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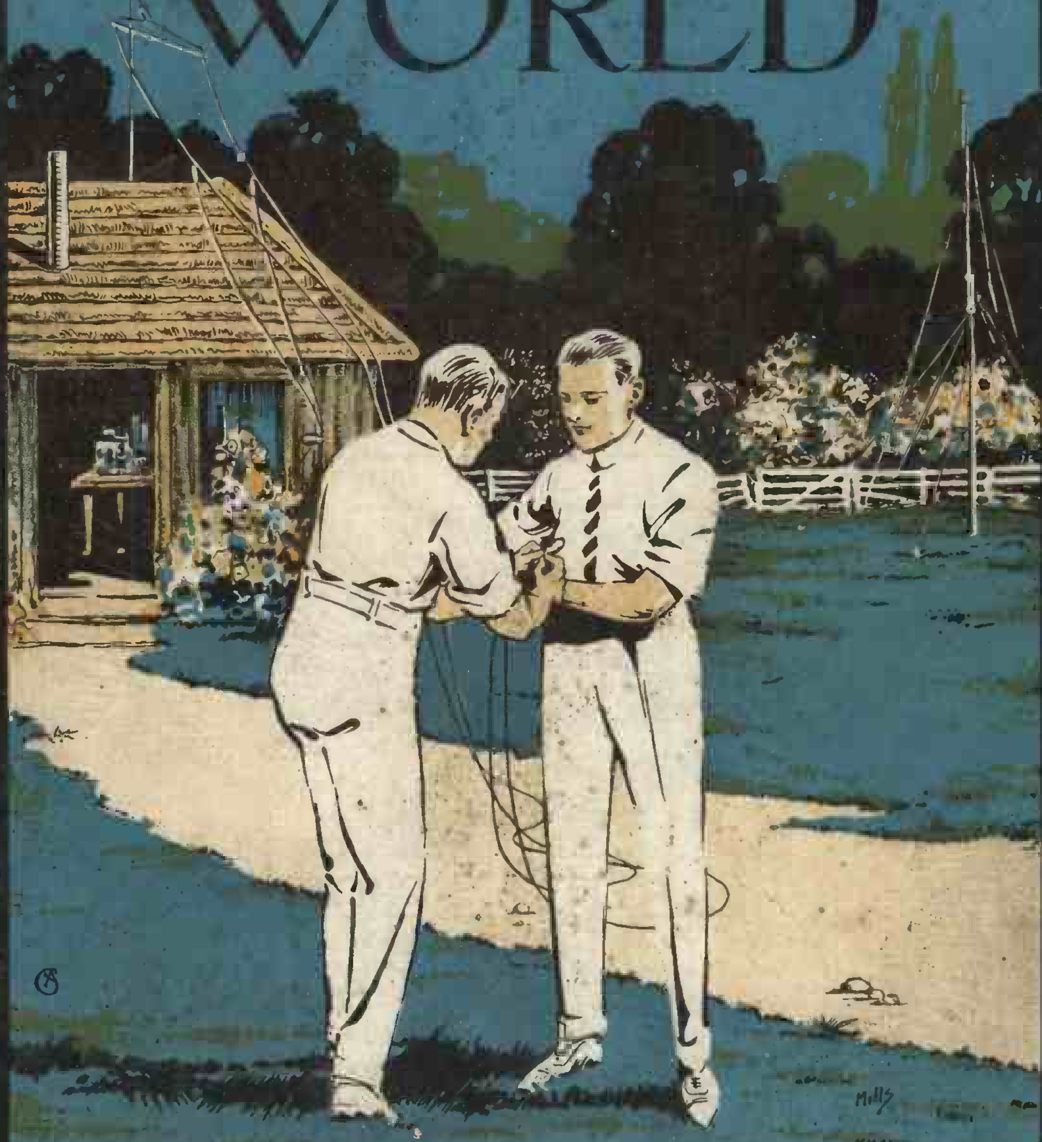

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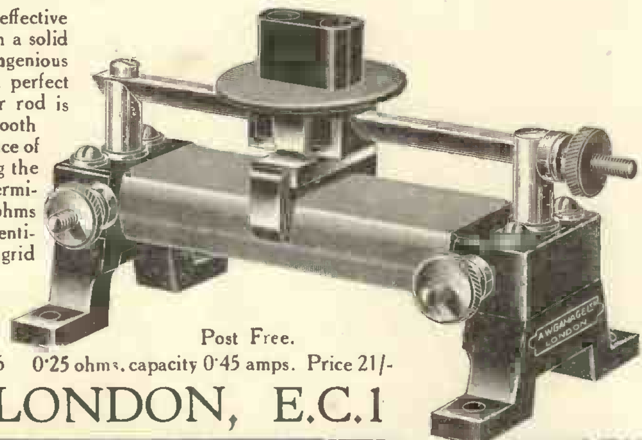

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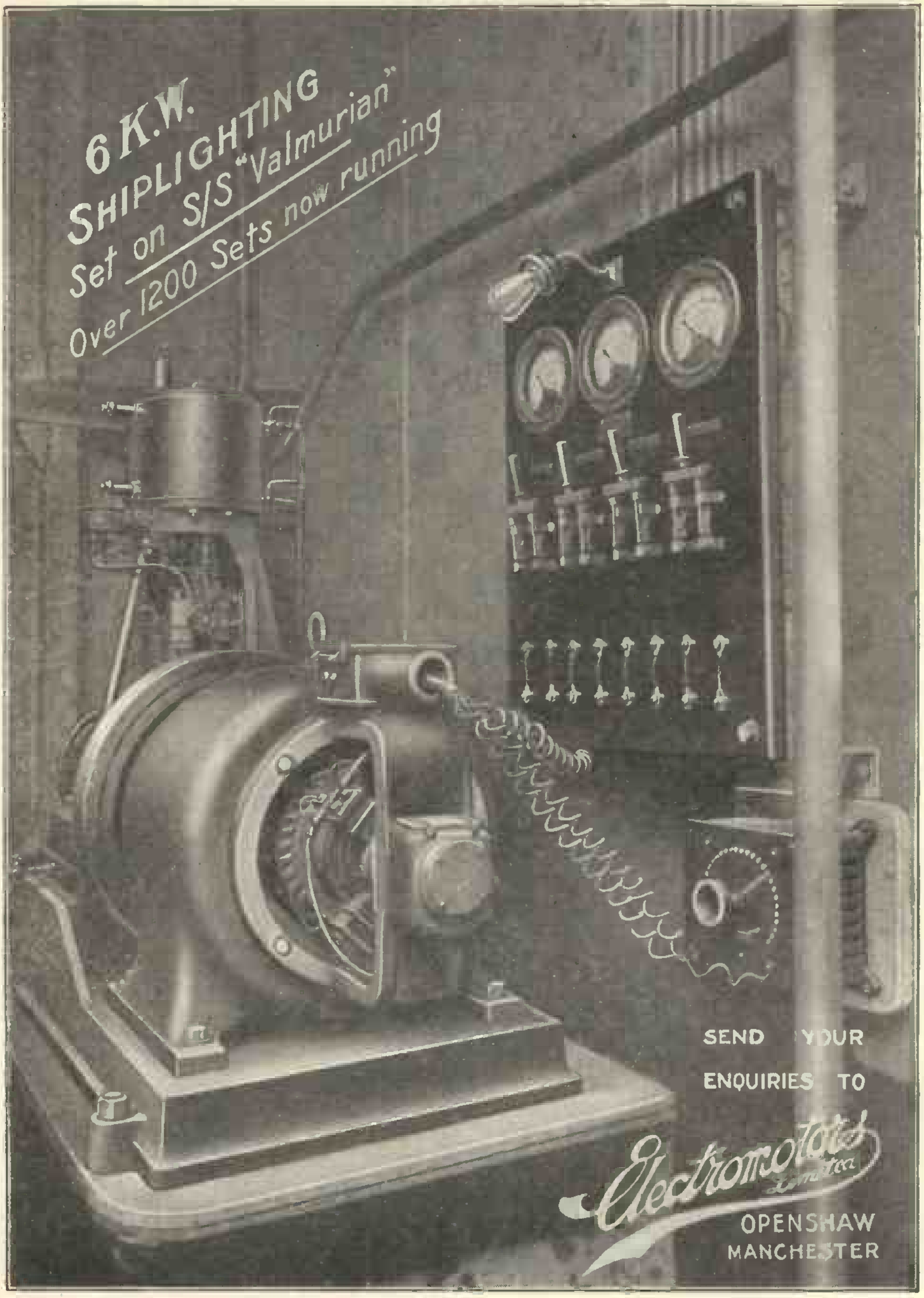
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THE WIRELESS WORLD

No. 84 Vol. VII

MARCH 1920

Wireless Telegraphy in the Red Sea during the War

By COMMANDER G. MONTEFINALE (Royal Italian Navy).

THE Christmas of 1916 was approaching when I received an appointment for Radio service in the Red Sea and was obliged to leave my wireless work at Brindisi, and many Allied and Italian comrades, and the hard daily duty of wireless communications across the Lower Adriatic, the Ionian and Aegean Seas.

The intensified campaign of Hun piracy in the Aegean and the Otranto Channel obliged the Allies to establish many Wireless D.F. stations, of the well-known Bellini-Tosi type, along the coasts of the Adriatic and Ionian Seas, at Malta and in some bases of the Near East, and for many months, in good and bad fortune, British and Italian radiotelegraphists had worked together in the daily routine of the fleet as well as in the hunt for enemy submarines.

The mail steamship that carried me to Dark Africa went circumspectly out from the harbour of Syracuse, escorted by two Italian destroyers. Many enemy submarines were reported at work in the high seas and we received instructions to steam for Corinth Canal. We entered safely the Patrasso Gulf as the sun sank amongst the Morea Islands. The following day we passed between the rocky walls of the Canal and when later we were in the open sea we found a very dangerous Archipelago, with a freezing, northerly breeze and heavy sea. These constituted the best assurances against the Hun's attacks.

For two long days we steamed alone, dominated by uncertainty, while many enemy pirates were reported by our wireless operator to be in the vicinity. Several times a day the Captain was obliged to alter the course of the vessel.

At last, in a pale, fresh day-break, tinted with some of the characteristic colours of the oriental skies, the passengers crowded on the deck cheered the long-desired land of Egypt. Coasting at full speed along the mouths of the Nile, we dressed our bow to the white tower of the Port Said lighthouse arising from the sands, and I read in every passenger's face a profound sense of joy and satisfaction when, passing the Lesseps statue, we left behind us the faithless Mediterranean! But alas! A big Russian cruiser, just clearing the harbour, struck a mine and blew up at a short distance from the beach and sank with all hands! Our joy was very soon changed to sadness, at this unexpected event.

It was the seventh time that I had passed through the Suez Canal bound to East Africa, but I took the same interest in the beautiful scenery and life of the great water-way. In the winter of 1917 the signs of the Great War in the Canal zone were not so imposing as in 1918, in the course of which year a powerful military base sprang up on the sands of El Kantara. Many cargo-boats were steaming along the Canal or waiting in the Ismailia lake, but one met very few mail and passenger liners and these were crowded with white and coloured soldiers instead of happy homeward-bound civilians. Some wireless masts rose from the sands amongst the far distant hills of the desert showing where the Australian and English trenches for the defence of the Canal zone were situated; gun-boats and monitors of the R.N., carrying huge guns on board and fitted with large aerials, were inspecting the Canal and Bitter Lakes shores at low speed, while their W/T. stations maintained constant communication with the Army field stations. Squadrons of the Indian Cavalry patrolled the plains, and in the ravines where the barbed wires extended their ramifications, the Australian soldiers casually took their baths.

Entering the Suez roads we met a big three-funnelled British cruiser bound north. The passengers and a crowd of native soldiers on our deck cheered the flag of our gallant allies. The cheer was renewed when we passed the Italian warship, *Calabria*, lying at anchor before the picturesque beach of Port Tewfik.

In the peaceful Suez roads I found and could admire once more the charming coloured Egyptian sunsets and the brightness of the sub-tropical nights. I saw, as in peace time, big liners and deep-bellied cargo boats passing by my ship: the former crowded with Indian and Australian troops, the latter filled with the Karachi and Industan corn and

A ship in the Suez Canal.

A British Cruiser going North through the Suez Canal.

the rice of the Far East. No more, as in the piping times of peace, the shining of electric lights on the decks, and the saloons peopled with passengers; no more the echoing orchestras on the placid waters of the Gulf. Silence and discipline ruled those vessels as the trenches of war ruled the world.

When the steamer went beyond Cape Zaffarana one splendid morning when the rocky chain of Gebel was painted a living red by a brilliant sunrise over holy Sinai, we entered the open Red Sea, in a good winter breeze from the North. We then began to hear in our crystal receivers the feeble voices of British and Italian shore stations. The first was that of Port Sudan, giving to the ships in the Red Sea and to the opposite station of Jeddah a "Press Bulletin" of the war. Then we could read the signals of Massawa, launching on her four thousand metres wave the Italian Official, and the Aden Marconi station, transmitting Reuter news.

From that day—January 10th, 1917,—and for two long years, those war bulletins became familiar to me and my companions, during our hard wireless work in that tropical climate, and they were the only recreation which relieved the monotony of our life.

When we reached Massawa, a picturesque little town, hidden at the bottom of the Dahlac Channels and built on some coral islands at the foot of the Abyssinian highlands, it was possible to observe all the changes imposed by the Great War on the local life and trades. The fine harbour was quite empty of steamers and of those characteristic dhows, fitted with lateen sails and handled by natives, that in ordinary peace times crossed the Red Sea in all directions, trading with the ports of Africa and the Arabian coasts.

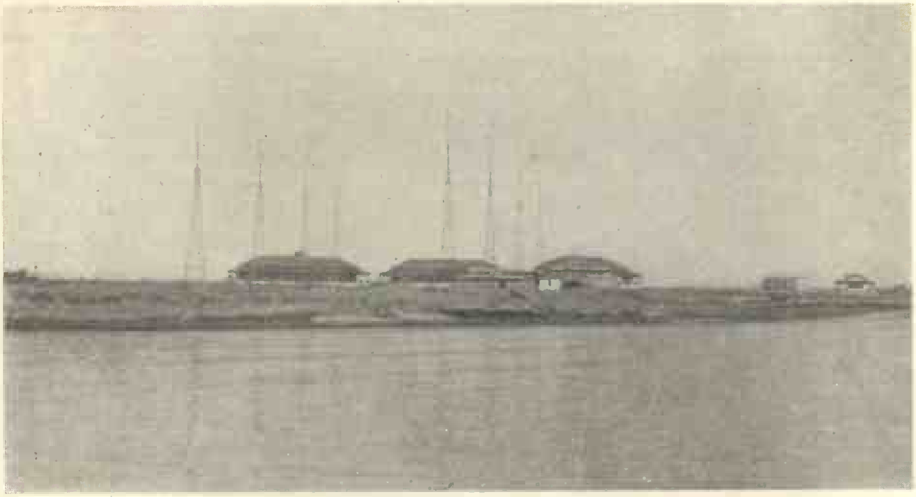
Now that trade had ceased as a consequence of the British blockade of the Yemen and Asir coasts, and of the guerrilla warfare in the interior of Arabia.

It was my particular task to organise the Wireless-telegraphy service of the Italian naval and shore stations, in conjunction with the Senior Naval Officers and the Resident Naval Officers of Aden and Suez, following the rules of the inter-allied books.

The Massawa High-Power station was linked with the Marconi stations of Aden and Abu-Zabel (Cairo), which latter was in direct communication with Rome (Centocelle). The station of Mogadiscio in Italian Somaliland (fitted with 100 kw. Marconi set), which had been linked with Massawa in 1911, was put in communication with British stations and authorities in Jubaland and the B.E.A. settlements. This organisation was very useful for the rapid signalling of the presence of German corsairs in the waters of the Indian Ocean. The allied flotillas in the Red Sea and in the Gulf of Aden received even more useful services from the 30 k.w. Marconi station of Assab, constructed just at the beginning of the war, by the Italian Navy, under enormous difficulties.

The Naval Radio Station of Assab acted as a relay between the English and Italian cruisers at sea and the shore stations of Massawa and Aden. For long weary months, in the cool and in the hot seasons, through good and bad fortune, British and Italian operators, in the common round of the daily work of wireless communication, became familiar with each other by means of the ætheric link between them. Far from their menaced countries, in a climate which is always unhealthy for white people, they accomplished difficult tasks like their companions in the Mediterranean and the Adriatic, but with much more modesty in what was, perhaps, believed not to be a real war-zone. Maintaining continuous radio communication at short and long distances is an uncommon duty for radiotelegraphists in the tropics, but this duty became absolutely arduous in the Southern zone of the Red Sea, which is included between the Sana highlands on the Eastern side and the Erythrean and Abyssinian ranges on the West. Here the atmospheric disturbances due to the terrific storms of the rainy seasons add their effect to the "strays" which Dr. De Groot affirms to be of an extra-

Massawa. A picturesque town built on coral islands.



The Massawa Wireless Station. 150 K.W. Marconi type.

atmospheric origin, and which are more intense in the afternoons and in the summer season.

In March, 1917, the Massawa station, which was already linked with the Marconi High-Power station of Coltano, near Pisa, was put in touch with a newly-opened station at Taranto which was fitted with the Poulsen arc. In the summer the same station was put in communication with the new continuous-wave station of Rodi. By means of Taranto and Rodi the communications with Italy were more efficient, especially in the bad season.

One of the more appreciable benefits of long distance radio-telegraphy during the War was the possibility of receiving, in savage Africa, the Official Bulletins and all other news radiated by Allied and enemy long-range stations in Europe. At Massawa it was possible to receive every day official and press messages transmitted by Malta, Horsea, Carnarvon, Paris, Lyons, Coltano, etc., as well as the propaganda telegrams of Nauen, Eilvese, Pola, Sayville and Tuckerton. All the war news received in the course of the day was gathered together in a small official newspaper printed by the Erythrean Government and widely distributed amongst the Italian and native people of the Colony. Some extracts from it were daily wirelessed to the Italian Somaliland stations, to ships at sea and also to the Italian Legation in Addis Abeba, where I had established the first W/T. receiving station of the Abyssinian Empire.

In November, 1917, the powerful voice of the new big station of Rome (San Paolo) first reached the aerials of the Red Sea and Indian Ocean stations.

As a consequence of the new facilities offered by radio-telegraphic connection with the Motherland, the traffic augmented rapidly at the Massawa station, and it was necessary, therefore, to erect a receiving duplex station at Asmara, the capital city of Erythrea. In this construction I followed the same systems employed with excellent results in other high-power Marconi stations, using a long directive Marconi aerial.

LIEUT.-COLONEL ADRIAN F. H. SIMPSON, C.M.G.

Personalities in the Wireless World

LIEUT.-COLONEL ADRIAN F. H. SIMPSON, C.M.G., (late) R.E., was born in 1880, the son of Surgeon-General Sir Benjamin Simpson, K.C.I.E. Educated at Clifton College and the Royal Military College at Sandhurst, he entered the Army in 1900 and was gazetted to the 31st East Surrey Regiment, which was at the time stationed at Lucknow. In the following year he joined the Hyderabad Contingent of the Indian Staff Corps and served in the Bengal, Bombay, and Madras Residencies, afterwards obtaining command of a detachment of Native Troops in charge of one of the Prisoner Camps which had been formed in connection with the South African War. He also took up his share of "the white man's burden" by serving on plague duty in Central India.

In 1903 he proceeded to Russia and in 1906 succeeded in passing the Military examination for a Russian Interpretership. He also obtained Government awards for proficiency in Persian and Hindustani.

In 1907 he retired from the Army in order to devote himself to the study of Electrical Engineering and, in particular, Wireless Telegraphy. He was the Directeur Administrateur of the Société Russe des Télégraphes et Téléphones Sans Fils, Petrograd, and Director of the Telephone Construction Company of Moscow and the Moscow Electrotechnical Works.

Lieut.-Colonel Simpson is widely travelled and has visited at various times Cashmere, Finland, Scandinavia, and is well acquainted with India and Russia.

On the outbreak of war he at once rejoined the forces and was sent on a special mission to Russia. Here he served with the Caucasian Cavalry Division and was A.D.C. to the Grand Duke Michael Alexandrovich in the Galician Campaign of 1914-15. He transferred to the R.E. in 1915 and served on the general staff at the War Office in 1916. Lieut.-Colonel Simpson has recently been appointed Director of Wireless Telegraphy under the Government of India. His long and close connection with Wireless Telegraphy in England and various parts of the Continent, and with a number of firms such as the English De Forest Wireless Telegraph Syndicate, Ltd., the Amalgamated Radio Telegraph Co., Ltd. (owning the Poulsen Patents), the Lepel Wireless Telegraph Co., Ltd., Marconi's Wireless Telegraph Co., Ltd., and the Russian Company of Wireless Telegraphy and Telephony of which he was Managing Director, his wide experience of men and affairs, and his linguistic attainments all furnish guarantees that he will carry out his new duties with distinction.

He is a Chevalier of the Order of St. Anne, 3rd degree, and of the Order of St. Stanislas, 2nd degree with Crossed Swords, and an Associate Member of the Institution of Electrical Engineers.

Notes on the Physics of the Thermionic Valve

By T. G. Petersen.

(*Continued from February Number.*)

Exhaustion Methods.

When discussing Tungsten as an emitter for valve work it was remarked that "it is necessary (1) to attain an exceedingly high degree of vacuum and (2) to maintain such degree of vacuum" (Wireless World, Jan. 1920). The attainment of the low degree of pressure necessary in hard valves, was not, at one time, an easy matter. Although gauges on the pumping circuits indicated extremely low pressures, valves exhausted showed no consistency in their behaviour. Occasionally it was found possible to produce a valve in which the necessary vacuum had been attained, but which on running in a circuit as a radio device, rapidly showed signs of lowered vacuum. This lowering of vacuum frequently rendered such valves quite useless.

In the manufacture of the modern Tungsten filament lamp, for lighting purposes, satisfactory results may be obtained when a well-designed mechanical pump is used as the only means of evacuation. The degree of pressure in such lamps will often reach as low as 0·000001 mm. of mercury after a run of a few hundred hours, but it should be borne in mind that the nickel or other metal supports are never sufficiently hot to cause them to throw off vapours, the heat area being largely confined to the Tungsten filament itself. This high degree of vacuum is therefore due to absorption of gases by the filament, as already explained.

Pumps of various designs which had been used successfully in the manufacture of electric lamps completely failed to produce the high degrees of vacuo necessary in valves employing a pure electron discharge. Since the functioning of these pumps is, in the main, dependent upon the diffusion of gases from the vacuous space into the pump itself, a limit is reached when the diffusion outward is less than the back diffusion from the pump. Unless means are taken to prevent back diffusion there must always be a limit to the degree of vacuum obtainable with such a device.

For instance, in the Sprengel type of pump (Fig. 18) columns of mercury are caused to pass an aperture of the vessel which is to be exhausted of gases, and in doing so to carry with them the gases diffused into their path from this aperture. Apart from the inherent limitations of such a pump mercury vapour is liable to diffuse back into the vessel under treatment, at a quicker rate than

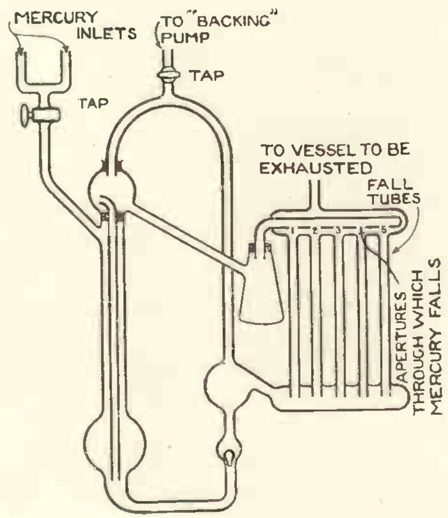


Fig. 18.

the gases diffuse outwards. In addition, this pump is extremely slow in operation and much auxiliary gear is required.

The Gaede mercury diffusion pump, although of greater speed, and capable of giving higher degrees of vacuo, has yet an inherent weak point which makes it unsuitable for use in evacuating valves. Instead of a continual succession of small columns of mercury, a blast of mercury vapour is caused to pass the aperture of the vessel. The width of the aperture, however, is accurately calculated from Gaede's theory that the maximum speed of the pump is reached when the aperture width is equal to the mean free path of the gases tending to diffuse back into the vacuous space. Whilst the blast of mercury vapour is very effective in carrying away the outward diffused gases (*i.e.*, those leaving the vessel to be exhausted), the vapour atoms will not all necessarily have vertical velocity components, but some will be moving towards the walls of the pump, and on striking that comparatively cold surface will condense. The heat thus generated will, however, be sufficient to cause some of them to re-evaporate as quickly as they condense. On becoming free once more they are just as likely to diffuse out through the aperture against those gases leaving the vacuous vessel. An attempt has been made to show this in Fig. 19.

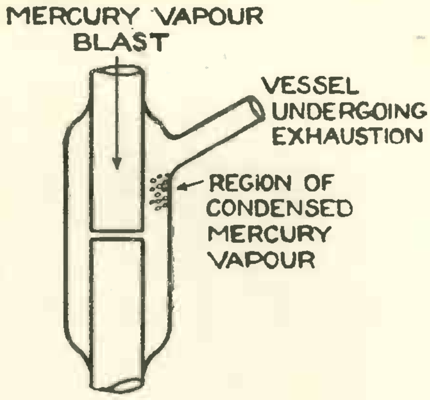


Fig. 19.

THE LANGMUIR CONDENSATION PUMP.*

In designing his condensation pump Langmuir was aware of this limitation, and sought to remove it by the careful design of the flare of the vapour blast funnel, and the dimensions of the aperture, but mainly by cooling at the desired points. The universal usage, at the present time, in respect of pumps embodying the water-cooling device as suggested by Langmuir, is sufficient evidence that he has been highly successful in his efforts at eliminating the defects of the mercury vapour pump as investigated by Gaede. Some idea of the operation of this pump will be grasped from the following. In Fig. 20 are depicted a Langmuir Condensation Pump, the liquid-air trap and a transmitting valve, with the voltage sources for filament and anode. The mercury at the base of the pump is heated externally, with the result that a blast of vapour is forced up towards the deflector D. Owing to the flare of the funnel the blast increases in intensity in its upward motion. On hitting the deflector the blast is sent downwards, and outwards against the water-cooled sides of the pump. Owing to the curvature of the deflector the majority of mercury vapour atoms will travel downwards, carrying with them the gases diffusing from the valve. Those atoms which have a transverse direction of movement will condense, and since the sides are water-cooled, re-evaporation will not take place, but the condensed mercury will return to the reservoir at the bottom of the pump. In this respect the condensation pump is much superior to the Gaede diffusion pump, in which, as has already been explained, re-evaporation does take place, with the consequent back diffusion and the limitation in degree of vacuum obtainable.

The gas brought down by the vertical blast will now be carried off by the backing pump working at A. The vapour blast increases in intensity as it nears the bottom and, owing to the constriction at this point, is caused to come under the influence of the con-

* "Physical Review," July, 1916.

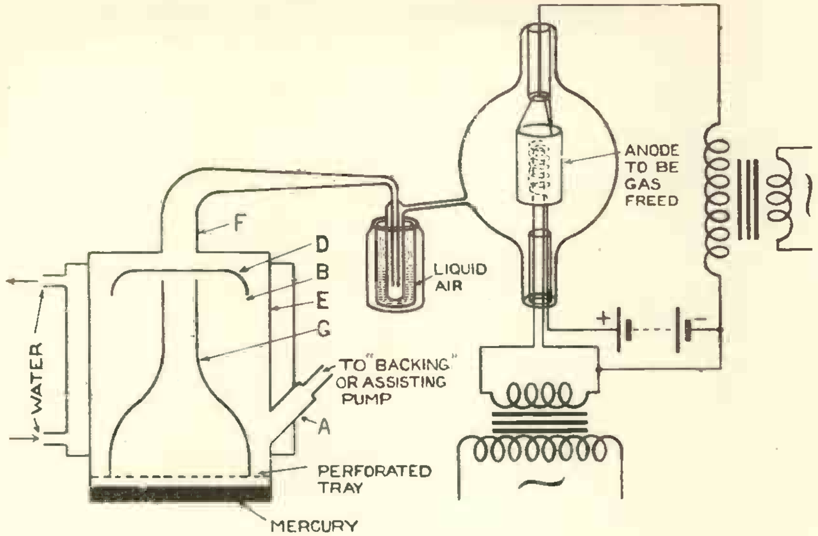


Fig. 20.

denser and thus falls back into the reservoir, ready for further cycles of evaporation and condensation.

There is, therefore, no theoretical lower limit to which this pump can exhaust, as the flow of diffused gas into the pump from the vacuous vessel is always greater than that tending to diffuse back. Pressures as low as 10^{-5} bar (1 bar = approximately one-thousandth of a millimetre of mercury pressure) have been obtained by means of this form of pump; the measurement was, however, recorded on a gauge of special design introduced by A. W. Hull.

The McLeod Gauge.

Gauges reading as low as 10^{-5} bar are not, however, absolutely necessary in practice, the McLeod gauge being robust and quite adequate to indicate the degree of vacuum at which gas-freeing of the electrodes may be commenced.

A simplified diagram of a McLeod gauge is shown in Fig. 21. When it is desired to ascertain the pressure arrived at during pumping, the movable reservoir of mercury is lifted up, thus forcing the mercury up both C and B. The level in C will be higher than that in B, since the gases in the former are practically unconfined, whereas those in B are compressed by reason of the tube's sealed end. The difference of these heights is a measure of the pressure in C. The volume of the gases in B is measured by the graduations along it. The total volume of A and the tube B above the point of junction with C is also known. If this

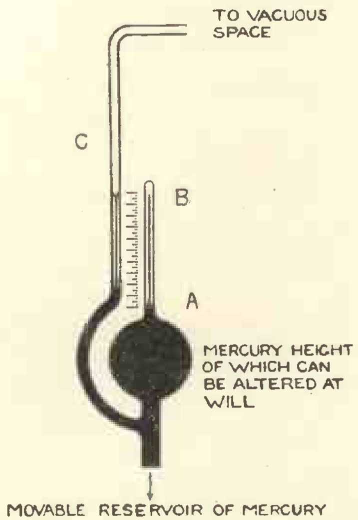


Fig. 21.

volume be represented by V, the volume of the gas confined in B by v, and the pressure indicated by the difference in level of C and B by P, then the pressure in millimetres of mercury, of the vacuous space to be measured is given by

$$\rho = \frac{Pv}{V}$$

In practice such a calculation is not made, but a scale is attached from which a rough indication may be obtained, or the pressure is read directly in millimetres of mercury.

Liquid Air.

Returning to the consideration of Fig. 20 it will be noticed that between the valve and the condensation pump a liquid-air trap intervenes. In this trap any mercury vapour that may have diffused back from the pump will be brought to such a low temperature as to make the pressure due to its presence a negligible quantity. For instance, if it be supposed that the inner surface of the trap has a temperature of $-180°$ C (the temperature at which liquid air commences to boil) then the pressure due to the mercury will be $2 \cdot 3 \times 10^{-27}$ millimetres of mercury, a negligible quantity.

The use of liquid air is very necessary, for, if the temperature be not lower than, say, $-40°$ C, although mercury freezes at this point the pressure it exerts is equivalent to ·0000023 millimetres of mercury, which may not be a value to be ignored.

Electronic Bombardment as a Gas-freeing Process.

It will be noted that in Fig. 20 there are shown means of heating the filament and of maintaining the anode at a high potential with respect to the filament. Although great care be taken to render gas-free the units comprising the electrodes and their supports before inserting them in the bulb, much remains to be done by reason of imperfect gas-freeing in the first place, and the absorption of gases by these components during the time after gas-freeing and before evacuation. The method employed to effect final elimination of gases from the metal parts is that of electronic bombardment.

In practice the anode is maintained at a high potential with respect to the filament throughout the process of exhaustion. This may be done either by means of an alternating or a direct voltage. Of the two the latter is more desirable and is easily obtained by using a high voltage transformer in conjunction with valve rectifiers, in which case it is necessary to connect the rectifier in one leg of the transformer secondary in such a way that one side of its filament is connected to the anode of the valve to be exhausted, thus maintaining this electrode at a high positive potential.

As will be obvious later, it is imperative that the filament of the valve to be pumped be kept dull. In the event of the high voltage available being insufficient, the bombardment may be assisted by the application of a positive potential on the grid, as shown in the figure.

When the McLeod gauge indicates a sufficiently high degree of vacuum, the filaments are brightened up and a blue fluorescence is produced throughout the bulb and down the circuit tubes. Simultaneously the anode becomes reddened, although this may not be apparent until the filament is dulled again. The process of alternately brightening and dulling the filament, with periods for cooling the anode, is employed until little or no fluorescence results.

This phenomenon of electronic bombardment, which manifests itself by the blue glow and by the reddening of the anode, puts a severe strain on the filament. During the periods in which the filament is dull the number of electrons hitting the anode is insufficient, in spite of their velocity, to heat it up to any appreciable extent. When, however, the emission is increased sufficiently, heat is produced on the plate by the bombardment of its surface by the stream of cathode rays caused by the strong electric field. Provided the heat produced is great enough, gases occluded in the electrode (*i.e.*, held within the metal or on its surface) will be released and drawn away by the continuous action of the pump. Some of the gases come within the path of the cathode rays from the filament and are in consequence split up or ionized. An immediate result is the release of additional electrons and the formation of positive ions of molecular dimensions. These additional electrons then assist in the bombardment of the anode, whilst the positive ions, attracted by the high negative potential, bombard the filament.

Now the filament is already at a considerable temperature (approaching that of its melting point), and coupled with the fact that it is fragile, the bombardment is very liable to disintegrate it, if allowed to become excessive.

In practice great care is required in this process, for much previous good workmanship may be spoilt by an unnecessarily long or too severe a period of bombardment.

It has been stated that it is imperative to keep the filament dull throughout the early stages of exhaustion. It will be obvious that if the bombardment is commenced when too much gas remains, the positive bombardment of the filament will be so great as to completely destroy that electrode.

If it ever becomes possible to produce the original emission by other than thermal means, such as photo-electric methods, the cathode might be robust enough to withstand this bombardment. The stage will then have been reached when much higher anode voltages may be safely used.

Minor Exhaustion Details.

In the case of small receiving valves it is possible to arrange that a number may be simultaneously gas-freed by the process outlined. This method considerably reduces the total time of exhaustion. With this type of valve difficulties are encountered during bombardment because of the close proximity of the electrodes, the static pull caused by the high potential on the plate frequently being sufficient to bow the filament to such a degree as to force it into contact with the grid. Assuming that the grid had been previously connected to the filament externally (*i.e.* it had zero difference of potential with respect to it), the screening effect now becomes entirely destroyed, and in consequence an excessive current flows through the valve—with disastrous results.

The total period of exhaustion, in spite of a lengthy bombardment does not in the case of small receiving valves usually exceed two hours. Further, as many as twelve valves may be exhausted simultaneously, so that this brings down the length of time for each valve to be exhausted, to ten minutes.

The larger variety have usually to be exhausted singly or, at the most, in pairs, and take from 3 to 5 hours in the exhaustion operation, even when a rapid pump is used.

Ionization in Valves during Use as Radio Devices.

The process of gas-elimination from the metal parts can, however, never be absolutely complete, and that this is so becomes apparent during the operation of the valve as a radio device. Especially is this true with respect to transmitters, where large electronic currents are present. If, however, keying arrangements are made which break and make these large currents, the danger of ionization is greatly lessened, since the spaces of time intervening between and in the Morse characters, are adequate to preventing undue accumulation of heat on the anode.

When such interruption is not practicable the anode may attain a temperature sufficient to release a little gas, in which case ionization by collision will take place, and if the valve is not immediately cooled (by dulling the filament or otherwise decreasing the flow of electronic current), the vacuum may be brought so low and the filament disintegrated so badly, as to render the valve of no further use.

Digest of Wireless Literature

ZWEI MIT HILFE DER NEUEN VERSTARKER ENTDECKTE ERSHEINUNGEN.

By H. Barkhausen.

Physikalische Zeitschrift, Sept. 1919.

(1) Noises from the Demagnetisation of Iron.

With the recently developed vacuum tube amplifiers it is easily possible to obtain a current amplification of 10,000 which is equivalent to an energy amplification of 100,000,000. By means of these instruments small changes in electric or magnetic fields which would otherwise escape our notice can be made perceptible. One can regard their help as being that of a new type of electrical microscope which magnifies things ten thousand times. Quite recently Scholtky has shown that, by using enormous amplification the electrons of a vacuum tube can be heard in their flight as the current executes spontaneous variations in accordance with the laws of the kinetic theory of gases.

A similar phenomenon has been discovered by the writer and Herr Dr. Tuczek in the case of iron. It has been found that iron produces a "noise" on being demagnetised. When the magneto-motive force is altered the molecular magnets settle down rapidly in their new positions and in so doing generate in a surrounding coil irregular electrical impulses which can be heard as a noise in the telephone. Fig. 1 shows the simple experimental arrangement employed. The iron core E is surrounded by a coil S of 25 mm. diameter and 300 turns. The ends of the coil are connected to a telephone through an amplifier. By moving the horse-shoe magnet M and so altering the induction the noises in the telephone can be produced.

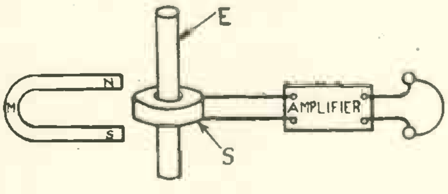


Fig. 1.

It has been found that the thicker the iron core the weaker is the noise produced. For example a core 20mm. thick gives no sound at all. From a great number of experiments it has also been found that the softer the iron the greater is the intensity of the noise. Hard steel gives hardly any effect while the noise with soft iron is particularly marked. It is desirable that many further and more detailed experiments should be performed on this subject as it seems probable that there is some connection between this phenomenon and the action of the Marconi magnetic detector.

(2) Musical Sounds from the Earth.

During the war amplifiers were used on both sides of the front for the interception of enemy telephone messages. The telephone currents were detected partly by electromagnetic induction and partly by means of the stray earth currents which escaped from the telephone wires at points of defective insulation. Although these currents are extremely feeble the enormous ampification available could be utilised to make them audible. The listening circuit normally used is shown in Fig. 2. The two earth electrodes A and B which are usually 100 metres apart are led through an amplifier to the telephone

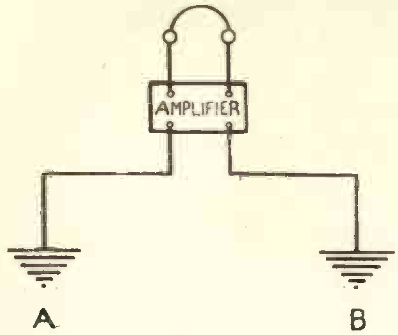


Fig. 2.

T. With such a circuit a most remarkable piping note is heard at times. At the front operators usually refer to these noises as "flying grenades." It is difficult to imitate the sound by a word but the spoken word "piou" gives a slight idea of what is heard. Physically the note appears to be that due to an oscillation of practically constant amplitude but of quickly varying frequency, the frequency at the beginning of the sound being the highest audible and dropping rapidly to the deepest audible tones. On account of the properties of the amplifier (design of telephone, etc.), the note is particularly strong when the frequency is 1,000. The whole phenomenon lasts about a second.

On many days these earth sounds were so strong and numerous that ordinary interception could not be carried on at the same time. The phenomenon seems to be correlated with atmospheric conditions and was particularly noticeable on the mornings of the warmer days of May and June. It differed completely from the normal atmospheric strays which produce only crackling or bubbling noises in the telephones.

The earth electrodes which are the origin of occasional noises can scarcely be regarded as the source of these sounds; neither is it probable that the effect is due to some meteorological influence on the deeply buried earth wires. Much more likely is the suggestion that the amplifier itself, energised by a particularly strong atmospheric generates these oscillations. But all experiments tried in the laboratory to imitate this phenomenon have so far failed. Various types of electrical impulses and spark flashes have been tried but with no result. Thus no complete theory can be advanced for the cause of these weak alternating currents which originate so freely in the earth.

THE RADIO RESEARCH BOARD.

The Department of Scientific and Industrial Research has appointed a Radio Research Board to co-ordinate and develop researches in wireless telegraphy and telephony, which are at present being prosecuted by Government departments. The Board is composed as follows:—Chairman, Admiral of the Fleet, Sir Henry B. Jackson, G.C.B., K.C.V.O., F.R.S.; Comdr. J. S. Salmond, R.N. (representing the Admiralty); Lt.-Col. A. G. T. Cusins, C.M.G. (War Office); Wing Commander A. D. Warrington Morris, C.M.G., O.B.E. (Air Ministry); Mr. E. H. Shaughnessy, O.B.E (Post Office), Prof. J. E. Petavel, F.R.S., and Prof. Sir E. Rutherford, F.R.S.

Stray Waves

THE AMATEUR POSITION.

So far as the progress of the Amateur Club movement is concerned matters improve steadily month by month. We have received news of the formation of several new clubs, shoals of enquiries as to where clubs exist, and a number of letters intimating the writers' willingness to start clubs. We are gratified, too, to note that the scheme to form an affiliation of the provincial clubs with the Wireless Society of London is meeting with great success. Under Wireless Club Notes will be found the definite proposals formulated by the last-named Society.

Professor E. W. Marchant, D.Sc., in his address as Chairman of the Liverpool Sub-centre of the I.E.E. on January 19th, said: " . . . . . . of all the branches of this problem the one which Liverpool people must fully appreciate is Wireless Telegraphy." "Liverpool is a centre which lends itself particularly well to the study of wireless problems, and it is hoped that the activities of research in this direction will be considerable." Now the Liverpool Wireless Association is trying to resume its activities, and we hope Liverpool amateurs will rally round the Secretary, Mr. S. Frith, 6, Cambridge Road, Crossley, and assist him to make the Association worthy of Liverpool.

* * *

WIRELESS SIMPLIFIED.

An article entitled " Wireless and the Press," which appeared in *The Newspaper World* of January 3rd, describes what appears to be the last word in wireless receivers and X-stoppers. After stating the times at which news is transmitted by certain stations, the article proceeds to explain that: "Contact is established with these stations at the above hours by bringing a switch into contact with a metal stud representing the wavelength of the particular station, whilst the rotation of a knob eliminates undesirable noises."

* * *

MESSAGES FROM MARS.

When the pure journalism is separated from certain recent articles in the daily press the fact emerges that Senatore Marconi is about to prosecute some researches in wireless phenomena which are observable on wavelengths of the order of hundreds of miles. Apparently signals have been heard on wavelengths much greater than any employed by known stations, and are deemed to merit investigation. The signals may be mere *x*'s. or they may represent deliberate attempts at signalling from another planet. In the present state of our knowledge one is at a loss to express an opinion on this question, especially as it brings up others, such as whether intelligent beings exist on Mars, and whether their intelligence has developed along the same lines as our own.

The following letter from Mr. Marconi appears in the *Electrician* of Jan. 30th:—

Sir,—I desire to protest against the interpretation that appears to have been put upon statements which I have made at intervals during the last few years with regard to the possible sources of what are being termed " mysterious messages from the unknown." Wireless messages are transmitted through the ether by the agency of electromagnetic waves of definite lengths which can be adjusted, and in order to receive such messages the receivers should be tuned to the particular wavelength that is being used for transmission.

At times signals are received which are apparently due to electromagnetic waves of great length (up to hundreds of miles), and these signals are not of the same character as those commonly called " X's " or " strays." Occasionally such signals can be imagined to correspond to the Morse signals for certain letters, and these signals occur at all seasons and irregularly.

The sources of such signals are unknown. They may be in the atmosphere or outside it, and due to electrical disturbances. If outside the atmosphere, they may arise in any point of interplanetary space, possibly in the sun, where it is well known that electrical disturbances occur.

Obviously, since the planet Mars is situated somewhere near in interplanetary space, the source of such signals might be on it or on any other planet. There is NOTHING, however, to show that this is the case, nor must any purely fanciful speculations of mine be interpreted to mean that I have asserted having received any intelligible or unintelligible messages from Mars or from any other point in space outside the earth.

I am, etc.,

G. Marconi.

London, Jan. 28th.

* * *

THE EFFECT OF GASES ON THE EMISSION OF ELECTRONS FROM HEATED FILAMENTS.

La Nature of January 10th last contains an interesting article which deals incidentally with the intimate relation between the electronic emission from heated filaments and the chemical activity of the filament.

The writer states that the emission of electrons from a filament is generally lowered by the formation on the filament of a layer of gas when traces of the particular gas are present.

He proceeds to say that experience shows that with tungsten in all cases where it has been employed with a chemically inert gas, the emission of electrons by the heated filament was not modified or choked, whilst in cases of gases which combine with tungsten this emission was diminished, and that it is reasonable to conclude from this that this action is due to the gaseous layer on the filament. According to the writer of the article, the layers have a thickness of one molecule, rarely of two or more.

In *Archiv für Elektrotechnik*, July 24, 1919, M. Abraham deals in an interesting manner with the effect on radiation of compound antennæ. Two aerials, erected in close proximity, radiating synchronously, and having their capacity to earth mainly concentrated in the horizontal portions, will require an amount of energy to maintain them in oscillation greater than the sum of the amounts required for each individually, as each aerial will induce currents in the other. This increase of energy results in increased radiation, through the superposition of the two fields, but it vanishes when the oscillations of the two aerials are displaced in phase by a quarter of a period.

The interaction between the aerials affects, of course, the radiation resistance of each and also the frequencies of the respective antenna currents.

By using, at a given distance, a secondary aerial, excited only by the influence of the main transmitting aerial (and tuned to the same frequency) a complete shadow is thrown by the former and the radiation is at the same time increased in the opposite direction by a kind of mirror action.

A secondary antenna may also be used in a receiving station to screen the main antenna from certain radiations.

The New Marconi Distress Calling Device

THE readers of the WIRELESS WORLD will have seen in various newspapers an account of a demonstration conducted between Chelmsford and Shelford (Cambridge), in which the station at Shelford rang an ordinary electric bell and exploded small mines at Chelmsford, by means of special wireless signals.

Some ships carry only one operator and he cannot spend anything like twenty-four hours per diem "listening in" on the offchance of hearing a distress call, and if such a call is made during his "watch below" it goes unheard by his ship.

To amend this state of affairs, and to make certain that distress calls would not pass unheeded, a little while ago the Research Laboratory of Marconi's Wireless Telegraph Company was instructed to carry out certain experiments on distant control. It was desired to be able to ring a bell at a distance by means of Wireless Telegraphy, and the object underlying the investigation was to contribute to the greater safety of life at sea.

The predetermined signal is a series of dots regularly transmitted at the rate of 180 per minute. This number was chosen as being not too fast for the operator to count and time, and as too slow to be interfered with by ordinary transmissions.

The first thing was to make a relay which would respond only to the predetermined signal, and which could be operated by the change in current produced by the reception of such a signal. The change in current with the valves in use in the receiver was never more than half a milliampere.

Many relays were made, and tried out, and for various reasons were rejected. The final design is as shown in Fig. 1, and in construction is not unlike the ordinary moving needle galvanometer. In brief the description is as follows:—Two rectangular hollow formers each wound with many hundreds of turns of very fine wire are placed one above the other on a brass base, the windings being connected in series, and the free ends being taken to two insulated terminals in the base. In the rectangular orifice of the coils swings a small ring magnet, pivoted at its centre and supported in jewelled bearings which are carried by two vertical brass pillars screwed to the base. The pivot also carries a small circular phos-

Fig. 1.

phor-bronze spring, one end of which is attached to a brass collet on the pivot, the other end being soldered to a tongued brass washer clamped to one of the brass pillars. This tongued washer serves the same purpose as the zero adjustment on an indicating instrument. By twisting it about its centre the position of the magnet can be altered and the best working position obtained. Besides these two details the pivot has fixed at right angles to itself a fine platinum-tipped steel arm. This arm is one pole of a switch and is connected by way of the brass pillar, spring, and pivot, to the base of the instrument. The other pole of the switch is a small piece of hard carbon, fixed to one end of a strip of flexible copper, the other end of which is supported on a small pillar and connected to a terminal insulated from the base. A glass front is provided in the case of the instrument, so that the action can be inspected from without, and the whole case screws down on to the brass base, rendering the interior dust-proof. Two gauze-capped leaden tubes containing a drying agent will be seen in Fig. 1. The whole instrument is swung in gimbals.

By adjusting the length of the phosphor-bronze spring it is possible to arrange that the wheel magnet, pivot, and arm oscillate at the rate of 180 complete periods per minute.

The resistance of the coils and the current available are sufficient to prevent a single dash, or series of mixed dots and dashes, such as are received in an ordinary telegraphic communication from swinging the moving system far enough to cause the two contacts of the tiny switch to touch. It is only by the regularly-delivered impulses arriving at the right moment that the swing can be built up from zero to full, and contact established.

Some trouble was experienced with this tiny switch. In the original model both contacts were made of platinum and sometimes they did not strike with sufficient force to make good contact at the first time. To overcome this fault Dr. Fleming's Patent No. 112544 of 1918 was employed. The modified connections of this patent are as shown in Fig. 2. In Fig. 2, Pt is a contact of platinum

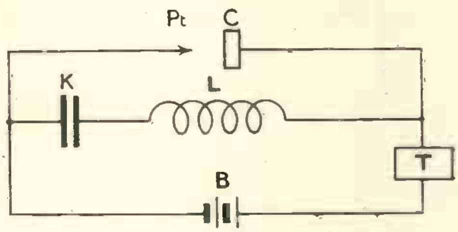


Fig. 2.

or other noble metal, C is a hard carbon contact, K a condenser, L an inductance, T an instrument which it is desired to operate by the battery B on closing the switch Pt. C. The battery charges the condenser, and when the switch closes the condenser discharges through the inductance and oscillations pass across the points Pt C and improves the contact at those points.

The point next to be considered was an arrangement for permanently closing the alarm circuit once the contact had been struck, and the instrument shown in Fig. 3 was designed.

This instrument consists of two coils with soft iron cores mounted on a soft iron plate, forming an electromagnet.

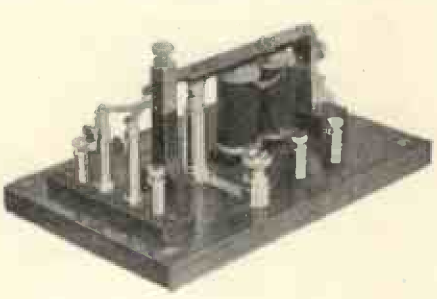


Fig. 3.

Above these coils is placed a soft iron armature connected with a flat steel spring at one end to a brass standard, the other end being free. At the free end is carried a small insulator, which, when the electromagnet is energised, will depress a short platinum-tipped steel spring on to a similar one; also at a little distance from the free end is fixed a manipulating key contact which can strike a similar one situated immediately beneath it.

The action is as follows:—The platinum-carbon switch of the receiving relay, is connected in series with a twenty-four volt battery and the coils of this electromagnet; the two platinum-tipped steel springs are connected in parallel with the platinum-carbon switch. When this switch makes contact the electromagnet is energised and the armature is drawn down and closes the switch formed by the two steel springs. This switch being closed and in parallel with the first switch the magnet will remain energised, and the armature depressed, until the battery is switched off. Fig. 4 shows these connections. Neglecting the resistance of the connections, it will be seen that as long as the electromagnet is energised there will be a P.D. of about twenty-four volts at its terminals. The alarm bell, which is an ordinary high-power bell working off twenty-four volts is connected in parallel with the electro-magnet, and so long as the latter is energised the bell will ring.

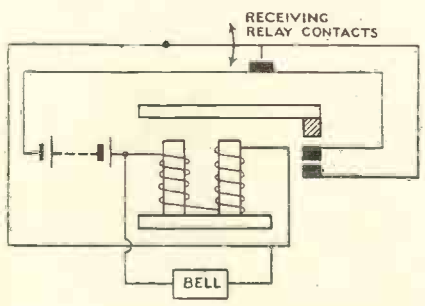


Fig. 4.

The adopted automatic transmitter is as shown in Fig. 5. The instrument consists of two iron-cored coils mounted on a yoke, the whole forming an electromagnet. Between the poles of this magnet swings a heavy brass ring with a soft iron diametric bar. To the shaft carrying the ring are attached a spiral steel spring, like a clock spring, and a light flexible steel arm tipped with platinum. Below this arm is a small platinum contact, supported by a helical spring contained in a tube. The free end of the clock spring is clamped to a projection on the wheel of a worm gear, and a handle is provided on the screw of this gear, so that the distance of travel between the moving contact on the shaft, and the spring-supported contact, can be varied. The variation of this travel controls the period of the transmitter, and it is found that the shorter the travel the shorter the period. Three terminals are brought through the base and the whole instrument is mounted in gimbals.

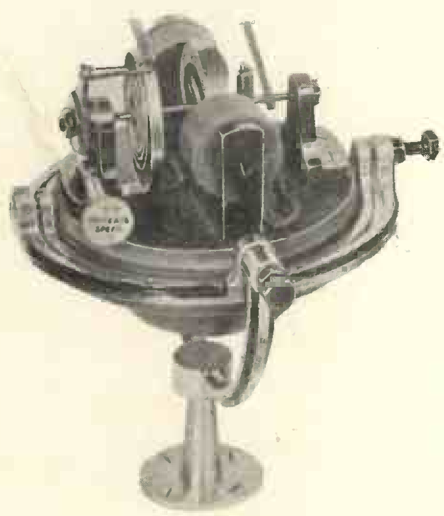


Fig. 5.

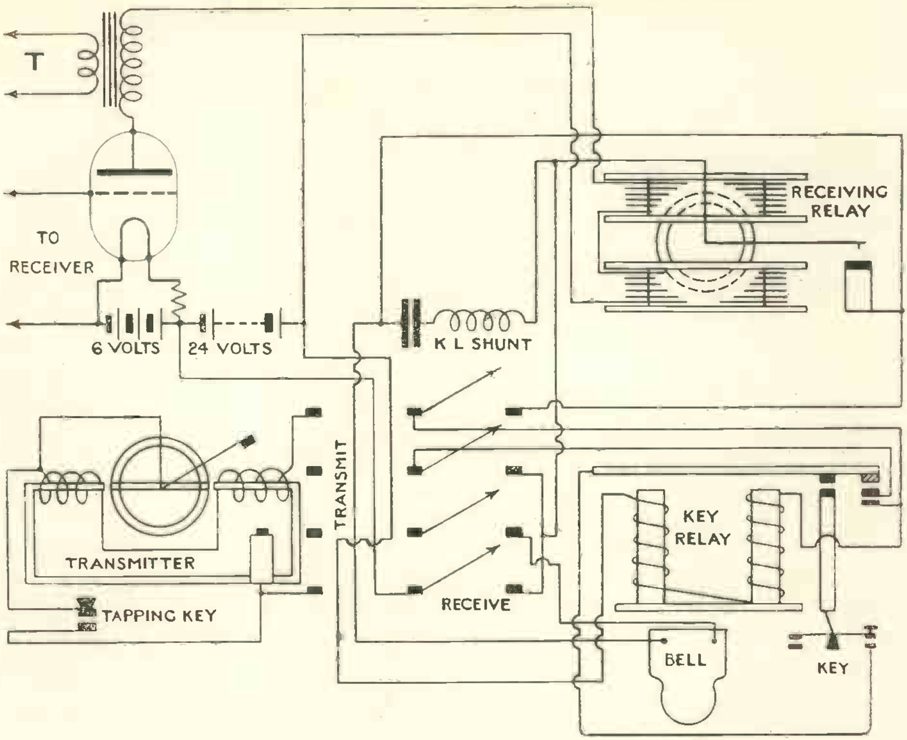


Fig. 6.

For transmission a series circuit is made comprising a twenty-four volt battery, the coils and contacts of the transmitter, and the coils of the instrument shown in Fig. 3; a small tapping key is connected in parallel with the transmitter contacts. To start the instrument this key is pressed and immediately released. By thus closing the circuit the electromagnets of both instruments are energised and the iron bar of the wheel swings towards the magnet. The circuit being broken and the magnet demagnetised the wheel is urged by the clock spring past its position of rest, and on until the contacts of the transmitter touch; attraction starts again and the circuit is again broken, and so the cycle of events is repeated as long as the battery is switched on. Each time the wheel transmitter is energised the electromagnet shown in Fig. 3 is energised, the armature is drawn down, and the heavy key contacts meet. These contacts are in parallel with those of the manipulating key of the ship set, so provided that the generator is running, sparking occurs at every striking of the contacts. By means of a watch and the worm gear previously referred to, the operator can adjust the frequency of his signal to a nicety, and when once this is adjusted it is unlikely to vary.

Fig. 6 shows the complete diagram of connections from the last valve of the receiver to the contacts of the manipulating key.

How to make a Telephone Transformer

By A. D. Kent.

Here, at last, is the article for which so many amateurs have asked.

IT is a common practice when using a crystal as a detector to employ telephones having a resistance of the order of 3,000ω to 4,000ω each. The reason of this is, that in order to increase to a maximum the magnetomotive force of the telephone field coils, the latter are wound with as many turns of wire as is possible. Therefore, the finest copper wire is used. This means that the telephones will have a very high resistance—about 8,000ω; this does not matter very much, however, considering that the resistance of the crystal at its most sensitive point is about 10,000ω. It is therefore obviously inefficient to use low resistance telephones of about 150ω in a circuit which already has a resistance of at least 10,000ω.

For the benefit of amateurs who only possess low resistance telephones and to whom the purchase of high resistance telephones is a big item, and also of amateurs who are in doubt as to which to buy—high or low resistance telephones,—I intend to describe the simple construction of a telephone transformer—the use of which in conjunction with low resistance telephones will give results equivalent to those obtained with high resistance telephones.

Apart from any other considerations, the use of a telephone transformer in a valve receiver circuit is most essential, for the telephones are then well insulated from all the other circuits. Amateurs who possess valve receivers will doubtless have experienced the troubles caused through bad insulation in their telephones.

CONSTRUCTION OF TELEPHONE TRANSFORMER.

To commence building the transformer the following materials will be required:—6 ozs. No. 30 single silk covered copper wire, 3 ozs. No. 44 single silk covered copper wire, 6 ozs. No. 24 soft iron wire, bare, 2 pieces of hard wood, $2\frac{1}{2}'' \times 2'' \times \frac{3}{8}''$, 4 brass terminals and nuts, insulating tape, waxed paper, paraffin wax and 12″ of rubber valve tubing.

To build up the core, cut the iron wire up into sufficient 3″ lengths to make up a circular iron core $\frac{3}{4}''$ in diameter, which must be firmly bound with insulating tape. The tape will serve the double purpose of securing the wire and insulating the secondary winding from the core.

The two pieces of wood we will use as the two flanges or cheeks of the bobbin, and to mount the terminals upon.

Fig. 1 shows quite clearly the method of mounting and fixing the core into the wood, preparatory to winding. The No. 30, or thick winding, we will call the secondary and will wind it direct on to the iron core which we have insulated. Proceed as follows:—Drill a small hole in the wood cheek just above the core, large enough to allow the wire with a few inches of valve rubber on it to go through. This wire can be secured to one terminal, but before proceeding to wind bind the first turn on to the core

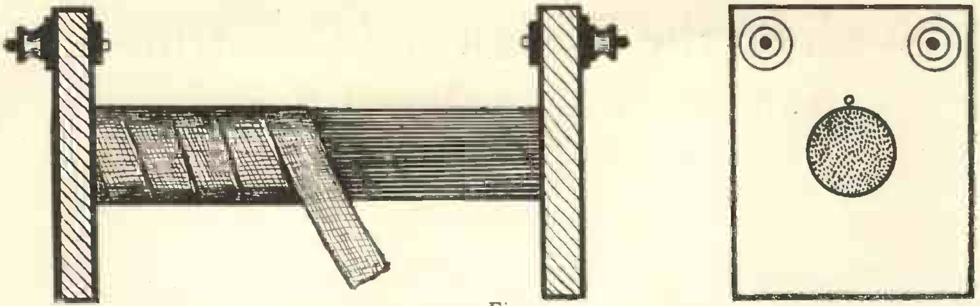
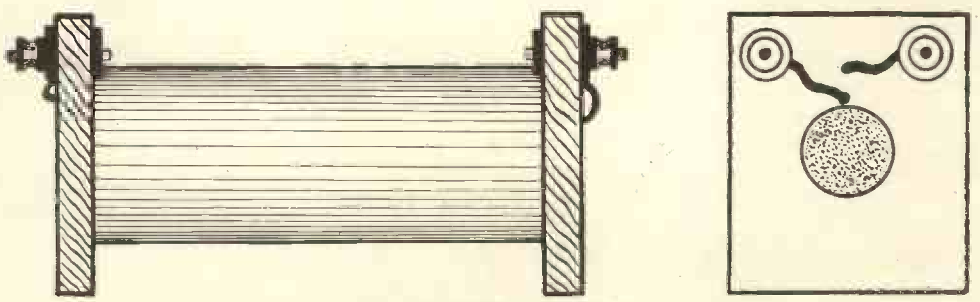


Fig. 1.

with cotton in order to take the strain off the wire connections. Winding can now proceed, care being taken to wind evenly and not to damage the insulation of the wire as it is guided through the fingers. It will be found easiest to wind over the bobbin, *i.e.*, turn the transformer bobbin clockwise, feeding the wire through finger and thumb, the reel of wire being mounted on a spindle and free to turn, not too easily, between yourself and the transformer bobbin.



The completed Tranformer.

When the end of the layer is reached commence another layer winding from right to left and so on, always winding in the same direction until the 6 ozs. of wire are used up. The last turn should be tied off with cotton and the end, insulated with rubber tube, should be brought through the wood cheek and secured to a terminal.

The two terminals should now be marked S. Before winding the primary wire on, wrap a few turns of waxed paper, not more than three, round the secondary. This will serve as insulation and also to give a fresh even surface upon which to commence winding again. Proceed to wind as in the case of the secondary, taking every precaution to protect the insulation of the wire during the process, as with these fine wires the insulation is easily rubbed off. Fasten the two ends of the wires to the remaining two terminals and mark them P.

The transformer now being complete, heat up some paraffin wax until it is just liquid. Immerse the transformer in it and leave it for half an hour, keeping the wax just liquid. If the transformer is taken out at the end of this period and left to drain, all the superfluous wax will drain out, although the windings will retain sufficient to protect the insulation from damp. To finish the transformer off neatly, wrap several layers of waxed paper round the primary and wrap one layer of bookbinder's cloth over all to complete. The resistance of the windings should be approximately :—Primary, 4,500ω; secondary, 60ω. The primary should be connected in the crystal circuit of the receiver, and the secondary connected direct to the telephones.

Notes on the Design and Construction of Valve Amplifiers

By John Scott-Taggart.

IV.—RESISTANCE AMPLIFIERS.

THE third general class of amplifiers embraces those in which the coupling between successive valves is obtained by means of non-inductive resistances. This class of receiver has been previously described by the Author*, but some additional remarks here will not be out of place.

A simple two-valve circuit employing a resistance coupling is shown in Fig. 15. Incoming oscillations vary the potential of the grid G_1 whose normal value is made slightly negative by means of the potentiometer B_2. This will help to ensure that the first vacuum tube will act purely as an amplifier of the oscillations. A resistance R_3, which should be devoid of capacity or inductance is connected in the plate-circuit of the first tube. This resistance should be of the order of about 80,000 ohms when valves of the French or " R " type are used. The resistance R_3 is usually made more or less equal to the resistance of the valve across filament and plate. The resistance may be made by using suitable high resistance material, making connection to a strip of paper over

*J. Scott-Taggart. "The use of Impedance Capacity and Resistance Couplings in High-Frequency Amplifiers," Wireless World, February, 1919.

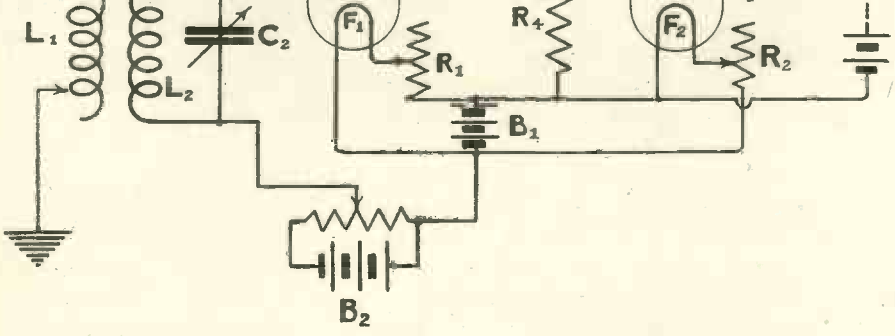


Fig. 15. Two-valve Resistance Amplifier.

which a pencil has been rubbed, or by other suitable means. Such resistances, however, do not usually give as good results as the commercial article.

An electron current will normally flow from the filament F_1 to the plate P_1, through R_3 *via* the plate battery H, back to the filament F_1 which is heated through a rheostat R_1 by preferably a six-volt accumulator B_1 which also heats the filament of the second vacuum tube.

Since an electron current is flowing through R_3 from Z to Y, it will be clear that Z will be negative with respect to Y. Since the resistance R_3 is high, there will be a considerable voltage drop across it. Consequently, we need a higher voltage plate battery H than in ordinary valve circuits. From 80 volts to 150 volts is suitable.

To explain the action of the resistance amplifier, let us consider that with a plate battery H of 100 volts, the current in the P_1 plate circuit is 0·5 milliampere. The resistance of the plate circuit is consequently 100 divided by 0·0005 which equals 200,000 ohms. Since R_3 is 80,000 ohms, the resistance of the valve under these conditions will be 120,000 ohms.

Since a current of 0·5 milliampere is flowing through R_3 the potential across R_3 is $0{\cdot}00005 \times 80{,}000 = 40$ volts and this acts in such a way that Z is negative. The potential of P_1 will obviously be +60 volts. Thus we see that while Z is −40 volts with respect to Y yet the opposing and greater potential of H makes the potential of Z − 40 + 100 or + 60 volts with respect to the filaments.

Now let us imagine that a half oscillation has made G_1 positive with respect to F_1. The current through R_3 increases. Consequently the potential across R_3 increases and Z becomes still more negative with respect to Y and this potential of Z with respect to the filaments may fall from +40 volts to say, +39 volts. The potential of Z and also P_1 has thus become relatively negative to the extent of 1 volt.

In the circuit shown, we communicate these voltage changes across the plate circuit of the first valve to the grid G_2 of the second. This may be done by connecting a small condenser C_2 of about ·00005 mfd. between Z and G_2. If Z were connected directly to G_2 the potential of G_2 would normally be +40 volts, a most unsuitable value. By using C_2, however, the potential of G_2 is in the neighbourhood of zero volts. The condenser C_2, however, will allow of pulsating or alternating E.M.F.s to pass through it. Consequently when the potential of Z suddenly changes from +40 to +39 volts, the grid G_2 acquires a *momentary* potential of −1 volt which will decrease the plate current of the second valve. A negative half cycle applied to G_1 would decrease the plate current of the first valve and so increase the resistance of the valve. The current through R_3 will decrease and so the potential across it. The potential of Z with respect to Y will now be, say, −39 volts instead of −40. The potential of Z with respect to the filaments will be $-39 + 100 = +61$ volts. The potential of Z has thus become positive with respect to F_2. This momentary increase will make G_2 positive with respect to F_2 and the plate current of the second valve will tend to increase.

In this manner oscillations may be passed on from valve to valve, each valve increasing the amplification. The last valve (the second in this case) may be made to act as a detector, and telephones included in its plate circuit. In the circuit under consideration a high resistance R_4 of about 5 million ohms (megohms) is converted as shown. This leak prevents the accumulation of a negative charge on G_2.

Fig. 16 shows a four valve receiver. The first three valves are intended to operate as amplifiers of the oscillations and consequently it is preferable to give their grids a slightly negative potential. This has been accomplished by inserting a resistance R as shown. This resistance may have a value of about 1 to 1·5 ohms and ensures that all the three first grids will have a negative potential. This potential, it will be noted, acts through the 5 megohm grid leaks since the grid current is negligible and consequently there is no voltage drop across these resistances. The last valve acts as a detector and might, if desired, have a separate filament rheostat.

Increased amplification is obtainable on these circuits by employing retroaction. It has been stated that when the first grid is momentarily positive, the first plate becomes relatively negative, the second grid negative, the second plate positive, and so on. If now we connect a very small condenser between the first grid and one of the subsequent plates which possesses the same potential sign at the same moment retroactive amplification will take place. This condenser is preferably variable and should have a capacity of about 0·00005 mfd.

Retroaction may be obtained by making connections between any two points which have the same potential sign. Thus, the condenser might be connected across the grid of the second vacuum tube and the plate of the third or fifth tube. It is usually preferable to obtain the desired retroaction by making the coupling between two plates of similar sign, such as the 1st and 3rd, 1st and 5th, 2nd and 4th, and so on.

If the degree of retroaction be sufficiently increased, the circuits will oscillate of their own accord at a frequency which may be varied by adjusting the aerial condenser. The amplifier may then be used as a continuous-wave receiver.

In place of a coupling condenser, a high resistance of about 10 megohms has been suggested, but the retroaction is not then conveniently variable.

An important advantage of resistance amplifiers over iron-core amplifiers, is that they are quieter in action. This is due to the fact that the small grid condensers offer a high resistance to the low-frequency variations and

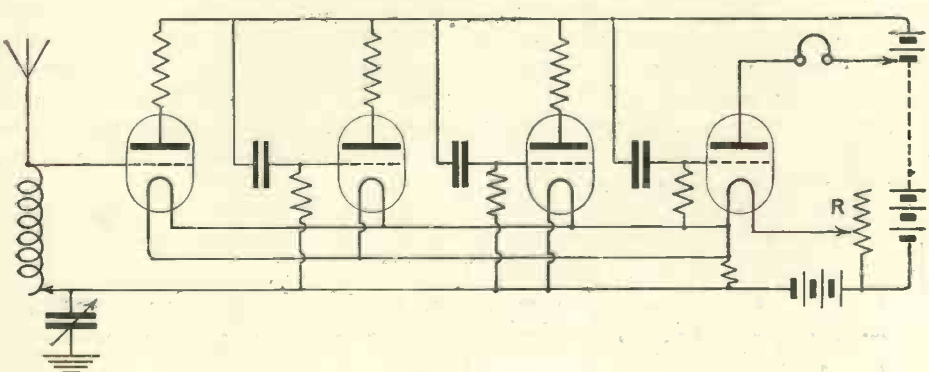


Fig. 16. Four-valve Resistance Amplifier.

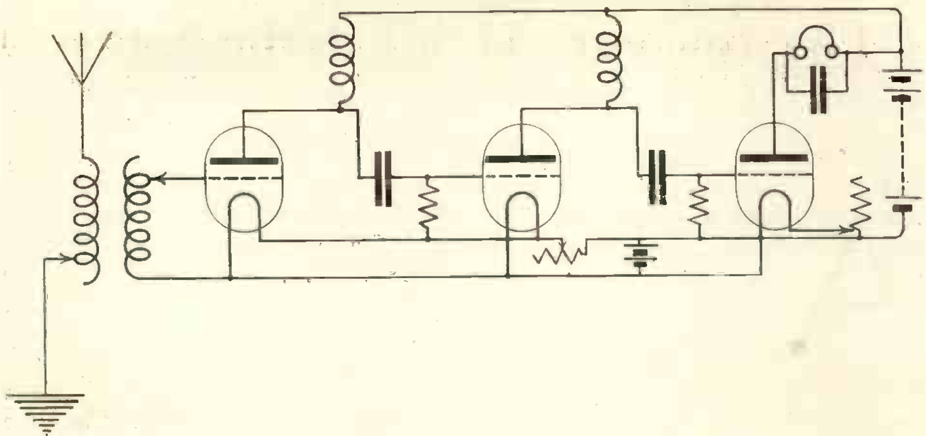


Fig. 17. Impedance Amplifier.

irregularities of plate curent which usually produce the noises. On the other hand, they readily allow high-frequency potentials to be transmitted through them.

Resistance amplifiers are most efficient on wave-lengths lower than 600 metres. This is because there is always a certain unavoidable capacity acting in shunt to the plate circuit resistances. High-frequency current will prefer to pass across this capacity than through the resistance. The effective impedance offered by the plate circuit resistance is decreased and the degree to which it is decreased will depend on the capacity and on the frequency of incoming signals. The greater the frequency the less will be the resistance of the capacity and the less the total impedance. Consequently, resistance amplifiers are not usually very efficient on short wave-lengths.

In place of non-inductive resistances, impedance coils have been used. Coils made by winding about 400 yds. of fine wire on an iron core may be used in place of the resistances. These amplifiers are more suitable for low wave-lengths since the impedance of such iron core coils increases with the frequency. The efficiency of such an amplifier would, however, vary according to the wave-length since the impedance depends on the frequency and the efficiency on the impedance. Fig. 17 shows such an impedance amplifier.

Since the Authorities have now made a preliminary announcement with regard to amateur licences we hope very shortly to give practical dimensions and details of some valve receiving circuits. We would particularly draw the attention of the amateur to the fact that it is necessary to obtain special permission from the Postmaster-General before installing or using any receiving circuits involving the use of three-electrode valves.

TO APPEAR SHORTLY.

A valuable article on A.C. work in connection with Triode Circuits, by Mr. R. C. Clinker, of the Wireless Society of London.

The Amateur's Guide to the Aether

WEATHER REPORTS FROM THE AIR MINISTRY.

A METEOROLOGICAL programme is circulated three times daily (at 8.15 a.m., 9.15 a.m., and 8.15 p.m., all G.M.T.). by the Air Ministry Wireless Station (GFA) situated at the top of India House, in Kingsway, London. It is transmitted by the C.W. system on a wavelength of 1,400 metres. We are now able to publish particulars of the special code used for this programme, to enable those of our readers who may wish to intercept it, to transcribe the messages received. The programme consists of a *précis* of meteorological reports received by the Air Ministry Station from all parts of the country.

We had the pleasure recently of visiting the station referred to above and shown in the illustration. It is the main control station of the Air Ministry and is used chiefly for the collection and dissemination of aviation meteorological reports and for controlling the British aerial service, both R.A.F. and commercial.

The installation includes two continuous wave transmitters, one of which, possessing a useful wireless range of 400 miles, is employed for transmitting all messages to places in the British Isles; and the other, of higher power, with a useful range of approximately 1,500 miles, is employed for communication with Paris, Brussels, Norway and Holland and many other places.

The observations which are transmitted at the times mentioned above, are made at 10 a.m., 7.0 a.m., and 6.0 p.m. (G.M.T.) respectively.

The message is arranged in two parts, the first part consisting of weather information from the following stations:—

101 Lerwick	150 Dungeness
195 Stornoway	174 Holyhead
199 Blacksod Point	162 Portland
182 Malin Head	110 Aberdeen
192 Valentia	118 Tynemouth
166 Scilly	136 Yarmouth

The identification number of each Station is followed by two groups of five figures which are arranged thus:—BBBDD FwBbb, and have the following significance:—

BBB—Barometer in millibars and tenths. The initial 9 or 10 is omitted.

DD—Direction of wind in points (02—N.N.E 16—S, etc.).

F—Force of wind on Beaufort Scale. (See Code I.) not m.p.h.

w—Present weather in international code. (See Code II.).

B—Characteristic of barometric tendency (See Code III.).

bb—Amount of barometric tendency during the previous 3 hours. (50 added for fall).

The first and second parts of the message are divided by one group of four X's.

The second part of the message consists of upper wind information from as many as possible of the following stations:—

Scotland, N., 107, Houton Bay.

Scotland, N.E., 109, Longside or 113, Fifeness.

Scotland E., 115, East Fortune, or 117, St. Abbs Head, or 119, Cramlington.

England, N.E., 123, Flamborough Head, or 125, Howden, or 131, Cranwell.

England, E., 135 Yarmouth or 137 Pulham, or 141 Orfordness, or 143 Felixstowe.

England, S.E., 147, Grain, or 149, Capel, or 151, Polegate.

Midland Counties, 173, Turnhill, or 139, Bedford.

Southern Counties, 153, Calshot, or 155, Stonehenge.

Channel, 161, Portland, or 163, Plymouth.

England, S.W. 165, Mullion.

S. Wales, 169 Pembroke.

England, N.W. & N. Wales, 175, Anglesey, or 177, Barrow.

Scotland, S.W., 179, Luce Bay, or 181, Inchinnan.

Ireland, N., 183, Malin Head.

Ireland, E., 184, Baldonnel.

Ireland, S.W., 191, Beerhaven, or 192, Valencia, or 189, Queenstown.

The identification number of each Station is followed by two groups of five figures arranged thus HDDVV and will have the following significance:—

H—Height.

DD—Wind direction in point (02—NNE 16—S., etc.).

VV—Wind speed in miles per hour.

The first of these groups gives the wind direction and speed at either one or two thousand feet, the height being indicated by the first figure of the group.

The second group gives the wind direction and speed at a height between three and ten thousand feet, the height being indicated by the first figure of the group. Ten thousand feet is indicated by the figure 0.

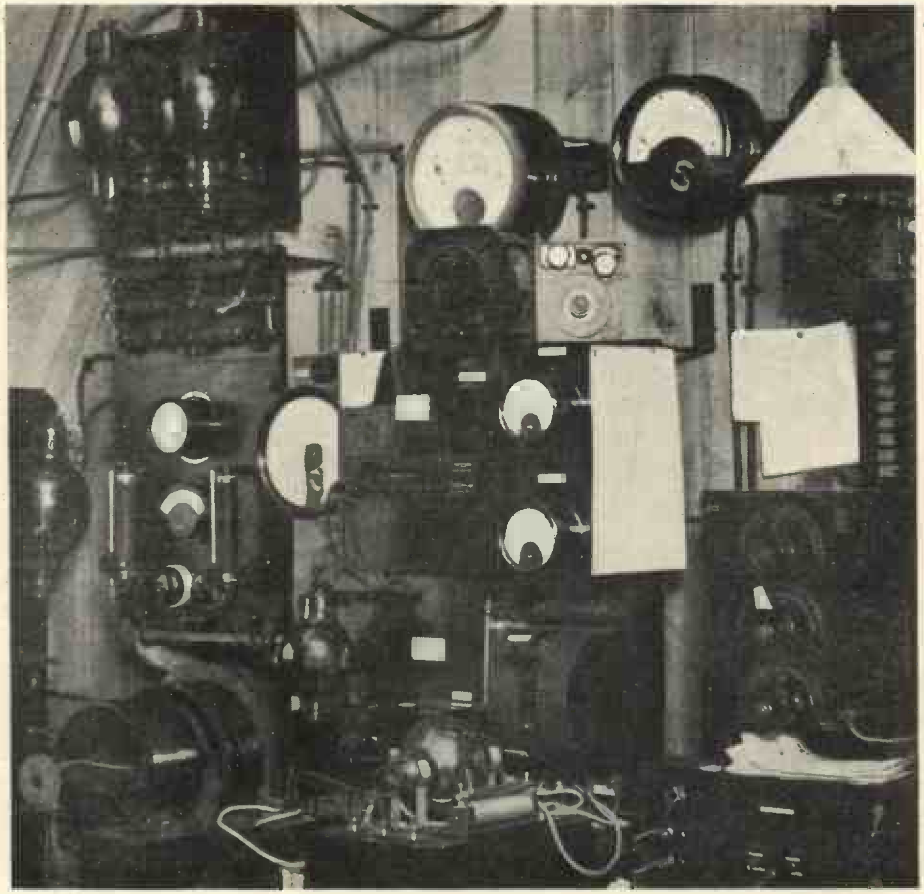


Photo. Photo Press.

Some of the apparatus at the Air Ministry Wireless Station.

CODE I.

Beaufort Number.	Miles per hour.	Metres per second.
0	Less than 1	Less than 0.3
1	1— 3	0.3— 1.5
2	4— 7	1.6— 3.3
3	8—12	3.4— 5.4
4	13—18	5.5— 7.9
5	19—24	8.0—10.7
6	25—31	10.8—13.8
7	32—38	13.9—17.1
8	39—46	17.2—20.7
9	47—54	20.8—24.4

Wind Force above 9 is sent as 9.

CODE II.

0—Blue Sky.
1—Sky ¼ cloudy.
2—Sky ½ cloudy.
3—Sky ¾ cloudy.
4—Sky completely overcast.
5—Rain falling.
6—Snow falling.
7—Mist
8—Fog.
9—Thunder.

CODE III.

0—Steady.
1—Unsteady.
2—Rising.
3—Falling.
4—Falling, then rising.
5—Steady, then rising.
6—Steady, then falling.
7—Falling, now steady
8—Rising, now steady or falling.
9—Storm indications; sudden rise with marked change of wind and weather.

THE NEW VOLUME.

THE eighth volume of THE WIRELESS WORLD, which commences in April, will bear in its general appearance and within its pages many signs that the prevailing spirit of reconstruction has not passed unheeded over the pioneer wireless magazine of the British Empire.

The most far-reaching improvement which will be effected is that the magazine will appear fortnightly instead of monthly, a change which, we are convinced, will meet with the unanimous approval of our readers. By this means we shall eliminate to a large extent the disabilities under which a monthly publication labours.

In its new form the WIRELESS WORLD will contain 36 literary pages and will be issued at sixpence per copy.

The policy of the magazine remains unaltered in its general aims, though its scope will be extended in certain directions. First, about policy. The latter can be defined in two words,—instruction and information As regards the first, special features will be introduced. For beginners in the study of radio work there will be a complete article in every issue, giving instruction in the principles underlying radio-communication and the apparatus by which this is effected. Although each article will be complete in itself, its position in the series will be carefully arranged beforehand and with a view to rendering the student's conceptions orderly and coherent. Another regular feature will be a series of complete articles by Mr. Philip R. Coursey, B.Sc., A.M.I.E.E., dealing with various radio topics and written in a manner similar to that known as the "popular lecture style," so that they may be made the bases of popular lectures, the demand for which is increasing every month.

For more advanced students we shall continue to publish technical articles by experts in various branches of radio work. Most of these articles will be specially commissioned—a procedure which will ensure that the magazine will keep abreast of the march of progress. The Digest of Radio Literature, always a popular feature, will be made more useful than ever by an increase in the number of articles covered in each issue, whilst the Book Reviews will, as before, deal promptly with all new books relating to wireless or allied subjects.

Our Questions and Answers Section, always full to overflowing, will be enlarged and made of greater interest to all readers by the inclusion of the questions to which the answers refer.

The important position which the amateur wireless community has attained, and the increasing number and activity of the Wireless Clubs point to the need for an Amateur Wireless magazine especially devoted to the instruction of novices and to the needs of private experimenters and clubs in respect to the construction of apparatus and the design of installations. These functions will be exercised by the WIRELESS WORLD, which has always endeavoured to forward the aims and interests of amateurs. As the official organ of that influential body, the Wireless Society of London, we shall publish verbatim reports of its proceedings, which means that many important and original papers will appear in our pages, together with discussions of the same by front-rank radio workers. A generous amount of space will be allotted to reports and notices of all the other Wireless Clubs, including those of other countries.

An entirely new feature of the magazine will be the inauguration of an Exchange and Mart Section, the advantages of which scarcely require description.

Finally, our policy is to give our readers the fullest possible information about the world of wireless, its personalities, its progress all over the world, its commercial aspects and the general trend of thought, research and development. It is impossible to overlook the importance of wireless as used in conjunction with aviation, and we have, therefore, arranged to publish regularly every six weeks an article dealing with the progress of commercial aircraft wireless, so that the completed volume will contain a record of the year's development of this phase of the art.

COMPETITION FOR COMMERCIAL WIRELESS OPERATORS

Names of Prize Winners

The competition which started in our September issue was an attempt to stimulate the powers of observation of Wireless Telegraphists, and, at the same time, to gather data which might prove useful in the resolution of the various outstanding problems of æther-wave phenomena. We hoped that the generous prizes offered and the manifold opportunities for observation enjoyed by operators would result in a large number of entries, but the number of competitors was not large. Perhaps the chief reasons for this are that many sea-going operators in distant parts of the world failed to learn about the competition and many others, on large passenger ships, were too busy about their wireless duties to be able to make regular observations. Not one attempt has been received from shore operators. The names of the prize-winners are as follow:

1st prize, Twelve Guineas, Mr. J. Williamson, 114, Duke Street, Leith.

2nd prize, Six Guineas, Mr. J. Cunningham, 35, Liverpool Street, Walworth, S.E.17.

Consolation prize of Books, Mr. E. A. Payne, "Hill Crest," Honywood Road, Colchester.

Consolation prize of Books, Mr. C. H. Beckway, 44, Blandford Road, Beckenham, Kent.

The other two consolation prizes have not been awarded because in no other instances were the papers submitted considered to contribute anything useful to the present stock of knowledge.

Notes of the Month

FRENCH NAVAL COASTAL WIRELESS STATIONS.

AN Admiralty Notice to Mariners (92 of 1920) states that the French Naval coastal wireless Stations established in France and Algeria are no longer to be used for commercial services; only the Stations under the administration of the Post, Telegraphs and Telephones will be used for this purpose; these Stations are as follows—

Boulogne—Ostrohove.
Havre—Bleville.
Ouessant (Ushant).
Bordeaux—Le Bousoat.
Marseilles—Jetée.
Cros de Cagnes (Nice).
Bonifacio.
Port de l'Eau.

The Direction-finding Station Barre de l'Adour (Bayonne) can, however, be used for local commercial services by vessels bound to or from Bayonne.

The French Naval direction-finding Stations will remain at the disposal of merchant vessels of all nationalities; this service will not incur any charge.

In Tunis, Morocco, and the French colonies the Naval wireless Stations will continue to be available for commercial services. In Tunis, however, merchant vessels should for preference use Cape Bon Station; Sidi Abdullah Station will only intervene in case of difficulty in communicating with Cape Bon Station.

The Naval Stations can still be utilised by the Allied warships desiring to communicate with the French Naval Authorities; they will follow the Inter-Allied procedure in force.

THE STEADY MARCH OF WIRELESS.

A wireless telephone equipment is being installed by the Public Service Company of Northern Illinois at its Blue Island and Joliet Stations, which Stations are 25 miles apart. The telephones will have a range of about 100 miles, and will safeguard communication in the event of the wire lines being for any reason put out of commission.

We understand that a wireless telephone system throughout the northern territory of Manitoba, to bring it into touch with the cities of the West, is recommended by the Commissioner.

Direction-finding Stations are to be employed by the Marconi Company on an airway route for the purpose of demonstrating the use of wireless telephony in aerial navigation. Successful experiments in wireless telephony have also been carried out by that Company between Chelmsford and a station 20 miles east of Amsterdam, with portable sets that can be carried on mules.

A demand for telephonic communication in British Columbia has arisen as a result of recent gold discoveries in the Yukon, and a Yukon member of the Overseas Club has asked the Overseas Trade Bureau to put him in touch with a firm which can supply wireless telephone sets capable of connecting Dawson with a camp 200 miles away.

From Pittsburg comes the interesting news that 400 owners of wireless telephones in that part of the United States enjoy concerts nightly by means of their instruments.

According to the *Liverpool Courier* of December 31st last, the U.S. Government is being asked by the

Admiralty for a report on a new phase of wireless telephony, which it is claimed will make it possible to focus radio messages sent out, as well as to attract and compel them to travel in close vicinity to the attracting wire. It is stated that Major-General George O. Squier, Chief Signal Officer of the United States Army, has perfected a system permitting ten or more telephone conversations to be transmitted simultaneously.

A proposal has been mooted to erect a wireless station on the coast of British Columbia, having a range of 6,000 miles, which would establish direct wireless communication with the Orient.

With the gradual return of normal conditions, many fresh wireless "links" are being forged. In the near future, the following services, amongst others, will be opened:

United States—Gt. Britain (terminal stations at Belmar, New Jersey, and Carnarvon, Wales).

United States—France (terminal stations at Tuckerton, New Jersey, and, probably, Bordeaux).

United States—Scandinavia (terminal stations at Marion, New Jersey, and Stavanger, Norway).

A direct wireless service between North and South America is also under consideration.

It is announced from Rotterdam that Messrs. L. Smit & Co.'s wireless station at Maassluis has been re-opened.

The Uruguayan Legislative Chambers have been recommended by the Uruguayan Council of Administration to authorise the Department of Wireless Telegraphy to contract for a loan of $200,000 (Uruguayan gold) to enable improvements and extensions to be effected in the wireless services.

According to the *Electrician*, it is announced that the Italian Government, having found the wireless service between Carnarvon and Rome more efficient than others, has instructed its delegation in Paris to adopt the Carnarvon-Rome route for all its important messages.

* * *

GALE WARNINGS BY WIRELESS.

The Admiralty has decided to institute a wireless service of gale warnings for ships at sea. The warning will be issued by various British coast stations when the strength of the wind is expected to reach or exceed 40 miles per hour, and will probably take the following form: (example): "Gale probable from S.W. and W., Irish Sea and Bristol Channel."

* * *

WIRELESS DIRECTION-FINDING.

An extremely interesting and instructive paper on Radio Direction and Position Finding, was read by Capt. H. J. Round before a meeting of the Institution of Electrical Engineers held at the Institution of Civil Engineers, on Jan. 14th. Captain Round dwelt on the history and the improvement during the War of Direction-Finding by Wireless.

* * *

BRITISH SHIPMASTERS' DINNER.

A dinner open to all British Shipmasters throughout the Kingdom will be given at the Adelphi Hotel, Liverpool, on Wednesday, March 3rd. Tickets, £1 1s. 0d. each. Obtainable from Captain P. O. Griffiths, Superintendent, Mercantile Marine Office, Canning Place, Liverpool. It is hoped that as many Shipmasters as possible will attend.

* * *

CATALOGUE OF WIRELESS APPARATUS.

We have received an attractive catalogue of standard condensers and wireless apparatus manufactured by H. W. Sullivan, Winchester House, London. An illustration of each instrument is given, with its price and particulars of special features.

The Proceedings of the Wireless Society of London

Ordinary General Meeting held in the Lecture Hall of the Institution of Civil Engineers, on Thursday, January 29th, 1920. The President, Mr. A. A. Campbell Swinton, in the Chair.

The SECRETARY having read the Minutes of the last meeting, and these having been passed and signed as correct, the PRESIDENT called on Mr. R. C. Clinker to deliver his lecture. This was followed by a discussion and a vote of thanks to the lecturer.

The CHAIRMAN (Mr. F. Hope-Jones), with regard to the scheme for the affiliation of the provincial and suburban clubs to the Wireless Society of London, then said :—

Mr. President and Gentlemen,—We sent out our invitation to fifteen wireless societies—all that we could hear of—early this month. Of those, I think I can say there have been no refusals of our proposals, but from three we have received no reply. I think the reason must be attributed to the fact that they have probably not resumed their activities yet. Five have definitely accepted our proposals, and the remainder have asked for more precise information of what we suggest.

The Committee having gone very carefully into the whole question of affiliation, have made certain definite proposals which are now being formulated to all. In the first place, the idea is that all members of every affiliated society shall have a general invitation to our monthly meetings, providing themselves, of course, with a note of identification from their secretaries. That will mean, I hope, that members of various provincial societies when they happen to be in town at the date of our meeting, will be in our audience. Then the affiliation of the society carries with it the offer of a membership to one of the officials of that society; whether the Secretary, or Chairman, or President, it is for them to say. They will make the election themselves, naturally. That member of each society will become a member of the Wireless Society of London. The intention is that we have ready for the disposal of each of the affiliated societies reprints of all the papers that are read before us here in London. It is intended to give a dozen copies of each, and if notice is given of any further number required they will be provided at the cost of printing and paper.

The proposals generally have been welcomed, and not least the suggestion that the societies shall add to their titles, "Affiliated to the Wireless Society of London." The greatest advantage that I think the whole scheme has to offer is a conference; it is proposed to hold one every year, making a beginning next month here in London. It is assumed that we shall not travel from town to town like the British Association, but that our conferences, for the present, at any rate, shall always be held in London ; and it is suggested that the coming month is proper, because at the end of next month we are overdue with our Presidential address—which will be the subject of our next general meeting—and I am sure you will agree with me there will be a very fitting opportunity to invite members or delegates from various provincial societies to join us on that occasion. The date has been fixed for Friday, 27th February, when the President will give us his address at the Society of Arts, for a reason which he will explain to you. It is hoped that the conference will be called for the same afternoon, probably in the same building. The idea is that the invitation to the conference is absolutely general to any member of an affiliated provincial society who happens to be in London. I have no doubt many societies will actually appoint delegates to attend it.

I need hardly say we are alive to the desirability of having the very latest information from the "powers that be" with regard to legislation, and perhaps with regard to slackening the rules a little bit ; but that must be left to the Committee of the Wireless Society of London, and cannot very well be discussed in public.

I ought to add that the fee for affiliation of each wireless society has been fixed at one guinea, with an annual subscription of one guinea. All those who have referred to it have accepted it at once as a reasonable request. I think that is all that need be said on the subject of affiliation at the present time. You will understand I am only anticipating by a post or two the official announcement that will be communicated to each of the societies concerned.

The PRESIDENT: It only remains for me to announce the fact that the next meeting will be held on the 27th February, and that it is proposed to hold the meeting at eight o'clock because it is thought that is a more convenient hour than six o'clock, the time at which the meeting must start if held in this building. It had been intended that the next meeting should be in this building, but I thought that probably you would like to have some experiments shown you, especially the reception of wireless signals from a distance without any aerial—simply on a coil. Unfortunately this building is very unsuitable for the purpose. It is entirely framed in iron girders, and experiment has shown that it is very difficult to get the signals on an inside aerial in this room at all. If you are going to show things of that kind to a large audience you want to get the signals fairly powerful; but with a three-valve amplifier in this room and a big coil we could not get anything at all. Outside, away from the girders, we got the signals at once; but this room is very unsuitable. We considered whether it was possible to apply to the Institution of Mechanical Engineers, which is close here. That is an old building, and not built, I think, in the way this one is; but unfortunately immediately at the back of it there is a very large building all framed in iron—just like this building—and I am afraid that we might there also have difficulty in getting strong signals. But the Society of Arts building was built by the brothers Adam about 1740, before iron girders were known; so I think we are fairly safe in going there. There is a trouble there—the alternating current. Some roof experiments I have made there show that it is not very conducive to the desired result; but I think we can get over that, and it is proposed the meeting shall be held at the Society of Arts at eight o'clock. Among other things I have got word from General Ferrié of the Eiffel Tower that he will be pleased to do what he did before in 1914—to send us a special message, which I hope to make audible to you. The meeting is now adjourned until February 27th.

A PORTABLE SET, AND SOME PROPERTIES OF C.W. CIRCUITS.

By R. C. CLINKER.

There are many members of this Society who have had a good deal to do with valves during the last five or six years, and who, of course, know a great deal about them. On the other hand, I think there are many members who have not had the opportunity, and are now beginning to use them and to learn the various customs of the valve. I thought I would make this lecture rather elementary,—at any rate to the first class, if they will excuse it,—because very familiar things may be put in, perhaps, new ways, and discussion afterwards is always very helpful.

I propose to do a little demonstration with this set and will describe it first. (Figs. 1 and 2.) It was intended as a complete unit primarily for obtaining time signals from Paris, and it combines all the apparatus in one case. It is rather a dreadful thing, from a wireless point of view, to put a lot of metal in the middle of a receiving coil, and it means a certain amount of damping; but with these two valves one can get quite good signals from Paris. The cover is made movable, and there is a central pivot so that the whole set can be rotated to obtain the approximate direction of signals. There is a compass fitted in the cover, which enables the latter to be laid down in the right direction, and the desired station can be found by turning the box round. This set will pick up such spark stations as Paris, Nauen and Poldhu; the C.W. stations come out a good deal better. Fig. 3 is a diagram of the connections, and there is nothing unusual about them. The receiving coil is wound completely round the inner frame, and the valve on the left is the detector. The main tuning condenser is shown on the left. There is also a reaction coil, and a transformer which connects to the amplifying valve. The filament battery is shown on the right. This set will not pick up spark stations to any extent unless it is oscillating. In other words, you do not get the true note, you get the "scratch"; but for time signals it is quite

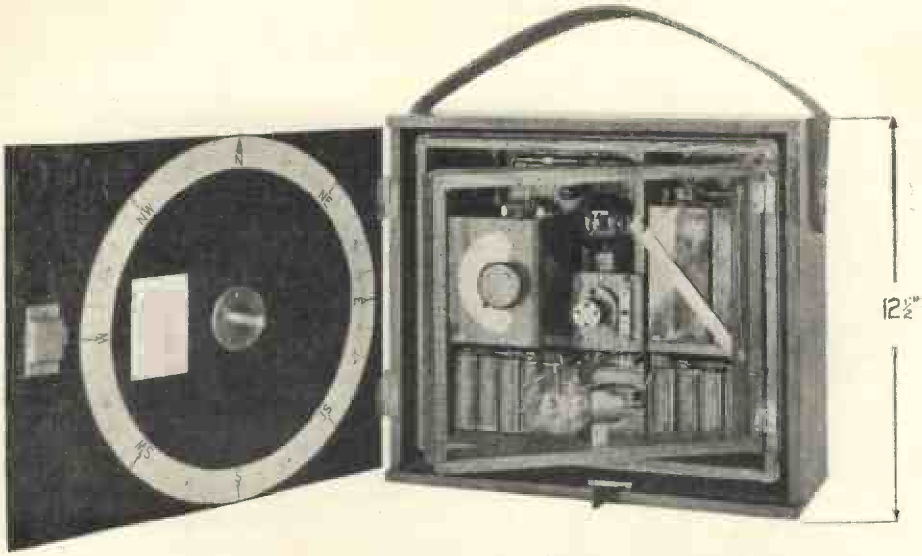


Fig. 1. Portable Receiver, showing pivot on detachable cover.

good. There is no difficulty in getting Paris even when there is a fair amount of disturbance. We have also picked up wireless telephone signals with it, and heard speech. There is a plug for putting the filaments in circuit which can be seen to the right-hand side of the centre where the socket for the amplifier

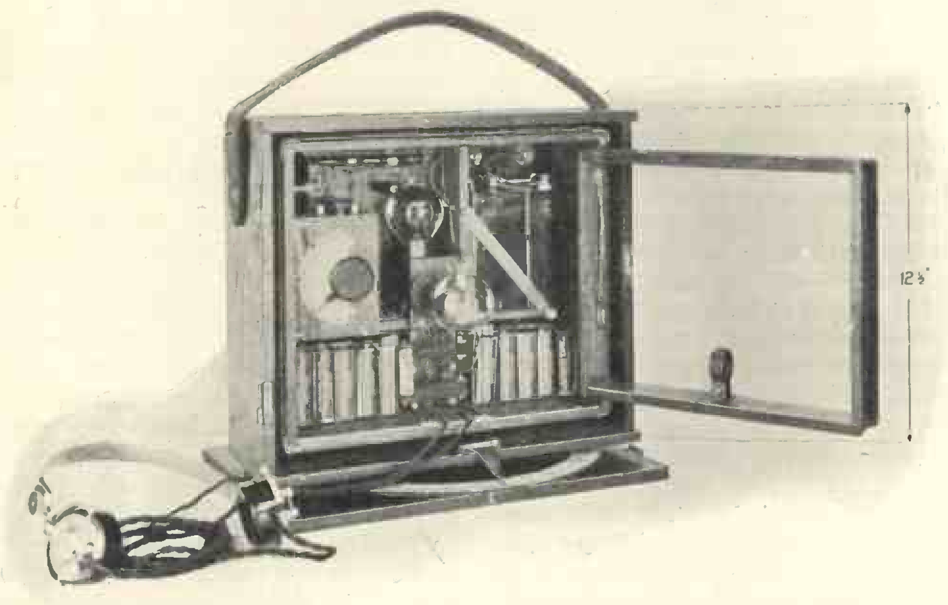
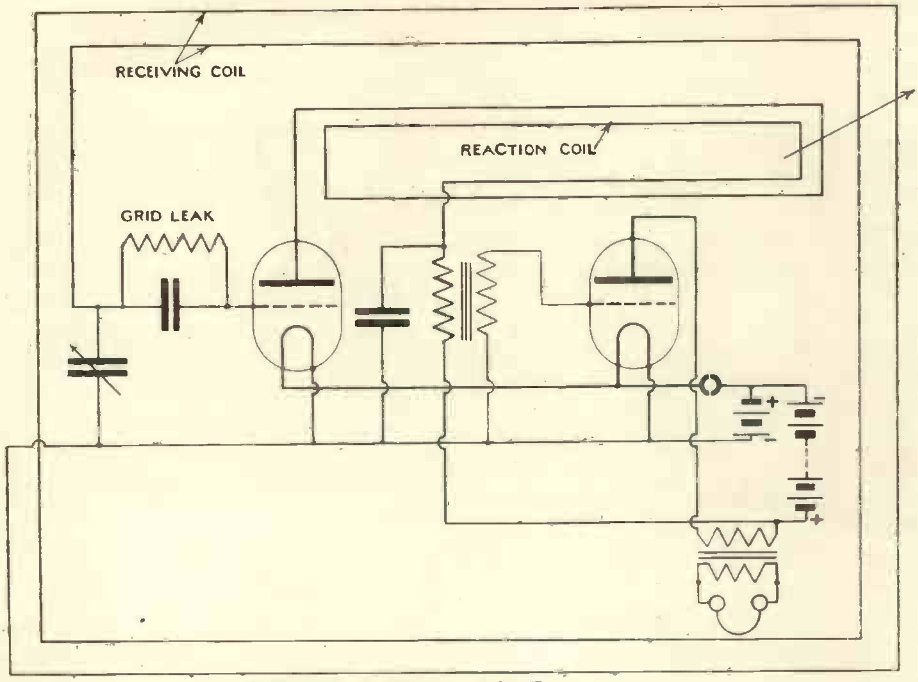


Fig. 2. Portable Receiver on pivot.



CONNECTIONS OF PORTABLE RECEIVER

Fig. 3.

is. That plug has a long handle, so that the box cannot be closed while the filaments are alight. The whole box can be readily carried.

I will deal first with the action of waves on a coil receiver such as is used in this set. If we consider the waves coming along to such a coil, we have the electro-static wave vertically, and the electro-magnetic wave horizontally. The wave sweeps along from the stations we are receiving, and cuts first one side of the coil and then the other, so that an alternating electro-motive force is induced first in one side of the coil, and then the other. I have a model here (Fig. 4) which represents the electro-magnetic wave advancing. The lower part (white) represents the wave, which can be moved horizontally in guides to represent it passing the receiving loop. The two white vertical arrows which rest upon the wave model and are moved up and down by it as the wave is moved along, represent the e.m.f.'s. induced in the two sides of the receiving coil or loop. These e.m.f.'s are equal and almost opposed in phase, but not quite, and it is the " not quite " which allows us to receive signals. In the illustration these arrows are shown close together, representing a narrow loop relative to the wavelength. The horizontal lines at the top form a scale for indicating the magnitude of the e.m.f.'s. The resultant e.m.f. in the loop is the algebraic difference between the e.m.f.'s. induced in the two sides. Suppose the coil is one foot long, and the wave five thousand feet long, you get a difference of phase of 360 degrees divided by 5,000, or only 0·072 of one degree. It is a tribute to the sensitiveness of the valve that you can detect such an exceedingly small difference of phase. Of course, if you make your coil wider you get a bigger difference of phase

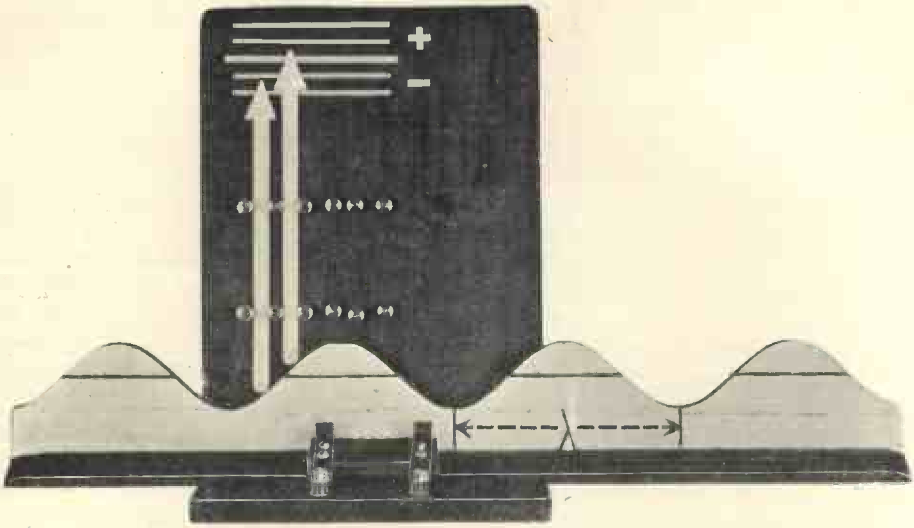


Fig. 4. Model showing action of waves on coil aerial.

between the two. This may be shown on the model by moving the right-hand arrow into one of the other guides. If you spread out your coil to a half wavelength you get as a resultant the full electromotive force which is induced in one side of the coil.

An oscillating set like the one shown (Figs. 1 and 2) is exceedingly useful for getting comparative measurements of inductances and capacity, and there is a method, which we may call the " double click method," which was referred to in the discussion on Mr. Scott-Taggart's recent paper, and also in the current issue of the WIRELESS WORLD. It is an exceedingly good method of comparing inductances and capacities. I have a diagram here which I think fairly well explains itself. (Fig. 5.) Suppose we are receiving a station, or have an oscillating set which is giving a certain frequency, and also have another one which we can mistune to a certain extent and so produce a beat note as shown on the diagram. I have marked the diagram in percentages; for instance a one per cent. increase of $L \times C$ means that your frequency has decreased roughly by one-half per cent., giving 500 vibrations per second; the 1.2 per cent. corresponds to 600 per sec. That diagram is approximately right, and near enough for the small changes marked at the bottom.

Now if you put a coil, which we will call A, in the neighbourhood of a circuit B, the effective inductance of B is modified. I use the term "effective inductance" in doing this experiment to show that B behaves as though its actual inductance were changed. We have now one set giving a standard,

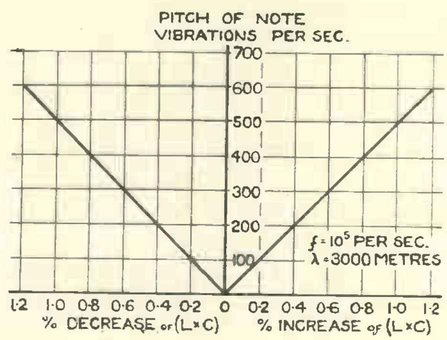


Fig. 5.

steady frequency. (The valve circuit is really a most convenient thing, because you can start it oscillating, and it will keep up the same frequency to one part in ten thousand until you want to change it.) What I propose to do is to tune this second set (coil B) exactly to the bottom of the curve (Fig. 5.) I am now going to decrease *C* and bring the note up approximately to the top of the line; I will ask you to assume that the note is somewhere up on the left-hand side. In the first place, consider the effect of a short-circuited coil in the neighbourhood. We have a certain magnetic flux from the oscillating coil B, cutting this other one, A; that produces a current which is a quarter of a period behind the electromotive force. The consequence is that the currents in A and B are practically opposite in phase, with the result that the effective inductance of B is diminished because the flux passing through it is reduced. When this coil is short-circuited you hear that the inductance is reduced as the note rises. This shows that the current in the coil A is circulating in opposition to the current in B. Supposing now we connect a condenser of not too large a capacity to coil A, you will notice that the current in that coil is exactly reversed from what it was before. The pitch of the note comes down. When we have a small capacity connected the current flows in the same direction as the primary current; when we short-circuit the coil we have the currents in opposition; there is, therefore, a change of half a period between these two conditions.

There is a very good mechanical analogy in the reed frequency indicator. In the slide shown on the screen all the reeds are vibrating with the same frequency. Assume that the one which is in the middle is tuned to 85 cycles a second. Reed No. 84, which is next, to the left, is vibrating also 85 cycles to the second, lagging behind about 90 degrees in opposition. On the other hand, the reed to the right of the vibrating one, whose natural period is 86 cycles a second, is forced to vibrate at 85, and in trying to vibrate faster it advances 90 degrees and is a quarter of a period in advance. Between 84 and 86 therefore you have a displacement of half a period. Suppose you look at the instrument through a stroboscopic disc, you will see the instantaneous position of all these reeds. Fig. 6 is a view taken as it appears through a stroboscopic disc and you will notice that Reed No. 85 is in resonance at the moment. You are looking at it as it is moving through the centre position. Reed No. 84 is displaced a quarter of a period downwards and 86 a quarter of a period upwards. You can there see the full displacement as you pass through resonance.

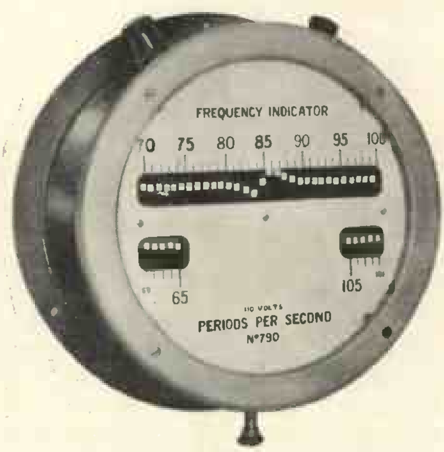


Fig. 6. Frequency Meter, as seen through stroboscope.

That is a very good analogy of the electrical circuit where, when you pass through resonance, you get a complete sweep round of the phase from 90 degrees lag to 90 degrees in advance.

This coil A has about eleven millihenries inductance. I start with the condenser at zero. At present there is no capacity and no oscillating current in A. As I increase the capacity I begin to get a current, which is leading and in phase with the primary. The result is it is increasing the inductance of coil B and the pitch gradually comes down the line (of Fig. 5) to a certain point. As we approach the tuned position, at a certain point we get instability, and then the phase of the current changes right over. The current is now lagging, the note goes up beyond the top of the line, and as you increase the lagging current it comes down to where it was at the start. If you decrease the capacity the jump occurs at a slightly different point. That is what happens when we tune a separate circuit to an oscillating valve circuit, and it is that which is the basis of this method of comparing inductances and capacities. We can move away the coil A so that the points at which these quick changes occur come very close together, and between these points you are in exact tune with your valve circuit. Suppose we want to measure an inductance or compare it with coil A, we take our standard inductance A, connect it with a condenser, and then couple it so loosely to an oscillating valve circuit that the two clicks come together. Repeating this experiment with the unknown inductance we can calculate its value by the reading on the condenser. It is a very convenient method, and gives very accurate results. Fig. 7 shows how the current changes

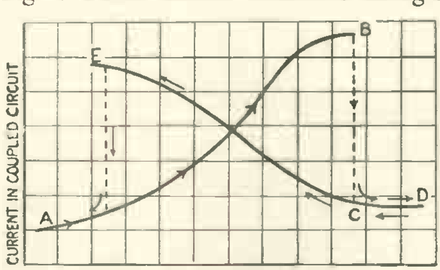


Fig. 7.

in the circuit. The readings were taken in a coupled circuit, and the Fig. shows the current in the coupled circuit as the condenser is increased from zero upwards. Starting with point A the capacity is very small, and the current is leading by 90 degrees; in other words, it is exactly in phase with the current in the primary. Starting with point A we go up the curve always with a leading current; when we get to B the circuit is very nearly in tune. This is a point of instability and the current drops down to C on another curve. Still increasing the capacity it goes on towards D. When we come back, we come up the lower curve, which is a curve indicating another frequency, on to point E and back to A. There are thus two frequencies present; those frequencies exist not together, but separately, but their values are the same as obtained with two damped circuits such as in a spark transmitter. In the spark circuit the two frequencies occur simultaneously, whereas with the C.W. circuit they occur

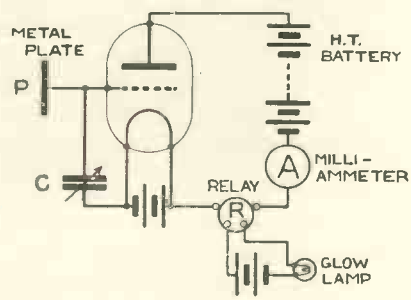


Fig. 8.

separately; but their values are the same, and depend on the inductance, capacity and coupling of the two circuits.

I have one other experiment I think perhaps will be of interest; it concerns the leakage off the grid of a valve. The arrangement is indicated in Fig. 8, the grid of the valve being insulated. The instrument A shows the plate current of the valve. The grid is insulated, but is connected to the variable condenser C, which is joined between the grid and the negative terminal of the filament. It is rather interesting to notice that in a valve with the grid insulated the electron discharge from the filament hits the grid so that it becomes electrically charged. Supposing the condenser C is put to its full capacity it then becomes charged up by the electrons. If we make a sudden reduction in capacity the negative voltage of the grid is increased, and the plate current is stopped. I have connected a relay R and a little lamp which lights up when the plate current is flowing. When we discharge the grid with the finger the plate current starts again. It is curious to see the effect of radium. Radium renders the air conducting in its neighbourhood, and will therefore discharge an electrically charged body when brought near the latter. It will be noted that uninfluenced by the radium the charge on the grid takes about 5 seconds to leak away before the plate current flows again and the indicating lamp lights up. On approaching the radium to the metal plate P, the charge takes only one second to leak away. I do not know whether I have made the experiment quite clear. Assuming that the capacity of the condenser is decreased about 70 times from maximum to zero, the negative potential of the grid will be increased 70 times. Hence, if the original voltage of the grid is minus 1 volt, it will fall to minus 70 volts. That is a very considerable potential so that the plate current goes right down to zero, and the charge takes some time to leak off. This forms a good way of showing that the grid naturally becomes negative if it is insulated.

DISCUSSION.

The PRESIDENT: I am sure we are very much indebted to Mr. Clinker for coming and showing us these very beautiful experiments and this very interesting apparatus. I dare say that some members will like to ask some questions and also to discuss the results he has brought before us. The paper is now open for discussion.

Professor G. W. O. HOWE: Mr. President, I am sure we are all very much indebted to Mr. Clinker for showing us these beautiful experiments and also for explaining them in such a clear and lucid manner. I was very pleased when Mr. Clinker, in opening his remarks, said that he was going to explain them in an elementary manner, and I am sure that was a very wise thing on his part. I am afraid it is a common failing with people who read papers to fancy that their audience knows nearly as much about the subject as they do themselves. They usually start too high above the heads of their audience, and the result is that the majority of the audience spend their time in wondering what it is all about.

I am very interested in this compact, useful set. I had the privilege of seeing the original model, which was made, I think, by Mr. Clinker himself, and which he once brought to my house and with which we picked up various Continental stations in my study. I was particularly struck then by the sensitiveness of the apparatus, and the ingenious way in which it was all fitted together into such a small compass. We are having illustrations every day of the enormous change that has been brought into wireless telegraphy by the three-electrode valve. All this would have been impossible, of course, without that instrument.

I was very much interested in the fact that Mr. Clinker used a mechanical analogy to explain leading and lagging currents in an oscillatory circuit when its natural frequency changed from a frequency above that of the forced oscillation to one below the forced oscillation. I was rather amused at this, because you will find a paper of mine read some four or five years ago before the Institution of Electrical Engineers on the amplitude and phase of higher harmonics in oscillographs; and there, where you are dealing with oscillations of a mechanical system, I think I make it clearer by an electrical analogy. So, while I explain the mechanical oscillations of the oscillograph by analogy with the electrical circuit, Mr. Clinker follows the other method and seeks to make electrical circuits plainer by means of a mechanical analogy.

I was interested in the final remark with regard to the method of the double click, where Mr. Clinker drew attention to the fact that these two frequencies are the same as you get in ordinary coupled spark circuits. In coupled spark circuits you get them, as he said, simultaneously, with the result that you get beats; whereas in the continuous wave case you either get the one oscillation or the other. When I am teaching the subject of the beats in damped oscillations I usually approach it in a way not usually found in text books—I published the method four or five years ago in the Ameri-

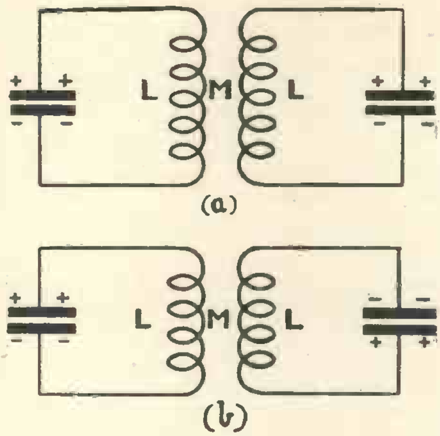


Fig. 9.

can *Electrical World.* If you have two coupled circuits (Fig. 9a) one a spark gap circuit and the other a secondary circuit, then, if instead of assuming that you have a spark gap in the primary circuit and discharge the condenser across it, suppose you assume that you break both circuits for the time being, charge up both condensers equally and discharge them simultaneously. Then, if these two circuits are tuned and have equal decrements (most of the treatment in the text-books assumes they have no decrement at all) they will oscillate together, and there will be no transfer of energy from one to the other; each circuit will oscillate almost as if the other were not there. In point of fact, because the current in one coil produces a magnetic flux in the other, that flux will either be added to or subtracted from the magnetic flux that would be in that coil were the first one not there. Now if you open the circuits again, charge the condensers in opposite directions (Fig. 9b) and then simultaneously close both circuits, the two circuits again will oscillate as before without any transfer of energy from one to the other; but here the two currents are in opposition. In that way you can prove the ordinary formulæ for the frequency of the oscillation, because the magnetic fluxes are added together in circuit (a) and you have increased the effective inductance from L to L + M—because you have equal currents in both circuits—and in the case of circuit (b) you have decreased the effective inductance of the circuit from L to L — M. That is exactly what is happening in Mr. Clinker's case. He has those two oscillatory circuits; in one case the magnetic fluxes are added, in the other they are opposing, and you get the same two frequencies.

Mr. John Scott-Taggart: I have been very much interested in the lecture we have just heard, and especially in the description of a novel method of measuring the length of continuous waves by the double click method which, I believe, Mr. Clinker attributes, to L. W. Austin. Members, no doubt, are already familiar with the ordinary type of oscillating wavemeter, several types of which I devised early in 1917, and have described in the *Wireless World* (Oct. and Dec., 1917), and the *Electrician* (Sept. 5, 1919). By combining two such oscillating circuits, I devised shortly afterwards a very sensitive capacity meter which I described in the *Wireless Age* (U.S.A.) of Dec., 1918, and more fully in the *Electrician* of April 18, 1919. As Mr. Clinker has described how the double click arrangement may be used to determine capacity and inductance values, my device may also be of interest to members.

The meter utilises the beat phenomenon. (Fig. 10). A circuit B oscillates continuously at a frequency which may be altered by means of a variable condenser C_2; the circuit includes a pair of telephones; another circuit A is arranged which also oscillates continuously at a frequency determined by the capacity of the condenser it is desired to test. This circuit sets up similar oscillations in the first circuit. There will, therefore, be two superimposed sets of oscillations in the first circuit; beats will be produced which when rectified will give a note in the telephones provided its frequency is within the audible limits. Now let a standard condenser C_1 of known capacity be placed

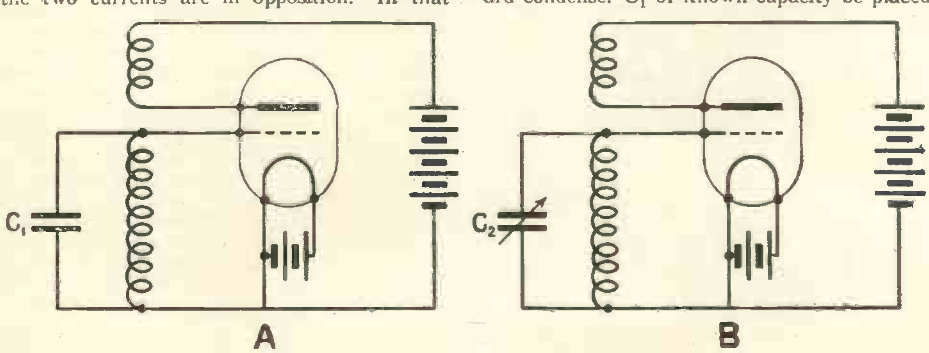


Fig. 10.

in the A circuit. The condenser C_2 is now varied until the silent point of the beat note is obtained. A graduation is now made on C_2 corresponding to the capacity of C_1. By substituting various known capacities in place of C_1, the condenser C_2 may be graduated in suitable units. To measure the capacity of a given condenser it is only necessary to connect it in place of C_1, tune C_2 until the silent point is obtained and then read off the capacity from C_2. The device may be used in very many ways which will occur to members of the Society. It may also be used to compare inductances by a substitution method. The arrangement is exceedingly accurate, and will detect the difference in the capacity of a condenser produced by placing the hand within a few feet of the condenser whose capacity is being measured.

Admiral Sir Henry B. JACKSON: Mr. President and gentlemen, we have had a very useful discussion of how the experiments were arranged. It brings home very forcibly to one the little troubles that are sometimes experienced through the position of the receiving frames. I have had very similar experiences to others in experimenting with rather a big frame at the Royal Naval College at Greenwich. There is a good deal of metal about the building—a metal roof and a good many radiators. On the ground floor, with no radiators and very few pipes, I got very good results; but I moved the frame to the top floor and got nothing. On the intermediate floor I got certain results. For no particular reason I moved the frame two or three feet to get a bit of passage round it one day, and found I got very different results. I moved the frame about in an area not much bigger than this table, and in one place got very good signals and in another nothing whatever. I traced the cause to the radiators and the iron in the building. This experiment shows the reason of the failure.

I think the Lecturer explained very clearly the difference of phase; I never heard it put quite so clearly as that. I should like him to state what wavelengths would suit his apparatus best; can he, judging from the phase difference, say if very short waves would give the best results? Most of us, I think, find the long waves rather better on the frames than the short ones.

Mr. Philip R. COURSEY: Mr. President and gentlemen, Mr. Clinker's demonstrations this evening have been very interesting. I was particularly interested in his demonstration of the double click method, as I have used it once or twice myself, but not very extensively. The trouble I found sometimes when trying to get very accurate results was the space between the two clicks. When the coupling is reduced sufficiently to bring the clicks really close together, they become rather too faint to get sufficiently accurate results. Another method that has been used is to insert a measuring instrument such as a thermal galvanometer into the oscillating circuit itself—not merely into the plate circuit of the valve—and thus to measure the drop in current when the second circuit is brought into resonance. The effect can be shown, I think, most conveniently when there is an intermediate coupling between the oscillating valve, and what in this case is the secondary circuit—but in which in the method I am now describing would become the third circuit. The intermediate coupling can be made aperiodic, but should preferably be tuned, and the thermal galvanometer inserted in the intermediate circuit. When the last circuit is coupled up there is a very sharp drop in the intermediate circuit current, and the coupling can be reduced until the drop is made quite small, but still noticeable on the galvanometer. I am rather inclined to think that this method will frequently give more accurate results, and will eliminate any discrepancies that may arise from the two clicks not being coincident.

Mr. L. A. T. BROADWOOD: Mr. President and gentlemen, there is a method where instead of using the telephone as an indicator you have a galvanometer in the plate circuit. Then you merely tune until your galvanometer gives the greatest reading. This gives the absolute tune position with considerable accuracy. When the two circuits are in phase you get the highest reading. That method was adopted in the Government heterodyne wavemeters towards the close of the war.

The PRESIDENT: If nobody else wishes to speak I will call upon the author of the paper to reply to the discussion. I would like first of all to say myself that I think we are very much indebted to him. I think it is a great advantage, if I may say so, in a society like this, that we can have actual experiments. After all, this society is mainly an amateur body, and I think experiments really appeal to most amateurs more than the drier dissertations that one has accompanied by pictures on the blackboard, and lantern slides. Actual experiments are the most convincing kind of demonstration that one can have, and are also the type of thing that will draw large audiences such as is present this evening. We are indebted very much to Mr. Clinker for the trouble he has taken in bringing the apparatus here and demonstrating it in such a wonderful way. I would like only to emphasise what he himself said about the wonderful results that it is possible now to obtain due to the three-electrode valve which is really one of the most marvellous discoveries in physics of modern times, and enables us to take cognisance of the almost infinitely small so far as electrical currents are concerned.

Mr. R. C. CLINKER: With regard to Professor Howe's remarks, I was much interested in the demonstration he showed on the blackboard. (Fig. 10.) That, of course, is the same case as far as inductance and capacity of the circuits are concerned, as the continuous wave, except, as he says, that there the two frequencies—where there are two—take place simultaneously; whereas here one can separate them and get one or other at will. There are always various ways of explaining a thing; if you read a book from a man mathematically inclined, he explains things in symbols. I am interested in Professor Howe's explanations because he gives a pictorial representation which I can understand. I was much interested in Mr. Scott-Taggart's remarks; I remember reading his papers on measuring inductance and capacity. The fact is that in experimenting with variable condensers I happened to notice this click occurring, and it seemed to me an accurate way of measuring those quantities. Very likely there are other methods which would give, perhaps, as great accuracy. On the other hand, in view of Mr. Coursey's remarks, I have generally found it possible to get the clicks so close together that in some cases the mere twisting of the spindle of the condenser is enough to throw it from one to the other with a quite sharp click. Some valves gives a sharper click than others. If the click is not sharp enough I have found that closing up the coupling of the anode coil is enough to make the click quite sharp. With regard to the remarks of Admiral Jackson, as to what wavelengths these sets were suitable for, a coil like this has a great many turns of fine wire and it is not possible to get much below two thousand metres. The idea in making it was primarily to pick up Paris; consequently two thousand was the minimum we tried for. One of the sets shown goes up to 7,700 metres, whereas the other has a smaller condenser and only goes up to 4,500 metres. I have another which goes up to 10,000 metres, and with that you can get other long-wave stations. There is just one other very interesting effect one gets with valve circuits which reminds me of the running in parallel of two alternators. If you couple two alternators to the same bus-bars they will pull into step. You get very much the same effect with two valve sets if you bring them together. I can show you that. (*Demonstrating*). One of these sets is oscillating with a wavelength of about 4,000 metres. If we start the other and gradually bring the two circuits closer together, when we get to a certain coupling you will notice that the heterodyne note absolutely disappears; the two circuits pull into synchronism and oscillate together. The action is to raise the frequency of the one and to lower that of the other, so that at a certain coupling they pull together. I do not think there was any other question to answer, and I thank you very much for your kind attention.

The PRESIDENT: I will ask you to pass a very hearty vote of thanks to Mr. Clinker for a most interesting paper and the beautiful experiments he has shown us. (Applause). I have to announce that the fourteen gentlemen whose names have been circulated have all been elected members of the society.

WIRELESS CLUB NOTES.

THE WIRELESS SOCIETY OF LONDON.

With reference to the affiliation suggestion made by this Society the following are the definite proposals now put forward:—

(1) That an affiliated Club should pay £1 1s. 0d. per annum as subscription and £1 1s. 0d. entrance fee.

(2) That such a Club should adopt as subtitle, "Affiliated with the Wireless Society of London."

(3) That affiliated clubs should name each year, say, in January, one member (probably the President or Hon. Sec.), who will be during the year a member of the Wireless Society of London, and to whom all notices, etc., of the Society will be sent.

(4) That each affiliated club shall receive twelve free reprints of the Wireless Society's monthly lectures and as many more as required at cost price plus postage.

(5) That members of affiliated clubs be invited to attend meetings of the W.S. of L. when in London, a letter of introduction being given from the Hon. Secretary of the provincial or suburban club.

(6) That an annual conference or convention be held in London, all members of provincial or suburban clubs being invited.

Hon. Sec., Mr. H. L. McMichael, 32, Quex Road, West Hampstead, N.W.

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THE MANCHESTER WIRELESS CLUB.
(*Affiliated with the Wireless Society of London.*)

A new buzzer circuit has been installed at the Club Rooms, 335, Oxford Road, Manchester. There are 5 notes each of different frequency and by means of switches jamming can be introduced on any of the 5 circuits. The arrangement was designed and wired by two of the members.

The first lecture was given on Wednesday, January 21st, by Mr. C. V. Morris. "A talk on Wireless Receivers" was the subject, and great interest was shown by the members, who took part in a discussion after the lecture.

A prize of two guineas and a valve has been offered for the best paper on "Wireless Telephony." All members are eligible to compete.

It has been decided to install an experimental receiving set at the Club's Headquarters. Members have offered to supply the necessary instruments.

New members will be welcomed and special interest is taken in the beginner. All communications to be addressed to the Hon. Secretary, Mr. J. C. A. Reid, 16, Hawthorn Avenue, Monton, Eccles.

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THE DERBY WIRELESS CLUB.

(*Affiliated with the Wireless Society of London*).

The following programme of meetings and papers has been arranged. All meetings will be held at 7.30 p.m., in Room 24, Technical College, Derby, unless otherwise notified.

Wednesday, February 25.—To discuss the Club Station. Members are invited to contribute items of Apparatus.

Wednesday, March 10.—Electrical Instruments and their Calibration. Mr. A. Domleo.

Wednesday, March 24.—Wireless Telephony, with demonstration. Mr. E. S. Huson.

Wednesday, April 7.—Electrical Apparatus in the Submarine Service. Mr. R. Huson.

Wednesday, April 21.—Loop Aerials. Mr. J. Lowe. Wavemeters. Mr. S. G. Taylor.

Wednesday, May 5.—Inductance and Capacity. Mr. A. N. McInnes, B.A.

Wednesday, May 19.—Speech Amplification, with Experiments.

Wednesday, June 2.—Electric Clocks. Capt. W. Bemrose.

NOTICE.

Mr. S. G. Taylor has kindly agreed to act as Hon. Secretary and Treasurer during the period February 15—April 1, and it is requested that all correspondence be addressed to him at St. Mary's Gate, Derby.

W. BEMROSE, Hon. Secretary and Treasurer, Littleover Hill, Derby.

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NORTH MIDDLESEX WIRELESS CLUB.

(*Affiliated with the Wireless Society of London*).

The 31st meeting of the Club was held at Shaftesbury Hall, Bowes Park, on January 28th, the President, Mr. A. G. Arthur, being in the Chair.

After the Secretary had read out a letter received from the Wireless Society of London regarding affiliation, the President said that a few words of appreciation were due to Mr. Gartland for his work as head of the Working Committee for erecting the aerial.

An attempt was made to receive signals, but owing to the temporary nature of the wiring, and the instruments being incomplete, little success resulted.

It is confidently anticipated that by the time of the next meeting on the 11th February a complete set of receiving instruments loaned by the Secretary will be available. Full particulars may be obtained from the Hon. Secretary, E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

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THE BURTON WIRELESS CLUB.

On Jan. 21st a lecture on "Capacity and Condensers" was delivered by Mr. A. J. Selby, Mr. A. Chapman presiding. Mr. Smith, in the absence of the Secretary, stated that a letter had been received from the Wireless Society of London regarding affiliation. The question of the provision of buzzers for Morse practice was raised, and Mr. Wright offered to present the Club with one, while Mr. Batt volunteered to lend one. Mr. Chapman said that the arrangements for the installation of a horn, for use when time signals were being received from Paris, would not be much further delayed.

A meeting of the Club was held on Wednesday, February 4th, Mr. A. Chapman (Vice-President), presiding.

The Hon. Secretary (Mr. R. Rose) read a letter received from the Hon. Sec. of the Wireless Society of London, dated Jan. 26th, regarding affiliation. The Club decided at a previous meeting to become affiliated with the London Society, and the Members were unanimously in agreement with the proposals set forth in Mr. McMichael's letter.

It was reported that the necessary sanction having been received, a Valve Set had now been installed at the Club Headquarters.

Mr. A. J. Selby explained in detail the construction of an amateur wireless set, giving a practical demonstration.

The members were instructed in the Morse Code, and concluded a very interesting evening with Buzzer practice.

The meeting held on Feb. 4th was well attended. Six new members were elected, making a total membership of thirty-six. It was decided that the following programme should be adopted: 7.0 p.m. to 7.30 p.m., Buzzer practice; 7.30 p.m. to 8.30 p.m. lecture (Technical); 8.30 p.m. to 9.30 p.m., Buzzer practice and discussion.

Hon. Sec., Mr. R. Rose, 214, Belvedere Road, Burton-on-Trent.

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THE SOUTHPORT WIRELESS EXPERIMENTAL SOCIETY.

(*Affiliated with the Wireless Society of London.*)

The President (Mr. E. R. W. Field) invited the members and their friends to a Social at the Drill Hall, Manchester Road, on Jan. 27th. The guests, about 60 in number, were received by the President and Mr. P. H. Christian.

The President, after welcoming the guests, gave an outline of the methods in which the Society proposed to work. He pointed out that it had been formed for the purpose of studying more deeply the subject of wireless telegraphy. It was not an ordinary "tapping club," but, as the title denoted, a wireless experimental club. They were out for good work, and would assist the Government and police authorities in preventing illicit wireless telegraphy. The apparatus they saw that evening was some which had been entirely constructed from odds and ends in the possession of members of the club, and they compared very favourably with many of the manufactured articles.

Messrs. J. Wainwright (Formby), Diggle, Lomas, Henshaw, F. Stansfield, and Christian showed and described the various exhibits to the guests. There were about 80 exhibits of members' apparatus, including loading coils, loose couplers, detectors, switches, different makes of telephones, a large assortment of crystals used in the reception of wireless telegrams and wave meters.

At the close of the exhibition, a concert was held, songs being contributed by Mrs. Lomas, Mr. Cooper, Mr. Christian, and Mr. Knock.

At the conclusion of the entertainment, Councillor Ball said he was highly gratified that such a society had been formed in Southport. It showed there was a desire by the younger of the population to study science. He would far rather encourage a number of people who were so engaged than he would a multitude of people who were given over to pursuits not of the same nature, and which were not so interesting and so helpful to the general public. He mentioned that he had been the hon. radiographer at the Infirmary 25 years, and in dealing with the X Rays he was working at the other end of the spectrum. He wished the Society every success.

Mr. Christian announced that Councillor Ball had promised to give a lecture to the Society.

Hon. Sec. (pro tem.), Mr. F. J. S. Stansfield, 107, Eastbank Street, Southport.

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The Three Towns Wireless Club.

Jan. 7th. The Hon. Secretary in the Chair. The Chairman, Mr. J. Jerritt, read a paper entitled "The Elementary Principles of Wireless Telephony," which had been communicated by Mr. E. Blake, A.M.I.E.E. A vote of thanks was passed by the members.

Jan. 14th. Mr. J. Jerritt in the Chair. Mr. Voss (late R.F.C.) lectured on "Various Wireless Systems and their efficiency." The Marconi, Poulsen, Lepel systems, and Goldschmidt's alternator were considered. It was stated that the Marconi C.W. system is very efficient.

Jan. 21st. Mr. J. Jerritt in the Chair. Mr. W. Rose (Hon. Sec.) lectured on "Telephony and the Use of the Selenium Cell in that connection." A number of interesting diagrams were shown. After the lecture and discussion the question of affiliation with the Wireless Society of London was considered. It was decided to hold the matter in abeyance.

Jan. 28th. Mr. J. Jerritt in the Chair. Mr. Lock described the construction of a condenser from simple materials.

Visitors or intending members, please apply to Mr. W. Rose, 7, Brandreth Road, Compton, Plymouth.

* * *

The Birmingham Wireless Association.

The first post-war meeting of the Birmingham Wireless Association will be held on Wednesday, March 10th, at 7.30 p.m. in Room 21 at the Birmingham and Midland Institute. All old members and others interested are invited to attend.

Many will no doubt remember that this association was incorporated in the Scientific Society shortly before the war, but very little was done before all experimenting was prohibited. Now, however, it is proposed to resume activities; the aerial has been erected and the instruments released from Post Office custody.

Will those intending to be present at the meeting on March 10th kindly advise the Hon. Secretary, J. C. Watkins, 215, Alexander Road, Acocks Green, Birmingham.

* * *

The Leicestershire Radio Society.

A meeting of this Society was held on February 6th at the Turkey Café, the President, E. Masters, Esq., occupying the Chair. There was a record attendance—upwards of 30 members being present. The speaker, Major A. L. Harris, R.E., was introduced by the Chairman, who expressed the pleasure the members had in welcoming one of the oldest of those who were associated with the old Wireless Association of pre-war days. Major Harris, in replying, said that he was delighted to find, on his return from service overseas, that the old Society had been resuscitated and also to see that it was a real live Society. Major Harris then proceeded to give an account of the part wireless had played during the recent war—in the Army.

Some interesting specimens of various apparatus were shown to the members and proved immensely interesting to all.

Following Major Harris' speech, an animated discussion took place, the speaker answering questions put to him by the members.

The next meeting was fixed for Friday, March 12th.

Anyone desirous of becoming a member of the Leicestershire Radio Society should communicate with the Hon. Sec.,

W. J. Rowlatt, 7, Highfield Street, Leicester.

* * *

GLASGOW & DISTRICT RADIO CLUB.
(*Affiliated with the Wireless Society of London.*)

At a meeting of the Club held at 30, Gordon Street, Glasgow, on Wednesday, 4th February, it was decided that the subscription be fixed at 2s. 6d. per annum, and that the Club become affiliated with the Wireless Society of London. Thereafter Mr. Adcock gave a most interesting lecture on "Directional Wireless," and Mr. Dewar, on behalf of the North British Wireless Schools, offered the entire use of a room at 206, Bath Street, as a Club Room, with occasional use of an excellent Lecture Room. This kind offer was gratefully accepted, and the new room will be used at the next meeting of the Club, on March 3rd.

At this meeting a lecture on Valves will be given by Mr. Snodgrass, and it is hoped that members will keep this night free.

Meanwhile will any readers who wish to join the Club communicate with Mr. R. A. Law, 7, Queen's Gardens, Glasgow?

* * *

BRIGHTON RADIO SOCIETY.

This Society was formed on January 19th, 1920, when 14 members were enrolled. Mr. J. E. Sheldrick, B.Sc., of the Brighton Technical College, has kindly consented to be President and has promised to conduct a series of lectures, some of which will be illustrated by lantern slides.

The second meeting of the Society was held on January 23rd, 1920, at the Y.M.C.A., Old Steine, and was well attended. Among the subjects under discussion was the proposed apparatus for the Society's station, and it was announced that the matter was well in hand. The aerial is a matter for further consideration.

A Committee of eight was elected which will meet shortly to discuss important business. At the close of the meeting eleven more applications for membership were handed in.

The third meeting of the Society was held at the Y.M.C.A., Old Steine, on January 30th.

The Secretary announced that Mr. Chapman, the genial Secretary of the Y.M.C.A., Old Steine, who has taken such a kindly interest in the Society, has allowed the use of a room for meetings, and has also offered the use of a lantern and screen for lectures.

An interesting exhibition of home-made wireless apparatus was held during the evening.

Arrangements were made for meetings to be held every Friday evening at 7.30 p.m. at the Y.M.C.A., Old Steine (Basement). Full particulars of the Society can be had upon application to the Secretary, Mr. W. P. Rogers, "Grasmere," Dyke Road Drive, Brighton.

* * *

THE WOOLWICH RADIO SOCIETY.

The officials of the Society are:—Secretary, Mr. James M. Ellam, 27, Nightingale Place, Woolwich, S.E.18; President, Col. Cousins, C.M.G., R.E. (o/c. Signals Experimental Establishment, Woolwich Common); Vice-President, Mr. A. Hogg (Principal of the Woolwich Polytechnic); Lecturer, Mr. W. James.

Mr. Ellam will be pleased to hear from other Wireless Clubs with a view to exchanging ideas, etc., and generally "pulling together."

For the time being meetings will be held every Friday in the Woolwich Polytechnic, William Street, Woolwich (by kind permission of the Governors of the Polytechnic).

On January 16th, Colonel Cousins, C.M.G., R.E., gave an interesting lecture on "The History of Wireless in the Army," bearing on its early struggles and rapid advancement.

Other lectures are being arranged, and it is hoped, in due course, to fix up a station, and to carry out some interesting and instructive experiments as soon as the G.P.O. licence is obtained.

It has been decided to affiliate the Club with the Wireless Society of London.

* * *

BRISTOL WIRELESS ASSOCIATION.

The opening meeting of the Bristol Wireless Association was held at 11, Leigh Road, Clifton, on January 24th, at 8 p.m. The business included a motion to affiliate the Association with the Wireless Society of London, which was heartily agreed to.

The Hon. Sec. (*pro tem.*), Mr. A. W. Fawcett, 11, Leigh Road, Clifton, would be glad to hear from any one wishing to become a member of the Association. The subscription is 5s. per annum. Members have the privilege of bringing friends to meetings.

* * *

THE SHEFFIELD AND DISTRICT WIRELESS SOCIETY.

The weekly meetings continue to be well attended, and the membership is gradually increasing as the work of the Society becomes more widely known. The difficulty of securing permanent headquarters is proving a serious handicap, but vacant rooms in Sheffield are apparently at a premium at the present time.

The following fortnightly papers have been read by Members:—

"Amateur-made Wireless Gear" by Messrs H. O'Neill and C. H. Handford, who described in detail how receiving and transmitting gear could be easily and simply made.

"The Æther." This formed the subject of a splendid lecture by Mr. J. G. Jackson.

"The Ionic Valve" was the title of an instructive paper by Mr. W. Forbes Boyd. The Author, who has carried out a good deal of experimental work in connection with the application of thermionic valves to aircraft, showed a thorough grasp of his subject.

A very interesting discussion followed, and the Secretary announced that a practical demonstration with a 3-valve amplifier would be given at the next meeting, using an indoor aerial.

Hon. Sec., Mr. L. H. Crowther, 156, Meadow Head, Norton, Woodseats.

* * *

THE AMATEUR IN BELGIUM.

Le Cercle Belge d'Etudes Radiotéléraphiques, founded in 1914, is reviving its activities and intends to become a wireless society of the first order. It wishes friends in allied countries to know of its existence and desires communications from other clubs. The Secretary is M. Pierre Tollenaere, 209, Bd. Leopold II., Brussels.

* * *

WANTED.

To form Wireless Clubs at Chelmsford, Croydon, Birmingham, Edinburgh, Halifax, Spalding and Doncaster. Those interested should communicate with: Mr. C. E. Jackson, 3, Seymour Street, Chelmsford; Mr. A. F. Lake, 318, Brighton Road, South Croydon; Mr. A. H. Staples, Y.M.C.A., Dale End, Birmingham; Mr. W. Winkler, 9, Ettrick Road, Edinburgh; Mr. J. R. Clay, "Woodview," Sowerby Bridge, Yorkshire (for Club in Halifax); Mr. A. H. Wasley, Glenholme, Ravensworth Rd., Doncaster.

Aviation Notes

AIRCRAFT WIRELESS ON THE LONDON-PARIS AIRWAY.

MAJOR N. B. TOMLINSON (late R.A.F.), is at present in charge of the Communications Department, which comprises the Wireless Organisation and personnel of the enterprising Aircraft Transport and Travel Company, of whom Mr. Holt Thomas (Chairman of Directors), and General Francis Festing, C.B., C.M.G. (Managing Director), are the leading spirits. Major Tomlinson has been connected with the Aircraft side of wireless engineering since 1911, in which year he was engaged on behalf of the Marconi Company in experimental work at Brooklands and Farnborough. During the war his experience has ranged over the fitting of W/T. gear to airships, airplanes, seaplanes, armoured trains, motor cars, and motor boats,—a striking illustration of the wide field of wireless work in modern warfare.

Major N. B. Tomlinson.

The cause of commercial aviation, when it wins through the present preliminary period of vicissitude to final success, will owe much to the untiring efforts and financial enterprise of Mr. Holt Thomas and his colleagues, and to the devoted labours of the flying and technical staff associated with them, who together have borne the brunt of travail that is the portion of those who lead the way and clear the path for others to follow.

The solid achievement represented by maintaining a practically uninterrupted daily service of aeroplanes in each direction between London and Paris throughout the severe conditions of last autumn and the present winter has won the genuine admiration not only of the man in the street, but also of those who have some inner knowledge of the almost insuperable difficulties that have been so successfully met and overcome.

* * *

WIRELESS EQUIPMENT.

Apropos of the question of wireless gear, Major Tomlinson explains that the demands of the moment call for a small, fast type of craft in which it is not feasible to provide special accommodation for a wireless operator. The pilot has too much on his hands, as can well be imagined under the present circumstances, to carry out the additional duties of a skilled Morse operator, so that, for the time, the undoubted advantages of telegraphy for the longer ranges have been outweighed by the comparative simplicity of the wireless telephone equipment.

The apparatus at present in use is the latest aircraft telephony set manufactured by the Marconi Company. It is so arranged that the only parts requiring manipulation by the pilot are the winding gear for dropping and winding-in the aerial, and the receiver adjustment by means of which signals are strengthened and weakened as the pilot leaves or approaches the station with which he is working. The H.T. generator is driven by a small air screw working in the slip stream of the main propellor.

* * *

W/T. COMMUNICATIONS *EN ROUTE.*

A wireless telephone receiver has been installed on the roof of the Company's Office in Old Queen Street, Westminster, by means of which it is hoped to maintain communication with planes from the time of leaving the London terminus of the London-Paris Service until they have crossed the French coast, a distance of some 70 miles. This will enable the London Office to know the whereabouts of their machines in all weathers until they are in France, and on the return journey to have all arrangements made for their reception and the speedy forwarding of passengers, mails, and goods to their respective destinations.

The W/T. Stations along the London-Paris Airway at present are Hounslow, Lympne (near Folkestone) and Le Bourget (near Paris). Once a pilot is out of touch with Lympne he must wait until he is within 60 miles or so from Paris before he can again pick up the Communication Service. It is hoped in the near future to erect an additional station in France to fill this gap and to enable the pilot to keep in continuous touch with the ground throughout his flight. This will be of great advantage, particularly in keeping the pilot advised of the weather he may expect to meet ahead of him. In winter time especially, the weather may change completely within the course of an hour or two, and local fogs appear and disappear with great suddenness.

* * *

FOG TROUBLES AND D. F.

Really dense fog is the bugbear of present-day flying and represents practically the only climatic conditions which really trouble the pilot. The aeroplane as a machine is not prevented from flying by fog, but the pilot is practically rendered blind, and therefore helpless in the matter of navigating his craft or landing it.

But with a perfected system of Directional Wireless, this difficulty practically disappears. Irrespective of mist or fog, or whether landmarks are visible or not the course will be determined by the constant signals received from beacon stations at known points either on or off the line of flight, but preferably at the destination end. The pilot can detect instantly from the signals, especially if " homing " towards a beacon, should he veer in any way from the set course, and is able to correct his line of flight accordingly.

* * *

THE VALUE OF WIRELESS.

Mr. Holt Thomas explains that when his present arrangements are completed, as they will be before the ensuing winter, he hopes to be independent of all but exceptionally severe weather conditions. " Wireless," he adds, " will help us enormously. We have now the services of one of the most practical experts in this country, who is concentrating his attention exclusively on the question as to how directional wireless and the wireless telephone may be made to help us in regular daily flying, and to overcome such difficulties as at present cause delay."

Aircraft Wireless Section

Edited by J. J. Honan (late Lieutenant and Instructor, R.A.F.).

These articles are intended primarily to offer, as simply as possible, some useful information to those to whom wireless sets are but auxiliary "gadgets" in a wider sphere of activity. It is hoped, however, that they may also prove of interest to the wireless worker generally, as illustrating types of instruments that have been specially evolved to meet the specific needs of the Aviator.

SHORT - WAVE TUNER (MARK IV.).

This set is smaller and even more convenient from the point of view of portability than the Mark III. It is designed to receive wavelengths between 90 and 320 metres.

As will be observed from the skeleton wiring diagram in Fig. 28, the telephones are permanently connected in the closed circuit so that the advantage of having a stand-by position is lost. Again, the buzzer can only be applied to the open circuit.

The open-circuit inductance is a fixed inductance of two values, the portion L_1

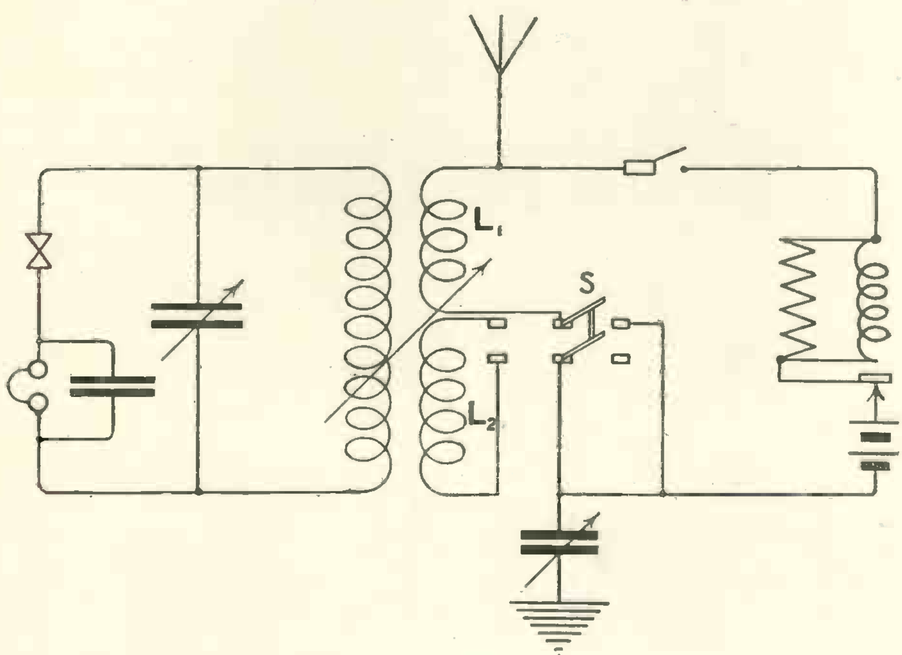

Fig. 28.

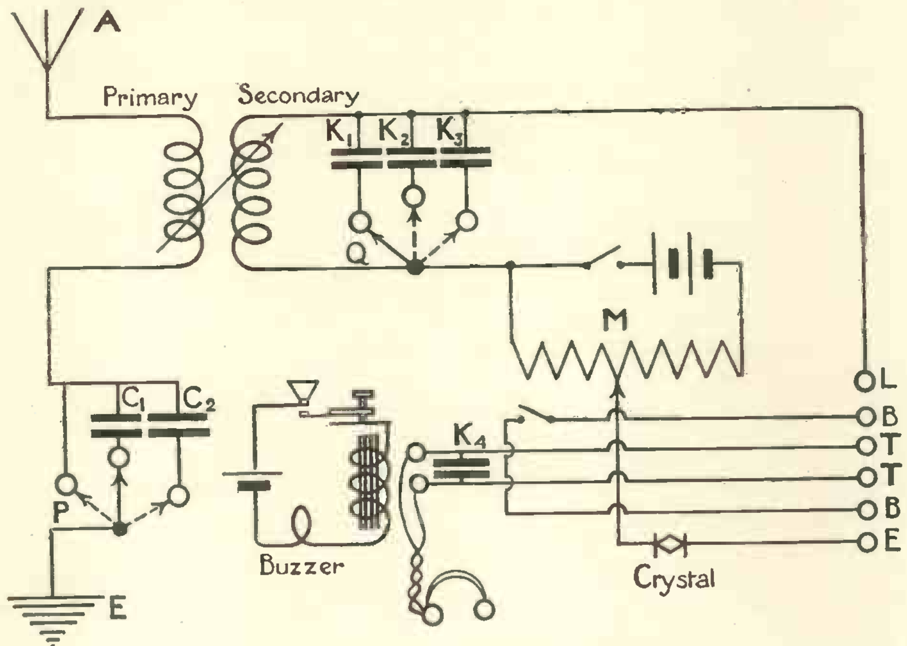

Fig. 29. Schematic wiring diagram of Tb Receiver.

being permanently in circuit, whilst the portion L_2 can be cut in or out by means of a switch S for long or short wavelengths. The open and closed inductances are of the pancake type and are coupled eccentrically.

Only one detector crystal (perikon) is fitted, so that the potentiometer battery is eliminated.

THE Tb RECEIVER.

This was one of the first crystal receivers actually used for work in the air, mainly by the R.N.A.S. It forms one of a series ranging from Ta to Tf which have done very useful work.

As a fairly exhaustive description has already been given of a typical crystal receiver (the S.W.T. Mark III.) it will be sufficient to point out one or two of the characteristic features of the present set.

AERIAL CIRCUIT.

By means of a switch handle P, Fig. 29, the aerial can be used without a condenser, thereby giving the natural wavelength, or the condensers C_1 or C_2 can be inserted in series for shorter wavelengths.

The primary of the magnetically-coupled tuning inductance is varied by means of a switch tapping eleven contact points.

CLOSED CIRCUIT.

The secondary condenser K_1 K_2 K_3 is so arranged that any one of three values can be thrown into the circuit by means of a handle Q.

The secondary of the tuning inductance has 12 contact studs. Coupling is varied by means of a slider, and since the whole of the aerial and secondary inductances are involved, any variation in

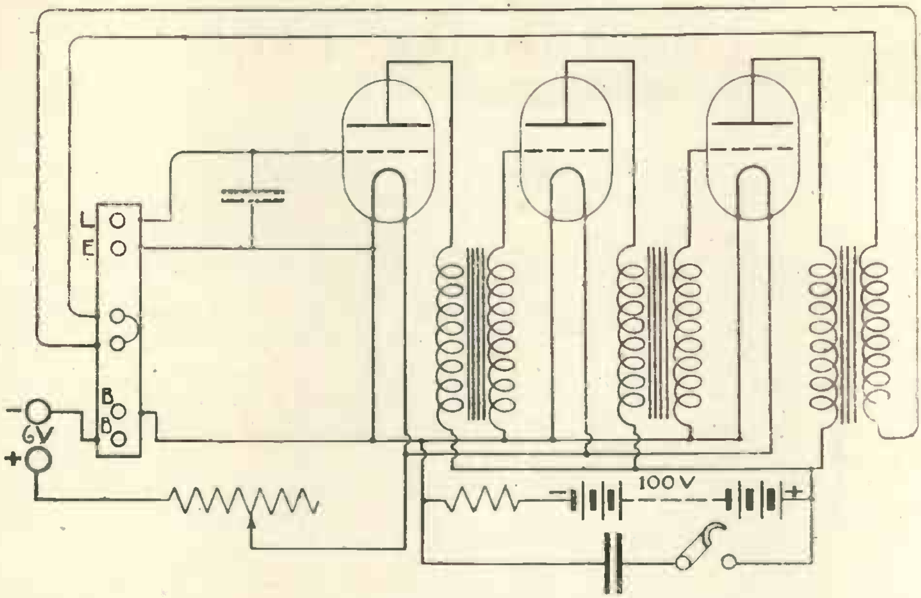

Fig. 30.

the degree of coupling will cause a sufficient alteration in the mutual inductance value of the combination to affect the tuning, which must consequently be re-adjusted.

DETAILS.

The carborundum crystal is adjusted by means of the potentiometer M. A shunt condenser K_4 is placed across the telephone terminals. A testing buzzer is provided and is worked from a dry cell, separate from the potentiometer battery.

The plug, BTTBE provides connection with a Brown Relay, or with the three-valve amplifier shown in Fig. 30, connection being made between the terminals designated by the same letters in each diagram.

A special plug closes the potentiometer battery (and the relay battery when it is used), and is so arranged that when it is in its operative position it is impossible to close down the front lid of the receiver. The object of this is to prevent the batteries from being left on and needlessly exhausted during such time as the receiver is out of action.

Aircraft Wireless in the New Volume

No up-to-date wireless magazine can afford to ignore the development of wireless in co-operation with Aviation. We have therefore arranged to publish regularly articles dealing with research, achievement and commercial developments in connection with this subject, written by men actually engaged in the work.

The Library Table

INDISCRETIONS OF THE NAVAL CENSOR.

By Rear-Admiral Sir Douglas Brownrigg, Bt.

London & New York, Cassell & Co., pp. 280, 12s. 6d. net.

THIS is one of the most pleasant of the post-war books by men who held high positions during the hostilities which we have read. It contains no attacks nor is it meant to justify the author's actions—thereby serving that very end the better—but is simply the story of his work in what must have been the most "ticklish" position filled by any man at the home front. Sir Douglas Brownrigg performed an arduous, and to a large degree thankless, task and relinquished his duties without taking with him a single rankling thorn. He recalls in charming fashion a number of occasions on which he or his department came into sparking contact with higher authorities, but there is no trace of bitterness and the hearty laugh is always near. As he spins his yarns one can imagine him jovially slapping his victims on the back. He did his duty to the best of his ability, standing aside for no one save his superior officers, allowing nothing to put him out of his stride, and asking no praise. His book bears the imprint of a serene conscience; it is simple and hearty and wholesome.

Sir Douglas deals with many things which once mystified us, such as the first British official report of the Battle of Jutland, the loss of the *Audacious*, and the death of Lord Kitchener, not without making one feel guilty of having formed hasty and unjust opinions of censors. Incidentally he reveals how multifarious were his duties. These were not confined to muzzling the Press and deleting the most thrilling portions of letters, but included the production of cinematograph films, the organisation of specially conducted trips to the Fleet, the supply of first-class music hall artists to such units as bade them welcome, and the hunt for authors and artists to depict various scenes and incidents of the war. Who would have thought that it was our common enemy, a Censor, who induced Mr. Kipling to write those wonderful articles about Jutland? We can forgive him much on that score alone.

In the chapter on wireless and war news the general public is enlightened about a matter on which it was for the greater part very hazy. How could we receive German war news? Why did the enemy send it to us? Who took it down? These questions were put to the writer many times during the war, but the querists never seemed to be wholly satisfied with the replies, partly because one was morally bound to be exceedingly sketchy and vague in speaking of those things and partly because even at that time the man in the street had not grasped the fundamentals of wireless.

In his preface Sir Douglas confesses himself to be painfully aware that his book shows no trace of literary merit. Well, we will not argue that point with a writer who gives us a book which we could not lay down until we had read it from cover to cover. The chapters about authors and publishers and the pressmen of allied countries are little works of art.

The Construction of Amateur Wireless Apparatus

This series of articles, the first of which was published in our April number, was originally designed to give practical instruction in the manufacture of amateur installations and apparatus, and arrangements had been made with Marconi's Wireless Telegraph Co., Ltd., to supply complete apparatus to the designs it was intended to detail. The restrictions on amateur work, however, remained in force, and the author was compelled to proceed on general lines only. A further series will be published giving the class of information originally intended.

Article Twelve.—RE-CONDITIONING OF PRE-WAR STATIONS.

IN our last article we considered certain simplified circuits for the amateur's use, and made some remarks concerning interference on a self-heterodyne receiver of the direct coupled variety. The reader may be somewhat puzzled to realise how the feeble radiation resulting from such a receiver can possibly cause any appreciable interference. It should perhaps be mentioned in passing that any aerial system which is picking up signals is always also radiating small amounts of energy due to the oscillations which are built up in it by the incoming waves. It is impossible to design a circuit which is a good absorber of radiation and yet not also a good radiator. In fact, broadly speaking, the conditions which have to be satisfied in designing a good absorbing (*i.e.*, receiving) circuit are precisely those which make the circuit a good radiator. As a rule, however, this tendency of a receiving aerial to re-radiate some of the energy it picks up does not cause trouble at other near-by receiving stations, because the amount of energy so re-radiated is extremely small. If the energy picked up by the aerial is of the order of a micro-watt, as is usually the case, it is evident that the amount which is re-radiated must be even less than this. Such amounts could only give trouble at other stations if these stations were very near indeed (as for instance, in the same building) or were using extremely sensitive apparatus. Cases do occur at times however when large receiving aerials, receiving high power stations on long wavelengths, pick up sufficient energy to re-radiate an appreciable amount, at frequencies which correspond to harmonics of the original waves as well as at the fundamental wavelength. These harmonics have been known to give quite readable signals at short-wave receiving stations distant perhaps a mile or two from the large receiving aerial.

The amount of radiation from a self-heterodyne set is of quite a different order to the above, owing to the fact that the oscillations are now being built up in the aerial from a local source which is quite capable of supplying an amount of energy some thousands of times as great as any incoming signals can give. Considering for a moment the simple circuit shown in Fig. 1 in the article in the February number, it is quite easy, by suitable design of windings, to build up oscillations in the circuit " A " of similar strength to those which could be obtained by exciting the circuit with a buzzer; and it is well known that it is possible to communicate over a range of some miles using the energy of a buzzer, with ordinary receivers. It is unlikely that under ordinary conditions of heterodyning the oscillations built up would be quite as strong as this, but on the other hand, when the radiation from the aerial caused by these oscillations arrives at another receiving station using heterodyning methods, it will be picked up by a receiver which may be many hundred times as sensitive as an ordinary crystal set. This being the case, the range at which it will give annoying interference with such receivers will probably be greater than that at which a buzzer could be picked up by a good crystal receiver.

In view of the fact that amateurs are at last able to resume practical work, it does not appear out of place to conclude this series of constructional articles by offering a few suggestions of a reconstructional nature, which may be of some use to those who are now overhauling and re-erecting old sets which have been dismantled since the beginning of the War. A few hours of careful examination of the gear before erection may possibly be rewarded by subsequent freedom from as many days of vexatious search for the cause of a complete absence of signals on a receiver which used to give as good results as could be desired.

The aerial will in many cases have to be designed afresh, owing to the present restriction of the amount of wire used to 100 feet of single, or 70 feet of double conductor. The type chosen will, of course, depend on the nature of the site, but in view of the small amount of wire permitted, it is more than ever necessary in planning the aerial to arrange it in the form in which it will be least screened from radiation. If the double-wire type is chosen the two wires must be separated by a distance of several feet, the more the better. If they are closer than this, very little better results will be obtained than with a single wire of the same length. If in any case masts have been erected to suit aerials which have now to be shortened, the length of span can be made up with cord separated from the wire itself by good insulators.

The spreaders, if any, should of course be located at the mast end of such cords, and not at the wire end.

The earth. It is particularly necessary with the new short aerials that the length of lead to the earth should be as short as possible, and that the resistance of this lead and of the earth itself should be as small as possible. No reliance should be placed in any earth system which has been buried without attention for some years. In cases where it is not practicable to bury plates close to the receiver, capacity earths of wire netting of close mesh, laid on the ground near the receiver, will be found to improve the results obtained.

Insulators. It is in the insulation of the set that the greatest deterioration is likely to be found. Porcelain and glass will be little affected, and will probably only need cleaning. Rubber will almost certainly have perished and need replacement. Ebonite will often look worse than it really is. All the old surface should be removed by scraping. If the material appears sound underneath it may be finished with coarse and then fine emery paper, and used again. In any case in which the deterioration appears to have gone much below the surface, the insulator should be scrapped, as its use will only lead to leakage and consequent inefficiency of working.

Coils should be carefully dried out by gentle warming. Any damp in the insulation of the windings, or in the formers on which they are wound, will lead to leakage and inefficiency. After drying out, coils should be treated with shellac varnish, which also should be thoroughly dried before the coils are used. All soldered connections or tappings should be examined and remade if they appear in any way faulty. Coils should be tested for continuity at every point by means of a telephone and dry cell, used as in Fig. 1. If the windings of the coil are intact, a click will be heard in the telephones every time that the circuit is made or broken. If, however, there is any fault in the windings nothing will be heard.

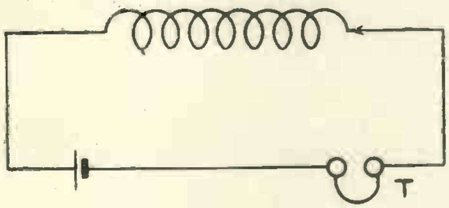

Fig. 1.

Condensers, if with a dielectric of ebonite, should be opened up and examined. If the dielectric is of air, glass, mica or similar material, they are not likely to have deteriorated much, and should not be interfered with unless there is any particular reason to suppose them faulty.

Switches should be carefully cleaned and tested for continuity in the same way as coils.

In connecting up the set, aerial leads inside the receiving room should be well insulated. Best results will be obtained if they are run in small fibre or porcelain cleats. Connections in the receiver itself should not be longer than necessary, and should be run neatly and fastened in place permanently. Wires left hanging about will be found to have an uncanny knack of fouling and causing a short circuit of some part of the apparatus just at a most inconvenient moment. Also, if all leads are fastened down neatly in such position that their exact course can be seen at a glance, not only will the appearance of the set be improved, but much time will be saved in tracing any faults such as disconnections which may arise in working. In deciding the position of the various pieces of apparatus, care should be taken to keep the different circuits apart. Coils should be so disposed that the coupling between them is as small as possible, except in the case when they are intended to be coupled together.

When the set is erected, all parts should be tested for continuity in the manner described above. If a testing galvanometer is available the earth should be tested by running a lead from some part of the aerial circuit through a dry cell and the galvanometer to another earth, such as a water pipe. For the purpose of this test it does not matter if this lead is quite long, provided it is not of too fine wire. If the earth of the set is good, a quite good deflection should be obtained on the galvanometer. The insulation of the aerial can then be tested by disconnecting the earth from the aerial at some point below that at which the lead is taken off. No deflection should then be obtained. This test will show up any definite short to earth on the aerial, but is not delicate enough to detect a small leak over an insulator. In the above tests, if an aerial tuning condenser is fitted it should be shorted.

In the new series of these articles which starts in the next volume information will be given on the details of practical design and construction of apparatus described in general terms in this series. As previously explained, it was originally intended to do this in the present series, but the plan was of necessity postponed owing to the non-removal for so many months of the restrictions on amateur working.

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 telegraphy. 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.**

G.H.S. (Hull).—A 220-volt supply will be quite satisfactory for a "Q" valve, provided that it is direct and not alternating. The value of 200 volts given as a maximum is a rough approximation only, and it is often possible to use a good deal more than this quite satisfactorily.

J.A.W. (S.S. Pearlmoor).—(1) We are afraid that the exact losses due to a jumper stay of only partly defined dimensions, situated near to an aerial of unstated length, carrying an unknown current, are quite incalculable,—without the additional complications of sparking between the stay and the mast, and other intermittent contacts. We are sorry, but the problem is rather beyond us! (2) The rough note you mention is sometimes due to too low a supply voltage. You can check this of course by noting what volts you get on the A.C. side. Incidentally, we may mention that it is very risky to put the transformer in series on the condenser in parallel unless the voltage is very low. The result of this experiment is often a pleasant half day spent in replacing broken plates in the condenser. Another possible cause of the roughness of the note may be unevenness of the disc studs. (3) We can recommend Bangay's Oscillation Valve, and Goldsmith's Radiotelephony. We do not know of a book dealing exclusively with direction-finding, and do not think that you would require one. You will get some account of this part of the subject in most of the better books on Wireless Telegraphy. (4) It will be more satisfactory if you apply direct to The Secretary, G.P.O., London.

A.F.L. (South Croydon).—There is nothing very remarkable in your hearing a wireless 'phone on your ordinary receiving set. Ordinary detectors though quite incapable of receiving C.W. are able to make audible the audio-frequency variations of the C.W. by which the speech is transmitted. You would of course not get the range that you would with a set designed for the purpose, but the station you heard was probably Hounslow, which is only a few miles from you, and uses a good deal of power. You will very likely hear him state who he is when you hear him again.

"SPARKS" (Exeter).—(1) We think the aerial with the horizontal top 40 feet long will be the better of the two arrangements you suggest. At any rate it will be a good deal the cheaper, as you will need much less wire, and this appears to be a consideration in your case. It should give the better signals too. (2) Two parallel wires are better than a single wire provided that the distance between them is some feet at least. If you put them closer together than that the results are practically no better than with a single wire. (3) The gauge of wire is not very important, provided that it is heavy enough to withstand the mechanical stresses to which it is exposed. The thicker you make it the less will be its resistance, and therefore the less the loss of energy due to that resistance. (4) There is no simple way of satisfactorily receiving long waves on a very short aerial. It can only be done with special apparatus and methods which are beyond the range of a beginner. You would be much better advised to commence with a set for short and medium waves only. You will find the information you require for this in the instructional articles published in the WIRELESS WORLD, or in any handbook for amateurs.

C.S. (Penrith).—The probable reason of your not getting sharp tuning is that the capacity of the receiving condenser is too small, if the dielectric is ¼ inch thick. With a condenser such as this, unless the plates were very large, the capacity of the coil itself would probably be important. The sound you got with the condenser disconnected would probably not be due to direct induction from the buzzer, but to forced oscillations set up in the receiving coil by the oscillations in the transmitting circuit, owing to the coupling between the circuits being too great.

F. J. K. (Co. Kerry).—It is quite possible to test the main condenser of a 1½ k.w. set by the method you suggest. A better method, however, is to test each bank separately. Reduce the gap between the spark rods of the induction coil to about 1 or 2 millimetres and if a spark is obtained on pressing the key the condenser is in working condition. If no spark is obtained open up the condenser and repeat the test when the broken plate can be located.

(2) A 450-metre wave can be obtained on a $1\frac{1}{2}$ k.w. set by using one-half of the main transmitting condenser, and with the transformer secondaries in parallel.

A better method perhaps would be to take a tapping off the jigger primary, using the condenser banks in parallel.

(3) A condenser placed in a circuit in which direct current is flowing would act as a very high resistance, in fact as an insulator, and, therefore, no current would flow in the circuit.

When a condenser is placed in an alternating current circuit the condenser sets up a back electromotive force which is equal and opposite to the applied E.M.F.

Imagine a simple circuit containing a condenser and an alternating pressure applied to its terminals. Let the pressure be in a positive direction increasing from a minimum to a maximum. As soon as a pressure is exerted on a condenser a B.E.M.F. is set up which opposes the charging pressure. When the charging pressure becomes a maximum the condenser has its maximum charge. As soon as the charging pressure is reduced the condenser starts to discharge in a negative direction, and will continue to discharge until the applied E.M.F. is zero.

Now the applied voltage will increase to a negative maximum during which time the condenser current will decrease to zero.

Thus during the first and third quarter periods the current is flowing with the pressure, while during the second and fourth quarter periods the current is flowing against the pressure.

C.T.A. (Leicester).—Without actually trying out your telephone transformer it is impossible to give a definite opinion as to whether it is suitable or not, but we think it would be well worth your while to make it up and try it out. Use a condenser across the primary of about .0002 mfd. A condenser across the secondary is not required, but if you do decide to use one make it about .05 mfd.

It would be advisable to immerse the transformers in hot paraffin wax in order to ensure good insulation between the turns.

C.E.B. Mech. W/T.—Asks why, unlike a crystal receiver, better results are obtained with a valve receiver when the detector circuit is coupled directly to the aerial instead of being inductively coupled?

We cannot agree with C.E.B. that better results are obtained with a valve if coupled directly to the aerial.

A crystal detector needs a certain oscillatory E.M.F. in order that it shall detect incoming signals. Now if the aerial be small and the received wavelength long the amount of inductance required would be sufficient to apply the required E.M.F. to the crystal. In this case a crystal directly connected to the aerial would be sensitive. On the other hand, if the aerial is large and the received wavelength short, little inductance would be required in the aerial, and the voltage across this inductance would be too small to affect the crystal. Hence a secondary circuit with small capacity and large inductance would be necessary.

The same remarks apply to valve receivers, the only difference being that valves do not require such a high oscillatory E.M.F. as a crystal, and can, therefore, be tapped off smaller inductances than can a crystal.

E.K. (Newport, Mon.).—Has been trying experiments with the $1\frac{1}{2}$ k.w. rotary converter and finds that if the slip rings are short-circuited and the starter handle is moved to the first stop, the armature gives little jerks, continually starting and stopping. Why is this?

When the starter handle is moved to the first stop a current will flow in the D.C. armature winding causing the armature to revolve. Now the slip rings are tapped off the D.C. armature winding at opposite points. When these two points come under two opposite brushes, the D.C. supply is momentarily short-circuited, causing the armature to pull up. This short-circuit will be only momentary owing to the ineritia of the armature.

We should like to point out that this experiment is not conducive to the well-being of the rotary, owing to the heavy current that will flow in the D.C. windings, besides the bad effect of short-circuiting the D.C. supply.

ENQUIRER (Leek) (1) (2) and (3).—These questions can be answered only by the firms themselves. We advise you to apply direct.

J. G. (Cork).—Yes, the wearing of uniform is compulsory for wireless operators on board ship.

F. J. K. (Cahirciveen) (1).—The method for testing the condenser bank is quite sound. In practice it is more convenient to isolate the two halves of the bank before applying the test, as by this means the broken down half can be at once traced. (2) The arrangement would give about 425 m., which might be brought up somewhat by the sliding inductance. This is the nearest that the set will give to 450 m. The fixed gap would not be necessary. (3) A condenser entirely prevents the passage of D.C. It will, however, allow the passage of A.C., but not without altering the phase relation between the current and the applied E.M.F.

J.G.R. (Enniskillen).—(1) In order to use your low resistance 'phones you will need a telephone transformer, which consists of two separate windings on a core of soft iron wires. One winding is of comparatively few turns of not too fine wire, say, No. 30, wound to have a resistance equal to that of the 'phones. The other winding consists of many turns of very fine wire, say, No. 36-40, having a resistance of at least 5,000 ohms. The high resistance winding is connected in the position shown for the high resistance 'phones. Your low resistance 'phones should then be connected across the low resistance winding. See article in this issue for further details of the practical construction. (2) "D.W.S.22" means wire of gauge No. 22, insulated with a double winding of silk. (3) Any other copper wire will do for the aerial, provided that it is sufficiently heavy for mechanical strength. The dimensions need not be altered. (4) This receiver was designed especially for the benefit of beginners such as yourself, in order that you should be able with very little experience to make a fairly efficient set. It could not be altered for greater range and selectivity without entirely re-designing it,—which, of course, we cannot undertake in these columns. We recommend you to confine your attention to the type shown until you possess greater experience. You will then find many other suitable types described in this magazine.

A.G.B. (Corsham).—(1) The circuit you refer to is quite obsolete, and we do not think it was ever used in practice. We have tried in vain to get further information as to the constants of the circuits employed. Your explanation of the action of the balanced crystals is quite correct. We think that there is an error in Bucher's statements with regard to the pitch of the note. With the values of the incident frequency and buzzer group frequency he gives, the pitch should be either 100 or 4,900, or a mixture of the two, depending chiefly on the damping in the circuit B. (It may, of course, be a mixture of these two values.) If the damping in B is excessive, a signal will only be obtained when the maxima due to the incoming radiation and the buzzer radiation exactly coincide, and the pitch should therefore be 100. If, however, the damping is negligible, there will always be a coincidence of maxima, and the pitch should therefore be that of the buzzer trains. (2) The apparent reason for the tuning of circuit B to a very high frequency is that by this means it is ensured that in each train of oscillations set up by the buzzer, at least one maximum should come near a maximum of the incoming radiation. This would not necessarily be true if the frequencies were nearly equal. (3) The oscillation transformer BJ will probably be about right with a similar amount of turns on each coil. (4) We are afraid we cannot suggest the best values for these condensers, which are probably used to diminish the shunting effect of the circuit J, across the crystals for the incident radiation.

STRATHMERE (Bayswater). — (1) The usual causes of false bearings are the presence of mountain masses in the region, the presence of deposits of mineral ores in the neighbourhood, and possibly the variation in conductivity of the earth in different directions from the receiving station—as for instance with a station on a rocky coast. (2) The aerial and its associated coils must of course be tuned to the incoming radiation. We do not think that any other relation between the Inductance and Capacity, subject to this condition, has been worked out. In considering the *mechanical* dimensions, the rough principle is to make the area of the loop as large as possible without the natural wavelength exceeding the desired value.

H.H. (Ely).—(1) There does not seem much wrong with your arrangements. However, the potentiometer connections in your diagram are quite incorrect. Consult any receiver diagram about this. This should not be enough to stop your getting any signals. Your earth is rather small. Try burying a lot more wire, and spread it more. If this is not convenient try wire netting laid on the ground. You should also insulate the lead-in more carefully,—the insulation at this point has probably chafed, and if the wooden wall is at all damp, you may be getting serious leakage there. Examine all your connections and insulation carefully. (2) No. (3) Yes, but get the set working without this additional complication first.

(We regret we are compelled to hold over many answers. In the next volume more space will be devoted to this Section, and we hope speedily to wipe out our arrears.)

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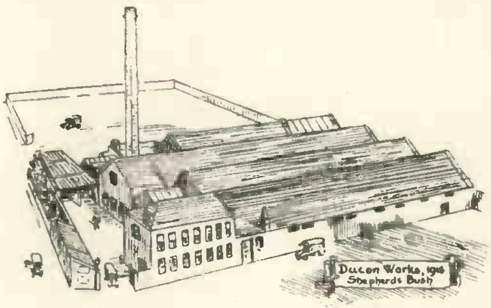

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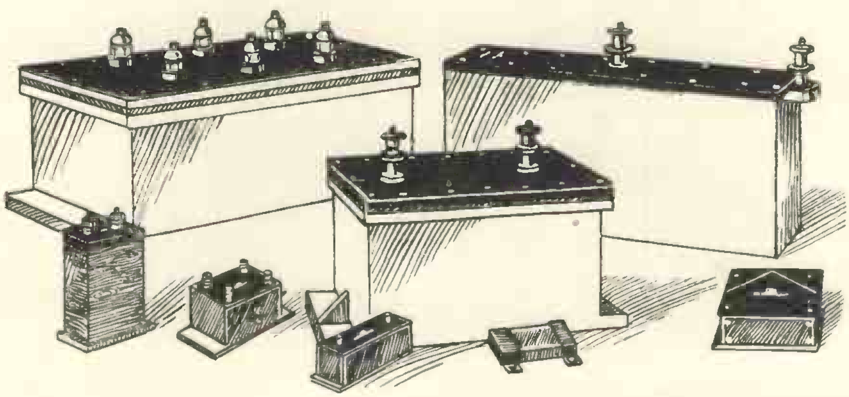

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Pelmanists *v.* Non-Pelmanists.

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"We most of us have competitors and rivals—and woe to the non-Pelmanist who tries to run the race and win against a Pelmanist." (F13131.)

The above letter has recently been received by the Pelman Institute. Some may consider it a remarkable letter. It is not a remarkable letter, however, from the Pelman point of view, as hundreds of equally striking letters are received by the Institute almost every day. But it contains certain points which will interest every reader.

MAKING BRIGHT MINDS.

In the first place, it emphasizes the intellectual benefits of Pelmanism. "I have gained tremendously on the spiritual or intellectual side," says the writer. The practical, business, and financial benefits which follow from a course of Pelmanism are so striking that sometimes this particular feature of the Pelman Course is apt to be overshadowed. But it is always present all the same. The atmosphere of optimism, the bright keenness of spirit, developed by Pelmanism is testified to by thousands. Men and women of all ages and professions write continually to say how Pelmanism has benefited them intellectually, how it has given them a new outlook on life, how it has opened to them rich stores of knowledge and enjoyment unknown to them before, how it has rolled away the clouds of depression and unrest from their minds and enabled them to live fuller, richer, and happier lives. The records of the Pelman Institute are full of such cases. The good that Pelmanism is doing in this direction can never be over-estimated or too highly praised.

INCOMES QUADRUPLED.

But then turning to the more practical side of Pelmanism, "I am now possessed of a life-long impetus" says the writer, "which will make it impossible for me ever to need money. I have earned and gained more cash since I took the Course than during any previous period of the same time." This same experience has been that of thousands. Space is inadequate to give the slightest idea of the work Pelmanism is doing in

doubling, trebling, and quadrupling the income-earning power

of those who take the Course. In every profession that could be mentioned, in every form of business or industrial work in which people are engaged, there are literally hundreds of men and women who are earning bigger money, holding higher positions, and rising rapidly to the summit of their ambitions entirely through the increased efficiency brought about by a short course of Pelmanism.

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165, 145, 100, and 70
members of their staffs in this way at one time.

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"To those of my acquaintances who have been sufficiently interested to ask my opinion of the Pelman training, I have said—and shall continue to say:—

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On Learning a Language.

By A. L.

If I inquired of the intelligent reader, "Can a sound knowledge of languages be acquired through the post?" I think he would answer, "I don't see why not, but"—and it is this possible "but" that I hope to deal with in the course of this article—"the question arises whether it will be acquired so quickly or so thoroughly as by the viva voce method."

* * *

I have before me the Courses issued by the School of Simplified Study. In some prefatory notes its scholarly authors remark, "We would ask students to remember that these Courses are not books, no particular attempt has been made at literary style. Our object has been to give in the simplest possible language the explanations of the teacher."

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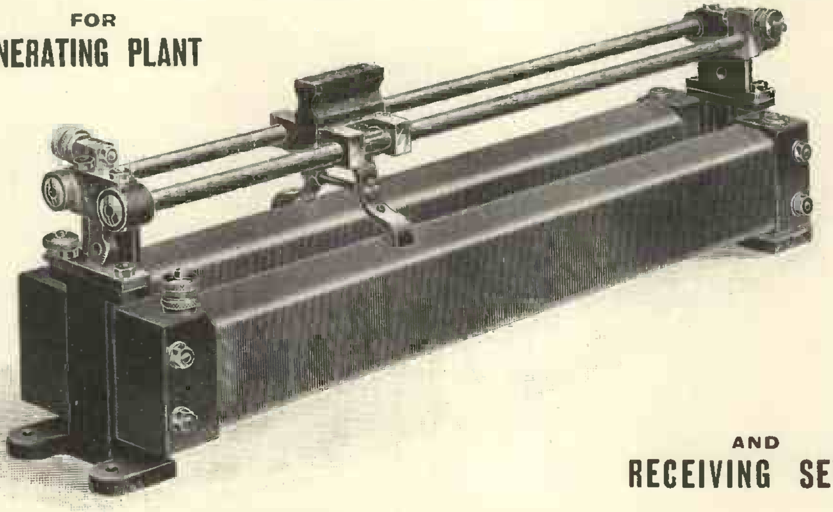

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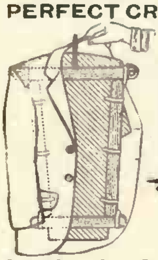

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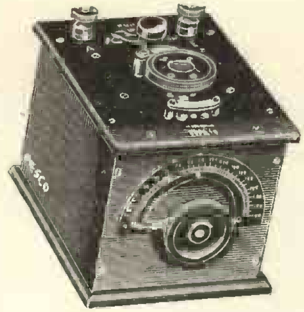

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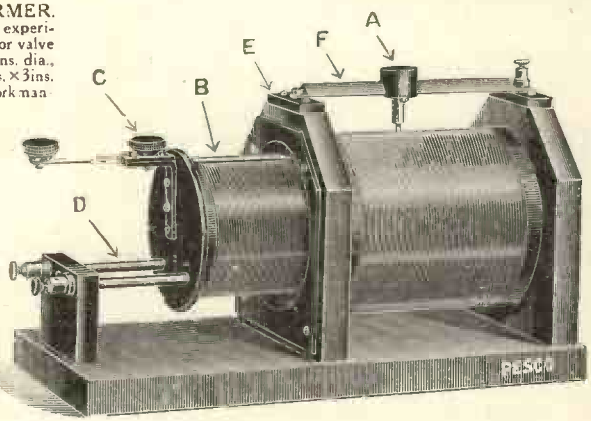

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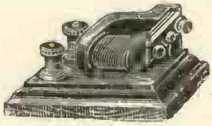

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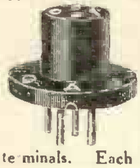

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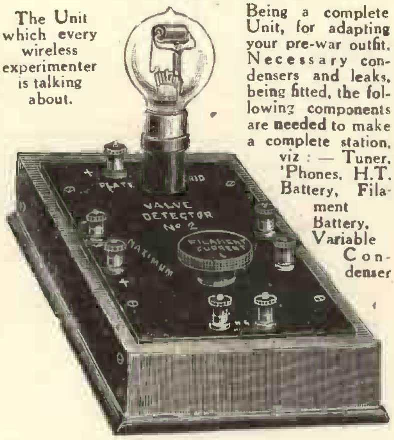

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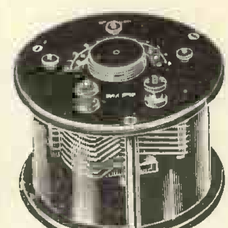

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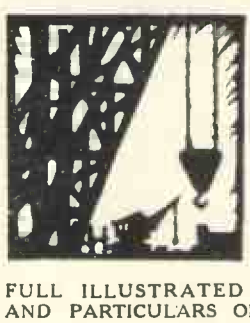

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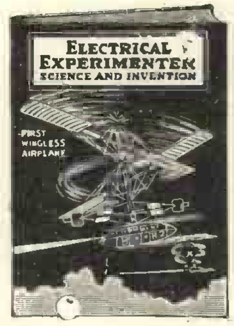

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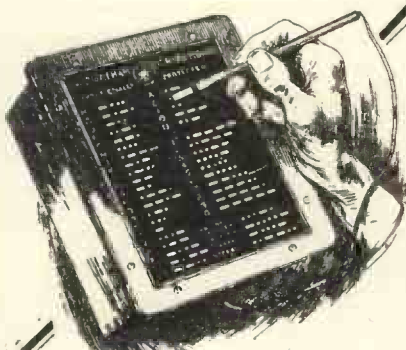

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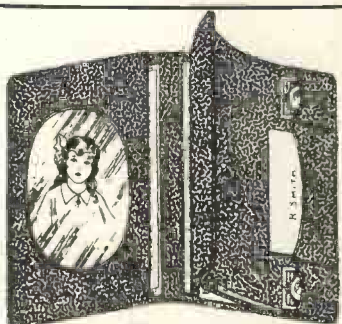

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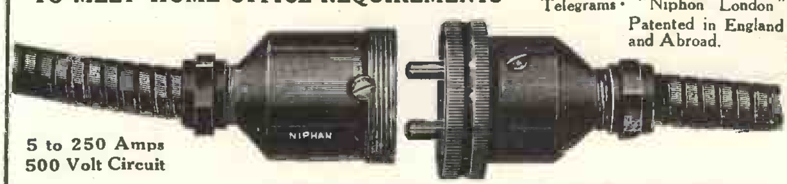

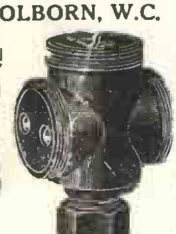

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