and 17,000 metres).

Our correspondent uses a 7-foot frame aerial with detector and one L.F. valve, and separate heterodyne. It is interesting to note that in receiving Hawaii the frame is directional to the North Pole, which lies in a straight line drawn from Holland to Hawaii.

Another Ether Poacher ?

The misuse of his call sign, **2 KG**, by another transmitter is suspected by Mr. A. E. Hay, who is at present operating on board ship. A number of reports on the excellence of his transmissions have been received by Mr. Hay in spite of the fact that for some time past his absence at sea has precluded transmissions from his station at Aberdare, South Wales.

It is significant that the reports, for the most part, emanate from the London area. Information regarding transmissions from any station using this call sign will be welcomed.

The Radio Society's Badge.

A great many entries have been received in connection with the competition arranged by the Radio Society of Great Britain in which a prize of £5 is offered for the best suggestion or design for a badge symbolising wireless and capable of use as the emblem of the Society. In the hope that even more ideas may be submitted, the term of the competition will be extended another month, the closing date being May 31st. Entries should be addressed to the Radio Society of Great Britain, 53, Victoria Street, S.W.1.

Italian Broadcasting Regulations.

The stringent regulations which have hitherto handicapped private wireless reception in Italy are now removed, and a receiving licence may now be purchased for 50 lires. It is believed that the country is on the eve of a radio boom.

New Conductor at 2 LO.

An interesting appointment at **2 LO** is that of Mr. Dan Godfrey as musical director of the station and conductor of the orchestra. Mr. Godfrey comes direct from the Manchester station, where his admirable work in a similar capacity has earned high praise.

Mr. L. Stanton Jeffries remains musical director of the B.B.C.

Berlin Radio Classes.

German zeal for radio progress is illustrated by the institution of a wireless course at one of the principal schools in Berlin. Tuition covers both the construction and operation of apparatus, and it is stated that the classes have attracted many pupils of the fair sex who intend to make radio their career.

Broadcasting in Mexico.

Although, according to estimates, there are only one hundred wireless receivers in Tampico, this select little company has the choice of two broadcasting stations, which are operated by local companies. Radio transmitters up to 20 watts capacity are permitted throughout the Republic of Mexico for a fee of $2.50 per annum.

Trans-Pacific Wireless Experiments.

Canadian interest in the Imperial Wireless scheme has been revived by the news that Commander E. C. Watson, representing the Pacific Cable Board and the British Post Office, has been conducting experiments from the Coast of British Colombia to Australia via Fanning Island, with considerable success.

Spanish Broadcasting.

Broadcast transmissions are now more or less regular from the Madrid School of Posts and Telegraphs. Programmes are at present broadcast on Sundays, between 6 and 8 p.m. on 480 metres, and listeners report that the modulation is exceptionally good. Transmissions consist of lectures, concerts, dance music and gramophone records.

Brussels Station's Reduced Wavelength.

The Brussels ("Radio Electrique") Broadcasting Station is shortly to lower its wavelength from 460 to about 250 metres, at the request of Telegraph Administration, says *La T.S.F. Moderne*.

The wisdom of using such a short wavelength is doubtful and it is likely that the general public will experience difficulty in adapting their sets to the change.

Transmissions will probably be suspended for a few days while the necessary alterations are made at the station.

German Wireless for Chile?

The Siemens-Schuckert Company of Berlin has applied to the Chilean Government to be allowed to erect a system of eleven wireless stations in the republic, the stations to be of the Telefunken type and to cost $1,385,000 (gold). The stations would range in power from two to five kilowatts.

At present radio stations in the Republic are of the Marconi type and are operated by the Chilean Naval Department. Public disapproval has been expressed regarding the proposed change from British to German type, but as the Chilean Ministry is changed so frequently, it is not improbable that the concession may be deferred, or, if granted, subsequently cancelled.

Radio Hopes in Turkey.

At present there is no demand for radio apparatus in Turkey, no official steps having been taken towards the establishment of broadcasting. German radio manufacturers have, however, applied for a concession for the purpose of erecting a low-power broadcasting station at Constantinople.

Private Transmission in India.

The first private wireless transmitting licence has been issued by the Government of India, says "The Radio Service Bulletin." This licence has been granted to the Radio Club of Bengal and is for both transmission and reception, but under the terms of the licence the Club is only allowed to transmit weather reports, concerts and lectures, and is specifically excluded from broadcasting items of news.

Japanese Broadcasting Plans.

The Japanese Government has introduced a bill regulating broadcasting. Limitations are placed on the power to be used and a definite band of wavelengths has been allotted. It is understood that the licence regulations are rather stringent.

Radio in Schools.

In the course of an interesting talk from **2 LO** on Thursday, May 1st, Mr. R. J. Hibberd, M.Inst.R.E., F.R.S.A., described how he had applied radio in his own school. Mr. Hibberd is Honorary Secretary of the Schools Radio Society.

"The course commenced by teaching the fundamental principles of electricity and magnetism," said Mr. Hibberd, "and as often as possible their relation to wireless was introduced and emphasised. At the same time the children were learning the Morse code as voluntary homework. In order to allow the pupils to understand fully the practical side of the subject, I permitted them to construct under my guidance, as much of the apparatus as possible. For example, the insulators were made from old bicycle tyres, the steel blades for the crystal detectors consisted of discarded safety razor blades. At the woodwork class boys made stands for the inductance coils and other necessary woodwork. It can be fully realised that the first receiving set constructed was very crude in appearance, but none the less efficient.

"Picking up signals from stations throughout the world cultivates concentration of a very high order, besides training the memory and making the brain alert.

"In the physical and political geography lessons I have found that radio has unlimited scope. Two pupils are detailed each day to take the wireless weather reports in Morse from the Air Ministry. These reports are fixed to a chart which the pupils have specially designed for the purpose and on which is also a blank map of the British Isles. The pupils mark on the map all the meteorological observations received such as anti-cyclones, etc. Each day, in the geography lessons, this report is read, and fully discussed as to cause and effect.

"During wireless reception there is always keen competition as to who can receive the most distant stations. Their location and approximate distance from the British Isles are learnt from the atlas and thus become familiar to the children. The astronomical time signals are received daily from Paris, and these have greatly assisted the children in the explanation of latitude and longitude.

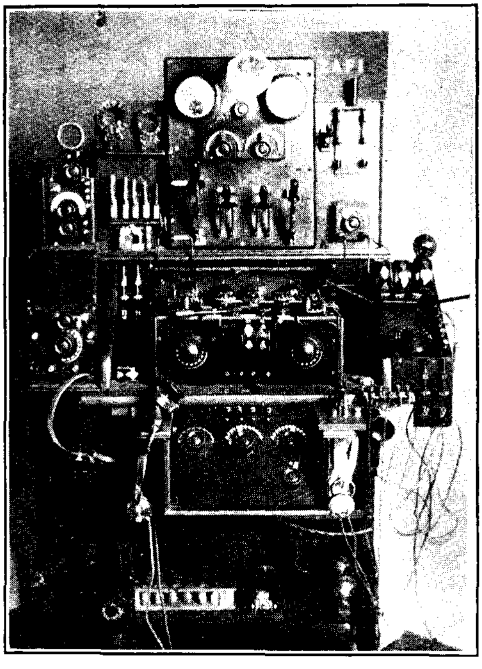
"The application of radio to language lessons is of great value, as the more advanced classes can hear the correct accent of the country which they are studying.

"With reference to actual research work I am of opinion that pupils should be encouraged to construct their own apparatus, as they learn much by so doing. At the same time, I have found by experience that it is advisable to have in the school, a good ready-made receiver which should be used for special experiments, demonstrations and the reception of broadcast. A good standard set encourages pupils to make improvements in their own receivers with a view to making them as equally efficient.

"Finally, the broadcasting of talks of interest is of immense value as it enables the pupils of an isolated country school to hear some of the most eminent authorities on various subjects of school interest. This was never more clearly demonstrated than by the striking success of the recent music lesson broadcast from this station by Sir Walford Davies.

"The Schools Radio Society, amongst its other activities, assists schools to develop wireless on the lines which I have outlined and to further encourage this work we are offering a shield for competition amongst the schools for the one which produces the best collective work over a given period. Schools wishing to compete for this shield must be members of the Society."

Mr. Hibberd concluded by inviting enquiries from those interested in the competition for the shield, and requested that letters should be addressed to him at the Radio Society of Great Britain, 53, Victoria Street, London, S.W.1.



*A compact transmitter and receiver, owned and operated by Mr. R. H. Franklin (**2 AFI**) of Barrow.*

The Late Mr. J. St. Vincent Pletts.

It is with deep regret that we have to record the death, from heart attack on Saturday, April 26th, of Mr. John St. Vincent Pletts.

The late Mr. Pletts, who was closely associated with radio development for many years, was born in the Isle of Wight in 1880, and educated locally and at the Central Telegraph College. In 1899 he joined the staff of Marconi's Wireless Telegraph Co., Ltd., and was responsible for the erection of wireless stations in Hawaii, Labrador, the Congo, Russia and the Far East. In 1919, after several years as Head of the Patent Department of the above Company, he took up a position as an independent consulting engineer.

Mr. Pletts was a director of the Wireless Press, Ltd.

Interference by Leafield.

Efforts are being made at the Leafield wireless station to minimise interference with broadcast reception, according to a recent statement by the Postmaster-General. Certain modifications are being made in the circuits employed and investigations are still proceeding.

New Coastal D.F. Stations.

The installation of wireless direction stations at different points of the coast, in addition to those at the Lizard, Berwick and Flamborough, has recently been considered by an Inter-Departmental Committee.

Although financial considerations do not admit of the completion of the whole of the original programme, arrangements are in hand for the provision of D.F. stations at Niton (Isle of Wight), Cullercoats (Newcastle), and in South Wales. Further stations will be erected later.

Radio Society of Great Britain.

An informal meeting of the Society will be held at the Institution of Electrical Engineers at 6 p.m. on Wednesday, May 14th, 1924, at which Mr. G. G. Blake, M.I.E.E., A.Inst.P., will open a discussion upon "Some Suggested Lines for Experimental Research."

Canadian Broadcasting.

Increasing interest in broadcasting in Canada is revealed in figures issued recently by the Federal Government Department of Marine. Since December last 11 licences for broadcasting stations have been issued, making a total of 45 broadcasting stations in Canada. The new stations are, by provinces, located as follows: Ontario 5; Nova Scotia, 1; Quebec, 1; British Columbia, 2; and Alberta, 2.

Montreal leads in the number of receiving licences issued to amateurs with 6,600, while in Toronto 3,400 have paid, and the work of collecting the licence fees is not nearly completed. Approximately 29,039 radio licences have been issued to amateurs in Canada up to January 31st, according to the records of the Department of Marine.

Amateur Activities in Australia.

Owing to the very stringent regulations in respect of amateur wireless which obtained in Australia until the beginning of last year, before when amateur transmission was absolutely forbidden, experimenters were compelled to concentrate on reception, with the result that receiver design has reached a very high standard of efficiency. Now that C.W. transmission up to 10 watts input is permitted, Australian amateurs have succeeded in establishing two-way communication with their cousins in New Zealand, 1,500 miles distant.

A large proportion of experimental work is still devoted to reception, however, and much time has been devoted to trans-Pacific tests. The first was held last May, and the second in October, with gratifying results, 230 different American stations having been heard. Interesting logs of these tests have been forwarded to us by Mr. Maxwell Howden (**3 BQ**) of Victoria, who succeeded in hearing an American amateur over a distance of 10,500 miles.

American Amateur Suspended.

The Chief Wireless Federal Supervisor for the Middle West has ordered the dismantling for one year of amateur station **9 AQB**, of St. Louis, on the ground that its owner not only "cluttered up the atmosphere with dots and dashes any time he chose," but also radiated impolite language.

2 NM's American Tour.

When Mr. Gerald Marcuse (**2 NM**), the well-known Transatlantic transmitter, left Southampton for America on Thursday, May 1st, he carried with him a special message of goodwill from British to American amateurs.

Mr. Marcuse will carry out a two months' tour of American amateur transmitting stations, and intends to arrange a fresh series of two-way communication tests.

Tracing Disturbance in Reception.

Disturbance to wireless reception caused by tramway working formed the subject of Mr. J. F. Cameron's discourse on April 7th before the Northampton and District Amateur Radio Society. Many crackling noises commonly called "atmospherics," said the lecturer, were due to leakages of current from the tramway system. The electric power driving the trams, although conveyed by overhead wire, was expected to return entirely by the rails. In practice, however, it was liable to find its way back to the negative bar at the generating station in a zig-zag path across country. Hence, it might easily happen that the very gas or water pipe to which a wireless set was earthed was also acting as part of the return system of the tramways.

To avoid the noise so produced in the 'phones, the lecturer strongly advocated the use of earth pins, instead of earthing to a gas or water pipe.

BOOK RECEIVED.

The Boy's Book of Wireless. By Ernest H. Robinson (**5 YM**). An interesting and popular explanation of the principles of radio by an experimenter and writer of boys' books and stories. (London Cassell & Company, Ltd., La Belle Sauvage, E.C.4. 242 pages. Copiously illustrated. Price 5s. net.)

Eiffel Tower Short Wave Transmissions.

We publish below a programme of the short wavelength transmissions which will be conducted from the Eiffel Tower Station during the month of May. The object of these transmissions is to ascertain the conditions covering the propagation of short waves by means of comparative reports from different locations.

Identification signals F or H are sent out with each transmission. F indicates that the aerial is functioning on approximately its fundamental wavelength, whilst H indicates that it is transmitting on a harmonic or by means of forced oscillations.

CENTRE RADIOTELEGRAPHIQUE DE PARIS.

Short wave transmissions—Programme for May, 1924.

Monday.	Tuesday.	Friday.	Saturday.		Wavelength.
5th	6th	9th	10th	..	115
12th	13th	16th	17th	..	115
19th	20th	23rd	24th	..	50
26th	27th	30th	31st	..	25

Time G.M.T.		Identification Signals.
From 0500 to	0510	f f f f f
0515	0525	h h h h h
0530	0540	f f f f f
0545	0600	h h h h h
1500	1515	f f f f f
1520	1535	h h h h h
2100	2115	f f f f f
2120	2135	h h h h h

The following text will be transmitted in morse very slowly and finally dashes of a few seconds duration will be sent to enable measurements of signal strength to be taken.

"v.v.v. de FL — FL — 115 m — emission f.f.f. or h.h.h."

The authorities at the Eiffel Tower would welcome reports of reception of these transmissions from any of our readers (which will be forwarded by this office), as they are of the utmost scientific interest.

Reporters should furnish the following information: Date of observation, time, (G.M.T.), signal strength, under headings F or H, according to the identification signal. Extent of disturbance, if any, from (1) fading, (2) interference, (3) atmospherics, (4) weather conditions, and finally, any detailed observations on the transmissions.

Special attention should be paid to supplying accurate details of weather conditions.

Forthcoming Events.

WEDNESDAY, MAY 7th.

Institution of Electrical Engineers (Wireless Section). At 6 p.m. At Savoy Place, W.C.2. Lecture: "Faithful Reproduction in Radio Telephony." By Mr. L. C. Pocock, Associate Member.

Royal Society of Arts. At 8 p.m. At John Street, Adelphi, London, W.C.2. Lecture: "Wireless Navigation of Ships and Aircraft." By Dr. J. Robinson, M.Sc., F.Inst.P. (Head of Wireless and Photography Department, Royal Aircraft Establishment, Farnborough). Admiral of the Fleet Sir Henry Jackson, G.C.B., K.C.V.O., F.R.S., will preside.

THURSDAY, MAY 8th.

Hendon Radio Society. At 8 p.m. At the Town Hall, The Burroughs, Hendon. Lecture: "Coils for Distortionless Amplification" (with demonstration). By Mr. J. H. Reeves, M.B.E.

Blackpool and Fylde Wireless Society. Lecture by Mr. J. V. Potter.

FRIDAY, MAY 9th.

Leeds Radio Society. At 7.30 p.m. At Woodhouse Lane U.M. Schools. Lecture: "The Wireless Transmission of Photographs." By Mr. E. V. Elwes.

Radio Society of Highgate. At Edco Hall, 270, Archway Road, Highgate, N.6. Lecture: "The Fourth Dimension." By Mr. D. H. Eade.

MONDAY, MAY 12th.

Ipswich and District Radio Society. At 55, Fonnereau Road. Open Night.

Hornsey and District Wireless Society. At Queen's Hotel, Broadway, Crouch End, N.8. Lantern Lecture: "Condensers and Their Uses." By Mr. Philip R. Coursey, B.Sc., A.M.I.E.E.

TUESDAY, MAY 13th.

West London Wireless and Experimental Association. At the Acton and Chiswick Polytechnic, Bath Road, Chiswick, W.4. Lecture by Captain P. P. Eckersley.

Leicestershire Radio and Scientific Society. At the Victoria Galleries, Granby Street. Lecture by Mr. T. R. Palmer.

Southampton and District Radio Society.*

An instructive lecture on low frequency amplification was given by Mr. G. W. Walton, of the General Radio Co., Ltd., on April 10th. The lecturer ably answered many questions that had perplexed members.

On Thursday, April 24th, Mr. J. Wansbrough, of the General Electric Co., Ltd., gave a highly successful demonstration with a Gecophone 2-valve set and loud speaker coupled to a Western Electric 2-valve power amplifier.

Broadcasting from the various stations of the B.B.C. was received with great strength.

Hon. Sec., Lt. Col. M. D. Methven, O.B.E., 22, Shirley Avenue, Southampton.

The Leicestershire Radio and Scientific Society.*

On April 15th an interesting evening was spent in testing loud speakers, and some very useful results were obtained. A large hall had been obtained at the local Y.M.C.A. and by means of an indoor aerial and a four-valve receiver the transmission of Birmingham was made audible to all. Loud speakers tested included Amplions, T.M.C., Ethovox, Sparta, Tangent, B.T.H., and, last, but not least, an home-made instrument by Mr. H. E. Dyson.

All communications regarding the Society to be addressed to the Hon. Sec., J. W. Pallett, 111, Ruby Street, Leicester.

The Radio Society of Highgate.*

An extremely interesting lecture was given on April 25th by Mr. G. A. V. Sowter, B.Sc., his subject being "A Practical Heterodyne Wavemeter." Mr. Sowter first explained the theory of "heterodyne reception," and proceeded to detail the construction of a wavemeter using the Hartley oscillator circuit. An unusual feature of the actual instrument described and exhibited is that it will oscillate without any high-tension battery being used, although for practical purposes an H.T. battery of about 24 volts gives best results with normal valves. A simple method of calibrating the instrument was next described, the harmonics of the broadcasting stations being used for this purpose. The range of Mr. Sowter's instrument is from 80 to 500 metres, thus covering all the amateur and broadcasting transmissions.

There are several vacancies for membership in the Society, and all those interested in wireless are invited to join. Full particulars of membership may be obtained from the Hon. Secretary, J. F. Stanley, B.Sc., 49, Cholmeley Park, N.6.

Tottenham Wireless Society.*

On April 16th, Mr. R. F. G. Holness gave an interesting lecture on a highly efficient one-valve and crystal dual amplification receiver of his own design. As a result of considerable experimenting with reflex sets the lecturer had come to the conclusion that the normal one-valve reflex was not equal, as it should be, to nearly three valves. Last November, Mr. Holness, after studying the principles incorporated in the De Forest "Ultraudion"—a valve detector circuit of unique design—evolved entirely in theory, the basis of his new circuit which he has named the "Ultra Flex." At first it was not very selective, but as the result of slight modifications this circuit is now remarkable, both for its efficiency and selectivity.

A most instructive lecture on "Interference Elimination," was given by the Chairman, Mr. F. E. Neale, on April 23rd. Atmospherics, said the lecturer, are the most troublesome type of interference encountered by commercial stations. Their aperiodic character and their power have so far resisted all efforts to eliminate them. The two most successful methods of minimising their effects are the balanced valve and Weagant's "Static" tank.

Selectivity of apparatus is the keyword for cutting out other stations. Coupled circuits, carefully adjusted reaction, tuned anode or the Hinton rejector circuit are all successful if properly used.

Interference from dynamos or lighting mains is mainly of low frequency and can be picked up by the earth, the aerial or even by the set itself. According to the source of the trouble the cure may be either screening the set by lining the case with tin foil or by using a counterpoise instead of an earth.

Hon. Sec., S. J. Glyde, 10, Bruce Grove, Tottenham, N.17.

Ilford and District Radio Society.*

On Thursday, April 17th, Mr. L. Vizard (Hon. Secretary), lectured and demonstrated on "The Recording of Wireless Signals." He first described the type of receiving set necessary, and pointed out that, besides sensitivity, selectivity was very necessary when trying to record signals. The method he used was then explained and the members were shown the Weston relay which formed the "link" between the receiving circuit and the Morse-inker.

Some very good records were obtained from some commercial and service stations, the apparatus proving capable of dealing with comparatively high speed work.

Hon. Sec., L. Vizard, 12, Seymour Gardens, Ilford.

Wimbledon Radio Society.*

The first annual general meeting of this Society was held on Friday, the 25th inst.

Mr. C. G. Stokes, the retiring Hon. Secretary, having presented his report on the activities of the previous session, and a very satisfactory financial statement having been adopted, the following officers were elected for the ensuing year:—President, Sir Joseph Hood, Bart., M.P. Vice-Presidents, Messrs. S. M. Gluckstein, T. T. Smith, J. A. Partridge (**2 KF**), and H. G. Oliver. Hon. Secretary, Mr. P. G. West. Hon. Treasurer, Mr. P. Gauntlett. Committee, Messrs. H. S. Rawlings, W. J. Rawlings, I. J. Babbage, A. Gardner, F. R. Wells and C. J. Frost.

The yearly subscription to the Society is 7s. 6d. (entrance fee 5s. for new members), and further particulars may be obtained on application to the Hon. Secretary, P. G. West, 4 Ryfold Road, Wimbledon Park, S.W.19. 'Phone, Wimbledon, 1832.

Sheffield and District Wireless Society.*

On Friday, April 25th, before a large attendance of members, Lieut. Duncan Sinclair delivered an interesting lecture on "Air Transport and its Communications." After discussing the various phases of aerial transport at the present time, the lecturer showed the vital importance of wireless communication to aircraft. He then explained several types of wireless traffic in detail, paying special attention to modern practice in direction-finding. A series of admirable slides illustrated the lecture.

Hon. Sec., R. Jakeman, "Woodville," Hope, Sheffield.

Kensington Radio Society.*

A lecture on "Detectors for Electric Wave Reception" was given by Mr. M. Child, at the April meeting.

The construction and action of various well-known types of detectors which had been in commercial use, such as the Lodge Muirhead coherer, magnetic, electrolytic and crystal detectors were dealt with in detail and demonstrations were given with several examples.

The Hon. Sec., J. Murchie, 33, Elm Bank Gardens, Barnes, S.W.13, wi be pleased to forward particulars to persons desirous of joining the Society.

Nottingham and District Radio Experimental Association.

There was a good attendance of members on Thursday, April 10th, when Mr. R. Pritchett, B.Sc., gave an account of his experiments in connection with the building of a four-valve neutrodyne receiver, the main feature of which was the clearness of received telephony. The set was demonstrated on the Society's aerial and good volume was produced. Tuning was very critical.

Hon. Sec., A. S. Gosling, 63, North Road, West Bridgford, Notts.

Honor Oak Park Radio Society.

On April 25th Captain A. Huss gave an interesting and instructive lecture on "Long Distances with a Single-valve." He gave three circuits, one employing capacity reaction, and another, reaction controlled by a potentiometer. The third set had a special tuner, using two variometers, and the lecturer exhibited one of his own design and make.

Hon. Sec., J. McVey, 10 Hengrave Road, S.E.23

St. Pancras Radio Society.

A very interesting lecture on "Capacity" was given on April 10th by Mr. J. S. Rowe. After a brief outline of the electron theory the lecturer proceeded to demonstrate certain properties of condensers. He then explained how to calculate the capacity of a condenser by the aid of a few simple formulae, and gave a list of the dielectric constants of some of the commoner insulating materials. He concluded by pointing out the detrimental effects of stray capacity in aerials and he suggested ways of minimising this evil.

Full particulars of membership will be gladly forwarded by the Hon. Sec., R. M. Atkins, 7, Eton Villas, Haverstock Hill, N.W.3.

Clapham Wireless Society.

A six-valve receiver operating three loud speakers was demonstrated at the last meeting of the Society. The apparatus was manufactured by The General Radio Co., Ltd., and the results obtained were excellent.

The Society is increasing its membership. Particulars will be gladly forwarded by the Hon. Sec., M. F. Cooke, 13, Fitzwilliam Road, Clapham, S.W.4.

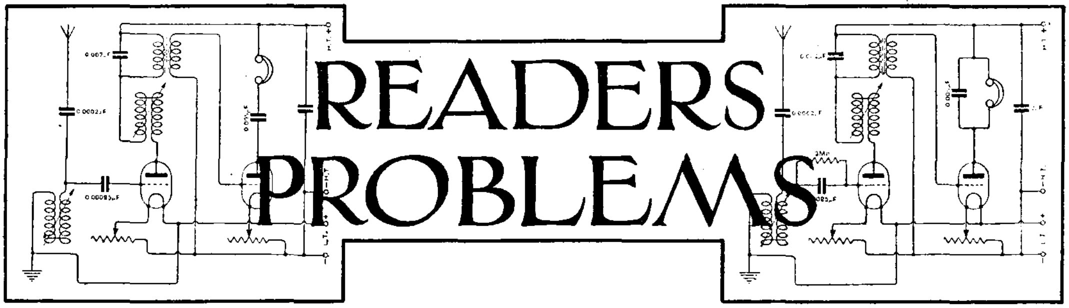
Northampton and District Radio Society.

"Low Frequency Amplification" was the subject chosen by Mr. H. L. Lewis, who lectured before the Society on Monday, April 21st. The majority of amateurs, in the opinion of the lecturer, were inclined to concentrate on the H.F. side of their receivers at the expense of their L.F. units. After dealing with the merits of resistance capacity coupling, Mr. Lewis turned attention to the more common practice of transformer coupling and warned his hearers to obtain the best possible components when employing this system.

Radio Association of South Norwood and District.

In the absence of the intended lecturer on April 17th, Mr. J. R. Jeffree (**5 FR**) gave a very interesting talk on transmission. Particular attention was given to a circuit which, by changing a switch, would be converted from a single-valve receiver to a telephony transmitter.

Headquarters, The Stanley Halls, South Norwood Hill, Norwood Junction, S.E.25.



1. *All questions are answered through the post. A selection of those of general interest is published.* **2.** *Not more than four questions may be sent in at any one time.* **3.** *Every question should be accompanied by a postal order for* **1/-**, *or* **3/6** *for four questions, and by a coupon taken from the current issue.* **4.** *A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

"*W.H.*" (*London, N.*) **asks for a diagram of a simple two-valve receiver (0-v-1) for use over a wide band of wavelengths. No switches are to be used.**

The diagram required is given in Fig. 1. A coupled aerial tuning circuit is used, and it is recommended that the effect be tried of connecting the minus side to the L.T. battery to earth, as shown by the dotted line in the diagram. The aerial tuning condenser is connected in parallel with the A.T.I. This method will be found most suitable for the reception of long wavelengths, and will also give satisfactory results on wavelengths as low as 300 metres. For shorter wavelengths it is desirable to connect the aerial tuning condenser in series with the A.T.I.

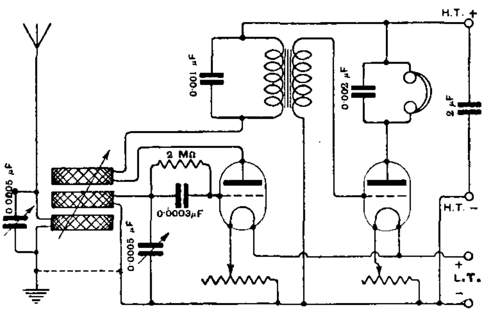


Fig. 1. "W.H." (London, N.). Connections of a receiver consisting of a detector and note magnifier.

"*G.H.*" (*Macclesfield*) **asks for a diagram of a heterodyne wavemeter for use on approximately 100 metres.**

The diagram is given in Fig. 2. The grid and reaction coils, A and B respectively, may be wound side by side on an ebonite former 3″ in diameter. The grid coil A should consist of 25 turns of No. 22 D.C.C. The number of turns required for the reaction coil B should be found by experiment, and should preferably not exceed the number of

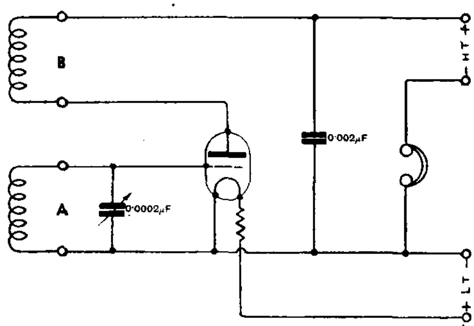


Fig. 2. "G.H." (Macclesfield). Connections of a short wavelength heterodyne wavemeter.

turns used in the grid coil. It will be noticed that the telephones are connected between −H.T. and −L.T., since by this means capacity effects due to the movement of the operator are often reduced. The by-pass condenser connected between +H.T. and −L.T. may have a value approximately 0·002μF.

"*G.W.H.*" (*Dublin*) **asks by what methods hand-capacity effects may be reduced in a receiver.**

The alteration in tuning which takes place when the hand of the operator is placed near the condenser dials can generally be prevented by connecting the moving vanes wherever possible to a point of fixed potential; thus, in the secondary tuning condenser the moving vanes should be connected to the filament end of the secondary coil, while the positive lead of the H.T. battery should be connected to the spindle of the anode tuning condenser. If this measure is not effective in eliminating the trouble, the back of the receiver panel near the condenser dial may be covered with thin sheet metal, which should be connected to earth or to the negative side of the L.T. battery.

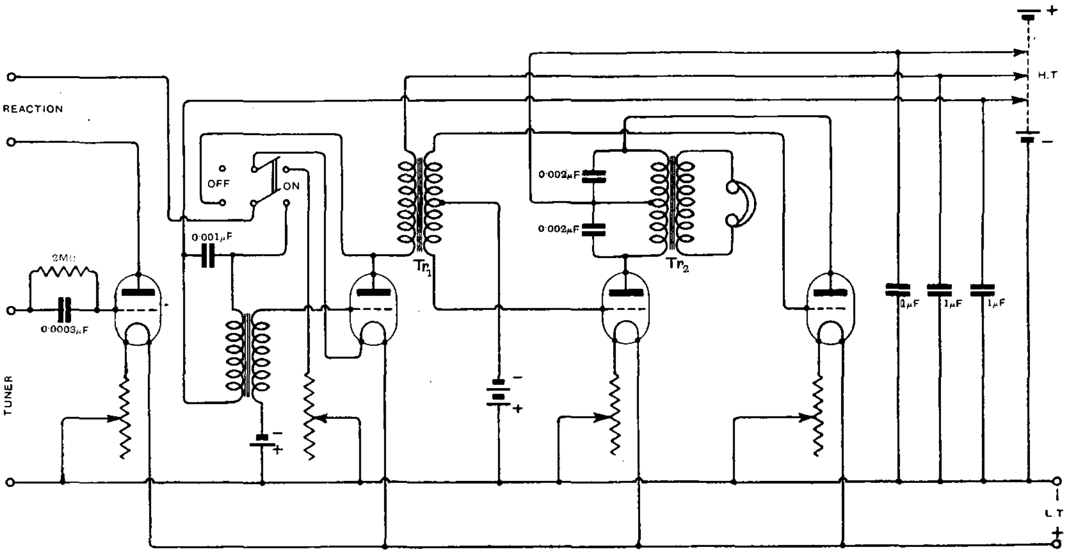


Fig. 3. " *A.H.H.*" (*Alcester*). *A receiver consisting of a valve detector, optional note magnifier, and a push-pull amplifier.*

" *A.H.H.*" (*Alcester*) **asks for a diagram showing the connections of a switch to cut out the first L.F. valve in the amplifier given in Fig. 4, page 773 of the issue of September 5th, 1923.**

The diagram is given in Fig. 3. As requested, suitable values have been indicated for the fixed condensers used in this arrangement. The transformers Tr. 1 and Tr. 2 may be of the same make if high resistance telephones are employed. If it is desired to use low resistance telephones, the secondary winding of Tr. 2 must be modified accordingly. If you find your present amplifier is noisy in operation, it does not necessarily follow that this will be eliminated by using the " push-pull " method. The source of noise in L.F. amplifiers will usually be found in the H.T. and L.T. batteries, and not infrequently in the valves themselves. Microphonic valve noises due to vibration of the electrodes may be diminished by mounting the valve holders on rubber, but crackling noises due to variations in emission of electrons from the filament cannot be cured. If the H.T. battery is in reasonably good condition, noises are not likely to occur if reservoir condensers are connected between each H.T. tapping and −L.T. as in the diagram.

" *F.W.H.*" (*Ipswich*) **asks for particulars of the windings suitable for a telephone transformer for use with 120-ohm telephones.**

The core may consist of a bundle of soft iron wire ½″ in diameter and about /″ long. The bobbin used to hold the windings may be 2½″ long, with cheeks 2″ in diameter. The primary winding should be wound on first, and may consist of 10,000 turns of No. 40 enamelled S.S.C. wire. After insulating with several layers of oiled silk or waxed paper, the secondary winding should be wound over the primary, and should consist of 1,000 turns of No. 34 D.S.C.

" *E.J.H.*" (*Hayes*) **asks for further particulars of the method of obtaining a negative grid bias in the receiver described on page 369 of the issue of December 19th, 1923.**

The advantage of this method of obtaining grid bias over the use of grid cells is that one is relieved from the anxiety of knowing whether the grid cells are in good condition. The disadvantage of the method is that the grid voltage obtained depends upon the value of the total anode current flowing through the main resistance. The grid bias will therefore change whenever the anode current is changed, say through the use of different types of valves. No. 40 S.S.C. Eureka wire will be suitable for this resistance. This particular gauge has a resistance of approximately 37·2 ohms per yard.

" *W.S.*" (*London, W.*3) **is about to erect an indoor aerial, and asks in which direction the top part of the aerial should point, in order to obtain best results from 2LO.**

A small aerial of this type will receive almost equally well in all directions, and it is not worth while taking any trouble to erect the aerial in any particular direction. The wires, however, should not be erected too close to the walls or the ceiling, in order that the efficiency of the aerial may be made as large as possible.

Calls Heard

Contributors to this section are requested to limit the number of calls sent in to those heard in the previous three weeks, these being of greater interest and value to transmitters than earlier records. The repetition of the same call sign in consecutive lists is not recommended. Contributors will also assist by kindly arranging reports in alphabetical order.

Denmark (Ehlersvej 8, Hellerup).
British: **2 ACU, 2 AW, 2 DR, 2 FU, 2 SX, 2 WY, 2 YT, 5 ID, 5 RQ, 6 FG, 6 NH, 6 UD, 6 XQ.** French: **8 AB, 8 AQI, 8 ARA, 8 CG, 8 CI, 8 DD, 8 ÉM, 8 OH, 8 PX, 8 SSU.** Holland: **AB 2, 37 X, 0 AG, 0 BQ, 0 FL, 0 GX, 0 PB, 0 PX, 0 US, 0 ZN, PCII, PCTT.** American: **1 AJP, 1 ALJ, 1 BCF, 1 BDI, 1 CMP, 1 XAH, 1 XAM, 1 XAR, 1 XW, 2 AGB, 3 ZX, 4 BZ, 8 XBT, 8 XS.** Canadian: **1 BQ.** Unknown: **2 T 4** (calling **8 AA** on February 17th on 200 metres). (J. Steffensen.)

Barnes, London, S.W.13 (January 27th to March 25th).
2 FJ, 2 GO, 2 LD, 2 SK, 2 ST, 2 VV, 5 AO, 5 CP, 5 IO, 5 OB, 5 OP, 5 WF, 5 XC, 5 XZ, 5 WX, 6 KI. (Wm. Ford.)

Liverpool (first three weeks of March).
2 ACI, 2 AD, 2 AO, 2 AU, 2 CPD, 2 PZ, 2 JV, 2 KW, 2 KZ, 2 MEC, 2 NM, 2 RP, 2 SH, 2 ST, 2 TO, 2 TR, 2 UQ, 2 YQ, 2 VQ, 2 WP, 2 WK, 2 WRA, 2 XG, 2 XY, 2 YQ, 2 ZT, 4 ZZ, 9 XZ, 1 MT, 1 JW, 5 AW, 5 BT, 5 BV, 5 DN, 5 HG, 5 IK, 5 KC, 5 KO, 5 MO, 5 NH, 5 OC, 5 OT, 5 PS, 5 QM, 5 QV, 5 RH, 5 RQ, 5 RZ, 5 SI, 5 ST, 5 SZ, 5 YI, 6 AH, 6 BT, 6 JX, 6 NF, 6 VP, 6 VQ, 6 XG, 6 ZY, 7 EC, 7 ZM, 0 AA, 0 BA, 0 KY, 0 XO, 0 YF, PCTT, 8 AB, 8 AE 3, 8 AQ, 8 AU, 8 BN, 8 BP, 8 CF, 8 CH, 8 CJ, 8 CT, 8 CW, 8 CZ, 8 DA, 8 DP, 8 DY, 8 ÉB, 8 ÉI, 8 ÉL, 8 ÉN, 8 EM, 8 JD, 8 OH, 8 RL, 8 SSU, 8 ZZ. (o—v—o). (John F. Cullen, **5 OL.**)

Eastbourne.
0 AA, 0 AG, 0 BA, 0 GS, 2 AP, 2 DS, 2 FN, 2 JX, 2 KF, 2 KW, 2 NM, 2 RS, 2 TO, 2 WK, 2 ZU, 5 DT, 5 FS, 5 IG, 5 KO, 5 MO, 5 QM, 5 QV, 5 TZ, 6 FQ, 6 IH, 6 PE, 6 YB, 8 BM, 8 BN, 8 BG, 8 CH, 8 CZ, 8 CJ, 8 CG, 8 CM, 8 DX, 8 FF, 8 JD, 8 PD, 8 SS, 8 YO. (o—v—1.) (D. R. Byfield, **2 ALV.**)

Pendleton, Manchester.
2 AGB, 2 AG, 2 CW, 2 DR, 2 FN, 2 MG, 2 NM, 2 TR, 2 YT (Poldhu), **2 XR, 5 FW, 5 KC, 5 LJ, 5 PC, 5 SI, 5 ST, 5 SZ, 5 TC, 5 WV, 5 WY, 5 QV, 5 OC, 6 FD, 6 LY, 6 PL, 6 UK, 6 XA, 6 XX, 8 AF, 8 CT, 8 CZ, 8 ÉB, 8 SSU, 4 ZZ, 0 MR, 0 BA, 0 KV, 0 XF.** (o—v—2.) (T. R. Johnson.)

Newark, Notts (between March 3rd and 23rd).
British: **2 DD, 2 DF, 2 DN, 2 DU, 2 FN, 2 GJ, 2 GK, 2 HS, 2 JF, 2 JK, 2 KF, 2 KR, 2 LX, 2 MO, 2 ND, 2 NM, 2 NP, 2 NV, 2 PC, 2 PK, 2 QH, 2 QR, 2 RD, 2 SH, 2 TH, 2 TM, 2 TO, 2 TV, 2 VJ, 2 VQ, 2 VW, 2 WD, 2 WY, 2 XF, 2 XM, 2 YQ, 2 YT, 2 YX, 2 ZK, 2 ZV, 5 AW, 5 DN, 5 DU, 5 FV, 5 ID, 5 KO, 5 MO, 5 NN, 5 QV, 5 ST, 5 SZ, 5 TK, 5 US, 5 YI, 5 XE, 5 ZV, 6 BT, 6 FG, 6 HS, 6 MJ, 6 NH, 6 RY, 6 XX.** French: **8 AÉ, 8 AP, 8 AQ, 8 AU, 8 BA, 8 BF, 8 BL, 8 BV, 8 CH, 8 CK, 8 CM, 8 CZ, 8 DD, 8 DK, 8 DO, 8 DP, 8 DU, 8 DX, 8 DY, 8 ÉB, 8 ÉO, 8 JD, 8 KG, 8 MH, 8 ML, 8 OH, 8 QS, 8 RO, 8 SSU.** Dutch: **0 AA, 0 AG, 0 BK, 0 KN, 0 KX, 0 MR, 0 NN, 0 NY, 0 PG, 0 QP, 0 ST, 0 TG, 0 XF, 0 XP, 0 YS, P 2, PA 9, PCRR, PCTT, PCXX.** Danish: **7 EC.** Swiss: **XY.** American: **1 XAM, 1 XAR, 1 XW.** Unknown: **1 ER, 1 ST, 4 ZQ, W 2.** (o—v—1.) (H. Edmonds.)

Copenhagen (since February).
British: **2 AP, 2 AW, 2 DF, 2 DR, 2 FZ, 2 KF, 2 KW, 2 LZ, 2 MM, 2 NA, 2 NM, 2 NO, 2 OD, 2 QH, 2 RB, 2 SM, 2 SZ, 2 SQ, 2 W, 2 WF, 2 WJ, 2 XY, 2 YT, 5 AW, 5 AT, 5 BV, 5 DN, 5 FS, 5 KO, 5 MO, 5 MQ, 5 SZ, 5 UO, 5 US, 5 WQ, 6 AH, 6 JX, 6 NF, 6 NI, 6 RY.** French: **8 AB, 8 AG, 8 AM, 8 AP, 8 AQ, 8 AZ, 8 BA, 8 BF, 8 BM, 8 BV, 8 CF, 8 CS, 8 CK, 8 CT, 8 DY, 8 DU, 8 ÉB, 8 ÉM, 8 ÉI, 8 GF, 8 LB, 8 OH, 8 PX, 8 RO, 8 SSU, FL.** Dutch: **0 AA, 0 AG, 0 BQ, 0 BM, 0 BS, 0 DV, 0 FL, 0 KX, 0 NN, 0 NY, 0 SA, 0 XF, 0 XO, 0 XP, 0 YS, PCII, PCRR, RCTT, PA, PA 9, PA0Y.** Danish: **7 EC, 7 QF, 7 ZM.** Italy: **1 MT, ACD.** Various: **YDL, MSM, 1 RP, 1 TT, 4 ZG, 4 UA, 7 AN.** Luxembourg: **1 JW.** (Borge Jorgensen.)

Havant, Hants.
2 IL, 2 KF, 2 KW, 2 LH, 2 MG, 2 OD, 2 OG, 2 OQ, 2 WD, 2 XG, 2 YQ, 5 AW, 5 BA, 5 DO, 5 DN, 5 HN, 5 ID, 5 LF, 5 MO, 5 NN, 5 PU, 5 SI, 5 SZ, 5 TZ, 6 AH, 6 FG, 6 OX, 6 QB, 6 RC, 6 VP, 6 XG, 6 XX, 8 AÉ, 8 AU, 8 BP, 8 BV, 8 CG, 8 CH, 8 DA, 8 DU, 8 DP, 8 ÉB, 8 ÉI, 8 ÉN, 8 ÉP, 8 FB, 8 JC, 8 RL, 8 AAA, 0 AG, 0 BA, 0 KX, 0 MR, 0 NN, 0 NY, 0 US, 0 XA, PCII, P 2, LOAA, 1 XAR, XY. (o—v—1 and 1—v—1.) (J. E. Sheldrick, **5 IG.**)

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FRANCE.

PARIS (Eiffel Tower), FL, 2,600 metres. 7.40 a.m., Weather Forecasts; 11.0 a.m. (Sunday), 11.15 to 11.30 (Weekdays), Time Signal and Weather Forecast; 12.0 noon, Market Report; 3.40 p.m., Financial Reports; 5.30 p.m., Bourse Closing Prices; 6.15 p.m., Concert; 7.20 p.m., Weather Report; 9.0 p.m. (Wednesday and Sunday), concert; 10.10 p.m., Weather Forecast.

PARIS ("Radio Paris"), SFR, 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.45 p.m., Exchange Prices; 4.30 p.m., Financial Report; 8.30 p.m., News and Concert.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres, 9 p.m. (Sunday, Wednesday, Thursday, Friday and Saturday), Talk on Literature, Dramatic and Musical Selections. 8.15 p.m. to 9.25 p.m. (Tuesday), Morse Practice, English Lesson, Lecture and Concert.

PARIS (Station Du Petit Parisien), 340 metres. 8.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2 p.m. and 6.50 p.m. Meteorological Forecast.

BRUSSELS ("Radio Electrique"), 410 metres. Daily, 6 p.m. and 9.30 p.m., Concert.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 4 to 6 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres, 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9 p.m. (Thursday), Concert.

THE HAGUE (Velthuisen), PCKK, 1,050 metres, 9.40 to 10.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9 a.m. and 5 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m. (weekdays), 8 to 9 (Sunday), Concert.

SWEDEN.

STOCKHOLM (Telegraverts), 450 metres. Monday, Wednesday, Saturday, 7 to 8 p.m.

STOCKHOLM (Svenska Radiobeglets), 440 to 470 metres, Tuesday, Thursday and Sunday, 8 to 9 p.m.

GOTHENBURG (Nya Varvet), 700 metres. Wednesday, 7 to 8 p.m.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,370 metres (Sunday), 10.40 a.m. to 11.45 a.m., Orchestral Concert. 4,000 metres, 7 to 8 a.m., Music and Speech; 12.30 to 1.30 p.m., Music and Speech; 5.0 to 5.30 p.m., News.

EBERSWALDE, 2,930 metres. Daily, 1 to 2 p.m., Address and Concert; 6 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 400 metres. 11 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7 p.m., Concert; 7 to 8 p.m. (Sunday), Concert.

BERLIN (Telefunken), 425 metres. 7.30 to 8 p.m. and 8.45 to 9.30 p.m., Tests and Concert.

FRANKFURT AM MAIN, 460 metres. 7.30 to 10 p.m. Tests Gramophone records.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres. 8 a.m., 12 a.m. and 4 p.m., Meteorological Bulletin and News; 4,500 metres, 10 a.m., 3 p.m., and 10 p.m., Concert.

KBELY (near Prague), 1,150 metres. 7.15 p.m. and 10.0 p.m., Concert and News.

SWITZERLAND.

GENEVA, 1,100 metres (Weekdays). At 3.15 and 8 p.m., Concert or Lecture.

LAUSANNE, HB 2, 780 metres. Daily, 9.15 p.m., Concert and Address.

SPAIN.

MADRID, PTT, 400 to 700 metres. 6 to 8 p.m., Tests.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12 a.m. 1,800 metres. 4 p.m. and 8.30 p.m., Tests, Gramophone Records.

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FRENCH EXPERIMENTS ON TWO-METRE WAVELENGTHS

No. 248 [No. 7 Vol. XIV]

POST OFFICE AND WIRELESS REGULATIONS

THE WIRELESS WORLD AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GREAT BRITAIN.

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F. H. HAYNES.

QUESTIONS AND ANSWERS DEPARTMENT:
Under the Supervision of W. JAMES.

CONTENTS

THE EDITOR will be glad to consider articles and illustrations dealing with subjects within the scope of the Journal. Illustrations should preferably be confined to photographs and rough drawings. The greatest care will be taken to return all illustrations and manuscripts not required for publication if these are accompanied by stamps to pay return postage. All manuscripts and illustrations are sent at the Author's risk and the Editor cannot accept responsibility for their safe custody or return. Contributions should be addressed to the Editor, "The Wireless World and Radio Review," 12 and 13, Henrietta Street, Strand, London, W.C.2.

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The WIRELESS WORLD AND RADIO REVIEW

THE POST OFFICE AND REGULATIONS.

By The Editor.

IT is the prerogative of the Postmaster-General to issue the regulations which govern the use of wireless in this country for experimental purposes.

Since the first regulations formulated after the war were issued, there have been a large number of revisions and amendments, taking the form of statements issued by the Postmaster-General, and published in the Press. As far as we know, however, these statements have not made it clear whether these subsequent revisions to the original regulations were to be taken as amending licences issued to individuals the terms of which were based on the earlier regulations. For instance, if you take a number of individual transmitting licences issued over a period of two or three years, it will be found that nearly all of these differ in the wavelengths authorised, and yet the earlier licences have never been recalled by the Post Office for amendment, and the owners believe that they would be acting within the terms of their licences if they continued to use the wavelengths and times of transmission set forth therein.

We believe that the Post Office would be well advised to issue a comprehensive statement of the present regulations which would embody all recent amendments, and it might also be stated at the same time that any licences, particularly transmitting licences, should now be read as amended in accordance with the comprehensive statement.

These, of course, are somewhat trivial matters, and have hitherto not been considered by many amateurs as of vital importance since the Post Office has seldom, if ever, taken any steps to check the transmissions or to enforce the regulations.

The very occasional inspections which have been carried out by the Post Office officials in the past were mostly made by persons unacquainted with the technicalities of the subject, and consequently unable to conduct a proper inspection.

From information which has recently reached us it appears that the Post Office authorities have at last been roused to an appreciation of their responsibilities, and have entrusted the work of inspection of amateur transmitting stations to at least one individual, who, from all accounts, has the necessary qualifications to enable him to carry out his duties satisfactorily.

This more vigorous action on the part of the Post Office has no doubt been taken for the reason that one or two transmitting licensees have been abusing the terms of their licences, whilst there is no doubt that a good many unlicensed transmissions have also been taking place.

Any action taken by the Post Office which will serve to control transmissions by unlicensed persons or to bring to book those few individuals who, although licensed, do not hesitate to make themselves a nuisance to other people, will be welcomed by transmitters generally and by all amateurs and listeners in.

It is hoped, however, that if the Post Office has occasion to withdraw any licences from individuals that they will not do so on the grounds of any breach of what may be termed "ill-defined regulations," and it is mainly for this reason we advocate that, before taking vigorous steps to round up offenders, the authorities should issue such a comprehensive statement as would abolish all uncertainty regarding the conditions under which experimental transmissions may be conducted.

COMPOUND DIELECTRIC CONDENSERS.

Variable condensers operated by driving the plates apart by means of a screw are sometimes fitted with a mica plate to avoid chances of short circuit when the condenser plates are brought near together. The properties of variable condensers built in this manner are here discussed, and by means of curves and the capacity changes for given variations in the spacing of the plates are shown when mixed air and mica dielectric is employed.

THE advantage of combining large capacity range with lightness, cheapness, and convenience, makes the compound dielectric variable condenser a very attractive proposition, but its disadvantages through certain tuning ranges detract considerably from its utility.

Briefly, the condenser consists of two thin circular metal discs, one fixed and the other capable of being moved co-axially towards or away from the fixed disc, with a mica, vulcanite, or rubber disc between them. Maximum capacity is given by closing the plates hard against the solid dielectric; minimum capacity by parting them and thus adding an air dielectric of variable thickness. It will be seen from what follows that the capacity curve for this type of condenser is a hyperbola, and that tuning on the higher values is much too coarse, and on the lower values too slow. Only over a very limited range does the capacity vary proportionately (approximately) with the rotation given to the screw.

The maximum capacity of the condenser depends on the thickness of the solid dielectric, being a maximum when the thickness is a minimum. For this reason mica is generally used as it can be obtained in varying thicknesses down to 1/1000th of an inch. In what follows mica has been taken as the solid dielectric. To enable maximum capacities of condensers of various diameters to be determined quickly, the series of graphs shown in Fig. 1 has been plotted. These cover diameters varying from 1 in. to 5 ins., with a mica dielectric ranging in thickness from 1/1000th to 10/1000ths of an inch. As an example, the capacity of a 3-in. diameter condenser with a 5/1000 in. mica dielectric is determined by reading up from the "5" graduation until the 3-in. graph is reached, and then across to the vertical scale, giving a reading of 0·002 mfds. In-

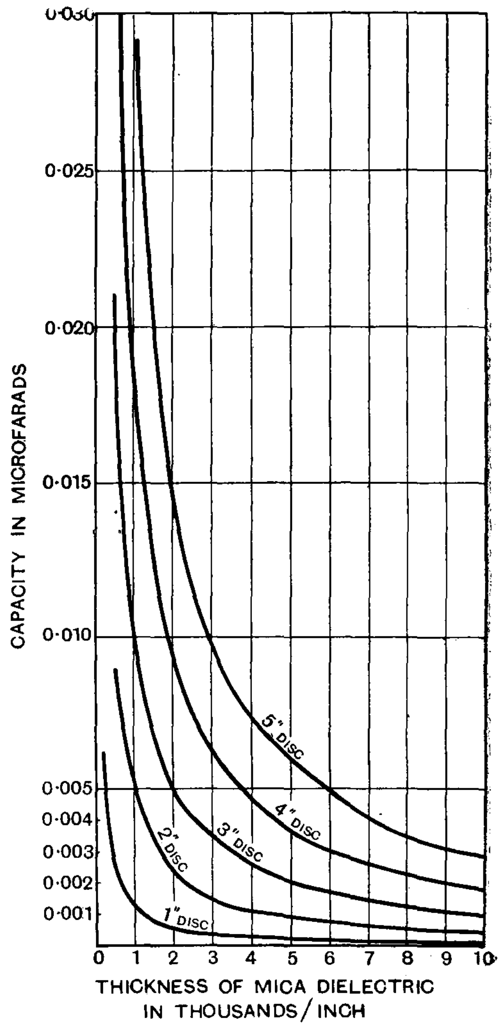


Fig. 1. The curves show the maximum capacity of circular variable condensers with mica spacing.

termediate values may be calculated by using the formula

$$C = \frac{0{\cdot}00117D^2}{t}$$

where D is the disc diameter in inches and t is the thickness of the dielectric in thousandths of an inch.

The capacity with an added air dielectric is given by

$$C = \frac{0{\cdot}0001763D^2}{d - \frac{5{\cdot}64t}{6{\cdot}64}} \text{ where}$$

D = disc diameter in inches.
d = total distance between plates in thousandths of an inch.
t = thickness of solid dielectric in thousandths of an inch.

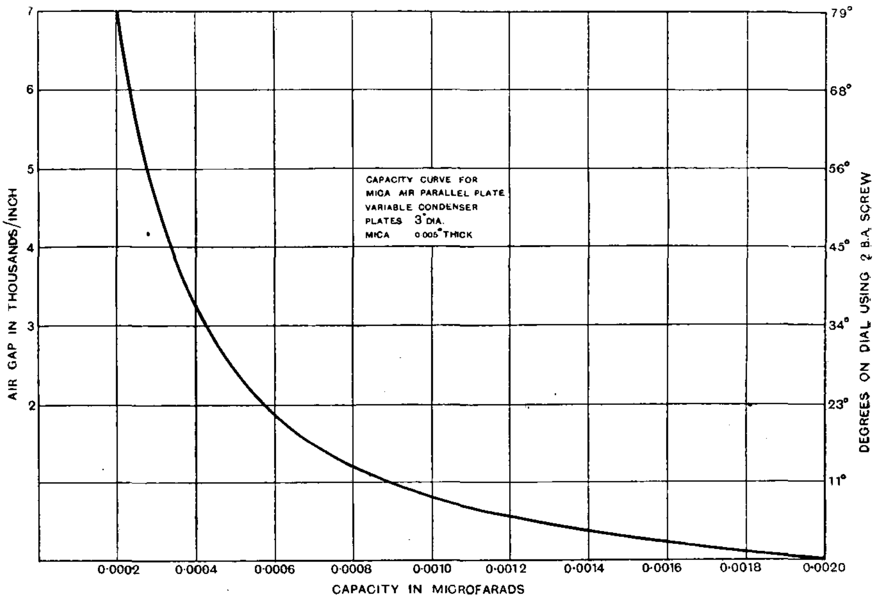


Fig. 2. An interesting curve showing the capacity changes produced by rotating the dial of a screw-operated variable condenser.

Fig. 2 shows a capacity graph plotted from the above formula for the case given in the previous paragraph, *i.e.*, 3-in. discs with 5/1000ths mica sheet, the maximum capacity of which is 0·002 mfds. It will be seen that an air gap of only 1/1000 in. reduces the capacity to 0·0009 mfds! Using a 2 B.A. screw to actuate the movable disc, this means that 11 degrees rotation decreases the capacity of the condenser by more than 50 per cent. At the other end of the scale, the minimum capacity end, the reverse is the case, complete revolutions of the screw giving little decrease in capacity. The following comparison illustrates the point for the condenser in question. When the capacity is 0·0015 mfds., 1 degree on the dial reduces it by 0·00012 mfds. When the capacity is 0·00015, 1 degree on the dial reduces it by 0·000001. In other words 120 degrees rotation at one point gives the same variation in capacity that 1 degree of rotation gives at another. This case is selected within the working range of the condenser, while other more extreme values show much greater variations.

Fig. 2 may be regarded as being typical of capacity curves for compound dielectric condensers. The curve is a hyperbolic one and shows that, for higher values, tuning on these condensers is much too coarse, and for lower values much too slow. Only over a small range are such condensers as convenient as the multi-vane type.

W. A.

AN INSTRUMENT TO COMPARE SIGNAL STRENGTHS.

Accurate measurement of signal strength requires great care and somewhat elaborate and expensive apparatus. The instrument here described will serve as a very fair means of comparing signal strength which is so important a matter in recording experimental results.

By A. Castellain, B.Sc. A.C.G.I.,

It has often struck the writer that some more reasonable scale than the usual R scale should be used in the estimation of signal strength. It is very obvious while listening-in on amateur wavelengths that no two people mean the same strength by R7 for example.

The ideal way to measure signal strength would perhaps be to pass the rectified signal current through a sensitive microammeter and so measure it directly. However, sensitive microammeters are costly and consequently the method is not suitable for average amateur use.

One of the simplest methods of estimating signal strengths is to shunt the telephones with a variable resistance, which is altered until the signal is only just audible. It will be seen that the stronger the signal the smaller must be the resistance in order that the signal may only just be heard in the telephones.

Suppose T is the resistance of the telephones and R the shunting resistance. Let i be the signal current and a the current which will give just audible signals in the telephones. Then i may be expressed in terms of R, T and a. Thus :—

$$\frac{a}{i-a} = \frac{R}{T}$$

$$\text{whence } i = \left(\frac{T+R}{R}\right)a$$

or i varies as $\frac{T}{R} + 1$ as a is assumed constant.

This reasoning is correct assuming that the impedance of the telephones at the signal frequency is equal to their resistance, and that the signal frequency always remains constant, neither of which assumptions hold in practice.

However, as very few amateurs have facilities for telephone impedance measurements, and as in any case this method is only useful for comparison purposes, the telephone impedance may be taken as the marked resistance of the telephone windings.

The constancy of frequency may be approximated by always testing signal strength on speech, and not on music or gramophone records.

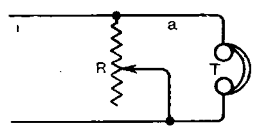


Fig. 1.

It is also convenient to adjust the shunting resistance until it is only just possible to distinguish what is being said.

The scale of signal strength is thus fixed by the equation signal strength $= \frac{T}{R} + 1 = S$.

e.g., Suppose $T = 4{,}000$ ohms.

(1) If $R = 500$ ohms $S = \frac{4{,}000}{500} + 1 = 9$ weak.

(2) If $R = 100$ ohms $S = \frac{4{,}000}{100} + 1 = 41$ strong.

The instrument to be described is a shunting resistance variable in steps, each step corresponding to a signal strength on the above scale.

MATERIALS REQUIRED.

(a) Ebonite panel, not less than 7″×5″×¼″ and box to suit about 2½″ deep for 2,000 ohm and 5″ deep for 4,000 ohm. 'phones.

(b) 50 yds. or ¼-oz. 38 S.W.G. Eureka D.C.C. or S.C.C. wire for 2,000 ohm 'phones and double this amount for 4,000 ohm 'phones.

(c) 3 dozen ¼″ contact studs with nuts and washers.

(d) Complete switch arm and bush.

(e) Four terminals.

(f) Piece of phosphor bronze strip, 4½″×½″×$\frac{1}{32}$″.

(g) Cardboard tube, 3¼″ diameter and 2″ long, for 2,000 ohm and 4½″ long for 4,000 ohm 'phones.

(h) Paraffin wax, sealing wax, and 1 yd. heavy gauge tinned copper wire.

A foot rule divided into inches and tenths right up to one end is also required.

THE PANEL.

The panel should be squared, marked out as in the dimensioned sketch and drilled.

The diameter of the pitch circle of contact studs is 4·3 inches, so that a special phosphor bronze arm will have to be made to fit in place of the 1½ in. arm on the bought switch.

The slot in the end of the switch arm is for the purpose of reading the number of the stud on which the arm happens to be.

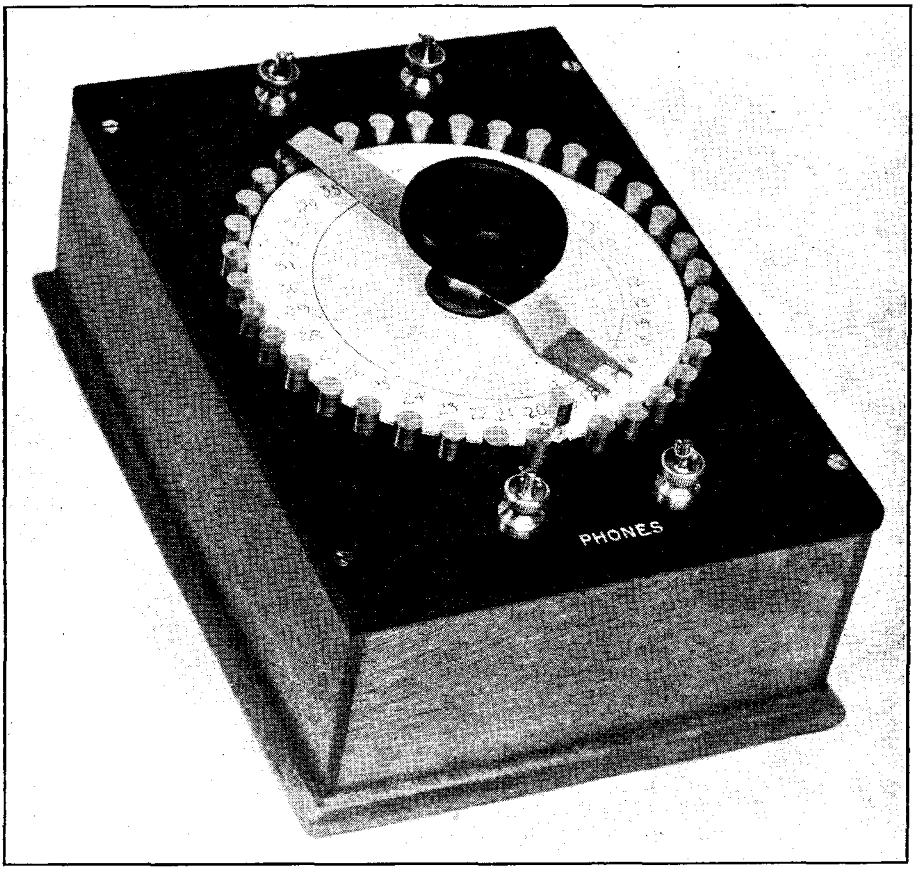


Fig. 2. An illustration of the instrument described in this article.

A 4-in. disc. should be cut out of stiff white paper and a 3-in. diameter circle drawn on it in ink. A centre hole must be cut just large enough to slip over the bush of the switch arm.

The paper disc is held in position on the panel by the "off" stud. This stud has two flats filed on it so as to clear the arm, and is fixed on to the panel as follows :— The paper disc is placed over the centre bush inside the ring of contact studs. A nut is screwed on to the "off" stud, which is then pushed through the paper and secured by another nut on the underside of the panel. The height of this stud should be so adjusted that the switch arm will be lifted clear of the other studs as it passes over. The reason for having an "off" stud of this nature is that it is very easy to find in a hurry.

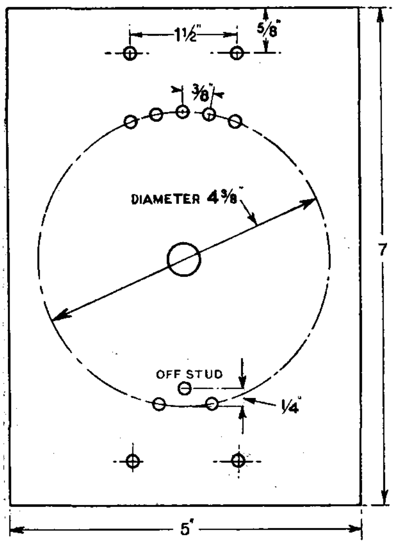


Fig. 3. A guide to the lay-out of the panel.

The new phosphor bronze arm should be polished with fine emery paper and lacquered, and the whole switch assembled.

The bottom of each contact stud and of the four terminals must now be tinned with a very hot iron and small pieces of tinned copper wire about ⅜-in. long soldered T fashion (and pointing to the centre) to the last 20 studs, after which all nuts should be tightened up.

THE RESISTANCE.

This is made in two parts, (1) lengths of wire in loops between the last 20 studs and (2) tappings to the remaining studs from turns wound on the cardboard former.

A table is given for 2,000 ohm and 4,000 ohm 'phones, of lengths of 38 gauge Eureka wire required between studs.

METHOD OF FIXING WIRE.

Take for example the wire between studs Nos. 24 and 25 (2,000 ohm 'phones).

(*Note.*—The numbers 3 to 37 (on the signal strength scale) should be scratched on the underside of the panel against the appropriate stud).

Unwind about 10 ins. of wire from the reel, bare ¼ in. at the end, and tin. Solder this end, using a very hot iron, to the inside end of the T-piece on No. 25 stud. When cold, pull the wire to see if it is properly set.

Now put the end of the foot rule on the T-piece by the wire, measure off about ½ in. more wire than is required and cut and bare the last ¾ in. Put the end of the rule on the T-piece again and, holding the bare part of the wire between the first finger and the thumb of the left hand, pull the wire tight against the rule and kink it at the correct length against the second finger nail of the left hand.

This operation is done in much less time than it takes to describe and is not difficult after it has been done once or twice.

The spare wire after the kink should be tinned and soldered to the inside end of the T-piece of No. 24 stud, taking care that the solder comes right up to the kink.

The next wire will start from the outside end of the T-piece of No. 24 stud and finish on the outside end of No. 23 T-piece and so on. In this way the resistances between studs 37 to 18 are obtained quite accurately.

Between each of the studs 18 to 3 the length of wire required is over 1 ft. and so cannot be measured very easily on the rule ; also the loops of wire formed would be excessively long, so that the method of winding the wire on a tube is adopted.

At this point it should be remarked that even if 3¼-in. diameter tubing is available, it is as well to measure the circumference of the tubing by measuring the length of one turn of the 38 gauge wire.

In the author's case this length was 10·43 ins. and figures are given for 2,000 ohm 'phones for this circumference.

The calculations for any other length of circumference are quite simple, as the length of wire required is given in the tables.

Thus :—

Length of wire required 315 ins. (say).
30 turns on 10·43 in. circumference .. 312·9 ins.

2·1 ins. over.

TABLES FOR 2,000 ohm 'PHONES.

Stud No. $= \frac{T}{R} + 1$	R in ohms.	Length of wire between Studs. 38 S.W.G. Eureka	Length of wire in winding. (yards).	Tapping at Turn No.	Length of wire over. (inches).
3	1000	—	36·75	127	—
4	666·67	—	22·75		
5	500	—	15·75	78	5·46
6	400	—	11·55	54	3·78
7	333·3	—	8·75	39	9·1
8	285·7	—	6·75	30	2·1
9	250	—	5·25	23	3·1
10	222·2	—	4·083	18	1·26
11	200	—	3·15	14	0·98
12	181·8	—	2·3864	10	9·1
13	166·77	—	1·75	8	2·56
14	153·84	—	1·2115	6	0·42
15	142·86	—	0·75	4	1·88
16	133·3	—	0·35	2	6·14
17	125	—	0	1	2·16
		11·11″			
18	117·65		—	Circumference of tube = 10·43″	—
		9·9″			
19	111·1		—		—
		8·83″			
20	105·26		—		—
		7·85″			
21	100		—		—
22	95·24	7·20″	—	—	—
23	90·9	6·56″	—	—	—
24	86·95	5·97″	—	—	—
25	83·33	5·47″	—	—	—
26	80	5·03″	—	—	—
27	76·92	4·66″	—	—	—
28	74·07	4·31″	—	—	—
29	71·43	3·99″	—	—	—
30	68·97	3·72″	—	—	—
31	66·67	3·48″	—	—	—
32	64·52	3·25″	—	—	—
33	62·5	3·05″	—	—	—
34	60·6	2·87″	—	—	—
35	58·824	2·68″	—	—	—
36	57·43	2·54″	—	—	—
37	55·56	2·4″	—	—	—
		84″			
Terminal	0		84″	8 turns	0·16″ over

The "2·1 in. over" is used to connect the tapping point to the correct stud, and if this is not enough, the difference is made up of thick tinned copper wire.

Before starting to wind the tube, about 3 yds. of wire should be cut off for the various odd lengths such as 2·1 ins. above.

Two pieces of tinned copper wire about 1 in. long should be pushed through the tube near one end and about $\frac{1}{4}$ in. apart, leaving their ends just projecting. This is for the beginning and end of the 8 turns (in the case of 2,000 ohm 'phones), which represent signal strengths greater than 37.

About $\frac{1}{8}$ in. further down on the other side of the tube another piece of tinned copper wire about $1\frac{1}{2}$ ins. long must be pushed through for the start of the rest of the winding.

The tappings are made as follows :—

The wire is bared for about $\frac{3}{8}$ in. at the end of the required turn, without breaking the wire, and a piece of the spare wire about 1 in. longer than required (thus about 3 ins. long in the case considered above), which has $\frac{1}{4}$ in. bared at one end, is twisted twice round the bare space on the first wire at the required point. The join should be touched with fluxite on the end of a match and quickly soldered with a very hot iron. The bare portions of the wires may now be thinly covered with hot sealing wax and the joint pressed on to the cardboard former while the wax is still hot. In this way each tapping is fixed to the tube and is thus well protected during the rest of the winding.

It is advisable to reverse the direction of winding every 20 turns or so, the "reverse" being made half-way round the tube from the tapping points and fixed with sealing wax; this is in order to keep the winding more or less non-inductive.

When all the turns have been put on, the tube is fixed to the underside of the panel inside the ring of studs with sealing wax. The connections to the remaining studs should now be made, the correct lengths of wire being found and fixed as before.

When all the connections have been made, and all the nuts tightened up, melted wax may be poured on the winding and over the studs. The loops of wire should be pulled straight and lightly fixed to the end of the tube by dabs of paraffin wax.

Those loops which will not conveniently go on to the tube may be fixed in a similar manner to the panel.

Finally, the stud numbers should be written on the paper disc in the slot of the switch arm, and each should correspond to the number of the stud with which the arm is making contact.

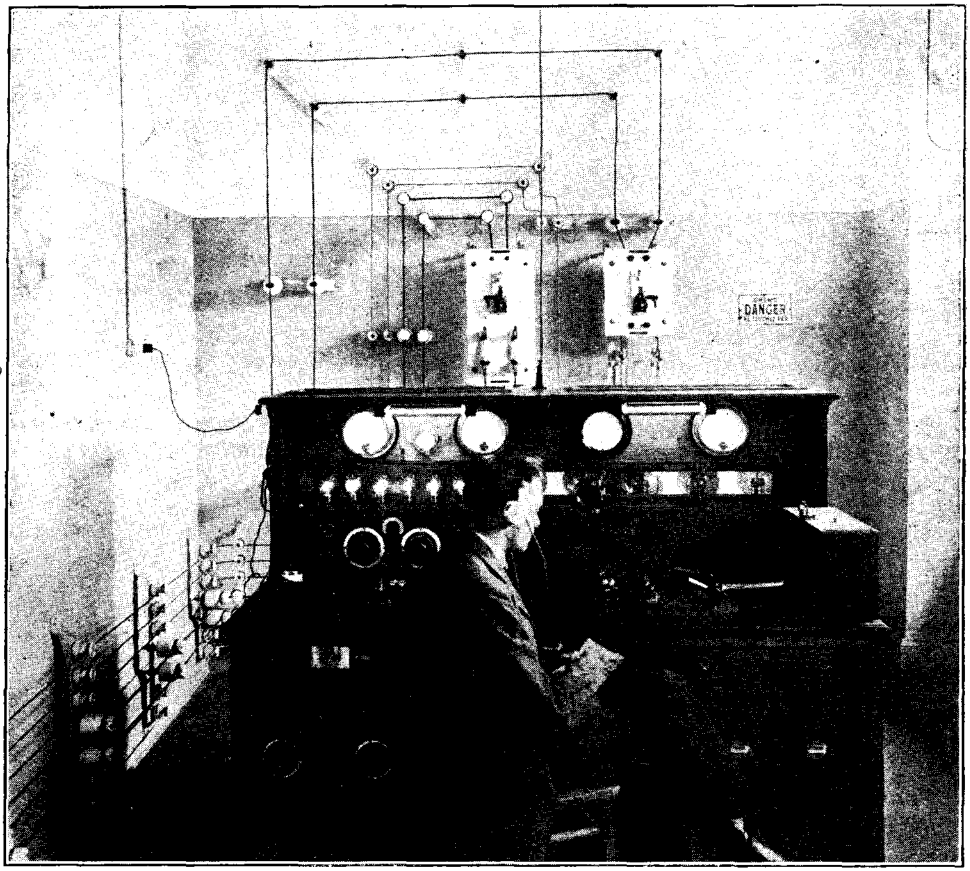
USE OF INSTRUMENT.

This instrument may be used, for example, to compare the signals given by various circuits on the same transmitter, or for assisting an amateur who wants to know what are the effects of his various transmitter adjustments on his received signal strength.

The instrument should not be used in a valve detector circuit when the receiver is very nearly oscillating, as altering the shunting resistance usually alters the circuit conditions enough for the receiver to start oscillating. However, this trouble does not occur when a good telephone transformer or a note magnifying valve is used after the detector.

In conclusion, this instrument will well repay time and trouble spent in making it, and, although it is useless for absolute measurements of signal strength, yet it is of far more value for general amateur use as a comparative scale than the R scale.

A SWISS BROADCASTING STATION.



The interior of the control room at the Aircraft Station at Lausanne. This station is also used at times for Broadcast Transmissions.

AN EXPERIMENTAL BOARD.

It is a curious fact that although many devotees to wireless provide themselves with numerous component parts of wireless apparatus yet so many begrudge the time and outlay for the construction of an experimental panel which would enable them to carry out their experiments in a systematic manner.

By A. J. BULL.

SUCCESSFUL experiments can and often have to be carried out by arranging a few components upon a convenient table or bench and making the necessary connections by means of covered copper wire, but such a procedure tends to confusion, is slow and cumbersome, and sooner or later the penalty is paid in the shape of H.T. batteries shorted, valves accidentally burnt out, and a low percentage of successful experiments.

The design for an experimental board which has given satisfactory results is shown in Fig. 1. It will be noticed that provision is made for the employment of from one to six valves and that the value of the H.T. and L.T. batteries respectively can be different for each valve.

On the other hand, should it be desired that the value of the H.T. battery shall be common to all the valves in use, then the H.T. terminals numbered from 1 to 6 can be instantly connected together by a piece of bare wire, and the battery inserted between " H.T. + " and " H.T. – " in the usual manner. Likewise if the value of the L.T. battery is common to all the valves in use it is only necessary to short the L.T. positive terminals numbered from 1 to 6 in a similar manner and insert the common battery between " L.T. – 6 " and " L.T. + 6."

The sets of terminals marked " P " and " S " are of course intended as connections for intervalve transformers and sufficient space has been allowed between P, P, and S, S, to accommodate a transformer or other

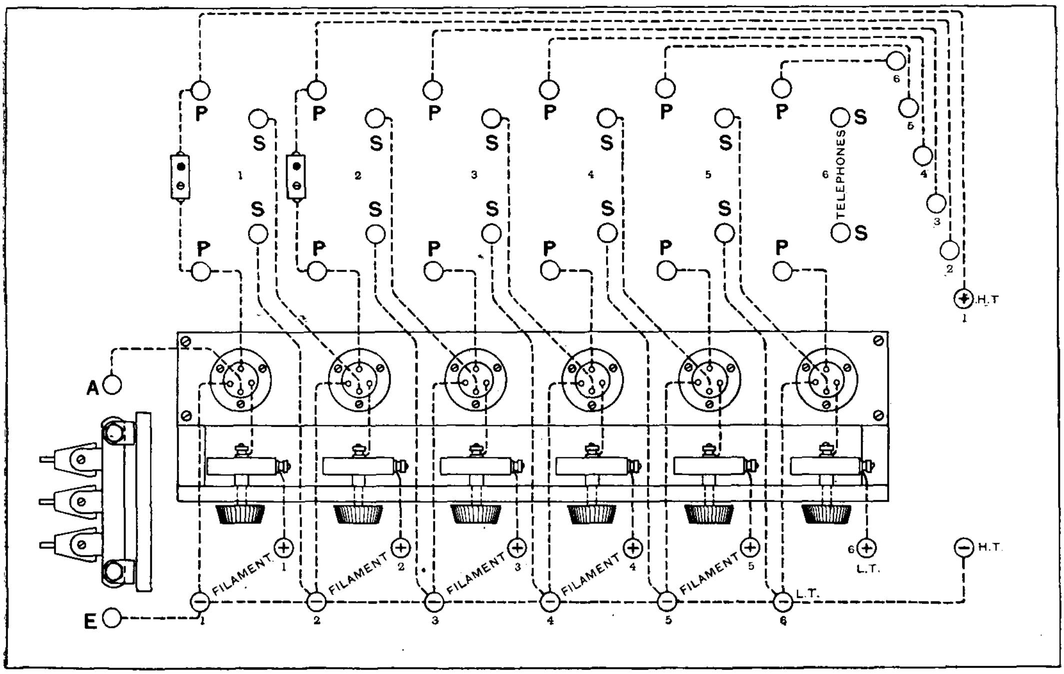


Fig. 1. Lay-out and connections of the experimental valve panel.

apparatus usually employed for connecting the output of one valve to the input of the next.

If the resistance method of high frequency amplification is required for valves 1 and 2, connections can be made as in Fig. 2, the coupling condenser, 0·0002 mfd., being joined between the lower anode terminal marked P and the top secondary terminal marked S. It will be found that resistances and condensers can be conveniently mounted on a small wooden panel as shown, no further insulation being necessary, as the resistances are marketed fixed between spring clips and mounted upon a small piece of ebonite complete with two terminals. Experiments employing the tuned anode method of high frequency amplification (Fig. 3) can easily be arranged for valves 1 and 2 by plugging suitable coils into the coil sockets provided, connecting suitable condensers to terminals marked P, and utilising the small unit in Fig. 2 (with the anode resistance removed) for coupling the valves together.

Although the construction of the experimental board is obvious and simple, yet to those whose leisure time is very limited, the following constructional details and hints may prove useful.

The base measures 2′ 6″ × 1′ 7″ × $\frac{1}{2}$″ and is constructed of hard wood stiffened at each end by wooden battens. Forty-five holes are bored in the board in the positions indicated in the drawing to receive ebonite bushes for the purpose of insulating the 45 terminals. The bushes can be purchased to size or cut from ebonite rod. If rod is utilised it should be cut to $\frac{5}{8}$-in. lengths and holed to receive the type of terminal selected. The bushes can be fixed to position in the board by means of cold glue and arranging that the bushes shall be a driving fit in the holes in the board. By arranging that the bushes are $\frac{5}{8}$ in. in length they will, when in position, slightly protrude above and below the baseboard, thus avoiding the necessity of ebonite washers. The diameter of the ebonite bushes will, of course, depend upon type of terminals utilised.

For the purpose of mounting the filament rheostats, a piece of board is prepared measuring 1′ 8″ × 3$\frac{1}{2}$″ × $\frac{1}{4}$″ and is fixed perpendicular to the baseboard by means of two brass angle pieces. To a similar piece of wood, but measuring 1′ 8″ × 2$\frac{3}{4}$″ × $\frac{1}{4}$″, and supported one inch above the base by two pieces of wood, the valve holders are ecured.

The adoption of the valve holders of the type shown in the illustration is recommended as by their use it is only necessary to bore six holes, each $\frac{7}{8}$″ in diameter (3$\frac{1}{4}$″ between centres), and attach the valve holders in position by means of small screws. The capacities between the valve legs set up by the use of solid mounted valve holders is negligible as compared with the capacities present in the valve, though it is advisable to select holders built with reliable insulating material.

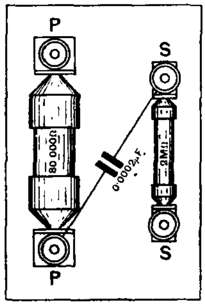


Fig. 2. Connections for H.F. resistance capacity coupling.

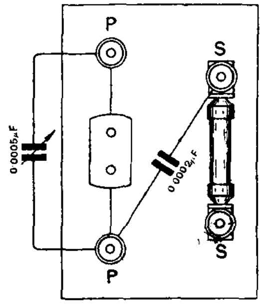


Fig. 3. Tuned anode H.F. coupling.

Wire connections, as indicated by the dotted lines in Fig. 1, can easily be followed. All of the permanent connections should be soldered, and made on the underside of the board.

Catalogues, ect., Received.

Scientific and Electrical Utility Co. (36, St. Paul's Road, King's Cross, Halifax, Yorks). Pamphlet describing the firm's wireless construction service, whereby sets are built up to customers' designs, free of cost, provided components are purchased from the Company.

Radiax Limited (4 Percy Street, London, W.1.). Catalogue No. 17a, illustrating and describing the firm's wide range of accessories and components.

Eagle Engineering Co., Ltd. (Eagle Works, Warwick). A well-produced brochure dealing with Chakophone Wireless Receivers and Accessories.

Hart Collins, Ltd. (38a Bessborough Street, Westminster, S.W.1). A sixteen-page booklet containing instructions in operation of Hart Collins wireless receivers, together with a price list.

A. H. Hunt, Ltd. (H.A.H. Works, Tunstall Road, Croydon, Surrey). General Catalogue, No. 52, of electrical, motor cycle, automobile and wireless accessories and specialities. With details of Hellesen batteries.

L. J. Chambers & Co. (Andrew Works, Cowthorpe Road, Wandsworth Road, London, S.W.8). Catalogue of a varied range of wireless component parts.

Chloride Electrical Storage Co., Ltd. (57, Victoria Street, S.W.1.). Battery Service Technical Letter, No. 4. Leaky Battery Boxes.,

Hindle, Son & Co., Ltd. (Union Engineering Works, Haslingdent Manchester). Illustrated leaflet, descriptive of Hindle Broadcast Receivers.

VALVE TESTS.

THE MULLARD "WECOVALVE" AND ONE-VOLT "ORA."

THE WECOVALVE.

LOW consumption filaments may be divided roughly into two groups: those in which the current is very small, and those requiring a very small voltage, the subject of our review falling under the latter heading.

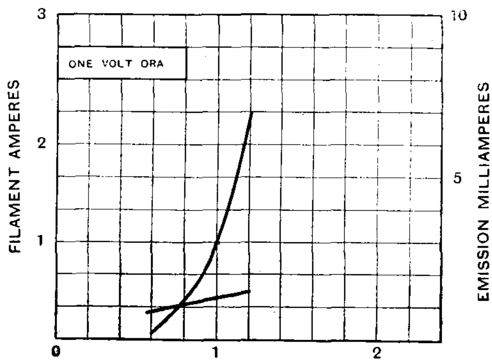


Fig. 1.

Originally hailing from the other side of the Atlantic, the Wecovalve has attained great popularity in this country and is now supplied with a standard four-pin base. It is fitted with a comparatively thick but stubby filament and is rated as 0·25 ampere at 1 volt.

Our standard tests were applied to a valve of recent production and the characteristics of the filament are given in Fig. 1, showing the tested sample to pass a current exactly in accordance with its rating, which produced an emission of 5·5 milliamperes.

The anode current-grid potential curves shown in Fig. 2 are seen to be particularly good, that at the higher anode potential being straight and steep over an extended range and good distortionless low frequency amplification at this potential should be obtained. The curves of Fig. 2 are of great value to the experimenter as they indicate amongst other things the amount of negative grid bias which should be applied for satisfactory low frequency amplification.

The curves of Fig. 3 give the magnification factor, plate impedance, and plate current as functions of plate voltage, the voltage of the grid being zero. Except at very low potentials the magnification is about 7 to 1 with an impedance of from 16,000 to 20,000 ohms. This ratio is very good, and is no doubt due mainly to the closeness of the electrodes. For the moment we will defer the results of the practical test on the Wecovalve and consider tests made with a somewhat similar valve.

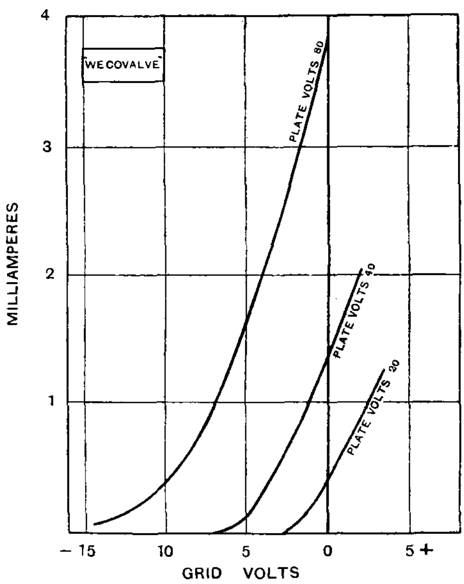


Fig. 2.

THE ONE-VOLT "ORA."

The reason we have taken these two valves together is because of the similarity of their internal arrangements. At first sight it would appear that the one-volt Ora was merely the Wecovalve electrodes placed in the standard Ora bulb, but closer inspection shows, that at any rate, the anode to be of slightly greater diameter.

Static tests are given in Figs. 4, 5 and 6, which the reader may compare with Figs. 1, 2 and 3, which refer to the Wecovalve.

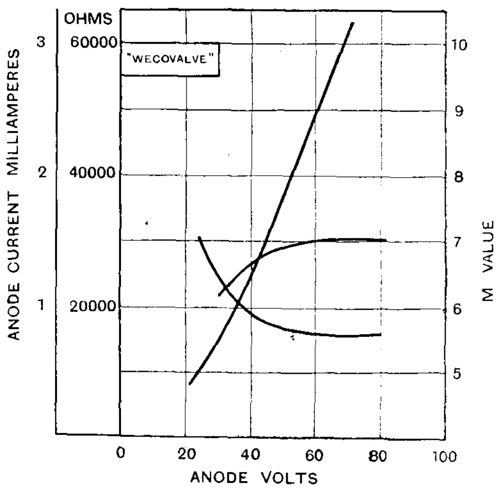


Fig. 3.

The filament efficiency of the sample tested was found to be somewhat less than normal, being but 3 milliamperes at one volt, and in order to obtain the curves of Figs. 5 and 6, we increased the filament volts to the upper limit (1·1) which voltage it will be seen from Fig. 4, brings the emission up to 5 milliamperes. At moderate plate potentials the magnification and impedance are 8·3 to 1 and 45,000 ohms respectively.

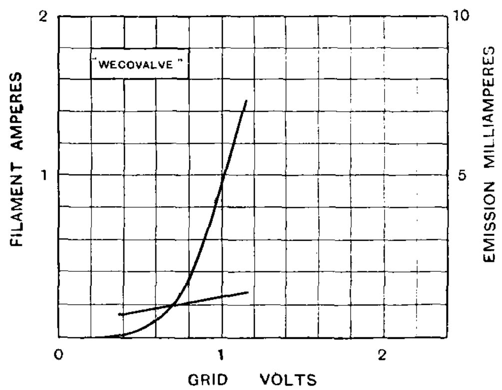


Fig. 4.

Valves of Mullard manufacture are of good mechanical construction and finish and in this direction those under review leave nothing to be desired.

On a practical test both types were found to be excellent rectifiers, the Wecovalve operating well on 20 volts, whereas the one-volt Ora required a somewhat higher value of plate potential, say 30 to 40.

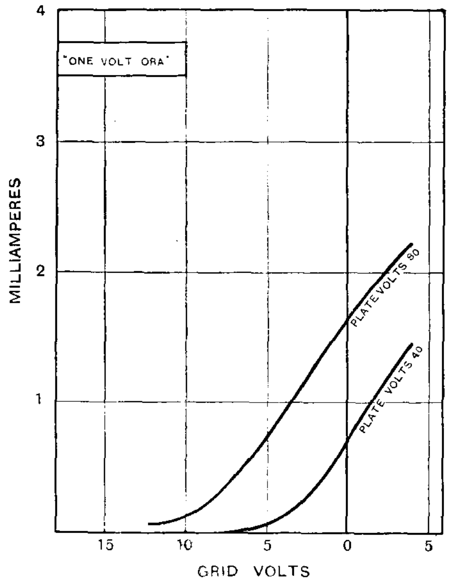


Fig. 5.

As a high frequency amplifier the one-volt Ora was distinctly the better, the Wecovalve being rather apt to burst into

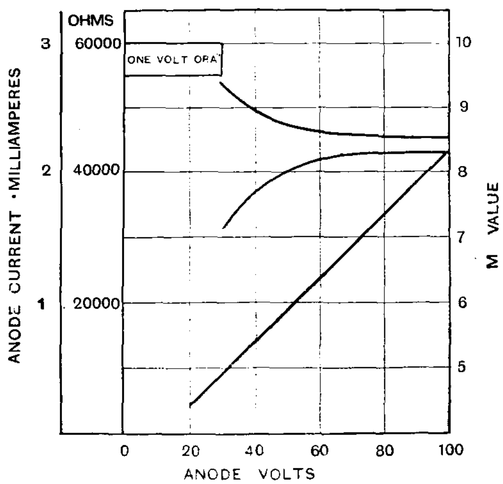


Fig. 6.

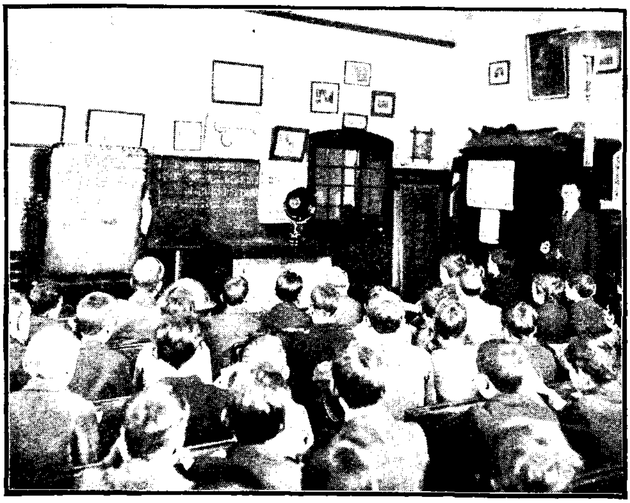
oscillation and a fairly large amount of grid damping was required to stabilise the set.

Both types are quite good on the low frequency side and with a plate potential of 80, good amplification was obtained, a grid bias of 4 and 3 being respectively used for the Wecovalve and one-volt Ora.

EDUCATIONAL BROADCASTING.

The introduction of educational broadcasting specially arranged for school education purposes is due to the initiative of the Schools Radio Society of Great Britain, which is a section of the main Radio Society. The hearty co-operation of the B.B.C. in carrying out the scheme is almost a guarantee of its future success.

In connection with these special transmissions arranged by the B.B.C. for the purpose of exploring the possibilities of broadcasting for educational purposes, it is interesting to note that very successful demonstrations have been carried out at various schools all over the country. Two particularly successful demonstrations were made recently at the Wheatley Street Schools, Coventry. The first occasion was on April 4th, when a lecture on "Music," by Sir Henry Walford Davies, was transmitted from the London station. The second transmission took place on April 11th, when a lecture on the "Migration of Birds," by Mr. E. K. Robinson, was broadcast.

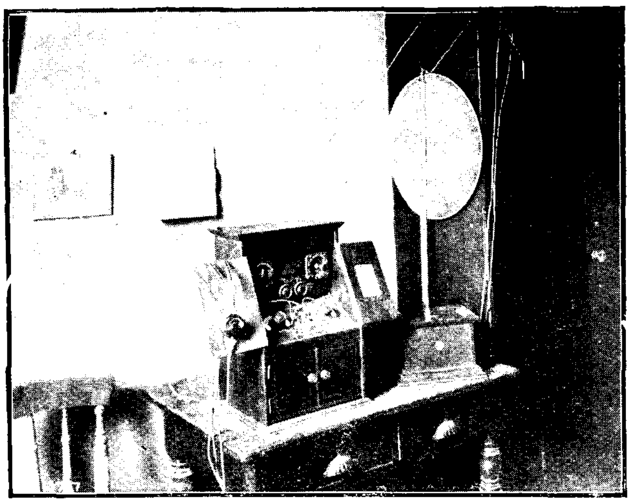


Broadcasting a lecture at the Wheatley Street School.

The receiving apparatus used on both occasions was of B.T.H. standard. On April 4th a single B.T.H. loud speaker was installed in one of the classrooms, and the lecture was heard quite clearly and distinctly by a double class of 70 boys. On the second occasion three B.T.H. loud speakers, connected in parallel, were installed in three separate classrooms, and the lecture was given simultaneously to three double classes totalling approximately 210 boys.

The representatives of the local education authority who were present at the second lecture expressed their complete satisfaction and keen interest with the results obtained.

The two demonstrations referred to were carried out by the British Thomas-Houston Company, Ltd., who manufactured and supplied the apparatus.



This picture shows B.T.H. apparatus installed in the head-master's private room at the School.

THE TRANSATLANTIC TESTS.

REPORT OF RECEPTIONS OF EUROPEAN SIGNALS BY AMERICAN AND CANADIAN STATIONS.

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

(*Concluded from page 159 of previous issue.*)

3 OT, I. B. Smith Jr., 1 Lindenwold Terrace, Ambler, Pa.
2 SZ, 5 PU, 8 AB, 8 BF.

3 APV, B. J. Kroger, 1630 Third Street, N.W., Washington, D.C.
2 OD, 2 SZ, 5 KO, 8 AB, 8 ARA, 8 BF, PCII.

3 CHG, E. R. Gabel, 412 Meredith Street, Kennett Square, Pa.
8 AB.

3 YO, Lafayette College, Easton Pa.
2 SZ, 8 AB, 8 BF, PA 9.

3 ZO, H. A. Beale Jr., Parkesburg, Pa.
8 AB, PCII.

3 CA, J. E. Wohlford, 118 Cambridge Street, Roanoke, Va.
8 AB.

3 BZ, W. T. Gravely, 854 Main Street, Danville, Va.
8 AB.

3 AB, A. B. Goodall, 1824 Ingleside Terrace, Washington, D.C.
8 AB.

3 ABS, E. F. Schwartz, 605 Mattoax Street, Petersburg, Va.
8 AB.

3 HS, F. Kral, 1814 Kilbourne Place, N.W. Washington, D.C.
2 SZ, 8 AB, PA 9.

3 LN, L. P. Tabor, 111, Iona Avenue, Nazareth, Pa.
8 AB.

3 BMN, R. J. Carr, 617 Union Avenue, Petersburg, Va.
2 SZ.

3 CEG, G. L. Kreider, Box 856, Annville, Pa.
6 NI.

4 BL, L. W. and T. E. Bryant, 307 W. Hillcrest Street, Lakeland, Fla.
8 AB.

5 AC, N. S. Hurley, 710 S. Carolina Street, Mobile, Ala.
8 BF.

8 PK, E. Seiler, Box 114, E. Bloomfield, N.Y.
8 AB, 8 BF, PA 9.

8 TW, J. M. Barnhart, 812 Sherman Street, Steubenville, Ohio.
8 AB, 8 BF.

8 ASB, E. K. Doherr, 704 Washington Avenue, Monaca, Pa.
8 AB.

8 BDR, De Los Underwood, 113 Pine Grove Avenue, Pontiac, Mich.
8 BF.

8 BLI, P. Will, Jr., 7 Highland Heights, Rochester, N.Y.
6 XX.

8 CKN, T. Van Loan, 31 Prospect Avenue, Catskill, N.Y.
8 BF.

8 CTK, J. S. C. Miller, 25 Gelston Street, Buffalo, N.Y.
8 AB.

8 AKN, H. S. Bixby, Dayton, N.Y.
8 AB.

8 AVL, H. F. Butler, 129 Lentz Avenue, Lehighton, Pa.
2 SZ, PA 9.

J. M. Tiffany, Summit, N.J.
5 KO, 6 XX, 8 AB, PCII.

A. R. Tabbut, Bar Harbour, Me.
5 AT, 6 XX, 8 AZ, 8 BE, 8 BF.

W. R. Woodward, 60 Maplewood Avenue, Hartford, Conn.
2 SZ, 8 AB, 8 BF, PA 9, PCII.

Bronx Radio Club, Mr. E. E. Laufer, Sec., 699 E. 137th Street, N.Y.C.
5 KW, 5 AT, 5 BV, 6 XX, 8 ARA, 8 BF, PA 9, PCII, PA0DV.

J. B. Smith, Ambler, Pa.
8 AB.

It may be of interest to summarise the above report, so as to show at a glance which American and Canadian stations reported reception of each British transmitter. This information is set out in Part III below.

PART III.

ANALYSIS OF RECEPTION REPORT.

Call Letters of British Station.	Reported by
2 FN	1 BDT, 1 ANA, 1 BCF, 1 BVL.
2 FQ	1 ANA.
2 FU	1 BDT.
2 IN	1 BDT.
2 KF	1 ANA, Canadian 1 BQ, Canadian 1 DD. (N.Y.C.).
2 KW	1 BDT, 1 ANA, Bronx Radio Club (N.Y.C.).

2 NM 1 BDT, 1 ANA, Canadian 1 AF, 1 BCF, A. A. Learned, (Providence R.I.).

2 OD Can. 1 BQ, Can. 1 DD, 3 APV.

2 ON 1 RR.

2 SZ 1 BDT, 1ANA, 3 II, Can.1 AF, Can.1 BQ, Can.1 DD, 1 AWE, 1 CZ, 1 AUF, 1 CAZ, 1 BCF, 1 AKZ, 1 RR, 1 AAC, 1 BDU, 1 CTP, 1 AUR, 1 AUC, 1 AQY, 1 GG, 2 AJF, 2 CRO, 2 NP, 2 BSC, 3 OT, 3 APV, 3 YO, 3 HS, 3 BMN, 8 AVL, W. R. Woodward, (Hartford, Conn.); A. A. Learned (Providence, R.I.)

5 AT 1 BDT, 1 ANA, Can.1 AF, 1 CZ, 1 BBM, 1 BCF, 1 RV, 1 AYN, 1 AJK, 1 BVL, 1 AKZ, 1 RR, 1 BDU, 1 AUR, 1 AUC, 1 GG, 2 CYH, 2 CWR, 2 APY, 2 BSC, N. R. Tabbatt, (Bar Harbour); Bronx Radio Club (N.Y.C.); A. A. Learned (Providence R.I.).

5 BV 1 BDT, 1 ANA, Can.1 BQ, Can.1 DD, 1 BCF, Bronx Radio Club (N.Y.C.).

5 KO 1 BDT, Can.1 AF, Can.1 BQ, Can.1 DD, 3 APV, J. M. Tiffany, N.J.

5 LC 1 BDT, 1 BCF, 1 SN, 1 CTP, A. A. Learned, Providence, R.I.

5 NN 1 BDT, 1 ANA.

5 PU 1 BDT, 1 ANA, 1 BCF, 1 BDU, 1 AQY, 3 OT, A. A. Learned (Providence, R.I.).

6 NI 1 BDT, 1 ANA, Can.1 AF, 1 BCF, 1 AAC, 3 CEG.

6 XX 1 BDT, 1 ANA, Can.1 AF, Can.1 DF, 1 AMQ, 1 AWE, 1 CZ, 1 AUF, 1 BBM, 1 BFA, 1 CAZ, 1 RV, 1 AJK, 1 SN, 1 BVL, 1 AKZ, 1 RR, 1 BDU, 1 AUR, 1 AUC, 1 AQY, 1 GG, 2 AJF, 2 APY, 8 BLI, J. M. Tiffany (N.J.); A. R. Tabbart (Bar Harbour); Bronx Radio Club (N.Y.C.); A. A. Learned (Providence, R.I.).

6 YA 1 BDT, Can.1 BQ, 1 BIS, 1 AYN, 1 BVL, 2 IP.

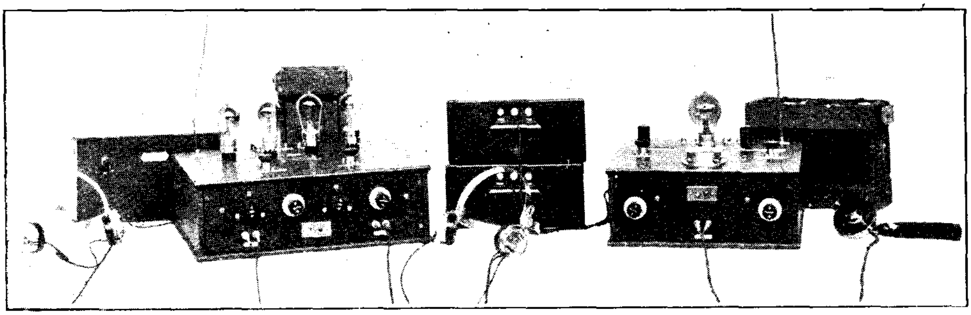
PART IV.

For the purposes of comparison the number of the United States and Canadian stations who reported reception of signals from European stations is tabulated in the right-hand column of the table, Part IV, the centre column of this table giving the number of days on which each European Transmitting station was heard, this information summarising Part I of the report as received from the American Radio Relay League.

Station Call Letters.	No. of days on which signals were reported out of total of 20	No. of U.S. and Canadian Stations who heard signals.
2 FN ..	6	4
2 FQ ..	1	1
2 FU ..	1	1
2 IN ..	2	1
2 KF ..	2	3
2 KW ..	3	3
2 NM ..	8	4
2 OD ..	5	3
2 ON ..	1	1
2 SH ..	*	*
2 SZ ..	19	32
5 AT ..	17	24
5 BV ..	3	6
5 KO ..	3	6
5 LC ..	4	5
5 NN ..	4	2
5 PU ..	7	7
6 NI ..	9	6
6 XX ..	16	29
6 YA ..	2	6

* See footnote to table, Part I.

The information contained in this report relates solely to the code word signals transmitted on a wave in the neighbourhood of 200 metres during the Test periods, and does not include the receptions and two-way communications effected on the shorter waves. Only reported receptions of which the code words have been verified by the transmission schedules have been included in this report. Details of any other receptions have not been furnished by the A.R.R.L.



A Duplex wireless telephone set which is amongst the exhibits of Marconi's Wireless Telegraph Company, Ltd., at Wembley.

ULTRA SHORT WAVE TRANSMISSION AND RECEPTION.

DETAILS OF SOME RECENT FRENCH EXPERIMENTS.

THE trend during the past twelve months in experimental transmission work has been to exploit the possibilities of communicating on shorter wavelengths than were formerly employed. The British, French and American amateurs have specialised in long distance communication, using wavelengths of 100 metres with considerable success, but there would appear to be a new field of research in exploiting the use of exceedingly short wavelengths of the order of under 10 metres, for then the adoption of directive transmission and reception becomes possible.

Many difficulties present themselves in the production of oscillations on the short wavelengths, and in this field there is considerable scope for experimental work, particularly as the power necessary to undertake tests of this sort need not exceed 10 watts. Some particularly interesting experiments in short wave work have recently

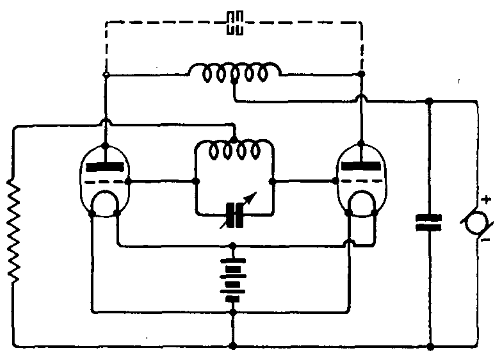


Fig. 1. Circuit employed for the short wave oscillator.

been conducted by Commandant René Mesny, which have been accompanied by considerable practical success.

The principle of the oscillating system employed is shown in Figs. 1 and 2, and it will be seen to consist essentially of a full wave oscillating arrangement. The valves employed are the usual French military type, each dissipating about 5 watts, and it is interesting to observe that special valves having low capacity between the electrodes

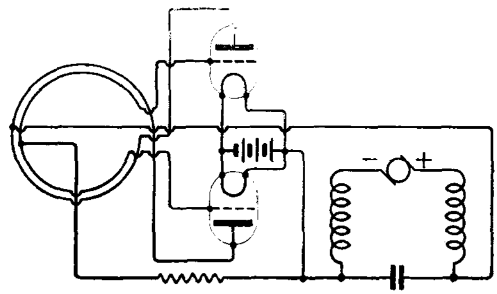
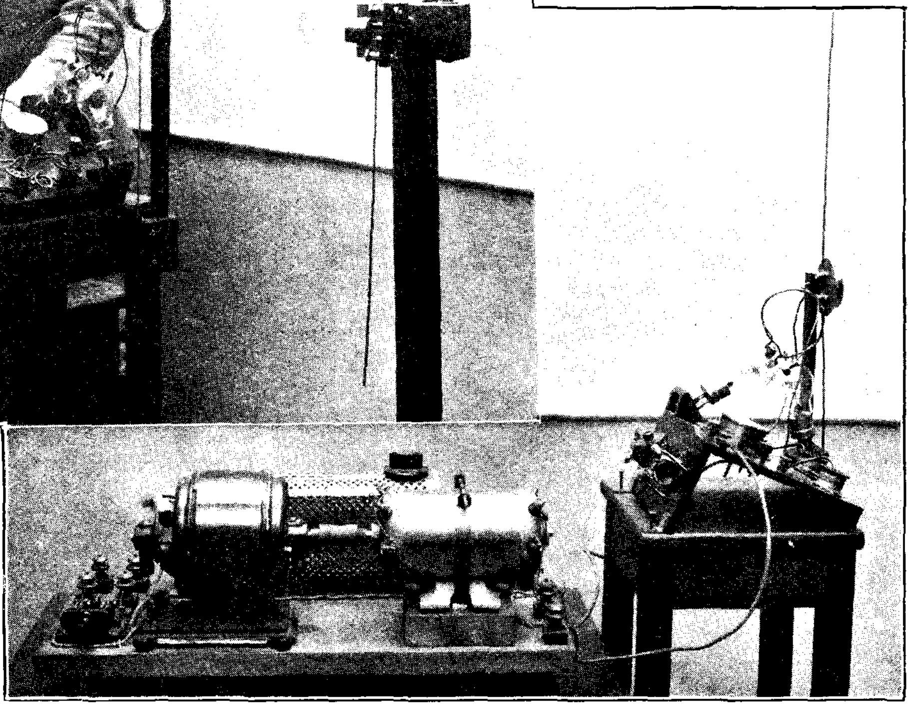


Fig. 2. The practical form of the oscillating circuit.

are not essential. In using a circuit of the type shown it is necessary to insert low capacity choke coils in the leads from the high tension generator in order to prevent oscillation leakage, whilst it is advisable also to insulate the entire apparatus and filament battery in such a manner that a minimum capacity to earth is present.

With the French military type of valve it was found that an ammeter reading of 180 milliamperes could be obtained in the aerial system shown in the accompanying photographs on a wavelength of 2 metres, which is the minimum wavelength usually employed. Considerable difficulty was experienced in the setting up of oscillations on shorter wavelengths. The inductances used on this wavelength consisted of wire loops, 8 centimetres in diameter, the grid circuit coil being arranged almost at right angles to the anode circuit coil. The anode circuit is coupled to the aerial circuit by bringing a portion of the loop near to the vertical aerial. It will readily be appreciated that on such short wavelengths, owing to the limited amount of wire required to form the tuning circuits, that relatively large inductive coupling must necessarily be present between various leads, whilst the effects of any capacity coupling will have considerably more effect than on longer wavelengths.

The aerial consisting merely of a straight wire has the advantage of very low ohmic resistance, and acts as an efficient radiator. Modulation has been introduced into the grid circuit of this oscillating arrangement for the transmission of telephony and successful telephony experiments have been carried out on wavelengths from 1·5 to 50 metres. The grid resistance is replaced by the plate filament impedance of a



Photographs of the apparatus employed by Commandant Mesny in carrying out experiments on wavelengths of the order of two metres. The right hand aerial in the upper figure is used for tuning purposes and is fitted with a two electrode neon detector.

valve, the grid potential of which is varied by the usual microphone transformer method (Fig. 3).

Tests carried out with apparatus of the type described here show that good results can be obtained up to distances of about 1¼ miles, though it was observed that unless open country was selected free from surrounding objects, that the range became limited owing to absorption. Using the apparatus for communication through a wood it was found that a telephonic range of about half a mile could be obtained. These tests were carried out without the use of reflectors, and it is to be assumed that considerable extension of range can be obtained when the transmitting and receiving aerials are placed at the focus of tuned parabolic reflectors.*

* For an account of the use of reflectors on short wavelengths see *The Wireless World and Radio Review*, Vol. XII, June 30th, 1923, page 419.

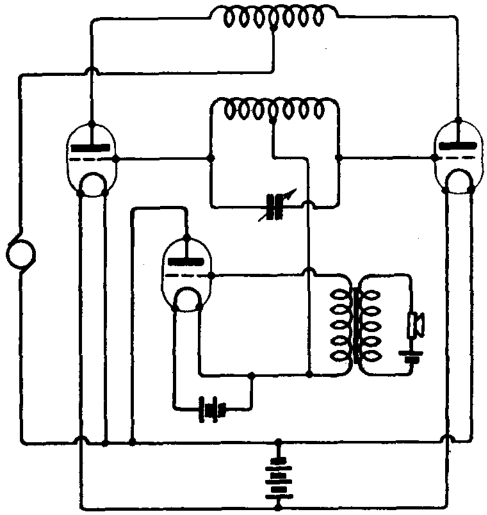


Fig. 3. Short wave transmitter with modulator circuit.

THE HUMAN BODY AS A DETECTOR.

A PROBABLE EXPLANATION OF SOME FREAK RECEPTIONS.

By JAMES STRACHAN, F.INST.P.

THE writer had occasionally heard statements made to the effect that faint telephony had been obtained in a simple crystal set *with the cat-whisker off the crystal* and did not credit them until, quite by accident, while experimenting with a crystal circuit, faint but clear telephony was heard under the conditions described. The circuit was carefully examined, but unsuccessfully, for a loose contact, and after a little patient investigation it was discovered that the reception was obtained when the crystal was disconnected from the cat-whisker and the experimenter's hands were bridging the gap by touching wires or terminals. It was further found that this only occurred when the contact with one hand was fairly firm and with the other very light.

The circuit was then tuned into the local broadcasting station and the crystal detector removed from the circuit. On holding the ends of the wires which were formerly connected to the crystal detector in the two hands, reception was again obtained and

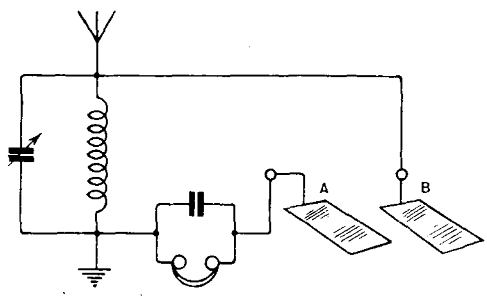


Fig. 1.

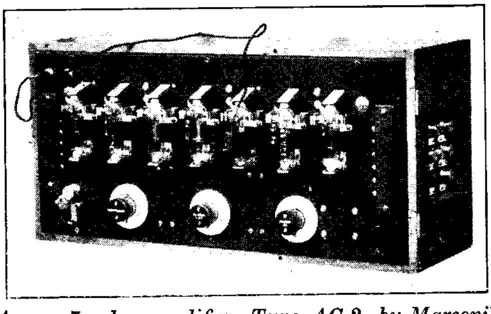
varied by the degree of contact between one hand and one wire.

The wires were then connected to two clean strips of copper foil (3 ins. × 1 in.), as in Fig. 1 (A and B).

With this arrangement the best results were obtained by applying the hands (thoroughly washed and dried) as described below. The fingers of one hand were pressed lightly on A while B was touched delicately with the forefinger tip of the other hand. Louder results were obtained when the four finger tips of this hand were bunched together and rested lightly on B. The same result was obtained by resting the wrist of one hand on A and the finger tips of the same hand on B. The degree of contact on B was such that one was just aware of contact. This depends upon the sensitivity of the nerves and it has been since found that the experiment only succeeds with an experimenter having soft sensitive finger-tips. Further, it is apparently only possible within a small radius of a broadcasting station (probably about a mile) and with a fairly good aerial. The reception is very clear but faint, the rectified current over the phones being measured as one-eighth to one-tenth of that obtained with the crystal. In commencing this experiment a fairly loud item on the programme should be selected.

While this experiment is of little practical value beyond the probable explanation of some freak receptions, and its successful demonstration limited, the phenomenon is of some theoretical interest, and its explanation may lead further.

The writer was tempted at first to connect these results with certain well-known facts in physiological electricity, but beyond the fact that the finger-tips abound in nerve-endings and that the nerves are good conductors, that science has certainly nothing to do with it. The body is such a good conductor of high frequency oscillations that the surprising fact is the distinct though slight rectification obtained. After numerous experiments the inevitable conclusion appeared that the phenomenon was purely electrolytic and that a solution of salt water (salt being the chief body electrolyte) having approximately the same resistance as the body, should give the same results. This was found to be the case. A long capillary glass tube filled with dilute salt solution acted quite as well as the human body. Further, it was also found that an electrolytic detector having a small copper plate as cathode and the tip of a No. 26 copper wire just touching the surface of a 10 per cent. solution of salt water, as anode, gave better results, the current passing being measured at approximately 50 per cent. of that obtained with galena in the circuit. Under the conditions of reception described above, very clear telephony was obtained without any applied potential other than that from the aerial circuit. Substituting a platinum point for the copper anode (in the fashion of the ordinary electrolytic detector) yielded much poorer results. It was also observed that for a given strength of salt solution, a definite area of anode contact was required, less or more giving poorer reception. It will thus be seen that such a detector operated by the high frequency oscillations alone differs from construction in the ordinary electrolytic detector controlled by an applied potential from an external battery. In the copper-salt detector rectification appears to be purely electrolytic, the copper point being the anode and the rectified current always flowing from copper point to copper plate, a polarisation film of hydrogen on the small anode stopping the other half of the oscillation from plate to point. This apparatus, although poor in its results compared with a good crystal, appears to support the purely electrolytic theory of salt detectors (as advanced by De Forest and others), and suggests that it is along such lines we may experiment in improving the electrolytic detector.



A new 7-valve amplifier, Type AG 2, by Marconi's Wireless Telegraph Co., Ltd., to be seen among their exhibits at the Wembley Exhibition.

CORRESPONDENCE.

The Thunderstorm of April 26th.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I should be very grateful if your readers will send me any information they possess regarding the occurrence of lightning flashes in last Saturday's storm (April 26th, 1924). From noon to 9 p.m. (summer time) some thousands of atmospherics were recorded at Cambridge, and it would be of great help to me in work on this subject if I could find out—

(*a*) Where and when the flashes were observed,

(*b*) How frequent they were, and

(*c*) Whether they were noticed to pass from cloud to ground or not.

E. V. APPLETON.

The Measurement of Low Frequency Amplification.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In reply to Mr. Huskinson's letter on p. 142 in your issue of April 30th, the measurements given in my article referred to were not carried below a frequency of 300 cycles per second because it is so extremely difficult to make telephone measurements at such low frequencies. Actually the testing of low frequency transformers is now carried out at frequencies down to 250 cycles per second, but anyone who has carried out measurements with telephone detection will appreciate that this puts a tremendous strain on the observer.

While appreciating that there are several octaves below middle C at 256, it is a fact that a current of such low frequency produces an extremely weak audible note, due to the great inefficiency at these frequencies of the combination of telephone receiver plus human ear.

Concerning the step-up ratio of the transformer when used as an intervalve coupling, Mr. Huskinson will, I hope, pardon me if I decline to discuss my objective measurements against the subjective impressions or estimated values of either himself or anyone else. There is, in my opinion, at the present time far too much discussion, both spoken and written, as to the relative merits of various wireless apparatus upon purely subjective observations. Anyone who has attempted to estimate sound intensities by ear will appreciate the inability of the ear to "remember" either the quality or intensity of sounds. Only by instantaneous change-over switching can anything in the nature of reliable measurements be made.

Mr. Huskinson is evidently unaware that an alternating current arising from speech or music modulation, however complicated its waveform may be, can be resolved into a number of perfectly pure sine waves of various frequencies, and the study of the behaviour of a wireless receiver or any component thereof with currents of each of these different frequencies is a perfectly legitimate and, indeed, probably the only scientific way of tackling such a complex problem.

I know from my quantitative measurements, which are in perfect accordance with theory, that a single stage of a valve plus transformer can give a voltage amplification of from 20 to over 30, whereas with resistance coupling and the same valve it is impossible to obtain more than the voltage factor of the tube, *i.e.*, from 8 to 10, and a more usual value is about 6, as stated in my paper. While fully appreciating the advantage the resistance-capacity coupling has over the transformer at the lower end of the range of audible frequencies, I also know of several disadvantages which are sufficient to lead many people to prefer a transformer where perfect reproduction is not the only consideration. Besides the relatively high value of high tension supply which is necessary, and the difficulty of constructing anode resistances which will carry currents up to 50 milli-amperes, there is also the fact that more than three stages of resistance coupling are required to give the same amplification as that given by two stages of transformer coupling (since 6^3, or even 8^3, is less than 30^2).

Of course, if Mr. Huskinson's resistance coupled stage is really equal to his transformer-stage, he has been rather unfortunate in his choice of transformer, in common, I feel, with very large numbers of other people.

R. L. SMITH-ROSE.

Teddington,
Middlesex.

Long Range Crystal Reception and Re-Radiation.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have read with great interest the letter from "B.H." on re-radiation. The question of re-radiating is, I think, of very great importance, and re-radiation may go a long way towards solving the difficulty of broadcast reception in the localities which are out of range from the B.B.C. stations.

As a suggestion I might propose that experiments should be carried out on about 75 metres, the transmitting station being received on one of my circuits, aptly called by Capt. Armstrong super-regenerative.

The quenching frequency might be quite inaudible on this short wave. The receiver could be made to re-radiate violently, thus enabling a crystal receiver to be satisfactory within a circle of several miles from the re-radiation.

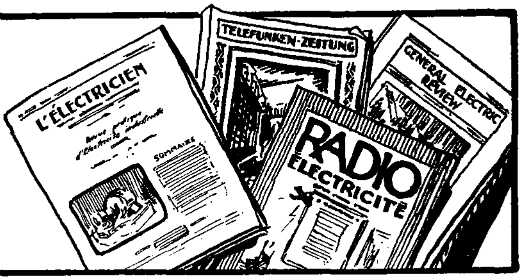
JOHN B. BOLITHO.

Gorey, Jersey, C.I.

A Simple Direct Reading Set for Measuring Capacity.

The buzzer circuit connections are incorrectly shown on page 173. A lead should be added between the buzzer armature and the nearer end of the buzzer coil, while the the connection between battery and armature must be removed and new connection made from the battery to the fixed contact of the make and break.

PATENTS AND ABSTRACTS



Improvements in Receiving Systems.

This invention* relates to means for reducing the effect of static or natural interference in the reception of radio signals, and may be explained by referring to Fig. 1. The incoming signals are amplified by the H.F. amplifier, rectified and passed through a note magnifier to the coupled coils 4 and 5. The opposite ends of coil 5 are taken to the grids of two similar valves 6 and 7. The filaments 10 and 11 of these valves are connected together and to the middle point of the coil 5. A common high tension battery 15 is connected to the anodes 13 and 14. The grid 6 is connected through a grid condenser and leak 17, 19, and the telephone or recorder, such as a siphon recorder or galvanometer, is connected at R, between the anodes 13 and 14.

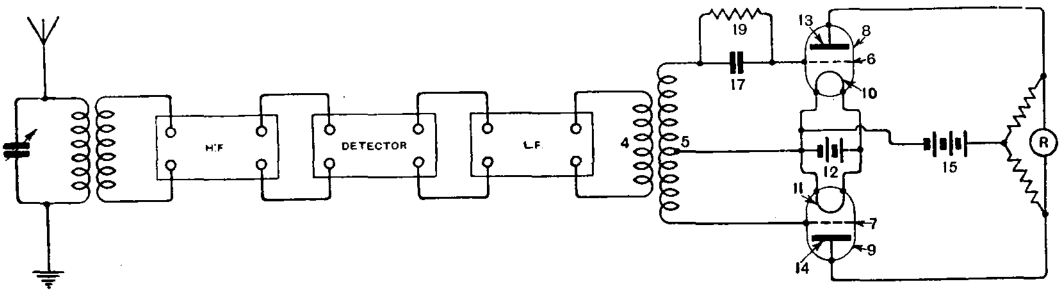


Fig. 1.

This arrangement of apparatus prevents impulses due to atmospherics from affecting the instrument at R, because instantaneous highly-damped pulses affect both valves alike, and the difference between the plate currents due to this is substantially zero. When signals consisting of continuous waves reach the aerial, the detector action between the two valves and the difference between the plate currents is indicated by the instrument at R.

* British Patent No. 202,320, by Marconi's Wireless Telegraph Co., Ltd.

Improvements in Radio Frequency Transmission Circuits.

Referring to the wireless telephone transmitter of Fig. 2, a valve, 10, is arranged to operate as a generator of high frequency oscillations in the usual way, and valve 9 serves to modulate the oscillations. Valves 7 and 8 are connected to operate as speech amplifiers.

The apparatus usually employed for the conversion of sound vibrations into electrical vibrations generally causes a little distortion ; that is to say, the electric current is not faithfully modulated in accordance with the sound vibrations. The distortion may be due to resonance of the diaphragm, and other causes.

It is therefore proposed* to employ a photo-electric element or cell for the purpose of obtaining speech currents, the cell being subjected to light rays which are varied in accordance with the frequencies and amplitude of the acoustic vibrations to be transmitted.

* British Patent No. 213,034, by the Metropolitan Vickers Electrical Company, Ltd.

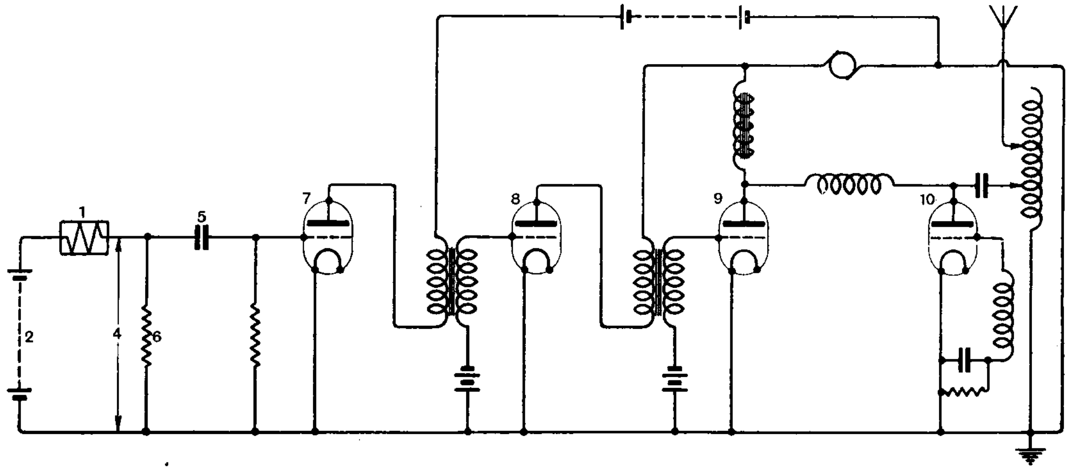


Fig. 2.

A diaphragm, which may be undamped or damped in any known manner is arranged to receive the sound waves, and to actuate the mirror which may be carried thereon or actuated by a lever.

Referring to the figure, the photo-electric cell, 1, is connected in series with a suitable battery, 2, and a high non-inductive resistance, 6. The terminals of the resistance 6, are connected with a control circuit, which includes a blocking condenser, 5, and a grid leak resistance. The speech currents are amplified by the valves 7 and 8 and applied to the modulator 9.

Improvements in Inductances.

The usual inductance coils wound on solid masses of dielectric are generally not suitable for high frequency work, especially when employed in connection with the reception of wireless signals, the distributed capacity and energy losses due to the presence of the dielectric, and the insulation losses of the usual form of closely wound coil tending to materially weaken the strength of the impressed electric oscillations. The object of the present invention* is to provide a variable inductance in which the undesirable absorption of energy is reduced to a minimum. The arrangement of a variometer of spherical form, having a series of turns wound in and out about the arms of a spherical skeleton support is described. A variometer of the type referred to is illustrated in Fig. 3.

* British Patent No. 193,873, by American Radio and Research Corporation.

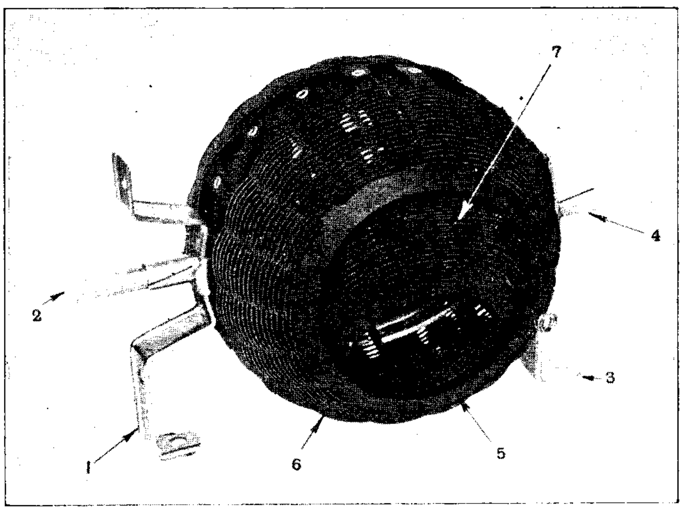
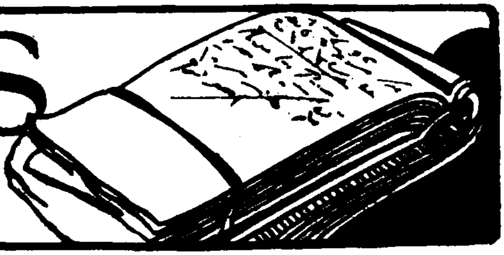


Fig. 3.

NOTES & CLUB NEWS



It is estimated that in Stockholm there are 20,000 listeners in.

* * * *

Two wireless telephony stations are being erected in Morocco, at Kasbah and Manouba.

* * * *

"Wireless television is to become an accomplished fact and an audience in one of London's theatres will witness a cricket match at the Oval."—Old Moore's Almanac for 1925.

* * * *

Chimney sweepers in Berlin, who carry out their task on the roof, have been instructed to report the location of all wireless aerials they discover. By this means it is hoped to track unlicensed sets.

* * * *

A wireless telephone system is being installed for communication between the Abertay Lightship and the Dundee Harbourmaster's office.

Scottish Transmitter "Gets Across."

Mr. Marcus J. Scroggie (**5 JX**), of Edinburgh, reports that his signals were heard by Canadian **1 DD** at 0400 G.M.T. on Saturday, April 26th. Mr. Scroggie used one Mullard 0.20 valve with home-made apparatus and a voltage raiser of his own construction as described in the issue of this journal for August 15th, 1923. The wavelength employed was 115 metres and the aerial current was 0·65 of an ampere.

5 JX is the first Scottish amateur to be heard on the "other side," and considering the time of the year, the performance is very gratifying. Mr. Scroggie ascribes his success largely to the kind co-operation of British **2 OD.**

Another transatlantic success is that of Mr. H. R. Adams (**2 NO**), of Walsall, whose signals were received by Mr. Edward Guildford (**2 CAV**), of Fanningdale, N.J., on February 16th. Verification of the report has just been received.

Italian Amateur's Success.

Signor Giulio Salom (**1 MT**), the Italian transmitter so well known to British listeners, has received notification from the American Radio Relay League that his signals have recently been heard by many American amateurs.

A photograph of **1 MT**, which is situated in Venice, appeared in our issue of December 27th, 1923.

Reports Wanted.

Mr. H. Lloyd Edwards (**5 UQ**), of Trevor Hall, Trevor, Wrexham, would be very glad to receive reports on his Morse transmissions, and to arrange tests. These transmissions take place nearly every evening on 150 metres between 9 and 9.15.

Bournville Carillon Broadcast.

An interesting and original item was broadcast from the Birmingham station on May 1st, when an inaugural recital performed on the new carillon of bells at the village school at Bournville, was transmitted by wireless. The occasion was the completion of the early carillon by the addition of 15 bells presented by Alderman George Cadbury, junior, and the recitalist was M. Nauwelaerts, official carillonneur of Bruges.

The transmission was exceptionally clear.

Rome ICD.

The increase in power of the Army Wireless Station at Rome (Centocelle, **ICD**) to 1 kW, has resulted in its reception in the West of England. A Bristol reader heard the station with a two-valve set (1 L.F.), on May 1st, at 4.45 p.m., B.S.T., and signals, though weak, were sufficiently clear to be identified.

Wireless in Church.

St. James's Church, Wilderspool Causeway, Warrington, claims to be the first church in the North to adopt wireless as an important feature in its services.

An indoor aerial has been erected in the church and a four-valve set and loud speaker installed. During Lent hymns and religious addresses from **2 ZY** were reproduced with such success that the Vicar (the Rev. E. Milner Smith) intends to renew the experiment in the autumn.

The Co-optimists.

A plan to transmit telephony across the Atlantic on a wavelength of thirty-two metres is being evolved by Reginald Gouraud, a young American at present in Paris.

According to a Parisian correspondent, the set with which Gouraud and his partner, Louis Schroeder, are experimenting, will place 480 watts in the antenna. The aerial is composed of one piece of copper tubing, about 25 ft. long, led diagonally to the apparatus. The owners are confident that reception of their signals would be possible in any part of the world with a three-valve receiver!

Bournemouth Wireless Ban.

The news that the Bournemouth Council has resolved to forbid wireless aerials and loud speakers on the beach will not, we believe, increase the popularity of that august body. Considering the proximity of the Bournemouth Broadcasting Station and the ease with which concerts could be received on the beach with quite small and unobtrusive aerials, the action of the Council appears particularly unreasonable.

To restrict wireless gear to certain portions of the front might be only fair to all concerned, but a wholesale ban seems thoroughly unjustified.

Radio Principles Applied to Cables.

The application of wireless engineering principles to submarine telegraph cables formed the subject of a paper recently read before the American National Academy of Sciences by Major-General George Squier.

During the past year, said General Squier, the U.S. Signal Corps has carried out development work in connection with the new Seattle-Ketchikan cable in accordance with a key plan based upon wireless engineering principles, with marked success. A universal automatic transmitter, applicable to wireless, land lines and submarine cables has been developed and tested over an artificial cable and an improved form of rectified received record has been devised and tested.

As in wireless, continued General Squier, the electron vacuum tube will play a dominating rôle in the new development. Amplification by several stages of received cable signals will open up an entirely new range of cable efficiency.

British Broadcasting Reception in South Africa.

The reception of the B.B.C. programmes is now a daily accomplishment in South Africa.

Mr. L. Lloyd, a resident in South Africa, reports that the singing, extracts of speeches and particularly the Savoy Bands are received almost continuously from 11.30 to 1 a.m. daily.

Equally gratifying is the experience of Mr. Grant Dalton of Johannesburg who, in one evening recently, received London, Bournemouth and **WGY.** Mr. Dalton's log, forwarded to the B.B.C., proved remarkably accurate.

In each of the cases referred to a standard McMichael three-valve set is in regular use.

The Edinburgh Relay Station.

The opening of **2 EH**, the Edinburgh Relay Broadcasting Station, on May 1st, was the occasion of a notable ceremony in the Usher Hall. Among those present were the Lord Provost, Mr. J. C. W. Reith (Managing Director of the B.B.C.), Principal Alfred Ewing, Bailie Philips Smith, Mr. D. Millar Craig (Director of Broadcasting for Scotland), and Mr. G. L. Marshall (the Director of the new station).

The programme consisted principally of speeches, an organ recital, provided by Dr. W. B. Ross, on the Usher Hall organ, and band selections by the 1st K.O.S.B.

Many reports of satisfactory reception have been received, and it is stated that the speeches in the Usher Hall were heard clearly in Aberdeen. On the other hand, not a few complaints have been sent in by listeners within a few miles that the Glasgow station is heard with equal or greater strength. It is somewhat early, however, to pronounce judgment on Edinburgh's transmission, and it is probable that with the experience of a few weeks, the engineers will be in a position to effet c improvements to suit the needs of allin the vicinity.

Radio Society of Great Britain.

An ordinary general meeting of the Society was held at 6 p.m. on April 30th at the Institution of Electrical Engineers, the President, Dr. W. H. Eccles, F.R.S., occupying the chair.

Captain P. P. Eckersley, Chief Engineer of the British Broadcasting Company, delivered a lecture entitled, "Faithful Reproduction by Broadcast," which was followed by a well-sustained discussion.

Transmitter and Relay Section.

"Duplex Telephony" formed the subject of a profitable discussion opened by Captain Eckersley, Chief Engineer of the B.B.C., at a meeting of the Transmitter and Relay Section of the Society on Friday, May 2nd, 1924.

Among the systems of quiescent aerial transmission first attempted, Captain Eckersley mentioned one whereby speech into the microphone acted as an automatic switch, a strong negative bias being imposed on the grid. The grid potential fluctuations set up by speech currents from the microphone transformer bring the potential to the operating point of the valve curve and oscillation is set up in the transmitter. This method has all the drawbacks of grid modulation, and in consequence of the cutting off in oscillation a condition is created in which the subsequent oscillation trains do not coincide, whilst the modulation oscillations *do* form part of one continuous oscillation train.

Another interesting system described by Captain Eckersley which has been employed to some extent in commercial apparatus, consists of setting up two oscillatory circuits in phase with one another, and coupled to a common circuit in such a direction that there is no resultant oscillation set up. Modulation of either of the two input oscillatory circuits creates a state of unbalance, and oscillatory currents are set up in the coupled circuit which is in turn linked to the aerial.

The systems referred to above relate to transmission and reception on one aerial, though very successful results can be obtained by working on two adjoining aerials on slightly displaced wavelengths.

In the discussion which followed, mention was made by Mr. Simmonds of his experiments carried out in conjunction with Captain Finlay, in which supersonic heterodyne reception facilitated the setting up of a highly selective arrangement. Mr. H. N. Ryan also described his efforts in this direction. A "chopper" system was also mentioned in which the interrupter was made to change over the transmitting and receiving connection to the aerial at a high speed. Messrs. F. L. Hogg and E. H. Robinson also described experiments which they had undertaken with a view to operating a duplex system.

An informal meeting of the Transmitter and Relay Section of the Society will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, on Friday, May 16th, at 6.30 p.m., at which Mr. T. E. Goldup will open a discussion upon the "Design of Transmitting Valves."

World-wide Broadcasting Scheme.

An ambitious plan for linking up the broadcasting systems of the world was recently put forward in an interview by Mr. H. P. Davis, Vice-President of the Westinghouse Electric and Manufacturing Company of America.

By a judicious selection of relay stations, Mr. Davis proposes to enable radio listeners to hear programmes from London Paris, Tokio and in fact any part of the globe, using the ordinary type of receiver such as is employed for local broadcasting. For the purpose of relaying transmissions a wavelength of 100 metres, which Mr. Davis regards as inaudible to the ordinary receiver, would be used. Chains of relay or "booster" stations, serving simply to receive, amplify and re-transmit these "inaudible" waves, would be established, and only at regular broadcasting stations would the waves be re-broadcast within the 250-600 metre band.

Mr. Davis envisions a time when the world will listen with wrapt attention to a famous statesman speaking in Paris, or to an event of universal importance occurring in Pittsburg, Pa. Only the scarcity of such happenings, so far as we can see, is likely to handicap such a ubiquitous service.

The "Leviathan's" Wireless Equipment.

What is believed to be the largest wireless installation afloat has been installed on the "Leviathan," of the United States Lines.

Five aerials are in use; three for transmission and two for reception. A high power valve transmitter is employed, transmitting on wavelengths of 1,800, 1,935, 2,100 and 2,400 metres.

Loudspeaking apparatus has been installed in various parts of the vessel connected direct with the radio cabin for the reception of broadcast programmes. The wireless staff numbers eight operators besides two messengers for handling Marconigrams.

Edison Bell Condensers.

An advertisement of Edison Bell Radio products, which appeared exclusively in a recent issue of *The Wireless World and Radio Review* gave the information that Edison Bell fixed condensers retailed at the uniform price of 1s. 3d. This information, however, was inaccurate and we regret to say has caused considerable misunderstanding among many traders throughout the country. The manufacturers ask us to point out that the prices of their condensers are the same as listed in their own publicity matter, namely, capacities ·0001 ·0002 ·0003, ·0004, ·0005 and ·001 at 1s. 3d. each, and capacities ·002, ·003, ·004, ·005 and ·006 at 2s. each.

Addresses, please.

The Honorary Secretary of the Radio Society of Great Britain would be glad if the following members of the Society would be good enough to communicate their present addresses to him at 53, Victoria Street, London, S.W.1:—

Messrs. Arthur Beattie, F. C. Lyne. Lieut. F. S. Mockford. Messrs. R. W. Murch, Thomas A. Simpson, H. J. Warner, and Albert E. Webb.

Yeovil and District Radio Society.*

Mr. J. J. Davis gave a very interesting lecture on "Valves," at a recent meeting. The manufacture of valves was dealt with very fully and illustrated with lantern slides. Characteristic curves of various types of valve were also discussed.

On April 16th an excellent lecture on "Selectivity" was given by Mr. H. W. Forshaw, M.Sc.Tech., of Woolwich. The subject was treated in a most thorough manner and proved exceptionally interesting. The theory of "Jigger" circuits was clearly explained, chiefly by means of curves, and several original selective circuits were shown. Another lecture was given on Wednesday, April 30th, by Mr. F. H. Merritt, A.M.I.E.E., his subject being "An Explanation of Resistance, Inductance and Capacity." Some excellent working models were employed to assist the explanation. A short chat followed on accumulators.

The headquarters of the Society are now at Hendford Manor Lodge, where an aerial has been erected.

Hon. Secs., R. J. W. Marr. "Kismet," Sherborne Road, Yeovil; W. J. Hall, B.Sc.Tech., Greenhill, Sherborne.

Leicestershire Radio and Scientific Society.*

A discussion with the object of ensuring expeditious working among local transmitters took place on April 29th. It is satisfactory to note that with one exception all transmitters in the neighbourhood are members of the Society.

An instructive lecture on "Valves" followed, the speaker being Mr. Cyril T. Atkinson, A.I.R.E. Altogether some twenty different types of valve were shown, and their functions, characteristics, and interesting points of manufacture were described in detail. It was pointed out that the trend of British design was in some respects following American practice, the D.E.3 and the B.5 being practically replicas of the UV199 and the B.4 of the UV201A.

Communications regarding membership should be addressed to the Hon. Sec., J. W. Pallett, 111, Ruby Street, Leicester.

Tottenham Wireless Society.*

A second talk on "Workshop Practice" was given by Mr. Tracey on April 30th to an appreciative audience. Advice as to types of tools to buy was given and their several uses explained. A new and very neat method of tapping a solenoid was explained and an example shown. Several "special use" tools, devised and made by the lecturer, were passed round.

Hon. Sec., S. J. Glyde, 137, Winchelsea Road, Bruce Grove, Tottenham, N.17.

Belvedere, Erith and District Radio and Scientific Society.*

"Insulators and Insulating Materials" formed the title of an illustrated lecture delivered by Mr. A. G. Warren, M.Sc., on April 25th.

The lecturer dealt with the difficulty experienced in making up high tension transformer panels, and the insulating material suitable for this purpose.

It was stated that the very high frequencies met with in wireless transmission made the choice of insulators very difficult, for a good insulator at a frequency of 50 per second would not necessarily function at periodicities between 500,000 and 2,000,000.

The Secretary reported that experimental work on the Society's transmitting apparatus, **5 OY,** was proceeding satisfactorily. Members were asked to co-operate by listening-in between the hours of 11 and 12 on Sunday mornings, and to report on the various tests, each of which will be numbered, the number being announced immediately before each test.

A description of the Society's transmitting apparatus was given by Mr. S. Burman on May 2nd.

The transmitting circuit was explained step by step by means of blackboard sketches, together with the system of modulation employed. It was gratifying to know, said Mr. Burman, that although the system had by no means reached its final stage of perfection, excellent reports on the test transmissions had been received from local and distant listeners.

Hon. Sec., S. G. Meadows, 110, Bexley Road, Erith, Kent.

Ilford and District Radio Society.*

The elimination of distortion of speech and music by loud speakers was dealt with in an interesting lecture given by Mr. Aston Cooper on Thursday, May 1st.

Various types of loud speaker were demonstrated, and marked differences were noticeable in the performances of different instruments, especially in respect of strength of tone, pitch and faithfulness of reproduction.

Excellent results were obtained from a a home-made hornless loud speaker constructed by the lecturer, which was remarkable for its low cost.

A short discussion followed on the question of distortion introduced by the receiving apparatus.

Hon. Sec., L. Vizard, 12, Seymour Gardens, Ilford.

Altrincham Radio Society.

At a well-attended meeting held on May 1st, arrangements for the summer months were discussed.

It was decided to hold meetings every alternate Thursday evening at the Society's headquarters, The British Schools, Oxford Road, Altrincham, commencing at 8.0 p.m., the Society having in hand sufficient funds to continue this arrangement until the autumn.

It was also suggested that outdoor experiments could be carried out at the week-ends intermediate between the meetings. The members gave this last proposal their hearty approval.

Intending members should apply to the Hon. Sec., J. F. Johnston, 43, Oak Road, Hale, Cheshire.

The Dulwich and District Wireless and Experimental Association.

A very interesting lecture was given on April 28th, by Mr. P. Falkner, entitled, "A Trans-Atlantic Receiver." Mr. Falkner illustrated his able lecture with a three-valve receiver.

All enquiries regarding membership should be addressed to the Hon. Sec., Harrie King, 2, Henslowe Road, East Dulwich, S.E.22.

Nottingham and District Radio Experimental Association.

On May 1st, Mr. W. H. Burton (**2 UG**) interested the members with a portable dual-amplification receiver of his own design. A new French dull emitter valve of the latest design, working on ·06 amperes, was used, mounted on a mottled ebonite panel. Two crystals, hertzite and cymosite, were mounted on this, for alternate use. The set operated on 30 volts H.T.

Hon. Sec., A. S. Gosling, 63, North Road, West Bridgford, Notts.

Portsmouth Radio Society.

At the second quarterly meeting of the Society, held on April 30th, it was resolved to move from the present headquarters in Fratton Road, to a room kindly placed at the disposal of the Society by Mr. Plumbe.

An interesting account of a new two-valve circuit was given by the Hon. Treasurer, Mr. W. Gall. The set was capable of working a loud speaker with good volume of tone and special attention was drawn to the use of a filter in the loud speaker circuit, which ensured great purity of tone.

The Society is making a special effort to assist in stopping the interference caused by local oscillation and transmission during broadcasting hours.

There are still many amateurs in Portsmouth who have not attended the meetings which are held every Wednesday, and to these a cordial invitation is extended.

Hon. Sec., A. G. Priest, 9, Peckham Street, Southsea.

The Sydenham and Forest Hill Radio Society.

On Monday, April 7th, an exhibition of members' sets took place, prizes to the value of £10 10s. being offered.

The competition was divided into three sections as follows:—(1) Valve Sets; (2) Crystal Sets; (3) Apparatus; and a special prize was awarded to the best of all classes.

The prize winners were as follows:—"Best of all" Mr. Hampshire. Class I.—(1) Mr. Taylor; (2) Mr. Smith; (3) Mr. Tobitt. Class II.—(1) Miss Hale; (2) Mr. Smith; (3) Mr. Lloyd. Class III.—(1) Mr. Cox; (2) Mr. Pace; (3) Mr. Batchelor.

In presenting the prizes the President (**5 DT**), passed a hearty vote of thanks to the gentlemen who had so kindly and ably acted as judges. A novel feature was the presentation of a souvenir, taking the form of a special crystal combination, to all visitors.

Hon. Sec., M. E. Hampshire, 139, Sydenham Road, Sydenham, S.E.26.

BROADCASTING.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:—

GREAT BRITAIN.

ABERDEEN 2 BD, 495 metres: **BIRMINGHAM 5 IT,** 475 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 2 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 353 metres; **PLYMOUTH 5 PY** (Relay), 330 metres; **SHEFFIELD** (Relay), 303 metres. Tuesdays, Thursdays and Fridays, 1 p.m. to 2 p.m. (**2 LO** only). Regular daily programmes, 3.30 to 4.30 p.m., 5 to 10.30 p.m. Sundays, 3 to 5 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), FL, 2,600 metres. 7.40 a.m., Weather Forecasts; 11.0 a.m. (Sunday), 11.15 to 11.30 (Weekdays), Time Signal and Weather Forecast; 12.0 noon, Market Report; 3.40 p.m., Financial Reports; 5.30 p.m., Bourse Closing Prices; 6.15 p.m., Concert; 7.20 p.m., Weather Report; 9.0 p.m. (Wednesday and Sunday), concert; 10.10 p.m., Weather Forecast.

PARIS ("Radio Paris"), SFR, 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.45 p.m., Exchange Prices; 4.30 p.m., Financial Report; 8.30 p.m., News and Concert.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres, 9 p.m. (Sunday, Wednesday, Thursday, Friday and Saturday), Talk on Literature, Dramatic and Musical Selections. 8.15 p.m. to 9.25 p.m. (Tuesday), Morse Practice, English Lesson, Lecture and Concert.

PARIS (Station Du Petit Parisien), 340 metres. 8.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2 p.m. and 6.50 p.m. Meteorological Forecast.

BRUSSELS ("Radio Electrique") 410 metres. Daily, 6 p.m. and 9.30 p.m., Concert.

HOLLAND.

THE HAGUE PCGG 1,070 metres. 4 to 6 p.m. (Sunday), 9.40 to 11.40 p.m (Monday and Thursday), Concerts

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres, 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9 p.m. (Thursday), Concert.

THE HAGUE (Velthuisen), PCKK, 1,050 metres, 9.40 to 10.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9 a.m. and 5 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metrse. 8.30 to 9.45 p.m., (weekdays), 8 to 9 (Sunday) Concert.

SWEDEN.

STOCKHOLM (Telegrarfverket), 440 metres. Monday, Wednesday and Saturday, 7 to 9 p.m. Sunday, 11 to 12 a.m.

STOCKHOLM (Radiobolaget), 470 metres, Tuesday and Thursday, 7 to 9 p.m. Sunday, 6 to 8 p.m.

GOTHENBURG (Nya Varvet), 700 metres. Wednesday, 7 to 8 p.m.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,370 metres (Sunday), 10.40 a.m. to 11.45 a.m., Orchestral Concert. 4,000 metres, 7 to 8 a.m., Music and Speech; 12.30 to 1.30 p.m., Music and Speech; 5.0 to 5.30 p.m., News.

EBERSWALDE, 2,930 metres. Daily, 1 to 2 p.m., Address and Concert; 6 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 400 metres. 11 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7 p.m., Concert; 7 to 8 p.m. (Sunday), Concert.

BERLIN (Telefunken), 425 metres. 7.30 to 8 p.m. and 8.45 to 9.30 p.m., Tests and Concert.

FRANKFURT AM MAIN, 460 metres. 7.30 to 10 p.m. Tests Gramophone records.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres. 8 a.m., 12 a.m. and 4 p.m., Meteorological Bulletin and News; 4,500 metres, 10 a.m., 3 p.m., and 10 p.m., Concert.

KBELY (near Prague), 1,150 metres. 7.15 p.m. and 10 p.m., Concert and News.

SWITZERLAND.

GENEVA, 1,100 metres (Weekdays). At 3.15 and 8 p.m., Concert or Lecture.

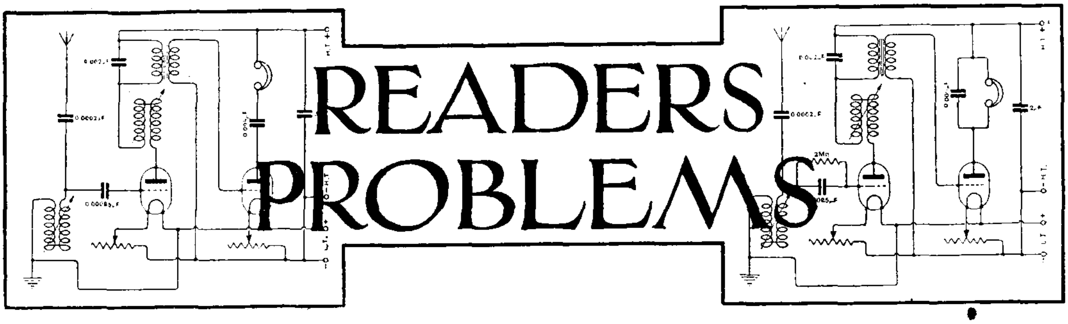
LAUSANNE, HB 2, 780 metres. Daily, 9.15 p.m., Concert and Address.

SPAIN.

MADRID, PTT, 400 to 700 metres. 6 to 8 p.m., Tests.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12 a.m. 1,800 metres. 4 p.m. and 8.30 p.m., Tests, Gramophone Records.



*1. All questions are answered through the post. A selection of those of general interest is published. 2. Not more than four questions may be sent in at any one time. 3. Every question should be accompanied by a postal order for **1/-**, or **3/6** for four questions, and by a coupon taken from the current issue. 4. A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

" *R.E.L.*" (*Bristol*) **asks for a diagram of a three-valve receiver suitable for general reception, in which the change from one wavelength to another may be made with the least possible delay.**

The diagram of a receiver which will adequately fulfil your requirements is given in Fig. 1. The first valve functions as a detector, with reaction between the plate and grid circuits, while the two succeeding valves operate as L.F. amplifiers. Only two tuning coils are used, and there are only two adjustments necessary in tuning, namely the adjustment of the aerial condenser and the reaction coupling. A series-parallel switch is provided in order that the condenser may be connected in series on short wavelengths. The use of a vernier adjustment on the 0·001 μF variable condenser will be found a distinct advantage when the latter is connected in parallel with the A.T.I. The switching of the L.F. valves is carried out by means of telephone jacks. If the telephone plug is removed from the receiver, the filament current to all the valves will be automatically switched off. The insertion of the plug in any of the three jacks automatically lights the appropriate valves. A separate H.T. tapping is provided for each valve.

" *F.S.*" (*Leeds*) **asks for a diagram of a five-valve receiver (1-V-3), the L.F. stages being resistance capacity coupled.**

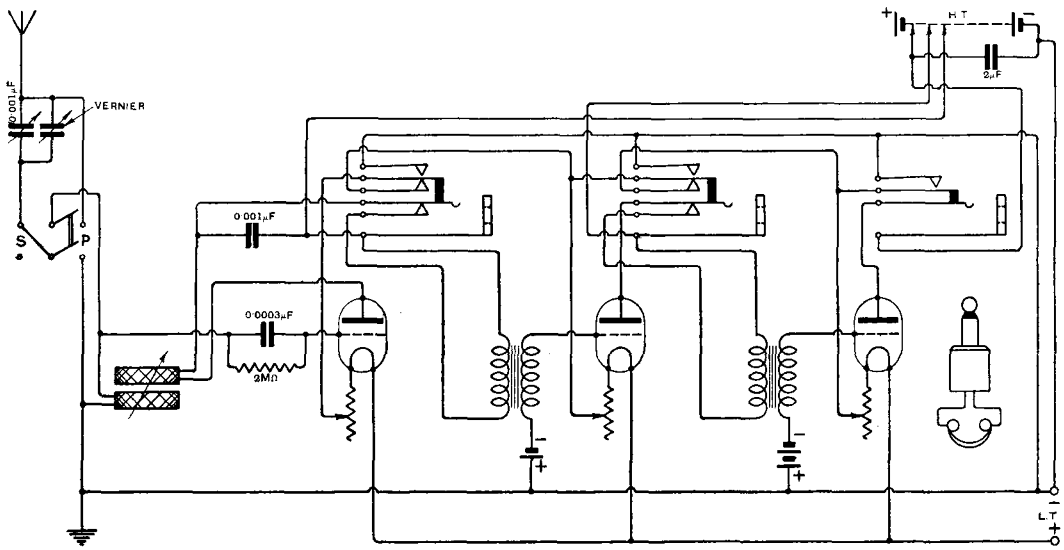


Fig. 1. " R.E.L." (Bristol). A three-valve receiver (o—v—2) for general reception.

The diagram is given in Fig. 2. As requested, the aerial is tuned by means of a variometer. The range of the variometer will be extended if a small fixed condenser is connected in series with the aerial, together with a short-circuiting switch. The efficiency and selectivity on short wavelengths will be improved when the short-circuiting switch is opened and the fixed condenser is included in the aerial circuit. A reaction coil is coupled to the anode circuit of the H.F. valve. The transformer used between the detector valve and the first L.F. valve should be chosen from the point of view of efficiency. The values of the resistances and condensers used to connect the L.F. valves will depend upon the type of valves used and the H.T. voltage applied. Three H.T. tappings are provided, one for the H.F. valve, another for the detector valve, and a third for the L.F. valves. This receiver will have a good range, and should be capable of receiving two or three of the B.B.C. stations at loud speaker strength without appreciable distortion.

directly coupled with the aerial circuit. The amount of radiation which takes place when the reaction coil is coupled to the anode circuit of a H.F. valve depends upon the capacity between the electrodes of the valve and the amount of stray coupling which may exist between the tuning coils in the receiver.

" *W.J.P.*" (*Romsey*) **asks what the capacity of a series aerial tuning condenser should be when used in conjunction with the standard P.M.G. aerial.**

This condenser should be given a value of from 0·0005 μF to 00·001μF. The reason why you are unable to obtain satisfactory results with a series tuning condenser is probably that the coil which you are using as an A.T.I. is too small. The effect of connecting the tuning condenser in series with the aerial is to reduce the effective capacity across the A.T.I., which must be increased accordingly if the same wavelength is to be received.

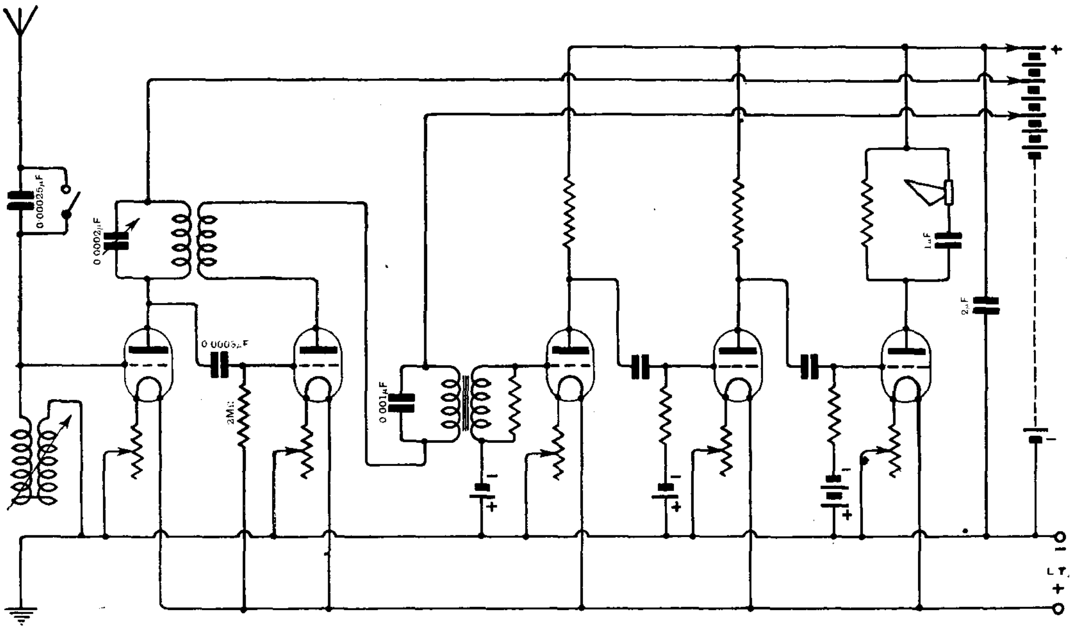


Fig. 2. " F.S." (Leeds). A five valve receiver in which the L.F. valves are resistance-capacity coupled.

" *E.A.M.W.*" (*Nuneaton*) **asks if the number of L.F. valves used in a receiver has any influence upon the amount of re-radiation which takes place from the aerial.**

The number of L.F. valves used in a receiver in no way affects the amount of radiation from the aerial. Similarly, in the case of H.F. valves, it often happens that a receiver employing several stages of H.F. amplification, in which reaction is coupled to the anode circuit of one of the H.F. valves, will radiate to a less extent than, say, a single valve receiver in which the reaction coil is

" *W.L.*" (*London, W.*10) **asks for the name of publications containing the complete international Morse Code.**

The complete code and a list of abbreviations in general use will be found in *The Year Book of Wireless Telegraphy and Telephony* and *The Wireless Annual*, both published by The Wireless Press, Ltd., and also in *The Handbook for Wireless Telegraph Operators Using Installations Licensed by H.M. Postmaster-General*, obtainable from H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.

Calls Heard

Contributors to this section are requested to limit the number of calls sent in to those heard in the previous three weeks, these being of greater interest and value to transmitters than earlier records. The repetition of the same call sign in consecutive lists is not recommended. Contributors will also assist by kindly arranging reports in alphabetical order.

London, N.W.6 (February 20th to March 25th, 1924).
British: **2 AH, 2 AU, 2 ABR, 2 ABZ, 2 ACU, 2 ACX, 2 AKS, 2 AIU, 2 AGT, 2 XAA, 2 BZ, 2 CA, 2 CW, 2 DF, 2 DR, 2 DX, 2 GO, 2 IN, 2 IZ, 2 JF, 2 JP, 2 JU, 2 KF, 2 KT, 2 KW, 2 LU, 2 MG, 2 MK, 2 OD, 2 OM, 2 PC, 2 PP, 2 PY, 2 QC, 2 SZ, 2 TA, 2 TO, 2 UV, 2 VW, 2 XR, 2 XY, 2 YQ, 2 ZK, 2 ZT, 2 ZU, 5 AC, 5 AR, 5 AW, 5 BA, 5 BT, 5 BV, 5 CF, 5 DK, 5 DN, 5 DT, 5 FD, 5 FN, 5 GF, 5 GG, 5 GJ, 5 GX, 5 HA, 5 IO, 5 JJ, 5 KC, 5 LF, 5 LZ, 5 MO, 5 NN, 5 NX, 5 OC, 5 OL, 5 OX, 5 PU, 5 QV, 5 RW, 5 RZ, 5 SI, 5 SZ, 5 UC, 5 UL, 5 US, 5 YI, 6 BU, 6 BY, 6 CV, 6 EM, 6 GM, 6 IY, 6 JT, 6 JX, 6 KI, 6 LJ, 6 NF, 6 NH, 6 OB, 6 QA, 6 QB, 6 QZ, 6 TD, 6 TM, 6 VL, 6 VP, 6 VR, 6 XX, 6 XY.** French: **8 AB, 8 AÉ, 8 AE, 8 AG, 8 AO, 8 AQ, 8 BM, 8 BP, 8 BV, 8 BX, 8 CH, 8 CM, 8 CS, 8 CT, 8 CQ, 8 CZ, 8 DA, 8 DE, 8 DO, 8 DU, 8 DY, 8 DX, 8 ÉI, 8 ÉB, 8 EI, 8 JF, 8 ML, 8 OH, 8 PD, 8 RL, 8 SSU, 8 WV, 8 ZQ.** Belgian: **W 2, P 2** (Luxembourg) **0 AA.** Dutch: **0 AA, 0 AG, 0 AR, 0 BA, 0 BQ, 0 DD, 0 KX, 0 NY, 0 PB, 0 XA, 0 XO, 0 XQ, 0 YS, 0 ZN, PC II, PCTT, PA 9.** American: **1 BGQ, 1 XAM, 1 XAR, 1 XW, 3 HY, 4 IO, 4 XE, 9 XZ, WNP**? (Reinartz Det.: 1 L.F.)
D. B. Knock, **6 XG.**)

Thornton Heath, Surrey (March 23rd to 27th).
2 AC, 2 AH, 2 ABR, 2 CA, 2 JT, 2 LH, 2 MK, 2 OZ, 2 QC, 2 TO, 2 TP, 2 UC, 2 WC, 2 ZT, 5 AW, 5 CV, 5 DB, 5 FD, 5 GF, 5 GL, 5 HN, 5 IK, 5 MO, 5 NN, 5 OT, 5 SI, 5 SL, 5 SZ, 5 UC, 5 US, 5 VP, 6 OH, 6 CV, 6 IY, 6 TR, 6 VP, 6 VR, 8 AQ, 8 AU, 8 BG, 8 BL, 8 BR, 8 CC, 8 CM, 8 EC, 8 EN, 8 HR, 8 JC, 8 JD, 8 OH, 8 ON, 8 OL, 0 AG, 0 BA, 0 FN, 0 KA, 0 MR, 0 NN, 0 XO, 1 ER, Swiss(?) **XY** and **XZ**, Spanish **4 AL** and **0 IR, 7 AB, 7 EC, P 2,** German(?) **2 W** or **W 2** and **BFU.** American: **1 CMP, 2 AC, 1 XM, 1 AL.** (Single-valve Flewelling.) (A. Richardson.)

Brussels (March 16th-22nd.).
2 BR, 2 YT, 5 CC, 5 KO, 5 SI, 5 SO, 5 SZ, 6 BT, 6 NF, 6 XC, 6 XG, 6 XX, 8 AL, 8 BM, 8 BP, 8 JC, 8 ML, 8 OH, 9 XZ(?), **0 AA, 0 MR, 0 QO.** (o—v—1.) (Rodolph Couppez.)

Coventry (February and March).
2 AIT, 2 AK, 2 AL, 2 BO, 2 CN(?), **2 CZ, 2 DM, 2 DU, 2 DZ, 2 FL, 2 FN, 2 GG, 2 GO, 2 HF, 2 JR, 2 KO, 2 KU, 2 LG, 2 LK**(? **2 LX, 2 MZ, 2 NM, 2 NP, 2 NV, 2 ON, 2 OQ, 2 OX, 2 PV, 2 QR, 2 RC**(?), **2 TO, 2 TR, 2 TN, 2 TV, 2 UO**(?), **2 VQ, 2 WD, 2 WA, 2 WM, 2 WU, 2 XG, 2 YC, 2 YT, 2 YV, 2 YX, 5 CT, 5 DT** (?), **5 FI, 5 FV, 5 FY, 5 IY, 5 KD, 5 KY, 5 LV, 5 MO, 5 NB, 5 NH, 5 TK, 5 YS, 5 YW, 6 AQ**(?), **6 HU, 6 MJ, 6 MQ, 6 RH, 6 UC, 6 UU, 8 AQ, 8 AU, 8 BP, 8 CM, 8 CJ, 8 CZ, 8 DA, 8 DY, 8 MH, 8 RL, 0 AG, 0 BA, 0 MR, 0 PN, 0 RA.** (o—v—1.) (J. Hanson, **2 AOX.**)

Edinburgh.
British: **2 AA, 2 AC, 2 AJ, 2 AP, 2 CW, 2 FN, 2 II, 2 JZ, 2 KF, 2 MG, 2 NM, 2 OD, 2 OM, 2 SH, 2 TA, 2 TF, 2 XG, 2 XZ, 2 ZT, 5 BA, 5 BV, 5 DN, 5 GN, 5 JX, 5 KO, 5 LA, 5 MO, 5 NW, 5 OL 5 QV, 5 RQ, 5 RW, 5 RZ, 5 SI, 5 ST, 5 US, 5 WR, 6 GY, 6 IM, 6 JX, 6 NF, 6 PS, 6 OW, 6 RY, 6 VK, 6 XX.** French: **8 AB, 8 AEI, 8 BÉ, 8 BP, 8 BM, 8 CS, 8 CT, 8 DA, 8 ÉB, 8 OH, 8 LY.** Dutch: **0 AA, 0 BQ, 0 FL, 0 KA, 0 KX, 0 MX, 0 NY, 0 XF, 0 XO, 0 SA, 0 ZZ, PAR 14, P 2.** Danish: **7 DA, 7 EC, 7 JS, 7 ZM.** Italian: **ACD.** American: **1 XAM, 1 XAR, 1 CMP, 2 XA, 3 MX,** (1—v—1.) (Francis G. S. Melville.)

Liverpool (during March).
ACD, 0 BA, 0 BQ, 8 BF (telephony R 5), **8 BL, 8 BV, CRRP, 8 CF, 8 CH, 8 DX, 8 DU, 8 DY, EFJ, 8 ÉB, 8 ÉI, 6 FG, 8 JD, 2 KF, 5 KC, 5 KO, 0 KX, 8 LM, 0 MS, PA 9, P 2, PCII, PCTT, 2 PC, 8 PX, 6 UD, W 2, 2 XG, 2 XY, 0 XO, 0 XQ, 2 YQ, 2 YT, 7 ZM, 0 ZN.** (o—v—1, indoor aerial, on 100 metres.)
(J. W. Heffernan, **2 ABL.**)

Bridlington, Yorks (during March).
English: **2 KF, 2 NM, 2 OQ, 2 PC, 2 SS, 2 WJ, 2 XAX, 2 XF, 2 XY, 2 YQ, 2 YT, 2 ZSJ, W 2, 5 AW, 5 BT, 5 BV, 5 DN, 5 IK, 5 KO, 5 MO, 5 MS, 5 OL, 5 RZ, 5 US, 6 BY, 6 QB, 6 XG.** French: **8 BF, 8 CT, 8 DU, 8 DX, 8 DY, 8 ÉB, 8 ML, 8 PX, 8 QA, P 2.** Dutch: **0 AA, 0 AB, 0 BA, 0 KX, 0 MR, 0 NY, 0 QV, PCRR, PCTT.** American: **1 AFT, 1 ML, 1 XAM, 1 XJ, 4 IS, 4 EITV.** (1—v—1.) ("Listener.")

The Hague, Holland.
2 JU, 2 OG, 2 OY, 2 QH(?), **2 TO, 2 WA, 4 ZZ, 5 KO, 6 AH, P 2, W 2, 0 AA, 8 AÉ, 8 BG, 8 BP, 8 CF, 8 CH, 8 CM, 8 CZ, 8 DU, 8 ÉB, 8 OH, 8 QS, 8 RR, 8 RS.** (o—v—1.) (A. T. L. de Groot.)

Heswall, nr. Birkenhead.
2 AHT, 2 AG, 2 AMM, 2 IF*, 2 JC, 2 ON, 2 PC, 2 QR, 2 XY, 5 QV, 5 YW, 6 LG, 6 SH, 6 UV(?), **6 XX, P 2, 8 BV, 8 CCR, 8 CN, 8 DD, 8 DX, 8 EI, 8 JC, 8 SSU, 0 AG, 0 AAL, 0 XF, 0 ZN, 0 XO, 0 PG, 0 KX.** American: **1 CMP, 1 BDI, 2 CPD, 9 AG**(?), **4 SC**(?)
*Good speech. (o—v—1.) (I. Auchterlonie, **6 OM.**)

Milan, Italy (March 19th-26th).
0 AA, 0 BA, 0 KX, 0 NY, PCTT, 2 PC, 2 XY, 5 MO, 5 KO, 5 CC, 5 NN, 5 AC, 5 QV, 5 BV, 8 AG, 8 AP, 8 AU, 8 BM, 8 CH, 8 CM, 8 AÉ, 8 DA, 8 DC, 8 DP, 8 DU, 8 ÉN, 8 ÉB, 8 ÉD, 8 ÉU, 8 FP, 8 jP, 8 NN, 8 RO, 8 WO, 8 WV. Italians: **ACD, 1 ST, 1 ER, 1 GN, 1 FL, 3 MB.** (Sigs. Ercole Ranzi and Libero Zannoni, **1 ZR.**)

Withington, Manchester (fortnight ending April 6th).
2 ACU, 2 GG, 2 IJ, 2 JU, 2 KF, 2 LH, 2 LU, 2 NM, 2 OD, 2 ON, 2 RB, 2 UV, 2 VJ, 2 VQ, 2 XG, 2 XY, 2 YQ, 2 ZU, 5 AW, 5 BV, 5 DN, 5 FD, 5 FW, 5 ID, 5 IG, 5 KC, 5 KO, 5 NN, 5 OC, 5 OT, 5 QM, 5 SI, 5 SZ, 5 UG, 5 US, 6 EA, 6 IY, 6 LJ, 6 NF, 6 RY, 6 XG, 6 XX, 8 CC, 8 CF, 8 CM, 8 CS, 8 CT, 8 CZ, 8 AN, 8 AU, 8 DA, 8 DP, 8 DU, 8 DX, 8 ÉI, 8 JD, 8 OH, 8 QS. Dutch: **0 AH, 0 BA, 0 DV, 0 KA, 0 KX, 0 MR, 0 NN, 0 NY, 0 XQ. 7 EC, 7 ZM, 1 CF, 8 SSU. XY. 1 JW, 0 AA. ACD, 1 MT, 4 ZG, 4 ZZ, W 2** American: **1 XAH.** (B. L. Stephenson, **5 IK.**)

Sheffield (March 15th-April 2nd).
2 DF, 2 FN, 2 JF, 2 LH, 2 LM, 2 OG, 2 WJ, 2 XAA, 2 XAR, 2 XY, 2 YQ, 5 AW, 5 JJ, 5 KO, 5 KW, 5 MO, 5 NN, 5 ON, 5 SI, 5 SZ, 6 NK, 6 UD, 6 RY, 8 AE 3, 8 AG, 8 AU, 8 BY, 8 CZ, 8 DA, 8 DC, 8 DN, 8 DP, 8 ÉB, 8 ÉI, 8 JC, 8 JD, 8 ML, 8 OH, 8 RO, 0 AG, 0 HA, 0 KN, 0 NY, 0 TO, 0 ZD, PCTT, P 2, W 2, 7 EC, XY, 1 ER. American: **1 XAM, 1 XW.** (o—v—o or o—v—1.) (All below 200 metres.) (L. A. K. Halcomb, Capt., **5 DN.**)

Ramsgate.
2 KT, 2 NM, 2 SV, 2 VD, 5 HN, 5 KO, 5 LS, 5 MO, 5 NF, 5 PZ, 5 QY, 5 SY, 6 BT, 6 XX, 8 BP, PCII. (o—v—1.) (R. Miller.)

FORTHCOMING EVENTS.

WEDNESDAY, MAY 14th.

Radio Society of Great Britain. At 6 p.m. At the Institution of Electrical Engineers. Mr. G. G. Blake, M.I.E.E., A.Inst.P., will open a discussion on "Some Suggested Lines for Experimental Research."

THURSDAY, MAY 15th.

Blackpool and Fylde Wireless Society. Discussion: "Broadcasting compared with the Gramophone."

Kensington Radio Society. At 2, Penywern Road, Earl's Court, S.W. Sale and Exchange.

Liverpool Wireless Society. At 7.30 p.m. At the Liverpool Royal Institution, Colquhitt Street. Lecture: "Technical Troubles of Broadcasting." By Capt. P. P. Eckersley, Chief Engineer of the B.B.C.

FRIDAY, MAY 16th.

Radio Society of Great Britain (Transmitting and Relay Section). At 6.30 p.m. At the Institution of Electrical Engineers. Mr T. E. Goldup will open a discussion on "Transmitting Valves."

Wimbledon Radio Society. At the Red Cross Hall, 59, Church Road. Lecture: "Continuous Wave Transmission." By Mr. C. E. P. Jones.

Radio Society of Highgate. At Edco Hall, 270, Archway Road. Demonstration by the General Electric Company.

MONDAY, MAY 19th.

Ipswich and District Radio Society. At 55, Fonnereau Road. Open night.

Kingston and District Radio Society. General meeting.

TUESDAY, MAY 20th.

Uxbridge and District Radio and Experimental Society. Lecture: "Home-made Coils." By Mr. Treadaway.

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THE WIRELESS WORLD AND RADIO REVIEW

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CONSTRUCTING A POWER AMPLIFIER

No. 249 [No. 8 Vol. XIV]

HOW CRYSTALS DETECT

THE WIRELESS WORLD AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GREAT BRITAIN.

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ASSISTANT EDITOR:
F. H. HAYNES.

QUESTIONS AND ANSWERS DEPARTMENT:
Under the Supervision of W. JAMES.

CONTENTS

THE EDITOR will be glad to consider articles and illustrations dealing with subjects within the scope of the Journal. Illustrations should preferably be confined to photographs and rough drawings. The greatest care will be taken to return all illustrations and manuscripts not required for publication if these are accompanied by stamps to pay return postage. All manuscripts and illustrations are sent at the Author's risk and the Editor cannot accept responsibility for their safe custody or return. Contributions should be addressed to the Editor, "The Wireless World and Radio Review," 12 and 13, Henrietta Street, Strand, London, W.C.2.

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The WIRELESS WORLD AND RADIO REVIEW

A POINT OF POLICY.

By The Editor.

NO other branch of science has ever achieved such an almost instantaneous popularity as wireless.

During the last few years wireless has been introduced either directly or indirectly to every family, perhaps to every home, in this country, whilst in America it has penetrated even more completely into the everyday life of the nation than is the case here. We do not mean by this that every home has necessarily installed a wireless receiver, but that wireless is now a familiar subject, and there are few families where wireless is not represented by at least one enthusiast who has taken a practical interest in the science.

This astonishing influence, whilst it has been of enormous benefit to the community, has at the same time offered splendid opportunities to those who are interested in exploiting the public, and in some cases, we fear, trading on their credulity and lack of technical knowledge to further mercenary interests.

Exploiting the public in this respect became a positive scandal in the United States a year or so ago, for it must be remembered that broadcasting in that country was started some time before it was taken up here. So serious did the situation become in America that special steps were taken to control the sale of bogus apparatus and so-called new inventions by boycotting the manufacturers and dealers who traded in them.

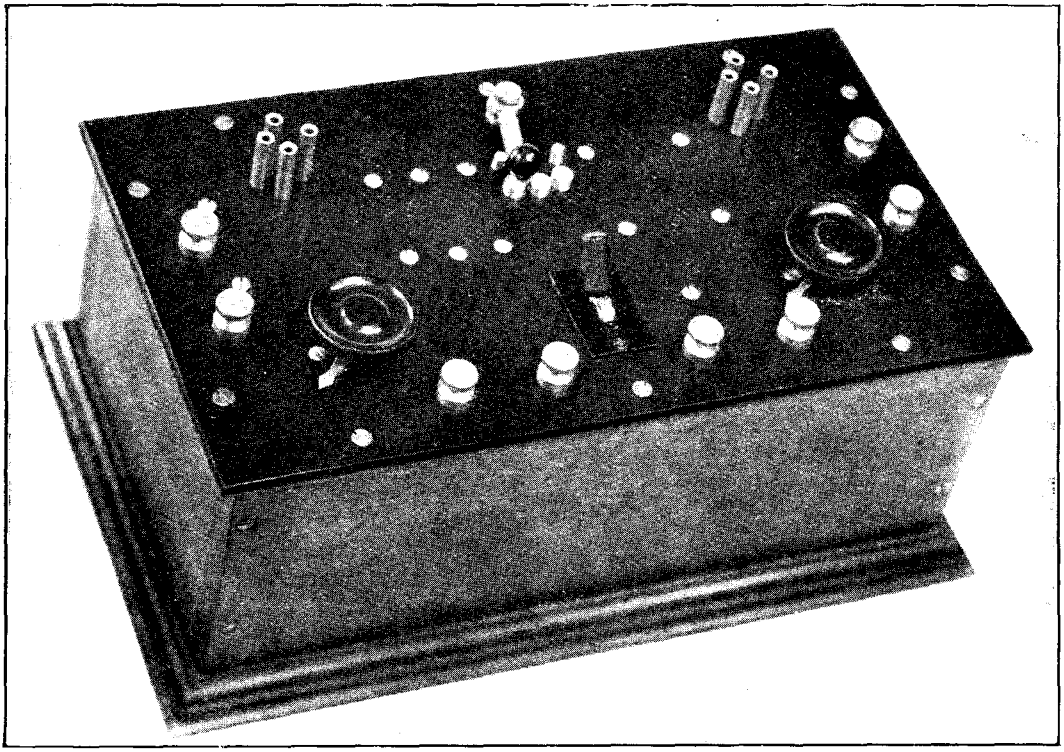
Similarly the press, particularly those journals which may be classed under the heading of *Daily Screams*, found in wireless an excellent opportunity for sensational headlines and descriptions of amazing new inventions, which in practice never got beyond newspaper print.

We believe that the British public are not so easily carried away by sensational reports and arresting advertisements, but perhaps for this very reason the danger is greater, because the announcements have to be more cunningly contrived and judiciously worded before there is any hope of attracting wide interest amongst the British public.

Some sections of the daily press in this country are always ready to take up and give publicity to any startling claims regarding wireless and other scientific inventions, without taking any steps to investigate either the novelty of the claims or the scientific value of the invention. Unfortunately one not infrequently finds the names of eminent wireless men linked up with such schemes, and one can only suppose that they have neglected to give the matter full investigation, not realising the extent to which the general public may be influenced by the glamour of their names. It is for this reason that a wireless journal with a reputation to maintain must be cautious in the information which it puts out to its readers, particularly in respect of new claims and inventions.

The Wireless World and Radio Review has no intention of allowing its readers to suffer by withholding information on any new discovery contributing to the progress of the science, and readers can rest assured that progress and new developments will be dealt with without delay in the columns of the journal, and will be treated from an entirely unbiased point of view.

It follows logically that startling announcements regarding new discoveries which may appear in other sections of the press, or apparatus for which new and arresting claims are made, when *not* dealt with in the columns of this journal, may be understood to have been investigated and in our opinion "found wanting."



A power amplifier built to the design given in this article.

CONSTRUCTING A TWO-STAGE
POWER AMPLIFIER.

The design is easy to follow and comparitively inexpensive to make up. A high degree of amplification with a minimum of distortion has been the aim in designing the set. The grid potential bias is obtained by feeding the plate current through a resistance which forms part of the grid circuits, thus avoiding the use of grid cells.

IT is surprising how often in conversation on wireless matters one is met with a statement something like this: "Oh, I would much rather listen in with head-phones; loud speakers are so tinny," or "so gramophoney." There does indeed seem to be a large body of opinion to the effect that the present-day loud speaker is a very imperfect instrument, and that if real quality of reception is desired it is very much better to limit oneself to a number of telephones. Criticisms of this nature might possibly have been directed against the loud speakers of a year or two ago with a good deal of truth, and of course, there are still a number of types of instrument of poor design and faulty construction on the market. There is, however, little doubt that the better makes now offered to the public are quite satisfactory, and the reason that they are still regarded with some suspicion is that they are all too frequently used with un-satisfactory receiving apparatus.

It is commonly thought that if a receiver ordinarily gives signals of a good strength, then by pushing reaction up to the limit and possibly adding a stage of "note magnification" with some sort of a low frequency transformer and an ordinary receiving valve good loud speaker results should be obtained. Unfortunately, the results are generally poor, owing to a number of pitfalls, of which the following are the most important. Firstly, an ordinary receiving valve is unable to handle sufficient power for real loud speech without giving distortion. This distortion is caused by the fact that the characteristic of the valve is only straight for a comparatively small part of its length, and if the power is pushed up too far the range of characteristic which is used includes regions having accentuated by the use of too much reaction in the high frequency circuits. Bearing in mind the above points it will be seen that few receivers as usually made or marketed are likely to give good results as they stand, and the labour involved in altering them would be so great that it is generally better to design the low frequency amplifier as a separate instrument in which all the necessary precautions can be taken from the start. If this is done, the results obtained should convince the most critical that a loud speaker of reliable make is not an

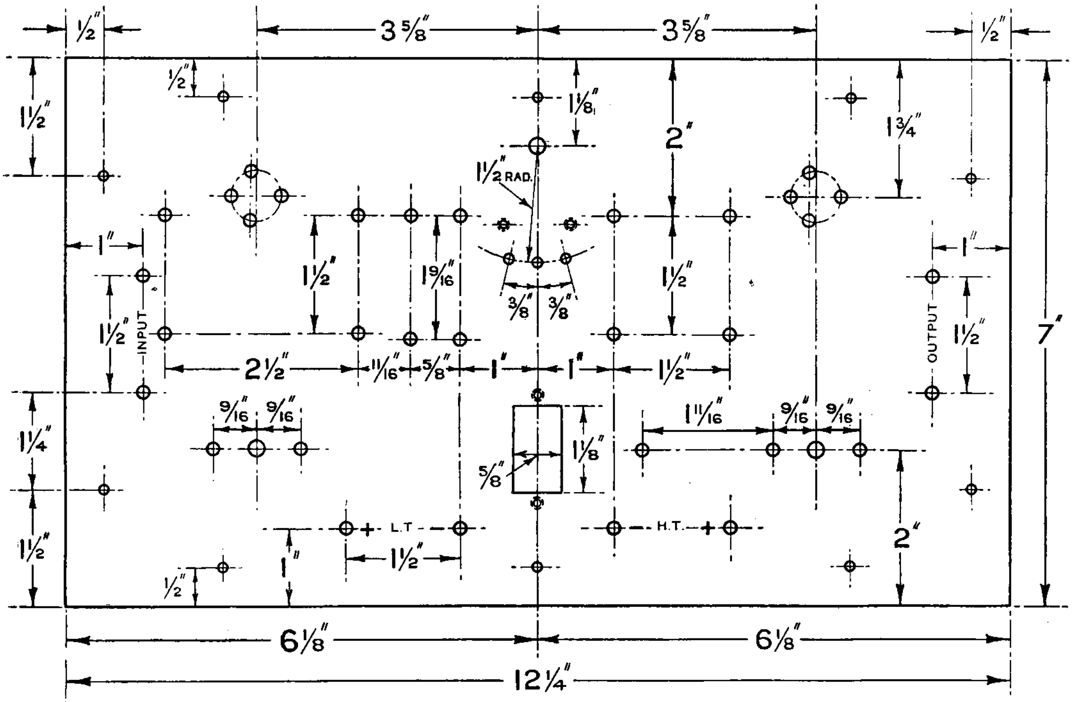


Fig. 1. Positions for drilling all holes for attaching the components. It is advisable to scrutinise the parts before setting out the holes in the positions exactly as shown. The centres of the components, fixing their location, can be followed precisely as shown.

appreciable curvature. Secondly, most low frequency transformers amplify different frequencies to different amounts. The reasons for this are many, and space does not permit us to discuss them here. The most common cause is too much economy in the materials, both iron and wire, of which they are made. Further, distortion is introduced if the valve is worked under such conditions that any grid current can flow. These are the most important directions in which faults occur in the actual low frequency circuits, but they are often instrument of torture, but is capable of pleasing even those of refined musical taste.

The amplifier here described has been designed to have sufficient magnification to work a loud speaker off signals of quite ordinary telephone strength, thus minimising the risk of distortion being introduced before the signals even reach the amplifier. It is also provided with valves which can handle sufficient power to fill a large room without distortion, and is provided with a switch to enable one valve only to be used when full power is not required.

The choice of a suitable valve is a matter of some importance. It is desirable that it should have a small anode impedance, as a valve of this type introduces a damping across the transformer which reduces any resonances which it may have. The ideal valve for the purpose has a characteristic

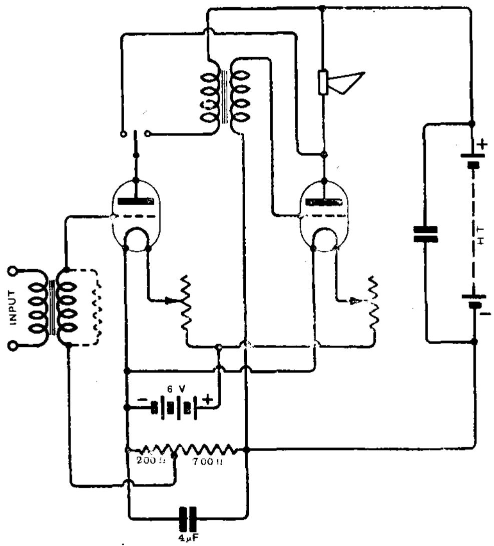


Fig. 2. Circuit of two-stage power amplifier in which the grid biasing potentials are produced across a resistance in the H.T. battery lead.

similar to the Marconi Osram " L.S. 5," but this valve is very expensive, and besides handling more power than is really necessary in an ordinary house, is very heavy on high tension supply. This being the case the new " D.E. 5 " type has been chosen, as it is considerably cheaper, and although its power handling capacity is comparable with the " L.S. 5 " (probably 60 to 70 per cent. of that of the more expensive type) it requires only 0·25 amps. of filament current, and between 5 and 10 milliamps of plate current at 120 volts. Comparing this with the 10 to 15 milliamps at 160 volts of the " L.S. 5," it will be seen that a very real saving is effected. In fact, the consumption of two of the latter valves is so high that it is almost impossible to run them economically without the use of high tension accumulators. Although the plate current for two " D.E. 5 " valves is high enough to need a battery of generous proportions, it is not sufficient to make the expense of renewals of dry batteries prohibitive. Another advantage of the " D.E. 5 " valve is that it is a really excellent general purpose valve, and may be used in experimental receivers of all types, both as a detector and also as a high frequency amplifier when it is not actually required in the power amplifier. The anode impedance of this valve is somewhat higher than that of the " L.S. 5," but is much less than that of ordinary receiving valves.

The theoretical circuit of the amplifier is shown in Fig. 2. It will be noted that two variable filament resistances have been introduced. These are not absolutely essential, as the " D.E. 5 " valve operates well and safely on any voltage between about 3·5 and 5·5; but they are a convenience, and not expensive, and have therefore been added. Two are supplied to avoid the inconvenience of an alteration in the filament brightness of the first valve when the second is switched on or off. The switching of the valves and also of the output is carried out by means of a Kellogg type switch of ordinary construction, with twelve blades. The arrangement of the connections is shown in Fig. 3, which shows in a diagrammatic form the wiring to the blades as seen from

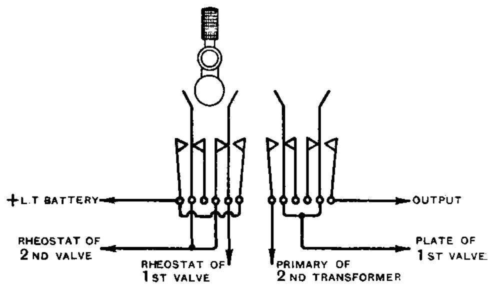
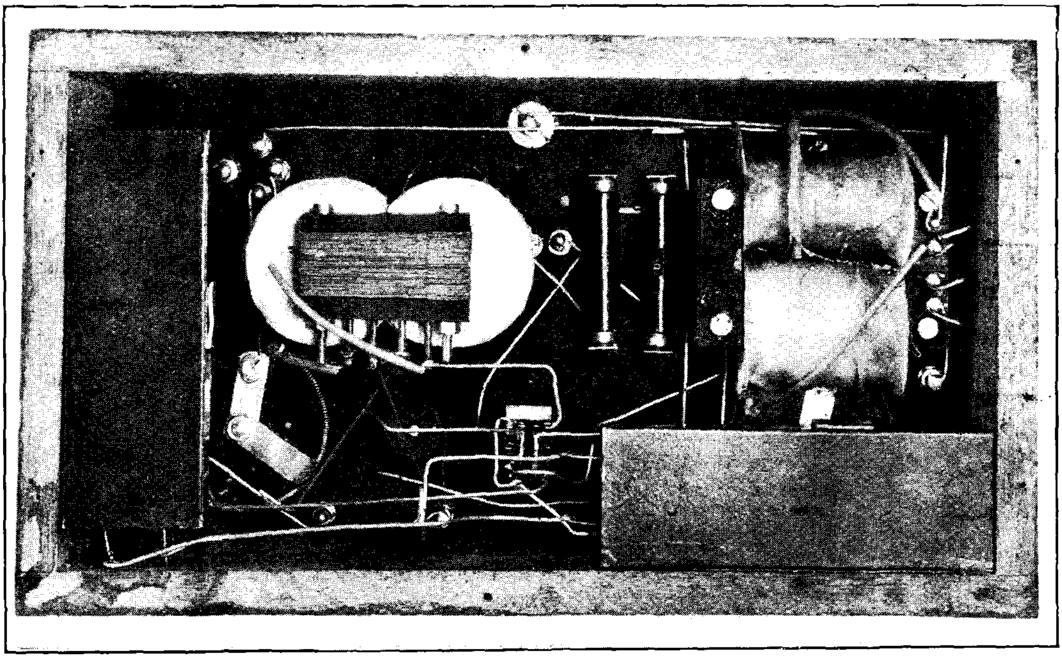


Fig. 3. Connections of key switch.

the underside of the panel. With these connections the amplifier is switched off when the switch is in its midway position. When the knob is pushed towards the top of the panel, the instrument acts as a one-valve amplifier, and when it is pulled towards the bottom of the panel both valves are in circuit as a two-stage amplifier.

In addition to the valve switching, the power can be further controlled by the switch in the top centre of the panel. This switch has three positions, in two of which different leak resistances are introduced across the secondary of the first transformer. These resistances not only vary the power output, but they do so in such a way as to further improve the quality by still more damping out any unevenness in the amplification curve of the transformer. The combination of this switch with the switch controlling the number of valves in use gives a total of six different possible strengths of output. With D.E. 5 valves suitable values for the leaks would be about 50,000 and 150,000 ohms, but they should be adjusted by trial and error to give a nice smooth gradation of strength.

The next item of interest is the arrangement for the provision of a negative potential on the grids of the valves. It is well known that whenever there is a positive potential on the grid of a valve, some current flows to it. Unless some device is provided to apply a static negative potential to the grid during each cycle of current from the transformer, there will be a brief period during which the grid is positively charged, and the resultant grid current will cause more or less serious distortion. This can be obviated by the use of a small polarising battery putting a few volts negative on the grids, the actual value being slightly greater than any voltage which is likely to be induced by the signal, but not sufficiently great to move the operating point far from the middle of the straight part of the valve characteristic curve. A grid polarising battery does not have to supply any appreciable current, and therefore may consist of quite small cells; but in practice there are drawbacks to its use, chiefly because small dry cells do not stand up well for long periods even on open circuit. An alternative method which, although not novel, has not been much used in spite of distinct advantages, has been incorporated in this design.



Underside of the amplifier. Details are given for the construction of the intervalve transformers. The large capacity condensers are attached to the cabinet and the connections completed when the panel is in position.

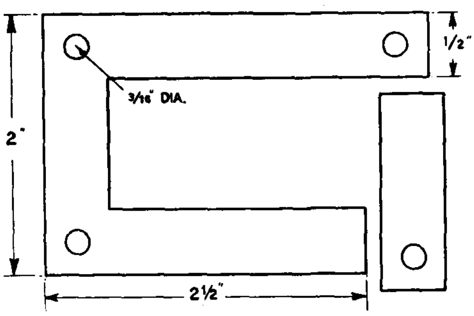


Fig. 4. The transformer stampings.

It consists of a resistance between the negatives of the low tension and high tension batteries, by means of which the necessary negative potential for the grids can be derived from the high tension battery. Considering the high tension circuit containing this resistance, it will be evident that owing to the current passing through the resistance, the potential at the end of the resistance nearer to the H.T. battery will be negative to that at the other end, and if this point is connected through the transformer secondary to the grid of a valve, the grid will be charged negatively as required. In actual practice more negative potential is required on the second valve than on the first, and the resistance is therefore tapped at an intermediate point and this tapping taken to the grid of the first valve, while the tapping for the second grid is taken from its end. The resistance may be wound on any convenient size of former, which may be quite small if say No. 42 silk covered "Eureka" is used. The total resistance of the winding should be about 700 ohms, with a tapping at 200 ohms from the end connected to L.T. negative for the first grid. No. 42 "Eureka" has a resistance of rather less than 50 ohms to the yard, which will enable the correct lengths to be determined without electrical measurement, as no great accuracy is necessary in the values of resistance used. It will be noted from the circuit diagram that a large condenser is shunted across the resistance. This condenser is essential to prevent the amplifier from oscillating. A value of 4 mfds. has been specified, although 2 mfds. may possibly be found sufficient. This condenser need not be of expensive type, in fact the Mansbridge variety of paper and foil, costing a few shillings, is quite satisfactory for the purpose.

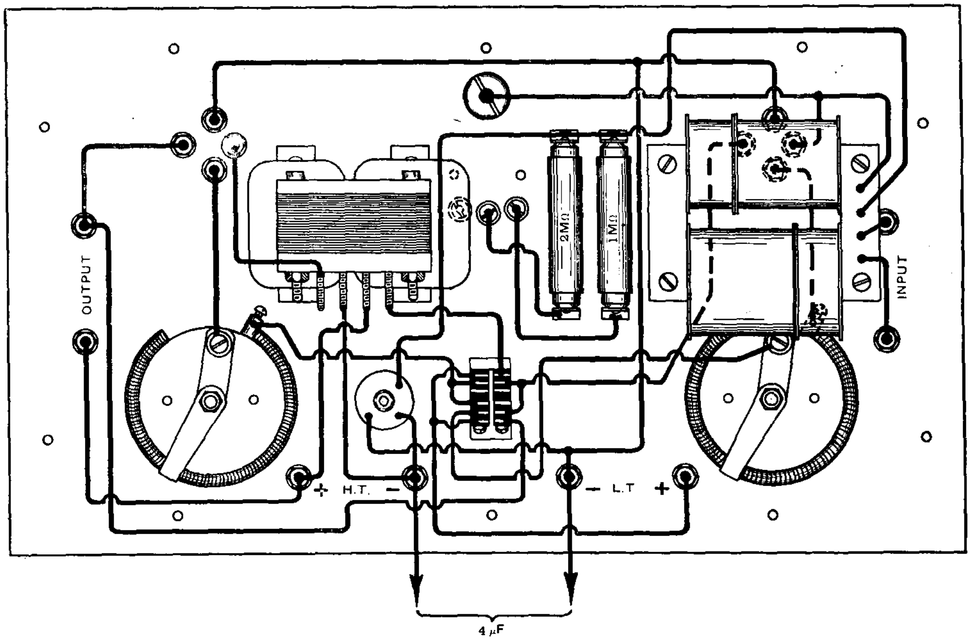


Fig. 5. Practical wiring diagram. The spool carrying the resistance wire across which the grid potentials are set up is just above the H.T. negative terminal.

We now come to the most important item in the instrument, the transformer. The winding and construction of a transformer, particularly where a high standard of performance is required, is a long and rather tedious job unless special appliances are available, but it is not essentially difficult. It is, however, by no means waste of time and labour to make them. The chief fault with most transformers which are offered for sale is that the keenness of competition in the trade makes it difficult for manufacturers to put enough iron and wire into them. The transformers here used are very generously provided with material, and their performance will be found to make this well worth while. There do not appear to be many places where suitable core stampings may be obtained, and the name is therefore given of Messrs. Joseph Sankey and Sons, who have premises in Regent Street, London, at which a variety of types of stalloy stampings can be obtained from stock. The form chosen is shown in Fig. 4, which may be obtained at 6s. per gross pairs, *i.e.*, large and small. About 60 of each size will be required for each transformer, as the core should be built up to a thickness of about ¾ in. The windings of each transformer consist of two pairs of coils, wound on separate bobbins, and the transformers are built up as shown in Fig. 5, so that one primary coil and one secondary occurs on each long leg. The two coils forming the primary winding are connected in series, and care should be taken to see that the sense (direction) of the connection is such as to make their magnetic fields assist and not oppose. These remarks apply to the secondary windings also. The wires used should be No. 44 single silk covered, and 3,000 turns should be wound on each primary bobbin and 10,000 on each secondary. This will require nearly 1 lb. of the wire for the two transformers. The bobbins may be built up of thick paper well impregnated with pure paraffin wax, or shellac, but care should be taken that there is a good thickness of insulation between the windings and the core.

The transformers are mounted in the instrument with their axes at right angles. This is partly to minimise the risk of trouble through magnetic coupling of their fields, and partly for convenience in order to provide room for the leak resistances between one of them and the panel. It should not be necessary to earth the cores of the transformers, but if any trouble is met with from oscillation this course may be found to be helpful.*

There is nothing unusual in the wiring methods adopted, the wire used being bare tinned copper, soldered at all joints.

The instrument when completed should be found to be quite stable, and to give sufficient output to saturate the second valve from telephone signals of reasonable strength. It will also be found to give readable loud speech from signals which are hardly readable in an average pair of telephones. It has, as stated above, been designed to take advantage of the characteristics of the D.E. 5 valves, but it will work quite satisfactorily on two R valves (or preferably an R followed by an L.S. 3) without any alterations to its components. If these valves are used, neither the amplification nor the maximum possible output will be so great as with D.E. 5's, although both will probably be sufficient for ordinary domestic use. A. S. C.

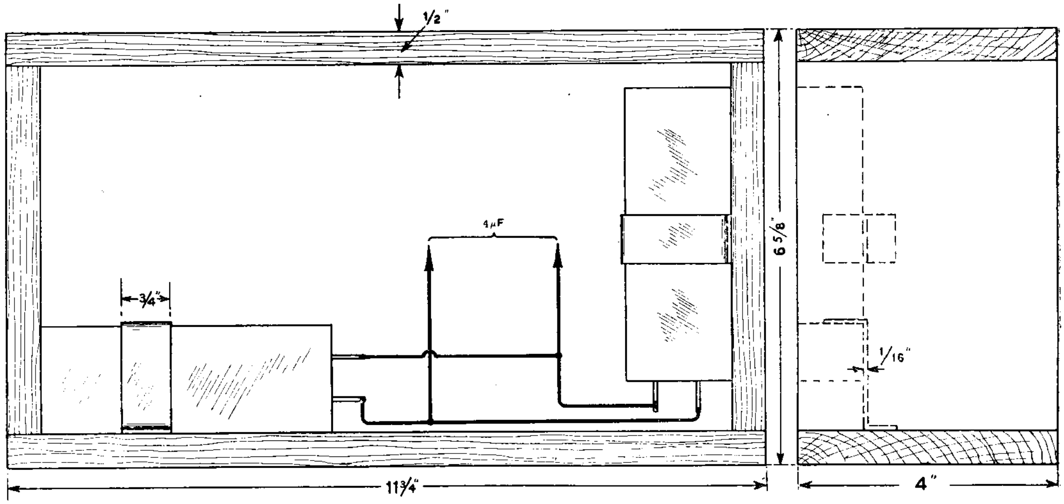


Fig. 6. Dimensional drawing of the cabinet, showing the fixing of the condensers.

* Note that stability of working may also be assisted by connecting together the negative of the L.T. battery on this instrument and that on the receiver. If desired, common L.T. or common H.T. batteries may be used for the two instruments, *but not both.*

THE CRYSTAL DETECTOR IN THEORY AND PRACTICE.

1.—ON PRESENT THEORIES OF CONTACT RECTIFICATION.

By JAMES STRACHAN, F.Inst.P.

TEN years ago the prototype of the modern crystal detector, with a firmly clamped galena crystal and a loose contact of fine copper wire, was described in *The Wireless World*[1] when it was stated that this type of detector was not in common use. At that time all of the existing theories of contact rectification had been advanced and since then no further progress appears to have been made in this direction.

Research workers have concentrated on the thermionic valve and in spite of the extended and popular use of the crystal detector the latter has been somewhat neglected by the professional scientist, who has not taken very seriously the random freaks of crystals as described by amateurs. There are signs, however, of renewed interest in the crystal and there is no doubt in the writer's mind that this type of detector has a promising future for the reception of broadcast telephony.

During the past few years great improvements have been effected in the production of synthetic crystals of greater sensitivity, and I venture to predict that when we thoroughly understand the mechanism of contact rectification, investigators along this line will meet with others who are aiming at the production of a " cold valve," and on common ground.

A history of the evolution of contact detectors from the coherers of Branly and Lodge, through the single-point coherer to the modern crystal detector, and of the concurrent theories devised to explain their action, would occupy a large volume. A concise and suggestive résumé of the subject from the pen of the well-known authority on crystal structure, Tutton, appeared in *The Wireless World*[2] and a most useful bibliography has been published by Coursey,[3] both of which should be studied as an introduction to the literature on contact rectification.

The principal theories may be classified briefly as follows : (1) Electrostatic ; (2) Unilateral conductivity ; (3) Electrolytic ; (4) Thermo-electric ; and (5) Thermal.

1. **Electrostatic theories** of the early forms of contact detectors (coherers) were advanced by Branly, Haga and Lodge (1895-96) based on variation in conductivity of the dielectric film at the loose contact, electro-static attraction and diffusion of metals at contact, and change of resistance due to piercing of dielectric with cohesion at contact points.

2. **Unilateral conductivity theories** have been advanced by various writers based on electrostatic and electrolytic phenomena but without definite experimental substantiation. Pierce (1907) established unilateral conductivity of certain carborundum crystals and suggested that the small area of contact in such detectors permits the passage of electrons more easily in one direction than the other. The general conclusions arrived at by Pierce from extensive investigations of crystal detectors militate against thermo-electric and electrolytic theories, and on his work is based principally the modern theory of unilateral conductivity of the loose contact. This is sometimes referred to as the " filter " theory.

3. **Electrolytic theories** were first applied to film coherers when it became recognised that the zone of reaction was not a film of air or condensed gas at the contact, but that the dielectric film consisted of an oxide of the metal and that even noble metals might be oxidised by the passage of electrical oscillations. Such theories, based on the ionisation and electrolytic polarisation of oxide and sulphide films, were latterly applied to crystal detectors but general experimental evidence is against them. Coursey[4] revived the idea that electrolytic action was suggested by the behaviour of certain detectors (galena-graphite and tellurium-aluminium). In this connection it should be noted that any thermal effect at the contact would

facilitate electrolytic conduction by increasing the mobility of the molecules and their ionisation. No direct experimental evidence has been brought forward to support this theory.

4. Thermo-electric Theories of rectification were also applied and denied by various writers in the early days of crystal detectors. This is the popular theory so often referred to in text-books and is based on thermal effects generated at the highly resistive contact (Joule's law) giving rise to a thermo-electric current (Seebeck effect) modified by the Peltier effect at the firm and loose contacts. Eccles'[5] treatment of this theory as part of his general electro-thermal theory of detectors is very complete. He also brings in for the first time the idea of a steep temperature gradient at the contact, thus introducing the Thomson effect and in proving this, mathematically, the deciding factor in the direction of the rectified current answers the objection raised to the thermo-electric theory by both Pierce and Austin that the thermo-electric current obtained by external application of heat to a crystal-metal contact is *sometimes* in the opposite direction to that obtained during rectification of high frequency oscillations.

The present writer's experience on this point is rather different. I have found that with all crystals in common use as rectifiers, in contact with a metal point, the thermo-electric current generated by external heat is *invariably* in the opposite direction to that of the rectified current *for the same contact.* This suggests that the rectifying properties of crystals are concerned with electron movements of a similar nature to those connected with the production of thermo-electric currents, but no more, in my opinion.

5. Thermal Theories.—The influence of temperature variations at the contact has been dealt with by various investigators in conjunction with the foregoing theories, but a purely thermal theory of a contact detector was formulated first by Eccles[6] for the single-point oxide film coherer and the galena-galena crystal contact. Here thermo-electric effects are practically eliminated and the theory is based purely on the Joule effect producing variations in the resistance of oxides and sulphides possessing large negative resistance coefficients. The lowering of the contact resistance by heating allows an increased flow across the contact from a local battery. It should be noted here that all the theories advanced for the explanation of contact rectification were based largely on experimental evidence obtained from detectors in circuit with an applied potential from a local battery.

As already indicated, the thermal theory of contact detectors was extended and developed by Eccles to include thermo-electric effects in crystal detectors with a firm and a loose metal contact (Peltier and Thomson effects) so that his general theory may be more exactly described as electro-thermal, the basic idea being that all contact detectors are operated essentially by thermal changes in a conductor that deviates from Ohm's law in its behaviour to the passage of an electric current.[7]

At the present time physicists regard the electro-thermal theory as the most satisfactory, but the unilateral conductivity theory has still many adherents, the latter theory being strongly supported by Tutton[8]. From the practical point of view none of the theories are entirely satisfactory. The present-day attitude is clearly expressed by Dye[9] when he states " that the exact nature of the action is still somewhat obscure, but from the point of view of measuring devices crystal rectifiers may be considered as unilateral conductors; so that when an alternating voltage is applied to them the resulting mean direct current is a function of the 'average' effective value of the alternating voltage."

Turning for a moment to the practical side, there are numerous points unexplained by the electro-thermal theories which may be mentioned more as facts requiring explicit explanation than as direct criticisms against the validity of such theories. For example, the electro-thermal theory offers no explanation as to why one crystal of galena is insensitive while another of exactly the same composition is extremely sensitive in its rectifying properties. Neither does it explain the lack of sensitivity in compressed amorphous galena. Again, a minute, almost microscopic, crystal of galena lying on a heavy plate of amalgamated copper gives quite as good rectification as a large crystal where the firm contact is a single copper point, the metal point used for the loose contact or "catwhisker" being the same in both. The consistent increase of crystal sensitivity, without change of the direction of the rectified current, when the whole detector is uniformly heated, requires explanation. Another point, already referred to, is that the direction of the thermo-electric current for a given contact is apparently always the reverse of that for the rectified current. A practical objection to the electro-thermal theory, already touched on in these pages,[10] appeals to anyone who has experimented much with crystal detectors, viz., that with the very minute area in action at the loose contact the externally applied thermal energy requisite for the production of a given flow of current is tremendously in excess of the energy transformed from the electrical oscillations giving rise to the same current during rectification. Finally there are two phenomena which have been reported repeatedly by amateurs, scientific and unscientific, both of which have been met with scant belief by the professional man. One is the reception of fairly loud telephony with an empty crystal cup and the other is a slight movement of the "catwhisker" by a sudden increase of current across the detector. Being very doubtful of such matters, but still more interested, I have investigated a large number of such cases with most surprising results.

The alleged movement of the metal point at the loose contact I shall deal with later, but the question of good reception of broadcast telephony with an empty crystal cup is of critical theoretical interest. In the first place it is possible to get very good reception with a slightly oxidised brass contact and the action has been proved conclusively to be that of a single-point film coherer. Numerous experiments with film coherers proved that reception of broadcast telephony was possible with a large number of metals and alloys *without an applied potential* on an aerial not too far removed from the transmitting station. Of all the substances tested certain specimens of brass were found to give the best results and I have one brass coherer which is only slightly inferior to the best galena. Next to brass, cerium oxide films on cerium gave the best results, reception with all the other metals tried giving much feebler results. Under such conditions reception was found to be possible also with a symmetrical galena-galena combination, but the rectified current in this case was only one-half of that obtained from either crystal in contact with a metal point.

The importance of these observations may be realised when we consider the basic idea of the electro-thermal theory. This, as pointed out by Eccles,[11] was first enunciated by Brandes in 1906, and states that any conductor which departs from Ohm's law will rectify alternating currents in some degree. In contact or crystal rectifiers two cases may occur. The characteristic potential-current-curve obtained by applying a steady current through the contact, first in one direction and then in the reverse, may be (1) unsymmetrical or (2) symmetrical. In the former case, *e.g.*, galena-metal point contact, the detector will rectify oscillations without an applied potential, but in the second case, which Eccles has shown includes the film coherers and the symmetric galena-galena contact, rectification should be possible only when the high frequency oscillations are superimposed upon a direct current of suitable magnitude flowing through the contact. This is not the case as proved by my experiments. It should be noted that the galena-galena combination was invented purposely by Eccles to eliminate the Peltier and Thomson effects, thus reducing the action to one of temperature-resistance, the basis of his coherer theory.

In the writer's opinion the electro-thermal theory fails here, but such experiments do not lead him to accept the unilateral theory

1 "Galena for Detectors." D. B. McGowan, *The Wireless World*, Vol. I, pp. 462-3, October, 1913.

2 "Crystals as Rectifiers and Detectors." A. E. H. Tutton, *The Wireless World*, Vol I, pp. 232-9, July, 1913.

3 Appended to his Paper on "Some Characteristic Curves and Sensitiveness Tests of Crystal and other Detectors," Proc. Phys. Soc., Vol. XXVI, p. 97, *et seq.*

4 *Loc. cit.*

5 "Electrothermal Phenomena at the Contact of Two Conductors," etc., Proc. Phys. Soc., Vol XXV, p. 273, *et seq.* (1913).

6 "On Coherers," Proc. Phys. Soc., Vol. XXII, p. 269, *et seq.* (1910), and "On an Oscillation Detector Actuated Solely by Resistance Temperature Variations," Proc. Phys. Soc., Vol. XXII, p. 360 *et seq.* (1910).

7 "Electrothermal Phenomena," etc., *loc. cit. vide* also *The Wireless World*, Vol. I, p. 425, October, 1913.

8 *Loc. cit.*

9 In "Radio-Frequency Measurements," D. W. Dye, Dictionary of Applied Physics, Vol. II, p. 647 (1922).

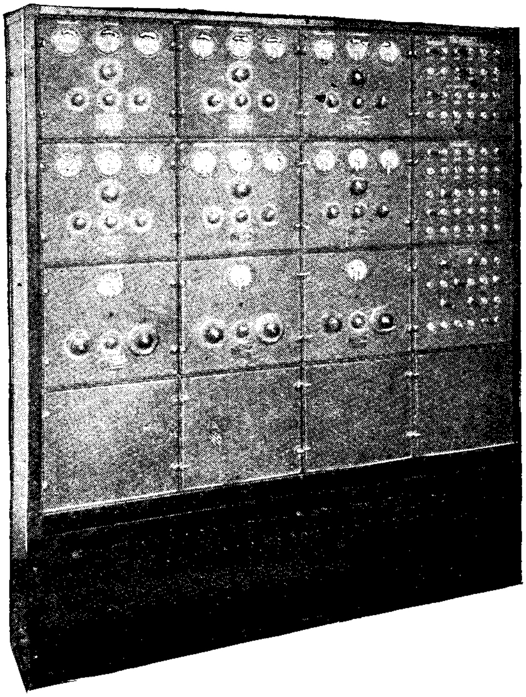
10 *The Wireless World*, Vol. I, p. 241, July, 1913.

11 *Loc. cit.*

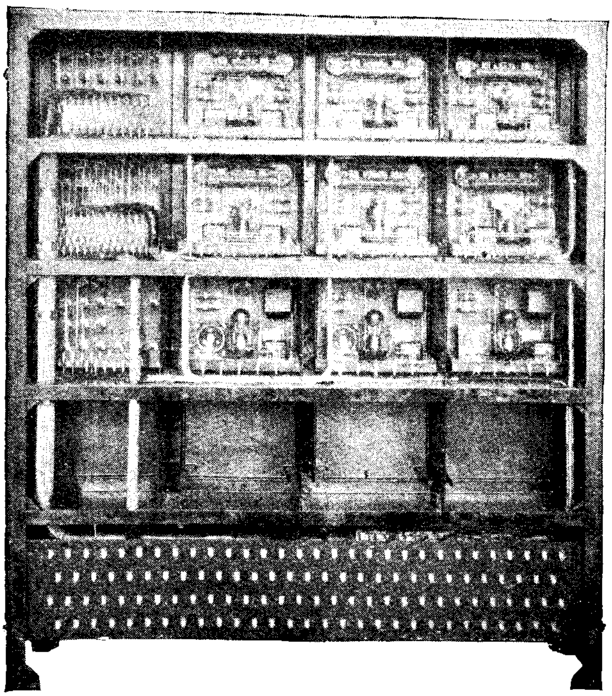
as presented by Pierce against which equally convincing evidence may be found, resulting in the conviction that the rectified current is not derived from unilateral pulses of current, but is an integration or unilateral transformation of both pulses of the oscillations.

If one admits the facts presented here, one conclusion is inevitable, viz., that the conduction of a loose contact, such as that of the crystal detector, is different in its nature for high-frequency oscillating currents from that observed by passing steady currents through the contact in different directions alternately. In view of our limited knowledge of the internal mechanism of conduction this conclusion brings us on to very difficult ground, but it appears probable that an attempt to explain the action of the crystal detector on such a hypothesis may prove fruitful in shedding light on the movements of electrons in conductors. I shall therefore attempt to outline a theory of contact detectors on those lines.

In our next issue the author will describe a number of experiments he has carried out with a view to establishing a theory concerning the operation of crystal and other contact detectors.



Unit amplifiers between microphone and modulating valves at KGO.



[Photo: courtesy "General Electric Review."

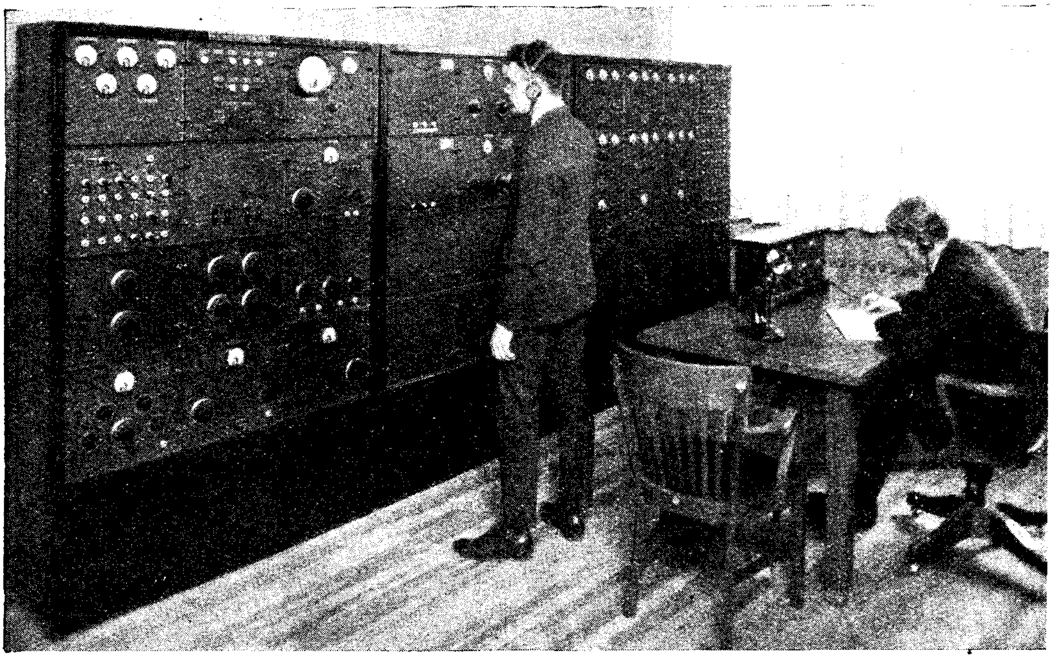
Rear of amplifying sections.

THE AMPLIFIERS IN THE MICROPHONE CIRCUIT.

The accompanying illustrations show apparatus designed by the General Electric Company of America for producing the required degree of amplification between the microphone and the modulating valves. Each panel is fitted with equipment to give one stage of L.F. amplification, and by means of break jacks and switches the required amplification can be obtained. The anode resistances are seen along the top of the panels, whilst the meters allow of observation being kept concerning the operation of the valves and ensure suitable adjustment of grid, anode and input potentials. Adjustments are provided so that the amplifying valves are worked on the correct part of the characteristic curve to avoid distortion.

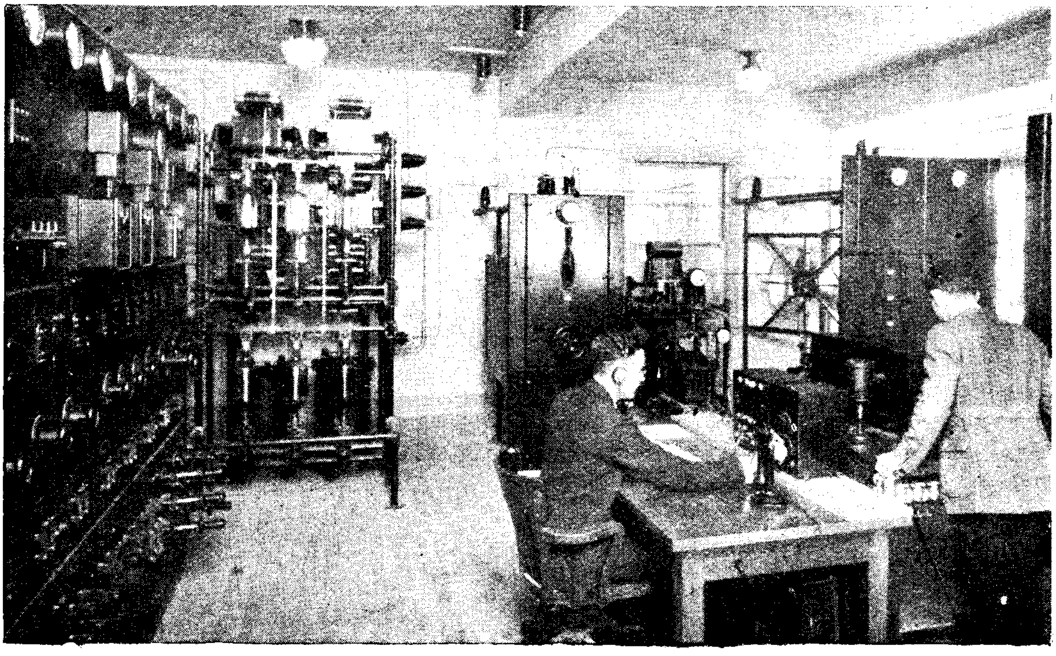
Sections of the apparatus can be utilised for amplification from land line circuits. The output signal strength is carefully regulated to a definite value, and then passed to additional amplifying equipment, intermediate between the preliminary amplifier shown here and the modulating valves.

The photographs are made from apparatus installed at the broadcasting station **KGO** located at Oakland, California.



Courtesy, " General Electric Review.'

Complete intermediate amplifying equipment. The bank of panels on the left give preliminary amplification of signals received from land lines or the local studio microphone. The signal strength is built up to a given amplitude and passed to another amplifier which feeds the modulator valves.



Courtesy, " General Electric Review."

Power panels and oscillating valve panels at KGO.

ADDITIONAL H.F. VALVE FOR A DUAL RECEIVER.

By H. L. MEYER.

SOME months ago the writer determined to devise a simple method of adding a stage of high frequency amplification to an existing receiver, with the desire to greatly extend the range of reception and to avoid the necessity of pressing reaction unduly.

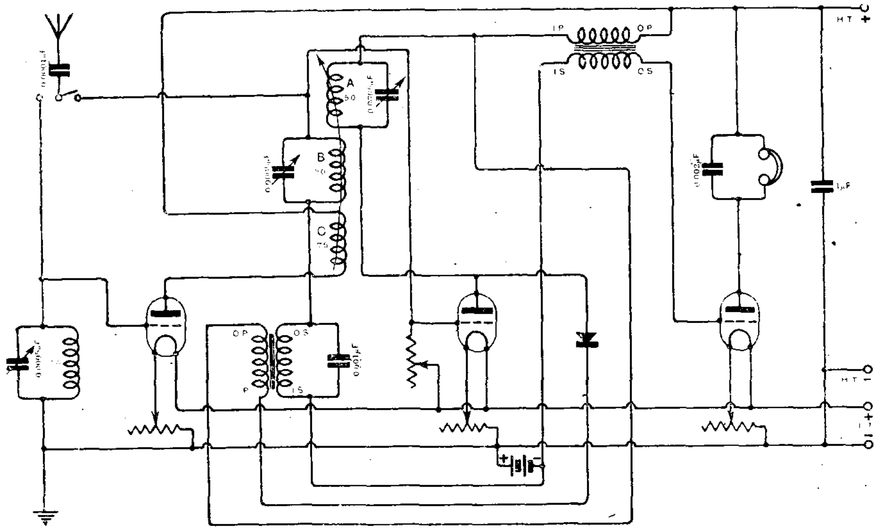
The features that appeared were :—

1. That the extra stage of H.F. should be switched into the circuit with a minimum of trouble.

2. That the existing wiring of the receiver should be disturbed as little as possible so that its use for reception of local broadcasting should not be interfered with in any way.

3. That stability should be such that a novice could handle the set without distressing howls and squeaks, etc.

4. That additional apparatus should be kept at a minimum.



The problem was eventually solved in the manner indicated in the circuit diagram above.

It will be noticed that coils A, B and C are mounted in a three-coil holder, and that the extra stage is controlled by a simple two-way aerial switch.

With the switch to the right, coil B becomes the aerial tuning inductance of a two-valve and crystal reflex circuit. With the switch to the left, coil B becomes the tuned secondary of a high frequency transformer, loose-coupled to an untuned primary.

Now as to results. The amplification obtained has exceeded all expectations. All B.B.C. stations, Radiola, etc., come in at full loud-speaker strength and with certainty.

Selectivity is marked; in fact, on a short aerial 12 miles from **2 LO**, both Cardiff and Manchester can be heard on a loud speaker without interference from **2 LO**.

WGY on 380 metres was received at the first attempt by sitting up to 3.30 a.m. and later, using short wave coils and the aerial tuning condenser in series, both **KDKA** and **WGY** on 100 metres were picked up on several occasions.

The same method of adding the extra stage has been tried on other circuits with equal satisfaction, and it would appear to be applicable to any set using plug-in tuning coils.

The writer is now using a circuit in which the tuned anode of the second valve has been replaced by a tuned transformer, as this allows a valve or crystal detector being used at will, the change-over being carried out by a D.P.D.T. switch.

VALVE TESTS.

THE BRITISH THOMSON-HOUSTON B.4 VOLT.

THE subject of our review this week is one of the class known as power amplifiers, such valves being used to operate loud speakers when a large output is needed.

Now, a loud speaker is a current operated device, comparatively large current changes being necessary for its satisfactory working, and it follows therefore that a valve required to work in conjunction with such a device must be capable of delivering the necessary current. A power amplifier may be described as a super low frequency amplifier, that is, it must fulfil the requirements of a low frequency amplifying valve, but in addition be capable of dealing with more power than is usual with the ordinary receiving valve.

There are certain essential requirements of a low frequency amplifying valve, one of the most important being that its plate current grid volts characteristic shall have an extended straight portion. This in itself is not, however, all, for it is also necessary that this straight portion should lie to the left of the zero grid volts line.

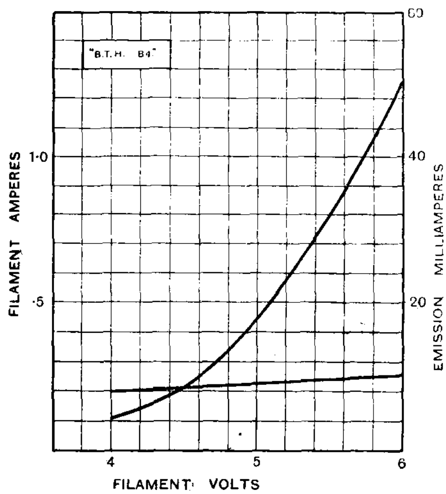


Fig. 1.

Previous to the introduction of low consumption filaments, power amplifiers were somewhat beyond the scope of the average experimenter, owing to the demands they made upon the low tension battery.

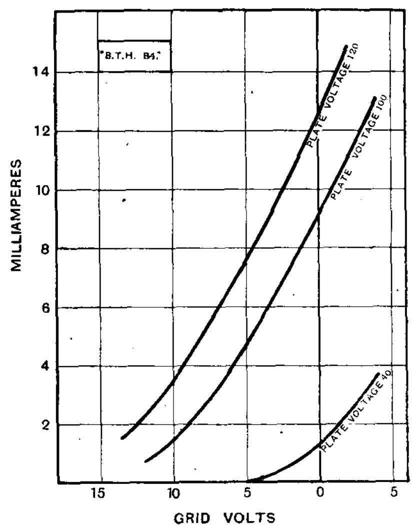


Fig. 2.

With the advent of the dull emitting filament this disadvantage has been overcome, and excellent power amplifiers consuming less filament energy than the old time R valve, are now available for amateur use.

The B.4 is such a valve, the filament of which is rated at 6 volts 0·25 ampere, that is, 1·5 watts. This does not necessarily mean that for all purposes the filament need be run at this wattage, for as shown in the steeper curve in Fig. 1, an emission of 18 milliamperes is obtained when the voltage across the filament is reduced to 5, showing the cathode efficiency to be of a very high order. Plate current grid volt characteristics are of particular interest to the experimenter, as they indicate the working plate and grid potentials for any particular purpose. These characteristics for the B.4 are given in Fig. 2, and it will be noted that at the higher plate potentials they are steep and straight over a considerable range of grid voltage. This portion of the characteristic, moreover, occurs at negative grid potentials, thus fulfilling those requirements of a low frequency amplifying valve previously mentioned. In order that the normal operating point may be set to the middle of these straight portions, Fig. 2 shows a negative grid bias of from 4 to 5 volts to be necessary, which figure is in close agreement with that given by the manufacturers.

The B.4 has a good magnification factor, which is, from Fig. 3, curve A, about 5·8 to 1. It has, morever, an extremely low internal impedance, this factor being as low as 6,500 ohms when a plate potential of 90 is used.

Although this valve is designed mainly as a low frequency amplifier we have tried it out as a general purpose valve, that is in all positions of the receiving set, and provided suitable adjustments of grid and anode potentials are made, satisfactory results will be obtained. As a detector, about 40 volts on the anode is the most suitable voltage, using the usual 0·00025 mfd. condenser and 3 megohm leak, but it is preferable to see that the grid return lead is connected to the positive end of the filament. This same value of anode potential is sufficient when the valve is operating on the high frequency side, but as a low frequency amplifier the anode potential should be increased to 80 or 100 and a negative bias from an outside source (such as a couple of dry cells) applied to the grid.

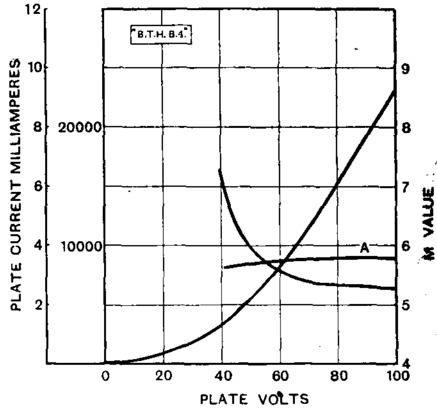


Fig. 3.

Due to the low internal impedance of this valve, the set will oscillate very easily when the B.4 is used as a H.F. amplifier and provision should be made to enable the operator to apply grid damping if required.

The B.4 is a valve we like and one we can recommend.

In the " Valve Tests " article appearing in our issue of May 14th, Figs. 1 and 4, were inadvertently reversed.

BOOK REVIEW.

The Bureau des Longitudes, of France, has issued a most interesting publication, entitled, "*Réception des Signaux Horaires*"* dealing generally with the Meteorological, Time and other scientific signals transmitted from Eiffel Tower, Lyons, Bordeaux, etc.

The book comprises 132 pages of descriptive and historical matter, five "annexes," and an appendix explaining the value of the various symbols used in the Meteorological Codes. The first chapter is devoted to a general description of receiving apparatus and the general principles adopted for automatic recorders. Chapter II deals particularly with Time Signals, and emphasises the enormous benefits which have accrued to the sciences of Astronomy, Geography and Navigation by the aid of wireless telegraphy, enabling the observatories throughout the world to pool their chronological observations and to secure a degree of accuracy otherwise impossible. Charts of the standard daily time signals are given, the methods of transmitting by hand, semi-automatically and automatically are described, and the comparison of the beats of standard clocks with the signals transmitted is simply and concisely explained.

The rythmic signals used for the accurate transmission of sidereal time are dealt with in Chapter III. A useful three-page diagram illustrates graphically the relation between the 300 dots and the standard seconds, and shows clearly the vernier effect by which extreme accuracy is obtained.

Chapter IV recounts the progress of Meteorology from 1854 to the present time, and gives a general account of the codes employed, of which more detailed particulars may be found in Annexe V and the Appendix, while Chapter V deals with earthquake warnings and records, calibration waves and U.R.S.I. signals.

The book is well illustrated, and contains many useful diagrams and tables.

* "Réception des Signaux Horaires." (Paris, Gauthier-Villars & Cie. 226 pp. 27 francs.)

IN THE WORKSHOP

HINTS ON THE USE OF SOFT SOLDERS

Extra Fusible Solders.—For certain jobs, as for instance, soldering the ends of insulated wires, or terminals which are already mounted on a panel, it is convenient to use an alloy which melts at a low temperature. With solder of this description the iron can be heated very quickly to the necessary temperature, and keeps hot enough for a longer time. Again, when a gas flame is not available, a small spirit lamp will suffice.

An alloy which melts at about the temperature of boiling water is obtained by melting together 2 parts (by weight) of bismuth, 1 of tin and 1 of lead. This solder is rather brittle, but brittleness, however, is generally of no consequence.

Another alloy, which melts at about 125° Cent. (257° Fahr.) is composed of equal parts of bismuth, tin and lead. This alloy is not quite so brittle, and is cheaper to make up. Bismuth is rather expensive, but the quantity required for wireless soldering is insignificant.

The melting is best done in a clean iron ladle, and the molten alloy is poured out to cool on a smooth flat stone so as to get it in a fairly thin sheet.

A special soldering iron should be kept for these alloys, and must be tinned with the alloy. A small light iron suffices, as it keeps hot long enough and is much handier to use than a heavy one.

Fusible Wire.—The wire used for ordinary electrical fuses is convenient for small jobs, as it can be bent round the piece as required, so as to make a neat joint, but this wire has not the advantage of extreme fusibility. Samples differ, but it usually melts at about 200° Cent. (392° Fahr.).

Fluxes.—It is necessary to use a flux to make the solder run freely and adhere to the metal.

The most effective flux is a solution of chloride of zinc, but it is very corrosive, and should never be used unless the work can be thoroughly washed afterwards. It is therefore unsuitable for soldering the ends of insulated wires. This solution is, however, necessary for tinning the iron, which must be thoroughly washed after tinning.

For work which cannot be washed ordinary resin may be used, but it is rather messy. A solution of resin in strong alcohol (5 grams of resin to 100 C.C. of alcohol, or $\frac{1}{2}$ oz. of resin to 1 fluid oz. of alcohol) is convenient for certain purposes, especially for soldering flexible wires, as it penetrates between the strands.

Any excess of resin or other soldering paste, if used, may be removed with a rag dipped in tetrachloride of carbon, which is an excellent solvent, and has the advantage of being non-inflammable.

Common Instrument Solders.—When purchasing solders for jointing the internal connections of electrical apparatus it is essential to obtain the soft variety in order to avoid excessive heating. Soft solder is usually sold in the form of thin strips. Hard solder, obtainable as a rule in thick sticks, is useful for securing together the brass parts of component instruments, and requires zinc chloride (known as "killed salts," as is made by dissolving zinc in hydrochloric acid or "spirits of salts" and diluting) as a flux. A convenient form of solder for jointing connections is a tubular variety about $\frac{1}{8}$ in. in diameter, with its interior filled with a flux consisting mostly of resin. The resin runs on to the joint as the solder is melted away, avoiding an excess of flux remaining on the work.

THE DEVELOPMENT OF SIMULTANEOUS BROADCASTING.

On reading over the account of the initial experiments in land line transmission of music which is given under, the author has felt that the average reader will be surprised at the simplicity of the whole thing and the average radio amateur will be inclined to say " Well, it looks quite easy, I could have done it myself." He is probably right, but lest he should be left with the idea that all that was necessary was the screwing up of terminals, it should be pointed out that there were moments (such as when the problem of crosstalk was unsolved) when the whole subject hung in the balance, and at that time things did not look at all easy to those who were handling the job. It is often rather difficult to give a clear and connected account of experimental work, and in this case it is especially so, since the work involved was not highly advanced, and the chief points of interest are really only the difficulties experienced. For this reason, this account consists firstly of a short historical sketch, followed by details of the various aspects presented by the problem as it unfolded.

By E. K. SANDEMAN, B.Sc.

General History of the Development.

IT is almost exactly a year ago now since the British Broadcasting Company approached the British Post Office and the Western Electric Company with the suggestion that tests should be made between Birmingham and London with a view to examining the feasibility of transmitting music for long distances over the ordinary telephone trunk circuits.

This was a natural extension of the work which the Western Electric had been carrying out in the collection of music from theatres, the broadcasting of speeches, lectures, Covent Garden Opera, and items of interest other than those actually reproduced from the London Station studio.

The success which had been obtained in the broadcasting of the opera from Covent Garden prompted the British Broadcasting Company to have experiments in land line transmission made on a larger scale.

Accordingly, arrangements were made to hire two lines from the Post Office between London and Birmingham for the night of March 20th, 1923, one line being required for control purposes and the other for the transmission of music.

A standard Western Electric power amplifier and loud speaker were installed at Marconi House, and the line terminals connected on with a simple resistance shunt which served the two functions of an extra control and an impedance equaliser, tending to prevent distortion owing to unequal reflection losses at each frequency.

The output of the speech input amplifier at the Birmingham Station (Fig. 1) was connected to the Post Office telephone line and in this way music from an orchestra in the Birmingham studio was put on to the line. In London the music was reproduced on the loud speaker mentioned above.

Experiments were made with different types of instrumental music, with a string orchestra, a 'cello solo, a piccolo solo, a pianoforte solo, with a man singing, a woman singing, and also with speech.

The results were really very much beyond expectation, the only serious distortion being due to the loss of the higher harmonies of the violin and the top notes of the piano.

On April 16th the same tests were made with music from Glasgow, and the results were even more pleasing. This was because, although Glasgow is 400 miles from London, while Birmingham is only 100 miles, it was possible to obtain the use of heavier conductors (one mile of line contained 600 lbs. of copper) for the greater part of the route, while on the Birmingham circuit 200 lb. conductors only were obtainable; further, the Birmingham line had a greater percentage of underground cable.

Following on these tests the natural development was to radiate the speech and music transmitted by land line.

The engineers of the Broadcasting Company estimated the power input requirements of their radio transmitters at 0·25 watts alternating speech energy. Since the power attenuation factor of the land lines employed was of the order of 30, the power input to each line worked out at $7\frac{1}{2}$ watts, requiring a total power for five lines of about 37·5 watts, the London station requiring under $\frac{1}{4}$ watt since it was so near to the distribution centre.

To give some idea of the significance of these powers it should be stated that the power output from an ordinary microphone is of the order of 1 millwatt (0·001 watt). The average power in a telephone receiver is less than 1/20th of this, so that the power involved was sufficient to operate nearly a million telephone receivers.

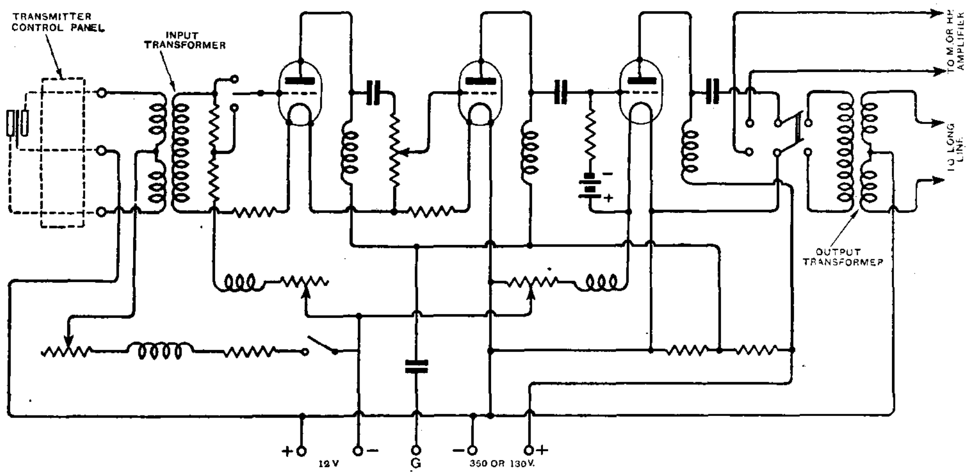


Fig. 1. Circuit for speech input amplifier.

In order to obtain this power it was decided to employ the amplifier which is normally employed with the larger Western Electric public address system, and which is capable of delivering a distortionless output of 40 watts.

This amplifier, together with a standard speech input equipment and a carbon push-pull theatre broadcasting microphone, was duly installed in Marconi House, in a small room which was then used as the distribution centre. The microphone was actually in an adjoining room for this first test, but in subsequent tests speech from the studio at 2 Savoy Hill was used. This was because the speech from the small room, which was undraped, was almost unintelligible due to reverberation.

By arrangement with the Post Office two lines were loaned for the afternoon of May 13th, from London to each of the following places :—

Newcastle, Glasgow, Manchester, Birmingham, Cardiff.

On this day the first simultaneous broadcast test was made, and, from a radio point of view, was an unqualified success. Unfortunately, as might be expected from the employment of so much power, very considerable derangement in telephone trunk line traffic resulted. It was practically impossible to use a great many lines owing to the enormous volume of crosstalk which occurred.

The Post Office engineers who were in close co-operation throughout these tests, naturally raised the question of reducing the power.

Accordingly, after a series of transmission tests with measured power had been made, a further simultaneous test, using the power amplifier of the No. 2 Public Address System and the same speech input equipment, was made at reduced power on May 13th.

As the crosstalk was still too great to allow regular service being maintained, the method of input to the lines was changed preparatory to employing a still smaller value of power. A bank of six loud speaker amplifiers was made up, operating with their inputs in parallel, the output of each being connected to a different line. Arrangements were made by means of which the power input to each line could be measured independently.

On May 17th a further test was made with the power in each line cut down to about 1 milliwatt, or one six-thousandth of the original estimated power, the balance, of course, being made up by increased amplification at the receiving end.

The crosstalk, however, was still too large. This was finally eliminated by the insertion of repeating coils between the output of each power amplifier and its associated line and the resulting arrangement, although a purely experimental set-up, has been used ever since for S.B. work. It is, of course, highly inefficient, and steps are being taken to replace it as soon as possible.

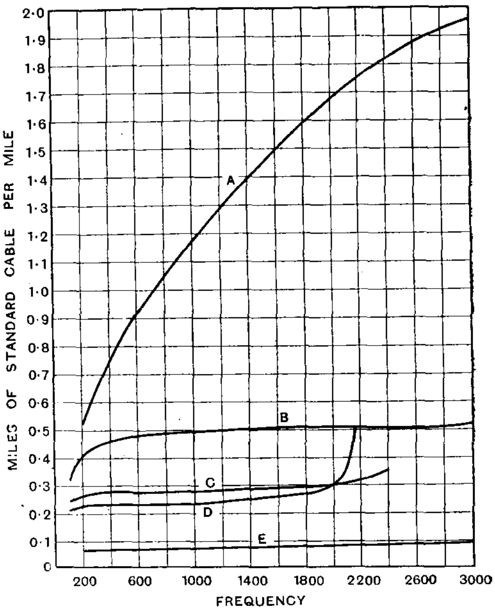
As soon as the preliminary development work was complete, the British Broadcasting Company assumed complete control and an arrangement was made between the Post Office and the British Broadcasting Company by which the latter had the use of one special circuit from London to each of the provincial stations during definite hours each evening. This single circuit was then made to serve the double purpose of music and control line.

Considerations Affecting the Choice of Lines.

In order to secure the best transmission of speech and music, in accordance with well-known principles, it is necessary that all frequencies in the audible range be equally transmitted.

In Fig. 2 are shown the transmission characteristics for various types of line expressed in terms of equivalent 800 cycle miles of standard cable, *i.e.*, at 1,000 cycles 1 mile of No. 19 B. & S. gauge cable attenuates current the same amount as 1·18, 800 cycle miles of standard cable.

The exact derivation of the "800 cycle mile of standard cable," perhaps requires some explanation. Originally, the greater part of the measurements made on telephone lines and telephone apparatus was made at 800 cycles; this being the frequency then considered to be most representative of the requirements of speech reproduction. In order to have a standard type of attenuation for purposes of comparison a certain type of cable in commercial use was chosen, having certain definite constants, and was made a standard to which all other cables could be compared. The attenuation of this cable, of course, varied with frequency, but it is the 800 cycle value of attenuation with which we are concerned. So that, when we say that a cable or telephone line has an attenuation of 10 standard miles at a frequency of say 2,000 cycles, we mean that the attenuation of this cable or telephone line at 2,000 cycles is the same as that of 10 miles of standard cable at 800 cycles.



[By courtesy of the Western Electric Co.

Fig. 2. *Attenuation-frequency characteristics of various types of line. A = Unloaded cable; B = Extra light loaded cable, heavy spacing; C = Medium loaded cable, heavy spacing; D = Heavy loaded cable; E = Open wire line.*

This may sound an unnecessary complication to the uninitiated, as indeed it does to the initiated, and there have been many proposals to do away with this notation, but it serves as a very useful basis for comparison. In an infinite line made of standard cable the ratio between the currents or of the voltages at points 1 mile apart would be $\epsilon^{0·109} = 1·115$.

From this we see that the current ratio for 11 miles of standard cable is 1·115. The accepted abbreviation for 800 cycle miles of standard cable is simply M.S.C.

Returning to Fig. 2 it is evident that unloaded cable is ruled out at once, while loaded cable is preferable up to the point termed its cut off, where its attenuation begins to rise steeply. In practice on ordinary circuits this cut off does not generally exceed 2,400 cycles per second, so that all frequencies above this point are suppressed.

Unloaded open wire (that is the ordinary telephone wires, strung on poles that run alongside every main road) on the other hand gives an attenuation which rises gradually with frequency and which has no definite cut off point. For this reason in the lines chosen it was endeavoured, as far as possible, to make use of routes where open wire line existed for the major part of the way.

An analysis of the make-up of the two trunk lines employed for these original tests is given in the tables. This shows, firstly, the length of each type of line in geographical miles, and secondly, the equivalent mileage of standard cable which would have the same attenuation at 800 cycles.

Owing to the great length of the Glasgow line it has not been thought worth while to show it in such detail as the Birmingham line.

Referring to the summaries of mileage for the two lines, we see that although the Birmingham line is a quarter the length of the Glasgow line, the expected transmission over the Glasgow line would not only be louder than that over the Birmingham line, but would have less distortion owing to the smaller percentage of cable in the make-up of the line.

The unavoidable presence of the cable accounts for the rather hollow sound obtained with simultaneous broadcast speech and music. A reference to Fig. 2 will serve to make this clearer if we consider the attenuation of 10 miles of unloaded cable. The attenuation at 200 cycles is 4·56 M.S.C., while that at 2,000 cycles is 16·7 M.S.C.; the current ratio for 4·56 M.S.C. is 1·64, while that for 16·7 M.S.C. is 6·2. This means that the reproduction ratio of the frequency 2,000 cycles is $\frac{1}{3{\cdot}78}$ of that for the frequency 200 cycles, and for higher frequencies the

ANALYSIS OF TRUNK LINE LONDON—BIRMINGHAM.

Part of Circuit.	Mileage.	Type of Line.	Estimated Equivalent Miles of Standard Cable.
Marconi House to Carter Lane	0·369	10 lb. Cable	0·56
Carter Lane to Birmingham	0·655	20 lb. ,,	0·72
	5·178	15 lb. ,,	1·74
	0·313	20 lb. ,,	0·35
	16·2	200 lb. O.W.	1·05
	1·198	100 lb. Cable	0·53
	33·26	300 lb. O.W.	1·54
	36·676	200 lb. ,,	2·38
	0·806	100 lb. Cable	0·35
	19·178	150 lb. / 200 lb. / 300 lb. / 500 lb.	1·25
	—	200 lb.	
	—	300 lb.	
	—	500 lb.	
	0·95	100 lb. Cable	0·42
Birmingham Trunk to Central Exchange	0·292	40 lb. ,,	0·22
Central to East Exchange,	2·19	10 lb. ,,	2·39
East to Exchange, Witton	1·2	10 lb. ,,	1·90
Total ..	118·464		15·39

SUMMARY OF MILEAGES.

	Miles.	M.S.C.
Cable	13·15	9·12
Open Wire ..	165·314	6·22
Total	118·464	15·39

ANALYSIS OF TRUNK LINE LONDON—GLASGOW.

Type of Line.	Mileage.	Equivalent M.S.C. Mile of Phantom Circuit.	Equivalent M.S.C.
100 lb. O.W.	0·766	·100	·077
150 lb. ,,	13·403	·072	·966
200 lb. ,,	1·966	·0622	·122
300 lb. ,,	15·414	·0393	·606
400 lb. ,,	1·542	·031	·046
600 lb. ,,	367·419	·023	8·46
12 lb. Cable	0·023	1·44	·033
40 lb. ,,	0·028	·721	·022
100 lb. ,,	0·022	·420	·009
200 lb. ,,	13·063	·261	3·41
Total ..	413·646		13·75

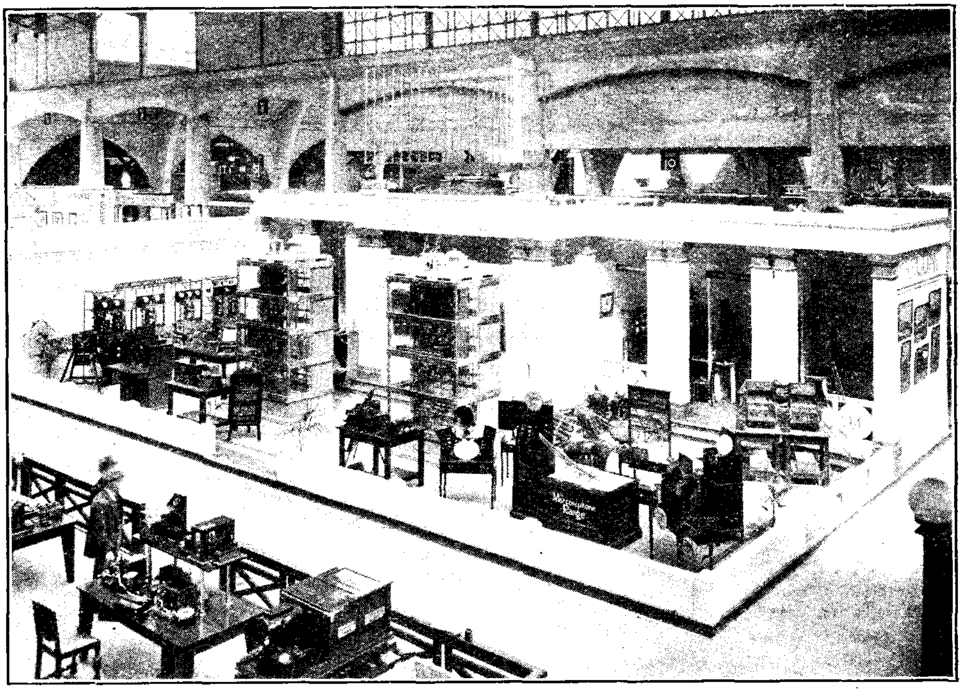
SUMMARY OF MILEAGES.

	Miles.	M.S.C.
Cable	13·136	3·474
Open Wire ..	400·646	10·276
Total	413·646	13·75

case is, of course, much worse. The reason for the greater attenuation of the higher frequencies is the mutual capacity of the wires of a pair in the cable ; in the open wire line the wires are further apart and the capacity is smaller, while in the case of the loaded line the effect of the capacity is opposed by the inductance coils in series in the line.

A very obvious future development is the insertion of a network in the line to compensate for the suppression of the higher frequencies.

This network ideally would be one whose attenuation was the inverse of that in the line so that the attenuation of all frequencies was made equal to that of the most highly attenuated frequency, the reduction in volume would then have to be compensated for by increased amplification, which is, of course, a simple matter.



The Marconi Pavilion at the British Empire Exhibition.

Correspondence.

A New Dual Circuit.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to Mr. Rowell's letter expressing appreciation of my single-valve dual circuit with "balanced reaction" (*Wireless World*, November 7th, 1923), I may add that this circuit is working satisfactorily in various localities from Devonshire and London in the South to Aberdeen in the North.

I am sorry that the draughtsman's error in Fig. 2 referred to by Mr. Rowell was not corrected sooner, as this may have led to disappointing results in some cases. Fig. 1 shows the correct direction of the winding for the reaction and balancing coils. Apart from its long range, this circuit presents other interesting features ; tuning on distant stations comes in with a sharp click, and when adjusted the control of reaction is perfect.

I hope to describe in the near future a tuning arrangement for this circuit whereby the local broadcasting station may be cut out entirely even when the set is operated close to the latter (within a mile).

Aberdeen. JAMES STRACHAN.

PATENTS AND ABSTRACTS

Improvements in Wireless Systems.*

The object of the present invention is to provide apparatus in which the regenerative amplification is substantially unaffected by the operations of tuning the apparatus. Amongst the advantages of such apparatus are the simplification of tuning adjustments and the prevention of the setting up of oscillations in the aerial circuit. The method consists in the use of mechanical coupling between the tuning means.

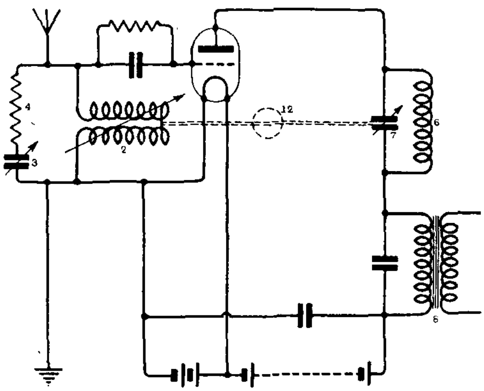


Fig 1A.

Referring to Figs. 1A, B and C, Fig. 1A shows a single-valve circuit; Fig. 1B, one form of mechanical coupling, and Fig. 1C is a view taken on line 3 of Fig. 1B.

The aerial circuit contains a variometer 2, connected in parallel with which is a variable condenser 3, and resistance 4.

The anode circuit contains a fixed inductance 6, and a variable condenser 7, and the telephones or low frequency amplifier may be connected to the transformer 8. The movable elements of the variometer 2, and the condenser 7, are mechanically coupled as indicated by the dotted lines at 12, so that both are simultaneously adjusted.

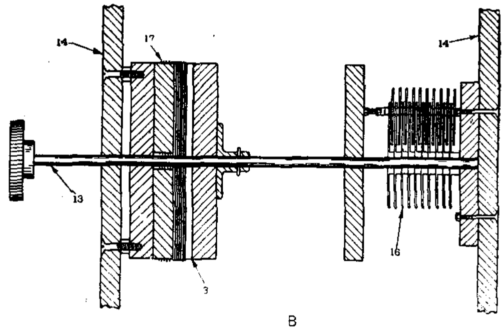


Fig. 1B.

In figures 1B and C, which show one form of coupling, the shaft 13, rotatively mounted in supports 14, carries the movable element of the variometer, and the moving plates 16, of the condenser. The rotation of the shaft 13 varies the inductance in the aerial circuit and the capacity in the anode circuit. It will be seen that due to the mechanical coupling between the anode condenser and the aerial tuning inductance, the value of the inductance in the aerial is determined by the setting of the anode condenser, and it follows that aerials of differing capacities can only be brought into resonance with the anode circuit by variations in the setting of the parallel aerial tuning condenser.

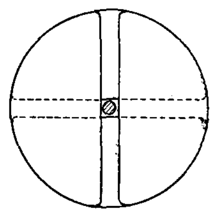


Fig. 1C.

* British Patent No. 213,309, by R. E. H. Carpenter.

Therefore the L/C ratio of the circuit joined between grid and filament of the first valve upon which ratio the reaction partly depends, is determined by the setting of the anode circuit, and is substantially independent of the capacity of the aerial system. It will be seen, however, that when working with aerials of small capacity, the greater part of the oscillating current flowing in the aerial tuning inductance will flow in the aerial tuning condenser circuit, and this circuit would normally have a much smaller ohmic loss than the aerial circuit proper; a small resistance shown at 4 may therefore be connected in series with the aerial tuning condenser to reduce this variation.

The method of setting up the receiver is described in the patent specification.

Improvements in Valves.

During the manufacture of valves, the conductors that support the various elements of the tube are, like the elements themselves, subjected to a bombardment which has the result of rendering the metal soft and ductile. The elements are therefore liable to be deformed by the slightest shock.

A valve has been proposed* in which the elements are arranged vertically, an upright standard supported at one end by the glass press having fixings for the lower end of the plate and grid, and guide fixings for the upper ends in order to provide for expansion. The anode, the grid and the filament are arranged vertically, and the improved manner of mounting is characterised by the feature that the plate and grid are connected to an insulating sheath which is threaded over the metallic support of the filament. The invention is sketched in Fig. 2. The anode 3, of triangular form, is fixed at one end upon a support by means of the groove 2, and at its other end upon the glass sheath, which is threaded over a support 4, of the filament 5. The anode is held to the support by a piece of wire as shown.

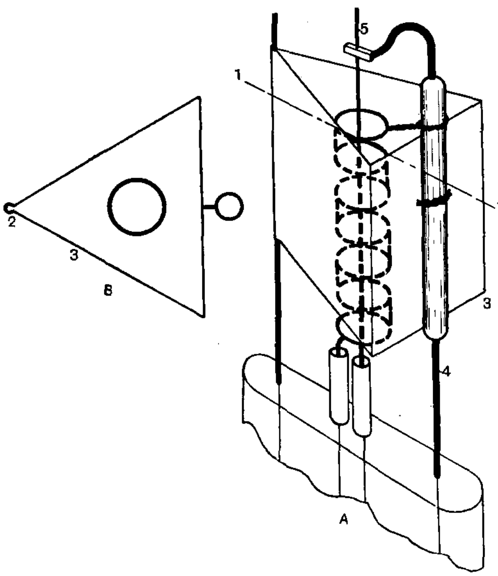


Fig. 2. Figure 2B *is a view taken along the line* 1—1.

* British Patent No. 205,457, by François Peri.

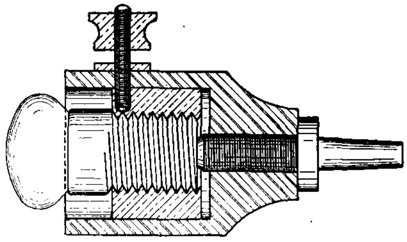


Fig. 3.

Protecting Valve Filaments.

If there is an accidental contact or wrong connection, the high tension battery may be applied to the filament circuit and destroy the filaments of the valves. It is proposed to provide in the high tension battery circuit a flash-lamp bulb, whose current-carrying capacity is less than that of a valve filament. The flash-lamp bulb may for convenience be combined with a coupling or wander plug included in the high tension circuit, as shown in the sketch of Fig. 3.*

Referring to the sketch, it is seen that the plug is constructed so that an electric bulb, such as a flash-lamp bulb, may be screwed into the top of the plug. The pin at the bottom of the plug fits into a socket on the H.T. battery, and the connecting wire is joined to the terminal. It will be noticed that the high tension current must flow through the bulb, which will burn out in the event of a current of over a certain value flowing from the battery.

* British Patent No. 213,387, by A. H. Hunt.

NOTES & CLUB NEWS

A Radio Exhibition is to be held in Moscow during August. Soviet and foreign apparatus will be displayed and a section will be devoted to amateur exhibits.

* * * *

The Burma railways have adopted wireless communication in parts where jungles and rivers make efficient cable work impossible. Successful experiments have been carried out between Rangoon and Bassein.

* * * *

A weekly lesson in Esperanto is to be transmitted from the Geneva broadcasting station.

* * * *

Two broadcasting stations are proposed for the Leeds and Bradford area instead of one, as originally intended.

* * * *

A French amateur transmitter, it is reported, has recently been heard in Algeria while working on 35 metres.

* * * *

"All that I can hope to contribute is that, in the course of a month or two, we may provide an efficient Empire wireless service."—The Prime Minister on May 8th.

* * * *

According to a Berlin telegram the public interest in wireless is spreading rapidly in Germany. In Berlin alone there are now 35,000 enthusiasts, and the total number in the country runs into hundreds of thousands.

* * * *

Brussels Station's New Wavelength.

The Brussels ("Radio Electrique") broadcasting station, transmitted its first programme on 250 metres on Friday, May 9th. We understand that the power of the station has been lowered.

"Radio Paris."

The "Radio Paris," **SFR,** broadcasting station has recently been experimenting on a wavelength of 1,190 metres. No exceptional results have been obtained, however, and until further notice the station will retain the usual wavelength of 1,780 metres.

Scottish Transatlantic Success.

In our last issue it was stated that Mr. M. G. Scroggie (**5 JX**), of Edinburgh, had been heard by Canadian **1 DD** on Saturday, April 26th, and it was claimed that Mr. Scroggie was the first Scottish amateur to "get across."

Immediately after going to press, however, came a report from another well-known transmitter north of the Tweed, Mr. C. Creed Millar (**2 MG**), of Bearsden, near Glasgow, stating that his signals had been received by American **2 CPD** and **2 BNT** on April 6th and 24th. **2 MG** employed a power of 30 watts with aerial current of 1·8 amperes. His wavelength was 180 metres.

Bowdoin's Weakened Signals.

American amateurs are speculating as to the reason for the drop in signal strength from the "Bowdoin," **WNP,** the ship of the McMillan exploration party, which is now frozen-in above Etah, North Greenland. The messages are also less frequent.

Several listeners report reception of chopper signals or pure c.w. from **WNP,** and the possibility exists that operator Mix has had trouble with his motor generator. He may consequently be using a low power set with dry cell plate supply.

Transatlantic Reception in Canada.

An account of his experiences in receiving European amateurs on an improvised receiver has been forwarded to us by Major William Coates Borrett (**1 DD**), of Dartmouth, Nova-Scotia. Major Borrett was one of the A.R.R.L. prize-winners in the Transatlantic tests, and his comparisons of the different transmissions from this side of the water are therefore of uncommon interest. The set used (0—v—2) was assembled in a night "in regular hay-wire fashion," and strange to say Major Borrett "hit the trail right off," by hearing **F 8 AB** calling **A 1 MO.** Since that memorable night (December 10th), he has logged the following European stations :—

British : **2 KF, 2 NM, 2 OD, 2 SH, 2 SZ, 5 BV, 5 KO, 5 NN, 6 XX.**

French : **8 AB, 8 ARA, 8 BF, 8 BM, 8 CT.**

Dutch : **PA 9, PA 0 DV, NAB 2, PCII, PCTT.**

2 NM, 2 OD, and **2 SH** have been worked.

The most consistent signals have been those of **PCII, F 8 AB, G 2OD,** and **G 2NM,** and these can be read with a single valve on any night that is reasonably free from disturbance.

The best European Transatlantic transmitters, in Major Borrett's opinion, are the following in the order shown : **G 2 OD** and **PCII, F 8 AB** and **G 2 NM, 2 SH** and **2 KF, PA 9,** and **2 SZ.**

Major Borrett's transmitter, with an input of 90 watts, radiates 1 ampere, and tests are carried out on 130 metres. He would be glad to receive reports.

That S.O.S. Call.

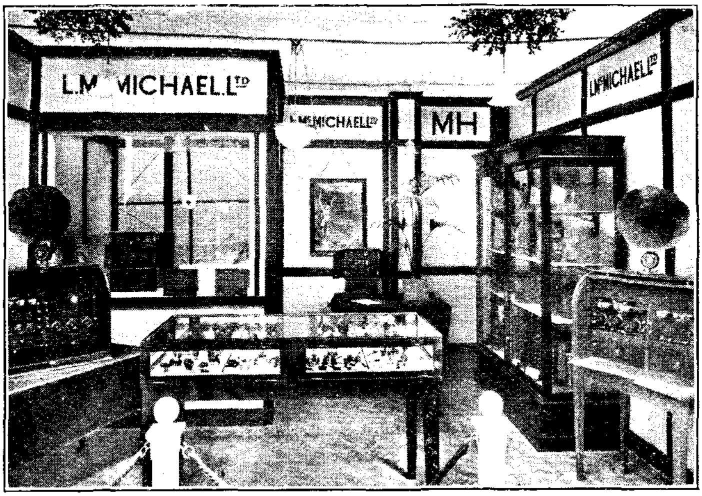
Apropos of the mysterious S.O.S. call heard on April 25th by Mr. D. B. Knock (**6 XG**) on 120 metres, we have received a number of letters confirming the reception of this transmission, including one from Copenhagen.

One reader suggests the possibility that the S.O.S. call was read owing to the bad transmission of a similar sounding call sign. On a previous occasion this correspondent imagined that he heard an S.O.S. but subsequently discovered that it was the erratic transmission from **5 OS,** now closed down. The Brazilian station **SOH** has been known to cause similar confusion.

It is difficult to imagine that any sane amateur would wilfully send out the distress call, and the solution of the mystery probably lies in faulty transmission.

New Zealand Wireless Service.

New Zealand wireless news, the first service of the kind in the Southern Pacific, was, on May 5th, transmitted to Inter-Colonial and Trans-Pacific



The attractive stand of Messrs. L. McMichael, Ltd., in the Palace of Engineering at the British Empire Exhibition, Wembley.

passengers in ships under the Government and amalgamated lines. The wireless was greatly appreciated by the travellers, and the question of its extension to Raratonga and the Chatham Islands is being considered.

Amplion Loudspeakers.

Messrs. Alfred Graham & Company advise us that they are exhibiting a full range of their products at the British Empire Exhibition. All models of the Amplion Wireless Loudspeaker will be exhibited and representatives will be pleased to demonstrate to readers in the audition room on the stand, Palace of Engineering, Avenue U, Bays 11-13.

2 QH.

Mr. C. Hewins (**2 QH**), of Grimsby, Lincs, regrets to state that owing to ill-health, he is closing down his station during the summer months, hoping to resume in October. He trusts that this note will catch the eyes of his many "**DX**" friends in Britain and abroad.

Summer Broadcasting.

Certain alterations are to be made in the broadcasting hours during the summer months commencing on June 1st. Generally speaking, transmissions will take place half-an-hour later, the children's hour commencing at 6 p.m. and the evening concert usually concluding at 11 o'clock.

On Saturdays a concert will be given between 4 and 6 p.m., but Sunday arrangements will be unchanged.

"International Language."

The May issue of this interesting magazine takes the form of a special wireless number, and contains a thoughtful leading article on Esperanto as the radio language of the world. Other features include an article on "Broadcasting and Languages," by Mr. A. R. Burrows, and a table of radio symbols with their appropriate terms in Esperanto.

"International Language" is published mid-monthly at 17 Hart Street, London, W.C.1., price 3d. post free.

Canadian Wireless Development.

Among the company registrations of importance just announced for British Columbia is that of the Marconi Wireless Telegraph Company of Canada, Limited, capitalised at $7,500,000, with head offices in Montreal and western headquarters in Vancouver. This is a preliminary step towards the establishment of two big wireless stations at Vancouver and Montreal, to form part of the Imperial wireless c ain.

The G.E.C. at Wembley.

On Friday, May 9th, a large party of representatives of the technical and lay press was entertained by the General Electric Company, Ltd., at the British Empire Exhibition.

During the morning a visit was paid to the "G.E.C. Pavilion of Electricity," which contained generating and converting plant, switch and transmission gear and a large display of the Company's wireless apparatus. Of particular interest was the section devoted to the latest models of G.E.C. valves.

Towards the close of the luncheon, which was served in the Lucullus Restaurant, the toast of the press was proposed by Mr. Hugo Hirst, and suitably replied to by Mr. H. W. S. Rentell, of "Electricity," who spoke in congratulation of the efforts of the G.E.C.

Wireless for Police Work.

One of the most interesting and useful applications of wireless is its employment for communicating between fixed and moving stations or between two or more moving stations. The system now in use by the Metropolitan Police Force affords an excellent illustration of the surmounting of difficulties inherent in the application of radio to road vehicles, and "Wireless for Police Work," an illustrated leaflet which we have received from Marconi's Wireless Telegraph Co., Ltd., provides instructive reading.

The Headquarters Station at Scotland Yard consists of a 730 metre wavelength transmitter, a special selective receiver on 265 metres, with motor generator, batteries and the necessary change-over switchgear. A special wireless car is employed containing a transmitter for the 265 metre wavelength, a coupled circuit tuner for 730 metre work, together with an amplifier and change-over switch. An adjustable aerial of 5 parallel wires is mounted on the roof of the car, and a frame aerial is included in the interior equipment. Telephonic communication with headquarters is possible within a radius of 30 to 40 miles, and telegraphy can be employed over greater distances. The car is able to keep in touch with Scotland Yard when travelling at speeds up to forty miles per hour.

The late Mr. J. St. Vincent Pletts, the well-known wireless engineer and consultant, whose death on April 26th, at the early age of 44, was recorded in a recent issue.

The Radio Society of Great Britain.

An Ordinary General Meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6 p.m., on Wednesday, May 28th, at which Major H. P. T. Lefroy will deliver a lecture upon "Wireless in British Military Aircraft up to August, 1914."

CATALOGUES, ETC., RECEIVED.

Marconi's Wireless Telegraph Co., Ltd. (Marconi House, Strand, W.C.2). Pamphlet No. 226, admirably produced and illustrated, describing Marconi wireless apparatus for aricraft. Pamphlet No. 229, giving a general description of Marconi Local Oscillation Generators, Type H.Q.

Siemens Brothers & Co., Ltd. (Woolwich, London, S.E.18). Catalogue 595 dealing with Siemens Wireless Sets and Accessories.

Mullard Radio Valve Co., Ltd. (Nightingale Works, Nightingale Lane, Balham, London, S.W.12). Pamphlet describing the new dull emitter power amplifier valves, D.F.A. 0, 1 and 2. Gives operating data and characteristic curves.

Alfred Graham & Co. (St. Andrew's Works, Crofton Park, S.E.4). Pamphlet describing two new Amplion models of the gramophone attachment type.

Bradford Wireless Society.*

A lecture on "Transmitters and Systems of Modulation," was delivered by Mr. J. Bever (**2 QK**) on May 2nd. Mr. Bever has done a considerable amount of work on the shorter waveband, and the lecture proved of great value.

After discoursing on suitable aerial and earth systems, Mr. Bever described a method of calculating aerial efficiency, and showed that a high radiation for a given input did not necessarily mean high efficiency.

The most usual forms of transmitting circuits were then described, with their respective advantages and disadvantages, special reference being made to the Colpitts Oscillator. The various methods of applying modulation to these circuits were then discussed, and of these the master oscillator method seemed to offer the most advantages for really short wave transmission.

Hon. Sec., S. R. Wright, 14 Bankfield Drive, Shipley.

Lincoln Wireless Society.*

On Thursday, May 8th, at the Municipal Technical School, it was decided to hold a series of debates on subjects of general interest. The first debate of the series, on the question "Dull *v.* Bright Emitters," took place on Thursday, May 15th. A number of field days are to be held during the summer months.

Hon. Sec., J. T. James, 126, West Parade, Lincoln.

The Southampton and District Radio Society.*

On Thursday, May 8th, the lecturer was Mr. Paul D. Tyers, whose subject was "Amplifiers for Speech Frequencies," with which he dealt in a very able manner.

At the conclusion of his talk, Mr. Tyers answered a number of questions on radio matters.

Hon. Sec., Lt.-Col. M. D. Methven, O.B.E., 22 Shirley Aveaue, Southampton.

Belvedere, Erith and District Radio and Scientific Society.*

On Wednesday, May 7th, 25 members of the Society had the pleasure of visiting **2 LO.** The party first visited Marconi House, where high speed telegraphy was explained, and also the transmitting apparatus of the **2 LO** station. This was followed by a visit to the studios at Savoy Hill. A most interesting and enjoyable time was spent, and the members greatly appreciated the courtesy shown to them by the officials.

On Friday, May 9th, Mr. F. O. G. Callender gave his lecture on "Multi-Valve Circuits," describing his ten-valve receiver, made up of 6 H.F., 1 detector and 3 L.F. valves. It was pointed out that in building such a set, the difficulty of tuning-in should be fully considered.

Hon. Sec., S. G. Meadows, 110, Bexley Road, Erith, Kent.

Streatham Radio Society.*

At the annual general meeting of the Society, held on May 7th, the Hon. Secretary's report on the work of the past year revealed an increase of membership to 90. Both the report and the Hon. Treasurer's balance sheet, which showed a satisfactory state of affairs, were adopted unanimously.

Mr. S. C. Newton, who tendered his resignation of the Secretaryship, was elected a Vice-President, Mr. N. J. H. Clarke being appointed Hon. Secretary in his place. Other officers were re-elected, and a Committee was appointed for the ensuing year.

The Society is taking steps to secure improved accommodation.

Hon. Sec., N. J. H. Clarke, 26 Salford Road, Streatham, S.W.2.

North Middlesex Wireless Club.*

"How I Received American Telephony" was the title of a paper read by Mr. J. H. Forbes on April 16th. The lecturer described in detail the apparatus used by him to receive the short wave station at Pittsburg, Pennsylvania, which he was successful in doing on five nights in one week. Mr. Forbes said he had found the ordinary earth connection quite useless, and gave particulars of the construction of the counterpoise he used instead. The construction of the various tuning coils was then detailed and the lecturer gave his own experiences in the selection of coils and gauges of wire.

At the meeting held on April 30th users of crystals were specially catered for by Mr. A. V. Ballhatchet, who delivered an extremely interesting lecture on "Crystals used in Wireless Reception." Discussing the theories of the rectifying action of the crystal the lecturer mentioned several problems which so far have not been solved. For instance, two pieces of crystal may be chemically identical, and may look exactly similar under the microscope and yet one may be very good for wireless purposes, and the other quite useless. The lecturer was able, however, to give some very valuable hints on choosing crystals.

At the conclusion of the lecture Mr. Ballhatchet exhibited a receiving set specially designed for testing crystals, which he had constructed for his own use. He stressed the point that micrometer adjustment of pressure on the crystal of the "catwhisker" was essential for satisfactory results.

Hon. Sec., H. A. Green, 100 Pellatt Grove, Wood Green, N.22.

Wimbledon Radio Society.*

On Friday, May 2nd, Mr. W. J. Rawlings demonstrated a three-valve receiver incorporating a Reinhartz circuit. The appearance of the instrument and the selectivity of the tuning circuit roused great interest.

The following were appointed to the "Works" Committee:—Messrs. Constance, Wells, Jones, Frost and the Hon. Secretary.

The weekly meeting of the Society on May 9th, was devoted to the burial of several pounds of sheet copper in the ground adjoining the Red Cross Hall, and it is anticipated that the Society's aerial-earth circuit will now be as efficient as it is possible to make it. All thanks are due to the willing workers who opened up the ground before Friday, although it was only the work of minutes to replace it!

The Hon. Sec., P. G. West, 4 Ryfold Road, Wimbledon, S.W.19. ('Phone, Wimbledon 1832) will be pleased to forward particulars of the Society to prospective members.

Barnet and District Radio Society.*

Captain P. P. Eckersley, the well-known chief engineer of the B.B.C., paid a visit to the Society on Monday, May 5th, and delighted his audience with a fascinating and witty account of the development of broadcasting.

The lecturer dealt with the establishment of eight broadcasting stations in the most populous parts of the country. Troubles were still present, however, and complaints of poor reception were still sent in.

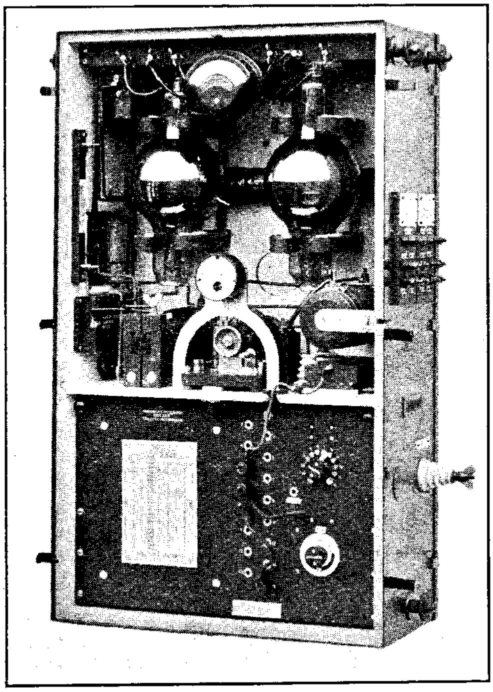
For this reason a scheme was suggested involving the erection of a 25-kilowatt station, transmitting on 1,600 metres. This caused new ground for complaint, many listeners declaring that great difficulties would be experienced in adapting their sets to the new station.

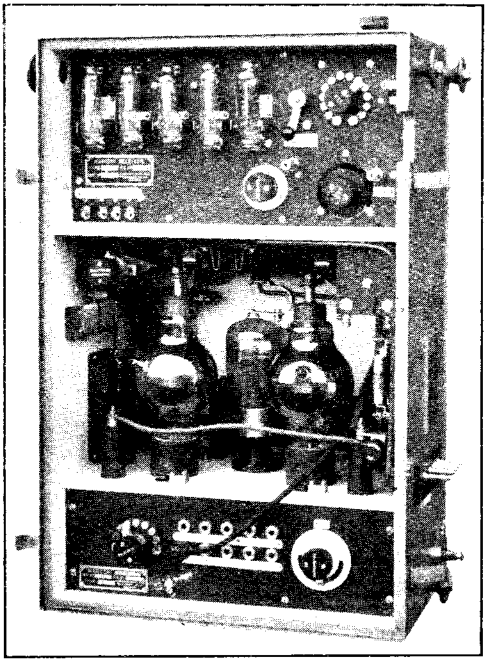
Captain Eckersley referred to the possibility that a receiver might become a transmitter. It was an inspiring thought. But for people to create disturbance simply because they did not agree with an item was entirely unsporting. The lecturer praised the work of the radio societies. It was in the interest of every wireless enthusiast, he said, to join the local society and learn more of such an interesting subject.

Hon. Sec., J. Nokes, "Sunnyside," Stapylton Road, Barnet.

Golders Green Radio Society.*

"Behind the Scenes at the B.B.C.," was the topic of the evening on May 7th, when an unusually large audience assembled to hear addresses by Mr. Arthur R. Burrows, Director of Programmes, and Captain Frost of the Engineering Department. Mr. Burrows, speaking of the





Marconi C.W. and telephony aircraft equipment. The set on the left is a ½ Kw. transmitter with transmitting and modulating valves. The lay out permits of the identification of almost every component instrument, all of which are easily accessible. A lower power set is shown on the right which is fitted with a receiver comprising several stages of amplification.

difficulties of programme arrangement, assured his listeners that criticisms are treated very seriously. Extracts were read from a batch of letters which had arrived simultaneously, all expressing very divergent views upon the same programme.

Captain Frost, who dealt with oscillation troubles, said that numbers of offending listeners, were ignorant that they were causing disturbance and he strongly urged every user of radio apparatus to join the local radio society in order to learn how to handle their set efficiently. A tribute was paid to the Golders Green Radio Society for the way in which it had handled the situation in its own area.

Hon. Sec., W. J. T. Crewe, "The Dawn," 111 Princes Park Avenue, Golders Green, N.W.11.

Leeds Radio Society.*

Mr. C. Wainwright recently delivered an excellent lecture to beginners and others on the subject of "Receiving Circuit Design." The lecturer expressed the opinion that the low temperature and fine filament valves now marketed would have a pronounced influence on the design of circuits.

An instructional meeting of an informal kind was held on May 2nd, when the Hon. Secretary described the elementary principles involved in the design and construction of "A Five-Valve Receiver."

Hon. Sec., D. E. Pettigrew, 37 Mexborough Avenue, Leeds.

Hackney and District Radio Society.*

An interesting evening was spent on May 1st when various pieces of apparatus belonging to the Society were calibrated. The wavemeter used was lent by Mr. L. Battell.

On May 8th Mr. E. Cunningham, Vice-Chairman, gave an entertaining account of his health trip through Northern Africa. Mr. Cunningham took with him a portable "Manday" one-valve set, and was able, with a temporary aerial, to receive London and Cardiff, 258 and 125 miles respectively.

Mr. Bell gave a talk entitled "Reminiscences of a Wireless Operator," and described in detail the type of Marconi transmitting and receiving sets used on minesweepers in the early days of the war.

A good programme has been arranged for the forthcoming season; this includes outdoor attractions and visits to various places of interest.

Particulars of membership will be gladly sent on application to the Hon. Sec., Chas. C. Phillips, 57 Highfield Avenue, Golders Green, N.W.11.

The Clapham Park Wireless and Scientific Society.

A most instructive visit was paid to the Mullard Radio Valve Company's works on April 9th, Mr. Goldup kindly acting as guide. Special interest was shown in the manufacture of high power silica valves. On the same evening, Mr. C. W. Richardson lectured on "The Potentiometer," and gave details for the construction of this instrument, subsequently carrying out experiments with a potentiometer built by himself.

An impromptu debate was held on April 30th, the subjects being "That Licences for Wireless Reception should be Abolished," and "That Broadcasting is a Thing to be Encouraged."

Meetings are held at 67, Balham High Road, on Wednesday evenings at 8 p.m., those interested being invited to attend or get into touch with the Hon. Sec., H. C. Exell, 41 Cautley Avenue, S.W.4.

Uxbridge and District Radio and Experimental Society.

A comprehensive lecture on "Wireless Components" was given on April 29th, by Mr. R. Piper. The lecturer dealt with the products of many different firms and gave interesting details of their methods of functioning.

Among future fixtures is included a dance and a special sub-committee has been appointed to make arrangements.

The Society is conducting a campaign against local interference and cars equipped with D.F. apparatus are scouring the district. Reports giving time, nature and suspected cause of any interference will be welcomed by the Hon. Secretary.

On May 6th the Chairman (Mr. R. F. Eagle), gave a capable address on "Oscillation," and enumerated some useful remedies for interference.

Hon. Sec., J. R. M. Day, 10 Prospect Terrace, Cowley Road, Uxbridge.

Hastings Radio Society.

The opening lecture of the Society was given on April 28th by Mr. John L. Baird, the inventor of the Baird system of Television.

The lecturer described his early experiments, which were based upon a study of the human eye. Little progress was made with selenium cells in the early stages owing to the very minute currents available, but the development of the thermionic amplifier removed this difficulty. The lecturer then explained his system of television.

(An account of Mr Baird's system appeared in *The Wireless World and Radio Review* of May 7th.—ED.)

Hon. Sec., A. E. Marriott, 42 White Rock, Hastings.

Birmingham Wireless Club.

"Some Causes of Distortion" formed the subject of a very interesting paper read by Dr. J. R. Ratcliffe, on May 2nd. Practically every known cause of distortion was touched upon, from the moment of transmission to the final reproduction in the loud speaker.

Hon. Sec., H. G. Jennings, 133 Ladywood Road, Birmingham.

Brockley and District Radio Association

A highly interesting and instructive lecture was recently delivered by a representative of the Cossor Valve Co.

Following a brief history of the thermionic valve a thorough explanation was given of the manufacture of the Cossor Valve. Curves were given, together with useful hints on the functioning of various types.

An attractive series of entertainments has been arranged for the summer months, and those interested are invited to communicate with the Hon. Sec., Harrie King, 2 Henslowe Road, East Dulwich, S.E.22.

Dublin College of Science Radio Society.

At a general meeting of this new Society, held at 86 St. Stephen's Green, on May 6th, Mr. P. O'Callaghan lectured in an interesting manner on "Electrons," providing many experiments and diagrams. This lecture was the first of a series to be given by Mr. O'Callaghan during the next few weeks.

The Society was formally constituted on April 8th, when Professor F. E. Hackett was elected President and officers were appointed.

All past students of the College who are interested in the Society are requested to communicate with the Hon. Secretary, F. R. A. McCormack, College of Science, Merrion Street, Dublin.

Forthcoming Events.

WEDNESDAY, MAY 21st.

Golders Green Radio Society. Lecture: "Short-Wave Transmission and Reception." By Mr. W. E. Corsham.

THURSDAY, MAY 22nd.

Hendon Radio Society. At 8 p.m. At the Town Hall, The Burroughs, Hendon. Annual General Meeting.

Hackney and District Radio Society. Talk and Demonstration on a Simple Vario One-Valve Circuit. By Mr. Bell.

Blackpool and Fylde Wireless Society. Lecture: "Practical Telegraphics." By Mr. H. D. Collinge.

FRIDAY, MAY 23rd.

Leeds Radio Society. At 7.30 p.m. At Woodhouse Lane U.M. Schools. Lecture: "Some High Power Radio Stations." By Mr. D. E. Pettigrew.

Radio Society of Highgate. At 8 p.m. At Edco Hall, 270 Archway Road. Lecture by Mr. P. G. A. H. Voigt, B.Sc.

MONDAY, MAY 26th.

Ipswich and District Radio Society. At 55 Fonnereau Road. Open Night.

Hornsey and District Wireless Society. At Queen's Hotel, Broadway, Crouch End, N.8. Lantern Lecture: "The Thermionic Valve." By the Cossor Valve Company.

TUESDAY, MAY 27th.

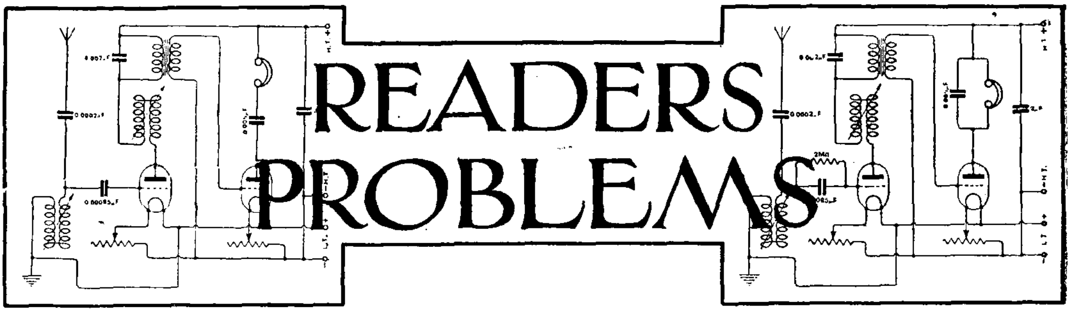
West London Wireless and Experimental Association. At the Acton and Chiswick Polytechnic, Bath Road, Chiswick, W.4. Lecture: "Crystals." By Mr. A. Hinderlich.

Leicestershire Radio and Scientific Society. At the Victoria Galleries, Granby Street. Discussion on Radio Problems.

Uxbridge and District Radio and Experimental Society. Lecture: "Valves and How they Function." By Mr. J. R. M. Day.

WEDNESDAY, MAY 28th.

Radio Society of Great Britain. Ordinary General Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers. Lecture: "Wireless in British Military Aircraft up to August, 1914." By Major H. P. T. Lefroy.



READERS PROBLEMS

*1. All questions are answered through the post. A selection of those of general interest is published. 2. Not more than four questions may be sent in at any one time. 3. Every question should be accompanied by a postal order for **1/-**, or **3/6** for four questions, and by a coupon taken from the current issue. 4. A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

"*J.Y.*" (*North Berwick*) **has an accumulator which will not hold its charge properly, and asks what is likely to be the cause of the trouble.**

It is possible that the acid which you are using is not chemically pure, or of the correct specific gravity. Another frequent cause of this trouble is the short-circuiting of the plates by small fragments of paste which may have been dislodged from one of the plates, or to the accumulation of silt in the bottom of the accumulator. We recommend that you give the cells a full charge and then empty out the acid and thoroughly rinse out the inside of the case with distilled water. If the accumulator is then filled with fresh acid of a specific gravity corresponding with the fully charged condition, it is probable that the source of trouble will have been removed.

"*H.M.W.*" (*Birmingham*) **asks for a diagram of a two-valve receiver (1-V-0). The receiver must be highly selective and suitable for reception of long distance broadcasting at telephone strength.**

The diagram of a receiver suitable for your purpose is given in Fig. 1. The aerial tuning inductance, the secondary tuning inductance, and the reaction coil are mounted in a three-coil holder, the secondary inductance being placed between the other two coils. By coupling the reaction coil to the aerial circuit instead of the anode circuit, it is possible to calibrate the latter circuit with a fair degree of accuracy. With careful manipulation of the coils in the three-coil holder a very high degree of selectivity can be obtained. The selectivity will be improved on short wavelengths if the 0·001 μF aerial tuning condenser is connected in series. The vernier condenser has been connected in parallel with the A T C in order to facilitate tuning adjustments when the latter condenser is connected in parallel with the A T I.

"*T.P.*" (*London, W.5*) **asks how to connect the primary and secondary windings of the two L.F. transformers used in the three-valve receiver described in the issue of December 27th.**

In the case of the first intervalve transformer which is used to couple the detector and L.F. valves, the outside end of the secondary winding should be connected to the grid of the L.F. valve and the inside end through the grid cells to — L.T. The method of connecting the primary winding is best found by trial, and will depend upon the particular make of transformers which you are using. The primary and secondary windings of the transformer which is used as a choke coil and is connected in the plate circuit of the last valve should be connected in series, so that the two windings produce magnetic fields in the same direction. If both windings run in the same direction, I.S. should be connected to the plate of the L.F. valve, and O.P. to + H.T., while the remaining

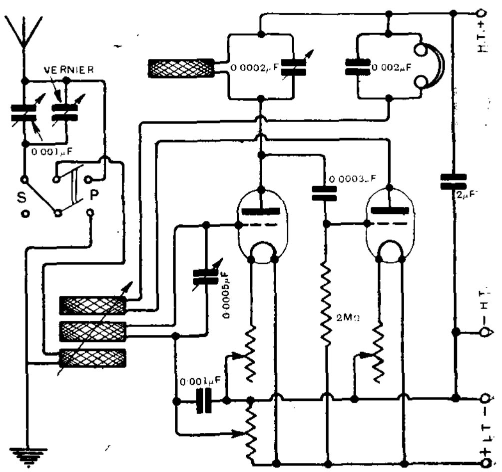


Fig. 1. "H.M.W." (Birmingham). A selective two-valve receiver with 1 H.F. and detector.

two terminals, I.P. and O.S., should be bridged by means of a short length of wire.

" *W.M.*" (*Hale*) **asks if the resistance-capacity method of coupling low frequency valves is suitable for use on short wavelengths.**

The operation of the resistance-capacity coupled L.F. amplifier is independent of the wavelength of the incoming signal since it is designed to amplify the low frequency currents obtained after rectification. A resistance-capacity coupled amplifier may be made up for high frequency amplification, but in general the amplification obtained when the signalling wavelength is below about 2,000 metres is negligible. We would refer you to the article entitled "Resistance, Choke or Transformer Low Frequency Couplings ? " in the issues of February 6th and 13th.

It would appear that the tuning coils used in your receiver are too small, and that the tuning capacity in parallel with the coils is rather high. If larger coils are used, together with smaller tuning capacities, the selectivity will be increased. The wire used in the construction of the inductance coils should not be of a smaller gauge than No. 22 S.W.G., and the coupling between the aerial and secondary coils should be made as loose as possible.

" *T.S.R.*" (*Tidworth*) **asks what type of receiver will be necessary in order to receive all the B.B.C. stations with one or two pairs of telephones.**

A two-valve receiver will be required, in which the first valve functions as an H.F. amplifier and the second valve as a detector. A reaction coil con-

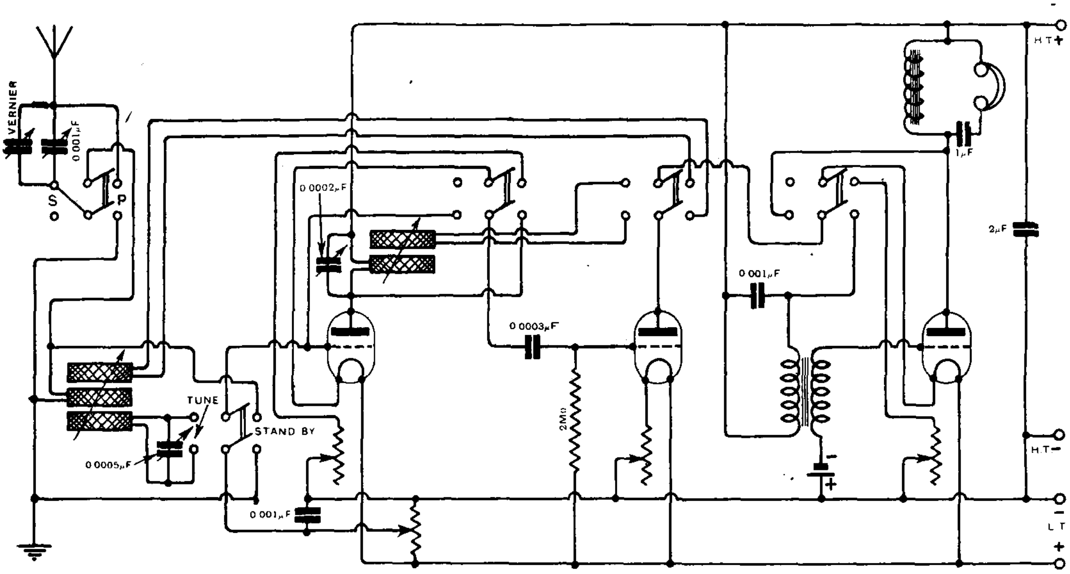


Fig. 2. "*H.A.B.*" (*Leeds*). *A receiver with 1 H.F., detector and 1 L.F. arranged with switches in the H.F. and L.F. circuits. The reaction coil may be coupled with either the anode, or the tuner coils.*

nected in the plate circuit of the detector valve should be coupled either with the aerial circuit or the anode circuit of the first H.F. valve. You will find the tuned anode method of coupling convenient from the point of view of ease of manipulation.

"*H.A.B.*" (*Leeds*) **asks for a diagram of a three-valve receiver (1-V-1), with switches to cut out the H.F. and L.F. valves when not required.**

A diagram of this circuit is given in Fig. 2. A change-over switch is provided in order that reaction may be coupled either with the aerial or with the tuned anode circuit when the H.F. valve is in use. Series-parallel and tune stand-by switches are also included in the diagram. The grid potential of the H.F. valve is controlled by means of a potentiometer. The section of the potentiometer winding included between the slider and — L.T. is shunted by means of a 0·001 μF fixed condenser, which acts as a by-pass to H.F. currents. The telephones are fed through a filter feed circuit.

" *J.B.W.*" (*Oldham*) **asks how to improve the selectivity of his three-valve receiver.**

" *A.B.*" (*Huddersfield*) **asks if the resistance-capacity method of coupling could be used for the two L.F. valves in the neutrodyne receiver described in the issue of December 19th, 1923.**

We recommend that you retain the transformer method of coupling in the two low frequency stages. It is probable that you would not obtain sufficient volume from two resistance-capacity coupled valves to operate a loud speaker satisfactorily. You will not be troubled with distortion if the L.F. transformers used are of good quality and if you carefully adjust the H.T. and L.T. voltages and the grid bias of each valve

Calls Heard

Contributors to this section are requested to limit the number of calls sent in to those heard in the previous three weeks, these being of greater interest and value to transmitters than earlier records. The repetition of the same call sign in consecutive lists is not recommended. Contributors will also assist by kindly arranging reports in alphabetical order. Full address (not for publication) should be given to enable correspondence to be forwarded.

Saltley, Birmingham (March 2nd-April 5th).
Telephony: **2 DU, 2 HF, 2 JR, 2 KO, 2 KU, 2 LX, 2 NV, 2 NP, 2 OP, 2 OQ, 2 OX, 2 PV, 2 QR, 2 RG, 2 RQ, 2 RC, 2 SV, 2 TN, 2 TV, 2 WQ, 2 YC, 2 YD, 2 YX, 2 YV, 2 ADF, 2 ADX, 2 AIT, 2 AKA, 2 STA, 5 DG, 5 IY, 5 KD, 5 MB, 5 PX, 5 KY, 5 UW, 5 WO, 5 YS, 6 AJ, 6 CC, 6 HU, 6 MJ, 6 NJ, 6 NQ, 6 NZ, 6 RH, 6 SY, 6 UU, 6 ZX, 8 AB.** Morse: **1 AW, 2 VQ, 2 KU, 2 VI, 2 UV, 4 ZZ, 5 OC, 5 JJ, 8 DD, 8 DP, 6 UU.** (B. Smith.)

Kolding, Denmark (March 22nd to April 7th).
2 DF, 2 FN, 2 KU, 2 KW, 2 OD, 2 TR, 2 UF, 2 WJ, 2 XG, 2 XY, 5 AW, 5 BV, 5 DN, 5 JJ, 5 KO, 5 MO, 5 RZ, 5 SZ, 5 US, 6 EA. 6 UD, 6 XG, 8 AP (telephony), **8 BV, 8 CF, 8 DN, 0 BA, 0 KX, 0 MR, 0 NM, 0 NN, 0 XP, 0 ZN, 4 ZZ, 7 EC, XY.** (o—v—o or o—v—1.) (H. C. Meyer.)

London, N.W.8 (during March).
2 CA, 2 DW, 2 GG, 2 JV, 2 KW, 2 KZ, 2 LH, 2 LU, 2 MY, 2 OS, 2 RB, 2 SF, 2 VJ, 2 WY, 2 XG, 2 XO, 2 XY, 2 YT, 2 ZJ, 5 AW, 5 BA, 5 DN, 5 DQ, 5 FD, 5 GL, 5 HW, 5 IK, 5 MY, 5 NN, 5 OG, 5 ON, 5 RW, 5 SZ, 5 UC, 5 US, 5 WF, 5 XC, 5 XG, 6 CH, 6 CV, 6 GM, 6 IY, 6 NH, 6 OB, 6 OM, 6 PD, 6 PS, 6 QA, 6 RJ, 6 TD, 6 UD, 6 VO, 6 VR, 2 ACX, 2 AKS, 2 XAA, 8 AA, 8 AE 3, 8 AM, 8 BG, 8 BX, 8 CM, 8 CN, 8 DD, 8 DP, 8 ED, 8 EP, 8 EQ, 8 JC, 8 JD, 8 LM, 8 ML, 8 QS, 8 RL, 8 ZZ, 0 AG, 0 BA, 0 KA, 0 NN, 0 PG, 0 SA, 0 XW, PCTT, 4 ZZ, 1 CF, 1 ER, W 2. (o—v—o.) (M. Samuel, **2 ACU.**)

Cobham, Surrey (March 20th to April 2nd).
English: **2 ACU, 2 AH, 2 AJ, 2 AQ, 2 DF, 2 FN, 2 GX, 2 JU, 2 KF, 2 KW, 2 LU, 2 NM, 2 OD, 2 OG, 2 OT, 2 RZ, 2 TO, 2 TP, 2 WJ, 2 XAA, 2 XV, 2 YT, 2 ZT, 5 BA, 5 DN, 5 HN, 5 HW, 5 IO, 5 MO, 5 OT, 5 QV, 5 RF, 5 SI, 5 VW, 6 AA, 6 CV, 6 EA, 6 NF 6 NH, 6 NM, 6 TD, 6 VP, 6 XX.** Dutch: **0 AG, 0 EA, 0 BQ, 0 BY, 0 FN, 0 KN, 0 KX, 0 MR, 0 NN, 0 NY, 0 ZN, P 2, PA 2.** French: **8 AB, 8 AQ, 8 AU, 8 BF, 8 BM, 8 BN, 8 BX, 8 CF, 8 CM, 8 CN, 8 CZ, 8 DO, 8 DX, 8 ÉB, 8 ÉI, 8 ÉP, 8 ÉU, 8 JC, 8 JD, 8 OH, 8 PX, 8 WW.** American: **1 BN, c1 BQ, 1 OW, 1 XAH, 1 XJ, 4 HS.** Swiss: **XY.** Unknown: **GG, 3 LF.** (o—v—1.) (E. J. Martin.)

Edgbaston, Birmingham (April 5th).
2 ADM(?), **2 AEX, 2 AGM, 2 AIP, 2 ZV, 5 IY, 5 WO, 6 UU,** (April 6th) **2 ACP, 2 ADF, 2 ADF, 2 AGM, 2 AMJ, 2 AMT, 2 ANP, 2 AK, 2 FJ, 2 QR, 2 WM, 2 YV, 2 YX, 2 ZX, 5 KB, 5 KD, 5 KO, 5 WO, 5 YS, 6 KRG, 6 MJ, 6 MQ, 6 MZ.** (K. R. Brecknell, **2 AHH**).

Stockport (fortnight ending April 7th).
2 AAH, 2 AAN, 2 ANT, 2 AIP, 2 AC, 2 KD, 2 OM, 2 PC, 2 PP, 2 RK, 2 UF, 2 WW, 2 ZK, 2 ZU, 5 BT, 5 DC, 5 HE, 5 KL, 5 LP, 5 OL, 6 HS, 6 JQ, 6 LC, 6 MU, 6 OM, 6 OS, 6 QS, 6 RF, 6 SM 6 VK, 1 AW, 1 XM, 3 AJD, 8 XE, 8 AB, 9 BAK. (o—v—1.). (F. Bamford, **2 AOI.**)

Malvern, Worcs.
2 KR, 2 KW, 2 MG, 2 MZ, 2 RB, 2 TO, 2 TR, 2 YT, 5 AW, 5 CC, 5 FH, 5 JJ, 5 MO, 5 OO, 5 SZ, 6 HU, 6 IH, 6 MZ, 6 NF, 0 RY, 6 UP, 6 XX, 8 AE, 8 AQ, 8 BB, 8 CA, 8 CM, 8 DP, 8 DX, 8 JC, 8 OH, 8 RL, 8 RZ, 0 AG, 0 BA, 0 KA, 0 MR, 0 NN, 0 XQ, 4 ZZ, 7 EC, 1 ER, W 2. (1—v—1, 150-250 metres.). (N. H. Gwynn Jones, **5 FV.**)

New Shildon, Co. Durham.
2 FN, 2 GG, 2 IS, 2 TO, 2 ZR, 5 MO, 5 QV, 6 CV, 6 TR, 6 XX, 8 BQ, 8 CH, 8 CM, 8 DP, 8 JD, 8 OH, 0 HA, W 2. (H. Vickers.)

Coventry.
2 AOX, 2 DU, 2 FP, 2 HF, 2 IB, 2 JF, 2 KO, 2 KR, 2 KW, 2 LG, 2 LH, 2 LX, 2 MZ, 2 NP, 2 NV, 2 OM, 2 OX, 2 PV, 2 QR, 2 QT, 2 TN, 2 TV, 2 WD, 2 XG, 2 YV, 2 YX, 5 DT, 5 FI, 5 FH, 5 HW, 5 KY, 5 KD, 5 KW, 5 LV, 5 TW, 5 YS, 5 YW, 6 GW, 6 MJ, 6 XX, 8 AÉ, 8 AL, 8 AU, 8 AG, 8 ÉM, 8 CM, 8 DA, 8 LB, 8 OH, 8 SSU, 0 AG, 0 HA, 0 KB, 0 KX, 0 MR, 0 NN, XY. (Receiver, o—v—o.) (Brian W. Warren, **2 APG.**)

Bolton, Lancashire (April).
2 AAF, 2 AHT, 2 ARL, 2 FC, 2 II, 2 TN, 2 SS, 5 CR, 5 CS, 5 DC, 5 OT, 5 VK, 6 HS, 6 JQ, 6 JT, 6 LC, 6 LS, 6 PQ, 6 SC, 6 SH. (1—v—1 or 2.) (H. P. Holden.)

Broadcasting.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:—

GREAT BRITAIN.

ABERDEEN 2 BD, 495 metres; **BIRMINGHAM 5 IT,** 475 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 2 NO** 400 metres; **BOURNMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON** 2 **LO,** 365 metres; **CARDIFF 5 WA,** 353 metres; **PLYMOUTH 5 PY** (Relay), 330 metres; **EDINBURGH 2 EH** (Relay), 325 metres; **SHEFFIELD** (Relay), 303 metres. Tuesdays, Thursdays and Fridays, 1 p.m. to 2 p.m. (**2 LO** only). Regular daily programmes, 3.30 to 4.30 p.m., 5 to 10.30 p.m. Sundays, 3 to 5 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), FL, 2,600 metres. 7.40 a.m. Weather Forecasts; 11.0 a.m. (Sunday), 11.15 to 11.30 (Weekdays), Time Signal and Weather Forecast; 12.0 noon, Market Report; 3.40 p.m., Financial Reports; 5.30 p.m., Bourse Closing Prices; 6.15 p.m., Concert; 7.20 p.m., Weather Report; 9.0 p.m. (Wednesday and Sunday), concert; 10.10 p.m., Weather Forecast.

PARIS ("Radio Paris"), SFR, 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.45 p.m., Exchange Prices; 4.30 p.m., Financial Report; 8.30 p.m., News and Concert.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres, 9 p.m. (Sunday, Wednesday, Thursday, Friday and Saturday), Talk on Literature, Dramatic and Musical Selections. 8.15 p.m. to 9.25 p.m. (Tuesday), Morse Practice, English Lesson, Lecture and Concert.

PARIS (Station Du Petit Parisien), 340 metres. 8.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2 p.m. and 6.50 p.m., Meteorological Forecast.

BRUSSELS ("Radio Electrique"), 250 metres. Daily, 6 p.m. and 9.30 p.m., Concert.

HOLLAND

THE HAGUE PCGG 1,070 metres. 4 to 6 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres, 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9 p.m. (Thursday), Concert.

THE HAGUE (Velthuisen), PCKK, 1,050 metres, 9.40 to 10.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9 a.m. and 5 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m. (weekdays), 8 to 9 (Sunday), Concert.

SWEDEN.

STOCKHOLM (Telegrafverket), 440 metres. Monday, Wednesday and Saturday, 11.45 a.m. Weother Report, 11.55 a.m. Time Signal, 7 to 8 p.m. Concert, Sunday, 11 to 12 a.m.

STOCKHOLM (Radiobolaget), 470 metres, Tuesday and Thursday, 7 to 9 p.m. Sunday, 6 to 8 p.m.

GOTHENBURG (Nya Varvets), 700 metres. Daily, 10 a.m. and 6 p.m. Fishery Report, 11.55 a.m. Time Signal, Wednesday, 7 to 8 p.m.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,370 metres (Sunday), 10.40 a.m. to 11.45 a.m., Orchestral Concert. 4,000 metres, 7 to 8 a.m., Music and Speech; 12.30 to 1.30 p.m., Music and Speech; 5.0 to 5.30 p.m., News.

EBERSWALDE, 2,930 metres. Daily, 1 to 2 p.m., Address and Concert; 6 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 400 metres. 11 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7 p.m., Concert; 7 to 8 p.m. (Sunday), Concert.

BERLIN (Telefunken), 425 metres. 7.30 to 8 p.m. and 8.45 to 9.30 p.m., Tests and Concert.

FRANKFURT AM MAIN, 460 metres. 7.30 to 10 p.m. Tests Gramophone records.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres. 8 a.m., 12 a.m. and 4 p.m., Meteorological Bulletin and News; 4,500 metres, 10 a.m., 3 p.m., and 10 p.m., Concert.

KBELY (near Prague), 1,150 metres. 7.15 p.n. and 10 p.m., Concert and News.

SWITZERLAND.

GENEVA, 1,100 metres (Weekdays). At 3.15 and 8 p.m., Concert or Lecture.

LAUSANNE, HB 2, 780 metres. Daily, 9.15 p.m., Concert and Address.

SPAIN.

MADRID, PTT, 400 to 700 metres. 6 to 8 p.m., Tests.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12 a.m. 1,800 metres. 4 p.m. and 8.30 p.m., Tests, Gramophone Records.

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THE WIRELESS WORLD AND RADIO REVIEW

PRICE 4D. NET.

BUILDING A MULTI-CIRCUIT TUNER

No. 250 [No. 9 Vol. XIV]

P. P. ECKERSLEY on FAITHFUL REPRODUCTION

Barry

THE
WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GREAT BRITAIN.

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Under the Supervision of W. JAMES.

CONTENTS

THE EDITOR will be glad to consider articles and illustrations dealing with subjects within the scope of the Journal. Illustrations should preferably be confined to photographs and rough drawings. The greatest care will be taken to return all illustrations and manuscripts not required for publication if these are accompanied by stamps to pay return postage. All manuscripts and illustrations are sent at the Author's risk and the Editor cannot accept responsibility for their safe custody or return. Contributions should be addressed to the Editor, " The Wireless World and Radio Review," 12 and 13, Henrietta Street, Strand, London, W.C.2.

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THE WIRELESS WORLD AND RADIO REVIEW

POPULARISING WIRELESS.

By THE EDITOR.

AS John Henry would say, "It's all wrong," and we agree with him. The public are not approaching wireless from the right point of view to get the fullest enjoyment out of it. Neither does there appear to be any strong desire on the part of those who are in a position to help them to show them where they are wrong.

There are two ways of interesting oneself in wireless. Perhaps it may be said that there are three. Firstly, wireless can be taken up entirely from the practical side and sets can be put together by following precisely the instructions contained in the various wireless publications or popular books. Those who know nothing about wireless may get satisfactory results in this way and they may not. If anything goes wrong they are at a loss to understand the reason, and have to seek advice. Then there is also a class which takes no interest in wireless as such, but is merely concerned with the reception of the broadcast programmes and is quite content with a satisfactory commercial receiver purchased complete.

The aim of *The Wireless World and Radio Review* has always been to interest those who take up wireless so that they concern themselves to a more or less serious extent in the theoretical side, as well as the practical. We believe that unless some understanding is arrived at of the operation of the wireless receiver, that wireless as a hobby cannot be fully appreciated by those who take it up.

The greatest joy in wireless as in most other subjects is knowledge—the understanding of why various alterations to circuits produce such and such results. Even a little understanding of theory will sometimes save hours of labour in practical experiment because theory will expose a fallacy immediately, instead of time being wasted in proving it experimentally.

One can hardly imagine a more uninteresting occupation than the carrying out of say a series of chemical experiments without the faintest knowledge of what was the cause of the results obtained. When one can predict what is likely to happen before an experiment is carried out, the interest is doubled, whilst the results are far more convincing than they otherwise would be.

Making wireless simple—popularising it to meet the public taste, is all very well, but an interest so derived is scarcely likely to be lasting, whereas a little study, and it may only need to be a very little at first, will give to the subject a fascination which it never had before.

Popularising wireless is usually regarded as making the subject simple and devoid of all theory, but anyone who regards himself as an amateur or experimenter, would never be satisfied to disregard a study of theory, however superficial, for he recognises that herein lies the true fascination of the subject.

THE MULTI-CIRCUIT TUNER.

This article describes a novel method, utilising plug and socket connectors, by which a vast variety of tuning systems can be set up while the individual components can, if desired, be used in association with other apparatus.

By R. H. Cook.

It is not possible to produce a receiver with an extensive tuning range unless some system of switching is introduced or alternatively duplicating certain parts of the apparatus such as tuning coils and condensers. By introducing switches it is possible to throw condensers in series and parallel and to form resonance circuits with extensive wavelength range, but it is necessary to employ well designed switches and a carefully thought out wiring arrangement in order to avoid losses through the capacity presented by the many leads.

It occurred to the writer that plugs and sockets could be arranged to serve the purpose of changing out the connections of a tuner somewhat on the same lines as the system employed for altering the circuit of a simple receiver, described in a recent article.* The arrangement is inexpensive and quite efficient, whilst the internal connections are short and well spaced and not so numerous as when wiring to the contacts of elaborate switches. A number of circuit arrangements can be produced by the use of plugs and sockets, probably more than by any system of switches, and all types of circuits can be easily tested, whilst the complete instrument is reasonably compact.

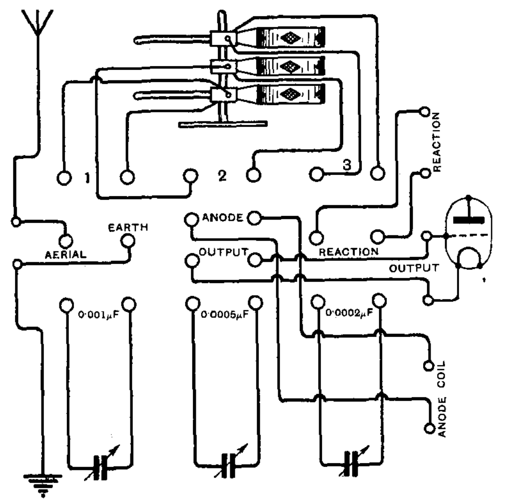


Fig. 1. The tuner is fitted with 20 sockets for plugs and the method is shown of connecting with the components.

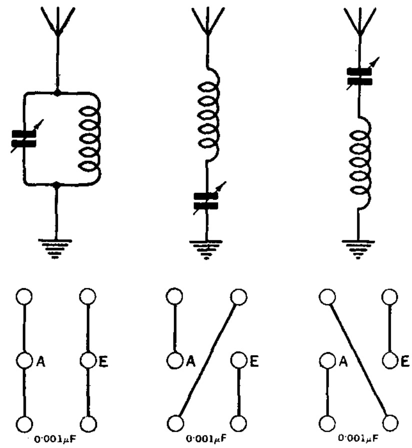


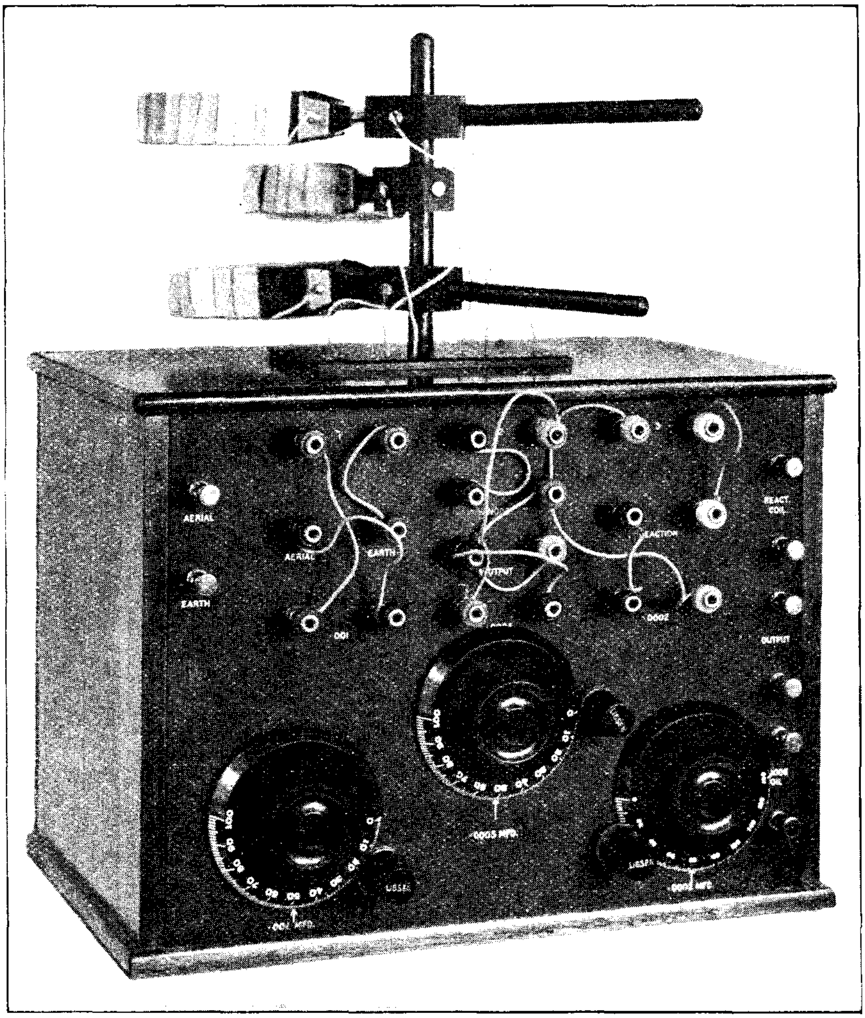
Fig. 2. External connections by means of plugs to produce three systems of aerial circuit tuning.

Referring to Fig. 1, which shows the connections of the tuner, it will be seen that the instrument has many applications. It is fitted with three variable condensers and a three-coil holder, which allows of its use as an aerial circuit, with closed coupled circuit and tuned anode or reaction. The condensers can be interchanged and used with any of the inductances, while the inductances may form part of any of the circuits so that the closed circuit may be intermediate between aerial and reaction, or the reaction coil may operate on to the aerial coil with an independent tuned anode circuit. Various circuits are shown in Figs. 2, 3, 4, 7 and 8.

* *Wireless World and Radio Review,* March 12th, 1924, p. 785, "Multi-Circuit Experimental Valve Panel."

The construction is quite simple. The list of component parts is given below :

Ebonite panel, $12'' \times 9'' \times \frac{1}{4}''$
Ebonite panel, $5'' \times 3'' \times \frac{1}{4}''$
Ebonite $\frac{3}{4}''$ thick, for making the coil holder.
Ebonite rod, 1′ of $\frac{3}{8}''$ diameter.
Ebonite rod, 6″ of $\frac{1}{2}''$ diameter.
3 Vernier attachments.
8 Terminals.
1 Cabinet, $9'' \times 12'' \times 8''$ (internal dimensions.
3 Coil plugs.
3 Coil sockets.
16 S.W.G. tinned copper wire.
Screws, etc.



The completed set.

20 Clix sockets.
24 plugs.
20 bushes.
1 0·001 mfd. variable condenser.
1 0·0005 mfd. „ „
1 0·0002 mfd. „ „

The sheet of $\frac{1}{4}$-in. ebonite is first squared up to $12'' \times 9''$ and the positions for the holes carefully marked out with the use of square and dividers. The necessary dimensions are shown in Fig. 5, which can be followed **exactly, provided the same style of com-**

ponents are employed as those shown in the accompanying illustrations. Ample space has been allowed, however, so that components of other makes may be employed according to the tastes of the reader. It is as well to drill the holes prior to rubbing down the surface and when all drilling is

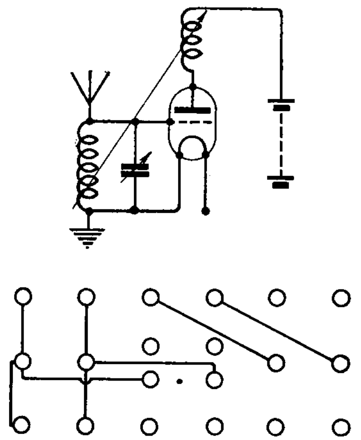


Fig. 3. Connections of parallel tuned aerial circuit with reaction.

completed, the panel may be screwed down to the face of the bench and the surfaces

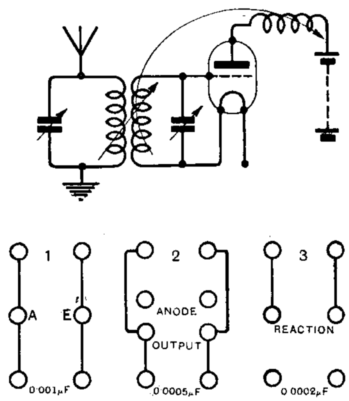


Fig. 4. Loose coupled set with reaction.

finished by rubbing with medium carborundum cloth. A circular motion should be employed to avoid scratches and the black surface of the ebonite may be restored by treatment with turpentine or with oil sparingly applied.

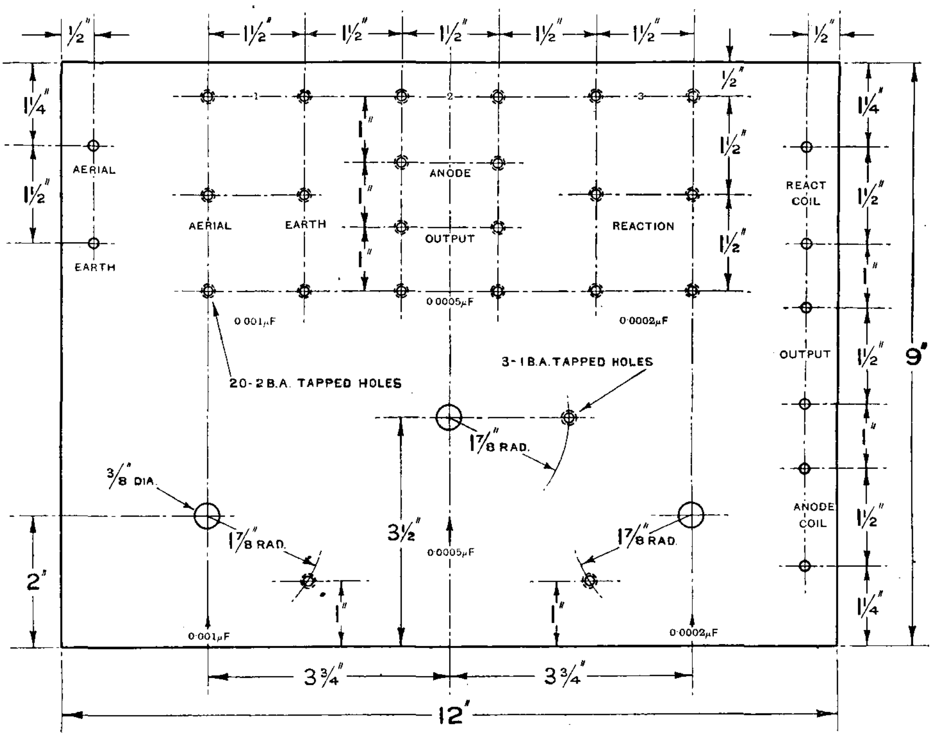
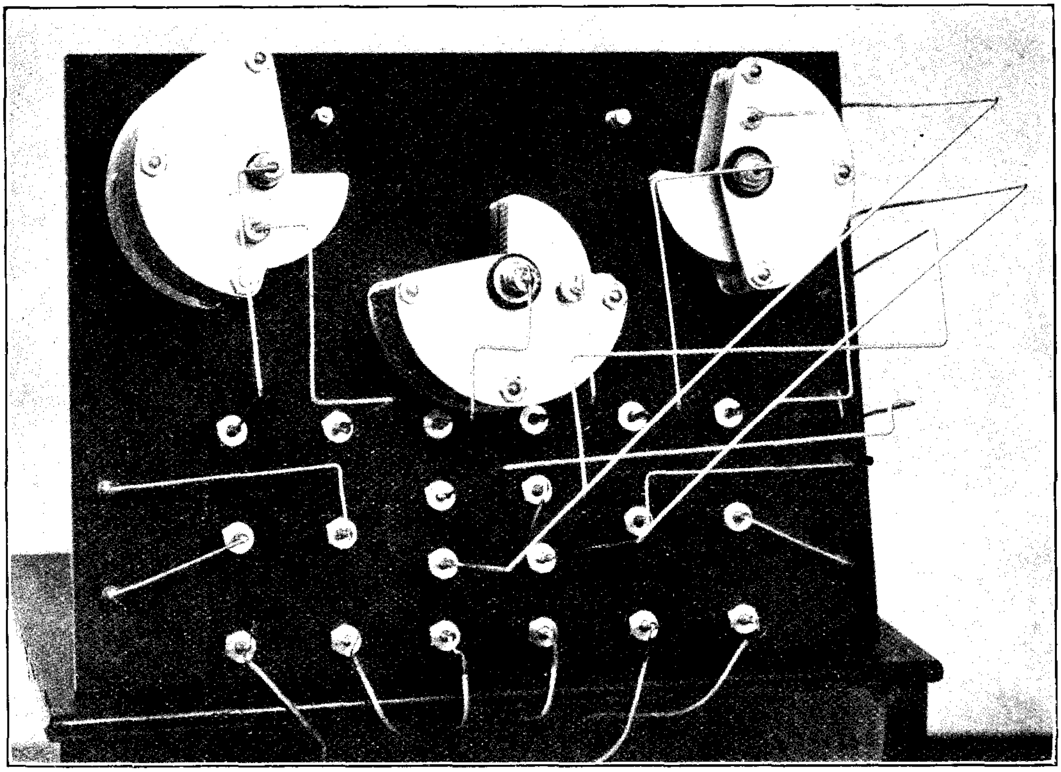


Fig. 5. Setting out positions of the holes in front panel.

The components are next assembled on the panel, which presents no great difficulty, and wiring up proceeded with. No. 16 S.W.G. tinned copper wire should be employed, previously straightened by stretching. It is advisable to bend the connecting wires round the ends of the terminals, sockets, etc., to ensure that a good mechanical contact is made and that the connecting wires are not held in place entirely by the solder. If soft tinman's solder is used with a moderately hot iron, the parts will not become overheated, and care must be taken to avoid any excessive heating as most of the points to which connections are made contain so little metal that the temperature is apt to rise rapidly. It is essential to use a good hot iron so that the heat is transferred rapidly for if the iron is not sufficiently hot and is slow in heating the metal a great deal of heat will be transferred before the solder will run.

Primarily with the object of limiting the cost of the instrument, the construction of a tuning stand was undertaken, a brief description of which is given for those who do not desire to purchase a three-coil holder. Care will be required in making up this component though the design has been made as simple as possible. The arrangement consists essentially of an ebonite base measuring nearly 5 × 3 ins. which supports a vertical pillar made from ½-in. ebonite and 6 ins. in height. The vertical rod is attached to the base piece with a 2 B.A. screw driven into a tapped hole in the ebonite rod. Ebonite pieces are made to carry the coils from ¾-in. ebonite sheet and these have a length of about 1½ ins. by a width of 1 in. A ½-in. vertical hole is made through each piece so that it will slide on to the rod whilst another hole in the side, tapped ⅜ in. or 5/16 in. Whitworth provides a means for securing a coil holder to any part



View of the interior showing the simple wiring.

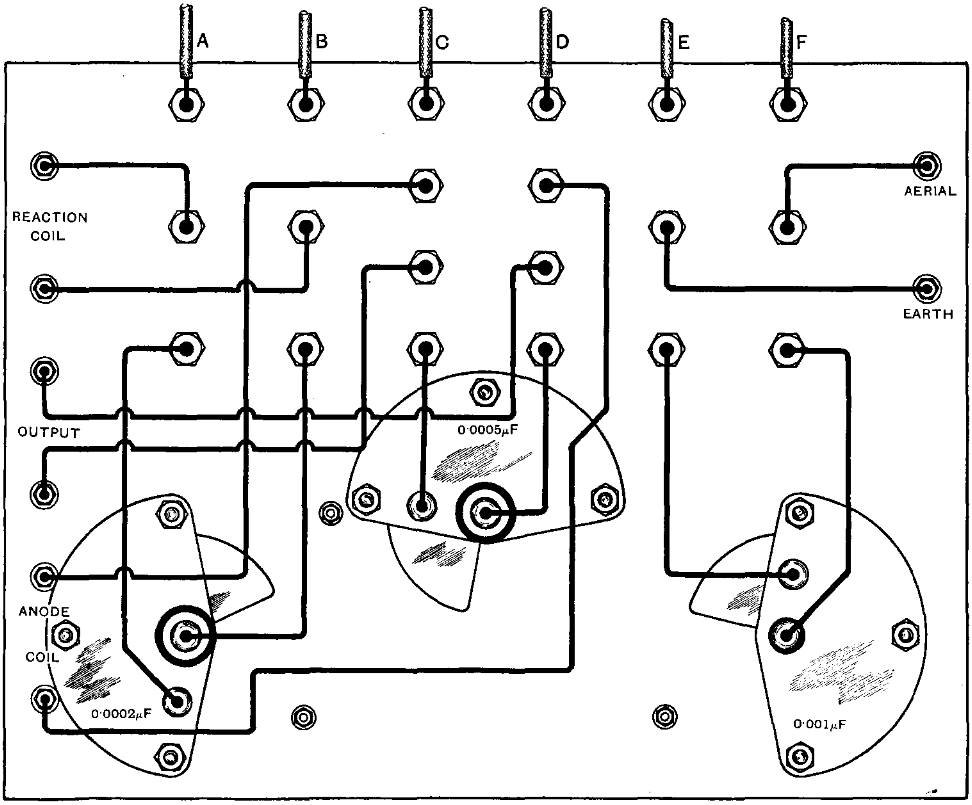
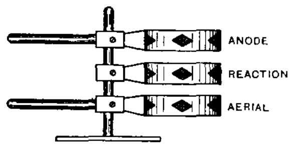


Fig. 6. Internal connections. The leads A and B connect to the top coil holder, C and D to the centre, and E and F to the bottom.

of the vertical rod. Two more pieces of ⅜-in. rod are reduced in diameter by filing and threaded ⅜-in. or $\frac{5}{16}$-in. Whitworth are screwed into the side holes so as to provide a means of fixing the sliders in position.



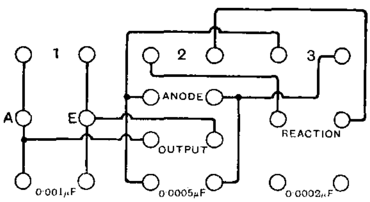


Fig. 8. Plug connections for a H.F. amplifier set.

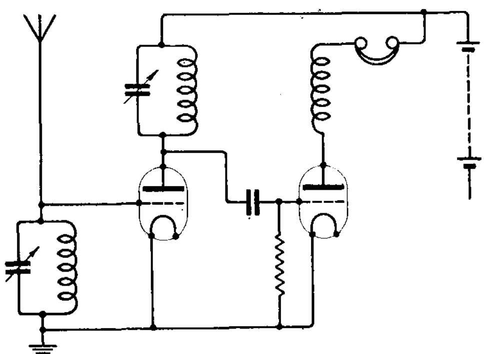


Fig. 7. High frequency amplifying circuit obtainable by the connections given in Fig. 8.

Coil holder plugs and sockets can be obtained and fitted in position with screws driven in from the sides which also serve as terminals. Other minor constructional details can be seen in the illustration on page 243.

CRYSTAL DETECTORS IN THEORY AND PRACTICE—II.

A NEW THEORY OF CONTACT DETECTORS.

By JAMES STRACHAN, F.Inst.P.

THE theory outlined in the present article is based on observations of the properties of crystalline substances. These comprised a typical selection of over a hundred distinct substances, chiefly minerals, but also included numerous artificial or synthetic crystallisations. The crystals were examined for—

(1) Electrical conductivity.
(2) Thermo-electric properties.
(3) Rectifying properties without applied potential.
(4) Rectifying properties with applied potential.
and (5) Application of external heat to the loose contact, and to the whole detector during rectification.

The rectification experiments were all performed on an aerial less than a mile from one of the B.B.C. stations. Some idea of the average reception may be conveyed by the fact that the rectified current from a good synthetic galena averaged 1½ to 2 milliamps, just enough to work a 4,000 ohm loud speaker audibly in a quiet room. A number of experiments were also conducted under the same conditions with film coherers, and amorphous substances.

The general conclusions arrived at from these experiments, and on which the theory is based, are as follows :—

(1) While the majority of the crystals in common use belong to the regular (cubic) and hexagonal systems, rectification cannot be associated with particular systems of crystal symmetry beyond the larger number of substances crystallising in such systems. Crystals with rectifying action were found to occur in the other four systems of crystal symmetry.

(2) Crystals possessing piezo-electric and pyro-electric properties (*e.g.*, tourmaline, calamine, boracite and rochelle salts), are very feeble conductors, and do not exhibit rectifying properties.*

(3) In the case of good holohedral or euhedral forms of rectifying crystals no definite connection could be established between that property and particular crystal faces.†

(4) In the case of many crystals extensively used in detectors, *e.g.*, synthetic galena, zincite and carborundum, the most sensitive specimens show a predominance of hemihedral or subhedral asymmetry.

(5) In the case of certain well-marked holohedral crystals possessing good rectification (*e.g.*, iron pyrites and cassiterite)‡, the most sensitive spots were not found on crystal faces, but on fractured surfaces not corresponding with definite crystal planes. Weak rectification may be obtained from the faces.

(6) Insensitive spots on highly sensitive crystals are generally associated with unbroken smooth surfaces of predominant cleavage, and the most sensitive spots with planes meeting same at an angle. A predominant cleavage plane possessing isolated sensitive spots shows that the latter are located on re-entrant angles, of microscopical dimensions, with other planes.

(7) This feature is most marked in the case of laminated or foliated crystal growths such as graphite, molybdenite, covellite and synthetic galena containing tin sulphide. In these crystals the most sensitive spots are on the edges of the laminæ, or at irregularities on the surfaces of same.

(8) Anhedral or crypto-crystalline masses (*e.g.*, copper pyrites and iron pyrites) are

*† Following on lines of enquiry suggested by Tutton, *loc. cit.*, *The Wireless World*, Vol. I, p. 239.

‡Cassiterite (Tinstone), oxide of tin, SnO_2, a good rectifier previously not noted. It is better than silicon, about equal to zincite and more easily obtained than the latter, being the commonest ore of tin.

not usually very sensitive as rectifiers, but are much improved by the use of an applied potential. A compound sulphide of lead, silver and antimony (frieslebenite) is exceptional in this respect, giving good contact rectification on a polished metal-like surface of this substance.

(9) Some amorphous substances (precipitated sulphides, etc.), which are normally insensitive as rectifiers, may be made sensitive by use of an applied potential (direct current from a local battery), when properly prepared.

(10) Practically all the crystalline substances examined which gave rectification while a direct current was passing through the loose contact, also gave rectification without the applied potential when acted upon by strong oscillations.

(11) Practically all the crystalline substances examined, which gave good rectification without an applied potential from a direct current, gave better results by the application of a direct current of suitable P.D. across the contact. Synthetic galena is exceptional in this respect, but natural galena is improved by an applied potential.

(12) With several crystals (*e.g.*, silicon, molybdenite and zincite) the application of a direct current potential, for a few moments only, during reception, rendered weakly sensitive spots into strongly sensitive spots, *i.e.*, the crystal continued to rectify strongly after the applied potential was removed. This state of affairs continued until the contact on the spot was broken.

(13) The great majority of rectifying crystals exhibit a constant sign in respect of the direction of the rectified current with reference to the loose contact when used without an applied potential, and this, the natural direction of the rectified current, is the best direction to send a direct current through the contact when using an applied potential on a particular crystal, *e.g.*, graphite, silicon, and the best synthetic galenas are + *ve* and zincite, iron pyrites, carborundum and most specimens of natural galena are − *ve* respectively to the loose contact.

(14) A few crystals, *e.g.*, natural galena, zincite and molybdenite exhibit both + *ve* and − *ve* spots in respect of the direction of the rectified current, but in such cases one sign is constantly and predominantly stronger than the other.

(15) Synthetic galenas, originally strongly + *ve* in sign, when they have fallen off in rectifying value (usually due to overheating when setting in fusible metal) are found to have reverted to the − *ve* sign as in natural galenas.

(16) In galena slight alterations in the composition alter the sign of the crystal. A small percentage of tin sulphide renders the crystal − *ve* while a small percentage of silver sulphide renders the crystal + *ve*. The addition, however, of a molecule of tin sulphide to each molecule of galena renders the crystal quite inactive, while the addition of a molecule of silver sulphide in the same fashion yields a highly sensitive crystal, which, as will be explained later, is most difficult to control.

(17) Crystal sensitivity is a function of (*a*) chemical composition and (*b*) physical properties, such as hardness and electrical resistance.

(18) While a good crystal contact is an efficient rectifier, all such contacts pass H.F. oscillations to some extent. Placing several contacts symmetrically in parallel reduces the degree of rectification and placing several detectors in symmetric series increases the degree of rectification. The latter action is limited by resistance but under certain conditions, to be noted later, the best results may be obtained by using several crystal detectors in series. In this connection it should be noted that the degree of contact required for reception of B.B.C. telephony involves a very much lower resistance than that generally associated with the crystal detector as used during past years for long-range spark signals.

(19) Various observers* have noted that the application of heat to a crystal detector (as a whole) has a similar effect to the application of a D.C. potential in increasing sensitivity. There appears to be a critical temperature at which a particular crystal works best. This temperature may be very low (about 40-50° C. in the case of galena) to a red heat in the case of thorium oxide.

(20) In certain cases, *e.g.*, zincite-chalcopyrites, it was observed that a momentary or

***Vide* Tutton *loc. cit.*; also "Crystals as Detectors," H. J. Round, in *The Wireless World*, Vol. I, p. 296, August, 1913, and "The Influence of Temperature and Pressure on the Sensitivity of the Carborundum Crystal Detector," B. Hoyle, in *The Wireless World*, Vol. III, pp. 356-60, September, 1915.

temporary rise of temperature conferred great sensitivity on weakly sensitive spots and that this condition endured after removal of the external source of heat so long as the contact was not disturbed.

(21) In all crystal-metal contacts tested it was observed that the application of heat, to the loose contact only, resulted in generation of a thermo-electric current in the reverse direction to that of the natural direction of the rectified current.

(22) Single-point oxide film coherers are essentially identical with crystal detectors in their mode of operation. The thin transparent oxide film requisite for their satisfactory performance is crystalline in nature, most probably pseudomorphous after the crystalline structure of the metal on which they are formed. Brass alloys give the most sensitive coherers of this type and cerium oxide film the most sensitive of a pure metal.

(23) In crystal detectors rectification depends on molecular actions in a thin film of the crystal at the point of loose contact.

(24) There is definite evidence that the molecular action at the point of contact, under certain conditions, produces vibratory movements of the metal point and that sudden changes in the passing oscillations may increase this movement to such an extent that the loose contact is broken (or as an amateur has described the phenomena —" the catwhisker is jogged off the crystal.") As this is a very important point it will be dealt with very fully at a later date.

(25) These movements of the metal point or " catwhisker " interfere with proper rectification and produce distortion during reception of telephony (*a*) when the contact is too light, (*b*) when a super-sensitive crystal is used and (*c*) with the application of a certain D.C. applied potential when the latter is opposite in direction to that of the natural direction of the rectified current for a particular crystal.

The mass of evidence leading to the above conclusions cannot be given here in detail, but as indicated above, a number of the more important points will be dealt with later.

All the evidence obtained is strongly in favour of an explanation of rectification depending upon a molecular action at the point of loose contact, which is different in its effects during the passage of high-frequency oscillations, compared with the slow alternations of direct currents applied in the usual experiments on which the electro-thermal theory is based.

In the first place it must be recognised that the rectification reaction at the loose contact is confined to a film on the surface of the crystal, most probably only a few layers of molecules. This may be demonstrated by grinding up a sensitive crystal of galena into very fine dust in an agate mortar and adding just enough of the crystal dust to form a bluish coloured film on the surface of some mercury in a metal cup. The galena film on the mercury behaves exactly as a crystal when a loose contact is made with the surface. In the second place the difference between a firm contact and a loose contact must be noted. With rectifying substances firm contacts yield ordinary metallic conduction to oscillating currents but in the case of a loose contact something quite different evidently takes place.

This brings us to consideration of the internal or molecular theory of conduction, concerning which we are very much in the dark at the present day. In the minerals and crystals examined the behaviour at the loose contact may be classified under four heads, as follows :—

(*a*) Metallic conduction without rectification.
(*b*) Electrolytic conduction, with or without slight rectification.
(*c*) Non-conduction ; extremely feeble conduction or insulation, and
(*d*) Conduction with good rectification.

(*a*) Includes such substances as compounds of arsenic and selenium with certain metals.
(*b*) Includes certain sulphides and halides.
(*c*) Includes the majority of mineral substances, such as silicates, carbonates, phosphates and many oxides.
(*d*) Includes a limited number of oxides, sulphides, etc.

While these substances can be classified under one of these heads, it should be noted they gradually merge into each other and a complete sequence of substances may be obtained varying gradually in conduction, the apparent order of the phenomena being (1) metallic conduction, (2) conduction with rectification, (3) electrolytic conduction, and (4) non-conduction.

As the number of solid substances exhibiting the phenomenon of electrolytic conduction at ordinary temperatures is few, we may consider substances with rectifying properties as occupying an intermediate and graduated position between good conductors and insulators. Thus some substances possessing rectifying properties, such as certain metallic oxides, possess also such a high degree of electrical resistance that they operate only in thin films, or at a high temperature where their resistance is lowered. On the other hand there are substances, such as certain metallic sulphides, which possess good rectifying powers, but they are also good conductors of electricity, and for the latter reason it is very difficult to operate a loose contact, as the slightest movement establishes metallic conduction without rectification. Between these two groups we find certain sulphides and oxides which occupy an intermediate position in conductivity and resistance, and these include the most efficient rectifiers in common use.

According to modern views of the constitution of matter, metallic conduction of electricity is produced by displacement of the atomic charges, resulting in a translatory movement of electrons through the conductor. The internal mechanism of non-conduction or insulation is not quite so well understood but it is more probable that, in a dielectric subjected to a potential difference, there is a displacement or separation of the internal atomic charges, without the translation of electrons occurring in a conductor.

Electrolytic conduction with ionic movements and transference of charges we need not consider here because the general evidence is against an electrolytic theory of rectification.

In the case of the substances under consideration, *viz.*, rectifiers which are neither good conductors or good insulators, we find that with firm contacts they behave as conductors, having a fairly high resistance. With a loose contact and a firm contact, however, we find that the resistance of such substances is not only increased, but a greater P.D. is required to pass a given current in one direction than in the other, or reverse direction. This means, in effect, that with a given substance, under certain conditions, and a given P.D., the molecules of the crystal at the point of loose contact have both conductive and dielectric properties according to the direction of the current. After very careful consideration of the experimental evidence summarised above, the writer was forced to the conclusion that this was the true nature of the action at the point of loose contact during rectification. The surface molecules at the point of loose contact on a crystal may be regarded as acting the part of a dielectric of large polarisation capacity to one pulse of an oscillation, and that of a metallic conductor to the reverse pulse, the unidirectional rectified current being an integration of both pulses. The energy of one pulse may be regarded as being stored up during the dielectric condition of the molecules and discharged in the same direction as the reverse pulse during the conducting condition of the molecules. Such an action, it should be observed, involves a certain constant loss of electrical energy, accompanied by molecular movements at the loose contact, consistent with the experimental evidence.

The explanation of this theory and its exact mechanism, in terms of atomic and molecular structures, and of electron movements, is in our present state of knowledge a very difficult matter, being beyond the most recent conjectures on the molecular or atomic mechanism of conduction and dielectric properties of matter. At the moment I do not propose to venture further into this aspect of the subject beyond indicating that the theory demands a movement of electrons in both directions, and a steady flow in one direction across the loose contact, and that in my opinion a close study of crystal structure in connection with rectification will shed new light on the electron movements, not only during ordinary conducting and dielectric conditions of matter, but also in the special cases involving the Peltier, the Thomson and other phenomena. The first step in this direction has been indicated by Lindemann* in his conception of metallic conduction as a displacement of an electron crystal grating relatively to that of the underlying metallic ions.

We may, however, venture on a cruder kind of working hypothesis, similar to the old molecular theory of magnetic phenomena. For this purpose we may conceive the molecules of a conducting crystal as possessing axes of conductivity, polar in nature and reversible, according to the direction of

*Phil. Mag. 29, (127) 1915.

the current, during firm electrical contact. At a loose contact, however, we may conceive the surface layers of the crystal molecules as possessing different properties from the internal molecules. The surface molecules of a crystal, although possessing a definite orientation, have also greater freedom of movement, so that at a loose contact we may imagine changes in the polarity of the conductivity axes as being accompanied by actual movements of the molecules themselves. Further, the definite orientation of the surface molecules as determined by the crystal structure would result in a definite orientation of the conductivity axes, yielding predominant properties of conduction in one direction, and requiring greater expenditure of electrical energy, in the case of a current passing in the other direction, to reverse the conductivity axes. On the one hand we may regard the conducting direction of the loose contact (the natural direction of the rectified current during rectification without an applied potential) to be determined by crystal structure (and chemical composition), and on the other, the dielectric direction to be produced by hysteresis or lag of the change in polarity of the conductivity axes, due to molecular movements, the frequency of the electrical oscillations being of a very much higher order than the vibrational frequency of the molecules. When a high frequency oscillation passes at the loose contact the changes in the polarity of the conductivity axes are controlled by the predominating orientation of the surface molecules and their freedom to move to some degree. One pulse of the oscillation passes readily in the predominating direction of conductivity but the other pulse is met by dielectric conditions, produced by the reluctance of the molecular movements to coincide with the tendency to reversal of the conductivity axes.

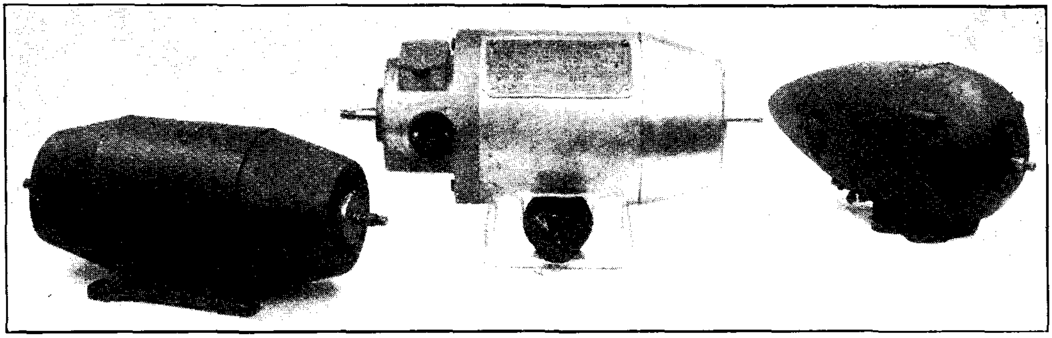
The function of an applied potential, even in the case of certain amorphous rectifiers, lies in determining the orientation of the conductivity axes, and the action of heat on crystal detectors effects the same state by giving greater freedom of movement to the surface molecules at the loose contact during reception.

One of the strongest evidences in favour of such a theory is the hysteresis effect observed in tracing the characteristic curve of a crystal by the steady current method. On reversing the current and completing a cycle of applied potential, the curve is found to enclose an area. This has been remarked upon by several observers.*

In conclusion it should be noted that this theory does not necessarily demand a loose contact because if we admit that the degree of contact involving a certain sensitivity is a function of composition and physical properties such as hardness and electrical resistance, it may be possible to find a substance which rectifies with two firm contacts. In this case rectification would occur in the surface molecules conducting the H.F. oscillation. I have found one substance which apparently acts in this fashion.

Further, the nature of the reaction suggested in this theory, leads us to a clearer explanation of the mechanism of the electrolytic detector, which, by its characteristic, is closely related to the crystal detector. This also we hope to refer to again.

*Pierce, "Crystal Rectifiers," etc., Phys. Rev., Vol. XXV, p.p 31-60; Goddard, "Conduction of Electricity at Contacts," etc., Phys. Rev., Vol. XXXIV, pp. 423-451; and Coursey, *loc. cit.*, Proc. Phys. Soc., Vol. XXVI, pp. 105-106.



New types of high tension generators developed by Messrs. Newton Brothers, Ltd., of Derby. Outputs from left to right 1,200 *v.* 0·133 *a.*, 1,200 *v.* 0·08 *a.*, *or as a rotary transformer*, 850 *v.* 0·08 *a.*, 1,500 *v.* 0·1 *a.*

FAITHFUL REPRODUCTION BY BROADCAST.*

A paper of outstanding importance. It is doubtful whether anyone has made a greater study of the problems of distortion in broadcasting, both in transmission and reception, than Captain Eckersley, and in these pages he gives his experiences and shows the lines of development adopted in the research work undertaken by the B.B.C. For those who endeavour to minimise distortion in reception it is essential that they should have an understanding of the steps taken by the B.B.C. with regard to maintaining quality in the design of transmitting equipment. As a result of certain observations in the course of this work many points present themselves in respect of the conditions necessary at the receiving station. Every listener whose aim is the elimination of distortion should have a clear idea of the work carried out by the B.B.C. and should avail himself of the suggestions here put forward by their Chief Engineer for the improvement of receiving equipment to correspond with the progress achieved in transmission.

By Capt. P. P. ECKERSLEY, M.I.E.E.

THE subject on which I am going to speak is undoubtedly a very bewildering one, and I am only going to introduce to you a certain number of views as they strike what I may call the man in the street of science, which I consider myself.

Technically, there are three paramount points as regards technical policy:

(1) Strong signals. (2) Freedom from interference. (3) Perfect quality.

As we all know, sound is a wave motion. That is proved in text books about a yard thick, but they seem to me to prove nothing else except that it is a wave motion. One has only got to realise that some of the newest halls that have been built for public debating are apparently designed so that no speaker can be heard to indicate the paucity of knowlecge of the subject of building acoustics.

It is a complicated subject; since it does not lend itself to measurement, there are no "sound" ammeters, as it were. However, one can at least define amplitude of sound wave and its meaning is obvious; pressure definitions I cannot so readily grasp.

If you start a tuning fork vibrating without harmonics and make it vibrate at twice the amplitude, it probably gives you twice the amplitude of the sound wave.

The first thing to define is the relationship between amplitude and equal audibility over a range of frequencies. For equal audibility whatever frequency of audible sound is created it should, to the average human ear, sound equally loud.

* A paper read before the Radio Society of Great Britain at the Institution of Electrical Engineers on Wednesday, April 30th, 1924.

On a basis of equal audibility over a range of frequencies from 0 to 20,000 the curve might be shown in Fig. 1. Generally the amplitude for equal audibility increases towards the bass and naturally at very high notes, since the human ear cannot apprehend sound vibrations above a certain maximum frequency.

The function of the microphone is to convert these sound waves into corresponding

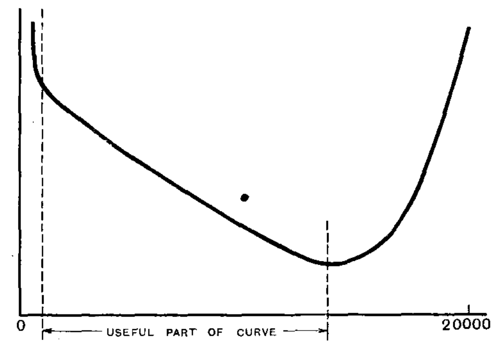


Fig. 1.

electrical variations. There is some confusion with regard to the term microphone. The microphone was first invented as a loose contact device for converting sound into electrical vibrations. The term "magnetophone" has been used for the electromagnetic types of "sound to electricity" converters, but it strikes me that the time has come for a real definition because although we may differentiate exactly between a microphone with carbon granules and a magnetophone, there is a danger of getting confused with many other types of apparatus flames, 'photo electric devices and so on; a single word is required to embrace all types.

For want of a better word I will continue loosely to talk of a microphone.

I want you to think of a perfectly flat and wide piece of paper which is wound with a coil of wire, as in Fig. 2.

Consider that the wire is in a magnetic field and you will see that if the paper and

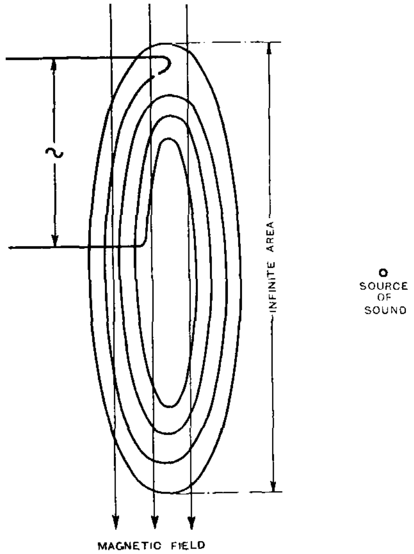


Fig. 2.

coil is perfectly free in space, the sound impulses hitting it will make it wobble up and down, and you will get certain electrical impulses.

It is interesting to study what happens if equal sound amplitudes A impinge normally at the surface of the armature.

Let F = force on the armature
M = mass of armature
V = velocity of armature
E = voltage produced by armature.

$$\text{Then } F = M\frac{d^2v}{dt^2} \text{ but } F = A \sin pt.$$

$$\therefore \quad \frac{dv}{dt} = \frac{A}{mp.} \cos pt = E.$$

If there is equal amplitude of sound impulses impinging on the armature, the voltages produced (E) will be inversely proportional to the frequency. In other words, it will increase all the electrical amplitudes of the lower tones to the detriment of the higher tones.

Supposing you were to connect the theoretical microphone to an exactly similar coil acting as a "loud speaker," you will have no possible means of distortion and you will have a system which approximates to perfection. The movements of the loud speaker armature will be proportional to p, and so a perfect system will be achieved.

Turn now, however, to practical conditions. As a public address system, the system described is hardly what I would call practical. Consider a public address system where wireless does not enter into it at all, where I am talking into a microphone which is attached to wires, and somebody is in another room listening to me. One of the first questions is that of amplification. The thermionic valve gives us the opportunity of amplifying distortionlessly. I think it would be worth while to go into the question of amplifying by means of the thermionic valve.

In Fig. 3 is illustrated a curve of a theoretically perfect valve for distortionless amplification, and if you apply a certain negative permanent bias to the grid and superimpose on that bias an alternating current, you get reproduced an alternating current of an exactly similar sort in the anode circuit, but magnified. That is obvious. The point which I am almost ashamed to bring to your notice, and yet it is one which is frequently lost sight of, is the fact that every valve amplification system has its

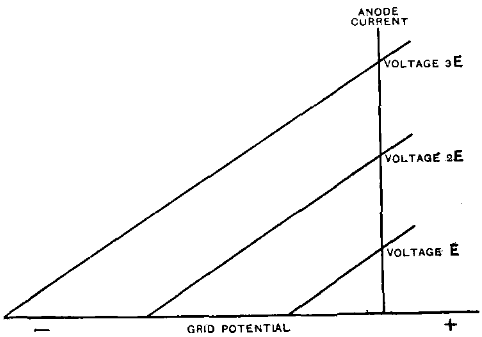


Fig. 3.

limits, and there is an amplitude for a given valve past which you cannot go without distortion and blasting.

Let us therefore now connect a microphone as shown in Fig. 4. In dealing with a system of amplification for this microphone, one does not want the amplitude of the electrical impulses to be inversely proportional to the frequency, because this places a limitation on the overall possible control with a given amplifier. Therefore, you cannot take this moving coil and connect it across the grid filament of the first valve of your amplifying chain and leave it at that; it is necessary to impose a practical connection. Thus in the anode circuit of the first

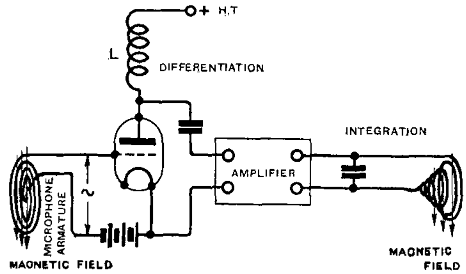


Fig. 4.

valve connect an inductance (L), the impedance of which is small compared with the impedance of the valve. The voltages across this inductance will be proportional to the frequency of electrical impulse across the grid and filament of the valve, but these in turn for equal amplitude of sound are inversely proportional to the frequency. The result is that by a process called differentiation we can arrive at a state of affairs where for *equal audibility* (sound impulses greater in amplitude for bass tones) one can have fed across the differentiating inductances equal electrical impulses. (Obviously a double differentiate is required.)

It now remains to convert back in the loud speaker system (Fig. 4). You can do that in a number of ways, the simplest being to put a condenser across the loud speaker, the impedance of the condenser *increasing* for higher frequencies. This process is called integration.

Thus, first your microphone was connected by differentiation so as not to limit your amplification, and therefore your loud speaker had to be integrated for perfect reproduction.

What is the next step? The next step, so far as we are concerned to-night, is to substitute wireless for wire connection. Everyone apparently knows how to set up a wireless telephone transmitter, but not everyone knows how to control it. I have listened. (*Loud laughter.*) There are two general types: one where the control system requires but little energy to control the output fully; the other where for full control an equal power is required for both oscillator generator and for control system. The former we may call a trigger system. Such a system, however, may be once and for all ruled out for broadcasting, because of the trickiness in handling and the difficulty of receiving by unskilled people.

The only system which we have been able to put into effective use so far—I am not dogmatising and saying it *is* the only system; there may be hundreds of others, but I have not used or tried them—is illustrated in Fig. 5. It is called the choke control system, and equal power is expended in the control system as in the oscillator generator. Its action is so well known as to require no explanation from me.

In considering what distortions may be imposed by the method, one must first consider the theory of wireless telephony. Briefly, in superimposing frequencies of 1,000 a second on frequencies of 1,000,000 a second, you get reproduced "side bands" of the order of 999,000 or 1,001,000. The illustration in Fig. 6 shows the superimposition of a number of "audible range" frequencies on the carrier wave. The breadth of side bands that you notice from a wireless telephone station is an indication of how much it is controlled in the higher

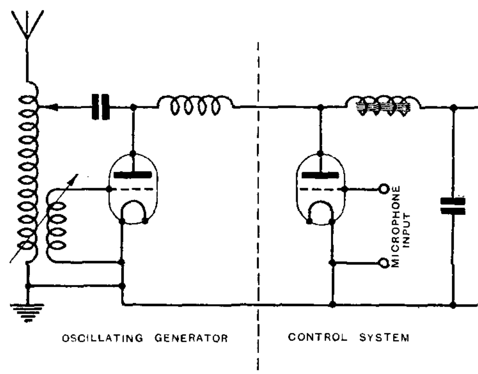


Fig. 5.

frequencies. I have heard many people say that it is wrong to have many side bands, and that they cannot "tune out" a station with such a broad band. In effect, it must be a good station. Theoretically, it is the heterodyning of the side bands with the carrier wave K that produces telephony. Distortion may occur due to the unwanted heterodyning of A and B or S in the picture instead of A, B, S, and K only, and to minimise this distortion it might be useful to cut out one set of side bands altogether.

We come next to the receiving end. High frequency magnification is practically dis-

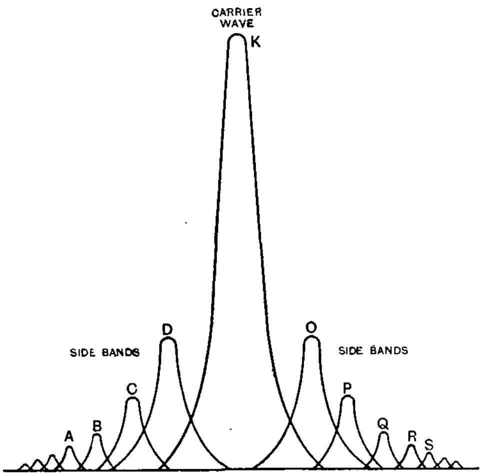


Fig. 6.

tortionless. From the purely mathematical point of view detection is liable to some grave errors, owing to square law rectification, but I do not think there need be (although there frequently is) serious distortion between the microphone and the telephones or loud speaker if proper precautions are taken. No doubt there will be some distortion when we have a proper criterion for judgment, but at the moment I do not think it is serious compared to other distortions, and this being an imperfect world, people have not got much money to spend on receivers. Therefore, the manufacturers in supplying receivers have had to rely, to an extent, upon getting a loud signal. There is a great craze for loud signals, and ambition seems to lead people to try and get Australia on half a valve. This tendency is inimical to the progress of the art. If people would only use as many valves as they are miles away, we might get nearer to perfection, because then no valve will be working outside its limits. (*Renewed laughter.*)

The electric impulses copying the sound waves, as I have shown you, have been differentiated and put out as equal electrical variations for equal audibility, and they have arrived undistorted at the receiving apparatus and are put into a pair of telephones or loud speaker. Efficient telephones, unfortunately, depart a long way from reproducing even equal sound for equal electrical amplitude. What is required for perfect conversion is, of course, greatly increased sound amplitude (from the telephones or loud speaker) for equal electrical impulse. If you were to take any pair of telephones and plot frequency of *equal* electrical impulses against amplitude of sound waves produced, you will arrive at a curve of the type shown in Fig. 7. I do not know whether you have listened to the piano scales which have been played from London, but if you have, if a really critical examination is applied, you will no doubt have noticed that the last top notes were wooden, the bass notes woolly, and the middle ones had a harsh barking sound. That is undoubtedly due to the effect of the accentuation of certain frequencies. Capt. Round, whose most inadequate interpreter I am, has devised a most ingenious method of overcoming this telephone resonance, and one which it would be well worth your while to try. If you have a circuit which works a loud speaker, you want to connect on to its output terminals a circuit such as is shown in Fig. 8.

The telephones are efficient only because they are resonant about certain frequencies and thus when they are corrected through a rejector circuit which cuts out those

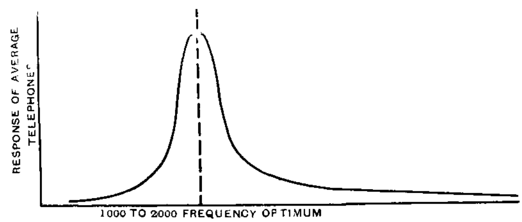


Fig. 7.

frequencies, they will not give such efficient results. It is amazing to listen to corrected telephones pressed closely to the ears. Barking notes become mellow and natural; the bass becomes warm; the high notes are sweet with harmonics.

Now, loud speakers. Loud speakers have been partially corrected, and no rejector circuit will benefit them. It really requires a thoroughly bad loud speaker for correction to be really effective, and, of course, there are none on the market. (*Loud laughter.*)

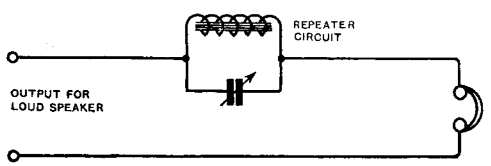


Fig. 8.

Loud speaker curves (I draw from memory) may be of this shape (Fig. 9), and it is interesting but not effective to use rejectors as for telephones. Some loud speakers improve with integration, but a condenser across their terminals does not always do this directly.

The question of the use of horns is interesting. It has been stated that I am a protagonist of those loud speakers which do not use a horn. I do not mind what is used as long as you get the theoretically perfect result. Those "behind the nose" barking sounds can be obtained with a horn just as easily as without. A horn is not necessarily a distorter. There is no doubt that by using a long horn bass resonance might be obtained, and then the horn would be an extremely valuable adjunct.

That, I think, deals in a very brief and very loose way with the problem of quality as I see it, from a theoretical point of view. Before leaving the subject, a few further points of interest arise in connection with the transmission.

In the first place, there is the question of echo. Many people seem to think that we ought to have more echo in our studios. Unfortunately, due to the wrong tone scale given by the average receiving 'phones, the effects of the sweet echo such a room might give are badly reproduced. In order not to give too much echo, in a place like Covent Garden we have to place the microphone right down on the footlights, because otherwise the sounds would be so blurred that the ultimate result would not be worth transmitting. If you had a perfect receiver we could put the microphone away back in the stalls, and you would hear in the auditorium. As it is, we have great difficulties in faking balance. There is another point about echo. If we had a large echo in our studio and if there was a loud speaker in a room which had an echo, you would have two echoes in series, and that would give distortion to a certain extent, and you would deviate to a certain extent from reality. This is an argument against an echoey studio, but we do "remember the poor 'phone user," and we realise an over-draped studio is uninspiring for the artist.

Finally, to achieve a practical system we have to depart from perfect amplification systems and use transformers. There has been a lot of talk about transformers, and one can see that people are beginning to realise that transformers which give them the loudest notes are not the best transformers necessarily for quality. By means of measurements we have proved that we do not depart from our ideals between 200 and 5,000 frequency, and after that there is not serious distortion.

The receiver has got to be improved before we can level serious accusations against the transmitter. When we shall attain the ideal of recording a dynamite explosion or a bat's squeak I do not know, but at any rate I do feel that the weak point in the chain now is at the receiving end. When the next great advance takes place I think it will be a revelation, and then there will be no criticism to level against the system in any particular. That is my ideal, and I am sure it is the ideal of many people who are working at the other end of the problem. I have spoken from my heart, and I admit that I know very little about the subject, and that others far wiser than myself have largely inspired my remarks which, if they only provoke a basis for discussion, have at least achieved something.

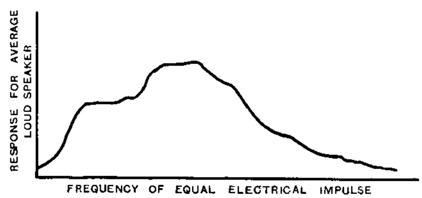
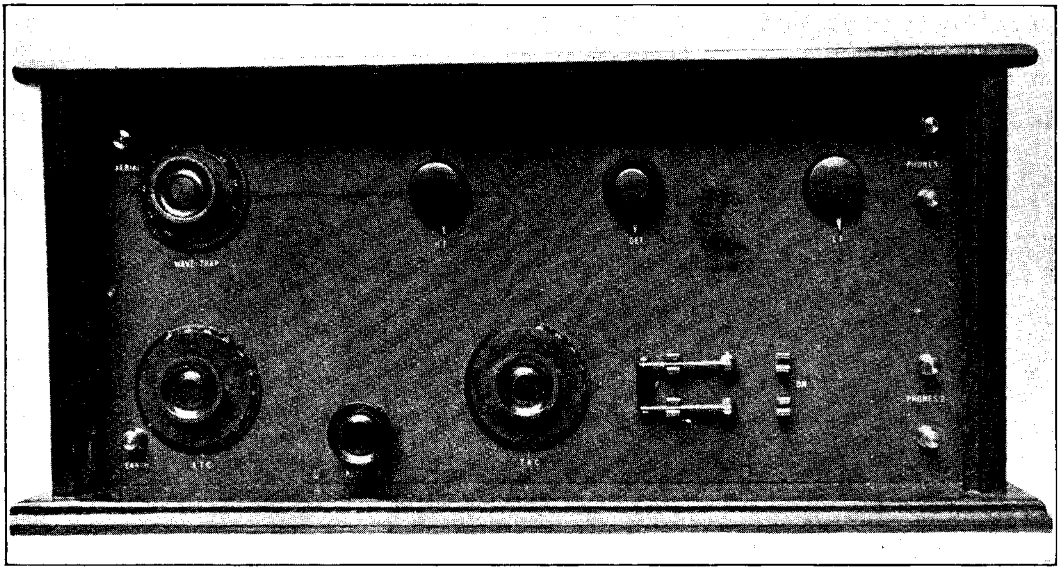


Fig. 9.

(The discussion which followed the reading of the paper will appear in a subsequent issue.)



Three-valve set of simple construction. The batteries are contained in the cabinet.

SELF-CONTAINED THREE-VALVE RECEIVER

This short article describes an amateur built receiver of simple design and construction, yet of good appearance and easy to operate. A feature of the design is the introduction of a wave-trap for the purpose of improving selectivity and eliminating jamming.

THE following three-valve receiver was designed with a view to compactness and simplicity and yet maintaining maximum efficiency. There are only six terminals on the set, two for aerial and earth and the remaining four for telephones. All the batteries are inside the cabinet, which can be shut up while the set is working, thus making it entirely self-contained. It is in fact a most useful set, suitable in external appearance for use in the drawing-room and ready at a moment's notice to give the programme of any B.B.C. station or of some of the Continental stations.

It was decided to use 1 H.F., detector and 1 L.F., using the B.T.H. dull-emitters, type B.5's.

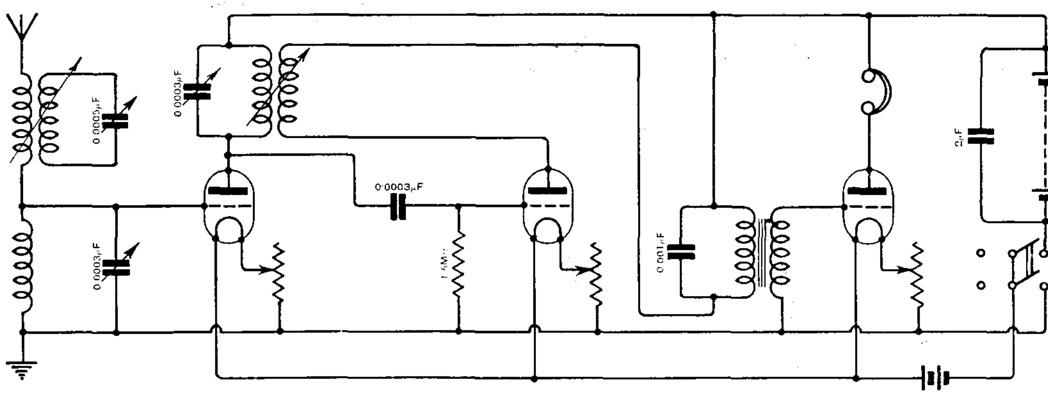
The aerial tuning apparatus consists of a single coil-holder into which is plugged an Igranic coil with a variable condenser arranged in parallel with it. In series with the aerial lead to the coil-holder is a wave-trap. This consists of an ebonite tube $2\frac{1}{2}$ ins. in diameter wound with 60 turns of No. 26 D.C.C. wire, over which is a layer of empire cloth carrying 10 turns of No. 18 enamelled wire. The ends of the outer winding are taken to terminals which are joined to the aerial terminal and one side of the coil-holder respectively, so that the thick winding is actually in the aerial circuit. A variable condenser having a capacity of 0·0005 mfds. tunes the under layer and forms a most useful wave-trap which can be operated to render the receiver highly selective and eliminate interference.

A coil holder is used for the tuned anode and reaction coils and is screwed to the base of the cabinet, while the extended handle comes through the panel so that the reaction is controlled from the front.

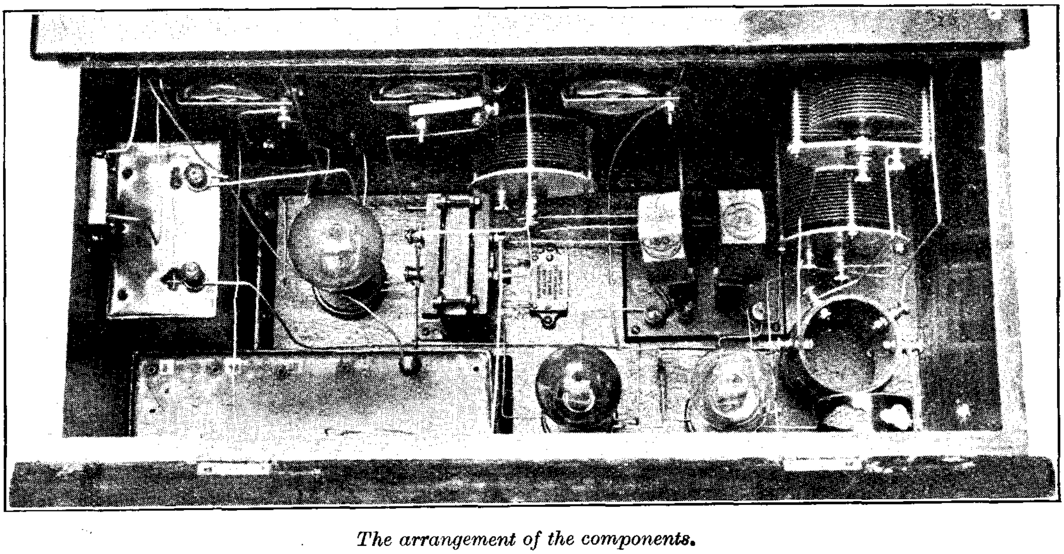
The double pole switch is for disconnecting the H.T. and L.T. batteries. The latter is a 4·5 volt dry cell with a resistance wire lead to somewhat drop the potential. Bare tinned copper wire is used for connecting up.

At 20 miles from **2 LO**, using a single-wire aerial 80 ft. long and 30 ft. average height, **2 LO** is comfortable loud speaker strength. The filament of the H.F. amplifier can be turned right out with little detriment to the signal strength, showing that H.F. amplification is scarcely required at the distance, while the capacity present in the valve is quite sufficient to carry the oscillations to the detector valve. With the H.F. valve functioning **2 LO** is received quite well on the loud speaker with a 1 ft. 6 ins. frame, while **5 IT**, **6 BM** and **5 SC** can be heard although rather weakly. Using the outdoor aerial **6 BM**, **5 NO** and **5 IT** and occasionally **5 SC** are sufficiently loud to work the loud speaker, while any of the other stations can be heard in the 'phones. Ecole Supérieure and Radio Electrique of Brussels are also of loud speaker strength. The wave-trap functions very well although the set is sufficiently selective to work on **5 IT** and **2 BD** without interference from **2 LO**. In this case the wave-trap can be used to cut out some of the spark-jamming which is very prevalent on the higher broadcast wavelengths.

H.C.



Circuit of simple three-valve receiver with wave trap.



The arrangement of the components.

THE DEVELOPMENT OF SIMULTANEOUS BROADCASTING.

By E. K. SANDEMAN, B.Sc.

(Continued from page 229 of previous issue.)

The Preliminary Experiments.

As explained above, in the first set-up employed, the 40-watt amplifier of the large type Public Address System was employed in association with the speech input amplifier and microphone also employed with the system. (The microphone is of the same type that is employed for broadcast purposes.) The circuit diagram for the speech input amplifier was shown in Fig. 1, while that for the high power amplifier is given in Fig. 3.

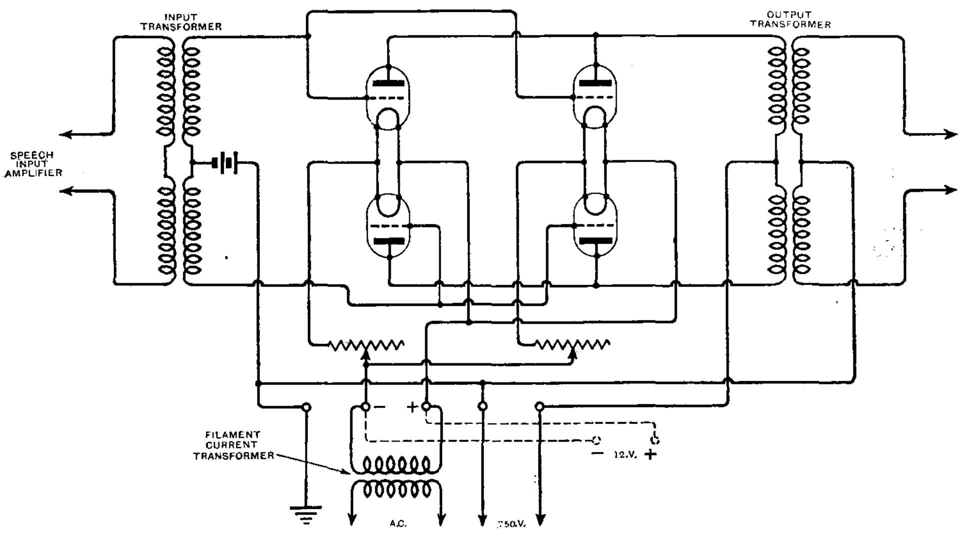


Fig. 3. Power amplifier in which the potential output from the transformer is divided between two pairs of valves.

These are only of passing interest in this narrative since they were dispensed with after the second test as it was possible to operate with less power.

At the second test break jacks were inserted in each line and the approximate value of the output current measured by means of a thermocouple inserted in series with one of the lines, and used in conjunction with a milliammeter.

A thermocouple is a very useful instrument, depending on the fact that when the junction of two different metals is heated an E.M.F. is generated across the junction. It consists essentially of a small heating unit placed in series with the current to be measured and a small "couple" made of different metals which is metallically connected to the heater to ensure good heat conduction. The current to be measured is passed through the heating unit and the couple is connected to two terminals which are connected to a milliammeter.

This instrument gives a very convenient

method of measuring alternating currents of the order of 1 milliampere. Of course, as might be expected, since it is so sensitive, it burns out at very small values of current. The particular one used in this instance by the author burnt out at about 10 milliamperes.

The way in which it burnt out was as follows. The small size public address system amplifier was connected up to the several lines on a test made with the Post Office one afternoon, and the thermocouple was placed in one line for measuring the current. The microphone was placed in front of the author, who unfortunately happened to cough just after the gain of the amplifier had been increased at the request of the Post Office engineer, who was observing at the central test. The needle of the milliammeter flew across the scale and then went back to zero; the thermocouple having ended its useful life. As a thermocouple costs about five pounds, it was rather an expensive cough.

When the time came to use this method of measuring output power during hours of transmission, it was found that the radio frequency energy from the Marconi House aerial induced currents through the thermocouple of the same order as those we were trying to measure. This was at first believed to be due to direct current in the line, but after attempts to remove it with the aid of a large capacity series condenser had failed it was successfully removed by means of a simple radio filter. This is shown in Fig. 4.

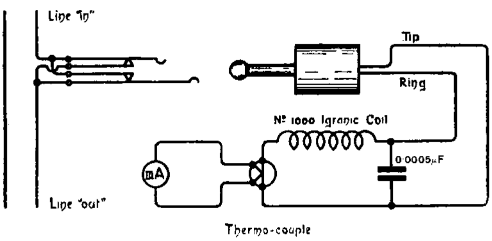


Fig. 4. Volume indicator measuring arrangement, including the radio filter circuit.

This filter having such comparatively small values of inductance and capacity has no appreciable effect on audio frequency currents, but effectively keeps out currents of radio frequency.

As mentioned above, owing to the fact that crosstalk was so large, the public address system amplifier was replaced by a bank of Western Electric loud speaker amplifiers operating with their inputs in parallel and their outputs connected on to each line. A series resistance was inserted in order to make the impedance matching correct.

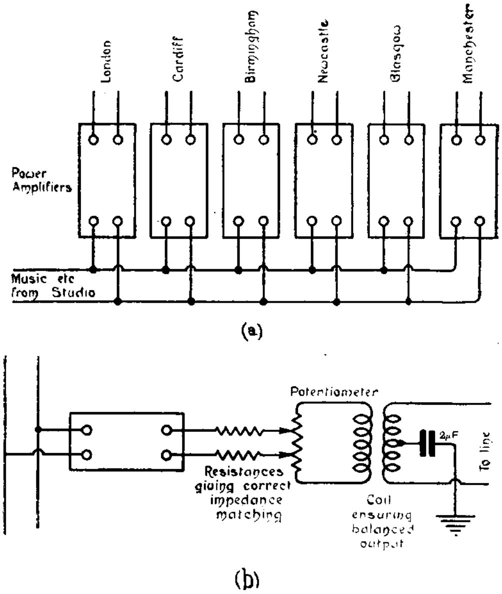


Fig. 5. (a) Final arrangement of amplifier.
(b) Output arrangement of each amplifier.

Since the output of the amplifiers was unbalanced it was necessary to insert a repeating coil between each amplifier, and its associated line; the middle point of the line side of the coil being connected to earth through a 1mfd. condenser. The final arrangement is indicated in Fig. 5.

The earth employed was simply the pipes of the heating system in Marconi House. With this arrangement and an average power output as measured on a thermocouple and a milliammeter of $\frac{1}{2}$ to 2 milliwatts with peak values rising to about 8 milliwatts, all crosstalk trouble was overcome.

After the successful elimination of crosstalk, the development of simultaneous broadcasting had completed its first stage, and at this point the British Broadcasting Company's engineers assumed full control.

A description of the development work in connection with simultaneous broadcasting would not be complete without some reference being made to the general helpfulness and co-operation which was experienced on all hands. The engineers of the British Post Office and the Marconi Company were both extremely anxious to do everything in their power for the furtherance of this project, while the engineers of the B.B.C. in their turn showed their appreciation of the nature of the problem by allowing those actually engaged a very free hand. The author would specially like to mention his indebtedness to Mr. Locke of the G.P.O. and Mr. Petersen of the Marconi Company.

A further development has already been indicated by the British Broadcasting Company on the occasion when they reproduced speech and music by land line from Paris. There is no technical reason why, in the future, it should not be possible for one individual situated anywhere in Europe to speak to the whole of England, or even to the whole of Europe.

Land line transmission in America has reached such a stage that speaking through 4,000 miles of line is already an accomplished fact, and there is no reason why even greater distances should not be covered if desired. In conjunction with this the progress of broadcasting has been so rapid that it seems highly probable that in another few years all countries in Europe will have a broadcasting service.

The only difficulty which would then be in the way of London being S.B. Europe would be the necessity of making agreements with so many Telephone Administrations and the finding of suitable routes for linking up.

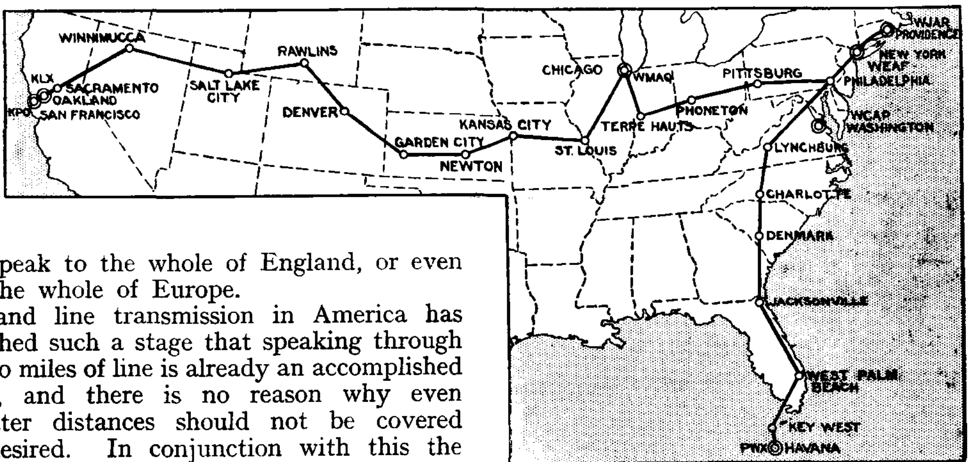
It is, however, conceivable that in the future the planning of lines of communication in Europe will be on an international basis, and will not be governed merely by local industrial and military considerations.

In such cases the possibility of one man talking to a continent is not unreasonable; as is mentioned under, successful operations on such a scale have already taken place in America.

The vista of possibilities opened by a consideration of the future effect of such a facility is enormous. It is conceivable that by its means international relations will be improved, and even wars averted owing to the mutual sympathy engendered by the direct intercourse of the leading minds in each nation with the populaces of neighbouring nations.

Simultaneous Broadcasting in Other Countries.

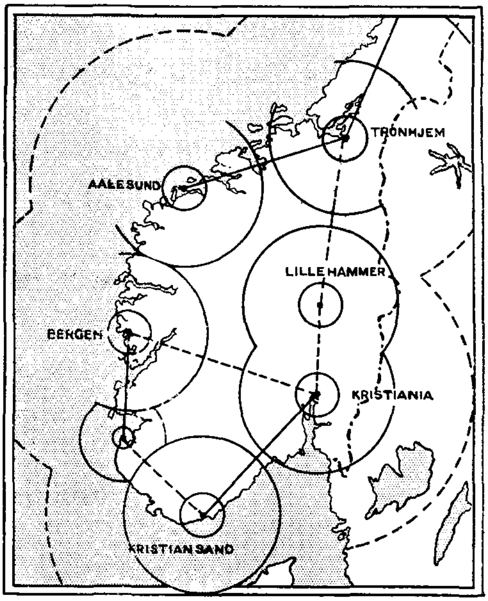
Up to the present the only other country which has actually attempted simultaneous broadcasting on a scale to be compared in extensiveness with that in England is the United States of America. Here it has



[By Courtesy The Western Electric Co. and *New York Times*.]

Fig. 6. Trans-continental radio and telephone chain.

been possible on occasion to operate on a far larger scale than in England. The sketch map shown in Fig. 6 gives the layout of an S.B. scheme which was successfully operated on Friday, February 8th, 1924, On this occasion a talk on the development in this comparatively new field was delivered by Vice-President and Chief of the research department of the Bell Telephone System,



[By Courtesy The Western Electric Co. and *Morgenbladet Kristiania.*]

Fig. 7. Proposed S.B. scheme for Norway.

speaking before a microphone in the Congress Hotel, Chicago. The speech was transmitted through telephone wires to stations **WJAR** in Providence, R.I., **WEAF** in New York; **WCAP** in Washington, D.C.; **WMAQ** in Chicago; **KLX** in California; **KTO** at San Francisco, and **PWX** at Havana, Cuba. 5,141 miles of telephone route were required for this purpose, while 22,000 miles of emergency line were held in readiness in case of breakdown.

The telephone link between Key West and Havana included 100 miles of submarine cable.

In addition to specially staged schemes like the above, a system of simultaneous broadcast is now established as a matter of regular routine but including stations not so widely set apart.

In Fig. 7 is shown a sketch map setting out particulars of a proposed S.B. scheme for Norway.

The stations are 500 watt sets, the innermost rings showing the expected limit of crystal reception, the middle rings the expected limit of three valve reception, and the outer rings the limit imposed by noise considerations, that is to say the point at which the ratio of atmospheric strength to signal strength becomes so large that proper appreciation of music and speech is difficult.

(*To be concluded.*)

NAGAOKA'S CORRECTION FACTOR K.

By E. J. HOBBS, M.C., Assoc. I.R.E.

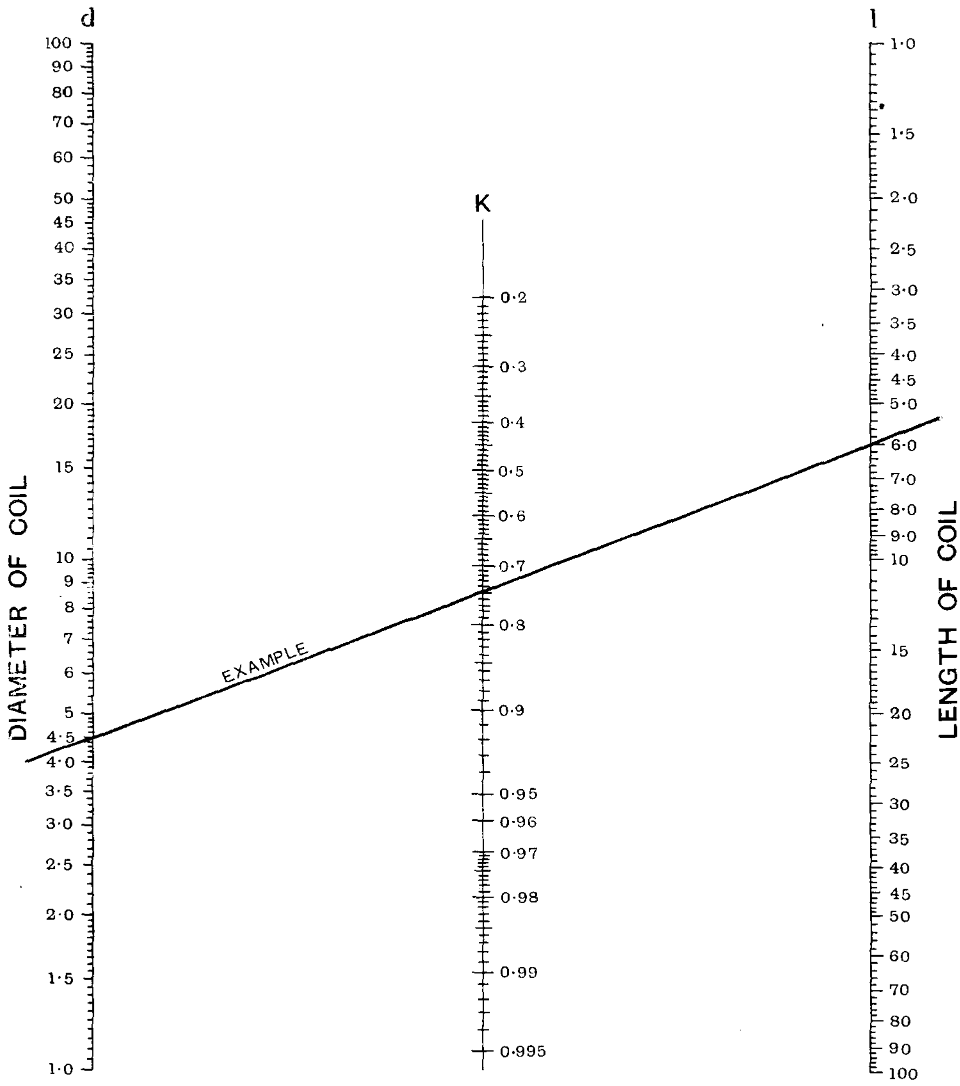
The accompanying nomogram has been specially designed by the writer to reduce the problem of finding Nagaoka's correction factor K to one of complete simplicity. It is also recommended as a good substitute for graph E, which appeared on page 575, *The Wireless World and Radio Review*, January 30th, 1924.

Three distinct advantages are claimed, viz.:—

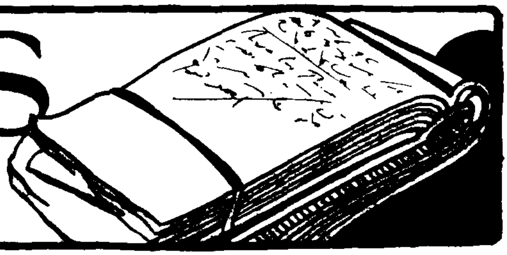
1. No calculation is necessary.
2. Almost unlimited range. As the correction factor for cylindrical coils depends upon the ratio $\frac{d}{l}$ of the winding, it is immaterial whether the dimensions are in inches or centimetres (provided, of course, both diameters and lengths are measured by the same unit). Hence, it is possible to ascertain the corrections necessary for coils whose diameters and lengths are as small as 0·1 centimetre or as large as 100 inches (nearly 3 yards).
3. Simplicity. If a straight-edge is placed across the nomogram so that it joins the outside scales at the points representing the diameter and length of the coil it will cross the centre scale at the correction factor K. In the

example the diameter is 4·5 cms., the length 6 cms., and the correction factor 0·75; if the dimensions were 4·5 ins and 6 ins. respectively, the correction would still be 0·75.

The values of K in this nomogram have been plotted from Table I, on pages 121 and 122, "The Calculation and Measurement of Inductance and Capacity," by W. H. Nottage (Wireless Press, Ltd.). As the correction scale is open and uneven from 0·9 upwards, a further subdivision has been made, although such extreme accuracy is unlikely to be required in general problems.



NOTES & CLUB NEWS



Proposals are being made for the erection of broadcasting stations at Great Yarmouth and in East Kent.

* * * *

The Union of Post Office Workers have issued a manifesto urging that British wireless should be undertaken by the State in the interests of national welfare and security.

* * * *

The German station, Nauen (**POZ**), now transmits time signals on 1,800 metres c.w., instead of on 1,300 metres. The times of transmission (noon and midnight) and the signal code (New International) remain unchanged.

* * * *

The League of American Pen Women have officially chosen **WGN**, the *Chicago Tribune*—Zenith broadcasting station, for weekly programmes of their talent.

* * * *

At the fiftieth anniversary of the City Temple, London, celebrated on May 9th, an overflow audience in the hall below the church heard the service by means of a loud speaker.

* * * *

American radio business during 1923 reached 50 million pounds sterling. Conservative estimates place the figure for 1924 at 80 millions.

* * * *

Argentine Amateur Heard in Britain.
A new record has been achieved by the reception of signals from an Argentine amateur by Mr. E. J. Simmonds (**G 2 OD**) and Mr. W. E. F. Corsham (**G 2 UV**).

At 5.5 a.m. (B.S.T.) on Wednesday, May 21st, Mr. Simmonds heard Argentine **CB 8** calling the American **1 XAM** (Mr. John Reinartz), and the following message was clearly received: "Argentine amateurs extend greetings to their Northern brothers. Braggio **CB 8.**" The report is corroborated in every respect by that of Mr. Corsham.

The occasion of this remarkable transmission, which took place on 125 metres, was the Pan-American Tests, during which two-way communication was carried on between the United States and South America. The approximate distance covered by the transmission from **CB 8** was 7,000 miles.

B.B.C.'s High Power Station.
The much-discussed high power broadcasting station now in process of erection at Chelmsford is likely to commence tests by the third week in June.

Transmissions will at first be of a purely experimental nature on a wavelength of 1,600 metres.

Irish Association's New President.
Mr. G. Marshall Harris, M.A., M.I.E.E., General Manager of the Dublin United Tramways Co., Ltd., has been elected President of the Radio Association of Ireland in succession to the late Professor W. J. Lyons.

Mr. Harris is a keen experimenter and under his presidency the Association should continue to progress rapidly.

Liverpool's Relay Station.
The new Liverpool relay Broadcasting stations, opening on June 1st, will be under the direction of Mr. H. Cecil Palmer. The station is located at Milner's Safe Works, Smithdown Lane, and the offices and studio are in Lord Street. The aerial is suspended from the 200 ft. chimney stack of Messrs. Milner's works.

Teutonic Broadcasting Zeal.
Rapid developments are taking place in German broadcasting and in the course of a few days new stations are to be opened at Konigsburg, Breslau, Hamburg, Stuttgart and Leipsic.

It is understood that these stations are of low power, intended for local requirements.

French Amateur Heard in Brazil.
M. Léon Deloy (**8 AB**), the well-known French transmitter, has received notification from an amateur in Rio de Janeiro that his signals on 108 metres have frequently been heard in Brazil. The signals come in very strong, it is stated, with a two-valve receiver (o—v—1).

The distance covered is approximately 5,000 miles, and M. Deloy is probably the first European amateur to be heard in South America.

Swedish SALD.
Enquiries have been received from several readers concerning the identity of a Swedish amateur transmitter with the call sign **SALD.** For the following details of the station we are indebted to Mr. W. D. Keiller, of New Southgate, London, N.11, who heard **SALD** working on May 11th, and wrote for particulars.

The owner is Dr. G. Alb. Nilsson, Skolgatan 5, Lund, Sweden. Describing his equipment he writes: "My transmitter consists of 1—4 French "R" receiving valves with about 250 volts H.T. from receiving anode batteries. Antenna current approximates to 0·25 amperes at 180-200 metres, using all four valves with 4·5 volts on the filament."

Dr. Nilsson hopes to improve his transmitter in the near future and in the meantime would be glad to receive reports or to arrange tests.

Misuse of Call Signs.
Mr. W. S. Ritchie, Hon. Secretary of the Downside School Wireless Society, of Stratton-on-the-Fosse, near Bath, reports that the call signs **2 XM** and **2 XN,** allotted to the Society, are being misused in other quarters. Many reports of reception have been received, particularly from the London area, which do not coincide with periods of transmission. A similar report has also been received from Newark, Notts. Any information which may lead to the discovery of the offender will be welcomed.

Wireless Operator's Fortitude.
The traditional heroism of the wireless operator was again demonstrated recently at the Anholt Lighthouse, in the middle of the Cattegat.

The air pump connected with the syren suddenly blew out, seriously injuring the wireless operator and cook, and inflicting severe damage on the lighthouse.

Although suffering acute pain and being nearly blinded, the operator managed to crawl to his instruments and send out an S.O.S. which was picked up by the naval authorities on the Jutland Coast. Two hydroplanes rescued the men, who though alive, will suffer permanent disablement.

Broadcasting Improvements at Sheffield.
Sheffield listeners, who, until recently, were complaining of low power and poor transmissions from the local relay broadcasting station, are now expressing satisfaction at the improvements which have been effected during the present month.

The original 100-watt transmitter has been replaced by one of 200 watts, and as a result of experiments by B.B.C. engineers, the aerial current has been increased from 1 to 3 amperes.

On the morning following the alterations 596 postcards and 175 letters were received at the station in praise of reception in the neighbourhood. The programmes have also been heard at Bakewell and Doncaster on crystal sets.

Transatlantic Reception Records.
During the past five months Mr. S. K. Lewer, of N.W. London, has logged 532 American amateurs and broadcasting stations, using a two-valve (o—v—1) receiver. On April 13th, 73 amateurs and 7 broadcasting stations were heard in 2½ hours.

Unidentified Transmission.
Whilst endeavouring to pick up American telephony in the early mornings of May 9th and 10th, Mr. R. C. Blagg, of Petersfield, Hants, was hampered by a Morse station transmitting repeatedly: "VALRY, South Africa Test."

He would be glad of information regarding the identity of this station.

Wanted: A Correspondent.
An American reader, Mr. Leon Mears, 4511, Colfax Ave. South, Minneapolis, Minnesota, would be glad to carry on correspondence with a British amateur. Mr. Mears' call sign is **U 9 BF 1.**

British Broadcast Reception in Sweden.
A correspondent at Hultom, Sweden, reports that all the British broadcasting stations are plainly heard in his locality. Signals are strongest from Aberdeen, Newcastle, Bournemouth and Glasgow. With a three-valve receiver (o—v—2) the British stations can sometimes be heard louder than Stockholm.

A Lonely Wireless Post.

Willis Island, which is about half-way between Brisbane and the region of Papua and the Solomon Islands, has been equipped by the Australian Government with a wireless station and meteorological lookout post.

Situated in the centre of a hurricane area, Willis Island is merely a strip of rough grass land 468 yards long, fringed with a coral beach. Coral mixed with cement served to make the mortar in which the two 87-foot tubular masts are set, and for the foundations of the wireless hut and living quarters.

Two operators are in charge and in spite of their apparent isolation, are in wireless touch with the Australian station at Rabaul in New Guinea.

During the hurricane season the station reports its observations to the mainland every three hours, and the new service should prove of immense service to shipping in this treacherous region.

Broadcasting and Naval Wireless.

In the House of Commons on May 14th, Sir T. Bramsdon (L, Portsmouth Central), asked whether it was practicable to curtail naval wireless exercises between 8 p.m. and 10 p.m., to cause as little interference as possible to broadcast programmes during that period. In replying, Mr. Ammon stated that no wireless exercises are laid down in Admiralty Orders to be carried out between the hours mentioned. The attention of Commanders-in-Chief is being drawn to the desirability of reducing naval wireless signalling during these hours to a minimum.

Forthcoming Events.

WEDNESDAY, MAY 28th.

Radio Society of Great Britain. Ordinary General Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers. Lecture: "Wireless in British Military Aircraft up to August, 1914." By Major H. P. T. Lefroy.

THURSDAY, MAY 29th.

Hackney and District Radio Society. Surprise Night.

Ilford and District Radio Society. Annual General Meeting.

Blackpool and Fylde Wireless Society. Lecture: "Conversion of an Army Transmitting Set." By Mr. L. R. Blackburn.

FRIDAY, MAY 30th.

Leeds Radio Society. At 7.30 p.m. At Woodhouse Lane U.M. Schools. Lecture by Mr. A. M. Bage (President).

Radio Society of Highgate. At 8 p.m. Entertainment at the Highgate Literary and Scientific Institution, South Grove.

MONDAY, JUNE 2nd.

Hornsey and District Wireless Society. At Queen's Hotel, Broadway, Crouch End, N.8. Lecture: "Components in Wireless Receivers." By Messrs. Burndept, Ltd.

TUESDAY, JUNE 3rd.

Uxbridge and District Radio and Experimental Society. Lecture: "The Merits and Demerits of Certain Makes of Valves." By Mr. J. R. M. Day.

Radio Society of Highgate.*

On May 16th the Hon. Sec. announced that all arrangements had been made for the annual concert, which is to be held at the Literary and Scientific Institute, South Grove, Highgate, on May 30th. Mr. Yates, of the General Electric Company, then gave a lecture on "The Manufacture of 'Geco' Products," with special reference to Geco wireless apparatus. The lecturer gave useful advice on the choice of valves and mentioned some interesting details of valves shortly to be put on the market.

Hon. Sec., J. F. Stanley, B.Sc., A.C.G.I., 49 Cholmeley Park, Highgate, N.6.

*** The Southampton and District Radio Society.***

On Thursday evening, May 15th, Mr. F. R. Armstrong, of the General Radio Co., Ltd., gave a demonstration with the well-known G.R.C. apparatus. Using a high-frequency and detector valve unit to which was coupled a three-valve low-frequency amplifier, various broadcasting stations were received on the loud speaker.

Hon. Sec., Lt.-Col. M. D. Methven, O.B.E., 22 Shirley Avenue, Southampton.

Wimbledon Radio Society.*

On Friday, May 16th, Mr. C. E. P. Jones (**2 CA**), gave an instructive lecture on "Telephony Transmission." Mr. Jones first dealt with the formation of the carrier wave, illustrating with diagrams the various methods which are in common use, and then showed how the inaudible carrier wave is "modulated," in order that speech is heard in the telephones of a correctly tuned receiving station.

The Hon. Sec., P. G. West, 4 Ryfold Road, Wimbledon Park, S.W.19 ('Phone, Wimbledon 1832) will be pleased to answer enquiries concerning the activities of the Society.

North Middlesex Wireless Club.*

A feature of the evening's programme on May 14th was the fact that nearly thirty members contributed to it. Many knotty problems were debated, and the variety and scope of the questions asked proved that the Club is composed of real live experimenters. It would not be correct to say that every member's difficulty was solved, but each received a good airing and many valuable suggestions were put forward.

Those present welcomed the opportunity which such an informal meeting gives of getting into closer touch with other experimenters, and it was generally agreed that more information could be gained in this way than from some set lectures.

Prospective members and those interested in the Club are asked to communicate with the Hon. Sec., H. A. Green 100 Pellatt Grove, Wood Green, N.22.

The Leicestershire Radio and Scientific Society.*

An interesting discussion was held on Tuesday, May 13th, on the various problems relating to reaction. It is satisfactory to note that the intensive use of this form of amplification is rapidly losing favour among discriminating experimenters in many cases, with a greatly increased purity of reception.

All communications regarding the society should be addressed to the Hon. Sec., Jos. W. Pallett, 111 Ruby Street, Leicester.

Hackney and District Radio Society.*

On May 15th, Mr. Van Colle ably described and demonstrated his five-valve experimental receiver. This set is capable of over 50 combinations, and the workmanship is of the highest order.

The Society accepted with regret the resignation of Mr. Harry Epton from the position of Chairman, which had been necessitated by lack of time. A hearty vote of thanks was accorded to Mr. Epton for his past work. Mr. Cunningham was then unanimously elected to fill the position, Mr. Epton being appointed Vice-Chairman.

Assistant Hon. Sec., Geo. E. Sandy, 70 Chisenhale Road, E.3.

Tottenham Wireless Society.*

At the monthly business meeting, held on May 7th, the resignation of the Hon. Secretary, Mr. S. G. Glyde, owing to pressure of business, was accepted with regret. Mr. A. G. Tucker, the Assistant Hon. Secretary, was unanimously elected to fill the post.

It has been decided to hold meetings in June, July and August on the first and third Wednesdays in the month only.

Hon. Sec., A. G. Tucker, 42 Drayton Road, Tottenham, N.17.

Hounslow and District Wireless Society.*

During the past month the Society has been very active.

On April 3rd Mr. R. K. J. Stevenson gave a most instructive lecture and practical demonstration on "Accumulators."

The evening of April 10th was well spent discussing various difficulties that the members had experienced during the past week.

On Thursday, May 17th, the members welcomed Prof. A. M. Low, who delivered his very popular lecture entitled "Television." Prof. Low also gave a very interesting discourse on "Sound and Wireless," which was followed by a lively discussion.

Mr. P. R. Coursey, Hon. Secretary of the Radio Society of Great Britain, visited the Society on the 24th and delighted the members with a very interesting lantern lecture on "Condensers." Mr. Coursey described in detail the manufacture and use of condensers of all kinds and of all sizes. Nearly one hundred slides were shown on the screen, illustrating the processes of manufacture at the well-known Dubilier Condenser Works at Shepherd's Bush.

The committee of the above Society have decided to continue holding the weekly meetings during the coming summer months, and a very interesting programme has been prepared. Intending members should write for particulars of membership to the Hon. Sec., Arthur J. Myland, 219 Hanworth Road, Hounslow, or make a personal application at the Council House, Treaty Road, Hounslow any Thursday evening during the hours of 8 and 10.

Dulwich and District Wireless and Experimental Association.

"A Wireless Pot Pourri" was the title of a lecture given by Mr. F. Bartlett on May 5th. The lecture consisted of five-minute talks on the Bellini Direction Finder, choke and grid control transmitter, receiving circuits using L.T. for filament and anode voltage, and other subjects of general wireless interest. Mr. Bartlett's versatile treatment of all the subjects touched upon delighted his audience.

During the summer session, which has now commenced, meetings are held on the first Monday of each month. Prospective members are cordially requested to communicate with the Hon. Sec., Harrie King, 2 Henslowe Road, East Dulwich, S.E.22.

Wrexham and District Wireless Society.

This Society, which was formed in September last, has just concluded a successful winter session. During the summer, meetings will be held on the first Thursday in each month.

At present experiments are being carried out in underground reception and communications from other Societies who have carried out similar work would be welcomed by the Hon. Sec., John Davies, Maesgwyn Cottage, Maesgwyn Road, Wrexham.

Radio Association of Ireland.

At a general meeting of the Association held in Dublin on May 1st, Mr. G. Marshall Harris, M.A., M.I.E.E., General Manager of the Dublin United Tramways Co., Ltd., was unanimously elected President in succession to the late Professor Lyons.

The Hon. Secretary read encouraging reports from the Waterford and Limerick branches.

Arrangements have been made for the supply of the Irish "Radio Journal," the official organ of the Association, to all members.

The persistent interference with broadcasting in the Dublin area, due to oscillating sets, was discussed at the meeting, and it was agreed that the Hon. Secretary should request members to undertake the formation of branches in accordance with the revised rules, with a view to improving the amenities of broadcasting round Dublin.

Hon. Sec., J. P. Murphy, 3 Molesworth Street, Dublin.

Lincoln Wireless Society.

A lively debate was held at the Lincoln Technical School on May 15th, the subject being "Dull Emitters *v.* Bright Emitters."

At the conclusion a vote was put to the meeting which resulted in an almost unanimous decision in favour of dull emitters.

Hon. Sec., J. T. James, 126 West Parade, Lincoln.

Dublin College of Science Radio Society.

Over sixty members were present at a general meeting held on May 13th, presided over by Professor Hackett.

Mr. O'Callaghan delivered his second lecture on "The Thermionic Valve," dealing with both the two and three-electrode types. An instructive experiment with two mirror galvanometers was used to show how the plate current varied with the grid voltage. The equations for the curves of the valve were next investigated and the amplification factor obtained.

After an interesting discussion, several members availed themselves of the apparatus available to obtain the value of the amplification factor for their own valves.

Hon. Sec., F. R. A. McCormack, College of Science for Ireland, Upper Merrion Street, Dublin.

BROADCASTING.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS :—

GREAT BRITAIN.

ABERDEEN, 2 BD, 495 metres; **BIRMINGHAM 5 IT,** 475 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 2 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 353 metres; **PLYMOUTH 5 PY** (Relay), 330 metres; **EDINBURGH 2 EH** (Relay), 325 metres; **SHEFFIELD** (Relay), 303 metres. Tuesdays, Thursdays and Fridays, 1 p.m. to 2 p.m. (**2 LO** only). Regular daily programmes, 3.30 to 4.30 p.m., 5 to 10.30 p.m. Sundays, 3 to 5 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), FL, 2,600 metres. 7.40 a.m. Weather Forecasts, 11.0 a.m. (Sunday); 12.0 noon, Market Report; 12.15 to 12.30 (Weekdays), Time Signal and Weather Forecast; 3.40 p.m., Financial Reports; 5.30 p.m., Bourse Closing Prices; 6.15 p.m., Concert; 8.0 p.m., Weather Report; 9.0 p.m. (Wednesday and Sunday), Concert; 10.10 p.m., Weather Forecast.

PARIS (Radiola), SFR, 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.30 p.m., Exchange Prices; 4.30 p.m., Financial Report; 5.0 p.m., Concert; 8.30 p.m., News and Concert.

PARIS (Ecole Superieure des Postes et Telegraphes), 450 metres. 3.45 p.m. (Wednesday), Talk on History; 8.0 p.m. (Tuesday), English Lesson; 8.30 p.m., Concert; 9.0 p.m., Relayed Concert or Play.

PARIS (Station du Petit Parisien), 340 metres. 8.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2 p.m. and 6.50 p.m., Meteorological Forecast.

BRUSSELS ("Radio Electrique"), 250 metres. Daily, 6 p.m. and 9.30 p.m., Concert.

HOLLAND.

THE HAGUE. PCGG 1,070 metres. 4 to 6 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres. 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9 p.m. (Thursday), Concert.

THE HAGUE (Velthuisen), PCKK, 1,050 metres, 9.40 to 10.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday, 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9 a.m. and 5 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m. (weekdays), 8 to 9 (Sunday), Concert.

SWEDEN.

STOCKHOLM (Telegrafverket), 440 metres. Monday, Wednesday and Saturday, 7 to 9 p.m. Sunday, 11 to 12 a.m.

STOCKHOLM (Radiobolaget), 470 metres, Tuesday and Thursday, 7 to 9 p.m. Sunday, 6 to 8 p.m.

GOTHENBURG (Nya Varvet), 700 metres. Wednesday, 7 to 8 p.m.

BODEN, 2,500 metres. 6.0 to 7.0 p.m., Concert.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,370 metres (Sunday), 10.40 a.m. to 11.45 a.m., Orchestral Concert. 4,000 metres, 7 to 8 a.m., Music and Speech; 12.30 to 1.30 p.m., Music and Speech; 5.0 to 5.30 p.m., News.

EBERSWALDE, 2,930 metres. Daily, 1 to 2 p.m., Address and Concert; 6 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 400 metres. 11 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7 p.m., Concert; 7 to 8 p.m. (Sunday), Concert.

BERLIN (Telefunken), 425 metres. 7.30 to 8 p.m. and 8.45 to 9.30 p.m., Tests and Concert.

BERLIN (Funkstunde A.G.), 726 metres.

FRANKFURT AM MAIN, 460 metres. 7.30 to 10 p.m. Tests Gramophone records.

LEIPZIG (Mitteldeutsche Rundfunk A.G.), 450 metres.

MUNCHEN (Die Deutsche Stunde in Bayern), 486 metres.

AUSTRIA.

VIENNA (Radio-Hekaphon), 600 metres.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres. 8 a.m., 12 a.m. and 4 p.m., Meteorological Bulletin and News; 4,500 metres, 10 a.m., 3 p.m., and 10 p.m., Concert.

KBELY (near Prague), 1,150 metres. 7.15 p.m. and 10 p.m., Concert and News.

SWITZERLAND.

GENEVA, 1,100 metres (Weekdays). At 3.15 and 8 p.m., Concert or Lecture.

LAUSANNE, HB 2, 780 metres. Daily, 9.15 p.m., Concert and Address.

SPAIN.

MADRID, PTT, 400 to 700 metres. 6 to 8 p.m., Tests.

MADRID (Radio Iberica), 392 metres. Daily (except Thursdays and Sundays), 7 to 9 p.m. Thursdays and Sundays, 10 to 12 p.m., Concerts.

MADRID, 1,800 metres. Irregular.

CARTAGENA, EBX, 1,200 metres, 12.0 to 12.30 p.m., 5.0 to 5.30 p.m., Lectures and Concerts.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12 a.m. 1,800 metres, 4 p.m. and 8.30 p.m., Tests, Gramophone Records.

CORRESPONDENCE.

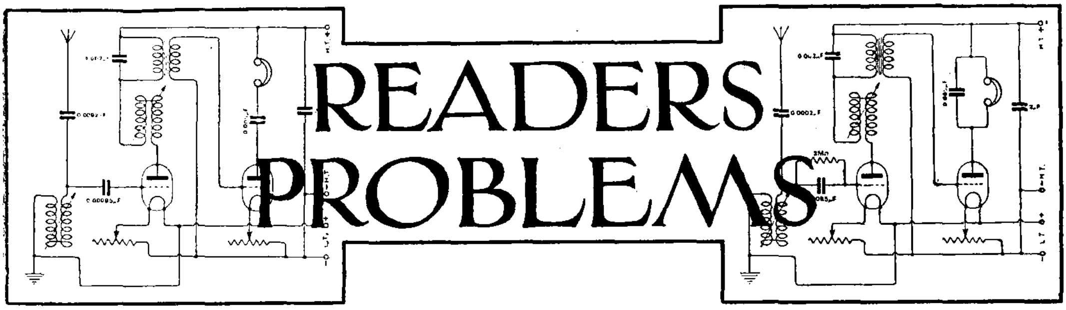
G 2 NM in Canada.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Just a line to let you know that I have succeeded in working with **2 NM** (Mr. G. Marcuse) when he was at Canadian **1 BQ**. I distinctly recognised his "fist" and later connected with **1 BQ** for the second time this week. We had a little chat and then **1 BQ** tried 'phone. I could easily recognise old **2 NM's** voice and caught a good deal of what he said though my receiver was only two valves at the time and QRN was bad.

W. R. BURNE.

Sale, Cheshire.



1. All questions are answered through the post. A selection of those of general interest is published. 2. Not more than four questions may be sent in at any one time. 3. Every question should be accompanied by a postal order for **1/-**, *or* **3/6** *for four questions, and by a coupon taken from the current issue. 4. A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

" *A.H.S.*" (*London, N.*19) **is using dull emitter valves in his receiver, and finds after making adjustments with the filament resistance that the set will not function properly.**

It is possible that the normal filament current required by the valve has been accidentally exceeded while making the adjustments with the filament resistance, and that the filament of the valve has been rendered temporarily inactive. The filament should be heated at the normal temperature for a short period with the H.T. battery disconnected. The valve will then function normally when the H.T. battery is again connected to the receiver. It is a good plan to insert a fixed resistance in series with the variable filament resistance. The value of this fixed resistance should be such that the current passed when the variable resistance is all out is not in excess of the filament current specified by the makers.

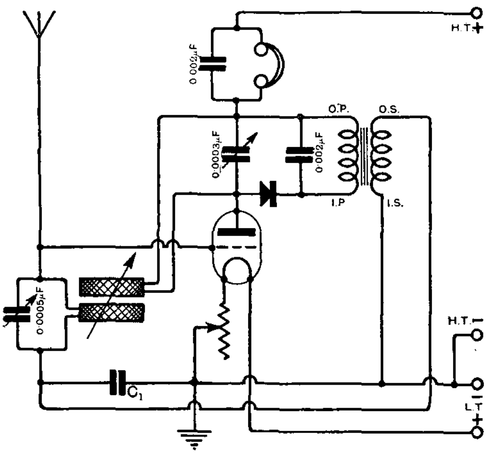


Fig. 1. " *DON BEER* " (*Southall*). *A single valve and crystal reflex receiver.*

" *DON BEER* " (*Southall*) **asks for a circuit diagram of a simple and efficient single valve dual amplification receiver.**

The diagram is given in Fig. 1. The aerial and plate circuits are tuned by plug-in coils and variable condensers, the plug-in coils being mounted together in a two-coil holder in order to obtain reaction effects. The reaction coupling must be adjusted with caution in order to minimise as far as possible radiation due to oscillation of the receiver. The amplified H.F. currents in the anode circuit are rectified by means of a crystal receiver and passed through the primary winding of an intervalve transformer. The secondary winding of this transformer is connected between − L.T. and the lower end of the aerial coil. The low frequency voltage variations from the detector circuit are therefore impressed upon the grid of the valve and are again amplified, passing through the comparatively low resistance of the anode coil to the telephones. It will be noticed that the negative side of the L.T. battery is earthed, as it is found that this connection often gives greater stability. The capacity of the condenser C_1 should be found by trial, as it often has a critical value. Capacities between 0·0001 and 0·005 may be tried. The earth wire may be taken from the lower end of the A.T.I. if desired.

" *R.A.A.*" (*Manchester*) **asks (1) How to prevent howling in a two-valve L.F. amplifier, and (2) How to determine the grid bias necessary for each L.F. valve.**

(1) In order to prevent howling, a large condenser should be connected across the H.T. battery, and fixed resistances of about 1 megohm should be connected across the secondary windings of the transformers. The grids of the L.F. valves should be connected to O.S. and the I.S. side of the secondary windings should be connected to − L.T. through the grid cells. The effect of reversing each of the primary windings should then be tried. (2) The correct grid bias required by each valve could be determined by reference to the characteristic curve of the valve, but it is generally better in practice to find the number of cells by trial.

" *F.D.C.*" (*Plymouth*) **has difficulty in preventing self-oscillation in his receiver and asks how this trouble may be eliminated.**

We recommend that you first of all try the effect of reversing the reaction coil connections, and if this is not effective, it would seem to indicate that the reaction coil is too large. It is also possible that the oscillation is being caused by stray coupling between the aerial and anode coils. These coils should be mounted at right angles and should be spaced as far apart as possible. The wiring of the receiver should be arranged so that the grid and plate leads are well separated and as short and direct as possible.

" *A.C.S.*" (*London, W.*13) **has fitted a potentiometer in a receiver using dull-emitter valves, and finds that the effect of adjusting the potentiometer slider is very small.**

If the dull emitter valves which you are using require a filament voltage of only two volts, it is possible that the potential available from the potentiometer may not be sufficient to provide an adequate control of the H.F. valve grids. Under these conditions it will be necessary to connect one or more grid cells in the lead from the potentiometer slider.

" *C.J.V.*" (*Northwood*) **asks questions about the adjustment of a Weston relay.**

The amplitude of movement which the coil is allowed at present is excessive, and the contacts should be screwed in towards each other until they are about 1 millimetre apart. The damping which you observe in the movement of the coil is not due to friction of the bearings, but to eddy currents induced in the metal former upon which the coil is wound. This former is designed so that its resistance renders the instrument "dead-beat." The only method of eliminating this damping would be to rewind the moving coil on a non-conducting former but owing to the very small clearance allowed in this instrument, the work could probably be done only by a professional instrument maker.

" *W.M.*" (*Chesterfield*) **is using a four-valve receiver (1-v-2) with which he would like to operate a loud speaker, but is able to receive only with the use of telephones.**

The combination of valves which you are using at present should give the results which you require. One stage of H.F. amplification is usually sufficient to bring in all the B.B.C. stations when used in conjunction with a good outdoor aerial, and the fact that you are able to receive these stations on telephones is a sufficient indication that no further stages of H.F. amplification are necessary. We recommend that you pay particular attention to the low frequency valves. It seems probable that you would be able to improve signal strength by increasing the H.T. voltage to these valves, at the same time applying a suitable negative bias to the grid. A power valve of the L.S.3 or L.S.5 type might be used in the last L.F. stage.

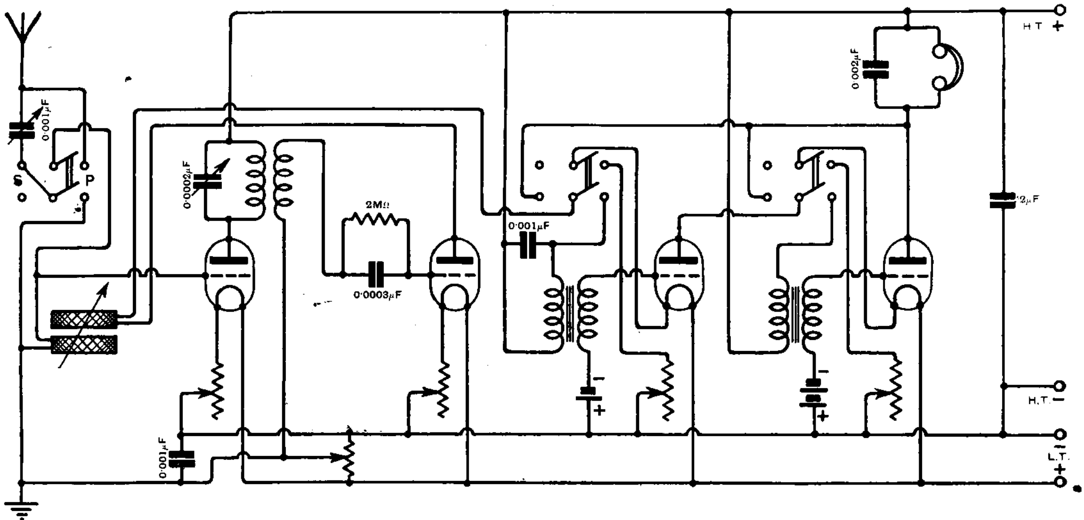


Fig. 2. " A.W.T." (Huddersfield). A four-valve receiver employing transformer coupling between the H.F. and detector valves, and transformer coupled note magnifiers.

" *A.W.T.*" (*Huddersfield*) **asks for a diagram of a four-valve receiver (1-V-2) in which the H.F. and detector valves are transformer coupled.**

The diagram is given in Fig. 2. Switches are provided to control the number of L.F. valves in use. As no provision is made for switching the H.F. valve in your circuit, it will not be necessary to provide a reversing switch for the reaction coil. The grids of the H.F. and detector valves are controlled by means of a potentiometer, while a suitable negative bias is provided by grid cells in the case of the L.F. valves. The aerial tuning condenser is provided with a series parallel switch.

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