The WIRELESS WORLD

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 17. NOVEMBER 13TH, 1920 FORTNIGHTLY

NATURAL WIRELESS AERIALS

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

SOME short while ago considerable interest was aroused by an announcement from America to the effect that during the war it had been found possible to employ ordinary trees as aerials for the reception of wireless signals. Further details of the methods used have since become available.

The moist parts of a tree constitute an electrical conductor—one of high resistance, it is true, but, nevertheless, one in which e.m.f.'s may be set up, and in which currents may flow In an earlier article in this series, on the subject of "Indoor Aerials," it was pointed out that almost any conductor possessing capacity to earth might be used to form a wireless receiving aerial. From this it follows that whether or not we employ such conductors as aerials, e.m.f.'s must be set up in them by every electro-magnetic wave in their vicinity—e.m.f.'s which simply require detecting by some appropriate means to render apparent their existence. As a logical deduction from these remarks we may infer that since the interior parts of trees are more or less conductive, passing electro-magnetic waves should set up e.m.f.'s and currents in them.

This, then, constitutes the germ of the idea of using trees as receiving antennæ, the presence of the waves and signals

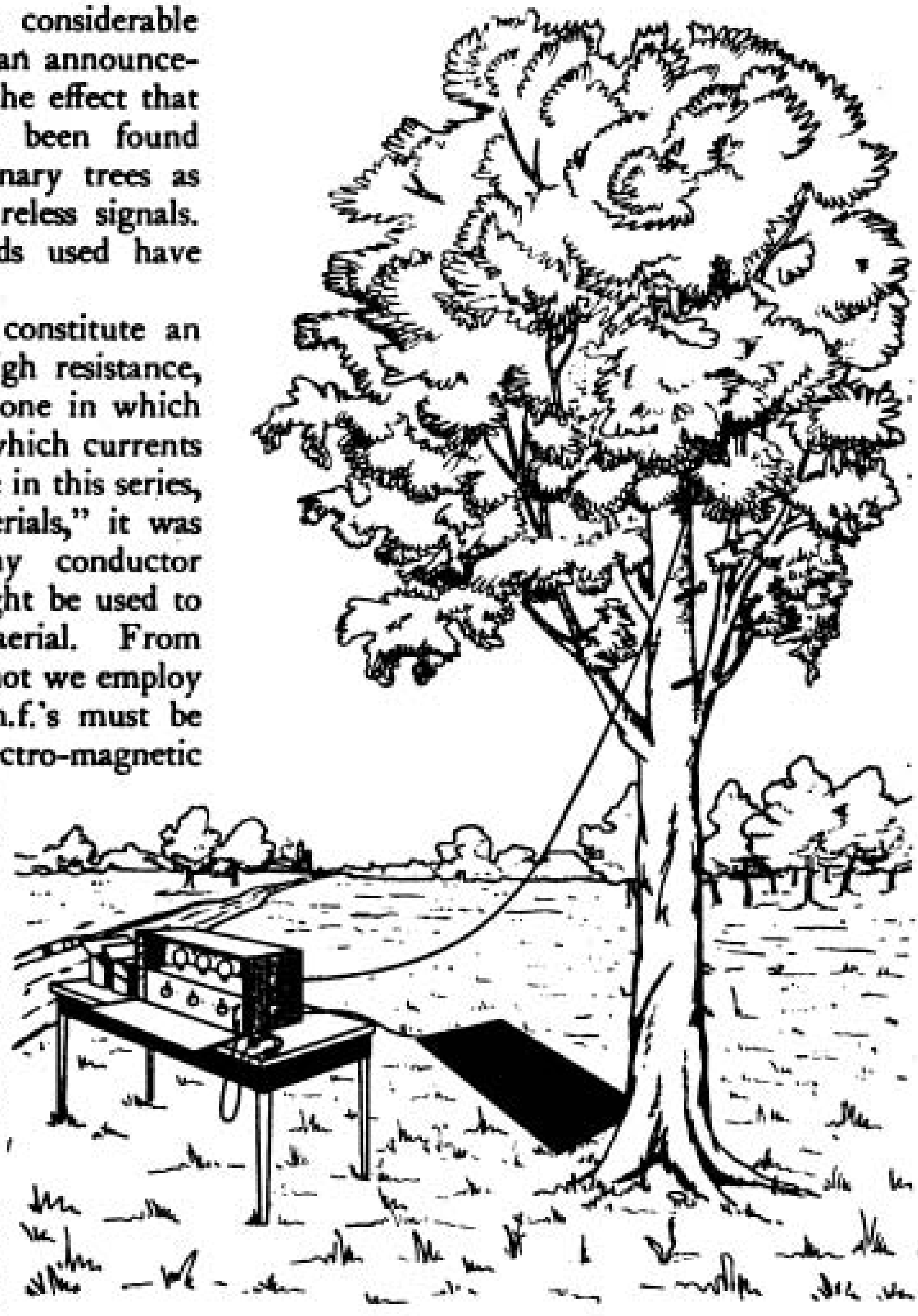


Fig. 1.

being brought to light by the application of suitable detecting apparatus to the parts of the tree itself. If oscillations occur in the conducting interior of the tree it should be sufficient to make connection to two parts of the tree—such as points near the top and bottom—between which an electrical potential difference may be set up. The connection of these two points to appropriate radio receiving apparatus, which may be tuned to the wavelength of the signals to be received, should suffice to enable them to be detected, since the act of tuning-up the receiver would reduce the effective impedance of the shunt path through it to a lower value than the resistance to earth of the interior parts of the tree.

A sufficiently good connection can easily be obtained by driving, some two or three inches into the tree at an appropriate height, a nail—preferably made of copper—to which the wire from the receiving apparatus may be connected. As a result of extensive experiments carried out by the U.S. Signal Corps, it was ascertained that for the most effective arrangement the connection from the receiver to the tree should be made at some point within the area of what would ordinarily be termed the "top," while the second terminal of the receiver should not be connected to a nail driven into the lower parts of the tree near its roots, but to some wire netting spread out on the ground, or to a series of wires buried in the earth around the tree and forming, therefore, an ordinary type of ground connection (Fig. 1).

This being the case, it is evident that the tree is then being used as an aerial much in the ordinary way, by virtue of the capacity of its parts to earth. It differs from the usual antennæ, however, in that its insulation resistance to earth is very poor, since its roots effectively connect the lower end of the tree to ground. Electrically speaking then, the tree and the ordinary antenna may be compared by noting that in the latter the receiver is joined in series, while in the former it is in shunt to the antenna. Obviously, for the second case, if the point of connection to the tree is too low down the majority of the current will flow directly to earth, instead of through the receiver, so that practically no signals will be received. This effect is shown up by the curves in Fig. 2, giving the observed audibilities of signals when the connection was made at various heights.

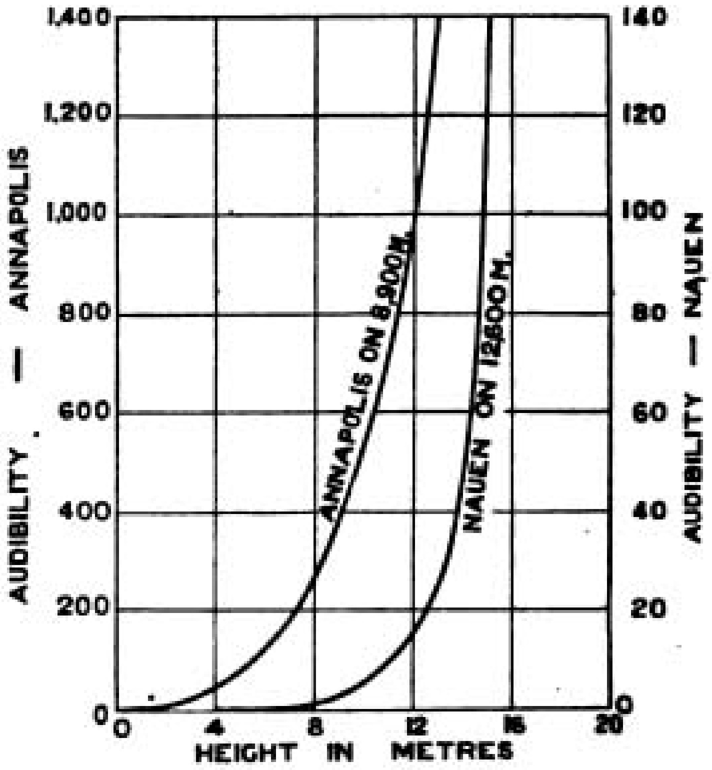


Fig. 2.

Audibility Curves for large Poplar Tree antenna using Heterodyne Receiver with two stage Amplifier.

From an examination of the test curves that have been published giving the results obtained by the U.S. Signal Corps, it does not seem quite obvious to what extent the tree contributes usefully to the reception, since evidently the wire connection from the tree to the instruments forms a by no means negligible aerial, which, moreover, can be better insulated when not connected to the tree. It is not without the bounds of possibility that, in many cases, the leakage loss, when using the tree, might overbalance any gain arising from the additional aerial capacity thereby obtained.

AMATEUR CRYSTAL AND C.W. RECEIVING SETS

By W. E. D.

THE two sets described herein have been constructed by myself and are both working in a very satisfactory manner. Taking the older type of receiver, viz., the crystal set, this was made in 1913 and was brought into use just before the late war.

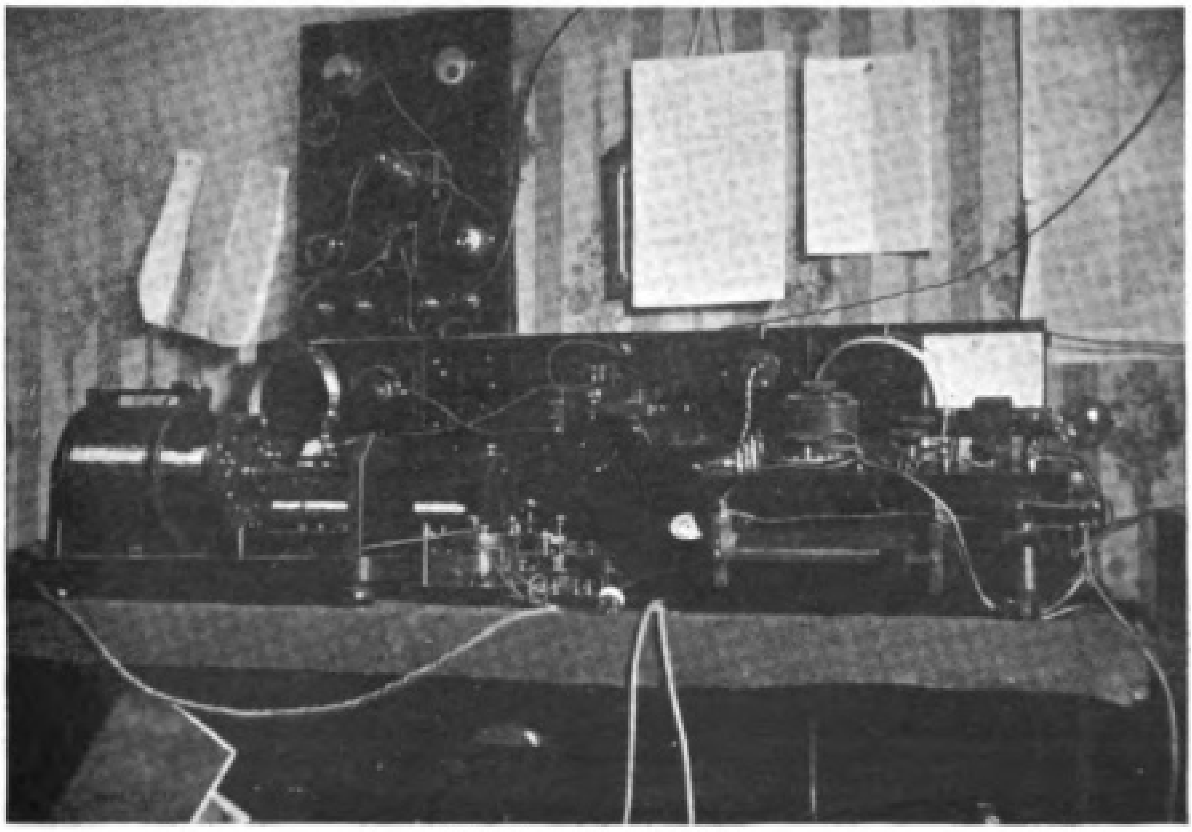
It consists of a tuning inductance 16 ins. long by 4 ins. in diameter, wound with 1 lb. of No. 24 enamelled wire, and is fitted with one slider. The loose-coupler, seen to the left of the photograph, consists of a primary 6 ins. in diameter by 5 ins. long, wound with No. 24 enamelled wire and also fitted with a slider. The secondary is 5 ins. in diameter by 5 ins. long, wound with No. 36 enamelled wire. The whole is mounted on a brass rod, the primary being screwed to an end board secured to a base.

The condenser across the secondary is of the rotary-vane type, and was made from particulars recorded in the *Wireless World*, of a pattern designed by the late Professor Duddell. It took some months to make, but it has never given out, and gives very good results. There is also a variable tube-condenser, made from two pieces of brass tubing separated by ebonite insulation, suitably mounted and joined in parallel, with one tuning inductance.

The blocking condenser is of tinfoil and paraffin-waxed paper, divided into three sections of ·0003 mfds., ·0002 mfds. and ·0005 mfds. respectively. The telephones are a pair of Messrs. Gamages and are 2,000 ohms each.

The whole set is fitted with the usual double-pole throw-over switch for putting the aerial to earth, and a buzzer is also provided for testing the detector. All terminals are fitted in ebonite, so that no possible leakage can take place.

Before giving a description of the C.W.



The two sets installed.

set perhaps it would be as well to give details of my aerial. This is of the inverted L type, and consists of two poles 38 ft. high, with two wires of No. 16 copper, fitted to insulated spreaders 6 ft. long. The over-all length, including the leading-in wire, just equals the prescribed length as laid down for amateurs. Two earths are used, one to the water main, and another to a plate 2 ft. in diameter buried in the earth to a depth of 2 ft.

When the war restrictions placed upon amateurs were removed, I decided to make a set capable of receiving C.W., and which would be self-contained in a box. Fortunately, I had the opportunity of seeing Mr. Stanley's volume on oscillation valves, etc., and selected therefrom a design from which to build. Being in possession of a small foot-lathe, and having a knowledge of tools, etc., the construction of the set was not difficult, though I must say that at the outset it seemed rather ambitious. The set consists of primary and secondary coils, each 4 in. by 5in., the formers being of well-dried cardboard, treated with shellac. The primary is wound with No. 24 D.S.C. wire, tapped off to 18 studs ; the secondary is wound with No. 30 D.S.C. wire, tapped off to 9 studs. There is also a reactance coil 2½ in. in diameter and wound with about 100 turns of No. 26 D.S.C. wire ; this is adjustable to any position in the secondary coil.

The valve is of the French type, and works well, off about 5 volts ; this is, of course, adjustable by means of the filament potentiometer. The latter is of the tubular pattern, and is about 6 ohms resistance ; the second potentiometer is also tubular in shape and of 300 ohms. Both wound with Eureka wire.

The valve-holder is of ebonite, shaped and drilled to take the brass tubing, which fits the pin-supports of the valves ; this is shown on the right of the photograph, and is fitted near the ebonite knob of the reactance coil. It will be seen that two condensers are used, one across the secondary coil, mounted on top of the box, and the other across the primary, which is inside the box, the adjusting knob being fitted through the

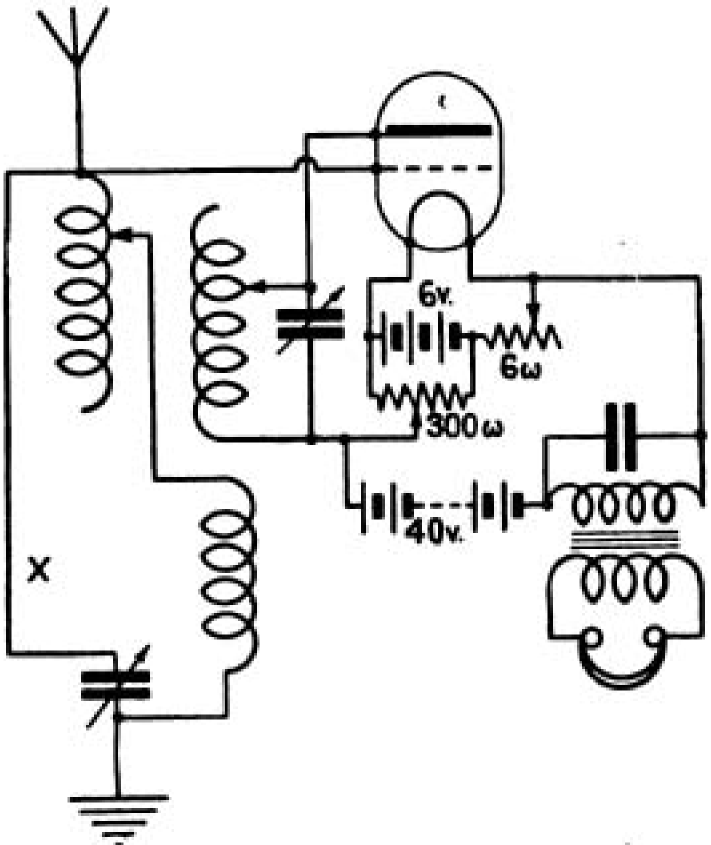


Diagram of Connections of Apparatus, X being modified to suit set.

ebonite top. These two condensers are designed from details given in articles in the *Wireless World*, as is also the telephone transformer, which is fitted on the bottom of the box in the left-hand side, with a ·0003 condenser across it. The two potentiometers are fitted in the front of the box, and the battery terminals, switch and fuse are fitted on the top. Thus, by releasing two or three external connections, the ebonite top can be lifted off the box, and the underside, with its coils and connections, can be easily examined.

WIRELESS SOCIETY OF LONDON.

The next meeting of the Society will take place on Nov. 18th, at 8.0 p.m., at the Royal Society of Arts, John Street, Adelphi, W.C.

NOTES AND NEWS

Scientific Appliances.—This firm of electricians, opticians and mechanicians have recently published a new illustrated catalogue obtainable at 11 and 29, Sicilian Avenue, Southampton Row, W.C.1. This little book gives full particulars regarding cells, wires, insulators, buzzers and other needs of the wireless amateur. A special section is devoted to wireless telegraphic and telephonic apparatus.

Amateur Call-signs.—The following additions should be made to the list of amateur call-signs, given in our issue of October 16th: **2 C Z**; Mr. C. T. Atkinson, Leicester. Hours of working (10 watts, spark), 11 a.m.—12 noon, 8—9 p.m. (G.M.T.), wavelengths 150 and 180 metres. **2 F N**; Mr. L. Baker, Ruddington, Notts. **2 A L** and **2 A M**; Marlborough College, O.T.C.

Devizes Wireless Station (G K U), operating on 2,200 metres C.W., is at present engaged in a six-hours' service at the following times: midnight—2 a.m., 8—10 a.m., 4—8 p.m. All times G.M.T.

Major-General Sir F. H. Sykes, C.B.E., K.C.B., Q.M.G., Controller of Civil Aviation, in his address on October 12th before the Air Conference, impressed upon aviation transport firms "the great importance, in the interests of safety and regularity, of every commercial machine being equipped with wireless," and quoted as an instance of the utility of such an equipment, the recent case in which an aeroplane with ten passengers aboard was able to ask, from the air, for landing lights, when forced to land at St. Inglevert after dark.

It is interesting in this connection to learn that nine of the aeroplanes engaged in commercial services between England and the Continent have already been equipped with the Marconi wireless telephone, and that others are now being similarly fitted.

Mr. A. A. Campbell Swinton, F.R.S., Chairman of the Council of the Royal Society of Arts and President of the Wireless Society of London, will deliver a lecture on "Wireless Telegraphy and Telephony" at the Royal Society of Arts, at 8 p.m. on November 17th. The lecture will be illustrated with experiments.

Scientific and Industrial Research.—The Committee of the Privy Council for Scientific and Industrial Research has just issued its fifth annual report, (CMD. 905 H.M. Stationery Office. Price 1*s.* net). The report states that the programme of the department can now be classified under four main heads, viz., the encouragement of the industrial research-worker; the organisation of national activities into co-operative research societies; the direction and co-ordination of research for national purposes, and the aiding of suitable researches undertaken by scientific and professional societies.

FL Weather Reports.—We are given to understand that as from November 1st at 0000 G.M.T, **F L** weather reports will be sent at the following times:—0245, 0815, 1130, 1415, 1930. The present programme of weather reports will be discontinued on the same day. These alterations have not yet been confirmed.

No. 1 (T.) Wireless School, R.A.F.—It is proposed to hold a reunion dinner for all ex-officers of the late No. 1 (T.) Wireless School, R.A.F., at the Holborn Restaurant, London, on Wednesday, December 1st. Tickets may be obtained from Flying Officer C. C. Bazell, Flowerdown, Winchester. price 12*s.* 6*d.*

The Amateur Position.—With the coming of the winter months and the reopening of the amateur wireless clubs, we are again able to review the position of the amateur in this country. As far as we are able to gather from our records there are in existence no fewer than 57 clubs, formed for the purpose of studying and practising wireless telegraphy and telephony. Of these clubs, 25 are affiliated with the Wireless Society of London. The total membership of these bodies would seem to be approximately 1,700, but since this figure is based upon information gleaned from old reports, our approximation must necessarily be short of the actual total. Many of these enthusiasts, together with some of their respective societies, are not only in possession of receiving apparatus, but have also at their disposal licensed apparatus for transmission. In response to a paragraph which appeared in our columns in a recent issue, information has reached us which reveals the fact that there are 16 stations, licensed to operate and transmit for experimental purposes, and though this figure would seem to be large, as compared with that of twelve months ago, there are still many more such stations of which we have no record.

Royal Aeronautical Society.—The Society has been informed by the Home Office that it is now authorised to adopt the use of the prefix "Royal" in the case of fellows and associated fellows. These members will, therefore, be entitled to use the letters F.R.Ae.S. and A.F.R.Ae.S. respectively after their names.

Diplomacy by Wireless.—According to the *Central News*, Sir Auckland Geddes and the Ambassadors of France, Italy and Japan, accompanied by Messrs. Colvy and Daniels, and the representatives of the International Communications Conference, recently left Washington for a tour of inspection of the wireless stations along the American Coast. The prospects are that wireless telegraphy and telephony will soon be inaugurated in the daily diplomatic communication.

Wireless Institute of N.S.W.—The N.S.W. founder of the Wireless Institute has been informed by the Director of Radio Service attached to the Navy Department, that it has been decided not to issue licences for the general and promiscuous transmission of wireless signals, but where transmission is necessary to aid scientific development, special permission can be obtained.

Meteorological Reports.—As from Oct. 6th, the synoptic reports issued by wireless telegraphy from the Air Ministry and Aberdeen will be as follows: Air Ministry **GFA.**, 1,400 metres wavelength, **C.W.** at 0205, 0805, 1405, 1905; Aberdeen **BYD.**, 3,300 metres wavelength, at 0230, 0830, 1430, 1930; the times being Greenwich Mean Time. The form of the reports and the codes will remain unaltered.

THE PROCEEDINGS OF THE WIRELESS SOCIETY OF LONDON

SOME PERSONAL EXPERIENCES IN CONNECTION WITH THE CONSTRUCTION AND ACTION OF A SIX-VALVE HIGH-FREQUENCY RESISTANCE AMPLIFIER

By M. Child.

(Continued from page 552.)

DISCUSSION

The President : This very interesting Paper is now open for discussion.

Mr. J. Scott-Taggart : There are one or two points in connection with this Paper which I think might be raised. In the first place, I do not altogether agree with the preliminary theory which was presented to us. The curves (Fig. 2) do not strike me as being particularly valuable, especially as there are no units shown on the anode curve; also, when the author came to the point in connection with the use of different values of resistance, he seemed to differentiate between high and low resistance for different classes of frequencies, and stated that a higher resistance could be used for longer waves. Since the resistance is not intended as a conductor of high-frequency current in any way, I fail to see that its value is very material; but, on the other hand, I consider that the higher the value the better, whether for long or short waves, and his values of 20,000 ohms. are considerably lower than those usually employed with the ES4 valve which I have designed. I find myself that a resistance of about 60,000 to 80,000 ohms. is usually more suitable. The important thing that counts, is not so much the value of the resistance, as the impedance which it offers to the high-frequency currents in the anode circuits. This impedance should be as high as possible. The resistance is not at all necessary.

We could use any form of inductance, provided its value is high; but since we are using a resistance, we must make the impedance effect as great as possible. The chief way of doing this is to eliminate any capacity which would act in parallel with the resistance, and so lessen its effective impedance. This can be done by lessening the capacity of the valve. The particular valves used in the described amplifier are not perhaps the best for high-frequency work, or at any rate for the higher frequencies. This is due to the capacities of the electrodes inside the valves themselves, and a valve of the RB30 or V24 type is likely to be more successful. On the other hand, if we desire to get the best results, *i.e.*, the greatest potential difference across the resistance in the anode-circuit, we should use a valve having a high internal resistance, *i.e.*, one having as large a spacing as possible, between the anode and filament. When, however, we increase this anode resistance, it is natural that the potential on the anodes will be decreased, so that we will necessarily need an anode battery of considerably greater size than would otherwise be required. Thus, if we have a battery of, say 100 volts when using a resistance amplifier, the actual voltage on the plates will be approximately half that value, viz., 50 volts, so that the greater the anode circuit resistance, the bigger will have to be the anode batteries, which, of course, is most inconvenient.

Another point in the Paper which struck me was the description of the use of the potentiometer. There is no actual reason given for the way in which it works, or the advantages we obtain with it. The chief advantage, in fact the only advantage, of having the potentiometer in the position shown by the author, is that it lessens the tendency of the amplifier to oscillate of its own accord. When we connect a potentiometer across the filament battery and its slider to the grids of the valves, any variation of the potentiometer will therefore always make the grids relatively positive to the negative end of the filament. Consequently, a grid-current will be established through the grid-leaks, causing a damping effect, and so lessening the tendency of the amplifier to oscillate.

There is one attendant disadvantage of doing this; since we are damping all the grid-circuits, incoming signals will not produce the same effect as if there were no damping, so if we desire to use the valves of the amplifier to the best advantage we will have to eliminate all damping in the grid-circuits. Not only will we not have to give them positive values by means of the potentiometer, but it will be desirable to give them negative values, and this may be done by connecting the potentiometer in rather a different position.

Suppose the valves of a high-frequency resistance amplifier are arranged as in Fig. A, in which, for simplicity only, three valves are shown. When using such an amplifier, the first thing that we require to do is to amplify the high-frequency currents which are applied to it from the receiver circuits L, C. When we have amplified these high-frequency currents, the next thing to do is to detect them, and this will usually be done in the last valve. In Fig. 5 in the Paper* no potential at all

*See page 547 of *Wireless World*, Oct. 30, 1920.

was applied to the grid of the first valve, consequently, when signals arrive, a certain amount of detection or rectification is bound to occur, and the grid-current set up will have a damping effect, which is undesirable.

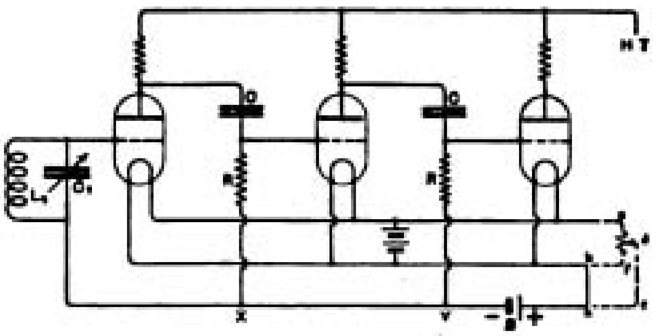


Fig. A.

If we desire to limit and decrease the damping effect in the grid-circuits, all we have to do is to give all the grids a negative potential, or at any rate, those grids of the valves which are acting purely as amplifiers, *i.e.*, the first five. This may be done by connecting all the grid-leaks to the potentiometer. R R are the grid-leaks of, perhaps, 2 megohms value each. If now we connect all these together (including the grid of the first valve), as at X Y, and connect a battery B—a single cell will do—with its positive terminal to the filament *via* **a b** (neglecting for the moment all the dotted lines), all the grids will be at negative potential. Hence, however, the grid potential, varied by the high-frequency currents, will never become positive and there will never be any damping in any of the first five valves. On the sixth valve, however, if we desire to use it as a detector, we leave out this battery and connect it either to the positive, or negative side of the accumulator, using preferably a grid-leak to obtain rectification. In addition to connecting the cell B, as described above, we can connect a potentiometer in order to vary the voltage of the grids, so as to operate all the valves at a suitable point on their characteristic curve by joining it across the filament battery as at **e f** and taking a tapping **d** on to it to replace the connection **a b**. We can therefore simply adapt the amplifier as described by connecting a grid-cell B in circuit with the grids of the first five valves.

There is still another point which I think might be explained a little further, and that is the values necessary for the coupling condensers between the different valves. The greater these capacities, the greater will be the low-frequency pulses which are transferred. In the amplifier as described in the Paper, the first valve undoubtedly acted as a detector, and probably all the other valves also acted to a certain extent as detectors; but if we arrange the circuits as shown in Fig. A we can limit the first five valves to a purely amplifying action, which is much more desirable. If, however, we use the circuit that was shown us to-night,* there is a certain amount of rectification and high-frequency amplification in each valve. That has a certain advantage, in that we can differentiate between strong and weak signals: strong signals will chiefly be rectified on the first valve, but weak signals will hardly be rectified at all.

Now, if the condenser—the grid-condenser or the coupling-condenser—is small, the rectified current will not be passed on to the next valve, since low-frequency pulses find it difficult to pass through a small capacity condenser, so that if we have all the condensers very small, the high-frequency potentials will be passed on, but not the rectified pulses which are due to the stronger signals. In this way, by using very small condensers, we can amplify the weak signals to a greater extent than the stronger signals. Instead of using condensers, perhaps members may be interested to know of other methods which have been used to prevent the high voltage of the high-tension battery from affecting the grids of the various valves. That, in fact, is the only reason why we used these coupling condensers. It is simply to prevent the potential drop across the anode-resistance being communicated to the grid of the next valve. There are therefore other methods which can be employed, two of which are indicated in Figs. B and C.

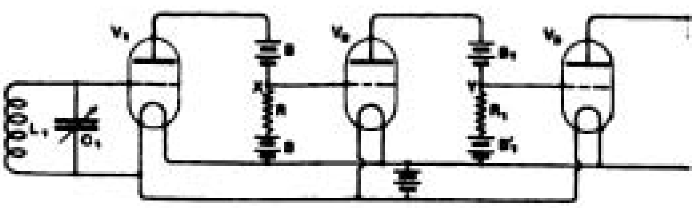


Fig. B.

If such an amplifier is required for amplifying direct-current, or direct-current potentials, the arrangement of Fig. A with coupling-condensers would be unsuitable, since the condensers would not pass on the potential variations. If we left them out, and simply connected the anode of each valve to the next grid, the grids would all be given a potential of about 50 volts. To avoid this we could connect an opposing battery in each grid-lead; but since it is very undesirable to use such batteries, we can employ the arrangement of Fig. B.

In this diagram the anode or plate battery is split into halves and resistances R R_1 are connected in series. The lower half of the anode battery is shown at B′ and B'_1. We can then connect the grids of the valves to the junctions. The potential

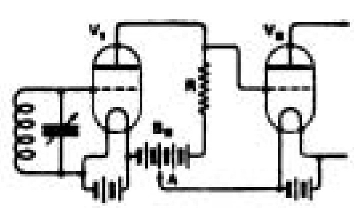


Fig. C.

drop across the resistances R and R_1 will tend to make the grids negative; but by splitting the anode battery into two, as shown, the points X and Y will be kept normally at zero potential.

*Fig. 5, page 547, *Wireless World*, 30 Oct., 1920.

Other methods are sometimes employed, such, for example, as that of Fig. C. In this arrangement, by adjusting the slider A, the potential across the grid and filament of the valve V_2 will remain zero, or in the neighbourhood of zero. This arrangement may not be particularly useful for high-frequency current amplification, but there are very many applications for valves coupled by resistances, and if any experimental work is to be done by members, these systems will probably be of use. In connection with the construction of the high resistances I have found that blotting-paper soaked in Indian ink is probably as good as any. It is quite reliable, and the resistance remains very constant under all conditions. If the resistance is not high enough, less Indian ink is used; if it is too high, you can give the blotting-paper a second soaking or as many soakings as is found desirable. Although this is a very cheap method of constructing a resistance, probably the best is that which is used on most service instruments—the use of carbonised cellulose. Cellulose is a material from which the filaments of carbon lamps are made, and the carbon is obtained by baking this cellulose until it is charred. If that process is stopped half-way the filament will be half charred, and its resistance will be of the value desired in high-frequency amplifiers, *i.e.*, about 70,000 ohms.

In conclusion, I would like to express my thanks to the author of this Paper for his many practical pieces of advice which he has taught us to-night in connection with these types of amplifiers.

Mr. P. R. Coursey: With reference to the remarks of the last speaker, I think I understood him to say that the anode resistance of such an amplifier would not be carrying any high-frequency current. I do not quite see the reason for that remark, as it appears to me that there must be some high-frequency component glowing in this resistance. Otherwise, surely the amplifier would not amplify. The object of this resistance is to cause the variations of the valve resistance, under the effect of the varying potential, to vary the current flowing through the anode resistance, and therefore, to vary the potential applied to the next valve. Hence, unless there is some high-frequency component of the direct-current, flowing through the anode resistance, it hardly seems as if there would be anything to pass on to the next valve.

He also referred to the impedance of this resistance. I think, in general with most commercial examples of anode resistance, the shunt capacity in parallel is extremely small, and generally negligible. In any case, its effect would seem to be rather in the opposite direction to that required by Mr. Child's remarks, viz., that the amplification of the higher wavelengths requires low resistances. If there is no appreciable capacity in parallel with the anode resistance, at shorter wavelengths, (and therefore higher frequencies), the impedance of the condenser would be reduced, and we would expect an increase in resistance to be necessary in order to bring up the impedance to its original value. Mr. Child's remark about the construction of this anode and grid resistance certainly agrees with the experience of others in that connection. The more usual resistances used in such amplifiers and in service instruments, I think are now available in almost any value of resistance one can wish for.

I recently came across a description of some new resistances which have been developed in the German research laboratories during the war, for higher resistances of this type. They are rather interesting, and this particular pattern consists of graphite deposited on a glass rod, or on one or two glass rods, or on a piece of glass rod spiralled up. The whole is mounted in a lamp bulb and enclosed in hydrogen. Its great feature is that the unit is easily replaced. You have only an ordinary lamp socket, and can apply any resistance at a moment's notice. They have, so the account goes, very constant resistance values, and will dissipate quite a considerable amount of energy, so that there should not be any trouble in making them for carrying anode currents of quite considerable magnitude. The type of construction that has been described seems very simple, and it might be worth while if some of the manufacturers in this country took up the construction of a similar type of apparatus.

The value of 20,000 ohms. for the parallel resistance also struck me as rather low, and I certainly think that from 50,000 to 100,000 is a more likely figure. In connection with the use of a grid-potentiometer it may sometimes serve to balance out any voltage-drop which may occur in the resistance of the grid-circuit of the valve. Particularly is that the case when receiving C.W. However much you make the grid-potential negative, unless the anode-current is stopped altogether, there must be some current flowing through the grid-circuit, and therefore, there is always a grid damping, as well as some potential drop in the grid-resistance. This, therefore, changes the operating point on the characteristic of the valve, depending to some extent upon the strength of the incoming C.W. If the C.W. is very strong under certain conditions and the grid-resistance very high, it will shut down the valve entirely by making the grid very negative. In that case, however, the use of a potentiometer connected in series with this resistance, might be valuable to partly balance out that effect and to bring the valve nearer its original operating point. The author's remarks as to inductively-coupled amplifiers *versus* resistance and capacity-coupling are interesting and, I think, bear out the generally accepted practice. It is always taken that the construction of inductively-coupled amplifiers is very difficult, and this, in fact, is largely because with such inductive-coupling the amplifier is more sensitive, since the grid voltage is stepped up by the windings. Hence, by using perhaps three valves, one might get as good results as with six in a resistance amplifier. Hence, to use six valves in a transformer-coupled amplifier there is much greater tendency to oscillate than in the resistance capacity-coupled instrument, and they, therefore, are more difficult to handle and to get to work properly. The chief point is to get sufficient resistance into the windings, otherwise the whole apparatus becomes very unstable.

Mr. G. G. Blake: I should like to thank Mr. Child for his Paper, which I think is a great help to those who are trying to make high-frequency amplifiers. The first point which occurs to me is—these are practical points with regard to the working of the apparatus—is the amplifier used with the valves on their sides, because having been using some ES2 valves myself and using them on their sides, I find that the filaments tend to bow. With regard to the oscillation point, there is a certain critical point, which he has explained to us, where the valves commence to oscillate. Recently we have been trying to pick up the Dutch station PCGG on Thursday nights, and the whole difficulty seems to be in getting just outside the critical point. I should very much like to know if, with this amplifier. there is a comparatively large space just off the oscillating point, or whether the adjustments are critical.

Mr. J. Scott-Taggart (*communicated*): The remarks of two of the speakers seemed to show some misunderstanding of my comments on the theory of the anode resistance of a resistance amplifier. The speakers have considered it as a conductor of high-frequency current, whereas I consider it should be regarded as an impedance across which high-frequency potentials are produced and then communicated to the grid of the following valve. There is no question that the higher the impedance the greater will be the potentials communicated to the grid of the succeeding valve. We can substitute for the resistance a very high impedance choke coil, which would obviously be unsuitable for the passage of high-frequency current, yet very efficient results are obtained with it. Although there is certainly a direct current and high-frequency component in the anode circuit, yet it is always possible to resolve these two components into separate paths in parallel, one for D.C. and the other for H.F.

The President: I would like to say that I consider this Paper to be of a character we particularly want. I think it is very desirable that this Society should have Papers of this kind, in which the practical difficulties of making these instruments are gone into. Such Papers as these are very helpful to amateurs who wish to make their own apparatus. Personally, I happen to be very much interested, because, as the author of the Paper mentioned, I made one of these resistance-amplifiers some considerable time ago. In my case I never had any trouble with the resistances, because I bought them. They were the resistances which are made of partially carbonised filaments, and have never given the slightest trouble. I have got a number of them of different sizes, and they are perfectly reliable; not one of them has ever given out or become noisy. I may say I have tried a great many experiments varying the resistance, but I have never found that even varying it within considerable limits made much difference. I sometimes thought one was a little bit better than another, but you can vary them 20 or 30 per cent. or even a little more without the difference being appreciable.

One thing of importance I found, and about which I would warn those people who wish to make resistance amplifiers, is the relative positions of the different parts, particularly if they are crowded in a box, for this makes an enormous difference. In the instrument I made I first of all laid it out on a table, and I got entirely different results from when I tried to put it into a box, as the capacity effects, owing to the parts being near together, were then very considerable.

In getting one of these instruments to work properly it is very important to arrange the different portions so that they do not re-act upon one another, and the self-heterodyning properties of the instrument, I think, depend upon that very largely. If the parts are fairly wide apart the instrument will not self-heterodyne without capacity re-action, but if, as I said before, they are crowded into a box, the proximity of the different parts produces re-action all the time. I think this also has a good deal of effect upon the quality of the articulation one gets when these instruments are used for receiving speech. I think, as is well known, in order to get speech, one must on no account have the apparatus oscillating or near the oscillating point, and therefore, to get good articulation, it is necessary to be very careful that the different parts of the instrument do not re-act upon one another.

I am sure I am voicing the wishes of all present when I say that we are very much obliged to Mr. Child for the very interesting and instructive Paper, and I will now ask him to reply to the discussion.

Mr. Child: In regard to the remarks made by Mr. Scott-Taggart, about no units being shown on the anode-current curves in Fig. 2, I think that must be purely an oversight of his. I think he will see that there is a voltage marked on each plate-current curve.

Mr. Scott-Taggart: I meant galvo' deflections instead of milliamperes.

Mr. Child: Galvanometer deflections are shown, because it is only intended to get a comparison of the effect of one plate-voltage with another at a given filament potential. I give the diagram, because, incidentally, it shows, when you come to study it, that there is a critical external resistance when put in series with the plate of the valve, which gives a maximum change of voltage when the grid potential is altered by a given amount. I do not agree with Mr. Scott-Taggart in regard to the question of his theory. With regard to the use of the resistances, I am inclined to agree with Mr. Coursey, that there must be some high-frequency component passing through them, and if that is the case, it follows that if you make your resistance very high, which has been suggested for very short wavelengths, they must have the effect of tending to "smooth out," as I have expressed it in the Paper, the varying potentials which will occur in these circuits, and thus we do not get a transfer of potential from the plate of one valve to the grid of the next to the same extent as we should get if a lower resistance were used. With regard to the question of grid control raised by Mr. Scott-Taggart, I understood him to suggest that in the case of Fig. 5, the grid potential of the first valve was controlled. As a matter of fact, the first valve is not controlled, but I mentioned that it *could* be controlled by the use of an external potentiometer if necessary. I have found in practice with this particular instrument that it is not necessary as a rule to use a potentiometer, and that you get very good average results without any external potentiometer on the first valve; but, of course, it can be added, if desired. Again, if it is necessary, one can put in a leaky grid-condenser, and thus get rid of the resistance of the grid-circuit in that way.

With regard to the possible methods which Mr. Scott-Taggart showed in his diagrams (Figs. A, B and C) of doing away with the coupling condensers, I think it would be rather a waste of time to try and experiment with plate batteries, and I think we would get into very serious difficulties if more than one or two valves were employed in getting the necessary accuracy of adjustment; and, further, I think it would be necessary to employ a prodigious number of batteries before we finally got any results.

With regard to the question of resistances, I have also tried blotting-paper. I did not go into all the different materials that I have tried to get the resistances satisfactorily, but I quite agree that blotting-paper with Indian ink will give good results. One difficulty I have found with it, however, and which I could not satisfactorily solve, is getting reliable contacts. It is not a very mechanical substance to work with. When you have blotting-paper it is likely to get destroyed mechanically, and that is why I ultimately used slate, because it is a fairly strong mechanical material in a sense, and although we know it is brittle, once it is mounted up and fixed in an instrument it stands a good deal of knocking about. They are only very short pencils, about one inch long, and therefore I have found that slate is a very good material to use; but I certainly do not recommend ebonite. This seems a most unsuitable material for rubbing graphite on. Of course, I am very glad to hear that it is possible for us to buy resistances nowadays at a reasonable price, but, as I said, I started this amplifier in 1919 and I could not get these cellulose resistances at that time—at any rate, not for the values I required.

With regard to Mr. Coursey's remarks about the use of the potentiometer in the grid for adjusting the grid voltages, I quite agree that, in C.W. work particularly, if you do not have a potentiometer, there is a great tendency for your valves to stop oscillating after the first few seconds. After a short period the whole thing seems to shut up, so that the potentiometer is certainly a useful thing in keeping the grids sufficiently positive, and thereby ensuring that there is an absorption of the energy in that circuit.

With regard to Mr. Blake's remarks, I do not as a rule use the amplifier on its side, although it can be so used. I have used it satisfactorily that way. Personally I am using the ES4 valve, which Mr. Scott-Taggart designed, and he will probably be able to tell Mr. Blake some of the peculiarities and the difference in mechanical construction, if any, between the ES2 and the ES4. I have used the instrument in a horizontal position, and have not found any trouble; but I can tell you of one little tip which, perhaps, might be useful to know with regard to the bending or sagging of the filament on to the grid. I have found such sagging has happened in one or two cases, and that the valve has ceased to function entirely; but by lighting the filament and making it fairly bright, and then carefully tapping on the glass of the valves, right opposite the position where the filament is sagging, it can be gradually worked back into the middle, and it becomes remarkably straight. I have done this in more than one case, and found that the valve has been good for quite a long period afterwards; but obviously you must be careful to light up the filament first.

With regard to the question of the point of oscillation, I have found that if you are listening for speech, and the amplifier is tending to oscillate, if you couple up the circuit a little bit tighter with the aerial circuit, or perhaps alter the tuning very slightly off the aerial circuit, this can be got over. That seems to have a very desirable effect.

I do not know whether Mr. Blake is using coupled circuits of the ordinary type, but if he is, he will find that he will be able to get over that difficulty by adjusting the coupling. Evidently the extra capacity between the aerial circuit and the secondary circuit which is made, stops the oscillating he complains about.

The President: I will ask you to accord a very hearty vote of thanks to Mr. Child for his Paper.

The vote of thanks was carried.

The President: Before we break up the meeting and see Mr. Child's apparatus, I understand that Mr. Coursey would like to say a few words on the proposed attempts of trans-Atlantic amateur stations to transmit to this country.

Mr. P. R. Coursey: For some time past there have been a number of rumours of American amateur wireless enthusiasts, who are trying to bridge the Atlantic by getting into touch with experimenters over here, and some of us may have noticed a preliminary notice in *The Wireless World* in the September 18th issue. I am, fortunately, now able to amplify that a trifle more. Mr. Sleeper, in New York, has arranged, or is proposing to arrange, a test between the American amateurs and the British. As most of us know, the American amateur is in a much more fortunate position than we are, owing to the fact that he can sometimes get licences up to as much as 1 kilowatt for short wavelengths. We are limited to 10 watts over here, so that there is no question of trying to signal back the other way.

I have had a number of letters from Mr. Sleeper on this subject, and he has asked me to boost-up some interest in this country in the tests. I hope, therefore, that all members of this Society and of the affiliated clubs, will assist in whatever way they can.

It is proposed that on or about February 1st next, the most powerful amateurs in and around New York and near the Atlantic seaboard shall transmit programmes at scheduled times, and it is hoped that members of this and other wireless clubs who have sensitive receiving apparatus, will listen-in for them. The programmes for transmission have not yet been fixed, as at present the position of affairs is that they are simply asking in New York for entrants for the tests, and we shall hear later from Mr. Sleeper what luck he has had in securing them, although I feel quite sure there will be quite a number entering for the test. If anyone is interested in this country I should be very glad if they would communicate with me as soon as possible, because if it is going to be carried out it will be necessary to arrange some programme convenient to workers in both countries.

There is another point, too. The transmission, of course, would be on about 200 metres, so that we shall not only be engaged in some work very interesting to ourselves, but in all probability we may gain some useful scientific knowledge as to the capabilities of these short waves of traversing long distances. At first sight it may seem a little bit too hopeful to try and get an amateur station over 3,000 odd miles, but recent tests have shown that a ½-kilowatt telephone set has been heard 2,000 miles, so that, if a ½-kilowatt telephone will cover that, a ½-kilowatt C.W. set might be expected to go considerably farther, and a 1-kilowatt might be assumed to have some chance of reaching us.

That raises the point as to whether it would be possible to effect sufficient co-operation through this Society and the affiliated clubs so that, during the transmission times from America anyone in this country who has a licence for transmission purposes on short wavelengths, about 180 metres, shall certainly not radiate anything during that period.

If there is any amateur in this country sending out at 180 metres I do not expect there will be any possibility of being able to amplify up the signals sufficiently to get New York; but if we can come to some arrangement so that such transmissions are stopped voluntarily during this period we might have some hope of interesting work. Those of us who have valve amplifiers, I hope will co-operate in the scheme. I am sorry not to be able to announce anything more definite as to times of transmission, but I hope to be able to do so at a later date: and meantime I hope anyone interested will communicate with me at the following address: *The Radio Review*, 12-13, Henrietta Street, W.C.2.

It is no good doing any work on our own. If we are going to do anything, we must co-operate. The tests, as preliminarily announced, are intended to be open to amateurs only, so as to cut out any large wireless companies with almost unlimited funds, who could, perhaps, put on several dozen valves to get through. Of course, there is no objection to employees of wireless companies taking part, if they so wish, but it is intended to be understood that they should do it entirely on their own initiative. The test will, of course, have to be carried out at night, and that will be rather late for us. It will mean 11 or 12 o'clock over here at the earliest. Perhaps it will be worth while if the members of the Society can discuss it further to save time.

The President: At this late hour I think the most we can do is to say that, I am sure, the Society generally will be ready to co-operate in these tests, and we shall be glad to hear—there is some little time between now and February—when things are a little more definite.

I have to announce that the twenty-five gentlemen who were up for ballot have all been elected.

With regard to the next meeting, the date of that and the Paper to be read have not yet been fixed, but notice will be sent out in the usual way. I am asked to say that we are not very full of Papers at the present time, and the Hon. Secretary would be very glad to have any suggestions from any member with regard to Papers or exhibitions of apparatus or anything of the kind that they think would be of interest to the Society, to bring up at subsequent meetings.

THE MOST EFFICIENT METHODS OF RECEPTION OF SHORT WAVES BOTH SPARK AND C.W.

A meeting of the Society was held at the Institution of Civil Engineers on Friday, October 29th, the President (Mr. A. A. Campbell Swinton) in the chair. After the minutes of the last meeting had been read by the Hon. Secretary, and confirmed, the President then called upon Mr. P. R. Coursey, B.Sc., A.M.I.E.E., to open the discussion.

Mr. Philip R. Coursey: Troubles in the reception of short wavelength signals, and by these I mean wavelengths less than, say, about 250 metres, may be of two kinds—difficulties of tuning and difficulties of amplification. Of these the former may be overcome by proper design of the circuits, but the latter are not quite so easy to remove. In connection with the design of the tuning circuits themselves, undoubtedly the great feature to aim at is simplicity, as on account of the high frequency of the currents with which we have to deal, the effects of undesirable stray capacities are usually only too prevalent. All coils and condensers should be kept well insulated from earth, and should be spaced apart from one another, keeping all connecting leads as straight and free as possible.

The accurate tuning of a circuit for short wavelength signals involves primarily two difficulties—firstly, that due to the comparative sharpness of resonance, on account of which, when using ordinary patterns of variable condensers, it is not easy to pick up the desired signal, or to tune it accurately when once heard; and, secondly, one intimately connected with the first, the variation of tuning brought about by the capacity of the operator, to the apparatus and to earth when effecting the tuning operations.

Both of these can be reduced by providing the tuning instruments (condensers or variometers) with long handles and fine adjustments, so that a more accurate setting is possible, and, at the same time, the operator's hand is kept further away from the metal parts of the gear. The second difficulty can be reduced by electrostatically shielding all coils and condensers within an earthed metallic case. This, however, is liable to seriously increase the losses in the circuits.

It is, however, not proposed here to deal any further with this aspect of the question, but to describe briefly one method of reducing the difficulties of amplifying these signals.

With amplifiers as generally made, the magnification of very high frequency, or short wavelength currents, is not nearly so efficient as for the longer wavelengths. For instance, at our last meeting, Mr. Child mentioned that the instrument he described was best suited for wavelengths of 1,000 metres or over, and this sort of thing applies usually to most forms of this type of amplifier, using resistance-capacity couplings between the valves. The resistance-coupled amplifier, although undoubtedly the simplest to construct is, unfortunately, much less sensitive for short wavelengths, whereas, of course, the inductively-coupled instrument can be designed to have its maximum sensitiveness at almost any desired wavelength. (Fig. 1.)

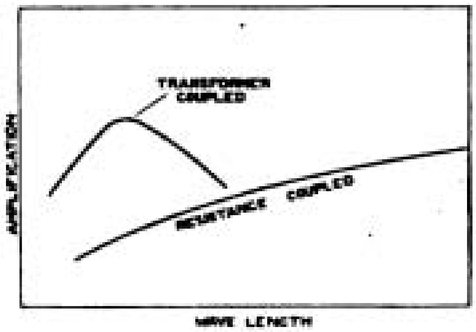


Fig. 1. Diagram showing the amplification obtainable with different types of amplifier and its variation with the wavelength of the signals.

In addition to sensitiveness we want also great selectivity, to cut out interfering signals of nearly the same wavelength, and, therefore, the simplest arrangement would be to use a tuned amplifier of two or three stages, were not the tendency to self-oscillation rather great. However, if one definitely gives up the idea of putting the instrument in a box, and has the space available to spread out the valves sufficiently, it is possible to obtain a workable apparatus. A suggested arrangement is given in Fig. 2.

In this diagram the anode circuit of each valve is shown as including a tuned circuit (C_1 L_3 and C_2 L_4 respectively). The coils of these circuits provide the coupling with the next valve. The grid coils could also be tuned, but usually if this is done when using a common H.T. battery continuous oscillations are set up. The whole apparatus should be well spaced out, and only just sufficient coupling arranged between L_1 L_2 L_3 L_4, and L_5 L_6 to pass on the impulses to the next valve. The tendency to oscillate can thus be kept under control, but the apparatus is even then a little difficult to operate.

For these short wavelengths it is usually best

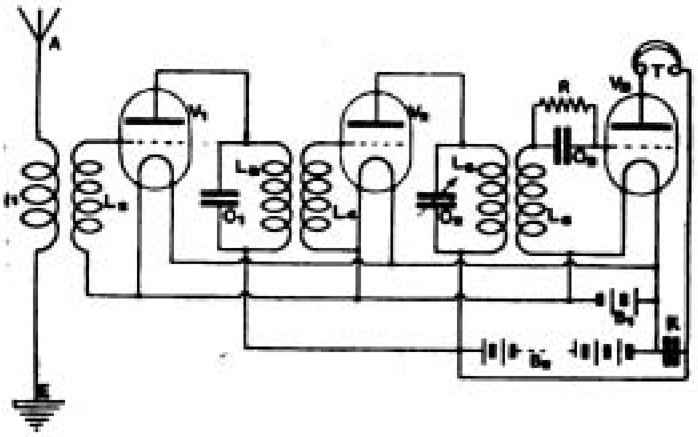


Fig. 2. Schematic arrangement of short-wave amplifier with tuned intervalve couplings.

to employ the simplest type of winding—*i.e.*, single-layer pancake or solenoid—for all the coils, as these give greater efficiency than special multi-layer windings, such as the honeycomb or other lattice coils.

As an example of what may be accomplished in this way, Capt. H. J. Round, during the war, successfully used a 22-stage inductively-coupled amplifier, which had extreme selectivity and enormous magnification on short wavelengths.

It may be of interest, however, to describe a method by which an ordinary amplifier and receiver designed for longer wavelengths may be employed for the reception of short wavelength signals. The principle of the arrangement has recently been patented by E. H. Armstrong,* and consists in heterodyning the incoming signals (by means of an ordinary type of separate heterodyne), not so as to give audible beats, as is usually done, but to give beats of a radio frequency lower than that of the incoming signal. These beats may then be treated as an incoming signal of longer wavelength, and amplified and detected in the usual manner.

For instance, take the case of 200-metre signals. The oscillation frequency is 1·5 million per second. If we heterodyne these with a local oscillation, having a frequency of 1·4 million (wavelength = 214 metres), the frequency of the beat currents will be 100000 ∼, which corresponds to a wavelength of 3,000 metres. Similarly, any desired beat current wavelength could be chosen. Thus, an ordinary type of resistance-coupled or transformer-coupled amplifier may then be used to magnify up this beat current before detection. The last part of the apparatus may thus consist of our ordinary receiving and amplifying apparatus. Arranged in the simplest possible way, we then get Fig. 3. In this diagram the aerial circuit A L_1 E is tuned

*British Patent 137271, July 9th, 1919. (Convention date December 30th, 1918); French Patent 01511 (Filed December 30th, 1918. Published April 13th, 1920).

up to the 200-metre wave in the usual manner by adjusting the value of the coil L_1, and the secondary circuit, L_2 C_2 of the 200-metre tuner, is likewise brought into resonance.

The ends of this secondary circuit are connected across the grid and filament of the valve V_1, the grid condenser C_1 and leak R_1, being interposed in the usual manner. If a pair of telephones were inserted at T in the plate circuit of this valve, signals (if strong enough) would be heard in the ordinary way, the valve V_1 serving as the detector.

The valve V_2 is arranged as a separate heterodyne, so that oscillations are set up in the circuit L_3 C_3. This heterodyne may be an entirely separate unit, or, for convenience, may be fed from the same filament and H.T. batteries in the manner indicated. It should be loosely coupled to the aerial circuit. Hence, the valve V_1 is traversed by the oscillations of both frequencies, and beats are thus set up. The circuit L_4 C_5 is tuned to this beat frequency, which, for convenience, we may adjust to somewhere about 100,000 ∼, so that L_4 C_5 and L_5 C_7 will both be tuned to about 3,000 metres wavelength. A certain amount of extra regenerative amplification may be obtained by inserting an additional coil L_6 and tuning condenser C_6 in the plate circuit of V_1, and tuning them to the frequency of the incoming signals. This condition is not, however, essential to the operation of the apparatus. To the terminals G and F, any ordinary pattern of amplifier and detector may be joined. From the points X Y then, we are using an ordinary receiving tuner amplifier and detector, suitable for, and which may be tuned to a wavelength of somewhere about 3,000 metres.

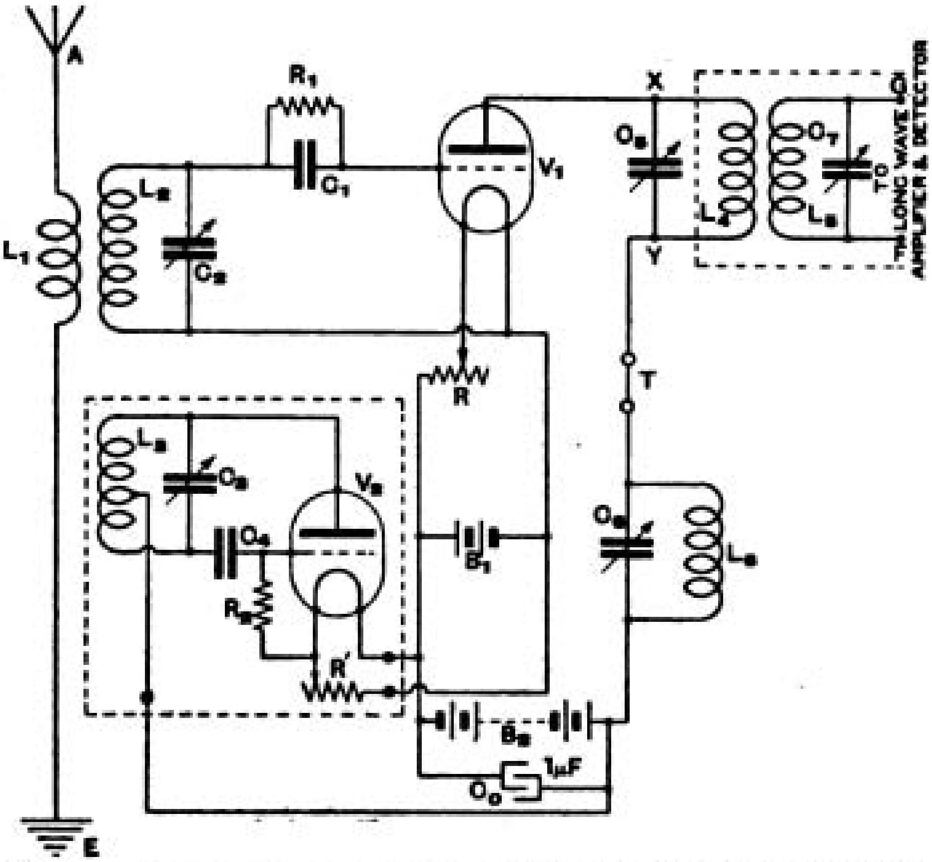


Fig. 3. General arrangement of apparatus, with supersonic heterodyne, to enable long-wave receiver and amplifier to be used for short-wave work.

Some such arrangement as this, whereby we may use our existing long-wave amplifying and detecting apparatus for the reception of 200-metre waves may prove very useful in long-distance tests, such as the trans-Atlantic ones on 200 metres which are now being organised, as by this means it is possible to avoid the use of a quantity of special high frequency amplifying apparatus. The proper adjustment of the apparatus may, perhaps, involve some little trouble, but once the correct values are found, by means of a local buzzer source of 200-metre waves, or by an oscillating wavemeter excited by a valve, it should be easy to work with. The method is applicable to either spark or C.W. reception, but is naturally best for the latter.

(To be continued.)

WIRELESS CLUB REPORTS

Wireless Society of London.

On October 19th the above Society held its usual monthly meeting, at the Institution of Civil Engineers, when a discussion took place dealing with "The most efficient methods of reception of short waves, both C.W. and spark." On the afternoon of the same day, a party of 30, formed from members of the Society, visited the Lots Road Generating Station. Members are reminded that subscriptions are now due, and should be sent to the Hon. Treasurer, in order that a new membership card may be issued for the year ending September, 1921. Hon. Secretary, Mr. L. McMichael, 32, Quex Road, West Hampstead, N.W.6.

Manchester Wireless Society.

(Affiliated with the Wireless Society of London.)

On September 25th the members visited Stuart Street Generating Station, Manchester, by kind permission of the Chief Electrical Engineer, Mr. H. S. L. Pearce, C.B.E. They were conducted by Mr. D. J. Davies, one of the station engineers and a member of the Society, assisted by one of the attendants. The visit proved very interesting and instructive, and it is to be hoped that many more will be arranged during the session.

On October 6th the usual meeting was held at the club-rooms, and Mr. H. A. Blackburn led a discussion on valves.

On October 13th a lecture on Inductances had been arranged to be delivered by Mr. Evans, the Hon. Secretary; but, unfortunately, inclement health intervened, and the lecture was therefore postponed indefinitely. It is hoped that the Hon. Secretary will be sufficiently recovered to give his lecture during the course of the next few weeks.

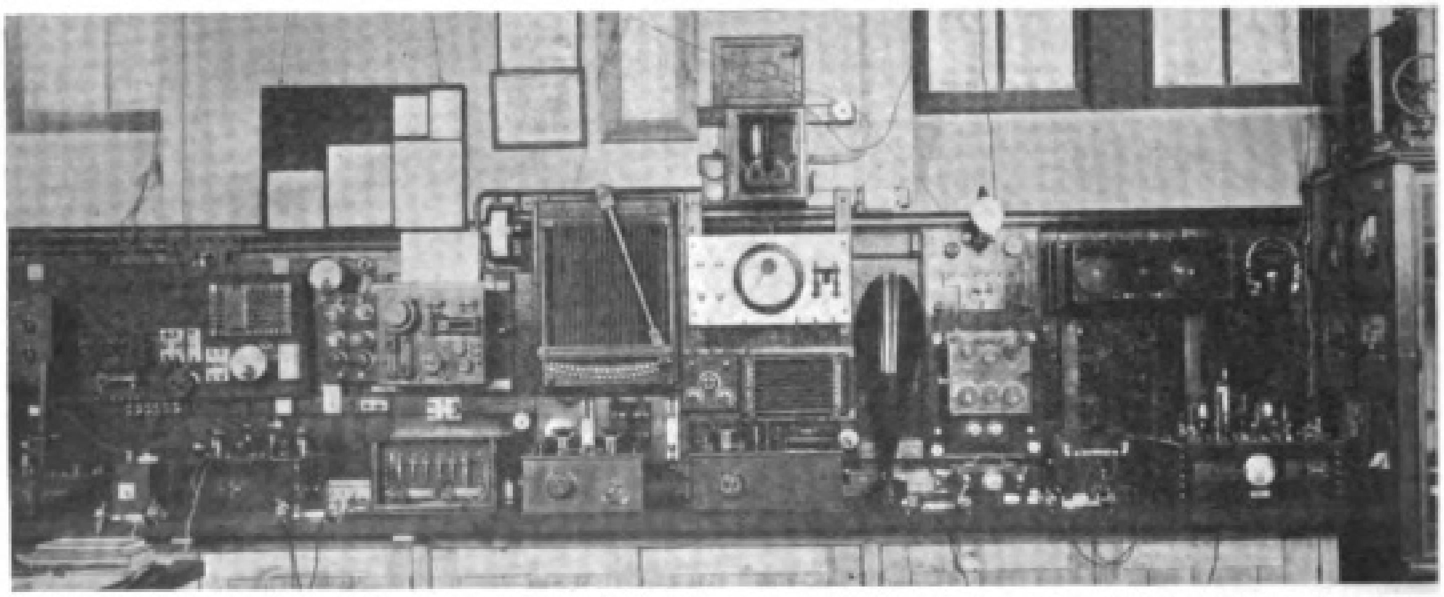
October 20th.—During the previous week exhaustive experiments had been carried out by several members with a trans-ocean set, loaned by Capt. J. E. Wilkes, of Coddington, Newark-on-Trent, and excellent results were obtained, which justified the report issued with the set.

Another set, kindly lent by Mr. Varetto, a member of the Society, was also on view, and considering the size of the instrument and the fact that Mr. Varetto had made it himself, the signals obtained were quite good. It is hoped to provide other demonstrations with home-made sets. Hon. Secretary, Mr. Y. Evans, 7, Clitheroe Road, Longsight, Manchester.

Sussex Wireless Research Society.

(Affiliated with the Wireless Society of London.)

The winter session of this Society opened on Thursday, September 30th. Owing to the inclement weather the attendance was not very large, but useful work was done in testing a new long-wave set which has just been installed. This set has a range of 1,000—17,000 metres, and in conjunction with a six-valve amplifier, Brown's relays and loud-speaker, signals from Hanover, Carnarvon, Lyons, Budapest, etc., were deafening. Atmospherics were also apparent.



This very fine collection of apparatus is installed at Cottesmore School, Upper Drive, Brighton, where the Sussex Wireless Research Society holds its meetings, and represents a portion of the apparatus at the disposal of its members.

It was decided to continue to hold meetings weekly, the evening to be Wednesday instead of Thursday.

On Wednesday, October 6th, it was announced that Dr. W. Mansergh Varley, M.A., D.Sc., Ph.D., Principal of the Brighton Technical College, had accepted honorary membership of the Society. Two new members were also introduced.

Capt. E. A. Hoghton, F.P S.L., gave a lecture on the "Conduction of Electricity through Gases," which was profusely illustrated with excellent experiments with vacuum tubes. The history of this subject was traced and very fully explained from the time when Sir William Crookes and Sir J. J. Thompson made their experiments.

The Hon. Secretary, Mr. J. E. Sheldrick, B.Sc. (Eng.), Lond., 35, Southdown Avenue, Brighton, will be pleased to hear from anyone in Sussex desirous of becoming a member of the Society.

Sheffield and District Wireless Society.

(Affiliated with the Wireless Society of London.)

The annual general meeting was held on October 7th, when the following officers were elected for the ensuing year: President, H. E. Yerbury, M.Inst.C.E., M.I.E.E.; Vice-Presidents: E. H. Crapper, B.Sc.Eng., M.I.E.E.; W. E. Burnand, A.M.I.E.E.; H. Greaves; D. G. Jones, A.M.I.E.E.; F. Lloyd; J. Patrick, A.M.I.E.E.; J. Ward; A. J. Ward; H. West, A.M.I.E.E.: Hon. Secretary, L. H. Crowther, A.M.I.E.E.; Hon. Treasurer, C. H. Hainsworth, A.M.I.E.E.; Executive Committee: Messrs. D. G. Jones, J. Patrick, W. A. Ward, F. Adcock, L. Johnson, and W. F. Boyd, together with the President, Hon. Secretary and Hon. Treasurer.

Prior to the election of the above, the Hon. Secretary gave a report on the past year's work, showing the remarkably good attendance of the members at all the meetings, and the keen interest evinced in the series of lectures.

The disadvantages of the temporary club-room precluding the installation of permanent apparatus, was also touched upon, and was followed by the announcement of an offer received from the Vice-Chancellor of the Sheffield University, to provide a room in the Electrical Department at St. George's Square for the purpose of the Society's weekly meetings, permission to erect an aerial being also given.

Several applications for membership were received, and an appeal was made for all amateurs interested in wireless matters to join the Society, and thus help to strengthen the amateur movement throughout the country.

The first meeting in the new club-room was held on Friday, October 15th, when an exhibition of apparatus was held. Some sixty members were present and opportunity was taken to renew acquaintances and exchange experiences.

A splendid series of fortnightly lectures has been arranged, details of which, with all information regarding the Society, may be obtained from the Hon. Secretary, Mr. L. H. Crowther, 156, Meadow Head, Norton Woodseats, Sheffield.

Southport Wireless Experimental Society.

(Affiliated with the Wireless Society of London.)

The usual weekly meeting of the Society was held on Tuesday, October 19th, the President (Mr. E. R. W. Field) being in the chair.

A room has now been procured as the Society's meeting-place, and in a short time it is hoped that with the P.M.G.'s permission instruments may be installed.

Friday evenings have been fixed as nights devoted to beginners, Tuesday evenings being open for general discussions, papers, etc.

A letter *re* — trans-Atlantic transmission by American amateurs was read, and, after a little discussion, it was decided that all members would co-operate in the scheme.

During the past few weeks several new members have been enrolled. Prospective members are invited, and particulars may be had on application to the Hon. Secretary, Mr. H. Sutton, 68b, Marshside Road, Southport.

The Manchester Radio and Scientific Society.

(Affiliated with the Wireless Society of London.)

A meeting of this Society was held on Wednesday, October 13th, at the club-room in the City School of Wireless, High Street, Manchester. A good number of enthusiastic amateurs were present, and various members were elected to certain vacant offices. It has been proposed to hold a social evening about the end of November, and many other arrangements are being made for an exceptionally good session.

It was most successfully demonstrated that a three-valve amplifier, using R type valves, could be made to oscillate with only 15 volts on the plates. Very loud C.W. signals were received from various commercial stations. The wiring circuit of a simple telephone set was also described. A small De Forest duo-lateral coil to work up to 4,000 metres was exhibited by one member.

This session promises to be an exceptionally good one, and new members will be most welcome. All communications should be addressed to the Secretary, Mr. P. Thomason, 7, Brazennose Street, Manchester.

Liverpool Wireless Association.

(Affiliated with the Wireless Society of London.)

A meeting was held on October 13th at the new club-room at the Royal Association, Colquitt Street, when an address was given by the President, Professor E. W. Marchant, D.Sc., on "The Most Useful Things, from a Scientific Standpoint, that an Amateur can Observe." Dr. Marchant dealt with the variation in signal strength and range, freak results, directional finding and errors. The question of American amateurs attempting to transmit to England was discussed, and it was agreed to co-operate in the scheme.

On December 22nd (by invitation of Professor Marchant) the members are to visit the wireless station at the Liverpool University.

Mr. S. Frith, Hon. Secretary of the Liverpool Wireless Association.

The meetings of the Association are held the second and fourth Wednesdays in the month. Subscription, 5*s*. New members continue to join, and fresh applications are cordially invited. Interviews by appointment.—Hon. Secretary, Mr. S. Frith, 6, Cambridge Road, Crosby.

Gloucester Wireless and Scientific Society.

(Affiliated with the Wireless Society of London.)

A meeting of the above at the Club's headquarters was held on October 21st. Business having been transacted, the President called upon Mr. Sandow to bring forward his valve set for exhibition. The question of trans-Atlantic amateur tests was brought forward and all members expressed their great willingness to take part.

Meetings are held every first and third Thursday in the month at 7 p.m. at the Science Laboratory at Sir Thomas Rich's School, Gloucester, and new members are cordially invited to attend. Hon. Secretary, Mr. J. J. Pittman, 1, Jersey Road, Gloucester.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

A meeting of the Association took place on October 13th, when the discussion on indoor aerials was resumed. Another subject to receive discussion was the working of the loud-speaking telephone. Several new books were presented to the library, and it is hoped that more will follow.

Members of the Association met on October 20th at 16, Peckham Road. Mr. Voight opened the discussion on the theory of the loud-speaking telephone, and traced the transformations of energy from the electrical to the mechanical circuits.

An illuminative and instructive discussion followed, and more than one of our members showed that they were not unacquainted with the physics of acoustics.

Mr. Voight subsequently demonstrated the fact that not with all crystals is it advantageous to have the telephones of approximately the same resistance as the crystal detector. Hon. Secretary, Mr. Geo. Sutton, 18, Melford Road, E. Dulwich, S.E.22.

Three Towns Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting on October 13th was devoted to a lecture on D.F. work, by Mr. L. J. Voss. The lecturer, who seemed to be quite at home with his subject, gave a most interesting and instructive discourse. The meeting closed with a hearty vote of thanks to the lecturer. Full particulars of the Club may be obtained from the Hon Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

The Technical College, Loughborough.

The first meeting of the College Wireless Society was held on October 1st, 1920, at 6.45 p.m., in the College. Captain Frank Pamment, who had called the meeting, proposed the formation of a Wireless Society. Captain Pamment then proposed gentlemen to fill the offices of President, Vice-President, Committee and Secretary. A temporary Committee was formed in order to deal with any difficulties which might arise.

P. H. Cook, Esq., proposed that Captain Pamment should be Hon. Secretary of the Society. A. S. Jones, Esq., seconded, and the resolution was carried unanimously. Mutual discussion then took place, and the meeting adjourned at 7.30 p.m.

The second general meeting of the College Wireless Society was held on October 11th in the College. The Hon. Secretary opened the meeting by informing the members that the Principal of the College had accepted the office as President of the Society. The Hon. Secretary then proposed that H. V. Field, Esq. (one of the College tutors in the department of Electrical Engineering), should become one of the Vice-Presidents: this was seconded, and carried unanimously. He then proposed the formation of a Committee to take the place of the temporary Committee. Ten names were put up by the members. The Hon. Secretary then called on each of the ten gentlemen proposed. to give a brief record of their experience. The members then left the choice of five names to the decision of the Vice-President, who elected Messrs. P. H. Cook, W. E. Hopthrow, F. E. Wheeler, W. Turner and E. Springfield to be members of the Committee. Four other names were then put up, and by vote Messrs. S. J. Holmes and A. H. Warry were also elected members of the Committee.

The period of office of the Committee was then discussed, and by vote it was decided that the present Committee should remain in office until the end of the term, and at the beginning of next term, *i.e.*, January, 1921, another Committee should be elected: hereafter a Committee should hold office until the end of each session.

A method of training inexperienced members was discussed and left to the Committee to decide.—Hon. Secretary, Captain Frank Pamment, The Technical College, Loughborough.

Radio Society of South Africa.

The first annual general meeting was held at the Physics Laboratory Lecture Room, of the Cape Town University, on September 24th. The chair was occupied by Professor A. Ogg. The minutes of the previous general meeting were read and confirmed.

The following were proposed for the posts of officers by Mr. Streeter, seconded by Mr. Heugh, and carried unanimously: Chairman, Professor A. Ogg; Vice-Chairmen, Mr. H. E. Penrose and Mr. J. Williams; Hon. Secretary, Mr. A. T. Stacy; Hon. Treasurer, Mr. L. B. Bridge. The following were elected elective members of the Provincial Committee: Mr. G. Grey, Captain B. Walsh, Mr. G. Heugh, Mr. A. Rogers, Mr. J. Streeter, Mr. W. Copenhagen and Mr. A. Speight. The recommendations regarding completion of the constitution, put forward by the Temporary Committee, were put to the meeting and carried.

The question of the advisability or otherwise of retaining the office of Acting Vice-President was put to the meeting, who voted that the office be retained. The Committee were instructed to bring forward at the next general meeting a recommendation for the office of Acting Vice-President.

Twenty members indicated their desire to procure licences. The Committee were instructed to bring forward at the next general meeting recommendations regarding the number of ordinary general meetings to be held per annum. It was resolved that Friday evenings would suit the convenience of the majority of members.

North Staffordshire Railway Electrical Department Wireless Club.

The first meeting of the above Club took place on October 12th in the Works' Messroom, by the kind permission of A. F. Rock, Esq., M.I.E.E., Superintendent and Engineer. A vote of thanks was passed to Z. A. Faure, Esq., of the Stockport and Cheesham Wireless Society, for the letter and rule card, the latter being of much assistance in helping us to formulate the rules for our Club.

Our Vice-President and Chairman, F. Y. Scragg, Esq., read the first chapter from R. D. Bangay's "Wireless Telegraphy," giving symbol illustrations on the blackboard. Mr. G. Taylor (late of H.M. Forces, Wireless Section) was appointed as instructor to the Club. Under the presidency of our Superintendent (A. F. Rock, Esq.) we are looking forward to a pleasant winter's study.

The Club is desirous of getting in touch with other wireless clubs, with a view to inviting them to send one of their members to give a lecture. Expenses would be paid.

The Secretary would be glad to receive copies of any lectures which have been read at the various societies' meetings.

Will secretaries interested please communicate with the Hon. Sec., Mr. P. E. Banks, 87, Spencer Road, Shelton, Stoke-on-Trent.

East Kent Wireless Society.

On Wednesday, October 13th, at 7.30 p.m., the East Kent Wireless Society held their first general meeting at the Oddfellows' Institute, Pencester Road, Dover. The temporary Secretary, Mr. H. Alec. S. Gothard, gave a short address on the objects of the Society, after which the President, Hon. Secretary and Committee were elected, and are as follows:—President, Major Martin; Hon. Secretary, Mr. H. Alec. S. Gothard; Committee: Messrs. E.W. Austen, H. J. Sargent, S. G. Vaugham.

Major Martin, who has had considerable experience in training wireless telegraphists, has very kindly offered to give weekly lectures as from October 20th. Mr. Kelsull very kindly offered to conduct a correspondence section of the Society. Mr. Vaugham also very kindly offered the use of his extensive workshop, and he will be pleased to give instruction in the manufacture of wireless apparatus.

At the conclusion of the general meeting a Committee meeting was called by the President, when it was decided to hold weekly meetings at the above address at 7 p.m. Various rules were drawn up and decided upon by the Committee.

All intending members should communicate with the Hon. Secretary, Mr. H. Alec. S. Gothard, who is at present residing at Richmond House, Marine Parade, Dover.

Newark-on-Trent Wireless Society.

The first meeting of the above Society was held in the Y.M.C.A., a number of amateurs attending. Eleven gentlemen who were present expressed a desire to become members of the Club, and letters to the same effect from several other gentlemen were read.

All information can be obtained from the Acting Secretary, Mr. G. T. Sindall, 44, Hatton Gardens, Newark-on-Trent.

Glevum Radio and Scientific Society.

A number of gentlemen met at the Royal Hotel, Gloucester, on Thursday, October 14th, with the object of forming a Wireless Society.

At this well attended meeting it was decided to name the Society "The Glevum Radio and Scientific Society," and the following officers were elected for the season:—President, The Mayor of Gloucester, Councillor J. O. Roberts; Chairman, G. Courtenay Price, Esq.; Hon. Treasurer, C. H. Box Esq.; Hon. Secretary, J. Mayall, Esq.; Assistant Hon. Secretary, A. G. Adams, Esq.

An interesting programme for the winter was arranged, and forty members were elected.

The Hon. Secretary, Mr. J. Mayall, "Burfield," St. Paul's Road, Gloucester, would be pleased to hear from intending members and those interested in radio work.

Co-operation Wanted.

It is proposed to form at Southampton an amateur wireless club, and those who may be interested are requested to communicate with Mr. E. H. Cole, Woolston Lawn, Woolston, near Southampton.

Co-operation in Sunderland.

Mr. H. Burnley, of 8, Briery Vale, Ashbrook, Sunderland, is anxious to form in or about his district an amateur wireless club. Those of our readers whose interest in wireless is centred in or about this county would do well to communicate with Mr. H. Burnley.

Wireless Club at Redhill.

Mr. G. R. Wigg, of Rockshaw, Merstham, Surrey, is anxious to form an amateur wireless club in the district of Redhill. With this purpose in view, he will be pleased to hear from anyone interested who is willing to co-operate.

Co-operation wanted at York.

It is purposed to form a wireless club in the district of York, and interested amateurs in that neighbourhood would do well to communicate with Mr. H. B. C. Chadwick, at the Y.M.C.A., Clifford Street, York, who is at present in charge of the movement.

Crystal Palace and District Radio Society.

The above Club is now open to receive applications for membership forms, to be obtained from the Hon. Secretary, Mr. W. E. Harper, 25, Beckenham Road, Penge, S.E.20.

This Club, although one of the youngest, is, perhaps, the most fortunate, inasmuch that in addition to a first-class club-room, a fully equipped workshop is at the disposal of members.

A good programme has been arranged for the coming winter, due to the efforts of a live committee, who are sparing no effort to make this Club a success.

The DESIGN & CONSTRUCTION *of an* EFFICIENT DETECTOR AMPLIFIER

By Cyril T. Atkinson.

AS it is undoubtedly the ambition of every up-to-date experimenter to have his wireless receiving apparatus equipped with a valve-amplifier, it is felt that the following article dealing with the construction of a 3-valve set will be of interest. It must not, however, be considered that it in any way represents the last word in such things, but with due consideration of the conditions prevailing at the average amateur station it is certainly well fitted for use therein.

Taking the design in detail it will be seen that the first two valves are used purely as amplifiers, the third valve rectifying on the cumulative leaky grid-condenser principle. This was found to be the most efficient combination, as the original oscillations received on the average amateur aerial from all but the most powerful stations are far too weak to effectively operate any rectifying device without some strengthening. "R" type valves, supplied by the Edison Swan Electric Company, were used, the writer being familiar with their characteristic curves, and the parts were designed for use with these particular tubes. We will now take the actual construction in detail, beginning with the case. This can be made from any well-seasoned hardwood, such as mahogany, or teak. The actual finish depends upon the skill and fancy of the constructor. The various sizes are given in Fig. 1, which shows the method of construction. It will be seen that by removing the eight screws holding the front, the entire inside can be removed *en-bloc*, thus greatly facilitating wiring up, etc.. Normally, for the removal of the valves, the top portion of the back is opened, hinges being provided for this purpose. The front panel should be carefully marked with the position of all holes and then carefully drilled ; the shelf A should also be prepared for the valve-holders and transformers. As the case is designed of ample size, there is no reason why the position of some of the holes should not be slightly altered if the rheostats should happen to be of different dimensions to those described herein, but great reserve should be exercised with the other parts, as a very slight variation in the position of certain conductors will render the set unstable, and cause it to oscillate when it is not intended to do so. The rheostats are mounted on porcelain bases, and should have a maximum resistance of about 5 ohms. The writer made slight alterations to those used by him in order that they might be mounted inside the case, the adjusting knobs being outside ; they may, however, be mounted outside the front, exactly as purchased.

Three valve-sockets are next constructed, the actual socket being turned from ¼" brass rod. Four of these socket-pins go to each holder, and they are mounted on an ebonite base by their shanks. Connection is made by soldering a wire on to the tip of the shank itself. Details and dimensions are given in Fig. 2.

Two condensers next claim our attention. One of these is used in series with the grid of valve No. 3, and one across the telephones, the difference between them being that the telephone condenser is of a larger capacity. The leak, which is connected across the grid condenser can easily be made by filling a groove in a piece of ebonite with pencil graphite, suitable connections being made at the ends. Condenser sizes are clearly given in Figs. 3 and 4. Fig. 3 shows the size of the ebonite clamping plates, of which two are required for each condenser. The mica insulators are also cut to these dimensions, four being for the grid and nine for the telephone condenser. Fig. 4 shows the size of the copper-foil plates, three of which are for the grid and eight for the telephone condenser.

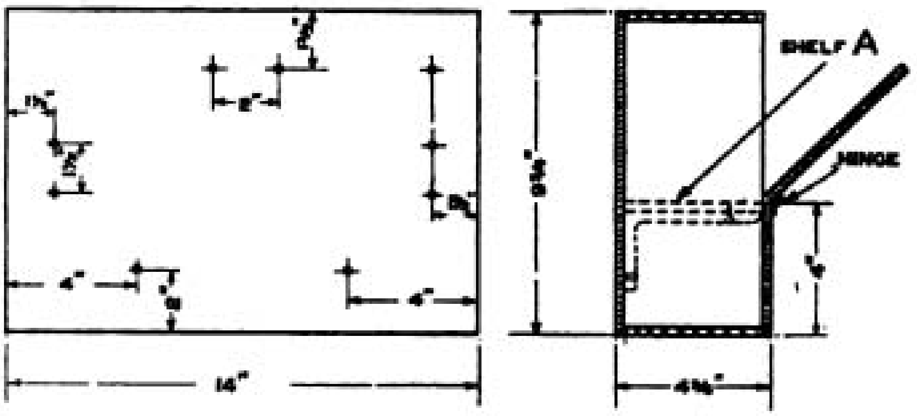
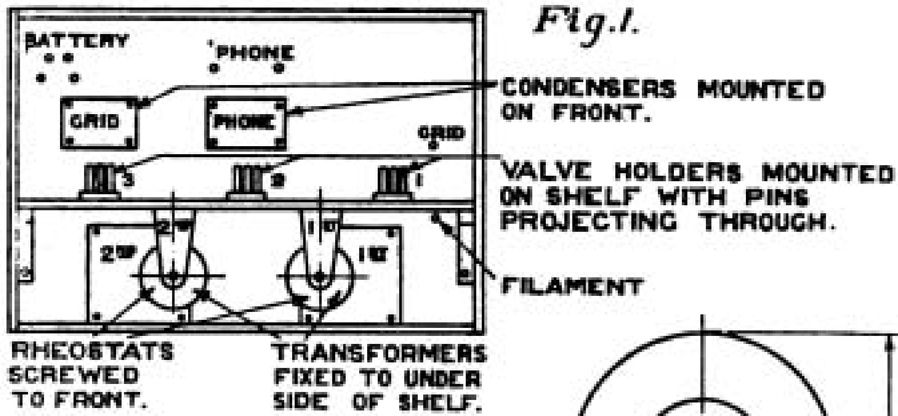


Fig. 1.



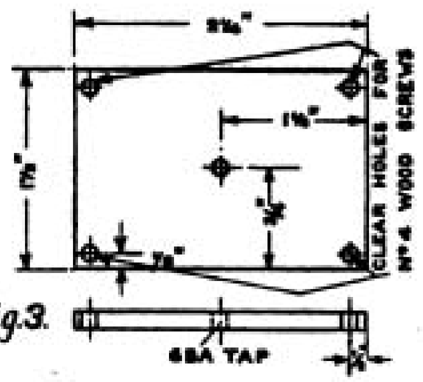


Fig. 3.

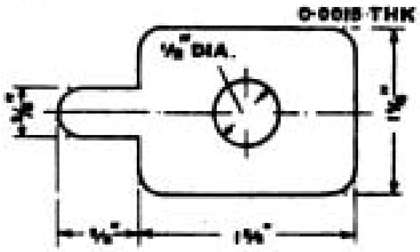


Fig. 4.

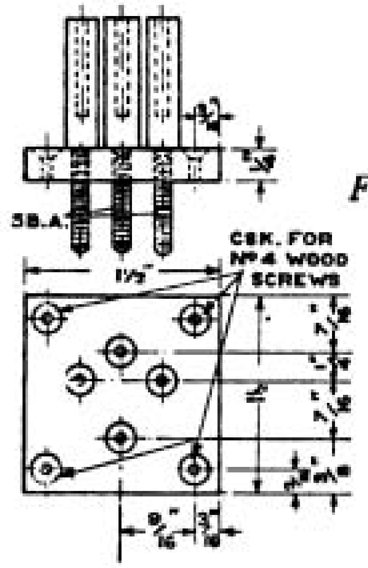


Fig. 2.

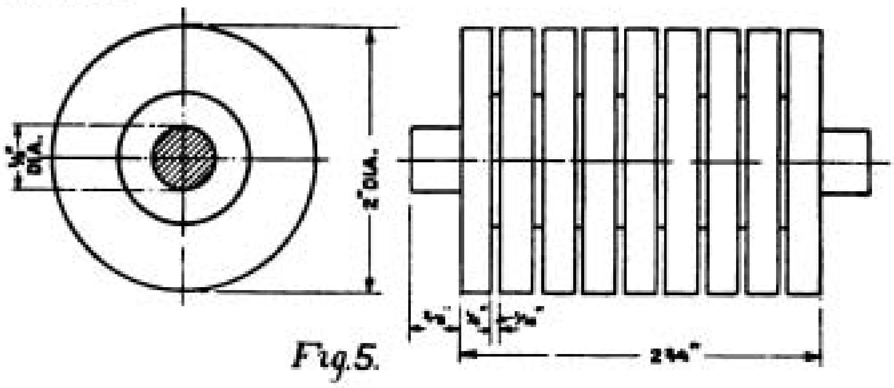


Fig. 5.

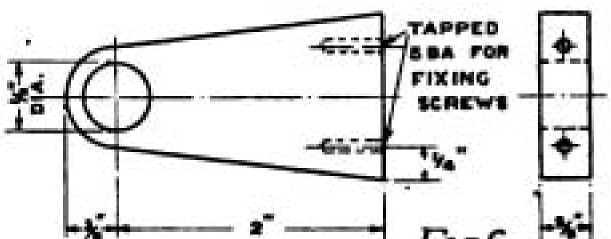


Fig. 6

The two coupling transformers which transfer the energy from the plate of one valve to the subsequent grid, are wound in a ratio of 1 to 1, and therefore have a primary and secondary of equal turns. The bobbin consists of a piece of ebonite rod $3\frac{1}{2}''$ long, the ends of which are first reduced to $\frac{1}{2}''$ diameter for a length of $\frac{3}{8}''$. The unreduced part should have eight slots turned in it, each $\frac{1}{2}''$ deep $\times$ $\frac{1}{16}''$ wide, each slot being separated from the next by a distance of $\frac{1}{4}''$ Fig. 5. These slots should each be wound with 500 turns of No. 40 S.W.G. wire, and alternate slots connected in series. Great care should be taken that the coils all act in the same direction so that each winding is electrically continuous. Brackets should be cut from sheet ebonite as in Fig. 6, and fitted to the reduced ends of the bobbin. There now remain only a few small items to consider, and it has not been thought fit to show detailed drawings of these. They consist of an ebonite board carrying four terminals for the attachment of the filament

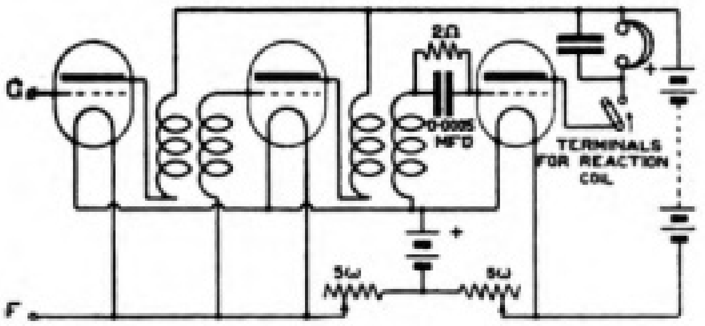


Fig. 7.

and plate batteries, two terminals for the telephones, and four ebonite bushes for the tuner and reaction-coil terminals. A rough drawing of the internal lay-out, coupled with a diagram of connections (Fig. 7), should furnish all the further detail required. The points to be watched are that none of the metal portions touch the wood, that the wiring is carried out with No. 18 S.W.G. copper wire, preferably tinned, and insulated with a prepared tubing now sold for the purpose, that all wires be as short and as straight as is consistent with decent separation, and every joint well soldered.

In conclusion, first connect the tuner to terminals G and F. If spark signals are to be received the reaction-coil terminals should be kept "shorted." For C.W., connect reaction-coil to these terminals, removing the shorting link. With a plate-batter of 30 volts and a filament battery of 4 volts, very good signals can be received.

The writer feels sure that any amateur will be well paid for the time and trouble expended in the construction of this amplifier which will enable him to increase his knowedge of the thermionic-tube.

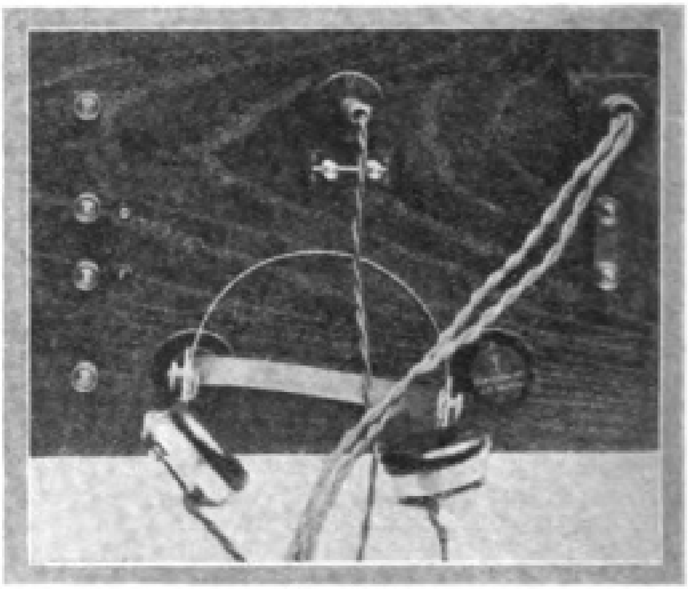


Fig. 8.

The photograph shows the complete amplifier. (Fig. 8). In this particular model the battery and head-gear connections are made by means of plugs fitting into corresponding sockets on the front of the case.

TRANS-ATLANTIC TESTS.

About 200 Amateurs have entered their names for the trans-Atlantic tests mentioned in the September 18th issue. Have you sent in yours? If not, why not? Address enquiries to Mr. Philip R. Coursey, c/o The Wireless Press, Ltd., 12-13, Henrietta Street, W.C. 2, who is in charge of the organisation of the project on this side of the Atlantic.

PAGES FOR BEGINNERS

Under this heading we publish COMPLETE *instructional articles, forming a series specially designed and written for beginners in wireless work. Hardly any mathematics will be introduced, and we hope to present the fundamental facts of wireless in such a manner as will prove attractive to a much wider range of students than that for which this series is primarily intended.*

THERMIONIC VALVES—II.

IN the last article it was seen that the quantity of electrons emitted by a hot filament depended chiefly upon two things—the temperature of the filament and the potential of the plate. Also, it will be remembered that corresponding to a certain temperature of filament, there is a maximum value of plate-potential, above which it is unnecessary to go. This value of potential is known as the *Saturation* value.

Until this value is reached, it is possible to control the electron emission by varying the plate-potential. There is, however, another method, the advantages of which will be seen as we proceed. If we insert in the bulb another electrode, between the filament and plate, and arrange to vary its potential between a few volts, negative and positive, it will provide an easy means of controlling the flow of electrons. The controlling electrode usually takes the form of a piece of wire gauze or an open coil of wire, and is termed the *grid*.

If the grid is positively charged, it will, provided the tube is not in a saturated condition, assist the flow of electrons. On the other hand, if the grid is charged with a negative potential, it will repel the negatively charged electrons, and prevent their travelling beyond it to the plate. These electrons will fill the space between grid and filament, and further repel the electrons emitted, until the space is completely filled with negatively charged particles, and the flow to the plate ceases altogether.

Now, suppose we momentarily alter the potential of the grid from negative to zero or positive. Instantly the stream of electrons will be released and flow to the plate, establishing the current again. If the potential is again altered to its previous negative value, the current will once more be interrupted. Further, if we imagine the potential of the grid to be continually varying, there will be a continuous variation in the electron-current through the anode. In fact, the valve can be considered to act as a very sensitive relay, where a slight change in the grid-potential will make a corresponding change in the electron-current. Fig. 1 illustrates a usual type of valve, with the grid in the form of a concentric spiral of wire round the filament, and the anode formed of a sheet of metal bent into a cylinder.

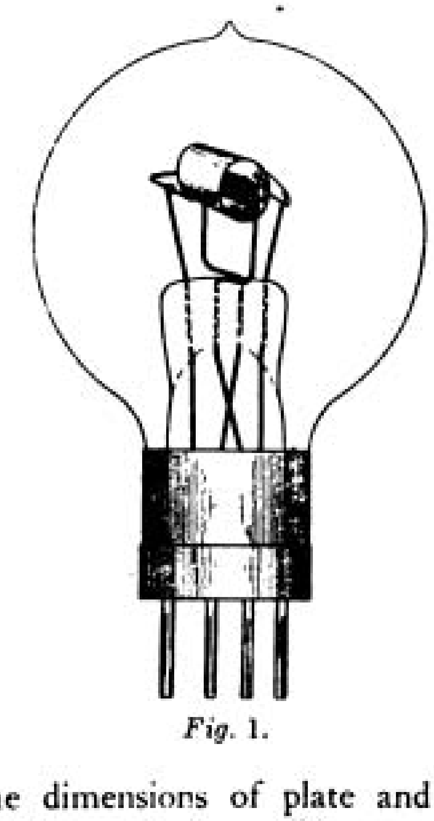


Fig. 1.

If the dimensions of plate and grid are suitably chosen it is possible to so arrange matters that a very slight alteration in the grid-potential will make a correspondingly larger change in the anode-current. The valve will then act in effect, as an *amplifier* or strengthener.

In order to find the best conditions under which a valve will operate, it is necessary to have some information regarding the variation of electron-current with grid and plate potential.

This information is obtained by observing the current which flows when the voltage of the grid is adjusted to a certain value, and plotting a series of these observations to form a curve.

For example :—Suppose we have just bought a valve, and wish to know the best value of grid-potential in order that its amplifying power shall be as high as possible. Valves, when supplied by the makers, are usually marked with the values of filament and plate-voltage at which they will work. Our newly-acquired valve, therefore, will bear such figures as 4 volts, 50 volts, (*i.e.*, 4 volts is the maximum safe potential for the filament, and 50 volts is a suitable value for the plate potential).

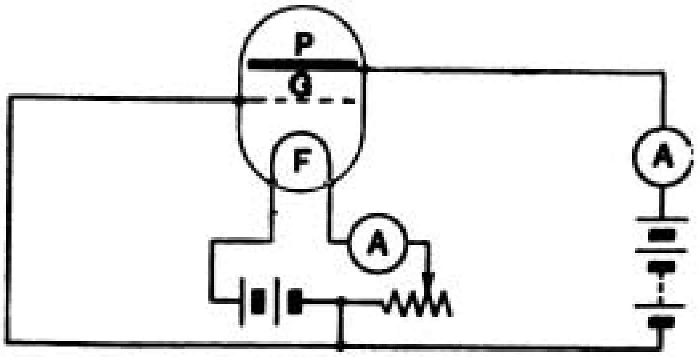


Fig. 2.

The valve is then connected, as shown in Fig. 2. The high-tension battery which supplies the plate should preferably be capable of adjustment. Convenient tapping points in a 50-volt battery would be at 25, 30 and 40 volts. In the filament-circuit is connected a 4-volt battery, and a variable resistance, R, which will control the current through the filament. Also, we must include measuring instruments—one in the plate-circuit and the other in the filament-circuit.

Now, with a constant potential on the plate, we vary the current through the filament (and hence its temperature), noting the change in the anode-current as the temperature is raised. The same series of observations can be made with a different value of plate-potential. Finally, these results can be plotted in a curve, which will be of the form shown in Fig. 3. From this curve it will be seen that after a certain value of filament

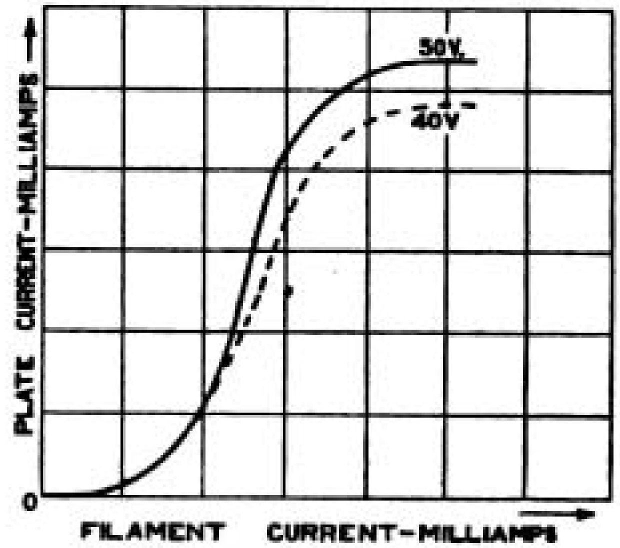


Fig. 3.

current is reached, there is a very large increase in the number of electrons emitted for a correspondingly small increase of filament temperature. The final flat shape of the curve is due to saturation, as mentioned before.

The next point to be considered is the effect of the grid upon the electron flow.

In order to observe this, we must connect the grid to a potentiometer supplied by a battery, so that the voltage can be varied from, say, 3 volts negative to 3 volts positive. This may be effected by connecting the battery to a reversing switch, so that the polarity may be easily changed. The essential

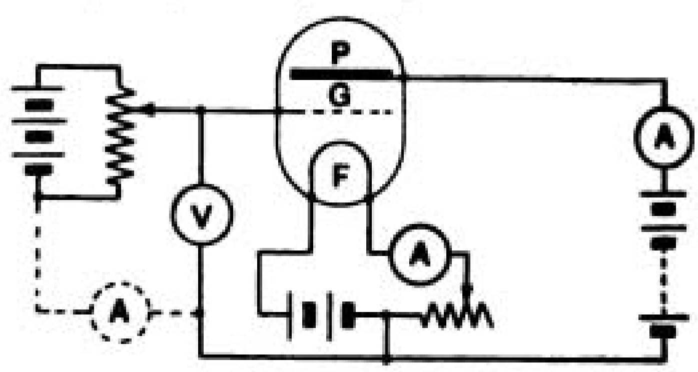


Fig. 4.

connections of the circuit are shown in Fig. 4, while the curve of Fig. 5 shows the variation of plate-current with grid-volts, for various filament temperatures.

For negative values of grid-potential, the plate-current is very small, but it increases as the grid-potential varies from zero to a small positive value.

Consider the effect of increasing the grid-voltage to a high positive value. It will behave as though it were a second plate, interposed between the true plate and the

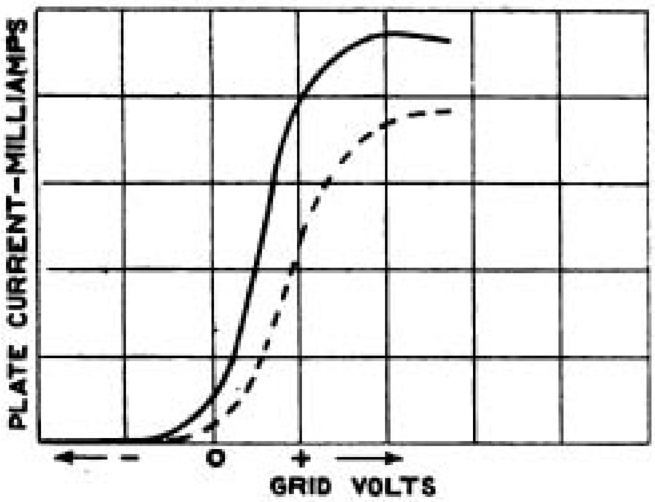


Fig. 5.

filament. Hence, the electrons will be diverted from the plate to the grid, and the plate-current will diminish again. This point is illustrated by the top curve in Fig. 5. The plate-current begins to diminish after the grid-potential has passed a certain value. The attraction of electrons to the grid will cause a current to flow between the grid

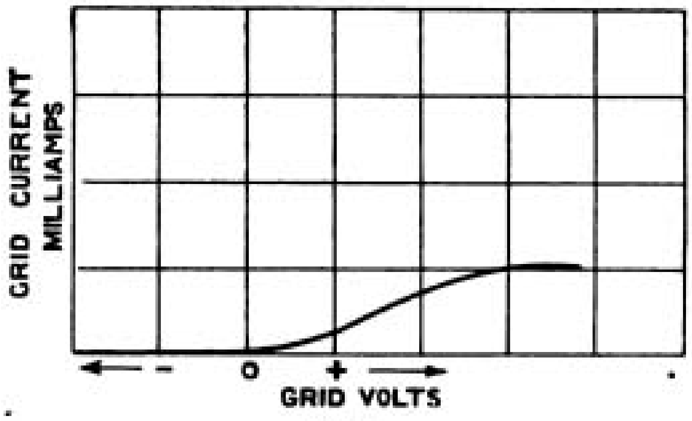


Fig. 6.

and filament (refer to Fig. 4), which will be recorded by an ammeter placed in the grid circuit (shown dotted in Fig. 4).

Thus, we can plot a third curve, connecting grid-current and grid-potential, as in Fig. 6.

These curves are usually termed "characteristics," and, of course, vary with the make of valve and dimensions of the electrodes. The three curves are known under the names of plate, filament or grid-characteristics, according to the values of the variable quantities that they show. Thus :—

Plate characteristic (or simply "the characteristic").	Curve connecting plate - current and grid-volts.
Grid characteristic.	Curve showing variation in grid-current with grid-volts.
Filament characteristic.	Curve connecting electron emission (*i.e.*, plate-current) with filament temperature.

NOTA BENE

Owing to the increasing activity amongst amateur wireless workers, the number of queries received for our "Questions and Answers" columns has trebled during the past three months and we have accordingly increased the number of pages devoted to them. In spite of this, however, we are regretfully compelled to hold over a number of replies each time we go to press. Readers may rest assured, however, that questions are dealt with in order of sequence.

The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

A FRAME AERIAL RECEIVING SET—II.

A FOUR-FOOT square experimental frame was wound, consisting of 40 turns of No. 20 D.W.S., the turns being spaced ¼" apart, and with loading inductance and suitable tuning condensers, gave very good long-wave C.W. signals, with a 3-valve amplifier and separate local oscillation-generator. We will adopt this winding for our purpose.

A suitable frame was described in the previous issue. This frame should be wound with 40 turns No. 20 D.W.S., the turns being spaced ¼" apart. The amount of wire required will be 2½ lbs. The pegs to take the winding—see Fig. 1, previous issue—should project 10½" from the frame, and should be notched or grooved every ¼", so that the wire may be bedded at the corners and the turns be equally spaced. It will be advisable to strengthen these pegs by means of two bamboo canes stretched across opposite diagonals, otherwise, when the turns nearest the ends of the pegs are being wound, the pegs will tend to spring in, and the turns which are already wound will become loose. See that the wire is pulled tight and is not allowed to sag. The two ends of the wire should be taken to two terminals mounted on the frame. No tappings will be required.

The experimental frame wound as above was found to have an inductance of 4,500 mhys. and a natural wavelength of 1,000 metres.

To obtain the wavelength range originally specified—15,000 metres—a combination of loading inductance and tuning condensers is necessary, in addition to the inductance of the frame itself.

The combination given below—a loading inductance of 8,500 mhys. and a condenser value—fixed and variable—of ·0055 mfd. approximately gave an overall wavelength range of 1,700 to 16,000 metres.

When the frame is made the next thing to make is the tuning panel, which is shown in Fig. 4. This is a hard-wood (teak or mahogany) panel, upon which the loading inductance, variable and block condensers are mounted. It should be cut from hard, dry wood, ⅜" thick, and should be 7½" long, 4" wide. We will now describe the parts mounted on the panel.

The Block Condensers.—There should be three condensers, ·0014 mfd., ·0028 mfd. and ·0042 mfd. capacity respectively, mounted in one clamp. This clamp may be made of hard wood, ¼" thick, and should be 3¼" long and 1" wide. Fig. 5 shows the condensers mounted in the clamp.

To make the condensers, obtain some mica sheets, ·01" thick and 2½" long, by ¾" wide. Some copper foil, ·02" thick, should also be procured and cut into strips

The various combinations and their wavelengths are as follows :—

Frame alone—no loading inductance.

Cap	·0015 mfd. variable	+	no block cond.	λ	1,700—4,700 metres
,,	·0015 ,, ,,	+	·0014 mfd. block	λ	4,500—6,500 ,,
,,	·0015 ,, ,,	+	·0028 ,, ,,	λ	6,200—7,500 ,,
,,	·0015 ,, ,,	+	·0042 ,, ,,	λ	7,300—8,700 ,,

Frame with loading inductance in series.

Cap	·0015 mfd. variable	+	no block cond.	λ	2,500— 8,000 metres
,,	·0015 ,, ,,	+	·0014 mfd. block	λ	7,800—11,300 ,,
,,	·0015 ,, ,,	+	·0028 ,, ,,	λ	11,000—13,500 ,,
,,	·0015 ,, ,,	+	·0042 ,, ,,	λ	13,000—16,000 ,,

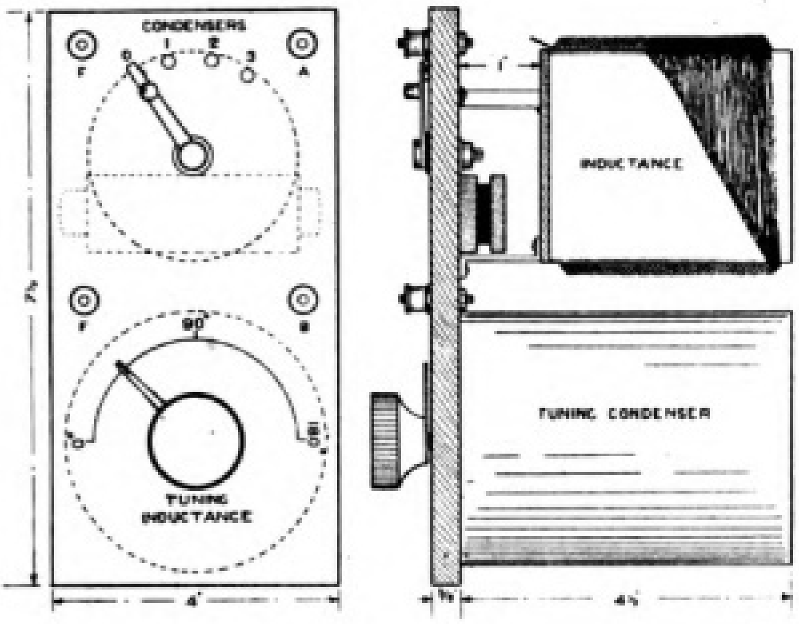


Fig. 4.

½" wide and 2¾" long. Make up the condensers with one sheet of mica between each copper foil, and place the foils so that they overlap each other by 1½". The foils and mica should be stuck together by means of shellac varnish, and when the condensers are complete should be clamped together, then thoroughly dried in an oven. For the ·0014 mfd. condenser use 2 foils each side. For ·0028 mfd. use 4 on one side, 3 on the other, whilst for the ·0042 mfd., 6 foils on one side and 7 on the other should be used.

The Loading Inductance.—An inductance of 8,500 mhys. is required, and to obtain this in a compact form, we must adopt a pile-wound former. Make a stout cardboard tube, 3½" outside diameter, and not less than ⅛" thick. Fit a ⅜" wood plug at each end of the tube, to give it mechanical strength. The plugs should be secured to the former by means of three countersunk wood screws, passing through the tube into the wood. Before the former is wound, the brackets which fasten it to the panel should be made and fitted. The shape of these brackets is shown in Fig. 6. They are made from brass strip, ⅛" thick and ⅜" wide, bent as shown. These brackets serve the double purpose of holding the former on to the panel and at the same time raising it 1", to make room for the block condenser. When the former is thus finished, it may be removed from the panel and wound.

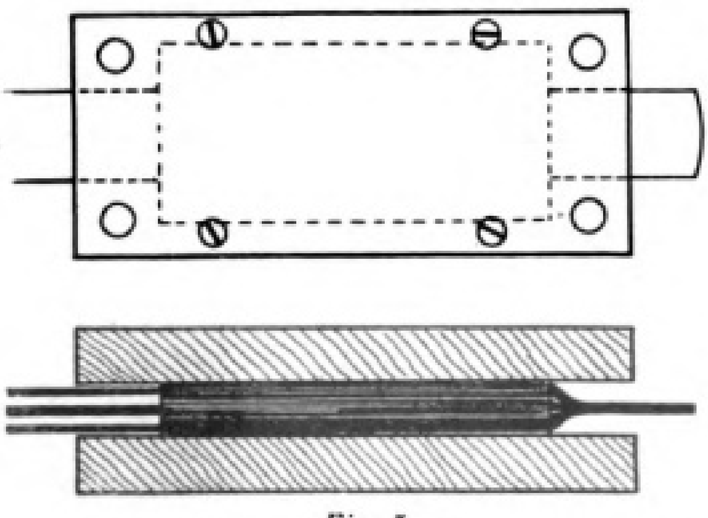


Fig 5.

The winding should be a 4-pile layer-winding of No. 22 D.W.S. The former

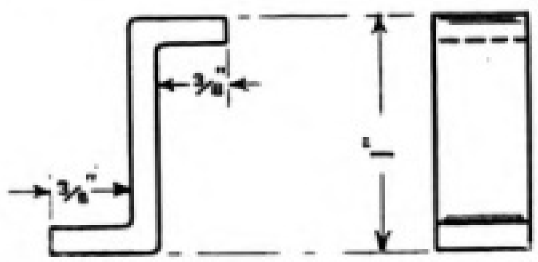


Fig. 6.

should be wound to within ⅛" of each end. Full descriptions of pile-winding having been given in recent numbers of the *Wireless World*, details can, therefore, be obtained elsewhere. It is sufficient to say that the winding must be carefully done, and the wire kept as tight as possible. For this winding, about 1 lb. of wire will be necessary. The start and finish should be secured by means of a looped tape slipped under some of the turns and the loop pulled firmly on to the end it is desired to hold. When finished the former should be given a coat of shellac varnish and dried in a moderately warm oven.

When these parts have been made, they should be finally mounted on the tuning panel. The ·0015 air-condenser was recently described in these columns, and reference should be made to back numbers.

A single-pole switch with four contacts should be mounted on the panel, as shown, to connect the block condensers in circuit. The wiring diagram of this panel will be given in conjunction with the wiring diagram of the 3-valve amplifier, to be described in the next issue.

BOOK REVIEWS

PRINCIPLES AND PRACTICE OF ELECTRICAL TESTING.

By R. G. ALLEN, B.Sc.(Lond.), A.R.C.Sc.I., A.M.I.E.E.

London : Longmans, Green & Co., pp. 363, with diagrams (18*s.* net).

In writing this book the author has endeavoured to present in a single volume the principles and operations of the fundamental electrical laboratory tests, the testing of circuits, and the testing of electrical machinery, the results of actual work being given in detail.

The book opens with two chapters exclusively devoted to general principles, following on with further chapters describing and explaining the principles of alternating currents.

Chapter VI gives a lucid treatise upon the measurement of resistance and the testing of insulation. Classifying resistances as low, medium, high, and those which contain a polarisation voltage, this chapter describes various methods by which measurements of these resistances may be arrived at, and although a certain amount of mathematics is involved, its reading should not be in any way too difficult for the student to follow. On page 105 a description and a diagram of the Crompton Potentiometer shows how the instrument is arranged for testing any required voltage within the limits of its range. Other descriptions include Stroud and Henderson's D.C. method of measuring liquid resistance, Callender's Pyrometer, A. Russell's method of determining dielectrics strength of insulation. Nearly every chapter of the book concludes with examples which the student may use to test whatever knowledge he may have gained from previous reading. Answers worked out by slide-rule calculation are given throughout the book.

LIGHTING CONNECTIONS.

By W. PERRIN MAYCOCK, M.I.E.E., and GUS. C. LUNDBERG, M.I.E.E.

London : A. P. Lundberg & Sons. Sixth Edition. Price 10*d.*

This little book dealing with a subject from which many amateurs could gain much information regarding the wiring of their apparatus, is both compact and interestingly written. Descriptions of many improved switches, mostly of the tumbler pattern, are given, together with a variety of useful methods of controlling lighting circuits, and though some of the controls have been in existence for years, they still remain to be discovered by many electrical people.

JANE'S POCKET AERONAUTICAL DICTIONARY.

Extracted from "All the World's Aircraft." Edited by C. G. Gray.

London : Sampson, Low, Marston & Co., Ltd.. Price 1*s.* 6*d.* net

This little book is a dictionary of both technical and slang terms as applied to modern aircraft. Many of the words are illustrated in drawings of "Pusher" and "Tractor" Biplanes, and the parts thus described may be identified by following the lettering of the squares on the drawings or plans.

QUESTIONS AND ANSWERS

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Questions should be numbered and written on one side of the paper only, and should not exceed four in number. (2) Queries should be clear and concise. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators wil save time by writing direct to the various firms employing operators.**

H.A. (Dorking) *asks* (1) *For a diagram of connections of the French L1 type amplifier. He does not understand why there are more than four leads to each transformer.* (2) *How many turns should a loop 4′ by 3′. solenoid winding, have to reach 20,000 metres with ·001 mfds. variable condenser, wire 22 S.W.G. closely wound.* (3) *Why can quite good signals be obtained with one valve in backwards, in the Marconi type 55 amplifier.* (4) *For a diagram of a Marconi 4-valve heterodyne set which he cannot get to work.*

(1) See Fig. 1.

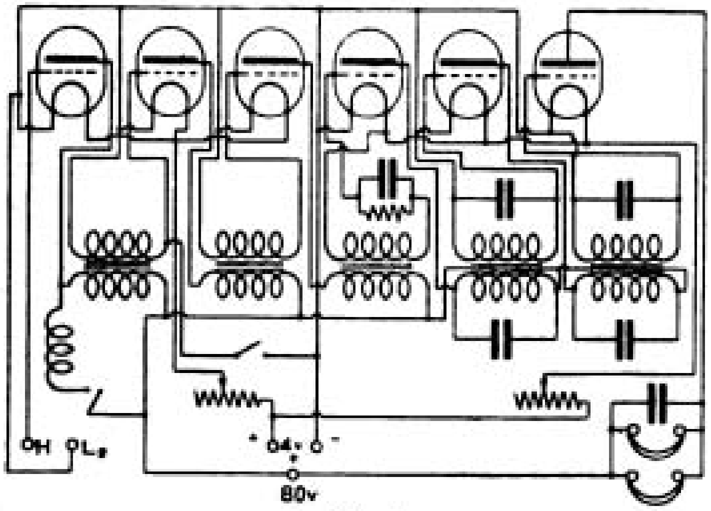


Fig. 1.

(2) This is practically impossible to calculate accurately, but about 300 would be required.

(3) It is not easy to say with certainty. Possibly the capacity coupling between plate and grid may account for it.

(4) We cannot identify this set without further information.

H.W.Y. (Shrewsbury) *is a comparative beginner and asks* (1) *If we can outline the apparatus required or a receiver to give the best possible results, expense not to be more than £20.* (2) *If in a loose-coupler it is not possible to make inductances longer and narrower than usually given, asking also how long the coils of a coupler would have to be if primary were 3″ and secondary 2¼″ diameter, for a wavelength of 10,000 metres.* (3) *If valves are really necessary.* (4) *What size of wire to use for a loose-coupler.* (5) *What good book will help him in his search for information.* (6) *If there are any parts of a central battery telephone station which might be useful in making a set.*

(1) We are afraid we cannot answer this adequately in the space at our disposal. We should recommend you to start with a comparatively simple set, as that for instance, described in the constructional article in the April 17th issue. You will find all the parts of this set easy to incorporate in a more advanced set, when you know sufficient to decide what type of advanced set you prefer.

(2) For the diameters you suggest and using No. 28 and No. 30 wire, respectively, length would have to be about 2′.-6″. Coils would not be very satisfactory.

(3) For a really good set—yes.

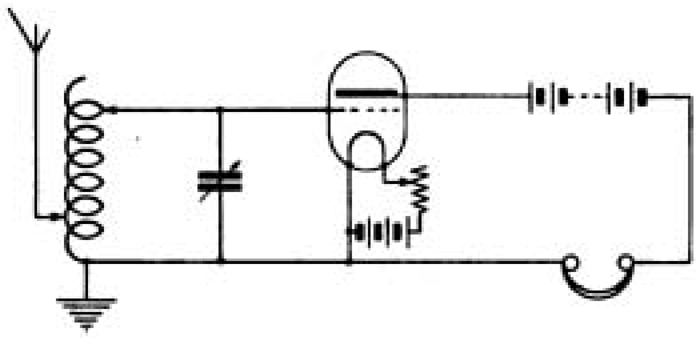
(4) Primary should preferably not be thinner than No. 22, but has, at times, to be made thinner if a long wavelength range is required. Secondary can be about No. 30.

(5) Try Bangay's "First Principles" and "The Oscillation Valve."

(6) Very little, except possibly the telephones. *Four questions only, please.*

G.D. (Wimbledon Park) *asks for a diagram of a circuit using one valve, double-slide tuning coil, variable condenser, H.T. batteries, filament accumulator and telephones.*

See Fig. 2.



F.V.G. (Loughborough) *sends some particulars of his own and of his friend's sets and asks the following questions.* (1) *Is my friend's aeral high enough for crystal reception, also please advise me re-earth.* (2) *For criticism of two receiving circuits.* (3) *For criticism of aerials.* (4) *If it is possible to receive Chelmsford concerts on both sets, without and with valves.* (5) *Approximate resistance necessary for filament potentiometer.*

(1) It should give results, but more height is desirable. Bury earth plate as suggested, but make area much more than 2¼ square feet.

(2) Fig. 3 is O.K. and Fig. 5 is O.K. except that the top lead from ·0005 condenser should go to other side of detectors.

(3) Both very fair, Fig. 4 aerial, reception would be better if removed from the tree, if possible.

(4) Most probably without valves, and certainly with.

(5) Not less than 100 ohms. *Four questions, please.*

F.B. (Hornsey) *wishes to make a compact receiver to tune from 150 to 20,000 metres, by using two separate coils with a change-over switch from short to long waves. He asks for the following information.* (1) *Diagram of a set, using one or two V24 valves.* (2) *What type of coils are recommended.* (3) *Full details of windings for all coils.* (4) *Values of necessary condensers.*

(1) More valves can be added in any of the orthodox ways. Fig. 3 gives a single-valve circuit.

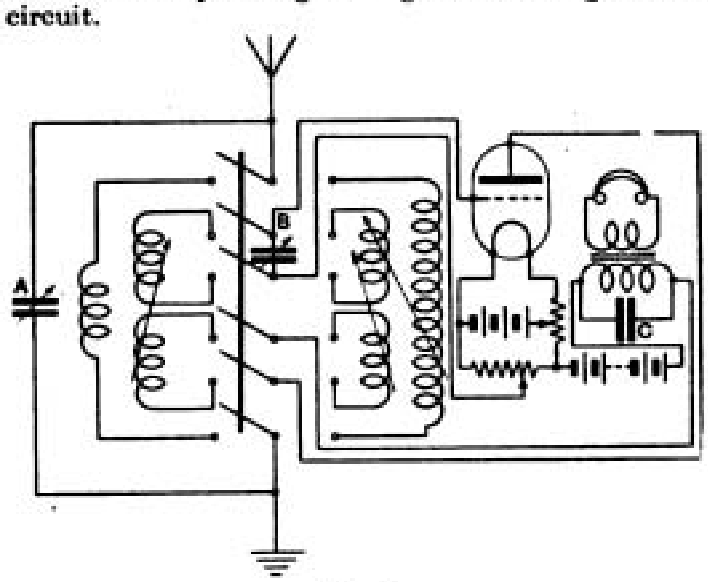


Fig. 3.

(2) For short-wave use single-layer cylindrical coils. For long waves use pile-wound cylindricals, pancake, or a honeycomb if obtainable.

(3) We regret that the number of questions to be answered does not permit us to undertake the detailed designs of unusual receivers in these columns.

(4) Condenser A equals ·0005 mfds., condenser B is ·0005 mfds. C should be not less than ·001 mfds.

F.J.F. (Polegate) *asks* (1) *What size coil would be necessary for transmitting about 2 miles.* (2) *The capacity of transmitting condenser and nature of transmitting inductance.* (3) *What sort of receiving inductance to use for receiving from above transmitter.* (4) *If the crystal detector described in No. 6 of the new series could be used for the purpose.*

As you do not say anything about your aerial, etc., we can only give approximate answers to your questions. Also we should recommend you to make your transmitters and receivers separate units, and not inter-connect them as shown.

(1) About 12 watts in the primary might be sufficient.

(2) Capacity might be about 1 jar. Inductance should be of auto-coupled type, having perhaps 20 turns of No. 10 copper, 6″ in diameter, spaced half-inch apart. A suitable number of these should be tapped across the condenser and spark-gap to tune this circuit to the aerial-circuit.

(3) Coil should be double slide, on a former, perhaps, 8″ × 4″ wound with No. 24 wire.

(4) Yes.

A.A.L. (Bradford) *sends a sketch of aerial system of a receiver which appears to give good results. The aerial is of twin type, with the outer ends jointed. He asks if he would get better results by* (1) *The removal of the connections between the tops of the wires.* (2) *Substituting a single-wire aerial of maximum length for the twin.* (3) *If improved results can be obtained by either of these means, what explanation of the improvement can be given.*

(1) This may give a slight improvement.

(2) We do not think this would make much difference.

(3) Disconnecting the ends may stop a certain amount of local circulation between the wires; but the bad effect of joining the ends is much less in the case of a twin than in a multi-wire aerial.

RADIO (Exeter) *asks* (1) *What are the capacities and wavelengths of two aerials (a) and (b) of specified dimensions.* (2) *If sheet zinc on a flat roof will have any effect on aerial.* (3) *If we have any suggestions or criticism on aerial, and which of the two described is the better.* (4) *Is there a wireless club in Exeter.*

(1) (*a*) About ·00027 mfds. (2-wire); wavelength about 96 metres. (*b*) About ·0002 mfds. (1 wire); wavelength is about 130 metres; increasing size of wire will increase capacity slightly, wavelength will remain constant.

(2) The roof will have the same effect on the aerial as the earth, *i.e.*, it will increase its capacity. It should not spoil your reception at all.

(3) Your arrangement seems satisfactory, and there is very little to choose between the two aerials.

(4) So far as we know there is none. Why not start one?

F.G.G. (Billericay) *sends sketch of frame aerial receiver. Coil A is 35 cms. long and 13·5 cms. diameter, Coil B is 15 cms. long and 15 cms. diameter, coil C is 15 cms. long and 12½ cms. diameter, all being wound with No. 30 wire. Condenser D has nine fixed and nine movable plates, each 15 × 10 × 1/20 cms. spaced ½ cm. apart, and asks* (1) *For criticism.* (2) *Whether connections are correct.* (3) *Approximate wavelength to which set will work. Frame has 20 turns spaced ⅜″ on a square former of 3 ft. side.*

(1) and (2) The receiver is almost useless as it stands; an open aerial circuit with frame aerial gives practically no results. We should recommend rearranging as in Fig. 4, not using coil A at all. Note alteration of potentiometer connections which were wrong. The spacing on frame would be better 3/16″ than ⅜″.

(3) Maximum wavelength with this arrangement would be about 5,000 ms., which is quite enough for this set. Better results would be obtained by re-winding all the formers with thicker wire, say No. 24, and then using all three for loading.

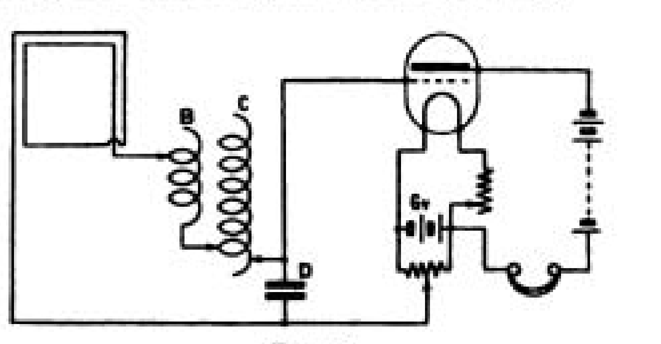


Fig. 4.

QUESTIONS AND ANSWERS

SPARKOLOGIST (Sussex) *asks* (1) *What would be the cost of making a receiving set intended to pick up signals from Chelmsford, Eiffel Tower, etc.* (2) *Are there any books or back numbers of the "Wireless World" giving directions on making such a set.* (3) *What voltage would be required, and could it be obtained from primary cells.* (4) *What alterations would have to be made for wireless telephony, and would they be expensive.*

(1) It is difficult to say, as it so much depends on the type of set and the ingenuity of the maker. Say, a few pounds.

(2) You will find two suitable sets described in the *Wireless World* for December and April 17th last. The December issue gives a set more elementary and cheaper to make; the other, of course, gives better results.

(3) If a crystal set is used, only about 4 volts of small dry cells will be needed. If a valve set is used, about 24 volts (or more, depending on the type of valve) of dry cells, and a 6-volt accumulator of capacity at least 10 ampere hours, will be required.

(4) No alterations are necessary for the reception of telephony.

J.T.D. (Wallsend) *has a two-circuit crystal receiver, with a 3,500-metres loose-coupler, which will only give signals from Cullercoats about six miles away. Aerial is double, 36′ long and 12′ high. He asks* (1) *If it is likely that he is getting earth currents and not aerial signals.* (2) *If seven-strand wire would give better results than single wire $\frac{1}{8}''$ in diameter for the aerial.* (3) *How to connect a Mark 3 short-wave tuner for a wavelength of, say, 4,000 ms.*

(1) We do not think so: the smallness of your aerial will almost explain the poorness of your results. Perhaps the crystal is rather poor.

(2) Very little, if any.

(3) See other replies recently. You should add considerable amount of inductance, both to your A.T.I. and tuned-circuit inductance. It will not be much good to re-wind the old formers, as they will not hold enough wire. For any specified range you will need at least twice as big a coil for your aerial as would be needed for a full-size P.M.G. aerial: to be safe, you should make it three times. For suitable coils, see recent replies.

R.E.H.B. (Ilford) *has a Mark 3 short-wave receiver, and wishes to convert it in order to receive up to 5,000 ms. He asks how to do this without converting the coils of the tuner. He also proposes to use a double-slide inductance for the purpose.*

This matter has been dealt with in several replies recently, which say 5,000 metres is too long for efficient work on a set adapted in this way. For 3,000 metres, see reply to **F.W.S. (Coventry)**. If you wish to avoid altering coils in receiver you will have to make an entirely new loose-coupler and connect the new coils to the terminals to which original coils were connected. For suitable dimensions of loose-coupler, see many recent replies.

L.J.N.K. (Towyn) *asks* (1) *If a circuit, sketched, is suitable for C.W. and spark reception.* (2) *What is the best size for the reactance coil if his aerial inductance is made as described by A. D. Kent, in the December, 1919, number, and wound with wire similar to an enclosed sample.* (3) *What alterations, if any, will be needed to receive telephony.* (4) *Which will be the more efficient* (a) *a single-wire aerial 90′ long with a 10′ down-lead, or* (b) *a twin-wire, 3′ apart and 60′ long, with a 20′ down-lead.*

(1) Yes.

(2) This will depend on the valve, etc. Try about $4'' \times 4''$ of same size wire as A.T.I.

(3) None.

(4) If the 20′ down-lead means double the height for the aerial, the twin-aerial will probably be the better; but if the aerials are both the same height, single wire will be more efficient.

R.H. (West Hartlepool) *sends sketch and description of a two-circuit crystal receiver,* A.T.I., $11'' \times 4''$, *of No. 24, jigger-primary* $7'' \times 5''$, *of No. 26, jigger-secondary* $6'' \times 4\frac{1}{2}''$, *of No. 32. Aerial twin-wire 25′ long, not including down-lead, height about 30′. He asks* (1) *For criticism of set.* (2) *If he will get* FL, POZ *and* GCC. (3) *If he can dispense with an aerial condenser* A.

(1) General arrangement of set is quite good, but the aerial is undesirably small.

(2) As you do not give enough dimensions for us to calculate capacities of condensers, we cannot say. Without A.T.C. you should get about 1,800 metres, and therefore if condensers are of reasonably suitable values, you will probably hear FL.

(3) Using it as you have done, *i.e.*, in parallel with A.T.I., the condenser increases wavelength of aerial circuits, and is therefore desirable with such an aerial as yours.

F.W.S. (Coventry) *asks* (1) *How to convert a Mark 3 short-wave tuner for longer wavelength, and wishes to use No. 36 wire for the windings, if possible.* (2) *What would be the practicable wavelength possible to attain under the above conditions.* (3) *What increase in wavelength is possible with extra inductance in aerial circuit. He has a P.M.G. aerial.*

(1) We do not advise using such thin wire as No. 36 for an aerial circuit. You might re-wind tuned-circuit coil with No. 32 and A.T.I. with No. 26.

(2) With a suitable outside loading-coil in outside circuit, this arrangement should give you about 3,000 metres.

(3) With loading-coil alone you will get very little increased wavelength, but with re-arrangement of windings as given above, and a coil about $9'' \times 6''$ of 24 wire you will reach 3,000 metres.

P.R.P. (Derby) *wishes to buy a set to receive over distances of about 1,000 miles, and to get all stations which send messages of general interest. The total cost is not to be more than £25. He asks* (1) *For our advice.* (2) *If a receiving set, as usually advertised, includes everything, such as aerial, etc.*

(1) We should recommend you to get lists from the various advertisers in our pages; at the same time, if you like, asking them what they recommend. You should be able to get quite a good set for the money. We cannot suggest any particular set or maker for obvious reasons. You should preferably get a valve-set with about 2 or 3 valves, with a wave-range of about 5,000 metres.

(2) A receiving set does not, as a rule, include aerial, batteries, valves, or telephones, unless it is

specifically stated to the contrary. Our advertisers will quote you for all these items, and doubtless tell you exactly what types will be best for the set you propose to buy. In any particular case we shall be pleased to advise you.

J.J. (Higham's Park) *encloses sketch and particulars of a frame aerial receiving circuit, and asks* (1) *For criticism of, or any suggested improvements to the set.* (2) *Size of coils and number of turns of wire for pancake type tuner for 400 to 6,000 metres wavelength, using if possible No. 40 S.S.C. wire.* (3) *Size of coil and number of turns for reactance coil of tuner, using the same gauge wire.* (4) *Regulations regarding frame aerials, and whether there would be any difficulty in obtaining a licence for the circuit.*

(1) Your sketch shows no condenser in your frame aerial circuit. This should be provided, or, better still, your frame aerial should itself be included in the tuned-circuit. There is little, if anything, to be gained by providing a separate tuned-circuit for the frame aerial. Grid-condenser is too large: use about ·00005 mfds. You should not use wire as thin as No. 40, as results with such wire would be very poor. Set is otherwise O.K.

(2) Supposing that you use a single tuned-circuit, consisting of frame aerial, coil and ·0006 condenser, your coil should have about 500 turns of No. 28, the mean diameter of pancake being about 12 cms.

(3) Reaction coil might have 300 turns of, say, No. 32 wire, on a pancake of similar diameter.

(4) We do not think there would be any difficulty in obtaining a licence.

ANONYMOUS (Newark) *asks* (1) *Who are telephony stations 2BQ and 2BN.* (2) *For a diagram for a single-valve receiver, as his present one is not very efficient. He sends sketch (Fig. 5) and information as to components.* (3) *For values for a grid-leak.*

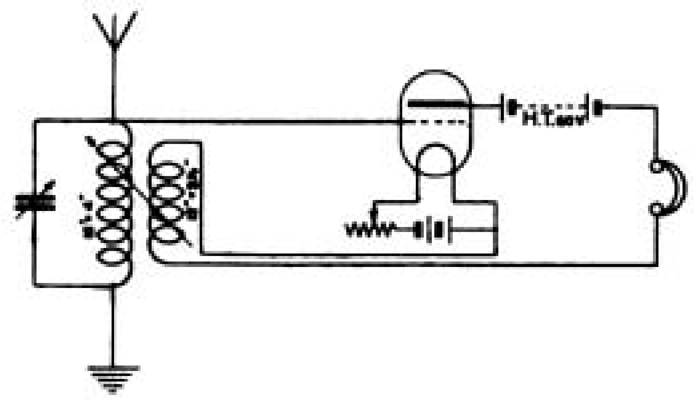


Fig. 5

(1) We have no information regarding these stations, but presume them to be amateur wireless telephony stations.

(2) Circuit shown is of quite good type for general work, but needs certain alterations: (*a*) connect filament battery to lower end of tuned circuit; (*b*) tuned circuit inductance would be much better of 12″ × 6″ of No. 24; even 12″ × 4″ of No. 24 would be better than your present one. Reaction coil would be better of No. 30 than No. 40. Also (*c*) put reaction coil on other side of telephones and H.T. battery; (*d*) for this type of set a blocking condenser across telephones is desirable.

(3) A grid-leak is not wanted for this type of set. When used it should be about 2 megs.

J.L.W. (Norbury) *wishes to make a set to receive the longest range possible but also wishes to get 600 metre stations. He asks* (1) *What size formers he would require for the A.T.I. tuned-circuit and reactance coils and gauge of wire for each coil.* (2) *Will telephones of 2,000 ohms resistance each receiver be O.K.* (3) *If a single-wire aerial would be suitable.*

(1) The circuit is of satisfactory type, grid-condenser should be about ·00005 mfds. You do not need two coils in aerial circuit; one is sufficient if a tuning-condenser is in parallel with it. A variometer arrangement is not satisfactory over a long range of wavelengths. A.T.C. might be ·001 mfds. A.T.I. might be 9″ × 7″ wound with No. 24 and with tappings down to quite a few turns. Reaction coil might be 5″ × 4″ of No. 28, but this depends somewhat on type of valve used.

(2) Yes.

(3) Yes.

W.H. (Bolton) *asks the following questions regarding the telephone set described by G. G. Blake in the July 24th issue.* (1) *Referring to the tuning inductance he asks what length of wire he will have to divide for the tens, also for the units. Does he divide the length of wire by 10 to get the tens, then divide one-tenth of the length to get units.* (2) *If a valve using only 25 to 35 volts on the plate, would do instead of the 60-volt H.T. battery used in this case.* (3) *What is meant by the hank method of winding.* (4) *Where is he to get a book for amateurs on the construction of wireless airships, boats, submarines, etc.*

(1) Take wire about 66′ long, take tappings at 6th, 12th, 18th feet, and on, until you come to 60th; then put 10 tappings in the last 6′ in the same way. Surely this is fairly evident from the description in the article referred to.

(2) Yes.

(3) It appears to be bundle winding as you suggest. This is rarely efficient, and you would be better advised to wind the coil in single-layer on a cylindrical former, using same number of turns with a diameter of say 3½″.

(4) Regret we do not know of one.

H.C.E. (Clapham Common) *asks* (1) *For criticism of a receiving set.* (2) *If he should be able to receive FL on spark, and if so, where on the inductance.* (3) *Whether the reason for not earthing to a gas-pipe is merely a prevention against risk of possible sparks during transmission, as he has a gas-pipe near by, but water-pipe is 49′ away.* (4) *What is the cost of a receiving permit.*

(1) The set is fairly efficient only, both on account of poorness of aerial (40′ twin about 18′ high) and resistance of loading-coil (12″ × 5″ of No. 30).

(2) Yes; probably with about three-quarters of the loading-coil in circuit.

(3) Chiefly on account of the probable high resistance to earth of the path obtained in this way.

(4) Ten shillings per year.

QUESTIONS AND ANSWERS

W.R.J. (Nunhead) *asks* (1) *Can the wavelength of an R.A.F. Mark 3 short-wave tuner be appreciably lengthened, and if so, how.* (2) *How could a valve be connected in the circuit. Is any extra connection necessary from the CC1 to form the reactance coil.* (3) *What plate-voltage is needed with a V24 valve.* (4) *What would be the normal range of the above set with a valve.*

(1) See answers to various other questions recently on this subject.

(2) Connect grid and filament across the tuned-circuit condenser. If C.W. reception is required, introduce a reaction coil in plate-circuit and suitably couple with tuned-circuit inductance.

(3) It depends somewhat on purpose for which used; for general purposes, 24 volts.

(4) Impossible to say. It depends too much on indeterminate factors, such as design of valve attachment and skill of operator.

READER (Chelsea) *has a difficulty with regard to his aerial system, he sends a plan of a proposed system and asks if telegraph wires have effect on aerial when same are at right angles with one another.*

As wires are at right angles to line of aerial, inductive effects will probably not be very bad, but make the distance more than 12′ if at all possible, *e.g.*, move pole to side of house above tank. The few feet of wire gained by taking it farther in are probably worse than useless. Telegraph wires will somewhat weaken signals coming from direction of house by their screening effect. Otherwise suggested system is O.K.

B.G.H. (Wembley Hill) *asks for* (1) *The fundamental circuits of the C.W. trench set Mark 2.* (2) *The fundamental circuits of the six-valve French amplifier, type* L1.

(1) We are not quite certain of the set, but believe it is as Fig. 6.

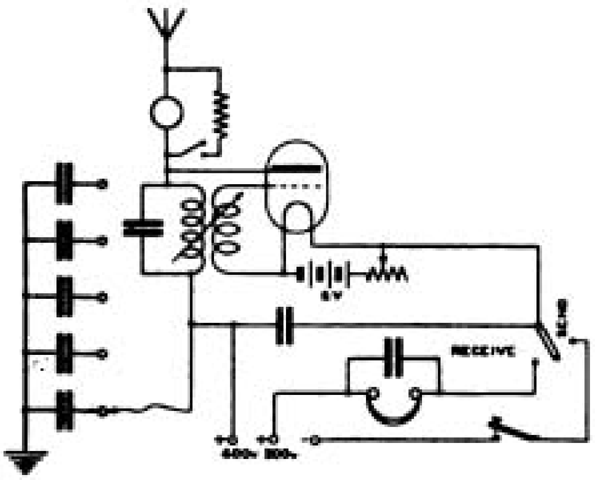


Fig. 6

(2) See reply to **H.A. (Dorking)**.

H.S. (Milton) *is a beginner at practical work, and asks* (1) *If he can use the following apparatus, in construction of a good receiver for 600 to 10,000 metres. Variable condenser, maximum capacity about ·00022 mfds., an inductance 8″ × 6″ wound with No. 26, and a bornite-molybdenite crystal.* (2) *He also wants to know if, in certain circumstances, he should apply for a licence as a Club or as an individual.*

(1) For crystal work we should advise a much less ambitious range. Use coil as primary of loose-coupler. Make secondary 7″ × 5″ wound with No. 30. Connect up as Fig. 7. This should make

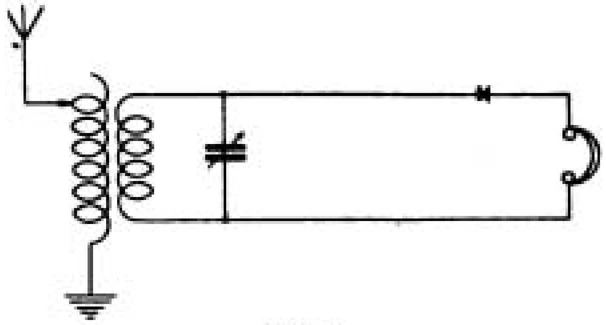


Fig. 7

a crystal set for use up to 3,500 metres, which is long enough for a crystal and short aerial. You can add further coils later if you desire.

(2) He should apply on behalf of Club only. We are sorry we cannot answer questions by post.

F.C.A. (Westcliff) *asks* (1) *In what place a variable condenser could be introduced in his set.* (2) *Does the resistance of the telephones have to suit other parts of the set.* (3) *If he would get better results by making a certain alteration to his aerial.* (4) *In what number of the "Wireless World" was the question concerning the use of mains for* H.T. *for valves.*

(1) Condenser might be added in aerial circuit between top of crystal and the aerial.

(2) Resistance of telephones should be about equal to resistance of crystal.

(3) Your aerial diagram is not very clear, but you would probably get better results with the alteration you suggest.

(4) We do not know which question you are referring to, as enquiries on this point occur fairly frequently; however, see Constructional Article in December issue.

BARKER (Sheffield) *has two cardboard tubes, and is winding one with No. 26 wire, and asks* (1) *With what size wire should he wind the other in order to give approximately the same wavelength.* (2) *Can he substitute a* L.F. *amplifier in place of his telephones, and if so, what alterations should he make to the existing circuit.* (3) *Could he use his two formers as a loose-coupler by putting one in the other.* (4) *How can he receive stations of a lower wavelength than about 1,800 metres, which is the lowest he can get at present.*

(1) This depends entirely on the capacities of the condensers to be used with the coils, about which condensers you say nothing. Possibly No. 28 or No. 30 would be all right.

(2) Yes; introduce a step-up L.F. intervalve transformer in place of telephones.

(3) The coils could be used as loose-coupler, i desired, though would not be convenient to handle. They should not be placed inside each other, as this would give much too tight coupling.

(4) You do not give dimensions of parts, but the obvious answer appears to be—use smaller inductances and condensers.

W.H.S. (Stafford) *encloses a diagram of a valve receiving circuit, and asks* (1) *If he would be able to receive spark and C.W. on this circuit.* (2) *If it is possible to receive long-distance stations on a 12′ indoor aerial or frame.* (3) *What capacity should A and B be, and what resistance telephones should he use.* (4) *What kind of valve do we advise him to get and from what firm can he obtain it.*

(1) Your circuit is incorrect as the grid is connected to the positive end of the H.T. battery. We append a diagram Fig. 8 of the circuit we think you intended to use. An additional variable condenser D is advisable. You should receive spark and C.W. with this apparatus. Your telephone transformer should have the high-resistance coil in the plate-circuit.

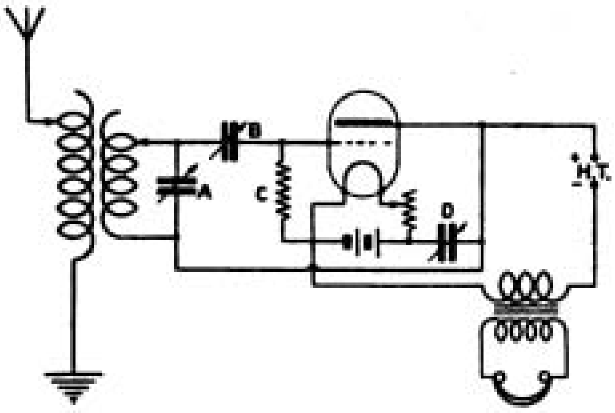


Fig. 8

(2) Yes, with a sufficiently powerful amplifier.

(3) All condensers ·0003 maximum. The leak C should be about 3 megohms. Low-resistance telephones, say, 60 ohms. are suitable.

(4) If you wish to use 4-volt lighting batteries, as specified in your sketch, we would advise an R type valve. See advertisement columns of the *Wireless World* for firms dealing in wireless telegraph apparatus.

J.B. (Manchester) *sends a sketch of a proposed pile-wound coupler to be used with a Mark 3 short-wave tuner and valve, for reception up to 8,000 metres; the variation of coupling being obtained by rotating one coil about a suitable axis. One coil is to be used in tuned-circuit and the other for reaction. He asks* (1) *If this arrangement will be efficient.* (2) *Dimensions of suitable windings.* (3) *If the effect of putting a condenser in series with an inductance is to reduce the self-capacity of the coil.*

(1) You do not say how you propose to adapt the Mark 3 tuner, and therefore we can only answer you approximately. This type of coupler should be quite efficient.

(2) Tuned circuit might be three-pile 6″ × 4″ wound with No. 28. Reaction could be about three-pile 4″ × 3″ of the same wire.

(3) No; this would reduce the total capacity of the circuit, but not the self-capacity of the coil itself.

SPAGHETTI (New Orleans) *asks* (1) *Capacity and natural wavelength of a twin T ship's aerial, horizontal span 230′, height above ship 60′, height above sea 85′, down-lead 75′ long at 45 degrees to horizontal.* (2) *If we can identify a circuit, sketch of which is sent.* (3) *If we can give data of apparatus required for the above circuit for a two-range receiver ranges being 500 to 2,500 ms. and 12,000 to 20,000 ms.*

(1) Capacity will be about ·001 mfds. and natural wavelength about 250 metres.

(2) We have not previously met this particular circuit, but there does not appear anything abnormal about it, except the division of the A.T.I. into two halves in parallel, which seems distinctly undesirable. First valve is arranged for detector, and second for L.F. amplification.

(3) We suggest the following: A.T.C. ·005 mfds., A.T.I. max. 30,000 mhys., grid-condenser ·00005 mfds., tuned-circuit inductance 4,000 mhys. and 150,000 mhys., grid-leak 3 megohms, telephone transformer and L.F. intervalve transformers, usual dimensions.

D.W.B. (Hammersmith) *asks* (1) *For criticism of a tuner of his own design and making.* (2) *Using an inverted L twin-wire aerial 40′ long and about 35′ high, to what wavelength could he tune the following—primary 11″ × 5″ of No. 24 enamelled wire, secondaries 8″ × 4″ and 2″ × 4″, each wound with No. 30 S.S.C.* (3) *Will a Marconi V24 valve be suitable,* (4) *What alterations are necessary to make this circuit receive C.W.*

(1) The set is of quite good type. You do not state capacity of tuned-circuit condenser, but if this is about ·0005 mfds., as it should be, you have more than enough inductance in tuned-circuit for your A.T.I.

(2) With a short aerial such as yours, aerial circuit will tune to about 1,600 ms. and tuned-circuit to 2,000 and 4,500 ms. respectively, for the two coils. You should therefore increase A.T.I. to about five times suggested inductance.

(3) V24 will be quite satisfactory.

(4) Introduce a reaction coil, say 4″ × 3″ of No. 28, in plate-circuit between H.T. battery and plate of valve, and couple this with the tuned-circuit coils.

SHARE MARKET REPORT.

There has been very little business in Marconi Shares during the last fortnight. The prices as we go to press (November 5th) are:—

Marconi Ordinary	3
" Preference	$2\frac{7}{8}$
" Inter. Marine	$1\frac{3}{8}$
" Canadian	9/-

The WIRELESS WORLD

VOL. VIII. No. 18, NEW SERIES] NOVEMBER 27th, 1920. [FORTNIGHTLY

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PRICE 6D. NET

THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 18. NOVEMBER 27TH, 1920 FORTNIGHTLY

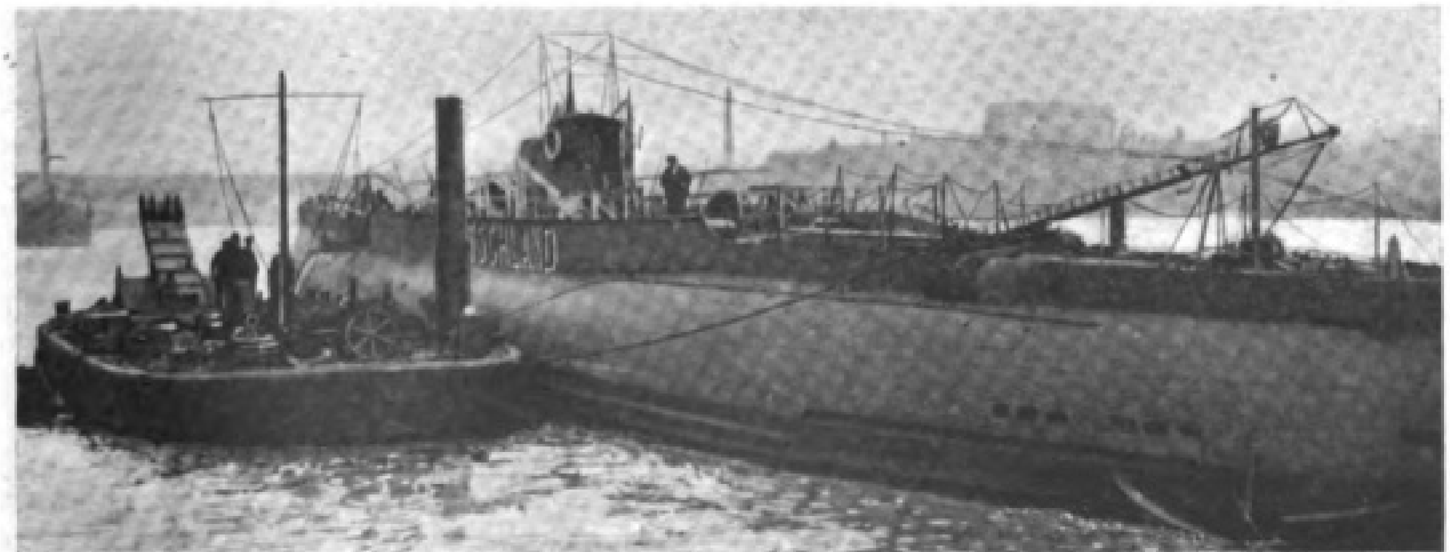
THE SUBMARINE'S WIRELESS

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

UNTIL quite recently the submarine vessel if fitted with a radio installation at all has only been able to communicate with the shore or with other vessels when upon the surface. Before submergence the aerial system required to be dismantled or at least lowered from its usual position, Fig. 1. In addition to these arrangements, others are now possible which greatly augment the utility of these vessels.

In an earlier article dealing with Hertz's early experiments with electric waves* reference was made to some of the "optical" experiments that may be performed with them which emphasise the similar nature of light and the longer hertzian waves. Using apparatus of the type there described or of any similar form, it is quite easy to show the opacity of all electrically conducting materials to the passage of the waves. The interposition of a sheet of metal between the transmitter and receiver serves to screen the latter almost completely from the effects of the emitted radiation. The reason for this effect is most simply seen by considering the electrical forces impressed upon the metal by the waves impinging upon it. The wave consists both of electrostatic and magnetic fields acting at right angles to one another. The action of both of these on a conducting body assists in the establishment in it of electrical potential differences and currents. By one of the most universally true of electri-

* "The Discovery of Electromagnetic Waves." *Wireless World*, 8, pp. 73–75, May 1st, 1920.



Photopress

Fig. 1. General view of Submarine, showing Wireless Aerials of the ordinary type.

cal laws, the direction of flow of these currents is such that the magnetic (and electric) fields set up by them act in opposition to the fields causing their establishment. These currents absorb the energy from the wave, with the result that to all intents and purposes the wave is stopped by the metal and prevented from travelling further in its original direction. The currents in the surface layers of the metal, however, set up magnetic and electric fields which give rise to waves which are propaged off in a direction perpendicular to the surface of the metal sheet. It is this secondary radiation that may be said to constitute the reflected wave sent back by the sheet.

As a result of these and similar experiments it has customarily been assumed that all conducting objects are completely opaque to electromagnetic waves. A consideration of the more accurate mathematical theory of wave propagation, however, shows that the whole of the energy of the incident waves is not absorbed by the surface layers of the metal, but that the absorption is gradual and follows an exponential law—that is to say as an approximate generalisation, the quantity of wave energy that exists at various depths in the metal or conductor decreases as the thickness of the metal is increased. The better the electrical conductivity of the metal the more rapidly does the effect disappear, and conversely with poorly conducting materials the wave penetrates to greater depths.

The higher the frequency of the oscillations—*i.e.* the shorter the wavelength—the less does the effect penetrate into the conductor. Hence, long wavelength signals penetrate to a greater extent so that the waves used in ordinary commercial wireless signalling will penetrate to a much greater depth into conducting materials than will the very short waves set up by a Hertz oscillator.

Seawater being an electrical conductor will not allow the penetration into it to any great extent of the waves falling upon its surface. The development of the extremely sensitive receiving and amplifying apparatus using electronic tubes has rendered possible the detection and reception of wave energies very much more minute than could previously be effected. This development has not only rendered possible the successful transmission of radio signals over greater distances with a less expenditure of power at the transmitter, but has also enabled the submarine which when submerged has always in the past been completely cut off from the outside world, to receive messages and instructions from ships and from other high-power wireless stations.

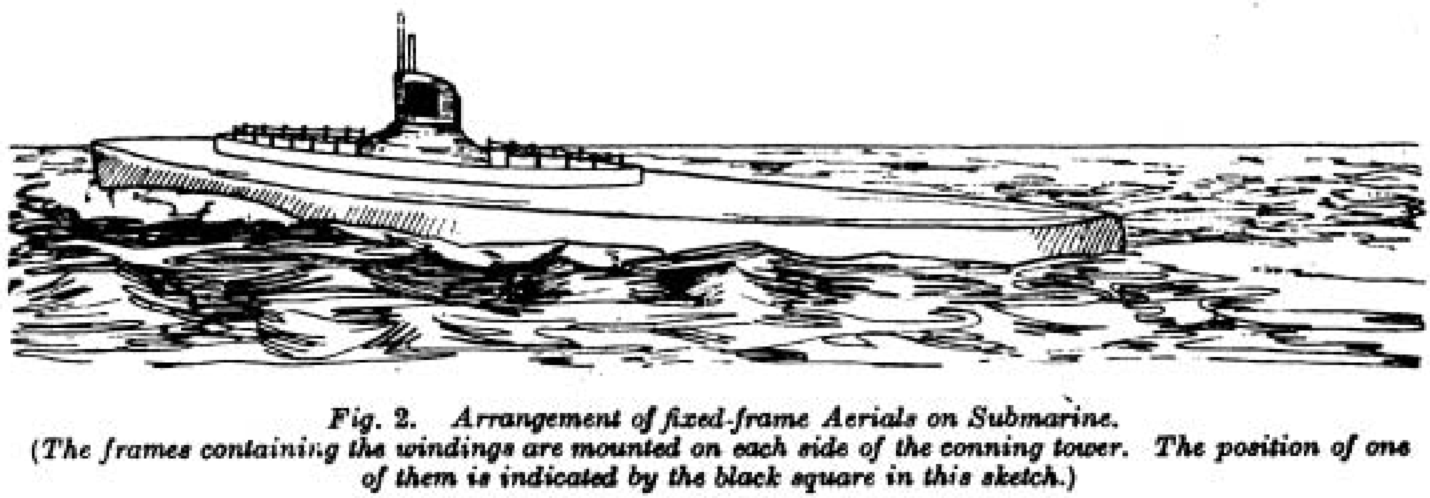


Fig. 2. Arrangement of fixed-frame Aerials on Submarine.
(The frames containing the windings are mounted on each side of the conning tower. The position of one of them is indicated by the black square in this sketch.)

The arrangement adopted depends upon the properties of the loop aerial, as this proves much better suited to the problem than the conventional pattern of ship aerial. In some cases well insulated and suitably protected loop aerials have been mounted outside the hull of the vessel and connected (through watertight glands) to the ordinary radio instruments inside, while in others—particularly in the American vessels—only a single turn loop has been employed stretched out for the whole length of the hull.

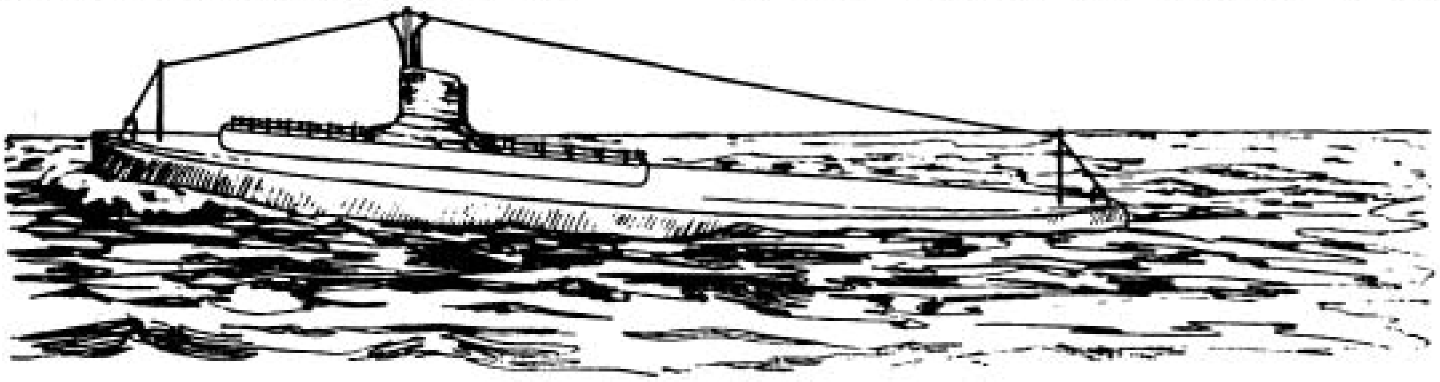


Fig. 3. Arrangement of single-turn loop Aerial on a Submarine. (The insulated wire is connected to the hull at both ends.)

The general arrangement of the former of these two types may be seen from Fig. 2, which depicts the arrangement of installation on a French submarine. The loop aerial is tuned to the wavelength to be received, by means of a variable condenser of appropriate value inserted between its ends. The condenser is joined to the terminals of an ordinary pattern of receiving amplifier and detector. A multi-stage high-frequency amplifier is practically essential for this purpose. This type of equipment is usually employed exclusively for reception.

The most important features of the American type of fitting are shown in Fig. 3. In this case the aerial consists of two wires which are led out from the radio apparatus and supported horizontally above the hull, one running forward and the other aft. At their extremities these wires are led down to the hull and connected to it, so that the return half of the loop is formed by the metallic shell of the submarine. Both wires should be most carefully insulated for their entire length from the leading-in glands and insulators to the points of connection to the hull, in order to preserve the proper loop character of the aerial. This type also is tuned and joined up to the radio apparatus in the same manner as the smaller multi-turn loop arrangement, the connections in this case being made from the centre of the upper (wire) side of the loop by two leading-in wires brought down and into the conning tower. This second type of aerial has been used not only for the reception of wireless messages, but also for transmission between the submarines. The range obtainable (about 10 miles when only just submerged), although short is at least a step in the right direction to increase the safety of their craft. Since the energy penetration of the waves falls off with increasing depth, it is not practicable to carry on communication at great depths. The strength of the received signals also falls off rapidly as the ship is submerged.

As an illustration of this drop in transmitting range with increased depth of submergence, the following figures may be quoted :

	Range	Aerial Current
Submarine running full speed on surface in heavy sea ..	50 miles	12 amps.
Submarine submerged, with top of loop near surface, and running at full speed ..	12 miles	6 amps.
Submarine submerged with top of loop nine feet below surface	3 miles	6 amps.

By means of relations established between the received signal strength and the depth of submersion, a comparison can be worked out between the transmission of radio signals entirely over sea and the transmission of the same signals to a submarine vessel at various depths, and in this way it is possible to ascertain at what depth signals can be received at various distances from a given transmitting station by using the ordinary type of wave transmission formula.

AN EARLY WIRELESS TELEPHONE PACK SET

By H. B. Dent.

THE description of a portable wireless telephone set which appeared in *The Wireless World* of August 21st, brings back to the author's memory particulars of a small set of a similar nature which was devised and used by some technical officers of the Royal Air Force, as far back as the autumn of 1918.

The set consisted of a tuner, used by the Royal Air Force at that time, and was made up of two distinct parts, joined by a flexible lead.

The oscillatory circuits, detector, and amplifying valves were located in one box, whilst another contained the necessary adjustments for wavelength and strength of signals. A slight alteration to the first arrangement was made by converting it from a tuned receiver to a plain-aerial receiving circuit, and across the aerial and earth terminals was placed a loop of wire in series with the inductance and tuning condenser.

Fig. 1.

Fig. 2.

After various designs of loops had been tried, and after the disposition of the apparatus was understood, the arrangement shown in Fig. 1 was adopted. As can be seen from the photograph, the apparatus was carried in the manner of an infantryman's pack, and, from the author's experience, was found to be just as uncomfortable, although the total weight did not exceed 45 lbs.

Referring to Fig. 1, the top box contained the oscillatory circuits and valves; below this, and to the left, was an 80-volt H.T. battery; to the right of this was the 6-volt accumulator, used for lighting the valve filaments. Fixed on the same base to which these instruments were attached was the receiving loop, raised about 18" above the wearer's head and consisting of four turns of bare wire in the shape shown.

The control and tuning device was strapped to the front of the wearer's belt—(see Fig. 2)—and contained all the necessary adjustments, including that for switching the valve current on or off.

Very satisfactory speech was received, both from machines in the air and from ground stations, whose transmitting apparatus was that used in aircraft during 1918 for wireless telephonic communication between machines in flight, the power radiated being very small.

The author also received very good speech while bicycling along a country lane, but in this case it was found necessary to wear a flying helmet to cut out external noises caused by the wind.

NOTES AND NEWS

Duddell Memorial.—A wish having been expressed that there should be a memorial erected to the late Mr. W. Duddell, C.B.E., F.R.S., by whose death in November, 1917, physical science suffered a severe blow, the Council of the Physical Society has invited the Councils of the Institution of Electrical Engineers and of the Rontgen Society to join in forming a committee for the purpose. Mr. Duddell for many years devoted himself to the study of alternating currents, latterly turning his attention to wireless telegraphy, and by his thermo-galvanometer was able to increase the currents received in the antenna circuit under various conditions.

The members of the Memorial Committee include Sir Wm. Bragge, President of the Physical Society, Sir Horace Darwin, Sir R. T. Glazebrook, Dr. R. Knox, Prof. T. Mather, Mr. Roger T. Smith, and Mr. R. S. Whipple who is Hon. Secretary to the Committee. Subscriptions or other communications should be forwarded to Mr. Whipple at 15, Creighton Avenue, Muswell Hill, N. 10.

Mr. E. H. Shaughnessy, O.B.E., M.I.R.E., of the Wireless Section, G.P.O., has been made a Vice-President of the Wireless Society of London.

Eiffel Tower Weather Reports.—The following extract from *Flight* of November 4th, is a worthy appreciation of what wireless has done for the progress of aviation :—

"Meteorology, plus wireless, is so essentially a part of the art of flying, that November 1st, 1920, will stand out as a red letter day for aviation, by reason of meteorological wireless messages being on that date issued again from the Eiffel Tower, for the first time since August 2nd, 1914. The exact hour was 11.30 a.m. So many aerial milestones have been passed since that date with which meteorology-wireless is a necessary appendage, that it is difficult to over-estimate the value to aviation of this return to the normal. The wireless messages dealt with observations from 14 stations as widely apart as Valencia, Stornoway, Copenhagen and Algiers."

Another Secret Wireless Station.—The steamer *Eten*, which was the German steamship *Rajah Kootis*, may have played a more important rôle in the war than merely that of housing a number of interned German soldiers in a Peruvian port. An examination of this steamer at an American port resulted in the discovery of a wireless set hidden in a water cooler in a state room of the steamer.

Wireless Telephony for U.S. Seaplanes.—It is reported that the U.S. Navy is now making use of wireless telephone sets for seaplanes, with which a transmitting radius of over 150 miles has been obtained. The transmitter radiates on two wavelengths, 1,600 and 600 metres respectively; for the former a trailing wire antenna of 0·0004 mfd. is employed, and for the latter an emergency aerial of 0·00026 mfd. The transmitter is supplied with two three-electrode tubes of the pliotron type. One tube is employed as an oscillator for the production of radio-frequency currents and the other tube is employed as a modulator and as an amplifier of the voice-currents that are communicated to it by the microphone.

Two Radio Cables.—The war use of electric cables for piloting ships in and out of unlighted harbours at night has been adopted by the U.S. Navy for New York harbour in peace, and an installation is now being erected there. The principle of the radio cable, as it is called, is to employ a cable through which flows an alternating current. Ships intending to use the cable while passing in and out of waterways are provided with a pair of coils which intercept the electromagnetic waves emanating from the cable. By noting the relative strength of the waves reaching each coil, it is possible for the ship's navigator to determine when he is approaching the cable, on which side it is, and with the sound in the telephones equal for both coils, when he is riding astride the cable.

On October 6th last the U.S. Navy conducted an interesting public test of a 16-mile radio cable laid from near the Ambrose Lightship to Fort Lafayette in the Narrows or in the main waterway approaching the port of New York. With his port windows covered with heavy canvas Commander Norton of the destroyer *Semmes* pilotted his vessel without mishap or a single hesitation.

The French Ministry of Marine is now considering similar installations at Calais, Boulogne and Havre.

Complete details of the New York Harbour installation are to be found on page 195 of the August 28th issue of the *Scientific American.*

Secrecy in Transmission.—Mr. McDonald, a former Lieutenant-Commander in the Australian Navy, has, according to the *Electric Review*, left for England to submit to the Admiralty the details of an invention for sending wireless code messages without danger of interception by the enemy.

New High-Power Wireless Station.—The Administration of Posts, Telegraphs and Telephones of Belgium announces that contracts may now be submitted for the building of an inter-continental wireless station, which it is intended to make one of the most powerful in the World. It is intended that the Belgian transmitting station shall be in permanent communication throughout the 24 hours with American stations, while a 12-hours' service is to be maintained to the Argentine and an 8-hours' service to the Congo; the latter service being necessarily of shorter duration by reason of the adverse atmospheric conditions which prevail in equatorial regions during the greater part of the day.

The station will probably be of from 750 to 1,000 k.w. capacity and will either be supplied by a special power station or from one or two distributing stations already in existence. The antenna will be supported by eight steel pylons, each 250 metres in height. The apparatus will receive on widely varying wavelengths and a service in both directions will be maintained at the same time.

Transatlantic Radio Tests for Amateurs.—With regard to these tests which are now being arranged, we have been informed of a proposal by the Marconi Scientific Instrument Co., Ltd., to offer one or more prizes to amateurs in this country who succeed in picking up the signals. An announcement giving further particulars will be found in the advertisement pages of this issue.

The tests will take place on 200 metres, and will commence on the evening of February 1st, 1921. The complete programmes have not yet been arranged, but particulars of them will be sent later to all who have intimated their willingness to take part. Intending entrants for the tests should communicate with Mr. Philip R. Coursey, c/o The Wireless Press, Ltd., 12-13, Henrietta Street, London, W.C.2, giving full particulars of the apparatus they propose to use.

University Engineering College has just published a new prospectus, cancelling all previous editions. Those of our readers who are anxious to take courses in mathematics, electricity, wireless telegraphy and allied subjects would do well to carefully read this new edition.

Amateur Call Signs.—The following additions should be made to the amateur call sign list given in our issues of October 16th and 30th:—**2 D V**; Mr. H. C. Woodhall, Bramhall, Ches. Spark, 180 metres wavelength, 10 watts. **2 H P**; owned by the same gentleman, but situated at Salford, Spark, C.W. and Telephony. **2 G R**; Mr. T. Forsyth, Ashington, Northumberland. Hours of working, 12.30—1 p.m. and 5.30—7 p.m. G.M.T. **2 G S**; portable station owned by the same gentleman, licensed to operate within four miles radius of Ashington. **2 H G**; Mr. T. Boutland (Senr.) Ashington, Northumberland. Hours of working, 12.30—1 p.m. and 5.30—7 p.m. G.M.T. **2 HH**; Mr. T. Boutland (Junr.), Ashington, Northumberland. Hours of working, 12.30—1 p.m. and 5.30—7 p.m. G.M.T.

The call-letters of the Halifax Wireless Club should read **2 G U** and not **2 G V** as given in our issue of October 16th.

Wireless Telegraph Stations.—The following stations have been established by the Service de la Navigation Aérienne:—Toulouse, (**A V**; 1,400 metres wavelength), C.W. This station works with Bordeaux, Nîmes and Lyons (both transmission and reception), and Le Bourget (reception only). Nice, (**A K**; 1,400 metres wavelength), C.W. This station works with Nîmes and Lyons, (both transmission and reception).

Flamborough Head D.F. Station.—Notice is given in Admiralty publications to the effect that the station has been reopened.

Nederlandsche Vereeniging Voor Radio-Telegrafie.—The badge of the N.V.V.R. is designed to embrace as many of the symbols met with in Wireless Telegraphy as is compatible with good appearance. Round the edge of the badge are the Morse characters of the letters N.V.V.R. separated by four waves; the upper and lower represent undamped, whilst those to the left and right represent damped oscillations. In the centre separating the letters N.V.V.R. is a condenser and helix, together with date of the year in which the Society was formed. The N.V.V.R. are to be congratulated upon their originality and initiative.

Wireless Recruits Wanted.—The regiment, the Middlesex Yeomanry (Duke of Cambridge's Hussars), which was raised in 1830 by the late Duke of Cambridge, is to remain a mounted unit, and it has been selected to form Signal Squadrons for a Cavalry Division. Wireless amateurs desirous of becoming members of the Wireless Troop can obtain all particulars by applying to the Adjutant, Cavalry Divisional Signal Regiment (Middlesex Yeomanry), Duke of York's Headquarters, Sloane Square, Chelsea, S.W.3.

League of Nations.—For the purpose of transmitting press to this country, a temporary station is being erected at Geneva. This station will be at the disposal of the League of Nations, the headquarters of which are at Geneva. For the first time in history preference will be given to press, such messages taking precedence with all others. Details will be published later.

THE PROCEEDINGS OF THE WIRELESS SOCIETY OF LONDON

THE MOST EFFICIENT METHODS OF RECEPTION OF SHORT WAVES, BOTH SPARK AND C.W.

At the conclusion of Mr. Philip R. Coursey's remarks made at the meeting, held on Friday, October 29th, the Chairman then called upon Major Basil Binyon to continue the discussion.

Major Binyon: Mr. Coursey has covered the field of short wave reception so admirably that I do not know that I have very much to add; but I am glad he suggested that other speakers should deal with the question of the most suitable tuned circuits to employ, as this is a most important matter in short wave working. One of the difficulties to be met is the necessity of employing very small value of inductances in the tuned circuits, which usually give rise to a low effective potential being communicated to the grid of the receiving valve. A circuit which was used in the R.A.F. and which proved both simple and highly sensitive is illustrated in Fig. 4. The aerial is connected directly to the grid of the valve through a variometer, L_1, and the usual grid-condenser and leak, C_1 R_1. To prevent charges accumulating on the grid, which in such an arrangement is entirely insulated, it is necessary to connect a resistance, R_2 of about 1,000 ohms between the aerial and the filament. With an aerial capacity of about ·0003 mfd. and a minimum value of $L_1 = 150$ microhenries, good tuning to wavelengths of 150 metres can be obtained. The tuned circuit comprises the inductance of the variometer, the self-capacity of the variometer to earth, the capacity of the valve and the aerial capacity. It is interesting to note that when the capacity of the aerial exceeds ·0003 mfd. the tuning is not affected by any variation in aerial capacity.

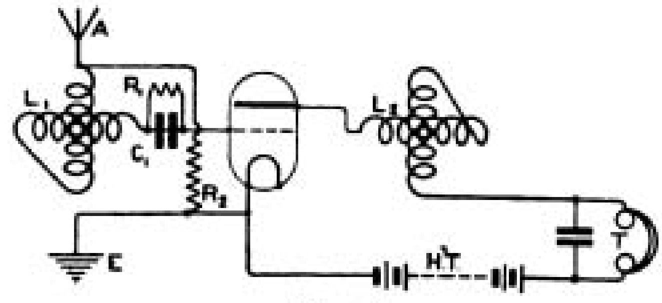


Fig. 4.

For the reception of C.W., reaction may be introduced into the circuit by the method known as anode tuning. A variometer, L_2 (or slider inductance) is connected in the anode circuit in series with telephones shunted by a condenser and the usual H.T. battery. It is not necessary to couple the inductance, L_2, with L_1, but by varying L_2 it is possible to bring the system just short of the oscillation point for sensitive spark reception, or to make the system oscillate for C.W. heterodyne reception. Such a circuit is simple, sensitive and easy to control, and although it does not present some of the advantages of loosely-coupled circuits, the tuning is sharp and interference much less than might be expected.

As regards short wave amplifiers, I was interested in Mr. Coursey's description of the amplifier shown in Fig. 2. I do not think it is essential to employ the condenser shown for tuning the anode circuits, unless it is desired to make the amplifier cover a wide range of wavelengths. I have seen quite successful short wave amplifiers constructed, by simply making the inductances and self-capacities of the transformers approximate to the wavelength it is desired to receive. I entirely agree with his remarks on the desirability of eliminating stray capacities, and short wave amplifiers tested in experimental form on the bench, will often refuse to behave in a stable manner when made up in the form of a compact and finished instrument, as a result of introducing stray capacities between leads.

I have known an amplifier to give excellent results when spread out on the bench, only to prove a complete failure when finally assembled, as the result of bringing the aerial tuning condenser within two inches of the first transformer. Tuner circuits should therefore be kept well away from amplifier circuits, and the assembling of apparatus after experiment should be carried out with care, in the most suitable manner of arranging components.

Valves having small capacity, such as the tubular pattern, are most suitable for short wave work.

To give a few practical details of a short wave amplifier, four to five tubular pattern valves may be mounted in a row (in clips), on the lid of a fair-sized box, allowing 2 or 3 inches between each valve. Mount the transformer directly under each valve, hanging downwards, so as to have as little capacity to the valve-fittings and lid of the box as possible. The transformers can be made from ordinary waxed cardboard tube, about 1″ diameter and 2″ long, both primary and secondary being wound with about 300 turns each of No. 40 D.S.C., the secondary being wound over the primary with a few layers of waxed paper between. This will give approximate transformer tuning between 200 to 300 metres. Fewer turns should be employed for shorter wavelengths.

One point has been omitted from the amplifier described by Mr. Coursey and shown in Fig. 2. It is important to have control of the grid potentials of all valves acting as high-frequency magnifiers.

To carry this out, instead of connecting all the ends of the grid secondaries to the negative filament busbar, join them together and connect to the slider of a potentiometer, the latter being connected directly across the filament battery, (see Fig. 5). By moving the slider of the potentiometer to the left, it is possible to make all grids more positive with respect to the filaments and at the expense of some sensitivity to stabilise effectively the whole amplifier and eliminate howlings and self-oscillation.

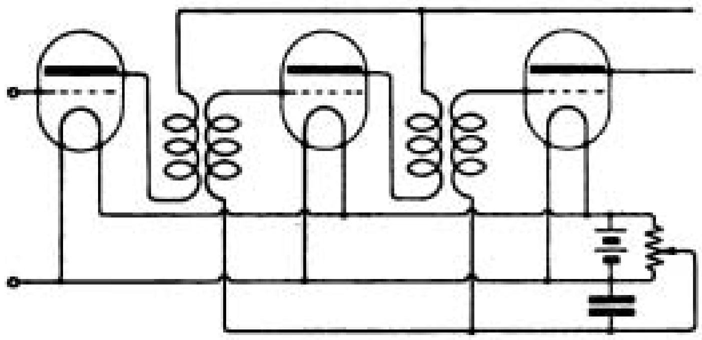


Fig. 5.

To prevent high potentials arising in the ends of secondary windings, condensers of about ·3 mfd. may be connected between these windings and earth, on the negative filament busbar.

An interesting transformer was recently described by Captain Crowther for use in high-frequency amplifiers. It consists of a primary and secondary winding, wound together on to two slabs which slide over each other. By reason of the double winding both primary and secondary windings may be tuned within a wide range of wavelengths by altering the relative position of the two coils. Each winding is tuned in this way by utilising the variometer effect.

With regard to Mr. Coursey's Fig. 3 circuit, I have seen this arrangement tried on fairly short wavelengths. It was suggested by Professor Whiddington, in 1918, at the Wireless Experimental Establishment at Biggin Hill. Short waves were heterodyned and then passed on to an ordinary long wave amplifier of the ordinary type, used for wavelengths of 2,000 metres and upwards. To my mind it was nothing like so successful an arrangement, from the point of view of sensitivity, as a transformer-coupled amplifier constituted for short wave reception.

I do not know that I have any more points to raise. I have already taken up rather more time than was my intention.

Mr. M. Child : I am afraid there is not very much left for me to talk about in this matter, but I should like, first of all, to say just a few words in connection with the tuning of the aerial circuit. In short wave reception, it is all very well to show a diagram of an aerial circuit which has an aerial, an inductance and an earth, as in Fig. 6, but supposing we take the case of a standard Post Office aerial, or what has become known as a standard Post Office aerial, which has a length of about 100 feet of straight wire. The natural wavelength of that aerial is, we will say, approximately 100 to 200 metres. It will, of course, vary a great deal in different circumstances of erection of the aerial, as probably all of you know. The capacity of the wire will vary considerably with different installations. But if we take it that 100 feet of aerial wire has an approximate wavelength of about five times its length, which I think is a fair average value, then we are starting right away with an aerial circuit without any inductance in it at all; simply an aerial that goes right through to earth with a wavelength of somewhere about 200 metres. The moment we begin to put inductance into the circuit to form a coupling coil we immediately begin to increase the wavelength, and we may get well above 200 metres with even a very few turns of inductance as a result. To neutralise this we put a condenser in series with the aerial, and the moment we do so we reduce the aerial capacity to a very small value, and, as a consequence, the aerial will not have a very large degree of selectivity in itself. It will be like a very thin pendulum, with practically no weight at the bottom. It will oscillate very readily and be very susceptible to waves of frequencies other than the one to which it is tuned.

Fig. 6.

Again, the question of getting a potential on the grid is important if using a valve. If we take the aerial circuit (Fig. 4) with the inductance L in series. We must have this inductance in order to give us any potential at all to be transferred to the grid; whether we use the grid condenser (Fig. 7) or connect direct to the grid —using a potentiometer—does not make much difference. The greater the inductance of L, the smaller must we make the capacity C, and we soon reach a condition of affairs where any increase of L brings down the energy in the aerial on account of the fact of C being so small, the net result being that there is practically no tuning. In Major Binyon's first diagram (Fig. 4), I do not remember him showing exactly where the earth connection went.

Major Binyon : To the filament.

Mr. Child : I thought I would mention the omission, because anyone taking a copy of the diagram might wonder where the earth connection should be made. In that set I do not think we can really consider the aerial as a proper oscillating

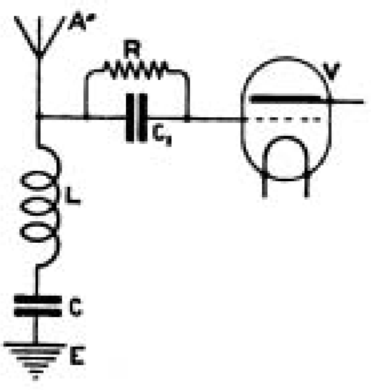


Fig. 7.

circuit. At any rate, it has no particular wavelength of its own. Now I suggest very tentatively, that if we are going to work on short wavelengths we ought to make a strong bid for something a little better, and always bring the grid direct on to the aerial circuit. If we do away with that altogether and use a coupled tuner, I think things ought to be a little better, because if the coil L_1 (Fig. 8) has only a few turns, say half-a-dozen, just enough to give the required coupling, and put a condenser C_1 in the aerial circuit, we shall be able to keep this condenser capacity fairly large, on account of the small value of L_1. If we then use a carefully designed secondary, wound with well-stranded insulated wire—I mean each strand separately insulated to reduce the H.F. resistance, and with a small condenser across it, if necessary, for tuning, we can use fewer turns for L_1 thus getting a far more efficient aerial circuit, and a circuit which can be made selective. The secondary circuit can be inductively coupled to a third circuit, if required, before coming on the valves. Preferably the ideal arrangement would be to wind the secondary so that its self-capacity would be sufficient to give the required wavelengths. With variable coupling between L_1 and L_2 we have the ordinary simple tuner, and my experience has been that you get a much higher efficiency by using such a tuner. Another advantage is that if the secondary circuit is carefully calibrated you can easily set it for the wavelength required, and the only thing to adjust is then the condenser C_1.

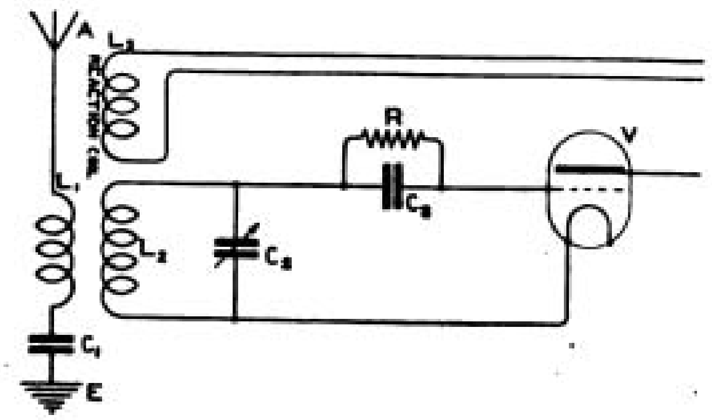


Fig. 8.

Now, with regard to the reaction coil. My experience has been that directly you introduce a reaction circuit with an ordinary reaction coil at L_3 (Fig. 8) anywhere near L_2 the calibration of the circuit is immediately upset, and in short wave work it is certain that the capacity effect of the coil L_3 tends to neutralise some of the available potential. I have not built up a circuit, using a variometer in the plate-circuit, as has been suggested (Fig. 4), but I think that will probably meet the case for short waves. It is then unnecessary to introduce a reaction coil, L_3, at all.

Mr. Scott-Taggart : The title of the discussion to-night is, I believe, intended to cover the reception not only of short continuous waves, but also damped waves. The method of reception in these two cases is entirely different, and several special problems attach themselves to the different methods of reception. For example, when receiving short continuous waves it is necessary to take the greatest care in tuning the local oscillations to approximately the same frequency, as the incoming oscillations, and, since the frequency is very high, it is exceedingly difficult to tune local oscillations correctly. The slightest alteration of the capacity of the circuits will alter the beat-note and make the reception of incoming signals specially difficult.

Mr. Coursey has already suggested the use of long handles in connection with the tuning of the condenser or variometer. Another arrangement is to connect a variable resistance across the receiving circuit, and by varying the value of this resistance to alter the frequency of the circuit. It is a well-known fact that the frequency of any circuit depends on the inductance, the capacity and any parallel resistance associated with such a circuit, so that if we connect a variable resistance of very high value across the receiver, we are able to tune it within a short range of wavelengths. One method of doing this is to use an ordinary two-electrode valve, which may be a special valve or an ordinary three-electrode valve, with grid and anode connected together. By connecting the anode to one side of the circuit and the filament to the other, and varying the filament current, we can vary what is equivalent to a parallel resistance across the circuit, and thus alter the frequency of the circuit.

When using short waves it is a useful procedure, when pressing the key, to vary the value of the condenser which tunes the transmitted signals. By turning the condenser several times, round about the wavelength which is being transmitted, it is possible to call the attention of the receiving station much more effectively than if the key were simply depressed in the ordinary way, and, moreover, it enables the receiving operator to listen on a fixed wavelength without continually having to vary his condenser. If this is not done, the receiving operator has to vary the constants of his circuit continually, perhaps for an extended time, until he receives the other station, and this difficulty is particularly accentuated when receiving short waves. It has been proposed actually, to have a mechanical device which will turn the condenser a little on either side when calling, or, if a condenser is not used, the variometer can be employed for the same purpose. The reception of telephone and spark signals, of course, presents no such difficulty, and the ordinary method of tuning is usually sufficiently good.

Several speakers to-night have pointed out that the potentials across the direct-coupled receiving circuit are usually not sufficient to give good signals. The obvious thing to do, of course, is to use some form of high-frequency amplifier before using a valve or a crystal as a detector. The other obvious solution is what is usually done on ship stations, namely, to have a few turns in the primary of a step-up oscillation transformer. Still another method is not to use the potentials across the inductance in the aerial circuit, but to take the potentials across a series condenser. This, when the inductance is very small, is a very much more effective method of obtaining the high frequency potentials to operate the detector. Fig. 9 shows one arrangement of carrying this idea into effect.

An aerial inductance is shown at L_1, a condenser C_1, preferably variable, being included in the earth lead. Instead of taking the potentials across the inductance L_1, we take them across the condenser C_1. The potentials now have a much greater value than those across L_1. We thus obtain a receiving circuit which will operate much more effectively than would otherwise be the case. In the figure is also shown a method of obtaining retro-action by connecting a coil, L_2, preferably aperiodic, in the anode or plate circuit of the valve. The coil L_2 is coupled to the inductance L_1 until the required amount of retro-action is obtained. If continuous waves are to be received the coupling is increased sufficiently to produce self-oscillations. This circuit, which has been used during the war in connection with the Army loop sets, has proved very effective indeed. It can be used for the very shortest waves, as short as 30 to 50 metres, with excellent results. One

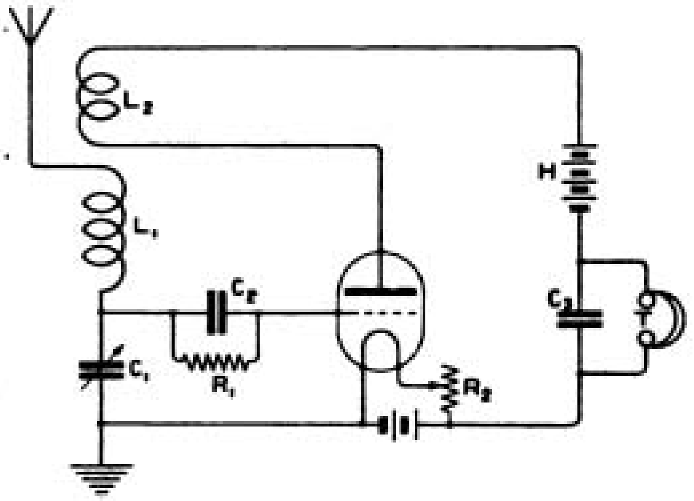


Fig. 9.

method of obtaining retro-action, which is desirable on short wavelengths, is not to alter the coupling between L_2 and L_1, but to vary the filament resistance R_2, or the value of the anode battery H. When the coupling between L_1 and L_2 is fixed, we can then bring the valve to different stages preceding self-oscillation by altering the value of R_2.

Fig. 10 shows a modification of Fig. 9. In this case the grid-leak R_1 is connected across the fixed condenser C_1, which acts partly as an aerial condenser and also as a grid condenser. In a circuit of this nature it is very desirable to prevent leakage between the filament battery and the earth, so that instead of taking precautions to prevent any possibility of current leaking to earth it is very convenient to connect the variable condenser C_2 in the earth lead, and by tuning C_2 we are enabled to tune the circuit to the required wavelength. The filament accumulators should be insulated. Another advantage of the condenser C_2 is that it enables the circuit to oscillate very much more readily than if a direct connection to earth were taken from the filament.

Fig. 11 shows a circuit in which we use an aerial inductance, L_1, having a small number of turns—few because it cannot be helped—and a secondary inductance L_2. The three-electrode valve is used

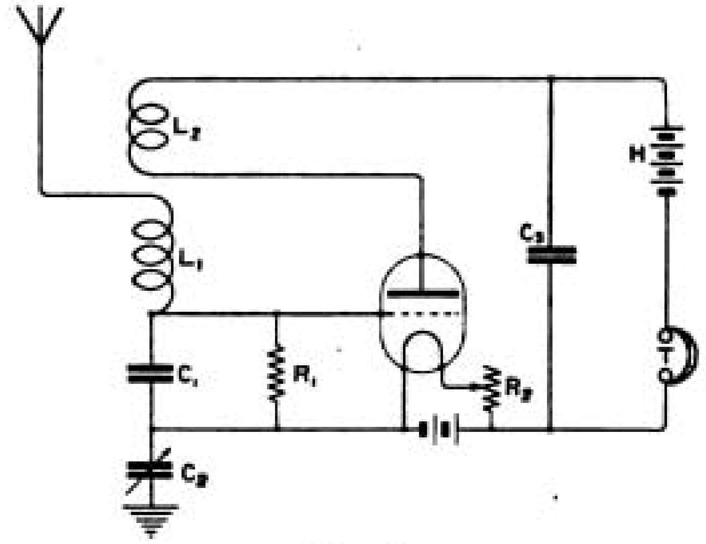


Fig. 10.

either as an oscillator or retro-active amplifier, a tapping being taken from the filament to a point on the inductance L_2. Condenser C_4 also communicates high-frequency potentials to the circuit L_2, C_2, which is tuned to the incoming wavelength. The requisite amount of retro-action may be obtained by varying the tapping on L_2 or the capacity of C_4. It is to be noticed that the anode D.C. circuit is separate from the anode oscillatory circuit, the battery and telephones being connected directly across anode and filament. These single-circuit arrangements are exceedingly useful and do not require the use of a retro-active coil, which in all cases is rather troublesome, and requires to be of different sizes for different ranges of wavelength.

In Fig. 12 we have another arrangement in which single circuit principles are involved. The aerial circuit contains the variable condenser C_1 and the inductance L, which is used to give the aerial circuit the wavelength desired. The anode circuit contains battery H and the telephones T, as usual. The variable condenser C_3 shunts them both. This circuit is capable of being made to oscillate just as the usual circuits employing a retro-active coil; but here, again, we are avoiding the use of such a

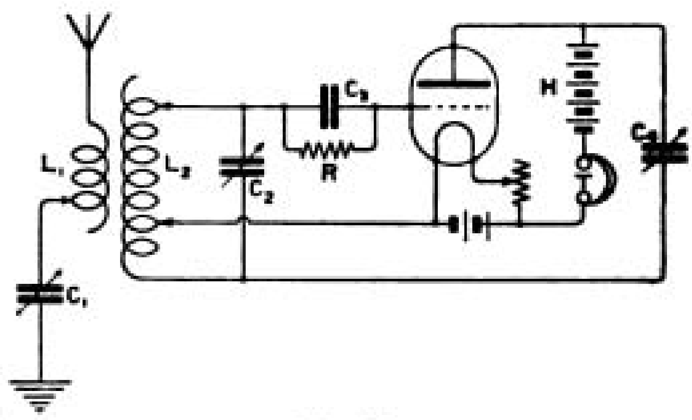


Fig. 11.

coil. A point in connection with these circuits, or, in fact, any circuit in which a retro-active effect or its equivalent is desired, is the use of a variable condenser across the telephones, or whatever impedance happens to be in the anode or

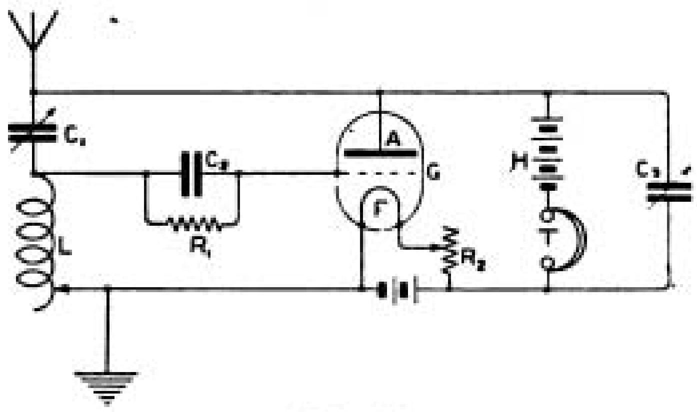


Fig. 12.

plate circuits of the valve. If we connect the condenser across the telephones and battery by altering the value of this condenser we can bring the valve to all the stages preceding self-oscillation, and if the capacity is sufficiently high the circuit will oscillate of its own accord. If lower than that value, an effect comparable to retro-active amplification is obtained.

Fig. 13 is another circuit in which only a single inductance, L, is employed, and the condenser, C_1, is used to tune the aerial to the required wavelength. The grid-leak is connected directly across grid and filament. This circuit has several advantages in connection with the reception of short

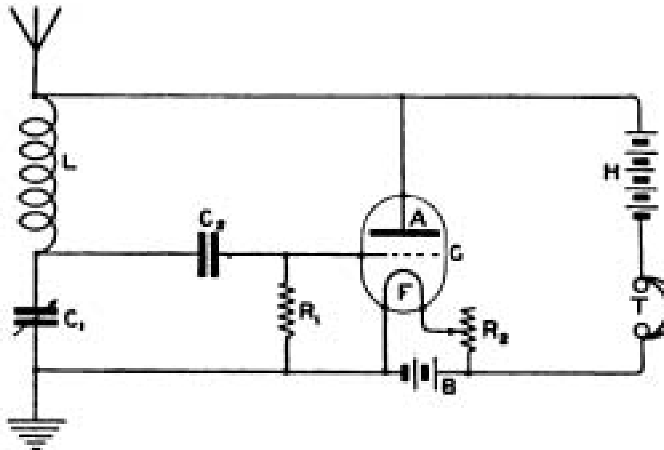


Fig. 13.

wavelengths, one of them being that the inductance, L, need not be of such a large value as in more ordinary circuits. The general principle of circuits of this type is that the connection from the filament is taken to a point midway between two condensers or capacities in the aerial circuit. In this case one of the capacities is C_1, while the other is the capacity of the aerial, these two capacities acting in series.

Fig. 14 is not new: in fact, none of the circuits I am showing you here have any inherent novelty; but their utility seems to justify describing them during this discussion. In this diagram the tuning of the aerial circuit* is accomplished by the inductance L and the variable condenser C_1. This circuit, although very good results have been obtained with it, is rather difficult to work with.

Fig. 15, on the other hand, is very much more to be recommended, and is similar to some of the very earliest retro-active receiving circuits. In this case the anode current flows through the telephones, T, which are also included in the grid circuit of the valve. By altering the capacity of the condenser, C_2, the various stages preceding self-oscillation may be obtained.

From the remarks that we have heard to-night, from the various difficulties that have been brought

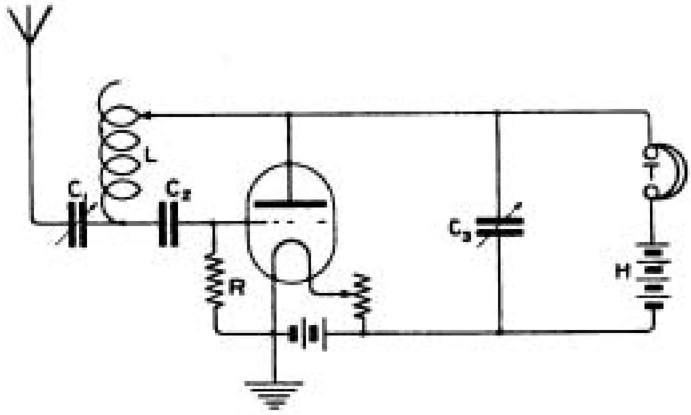


Fig. 14.

up in connection with amplifiers and receiving circuits generally, it will be readily understood that the subject is one which lends itself to more thorough investigation than has been already made, and the subject being one which experimentalists can grope into further, is one of particular interest to those who are working chiefly on wavelengths in the neighbourhood of 200 metres.

The Chairman: Before calling on the next speaker I will ask the assistant Honorary Secretary to collect the ballot papers. I will now call on Mr. Blake.

Mr. G. G. Blake: Having experienced some considerable difficulty in picking up the Dutch concert, which is transmitted on a wavelength of 900 metres, from the Hague on Thursday evenings, from 6.40 p.m. till 10.40 G.M.T., and also sometimes on Monday evenings, I thought my experiences in

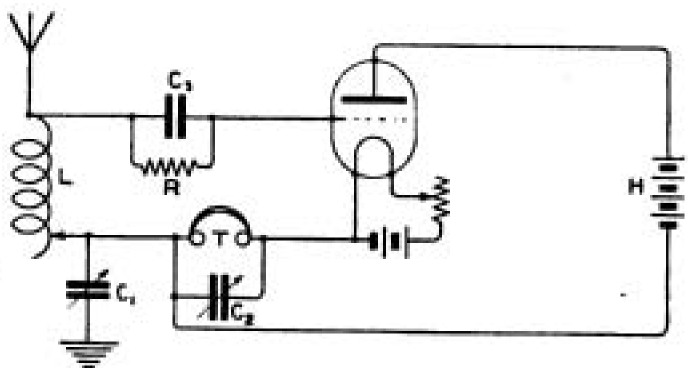


Fig. 15.

this matter might be of interest to members of this Society.

Using my P.O. regulation 100 ft. single-wire aerial, I have tried three or four different sets of connections, all of which will permit me to hear telephony from Croydon, Cricklewood, Lympne and Chelmsford. With these same connections I could hear the shrieking of the C.W. from the transmitter in Holland, but could not distinguish their concert. I have spoken to numerous amateurs about this concert, and find that all experience the same difficulty, so far as my enquiries have gone. Mr. Kitchen, however, has been successful for some time, and he kindly gave me some valuable suggestions.

Fig. 16 shows the small experimental set with which I am able to get the concert.

On the left is a small variable condenser, used across the reactance coil, which is hinged to the primary coil. To the right of this is the detector, and on the extreme right is the primary variable condenser.

Fig. 17 is a diagram of the connections employed.

The primary and also the reaction coil are wound in pancake form, similar to those described in *The Wireless World* of June 12th, with No. 38 double silk-covered wire. There are 240 turns on each coil, with tappings at every 20, so connected that one can add from the outside turns. The variation of coupling is achieved by altering the angle between the coils, which are pivoted together as shown in Fig. 18. In the same figure C and C_1 represent the two variable condensers. C is of the

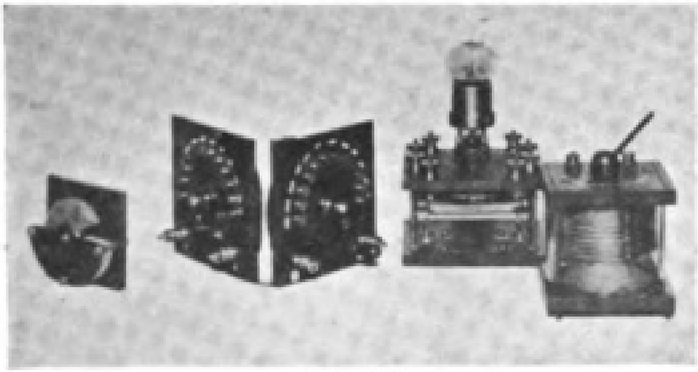


Fig. 16.

standard milli-microfarad type, and C_1, which is across the reactance, has a capacity of about ·0005 mfd. This latter condenser consists of two semi-circular movable vanes 2″ in diameter, moving between three fixed vanes. I find that this condenser is most important in obtaining fine adjustment, but its capacity has to be extremely small.

The grid condenser consists of two sheets of metal foil, 1 cm. wide, one on each side of a sheet of mica, 2 mms. thick, and overlapping $2\frac{1}{2}$ cm. Across this is shunted a wet cotton grid-leak, as described by Mr. Kitchen in *The Wireless World* of July 10th last. I have found this method of making grid-leaks very efficient and reliable. Brown's telephones are used, wound to 4,000 ohms.

To Receive PCGG.—The primary of the tuner is set so that 60 outer turns are in use, and 120 outer turns of reaction coil are shunted by about one quarter of the variable condenser C_1. The coupling between the two coils is set at an angle of about 60 degrees, while we search with the primary variable condenser C, for the humming

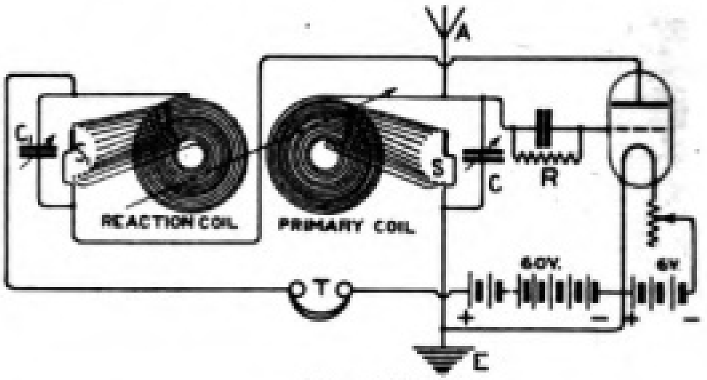


Fig. 17.

of the Dutch station's transmitter. Having got this, the coupling is loosened till the reaction almost stops (at about 70 degrees), when condenser C is adjusted to the silent point on either side of which the howling of the valves is to be heard.

Very slight variation of condenser C_1 will now bring in the concert.

The main difficulty in receiving PCGG lies in the fact that it is necessary to adjust the valve, just off the oscillation point, and the function of condenser C_1 is to make the adjustment fine enough to reach this point. I may here mention that the capacity of the grid condenser must be very small indeed, or condenser C_1 will not serve its purpose properly.

Fig. 18.

I have found that if C_1 is omitted, fine adjustment can be made by placing a small strip of metal foil between the primary and the reactance, and moving it in or out of the field between them. I do not think this method is quite so good theoretically, however, as energy must be lost in induced currents set up in the foil. Another method I have tried is to put a variable high resistance in the reaction circuit, but no useful results were obtained until, on the night of October 28th, I listened to part of the concert, and was able to hear Chopin's "Funeral March" all over the room, when amplified with a 4-valve low-frequency note-magnifier.

In *The Wireless World* of September 18th last, a very simple method of tuning was mentioned, but no constructional details or diagram were given.

I have made up a set, working on the lines there suggested, and thought perhaps a diagram and full details might be of interest. The method is admittedly rather crude, but it works quite satisfactorily, and has the advantage of extreme simplicity and cheapness.

It consists of a series of eight or more small hanks, or, better still, basket-wound coils, made on formers of No. 28 C.C. wire (similar to those described in *The Wireless World* of June 12th last).

The windings of these inductances is so arranged that if we take any three successive coils out of the series, the largest coil of the three (which is used as a reactance), has a number of turns equal to the sum of the turns on the other two coils, *i.e.*, if we commence with a coil of 50 turns, and the next coil has 100 turns, then the reactance-coil for these two will have 150 turns; or, if we commence with a coil of 100 turns, the next coil will have 150, and their reactance coil will have 250.

All the coils are fitted with plugs so that they can be quickly interchanged. When it is desired to receive signals, a selection of three successive coils is made, as shown in Fig. 19. The largest A, is used for reactance, and is connected in circuit with a pair of high resistance telephones, a high-tension battery, the filament of an R type valve, and its plate.

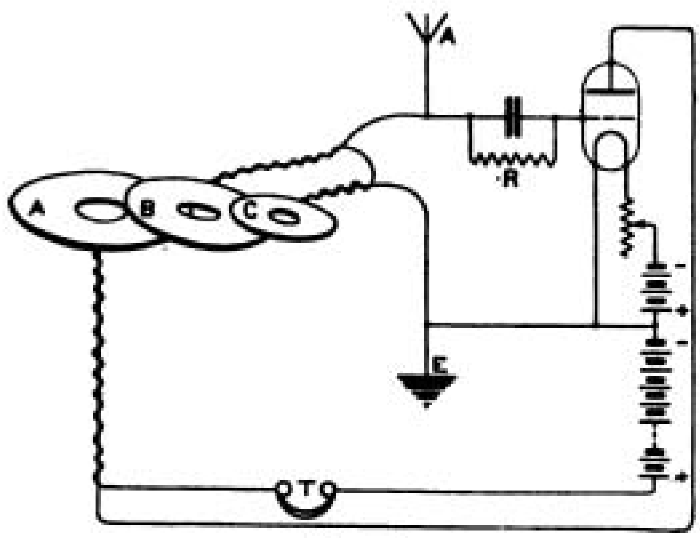


Fig. 19.

The other two coils, B and C, are connected in series, and to the aerial and earth; the aerial being connected to the grid through a small condenser with a grid-leak, and the low-tension battery, which heats the filament being earthed.

The three coils are laid, one partly on the other, as shown in Fig. 19. The proper degree of reaction is obtained by placing B at the right distance over the coil A, and tuning is then achieved by moving the smallest coil C to its correct position over or near to coil B.

In conclusion, I may mention that this method, while being satisfactory for the reception of such stations as Hanover, Paris, etc., or signals from ships, as it has no condensers for fine adjustment, is too crude for the reception of the Dutch concert.

Mr. W. J. Fry: In passing a few remarks relative to short wave receiving apparatus, I would prefer to leave the mathematical side of the question to some of our more experienced members. Being familiar with the difficulties met with in tackling the problem of short wave reception, with thermionic valve apparatus made on private lines, I would like to give a few of my personal experiences.

The orthodox instruments used in the days of the crystal detector, giving quite good results in receiving long or short wave signals on the same inductances, do not hold good with thermionic valve receivers. We all know the effect of introducing even quite small capacities in such circuits, an effect which when using crystal detectors would, a few years ago, have passed unnoticed. The difficulty is, presumably, in the fact that the mutual capacity effect of the coils themselves determines the ultimate results. Messrs. the Marconi Co. and others have long known the disastrous effect of "dead-ends" in receiving inductances, and have therefore introduced means of cutting out any unrequired inductance, and I believe that the secret of success in the reception of short wave signals lies in this direction. Fig. 20 shows the dimensions used by Mr. Hale and myself.

The inductance shown was originally constructed for 600-metre reception, but experiment proved signals on wavelengths lower than 400 metres to be inaudible. The circuit is an ordinary single-valve regenerative circuit, with a small reaction coil.

We accordingly reverted to the dead-end method.

The secondary tuning inductance containing 17 coils was reduced by 12 coils by means of a dead-end switch;the reactance composed of 3 coils was left unearthed, and the reception of signals on 300-metre wave lengths was then possible. The reaction coil was also fitted with a dead-end switch, cutting out 2 coils; a blocking condenser of ordinary capacity, fitted with a switch allowing 3 capacity adjustments, was connected from one side of the reaction coil to one side of the secondary coil, thus acting as a H.F. by-pass when 180-metre signals were received.

A point which seems of great importance when receiving very short wave signals appears to lie in the correct proportioning of the plate and reactance circuit.

In all cases the natural frequency of the reactance circuit must be the same, or a little lower, than that of the signals to be received. It is better—when a little extra adjustment is not an objection—to separately tune the plate and grid-circuits to a resonant condition, when the most effective reaction is obtained.

The effect of dead-end turns, when not counteracted, results in absorption, especially if the wavelength of the unused part of the coil happens to be the same as that of the signals to be received. Particulars of connections, dimensions of coils and parts are fully given in Figs. 20 and 21.

The Chairman: We have come to the last of the names of gentlemen sent in as probable speakers. I will ask if anybody else would like to say anything.

Mr. Powell-Rees: I would like to know what is the lowest wavelength on which oscillation is obtainable with a single valve. How low will one oscillate? There used to be a good deal of difficulty about getting a valve to oscillate as low as 200 metres, but that seems to be accomplished quite readily now. What is the lowest wavelength on which it is known that oscillation can be obtained with a single valve?

Mr. J. Scott-Taggart: I think about half a centimetre to two centimetres.

Mr. Powell-Rees: That means in any circumstances?

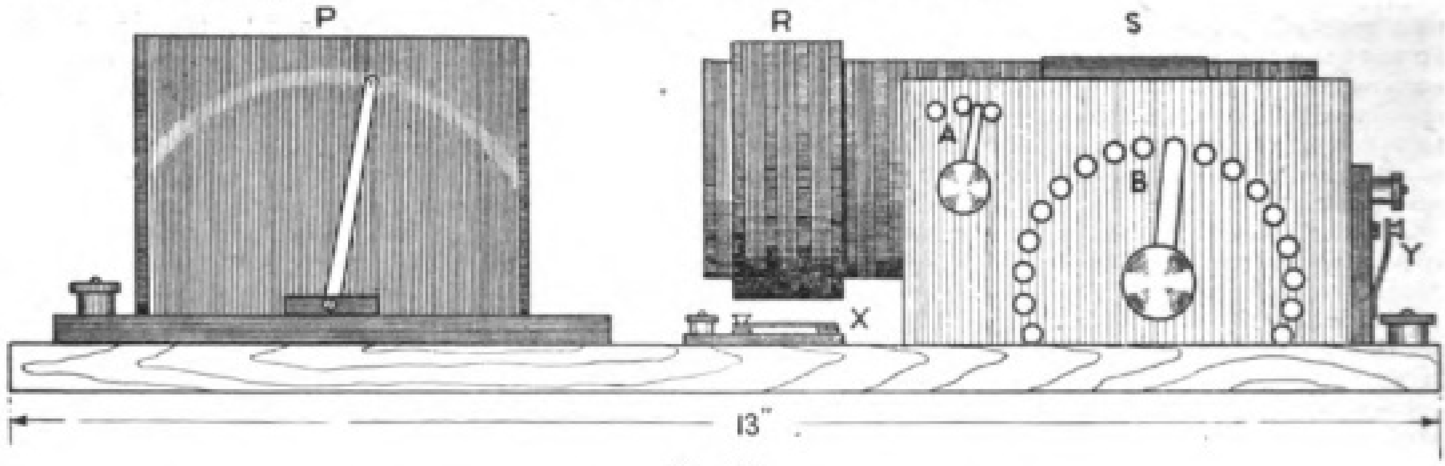


Fig. 20.

P = *Primary*, $2\frac{1}{2}''$ *diameter*, $3\frac{1}{2}''$ *long*; 200 *turns No.* 26 *S.W.G. enamelled copper.*
S = *Secondary*, $2''$ *diameter*, $5\frac{1}{2}''$ *long*; 18 *coils spaced* 1/16" *apart, wound with No.* 26 *S.W.G., S.S.C. and* 25 *turns in each coil.*
R = *Reaction-coil*, $2\frac{1}{4}''$ *diameter*, 1" *long*; 3 *coils wound with No.* 26 *S.S.C., the* 1*st coil having* 18 *turns, the* 2*nd and* 3*rd having* 24 *turns each.*
A = *Reaction-coil switch.*
B = *Secondary tuning switch.*
X = *Secondary dead-end switch.*
Y = *Reaction-coil dead-end switch.*

Mr. J. Scott-Taggart: You have usually to acquire special circuits.

Mr. Powell-Rees: On ordinary circuits such as members use, how low can one go?

Mr. J. Scott-Taggart: About two centimetres, I think.

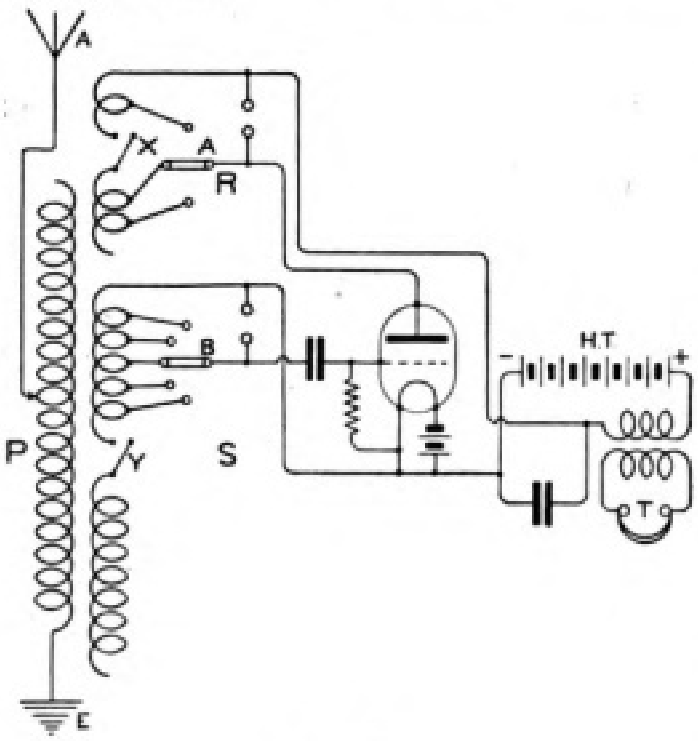


Fig. 21.

Mr. Powell-Rees That means they oscillate on all wavelengths?

Mr. G. W. Hales: How low is it practicable to get a circuit to oscillate when coupled to an aerial, and where there is a certain amount of radiation tending to prevent oscillation? I mean oscillating on load instead of quite free.

The Chairman: That is a further question perhaps some of the previous speakers might answer.

Mr. J. Scott-Taggart: I frequently make valves oscillate at 30 metres.

Mr. Child: I should like to ask about what size aerial you were using when you got 30 metres?

Mr. J. Scott-Taggart: It would be about ten feet.

Mr. Child: A very small capacity. But I take it most of the questions these gentlemen have asked are about the practicability of oscillating circuits coupled to an ordinary Post Office aerial. I imagine then the wavelengths would be relatively long. You might get them to oscillate at 80 to 100 metres, but, without special condenser arrangements, I think it would be very difficult to get the valve to oscillate in practice with an aerial coupled up in the ordinary way. I am only suggesting that there may be ways of doing it, but I think it would be a very difficult matter to arrange things with the ordinary Post Office aerial coupled up to the tuning inductance, and so on, in the circuits which we have been discussing.

Mr. Powell-Rees: I think that answers my question.

Mr. J. Scott-Taggart (*communicated*): With reference to my remarks *re* the shortest wavelength obtainable with a valve, the statement, "half a centimetre to two centimetres" should have been "about half a metre to two metres."

The Chairman: Time is getting on: perhaps we had better bring the meeting to a close. I am sure we are very much indebted to the gentlemen who have brought forward all these interesting circuits.

I have to announce that the gentlemen put up for ballot have all been duly elected. I have also to announce that the next meeting of the Society will take place at the Royal Society of Arts (John Street, Adelphi) at eight p.m. on November 18th, when we hope to have a demonstration of high-speed telegraphic printing by means of wireless telegraphy, for which we shall be indebted to Messrs. Creed, of Croydon. So far, we have only got informal permission from the Post Office, and the demonstration has not yet been tried; it is therefore perhaps a little rash to say we shall be able to show it But I think so.

The meeting was then adjourned.

WIRELESS CLUB REPORTS

The Wireless Society of London.

The next meeting of the Society will take place on December 10th, at 6 p.m., at the Institution of Civil Engineers, Gt. George Street, Westminster, when a Paper illustrated by experiments will be read by Dr. J. A. Fleming, M.A., F.R.S. (University Professor of Electrical Engineering in the University of London), on "A Four-Electrode Thermionic Detector for Damped or Undamped Oscillations of High or Low Frequency."—Hon. Secretary, Mr. L. McMichael, 32, Quex Road, W. Hampstead.

Brighton Radio Society.

(Affiliated with the Wireless Society of London.)

A meeting of the Society was held on the 15th Oct., Mr. M. G. Foster in the chair. There were four items of agenda: (1) To arrange for a local club-room, (2) Fixture of definite evenings for meetings, (3) To ascertain members who were licence-holders, (4) Application for a licence for Club station. It was decided to approach the committee of the local Oddfellows' Institute with a view to securing the use of a room in that building. This was acted upon, and the result will form the subject of discussion at the next meeting.

It was further decided that Tuesday evenings be fixed for meetings, subject to alteration if necessary, to suit special circumstances. For the time being it was agreed to let the matter of a Club station remain in abeyance until such time as definite headquarters are secured. The members present expressed their keen desire to embark upon the experiments in connection with the proposed trans-Atlantic tests.

During the course of the evening some very interesting little incidents relating to experiences at sea were contributed by Messrs. Bingham and Rogers.

A series of lectures are being arranged, and it is hoped that it will not be long before the Society embarks upon some really useful work.

Any gentlemen interested and desirous of becoming members are invited to communicate with the Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton, who will be pleased to furnish full particulars.

Three Towns Wireless Club.

(Affiliated with the Wireless Society of London.)

At a meeting of the Club, held on Wednesday, October 20th, a lecture and demonstration was given by Mr. Rose on the construction of honeycomb coils. With the aid of a former and string he was able to demonstate to his audience the method of winding.

At the meeting of October 27th no special lecture was arranged, but members were invited to ask questions or present constructional difficulties they wished to have solved. A very interesting and useful evening was spent in consequence. New members are still joining, and it is hoped that the Club will soon be in a flourishing and healthy condition again. Full particulars of membership may be obtained from the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

Derby Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting of the Club was held at the Technical College on October 13th, when Mr. Downes read a Paper on "High-Power Land Stations."

A further meeting was held at The Court, Alvaston, on October 30th, and after buzzer practice, Messrs S. G. Taylor and A. T. Lee gave some interesting information on the Poulsen Arc, followed by a discussion.

Four new members have joined the Club. Members are reminded that an exhibition is to be held early in the coming year, by which time it is hoped there will be a good collection of local apparatus.—Hon. Secretary, Capt. William Bemrose, Littleover Hill, Derby.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

A well attended meeting was held at Shaftesbury Hall, Bowes Park, on November 3rd, the President being in the chair. After the minutes of the previous meeting had been read and confirmed, the Secretary read a letter from Mr. Wm. Le Queux, regretting his inability to be present on that evening owing to recent illness, but promising to send a special greeting to the Club by wireless telephony. He hoped, however, to be able to pay a visit at some date in the near future.

A number of members brought instruments for exhibition, and Mr. Gartland's 3-valve amplifier was connected to the Club's set. At the appointed time Mr. Le Queux's call was received, but owing to interference his message was mutilated.

A number of instruments and accessories were kindly lent by the Radio Supplies Co., and these created great interest by reason of their good finish and unique design.

It has been arranged that members may borrow

Members of the North Middlesex Wireless Club.

the Club's set on payment of a small fee, and it is expected that this will prove of great assistance to members.

Full particulars of the Club may be had from the Hon. Secretary, Mr. E. M. Savage, Nithsdale, Eversley Park Road, N.21.

Burton-on-Trent Wireless Club.

(Affiliated with the Wireless Society of London.)

The first annual meeting of the Club was held on Friday, November 5th, the Vice-President, Mr. A. Chapman, presiding.

Mr. R. Rose (Hon. Secretary) read a report on the activities of the Club for the past twelve months and produced a Balance Sheet, from which it appeared that the expenses of the Club for the twelve months ending October 30th, were £5 17s. 6d., leaving a balance in hand of £4 8s. 0d.

Colonel John Gretton, C.B.E., M.P., was unanimously re-elected President; Mr. A. Chapman was re-elected and Dr. A. L. Stern elected Vice-Presidents. Mr. R. Rose was re-elected Hon. Secretary and cordially thanked for his past services.

A letter was read from Mr. Philip R. Coursey (*Radio Review*) regarding a proposed radio test from America to the United Kingdom, asking for the co-operation of the Burton Wireless Club in the scheme. It was resolved to co-operate as far as possible and to make arrangements, if practicable, for the erection of a temporary station on the Water Tower just outside the town, for the purpose of endeavouring to pick up the signals from the United States.

The Hon. Secretary submitted a draft of the new Rules which were approved and adopted, the old Rules being rescinded.

A list of books in the Club Library was submitted, and Mr. W. L. Butt was elected Hon. Librarian.

Members were asked to return books borrowed within fourteen days, and a Rule was made to this effect.

The annual subscription is 5s. for members over twenty-one years of age, and 2s. 6d. for members under twenty-one.

A list of proposed Lectures for the winter session was submitted, and it was decided that meetings of the Club be held every alternate Friday at 7.30 p.m. The question of Morse practice was raised, and a number of members appeared to be desirous of practising Morse. Mr. Maurice Lloyd (Marconi Company) who was in the town for a few weeks, was present at the meeting, and kindly offered his services in this connection; classes were arranged for Mondays, Tuesdays, and Wednesdays in each week. Four new members were elected, and Mr. M. Lloyd was unanimously elected an honorary member.

All communications to be addressed to the Hon. Secretary, Mr. R. Rose, 214, Belvedere Road, Burton-on-Trent.

Edinburgh Wireless Club.

(Affiliated with the Wireless Society of London.)

Rapid strides have been made both in regard to the results of our receiving set and also to the number of new members enrolled.

Several members, who have private stations, report that United States and South American stations have been heard locally with one valve, P.O. aerial and apparatus almost home-made throughout.

Our Club-room at 48, George Square, Edinburgh, is open every Wednesday from 8 p.m. to 10 p.m., and on Sundays from 3 p.m. to 5 p.m., when any visitor who would like to view our apparatus will be gladly welcomed.

Unfortunately we have had to raise our annual subscription from 10s. to 12s. 6d. owing to the increase in the cost of necessities. County members annual subscription, however, remains at 5s. and entrance fee 5s.; half annual rates will be allowed for members joining after January 1st.

Our general (business) meetings will, in future, take place on the first Wednesday of each month instead of the first Sunday, in order that as many members as possible may be present.

Further particulars can always be supplied if required by sending a post card to the Hon. Secretary, Mr. W. Winkler, 9, Ettrick Road.

Halifax Wireless Club.

(Affiliated with the Wireless Society of London.)

The Club is still progressing satisfactorily and the membership is now about sixty. A transmitting licence has been granted by the P.M.G. for use on wavelengths up to 180 metres, and a special wavelength of 1,000 metres, for C.W. and telephony, with a power of 10 watts. A transmitting set has been constructed by some of the members, and at a recent meeting a demonstration of C.W. transmission was given.

On October 6th Mr. J. R. Halliwell, Principal of the City School of Wireless, Manchester, lectured to the members on "The Thermionic Theory." The lecture was most instructive and helpful to members, our accommodation being taxed to the utmost.

On October 13th Mr. Harold Emmott, A.M.I.E.E., gave a short Paper on "The Principles of Electrical Measuring Instruments," and provided suitable instruments for demonstration. Since the demonstration of C.W. transmission above referred to, two of the Club members have carried out experiments with telephony, and after Mr. Emmott's Paper they gave a demonstration of wireless telephony, transmitting music and speech from a room some distance from the Club-room. The experiments, which were highly successful, were listened to with the greatest interest by a large attendance of members. The transmitting set has been constructed on the lines of the one described by Mr. G. G. Blake, A.M.I.E.E., before the Wireless Society of London, but with the microphone in the earth circuit, which, in our case, gave better results than as in the published description.—Hon. Secretary, Mr. H. L. Pemberton, Clare Hall, Halifax.

Plymouth Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting of the Society was held on October 29th at the Municipal Technical College, Plymouth, Mr. J. C. Andrewartha in the chair. A most interesting and instructive lecture was delivered by Mr. J. K. A. Nicholson, A.M.I.E.E., on the Telefunken system. The lecturer made special references to the inductor-motor and alternator-variometer and the quenched-spark system, as used on these installations, comparisons being drawn with the instruments used in the Marconi system. The emergency, transmitting and receiving instruments used in the Telefunken system were also described in detail. Mr. Nicholson provided the assembly with an exhaustive series of diagrams to illustrate the principal differences between Marconi and Telefunken sets. At the close of the lecture the chairman expressed his appreciation on behalf of those present of the lecturer's interesting discourse. —Hon. Secretary, Mr. H. P. Mitchell, Municipal Technical College, Tavistock Road, Plymouth.

Sheffield and District Wireless Society.

(Affiliated with the Wireless Society of London.)

The first Paper of the new session was given by the President of the Society, Mr. H. E. Yerbury, M.Inst.C.E., M.I.E.E., the subject being "Some Errors in Text-book Science." The author dealt with the subject of internal atomic energy, the Einstein Theory, Matter, its structure and potentialities, and how it can be transferred into energy, such as heat and electricity. Many present-day theories were criticised, and some unorthodox views were brought forward on many subjects, including the conservation of energy.

At the conclusion of the Paper some interesting experiments were conducted to show that by the liberation of internal atomic energy (in this case seen by the emission of tiny sparks), a strip of metal may be immobilised in space without visible support.

A very interesting and instructive discussion followed, in which several members took part, and it was decided to have the Paper printed for distribution amongst the members of the Society. —Hon. Secretary, Mr. L. H. Crowther, 156, Meadow Head, Norton Woodseats, Sheffield.

Birmingham Wireless Association.

(Affiliated with the Wireless Society of London.)

The opening meeting of the session was held on Thursday, October 28th, at the Midland Institute, when Mr. J. R. Halliwell gave a very instructive and interesting lecture.

On rising, the lecturer stated that he had the previous evening been afforded the pleasure of addressing the members of the Manchester Wireless Society, and that on his informing them that he was to address the Birmingham Wireless Association, they asked him to convey their heartiest good wishes to the members.

He went on to say that he had addressed a number of Societies, but had never had the pleasure of speaking to such a large attendance, and that the number present indicated a very keen interest in both Science and the Society.

Mr. Halliwell opened his lecture by describing the properties of the electron, as compared with the ion and the atom, following up with the action of the electron in the valve.

At the close of his lecture Mr. Halliwell said that he would be pleased to answer any questions put to him by the members.

The Chairman (Mr. J. B. Tucker), accorded a hearty vote of thanks to the lecturer, and asked him to convey to the members of the Manchester Wireless Association the cordial appreciation of their message and to wish them, in return, every success in the coming season.

The Committee have arranged a very interesting course of lectures for the present season.

Those who are interested are asked to communicate with the Hon. Secretary, Mr. A. H. Handford, 188, Hamstead Road, Handsworth, when full information with reference to membership lectures, etc., will be forwarded.

Bradford Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting of the Society was held on October 22nd, the President (Mr. Wood) in the chair.

A Paper was read by the Hon. Secretary on "The Construction and Working of Resistance Amplifiers." A three-valve resistance amplifier was exhibited by the lecturer, and signals from Carnarvon, Nauen, and many continental stations were received.

The meeting was a great success and well attended. A vote of thanks was proposed by the President and seconded by the Vice-President (Mr. W. Ramshaw). At the close of the meeting eight new members were elected.—Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Bradford.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At the meeting of the Association at 16, Peckham Road, on Wednesday, October 27th, Mr. Howard exhibited and described the small reactance set which he had made from particulars given in *The Wireless World* of October 2nd last.

With one valve and the standard 100′ aerial he had obtained considerable distances on 600-metre wavelengths.

The Association has decided to move from 16, Peckham Road to the Central Hall, Peckham, on the first Wednesday in December, and at the same time the monthly subscription will be reduced by nearly 50 per cent.—Hon. Secretary, Mr. G. Sutton, Melford House, 18, Melford Road, E. Dulwich.

The Gloucester Wireless and Scientific Society.

(Affiliated with the Wireless Society of London.)

A meeting of the Club was held on October 4th at Sir Thomas Rich's School Laboratory. We were pleased to see several new faces amongst us, and feel confident that the membership will steadily increase and so give us more influence in the world of amateur wireless.

Mr. I. Harris, one of the members, gave a very interesting lecture on a new single-valve pancake set he is at present experimenting with. With a number of pancakes, from a few turns of wire to some hundreds of yards, very good signals were obtained.

A vote of thanks was passed to Mr. Harris for bringing forward his apparatus.

All communications to the Hon. Secretary, Mr. J. J. Pittman, 1, Jersey Road, Gloucester.

Manchester Wireless Society.

(Affiliated with the Wireless Society of London.)

At the usual weekly meeting held on Wednesday, October 27th, the subject of transmission to members was brought up for discussion by the Chairman, Mr. J. McKernan, at the suggestion of the Hon. Secretary.

It was explained by the Chairman, that owing to lack of funds, the necessary set required for C.W transmission was at present out of reach.

It was then proposed by Mr. Parkinson, seconded by Mr. Blackburn, and carried unanimously by the meeting, that a private subscription fund be inaugurated immediately, for the purpose of acquiring this set and accessories.—Hon. Secretary, Mr. Y. W. P. Evans, 7, Clitheroe Road, Longsight, Manchester.

The Wireless Society of Glasgow.

A meeting was held in the Christian Institute, Glasgow, on Wednesday, November 3rd, when a demonstration was given with instruments kindly lent for the occasion by the British Thomson-Houston Co., Ltd. Mr. Weir Mitchell gave a short lecture on the constructional and theoretical details of the instruments.

Any interested readers should communicate with the Hon. Secretary, Mr. W. Buchanan, 2, Drive Road, South Gevan, who will be pleased to furnish all particulars of the Society.

Portsmouth and District Wireless Association.

The Association has now settled down in its permanent Club-room, and the first meeting held there was a great success.

A licence has been applied for, and efforts are being made to set-up valve instruments for research work, as soon as the necessary permission is obtained.

Meetings are held every Tuesday.

Corresponding members who live out of Portsmouth are asked to remit one guinea per annum. —Hon. Secretary, Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

Huddersfield (Y.M.C.A.) Wireless Society.

The first meeting of this Society took place on Monday, November 1st.

The first business of the meeting was the discussion of the formation of the Society. After the various points had been settled, the work of electing the executive officers was proceeded with. Mr. Frank Simpson being elected Hon. Secretary and Mr. Stafford Dyson, Hon. Treasurer.

The following minutes were confirmed: (1) That the Society be called the Huddersfield (Y.M.C.A.) Wireless Society; (2) that the Secretary proceed with the obtaining of a licence for erection and operation of a valve-receiving apparatus; (3) that the subscription shall be the sum of 7*s*. 6*d*. per annum; (4) that a list of rules be drawn up by the Committee, and that every member shall abide by the said rules.—Hon. Secretary, Mr. F. Simpson, 3, Daisy Street, St. Andrew's Road, Huddersfield.

The Aberdeen and District Wireless Society.

A meeting of the Society was held on Tuesday, October 26th, Mr. F. H. Cartwright in the chair.

The Secretary delivered a lecture entitled "An Outline of the Principles of Transmission and Reception of Wireless Signals." The lecture was amply illustrated, and a hearty vote of thanks was accorded the lecturer on the call of the Chairman.

On Tuesday, November 2nd, Mr. Jas. Simpson, M.M., read a paper on "Wireless in Warfare." He pointed out that on the outbreak of war Britain was sadly deficient in wireless equipment as compared with our French allies, and Germany. The Germans at the outset were invariably kept well informed in advance of all proposed raids by the Allies. The latter, however, made rapid progress, and were soon far in advance of the enemy in the matter of equipment.

Mr. Simpson's Paper was highly interesting, and a hearty vote of thanks was accorded him.

Occasion was taken to congratulate Mr. G. Benzie, Culter, a member of the Committee, who, along with another, Mr. Jas. Miller, Mile-End Avenue, Aberdeen, had intercepted from New Jersey, Sir Harry Lauder's song, "Roamin' in the Gloamin'," transmitted by Mr. H. Robertson, of Keyport, New Jersey. We are very proud that members of our Society should accomplish such a great feat. We are all looking forward to a Paper from them dealing with the subject.

Several new members have been enrolled. Membership cards, with the Society's Rules and Regulations printed thereon, are being issued on receipt of payment of Entrance Fee (5s.) and, Annual Subscription (10s 6d.). —Hon. Secretary, Mr. W. W. Inder, M.I.R.E., 41½, Union Street, Aberdeen.

Walsall Amateur Radio Club.

At a meeting of the Club held on Monday, November 1st, some of the apparatus made by members was exhibited and photographed.

The junior class of the Club is progressing very favourably and is most enthusiastic. Lectures on the principles of electricity and magnetism are given twice a week.

The senior members of the Club visited the Birmingham Wireless School, on Wednesday, November 3rd, where a very interesting time was spent. Hon. Secretary, Mr. Edgar W. Bridgewater, 17, White Street, Walsall.

The Blackpool and Fylde Wireless Society.

At a meeting of wireless amateurs on the 4th November, at 1, Boscombe Road, Blackpool, the above Society was formed.

A Committee and Temporary Secretary were elected, and the rules of the Society drawn up.

The syllabus of lectures and meetings for the season will be discussed at the next meeting.

All persons interested can obtain information from the Temporary Secretary, Mr. L. Pollard, 209, Cunliffe Road, Blackpool.

The Wireless Society of Epsom.

A wireless Society has recently been formed in Epsom, and the Committee, provisionally elected, hope that all amateurs in the Epsom district will take such formation as a welcome sign that something is being done on their behalf.

Will all those interested kindly communicate with the Hon. Secretary, Mr. E. J. Alway, 38, Miles Road, Epsom.

Amateurs in Coventry.—With a view to forming an Amateur Wireless Club, Mr. E. E. Stewart of Ash Green House, Exhall, Coventry, is anxious to get into communication with interested amateurs in and about his district. A number of *ex* Navy and Army operators are already co-operating with Mr. Stewart.

Wireless Club for Lincoln.—Messrs. A. L. Astill and A. J. Yeates are endeavouring to form an Amateur Wireless Club at Lincoln and request the assistance of all wireless enthusiasts in the district. These gentlemen are of the opinion that considering the number of amateurs in Lincoln holding P.M.G. licences, there is every possibility of a first-class Club. Interested readers should communicate with Mr. A. L. Astill, 168, West Parade, Lincoln.

AN AMATEUR STATION

OUR photograph illustrates the station belonging to Mr. E. J. Simmonds, of Gerrards Cross, Bucks, all of which is home-made with the exception of the telephones and valves.

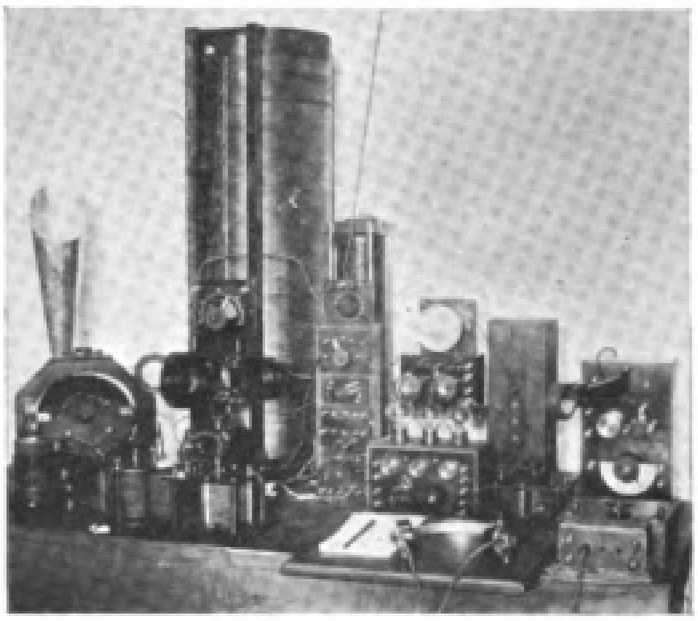
On the right is seen the wave-meter with adjustable search-coil, reading up to 20,000 metres, below which is a telephone block for plugging in extra telephones.

The amplifier is a five-valve (3H.F. and 2L.F.), but any number of valves from two upwards can be used.

In front of the large inductance, which is used for quick search-work, is seen a balanced-circuit tuner with honeycomb coils; some of the latter can be seen to the extreme left of the photograph.

Mr. Simmonds asserts that quite a number of American stations are audible on this apparatus the whole year round, and in spite of the strong atmospherics which prevail throughout the summer months, signals from NPL are always of sufficiently good strength for experimental purposes.

As the photograph shows, the set is both neat in appearance and well made.



A "SEMI-FIXED" CONDENSER

By J. R. Hoult.

No doubt there are many amateurs who have started their receiving stations without any of the essential data for the proper proportioning of their various instruments. When alterations become necessary, it is a good plan to make apparatus, the electrical or wireless value of which may be increased or decreased without a corresponding increase or decrease in its over-all dimensions, thus eliminating a re-arrangement of instruments.

A "fixed" condenser is about to be described, which, while not being as tedious as a rotary condenser to construct, is capable of quite a range of capacity without alteration to its mechanical dimensions.

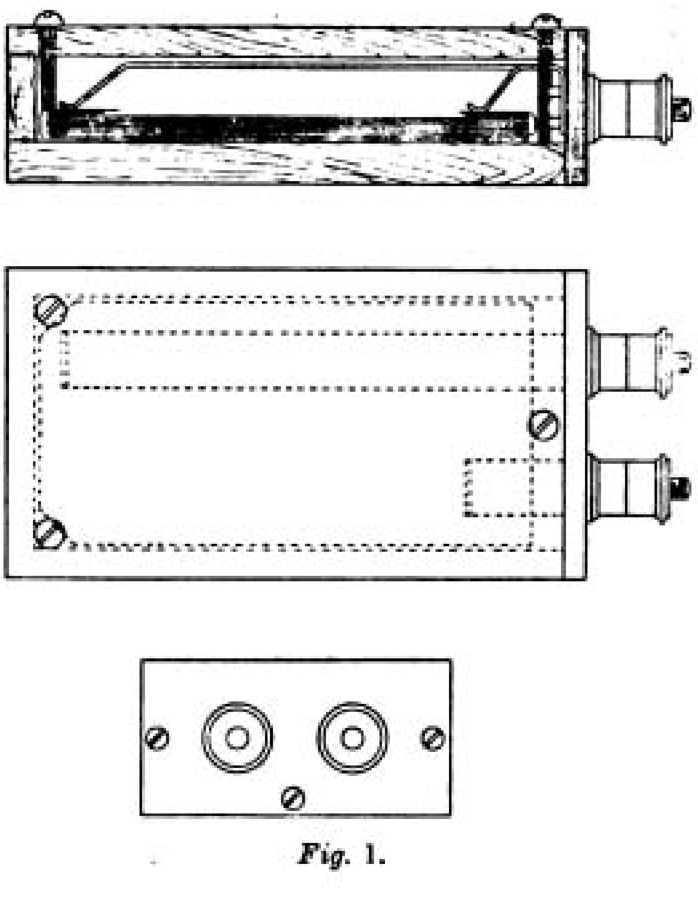


Fig. 1.

Fig. 1 shows the general arrangement of the component parts of the condenser. The box can be made of ebonite or wood, the latter being cheaper and quite suitable.

A piece of wood, 5" long, 2¾" wide and ¾" thick, is used for the base. To the two sides and to one of the ends, wood strips ¾" by ¼", are fixed, thus leaving one open end, to which is fitted a piece of ebonite 2¾" by 1¾" by $\frac{3}{16}$". A lid ¼" thick completes the case.

The ebonite carries the two terminals and the connecting strips ; the latter should be of springy copper, ½" long of No. 22 S.W.G., and bent as shown.

The condenser is made up in the usual manner, with alternate strips of foil and shellaced paper. Since the foil is bent over towards the top of the condenser, as in Fig. 2, care should be taken that a space of ⅜" is allowed between the longer edges of the paper and the foil, and ⅝" at the ends.

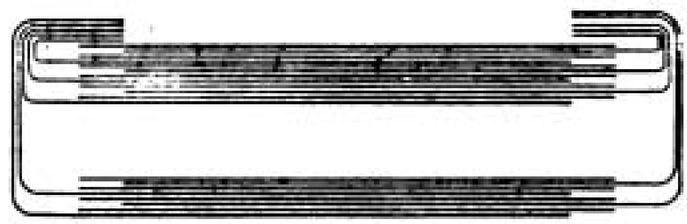


Fig. 2.

The sections of the condenser should preferably be made up in numbers of sheets that will give any figure between 1 and 9, as desired, *i.e.*, if the first section is made up of four sheets each side and the remainder three, two and one respectively, any number of sheets between one and ten may be obtained.

Care should be taken in seeing that the top foil of each section is covered and the underside left bare, so that when sections are placed together the correct thickness of insulation is maintained between them.

The lower foils of each section should be at opposite ends to the top foils of the same section, so that alternate sheets will be connected to separate terminals, as in Fig. 2.

The spare sections may be conveniently stored in the bottom of the case, an extra sheet or two of insulating paper separating them from the sections in circuit.

PAGES FOR BEGINNERS

Under this heading we publish COMPLETE *instructional articles, forming a series specially designed and written for beginners in wireless work. Hardly any mathematics will be introduced, and we hope to present the fundamental facts of wireless in such a manner as will prove attractive to a much wider range of students than that for which this series is primarily intended.*

THERMIONIC VALVES—III.

THE action of the valve as a relay, or amplifier, can best be understood by referring to the curve giving the variation of plate-current with grid-volts. A typical curve for valves of the R type is given in Fig. 1. At zero grid-potential, it is seen that the rate of change of plate-current is at its maximum. A slight variation in grid-volts, either positive or negative, will therefore result in a correspondingly greater increase or decrease in plate-current.

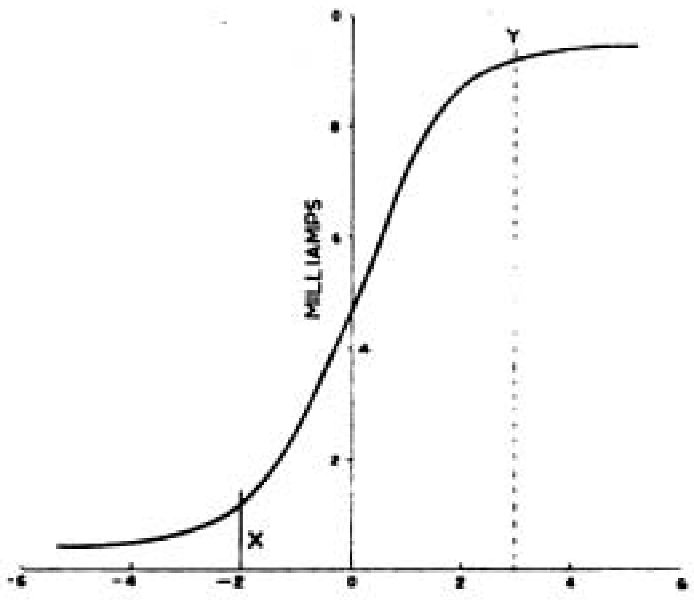


Fig. 1.

This magnifying effect of the valve is utilised in the making of amplifying sets, the details of which will be considered later.

Returning to the characteristic curve, let us examine the condition which arises when the grid-potential is negative. At the lower bend of the curve (marked X in Fig. 1) we see that a variation of grid-potential of two volts in the positive direction (*i.e.*, from -2 to 0,) results in an increase of plate-current of 3·6 milliamps. If, however, the grid is made 4-volts negative (*i.e.*, from -2 to -4), the plate-current only decreases by 0·8 milliamperes. Suppose now the grid were connected to a circuit so that its potential was continually varying between -4 volts and zero. The plate-current would vary also, but the increase of current due to the positive half of the wave would be greater than the decrease caused by the negative half The curves illustrated in Fig. 2 will

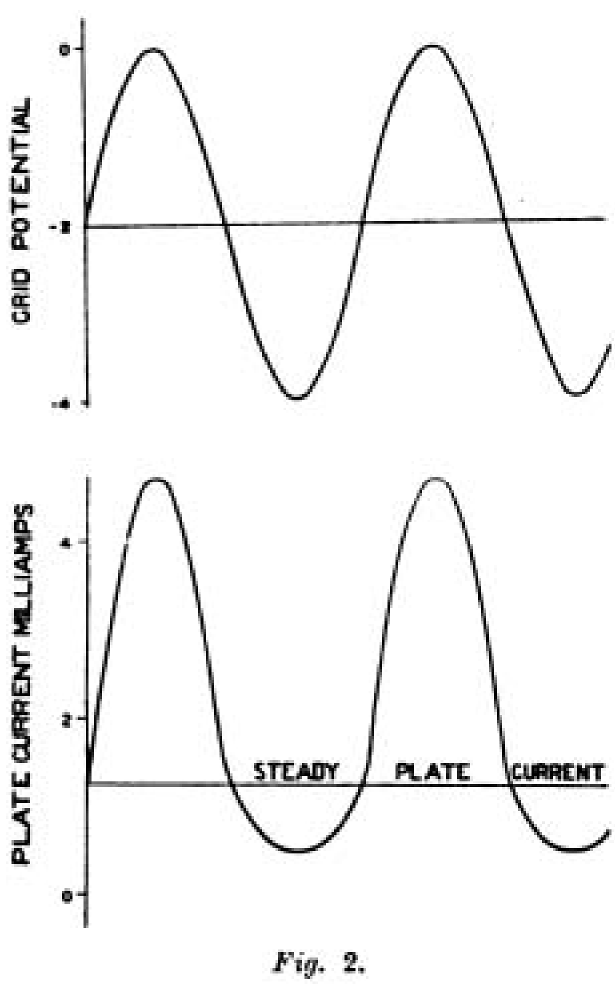


Fig. 2.

help to make this point clear. The top curve represents grid-potential, which is varied from -4 to 0. The variation in plate-current is shown by the curve below.

The result, therefore, of applying an oscillating voltage to the grid, is an *average increase* in plate-current. The next stage is to connect the valve in a receiving circuit and see how this increase of plate-current is utilised. The diagram of connections is given in Fig. 3. A potentiometer is included

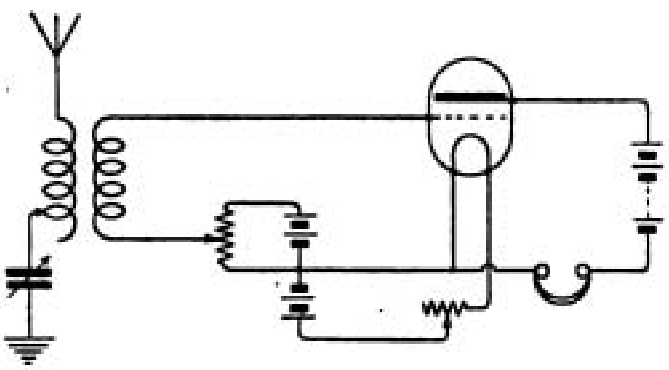


Fig. 3.

in the grid-circuit in order to apply an initial voltage to the grid. The plate is connected to the + terminal of a high-tension battery, the negative of which is connected through the telephones to the filament. If the aerial is not receiving signals there will be a small steady current flowing through the telephones which will not give rise to any sound. An incoming signal will cause a quick variation in the grid-potential (refer to Fig. 2) which in turn will cause an increase in the flow of unidirectional current in the plate-circuit. This average increase of current will then be marked by a click in the telephones at the commencement and end of the signal. In fact, the valve will be acting as a very sensitive rectifier, with the advantage—that the incoming signals lose but little energy in the grid-circuit. In the case of a carborundum crystal detector, the energy absorbed by the detector tends to damp down the oscillations. With a valve, however, the energy in the telephones is supplied by the high-tension battery, and there is less damping of the oscillations.

It has probably occurred to the reader that a similar rectifying action would be obtained if the valve were worked at the upper bend or "knee" of the curve (the point marked Y in Fig. 1).

In this case the grid would be given an initial positive potential, and the average plate-current would be decreased by the incoming signals. The only disadvantage of this adjustment is that there is a larger steady current flowing in the plate-circuit which shortens the life of the high-tension battery.

Consider what happens if the grid-potential is adjusted so that the variation in plate-current is equal for both halves of the oscillation, which will happen if the grid-potential is set at 0 (see Fig. 1). The variation in plate-current will then be the same whether the potential of the grid is changed from 0 to -1 or 0 to $+1$ volts. The plate-current will oscillate, in time, with the variations of the grid-potential, and the valve will no longer act as a good rectifier. However, since the plate-current is now oscillating in synchronism with the incoming oscillations, but with a higher amplitude, it is possible to make these oscillations in the plate-circuit help the incoming signal. In order to effect this, a coil is included in the plate-circuit which is placed near the receiving inductance.

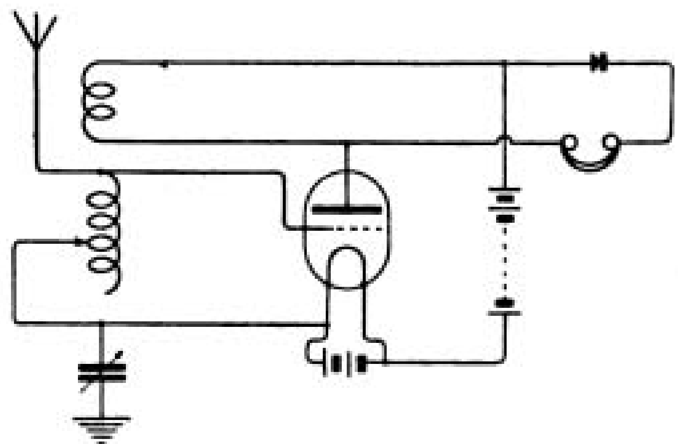


Fig. 4.

The incoming signals will induce an oscillatory current in the plate-circuit which will in turn increase the intensity of the incoming oscillations. By this means, it is possible to greatly increase the strength of signal received. A diagram of the circuit is shown in Fig. 4. The coil in the plate-circuit, because of its "acting-back" effect is usually termed a *reaction* coil.

The remainder of the circuit includes a detector and telephones which are connected across the plate-reaction coil.

This arrangement of the valve circuit simply serves to increase or amplify received signals, and is known as a high-frequency amplifying circuit.

The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

A FRAME AERIAL RECEIVING SET—III.

THE H.F. AMPLIFIER PANEL.

THE amplifier panel is to be designed to take four valves instead of three as was originally stated, and we will use for our purpose the Marconi V24 type valve. The amplifier will work on the well-known intervalve-resistance and condenser principle.

The clips for the four valves together with the filament resistance and grid-potentiometer handles will be mounted on the face of the panel. Clips for three anode - resistances and three grid-leaks will be mounted on the back.

The condensers will be mounted on the grid and anode clip screws. The filament resistance will also be mounted on the back of the panel, whilst the potentiometer will be fitted to two wooden supports screwed to the panel. A small telephone transformer will complete the panel.

The whole will be wired with stiff wire connections and should make a compact and useful amplifier for long wave working.

The panel itself should be made of ebonite, by reason of the fact that a wood panel would require all holes drilled, to be bushed with ebonite, thus making a far more expensive proposition.

The panel should be cut to $7\frac{1}{2}'' \times 7\frac{1}{2}''$ out of $\frac{3}{8}''$ ebonite. A number of plain holes should be drilled and for this purpose Fig. 7 will serve as a guide. The diagram shows all the holes which will be required, excepting those needed for fixing the screws into the box. The ebonite panel should be accurately marked in accordance with Fig. 7 and the holes above the points XY should be drilled for 5 BA clearance and those below XY should be drilled for No. 6 wood screws. After completing all necessary drilling the surface of the panel should be rubbed smooth

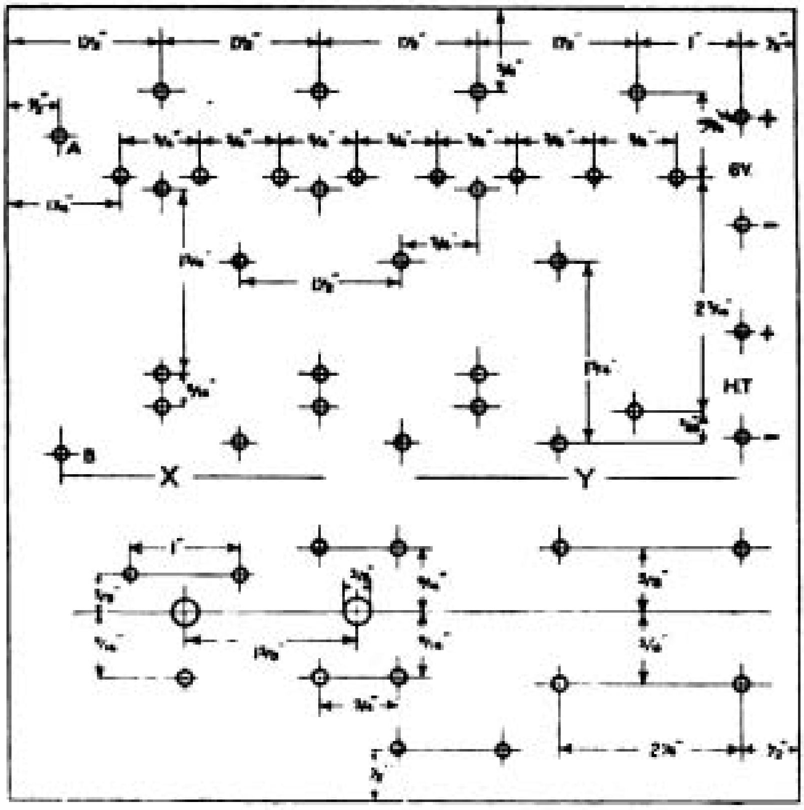


Fig. 7.

with emery paper until the outside surface of the ebonite is removed. This is done because the shiny surface of the ebonite is often detrimental to insulation resistance—causing surface leakage at high frequency.

With the panel finished, the valve and resistance clips should be made. There are three types of clip—valve-filament, grid, and anode, and resistance clips. All may be made of hard copper or phosphor bronze

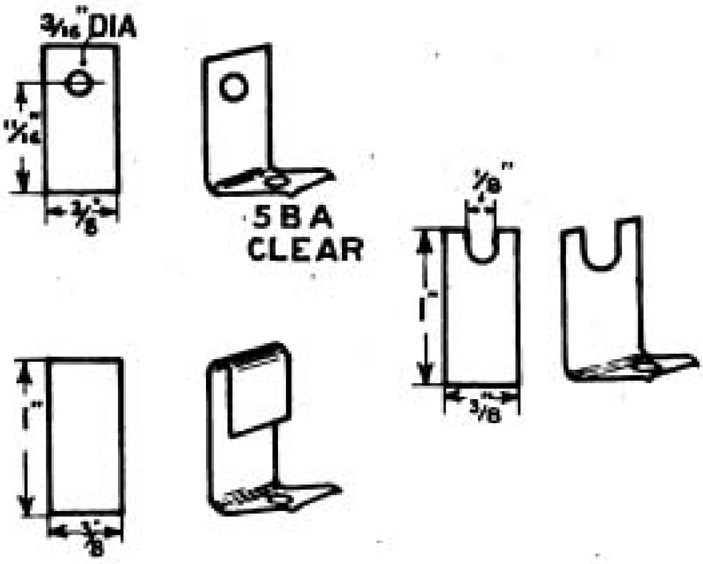


Fig. 8.

strip No. 26 gauge and 3/8" wide. The valve clips, of which 8 will be required, should be shaped as in Fig. 8, the base being 3/8" long and the vertical portion approximately 1" high. A 3/16" hole should be drilled in the vertical portion of each as shown and a 5 BA clearance hole through the centre of the base. The grid and anode clips, of which 8 will also be required, should be shaped as shown. They should be bent to the shape given, and have a 5 BA clearance hole through the centre of the base. They should be 1" high from the base to the top of the bend.

The resistance clips, of which 12 will be required, should also be as in Fig. 8. The height should be 1" and the base 3/8" long. A 5 BA clearance hole is drilled through the base and a slot 1/8" wide and 1/8" deep made in the top.

When bending the clips do not make sharp bends with square corners, but bend them on a piece of 1/8" rod, so giving the corners a certain amount of springiness. If this is not done the clips will probably break when the valves are put in.

In clips Fig. 8, it will be noticed that the ends of the springs are slightly bent. If little nicks are made in the ebonite panel to correspond with the bent springs it will be found that when mounting the clips, the bent points of the latter will fit into the little nicks thus making a good locking device to keep the springs from turning round.

The intervalve condensers, which are ·001 mfd. capacity, and which must be made sufficiently small to permit their being mounted on the fixing screws of the grid and anode clips, are the next items to receive attention. Full details of these together with diagrams showing the mounting of the clips and condensers fitted to the panel will be given in the next issue.

TYPE MARK III RECEIVER.

So many are the questions we receive asking particulars as to how the receptive range of these instruments may be increased, that we have decided to publish an article dealing with the subject in full, at the earliest available opportunity. Those of our readers who are in possession of Mark III Receivers, and who are in need of advice concerning them, would do well to watch future issues.

BOOK REVIEWS

AVIATION.

By Benjamin M. Carmina.

London: Messrs. Macmillan & Co., Ltd. New York: The Macmillan Co. Pp. 175, diagrams. (11*s.* net).

THE recent announcement made by the Royal Aeronautical Society, to the effect that in future all papers and communications destined for places abroad to which there is aerial communication will be sent by air mail, is a practical illustration of how aviation has developed. With the daily flights of passenger machines over European and American air services, with the rapid advances made in all directions of aviation, it befits us all to acquire at least an understanding of the fundamental principles upon which the study of aeronautics is based.

The need of a book, which though giving the theory of aviation loses nothing of its practical end, has long been felt, and the author in compiling the book under review has not only endeavoured to satisfy this needed desire, but has succeeded to some considerable degree.

For a given aeroplane part, the most common term has been chosen out of a maze of confusing terminology, and in Chapter II, which deals with construction, one becomes acquainted with the meanings of such words as "longerons," "struts," "nose-plates," and many others. Each part is shown in position, in well described and clearly drawn diagrams.

The book opens with a chapter exclusively devoted to the theory of flight, occupying thirty-three pages of interesting and instructive matter, written in a style simple enough to make its meaning clear, even to those whose knowledge of the subject is but nebulous and scanty. The science of mechanical flight is sufficiently treated upon to give the student, amateur or layman, an understanding of its general principles, without confusing him with unnecessary formulæ.

An appendix is added for the benefit of those students who wish to go deeper into the science of aerodynamics, and to facilitate the task of those who have not the necessary mathematical knowledge, the superficial elements of algebra, trigonometry and the metric system have been given in the definitions.

METEOROLOGY.

By R. G. K. Lempfert.

London: Methuen & Co., Ltd.

This volume, which has recently appeared, is from the pen of Mr. R. G. K. Lempfert, M.A., C.B.E., Assistant Director of the Meteorological Office.

The object of the book is to supply the general public, and in particular those who are concerned with the subject, in the daily performance of their occupation, with an up-to-date text-book which will present, in an interesting manner, the results which have been obtained up to the present day from the systematic study of the weather and the conditions and influences which govern it.

The author describes the methods used and the various instruments employed for the compilation of weather forecasts. An explanation of weather maps and their preparation forms a fascinating opening chapter.

One cannot read the book without feeling how powerful an aid to progress is the utilisation of information obtained from the study of this science.

From references given in the book, the inestimable service rendered by the Meteorological Office during the war can be appreciated.

QUESTIONS AND ANSWERS

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Questions should be numbered and written on one side of the paper only, and should not exceed four in number. (2) Queries should be clear and concise. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a " nom de plume."*
(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.

H.E.D. (Manchester) *asks* (1) *If a receiving set were made from certain apparatus, would it be efficient.* (2) *If, omitting the* A.T.I., *what wavelength he could receive.* (3) *For particulars of an* A.T.I. *to tune his set to a range of from* 600–3,000 *metres.* (4) *If it is advisable to have the variometer in circuit, and would the A.T.C. be better across the reactance.*

(1) The circuit is of a fairly suitable type, except for series inductance and variometer in aerial circuit, which are not long enough to be of much use. Reactance coil is also not big enough.

(2) About 700 metres, unless tuning condenser is shorted, in which case it would reach about 1,000 metres.

(3) A.T.I. should be about 8″ × 6″ of No. 24 wire.

(4) Variometer does no harm, but can be omitted if desired. A.T.C. should be placed as shown, and not across reaction coil. Fig. 1.

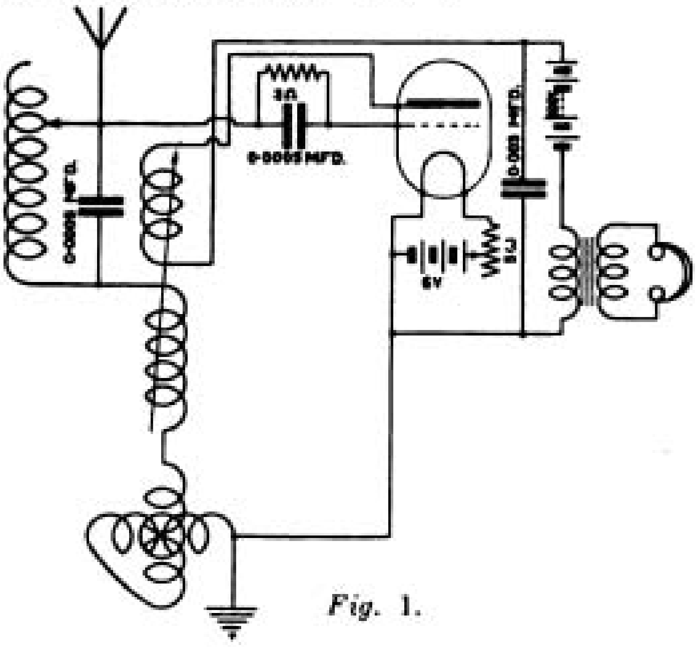


Fig. 1.

J.S.F. (Herne Hill) *has made a valve and crystal set as described in early issues of this volume. The set works well, but he wishes to use a second valve instead of crystal. He asks* (1) *For a design for such a set with all necessary details for construction.* (2) *What is the maximum efficient wavelength for such a set.* (3) *How set could be modified for* C.W. *reception without a separate heterodyne.*

(1) The complete detailed design of a set to meet any individual requirements is quite outside the scope of these columns, which are intended to help correspondents with particular difficulties they have met with. The type of set you have referred to is not suitable for alteration as you suggest, using single L.T. and H.T. batteries for both valves. To meet your requirements we should recommend H.F. resistance amplification for the first stage; you will then have little difficulty in adding a second valve. Many sets of this type have been sketched lately, which see and in particular reply to **E.J. (Sutton)** in issue of October 30th. For rectification after H.F. amplification a valve gives little better results than a crystal.

(2) Difficult to say, as it depends so much upon local conditions—possibly 6,000 to 8,000 ms.

(3) The original circuit should receive C.W. without an independent heterodyne. If you cannot do this, try interchanging or reversing the connections to coupling coil.

L.G. (Oxford) *sends a diagram of a crystal receiver and asks* (1) *If the transformer is rightly situated.* (2) *Would we give particulars for the construction of a transformer suitable for* 40 *ohm. telephones.* (3) *Is a blocking condenser needed, if so, in* A *or* B. (4) *What should be the capacity of the blocking condenser and variable condenser.*

(1) Yes.

(2) Transformer in the March 1920 issue, page 699, should be quite satisfactory.

(3) Blocking condenser is not necessary, but may somewhat improve results, it may be used on either side of transformer, preferably on the H.R. side.

(4) Variable A.T.C. maximum about ·002 mfds.

D.S. (Rugby) *asks how he can get* H.T. *voltage off a* D.C. *main.*

See page 544 of the issue of *The Wireless World* for December, 1919, obtainable from the Wireless Press, 12–13, Henrietta Street, London ; post free, 1s. 3d.

B.X.K. (Leicester) *sends particulars of a valve receiver which he intends building, and asks* (1) *For criticism of set.* (2) *Would honeycomb coils with tappings have any special merits, as he wishes to save space.* (3) *What would be approximate sizes of coils shown in his sketch, and what is the best size of wire to use.* (4) *If he is correct in assuming the set would respond to any wavelength up to* 5,000 *metres.*

(1) Type of set is all right. Reaction coil should be on plate side of H.T. battery and telephones, tuned-circuit condenser (·001)—rather big—make it ·0005 mfds., and tuned-circuit inductance 20,000 mhys. Grid-condenser much too big ; make it ·00005 mfds.

(2) Tapped honeycomb coils can be used, if desired. They should be fairly efficient, and should certainly save space.

(3) We can only give very rough estimates, the actual values will depend so much on the method of winding, etc. Say, for A.T.I. and tuned-circuit, 25 layers of 25 turns each of No. 24 on a former 2½″ diameter. For reaction coil use about half the above number of turns; thinner wire can be used, if desired, say, No. 30. Coupling can be between above pair of larger coils, direct if desired. If a separate coupler-primary is used it might contain about 100 turns.

(4) Yes, fairly comfortably.

F.L.D. (Manchester) *sends a diagram of an aerial Fig. 2 height 35 ft., length AB twin-wires 45 ft., length BC twin-wires 25 ft., gauge of wire, No. 16 S.W.G., together with receiving circuit and description of apparatus used (Fig. 3) and asks (1) For criticism of set and aerial. (2) If using pancake coils for A.T.I. and reactance units, the following arrangement will be satisfactory. One pancake coil tuning from 100 metres to 2,000 ms., one tuning from 2,000 metres to 10,000 ms., and one from 10,000 to 20,000. Each of these to have a reactance coil to couple with it. Tuning to be done with ·001 mfd. condenser. (3) For dimensions of formers and gauge of wire for above units.*

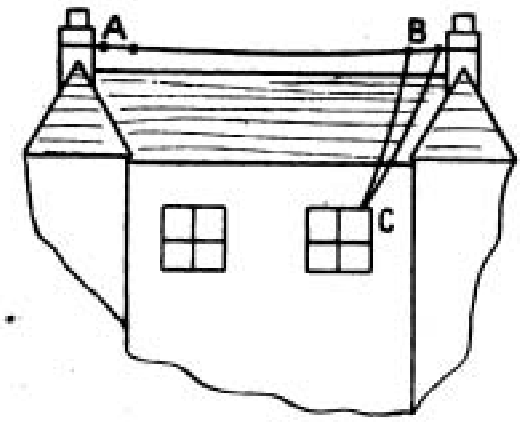


Fig. 2.

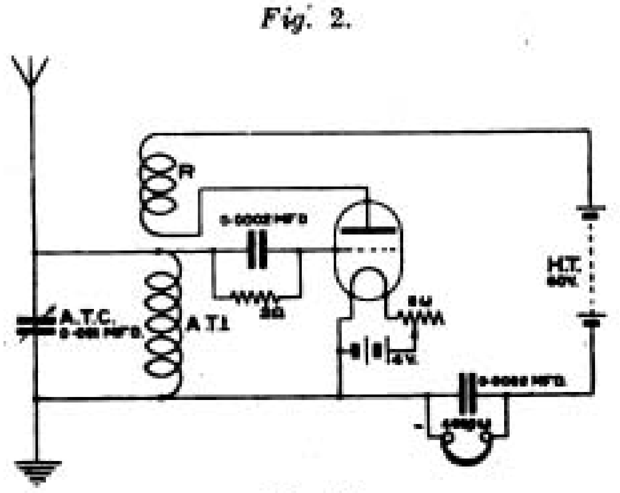


Fig. 3.

(1) and (2) Aerial O.K. Suggested circuit is fairly good, except that grid-condenser should be smaller than ·0002 mfds., say, ·00004 mfds. You will not, however, be able to get the ranges you suggest, as the maximum wavelength for any given A.T.I. will only be about three times the minimum for the same coil. You will have to put tappings and a switch on your A.T.I. Then make your ranges, say, 300–1,600, 1,600–6,000, 6,000–20,000. You will find difficulty in getting below about 300 metres with this type of circuit.

(3) A.T.I. first range, 120 turns, No. 26, mean diameter 8 cms.; A.T.I. second range, 250 turns, No. 26, mean diameter 14 cms.; A.T.I. third range, 750 turns, No. 32, mean diameter 24 cms. For reaction coils try about half as many turns as A.T.I. on first two ranges and one quarter as many on third range.

IN NUBIBUS (Woburn Sands) *encloses a sketch and description of his 2-valve receiver, which has multi-layer coils of enamelled wire for tuning purposes, and consists of a grid-leak detector and note magnifier. He asks (1) Why the set will not oscillate on certain studs of the reactance. (2) How he can reduce wavelength. He states that he cannot get below 6,000 metres, even when cutting out secondary condenser. (3) What is the capacity of a condenser, the construction of which he gives. (4) If the above receiver should get 2,000 metre stations.*

(1) We think the insulation of the coils may be faulty, or conceivably the losses due to the multi-layer winding may give you trouble.

(2) In all probability there is a definite minimum wavelength due to the self-capacity of the coils; this you will not be able to overcome.

(3) ·0023 mfds., approximately.

(4) It is not possible to predict the minimum wavelength of a set such as yours, where the self-capacities play such an important part.

H.H. (Newsham) *encloses diagram of a receiver, and asks (1) If we would explain how to add 1, 2, 3 or 4 more valves as amplifiers to a certain circuit. (2) If intervalve transformers are used, would the following be suitable: 3,000 turns of No. 40 B & S enamelled wire, with 12,000 turns of No. 44 B & S enamelled wire and suitably insulated. (3) If it is necessary to show tapping switches to inductances in a P.M.G. drawing. (4) Where he can get a description of a wavemeter to measure C.W. up to 25,000 metres and one to measure spark signals up to 10,000 metres.*

(1) Your drawing and connections are so complicated that we are quite unable to trace it out satisfactorily. Assuming that they are correct and give stages of rectification and note magnification, you would be well advised to introduce some stages of H.F. amplification. We cannot enter into the general design of such circuits in these columns, but possibly the most satisfactory type for long-wave work is the resistance amplifier. See article in March issue of this year.

(2) The windings would do, but preferably more turns in the same proportion should be employed: twice as many of each would perhaps be better.

(3) We do not think so.

(4) We do not know any description of this kind.

H.H. (Dewsbury) *asks (1) If it is possible to make a relay which will respond to W.T. signals. (2) If so, should it be polarised. (3) What size should the coils be made and how much wire should be used.*

(1) Yes, if you have a suitable valve circuit and fairly strong signals.

(2) Yes.

(3) Four ounces of No. 44 S.W.G. should give suitable windings for the average valve. The size of coils depends on the design of relay; apart from this, it is not very material. Consult any textbook on landline telegraphy for description of typical relays.

R.A.H.W. (London) *encloses a sketch of a crystal receiver with valve-magnifier, and asks for constructional particulars to give him a wave-range from 300 to 2,500 metres. He also asks* (1) *If the* A.T.C. *is only required when it is necessary to reduce wavelength, and to keep some* A.T.I. *in circuit to connect to the amplifier.* (2) *If some* A.T.I. *is in consequence, absolutely necessary with this circuit.* (3) *If he can use a galena crystal instead of carborundum in the circuit he gives.*

Your set is identical with the "crystal receiver with valve magnifier," described in the issues of April 17th and May 1st of this year. You will get full particulars in those two numbers. As regards your further queries—(1) Correct; (2) Correct; (3) Yes.

B.J.A. (Wembley) *asks* (1) *How to find the wavelength to which a loose-coupler will tune.* (2) *Why values for grid-condensers and leaks vary so.* (3) *What is the best rectifying valve.* (4) *What is the best value and whether the exact value is very important.*

(1) A loose-coupler will tune to the wavelength of the circuits in which its primary and secondary coils are included. Without particulars of these it is impossible to state what wavelength it will reach. The wavelength of the secondary circuit depends on the inductance (L) and the capacity (C) of the tuning condenser. You must calculate these and apply the formula $\lambda = \cdot 885 \sqrt{LC}$, where λ is wavelength in metres, L is inductance of secondary in microhenries, C is capacity of tuning condenser in microfarads.

(2) The determining factors in choosing the value for a grid-condenser are the wavelength and the capacity between grid and filament of valve. A smaller condenser is required for a shorter wavelength, but it must be much larger than the valve-capacity in any case. The value of the leak depends upon the value of the condenser and on the strength of signals. Smaller condensers require leaks of lower resistances. Apart from the above, different experimenters have found different values most suitable, and it is impossible therefore to make any rule.

(3) R and Q (Marconi) are both good. There are doubtless many others.

(4) One authority we know of recommends ·0003 mfds. and another ·000002 mfds. As a general rule you will find ·00002 to ·00008 mfds. suitable limits; grid-leak, 1 to 5 megohms.

A.E.H. (Forest Gate) *encloses diagram of a crystal receiving circuit with particulars, and asks* (1) *The maximum wavelength he can tune.* (2) *If he can use a variable condenser of certain dimensions for secondary tuning. At present, he states, it will only work at minimum capacity. He asks what alterations are required.* (3) *If by turning frame aerial through 360 degrees he can receive messages from all points of the compass.* (4) *With reference to the type of Leclanché battery mentioned in the issue of September 4th, he states that, using zinc 1/32" thick, area approximately 2" square and carbon ¼" in diameter, he can only obtain ½-volt. He asks why this is.*

(1) 2,500 metres on aerial circuit.

(2) This condenser is too small to tune to 2,300 metres, and will only give 800 metres. This does not explain your difficulty, which appears to be due to a fault in the condenser. You should test for short-circuiting.

(3) Yes.

(4) Your trouble is probably due to polarisation.

A.H.F. (Birkdale) *asks* (1) *For criticism of a proposed receiver, a sketch of which is given.* (2) *For the most suitable value for a variable condenser, shown in the above receiver.* (3) *The capacity of a certain condenser, particulars of which are given.* (4) *If above set would receive* BYW *on his aerial.*

(1) Your connections are wrong. See article in issue of September, 1919, for typical crystal receiver.

(2) In view of wrong connections, better omitted.

(3) About ·00013 mfds.

(4) Apart from the faults, it is impossible to say, as you give no particulars of the coil you use.

W.R. (Leeds) *sends sketch of a set he proposes constructing, and asks* (1) *For criticism of his set.* (2) *For range of set.* (3) *How set could be improved.* (4) *If 2,000 ohms resistance would be sufficient for telephones.*

(1), (2) and (3) We are afraid circuit is of little use. It is quite wrongly connected. Consult recent replies for diagrams of simple crystal circuits; we should also advise you to get a book on the subject such as Bangay's Elementary Principles. We do not understand how your potentiometer is intended to work, as it appears to have two terminals only. We would recommend you to use the ordinary wire type. For an A.T.I. you should use coarser wire than No. 32, say No. 24. Also increase the diameter of former to 5 or 6 inches.

(4) Yes, though somewhat higher would be preferable.

R.A. (Wicklow) *asks* (1) *What are the laws governing the electrical dimensions of a valve receiving circuit reaction coil.* (2) *Why we say multilayer coils wound in narrow grooves are unsuitable whilst he finds that these coils are virtually the same as pancake coils.* (3) *Referring to the method of pile-winding described and illustrated on page 464, which he says is difficult to wind owing to the crossing wire slipping, and also to the fact that the effect of the crossing wire is cumulative—is there any way of keeping the wires from slipping.* (4) *Is a spider used in honeycomb winding and would a coil wound on a spider having a double row of pegs, amount to honeycomb winding.*

(1) There are no simple laws. You will find certain quantitative expressions for mutual inductance of the reaction and tuned circuit coils in various text books (*cf.* Stanley, Vol. 2, page 96-7), but these expressions are almost useless for the determination of suitable sizes of coils for practical use, as they would involve calculations with factors

which are difficult to obtain and rather variable when obtained.

(2) Pancake coils differ from ordinary multilayer coils, in that in the former, turns, which are at a considerable difference of potential (*i.e.*, which are separated by a considerable number of turns in order of putting on), never lie close together whereas in the latter they do. This accounts for the difference in self-capacity.

(3) To get good results in pile-winding the various cross-overs from top to bottom should not be made at the same point on the circumference each time. By doing this a bad bulge is obtained which gets worse progressively. If, however, each cross-over is made about 1" further round the circumference than the last, then the bulge comes at a different place each time and does not grow unmanageably large.

(4) A spider is not usually used in manufacture. A good imitation of a honeycomb winding can, however, be made with a double spider as you suggest.

RANK NOVICE (Dorchester) *encloses specification of a crystal receiver and asks* (1) *If circuit is workable. If not, why not.* (2) *What capacity tuned-circuit and telephone condensers should have.* (3) *For a diagram if circuit is wrong.* (4) *If energy (accumulator or battery) is needed in detector circuit.*

(1) Circuit correct.

(2) It depends on wavelength you propose to receive, which you do not specify. Assuming that you have an aerial of maximum P.M.G. dimensions your aerial-circuit should tune to 2,300 metres. A variable condenser of ·0002 mfds. will be enough for your tuned-circuit for the same wavelength. The telephone condenser is not really necessary, ·003 mfds. is a suitable value if used.

(3) No need.

(4) Some crystals, *e.g.*, carborundum, require a potentiometer to adjust them to their most sensitive point. It is not a question of energy, as other crystals work equally well without batteries.

H.P. (Ashtead) *encloses diagram of his crystal receiver with certain particulars regarding it. He asks* (1) *Why he cannot get Nauen, though he has apparently enough inductance to do so.* (2) *With regard to his telephone transformer, which he has constructed on the lines of that described in the issue of March, 1920, would his primary winding of 4 oz. of No. 38 S.W.G. plus 4 oz. of No. 42 S.S.G., account for his getting bad signals.* (3) *If it is practicable to wind No. 16 tinned-copper wire, on a former made up of 4 porcelain rods clamped between two wooden cheeks, and what would be the approximate inductance of such an arrangement. (Dimensions given.)* (4) *If the resistance of the tinned surface of the wire is worth considering.*

(1) The inductance in your aerial circuit should certainly be enough to tune to 5,000 ms. Are you certain there is no fault in your circuits, *e.g.*, a bad contact or faulty insulation in any of your sliders.

(2) The resistance should be of the same order as in the original. It is possible you may have the two parts of the primary winding oppositely connected. Try reversing the connections of one.

(3) Yes, about 3,300 mhys.

(4) No.

J.D. (S.E. 14) *sends sketch and particulars of his valve and crystal receiver, and asks the following questions.* (1) *If his present A.T.I. can be used as a loading-coil.* (2) *Gauge of wire and length required for tuned-circuit coil.* (3) *Gauge of wire and length required for reaction coil.* (4) *If he can use any of several basket type coils described.*

(1) Yes.

(2) Former 7" × 5" of No. 28, say 800 ft.

(3) Former 4" × 3" of No. 24, say 150 ft.

(4) We do not understand how you can get as many turns of wire on basket coils of so small diameter. Either of the No. 30 wire coils may be used in plate tuned-circuit for certain wavelengths, or the two may be used in series if desired. Coils of No. 36 wire will have a too high resistance to give very good results. ·0003 condenser should be used in plate-circuit, remaining two in parallel in aerial.

C. THREX (Harlesden) *encloses a diagram of the presumed connections of an A Mark 4 amplifier and asks* (1) *If they are correct.* (2) *If it would be correct to connect a magnetic reaction-coil at a certain point in the circuit.* (3) *If the connections of the secondaries of the intervalve transformers to the negative of the filament, and to earth, are as efficient as another arrangement he proposes in which they would be connected to the positive of the filament.* (4) *If connecting the iron-cores of the transformers to the positive of H.T. would be any good.*

(1) Yes, we are only in doubt about the terminals A and B which we thought were interchanged.

(2) No, it can do no good in the position you show, as there is nothing with which it can react. Reaction-coils are, in any case, of doubtful value in most note-amplifier circuits.

(3) The amplifier is, we believe, designed for 50 volts H.T. and R valves. For this purpose the grids of the amplifying valves should be at zero potential.

(4) If you are troubled with howling, it might stop it, possibly an earth connection would be better, though it depends on how transformers are wound.

STUDENT (Lewisham) *asks how to increase wavelength of a Mark 3 tuner to about 3,000 metres, preferably without dismantling the coils.*

This problem has been discussed in several recent replies, which see for details of various possible ways of altering the tuner. Briefly, we think you will get best results by using an additional A.T.I. in series with original A.T.I., placed outside the tuner, together with another tuned-circuit coil in series with, or instead of, the original tuned-circuit coil. It will probably be necessary to couple these additional coils together in order to get efficient coupling between the circuits. The original may be retained unaltered.

E.H.J. (London) *sends description and diagram of a crystal receiving set and asks* (1) *If we consider the circuit good.* (2) *Between what ranges of wave-*

length will it receive. (3) *What would be suitable dimensions for a loading coil to enable him to receive on much higher wavelengths, say 12,000 metres.* (4) *What would be suitable resistance for potentiometer.*

(1) Quite.

(2) From a few hundred to about 4,000 ms.

(3) Results with a plain crystal set and small aerial are very poor above about 5,000 metres, and would not be worth the trouble and expense of obtaining. For 12,000 metres, coil would have to be about 24" × 10" or equivalent tube-wound coil, of No. 26 wire.

(4) Anything between 100 and 500 ohms. would be quite satisfactory.

S.W. (Kilburn) *sends sketch and description of a crystal set, and asks* (1) *Our opinion of the set and of dimensions of parts.* (2) *If connections are right.* (3) *What resistance telephones to use.* (4) *What is the purpose of a loading-coil.*

(1) Our opinion of the set as shown is not high, the dimensions of the various parts should be fairly suitable however.

(2) No, the loading coil should not be in parallel with coupler-primary, nor the crystal in series with tuned circuit condenser.

(3) About 4,000 ohms.

(4) To increase the wavelength to which the circuit in which it is placed will tune.

H.W.L. (Liverpool) *encloses diagram of a single-valve receiving set and asks* (1) *What gauge of wire should be used on the A.T.I., coupling-coil and secondary-coil to tune to 8,000 ms. (sizes of formers specified).* (2) *What is the best type of valve to use with this circuit, using filament battery of 4 volts and H.T. battery of 40-60 volts.* (3) *What should be the capacity of the condenser across the H.T. battery.* (4) *For criticism of circuits.* (5) *If a valve with broken filament can be repaired and if so at what cost.*

(1) You give no particulars of your aerial. Assuming usual P.M.G. dimensions, No. 28 S.W.G. would be suitable for tuned-circuit and coupling-coil. No. 32 S.W.G. for secondary and reaction coil.

(2) R type is about the most suitable if you are limited to 4 volts L.T.

(3) About ·003 mfds.

(4) Circuits theoretically O.K.

(5) No.

(*Four* questions only, please.)

R.C.B. (Bexhill) (1) *Sends a list of basket-wound coils, giving dimensions, and asks if they would be suitable.* (2) *He asks for a criticism of a valve circuit he is using.* (3) *What wavelength he could tune to with an aerial of specified dimensions.* (4) *Is the ratio of the inductance of primary to that of secondary, and of secondary to reaction, the same when tuning for different wavelengths, and if so, is there a simple formula for calculating it.*

(1) We are afraid we cannot help you, in that you say nothing about the tuner you propose to make, or what wavelengths you wish to receive. The smaller coils might be suitable for reaction and the larger for tuned circuit. The A.T.I. should be wound with thicker wire.

(2) This receiver should be quite satisfactory.

(3) About 2,500 metres.

(4) There is a certain amount of proportion between these inductances, but not quantitatively so. There is no simple formula covering this.

66G (London) *Has a valve set with loose-coupler (primary 7" × 5½" of No. 28—secondary 7" × 4½" of No. 32), primary being in aerial across grid and filament of valve, and secondary in plate circuit. For reaction his coil is to be placed inside the other two. He asks* (1) *Will this work.* (2) *What wire to use.* (3) *How many tappings.* (4) *If we can suggest anything better.*

(1) and (4) Not very well, owing to the fact that reaction coil will be coupled to both aerial and tuned circuits. Set should be arranged so that there is direct coupling between primary and secondary, and between secondary and reaction coil, but as little as possible between primary and reaction coil.

(2) About 5" × 3" of No. 30.

(3) About 6 should be ample.

V.H.K. (Port Elizabeth) *asks* (1) *Which would be preferable, a ten-foot square horizontal frame aerial or a four-foot square vertical one.* (2) *Whether solenoid or pancake type of winding.* (3) *If the type of amplifier illustrated in Fig. 1, page 290, No 8 would give good results with a crystal rectifier instead of the Q valve.* (4) *Number of valves suggested as a working minimum.*

(1) We would prefer the small vertical frame.

(2) Equally good.

(3) Yes.

(4) As you say nothing of wavelengths it is difficult to say. A resistance amplifier works less efficiently on low wavelengths, consequently more stages would be needed. For receiving signals from ships we would almost advise another type of amplifier. Otherwise, try two stages of resistance amplification on the longest wave station you can get, adding more stages as required.

H.A.T. (Handsworth) *asks* (1) *What are the regulations with reference to wavelength and range of amateur telephony.* (2) *For number of turns and gauge of wire for a loop-aerial 6 ft. square for D.F. reception, on wavelengths from 1,000 to 5,000 metres.* (3) *What capacity in parallel would be required to increase such an aerial to 10,000 metres.* (4) *What power would be required to transmit speech over a range of 1 mile using a standard G.P.O. outside aerial for transmission and reception, and can we give a good circuit diagram using anything up to six valves and transformers.*

(1) They vary according to the applicant for licence. Write to Secretary G.P.O. stating your wishes.

(2) For aerial 6 ft. square, use up to 60 turns, spaced about ⅜", wound with about No. 18 wire.

(3) Parallel condenser should be about ·0005 mfds., wavelength should be brought up by a loading inductance. For 10,000 ms. you will require about 60,000 mhys.

(4) About 10-15 watts should be sufficient. For the diagram see page 316 of the present volume.

SIREN (Salford) *asks for help in designing gear, introducing valves, to make gramophone music audible over a large hall.*

We are afraid the solution of this problem, which is hardly a wireless one at all, is rather out of the scope of these columns. You can, of course, try any of the well-known L.F. types of amplifiers, but we doubt if you will get very good results owing, partly to the limitations of power output of the ordinary receiving valves, and also to the distortion of speech and inefficiency of the usual intervalve transformers on heavy load. For such purpose we should recommend a loud speaking telephone operated by a battery of Brown telephone relays. The makers of these relays would probably be pleased to help you further in the matter.

WIRELESS (Oxford) *sends description and sketch of a crystal receiver and says he has not had very good results with it. He asks* (1) *The best and simplest way to earth the apparatus.* (*His earth is to a water tap 40 ft. away.*) (2) *If there is anything wrong with his set.* (3) *If a potentiometer would improve the circuit.* (4) *How to connect a valve amplifier in the circuit.*

(1) Why not bury plates near the receiver in the usual way ?

(2) The receiver is fairly good, but would be improved by a ·0005 mfds. condenser across coupler-secondary. Also on stand-bi side, A.T.I. as well as coupler primary should be put across crystal.

(3) Very probably.

(4) This depends on the type of amplifier used ; if H.F., crystal should be discarded and amplifier used in its place. If L.F., crystal should be retained, and amplifier connected *via* a L.F. transformer (step-up) in place of the telephones.

F.C.W. (Madeira) *asks* (1) *What is the objection to multilayer* A.T.I. *coils, which he has used successfully up to* 3,000 *metres.* (2) *If when pancake coils are used, they may be placed in any position relative to each other, having regard to the effect of mutual induction between them.* (3) *What are the resistance ratios of* (*a*) *primary to secondary of intervalve transformers,* (*b*) *secondary of telephone transformer to telephones.* (4) *If, under good conditions there is any chance of hearing telephony in Madeira, if so, what are the best approximate times and wavelengths to look out on.*

(1) Multilayer coils with unspaced windings behave as if they were of abnormally large resistance owing to the capacity between layers, and consequently do not tune so well. There is a further disadvantage in that they have a natural wavelength of unusually high value owing to their large self-capacity. Unless you took special precautions in constructing your coils we think that you would probably have obtained much better results with the single-layer type.

(2) The inductance of the whole is equal to the sum of the inductances of the individual coils and the mutual inductances, positive or negative between the several pairs. With pancake coils this last factor is important and the inductance may be varied within very wide limits by altering the position, a highly efficient variable inductance being obtained in this way.

(3) (*a*) About 5:12. (*b*) About 10:1.

(4) This depends entirely upon your apparatus. If you have a good aerial and an efficient amplifier, there is a fair possibility. Regarding the times and wavelengths, this is impossible for us to say, but probably if you listen on wavelengths between say 1,000 and 3,000 ms. during the evenings you will stand a good chance. Particulars of the Dutch station **PCGG** are given on page 221 of June 26th issue.

H.B. (Newlands, Sussex) *encloses a diagram of his receiver which consists of an alternative valve and crystal arrangement. He states that when the set is thrown over to the crystal side, the valve being alight, he obtains exceptionally loud spark and* C.W. *signals. Diagrams are given of the exact conditions under which this effect is obtained. He asks* (1) *What causes this, as he understood it was not possible to receive* C.W. *with a crystal.* (2) *If he has evolved any recognised system.* (3) *What does the crystal do to improve the signals.*

(1) Your effect is due to the valve circuit setting up oscillations in your aerial circuit, thus enabling you to receive C.W. with the crystal detector, owing to the phenomena of beats. C.W. reception with a crystal is only impossible when no means is provided (*e.g.*, a tikker or a heterodyne) of rendering the wave-train audible.

(2) The employment of a separate heterodyne with a crystal receiver is not standard practice, but is not original.

(3) The crystal is connected across the whole of the A.T.I. and the aerial resistance is reduced, by the reaction of the valve circuit for the frequency to which it is tuned. These conditions make for strong signals but poor selectivity. The detector action of the valve probably does not come into play.

H.H. (Bardsley) *has a loose-coupler with a primary* 11″ × 5″ *of No.* 26 *wire and a secondary* 11″ × 4½″ *of the same wire—his aerial is* 70 *ft. long and* 30 *ft. high,* L *type twin, of No.* 18 *wire. He also describes a condenser and asks* (1) *For dimensions of former and size of wire for* A.T.I., *to use in conjunction with his apparatus.* (2) *For inductance of the* A.T.I. (3) *For approximate maximum capacity of the described condenser.* (4) *For inductance and capacity of aerial.*

(1) 10″ × 6″ of No. 24.

(2) Approximately 13,500 mhys.

(3) You do not state what units the dimensions are in. If inches are understood, capacity is ·000066 mfds.

(4) We cannot say exactly without more data, *e.g.*, the spacing between wires. Inductance will be about 60 mhys. and capacity ·00002 mfds. Your coupler should be well separated, or else you will get too tight coupling with such big coils.

R.W.B. (Cambridge) *is constructing a receiver of the type shown in Fig* 5, *page* 471 *of the present volume. He has a* 50 *ft. single-wire aerial with* 20 *ft. down-lead and he asks* (1) *For the size of former and gauge of wire for the auto-coupler and roughly, the number of ozs. required.* (2) *For similar particulars of the* A.T.I. (3) *What is the maximum capacity of the variable condenser.*

(1) Tuned-circuit coil 6″ × 5″ of No. 26, about 6 ozs.

(2) A.T.I. 10″ × 6″ of No. 24, say about 14 ozs.

(3) About ·0005 mfds.

E.R.W. (Carmarthen) *sends a description and diagram of a crystal receiver and asks* (1) *What* *would be the maximum wavelength of his set.* (2) *How can he increase his wavelength.* (3) *Where can he obtain a description of the Paris time signals.*

(1) Set would probably tune to about 1,000 metres.

(2) To get any considerable increase of wavelength you should add considerably to the inductance in both circuits. You might also add a condenser in parallel with A.T.I. capacity up to about ·005 mfds. You should not increase tuned-circuit capacity very much.

(3) *The Wireless World* of May 15th, page 138, or Year Book of Wireless Telegraphy.

B.R., Jnr. (Oxford) *states he is a new reader, and has no issue before September 18th, 1920. He asks* (1) *With reference to the single valve trans-oceanic receiver described in the September 18th issue, what are the eight coils used for when apparently only three are employed at the same time.* (2) *For particulars as to dimensions of the honeycomb coils used in the above.* (3) *What is the highest aerial the P.M.G. regulations allow.* (4) *For a diagram of a two-valve receiving set using honeycomb coils and a telephone transformer, but as little other apparatus as possible.*

(1) Three coils are required for reception within any one range of wavelengths but these must be differently designed for different ranges.

(2) We have no particulars regarding this set other than those already published.

(3) Any height provided not more than the specified length of wire is used.

(4) We regret we cannot undertake the design of such a complicated set in these columns. There is no essential difference between sets using honeycomb coils and ordinary coils. We would advise you to obtain a few back numbers and study the circuits described in them.

VICTOR (Nottingham) *encloses a diagram of a receiving set and asks if he can hope to get* 3,000 *metres with it. Dimensions of coils, etc., are given.*

No, both your inductances are too small. You should use additional A.T.I. (preferably variable), of the same dimensions as your existing coil; you should have also, an inch more winding of the same wire on your secondary coil. Your diagram shows no means of tuning the aerial circuit—either a variable inductance or a series condenser is necessary.

F.W.R. (Hayes) *asks* (1) *For details of the coils (pancake) for use in the set described in the "Wireless World" of May 1st, under "A crystal receiver with valve magnifier."* (2) *Where would the tappings come on secondary to give the same results as given on page* 99 *of the same issue.*

(1) If coils are basket-wound they should be as follows:—A.T.I. about 13″ diameter, wound with No. 24. Tuned circuit inductance 9″ diameter, wound with No. 30. Coupling coils 6″ diameter, wound with No. 24.

(2) Divide the tuning coil in about the same proportions as in the original article, then move the taps to give more turns in each of the first two sections.

D.S. (Hornsey) *wishes to make a receiving set for spark,* C.W., *and telephony, with a wavelength range of* 600-6,000 *ms., and wishes to include certain apparatus which he has. He asks* (1) *For criticism of an enclosed single-valve circuit.* (2) *If the following dimensions of coils will give the range required.* A.T.I., 10″ × 5″, *wound with No.* 26. *Secondary,* 8″ × 5″ *of No.* 30. *Primary,* 9″ × 6″ *of No.* 26. *(Loose-coupler.)* (3) *With co-axial coils what is the advantage of tapping the secondary, as is usually done in loose-couplers.* (4) *Would we advise him to put a variometer in series with primary coil.*

(1) Circuit should give quite good results. A loose-coupler instead of an auto-coupler between aerial and tuned-circuit would be an improvement, but this is not by any means essential.

(2) A.T.I. is too small for 6,000 ms. Make it about 12″ × 8″ of the same wire. Reaction coil which we presume is the 8″ × 5″ coil, is unnecessarily large. About half this should be sufficient.

(3) Tapping the primary facilitates tuning. Tapping the secondary gives a bigger range of reaction-coupling than can be obtained by sliding the coil alone.

(4) Variometer could be used at A if desired, but it is not necessary. If the ·001 condenser is continuously variable the variometer will not improve tuning.

D.L. (Ilford) *asks* (1) *How can one calculate the distance a given aerial will transmit, knowing the amount of current flowing in the aerial, when using undamped waves.* (2) *What distance, for instance, would a regulation* P.M.G. *aerial transmit* C.W., *the current flowing in the aerial being one tenth of an ampere.* (3) *How far could the receiver be removed if equipped with a 3-valve amplifier.*

(1) There are various, more or less complicated, distance formulæ, as for instance, the Austin formula quoted recently; none however, can be used to give information of practical value as to how far an amateur would be able to transmit with a given small power. We do not know of a better way of estimating such a quantity, than comparison with known previous results, and even this is not very suitable, as conditions vary so much between different stations.

(2) This is very difficult to say, there being so many unknown factors, *e.g.*, height and type of aerial, efficiency of reception. Possibly from to about 3 miles.

(3) This will depend almost entirely on design of amplifier and freedom from interference—it might increase range anything from twice to twenty times—the latter only under favourable conditions.

SHARE MARKET REPORT.

Dealings in the Wireless Group have been greatly restricted during the last fortnight. Prices as we go to press (November 19th) are:—

Marconi	Ordinary	£2 - 17 - 6
,,	Preference	£2 - 13 - 9
,,	Inter. Marine	£1 - 6 - 5
,,	Canadian	8 6