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An Experimental Radio Transmitting Set.

By E. M. DELORAINE, ING. E.P.C.I.

GENERAL.

MOST amateur transmitting stations in this country probably use the "choke control" or "constant current" system of modulation.

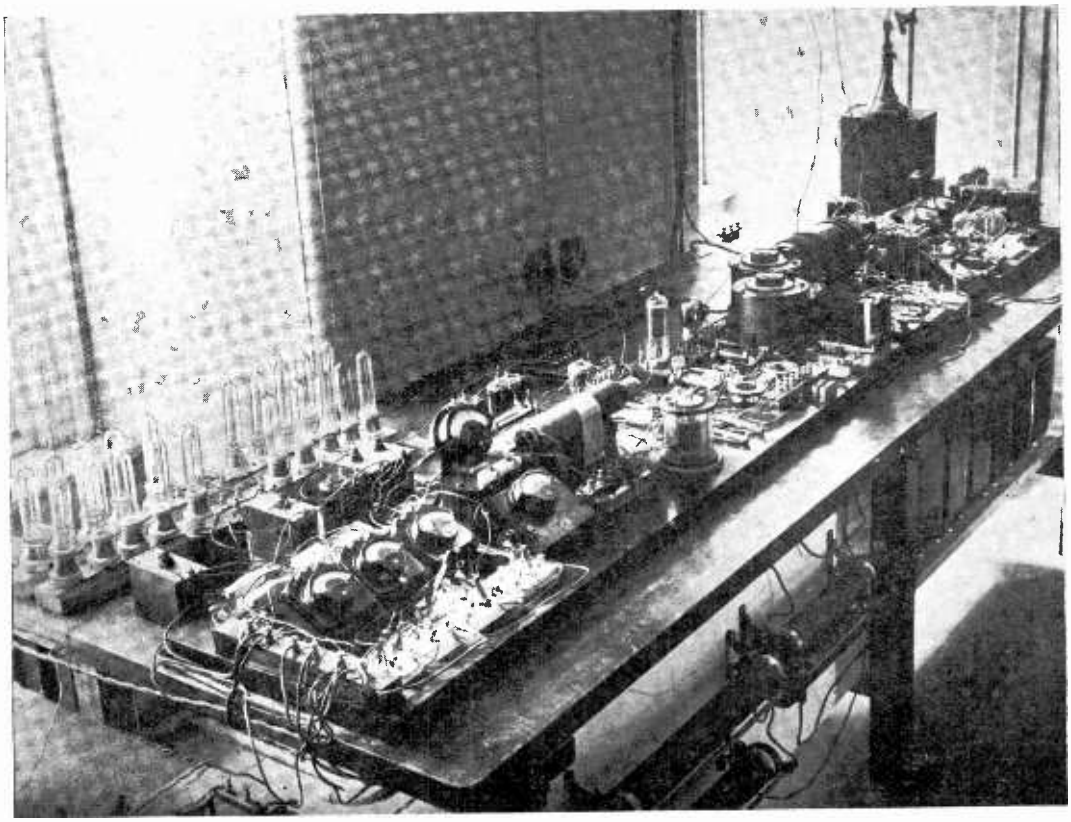


Fig. 1. General view of the Transmitter.

This system comprises essentially two vacuum tubes (or two groups of vacuum tubes) having approximately the same characteristics, one tube being the oscillator and the other the modulator. The plates of both tubes are fed through a low frequency choke coil. The high inductance of this coil opposes rapid variation of current, and so ensures that the supplied

current remains approximately constant. Between the plates of the oscillator and modulator is a high frequency choke coil which prevents the plate potential of the modulator from varying at radio frequency (Fig. 2).

If the grid potential of the modulator is constant the oscillator will supply a wave of high frequency current of constant amplitude, but if currents at speech frequency are impressed on the grid of the modulator, the plate current of the modulator will vary accordingly and produce slight variations of current through the low frequency choke coil. The inductance of the coil being large, the voltage across it varies to a considerable extent. For instance, suppose there is a 20 per cent. variation of current at a frequency of 1,000 cycles per second. If the inductance of the choke is 4 henrys, and the current 20 milliamperes, the variation of voltage will be :—

$$2\pi \times 1{,}000 \times 4 \times 0{\cdot}2 \times 0{\cdot}02 = 100 \text{ volts}$$

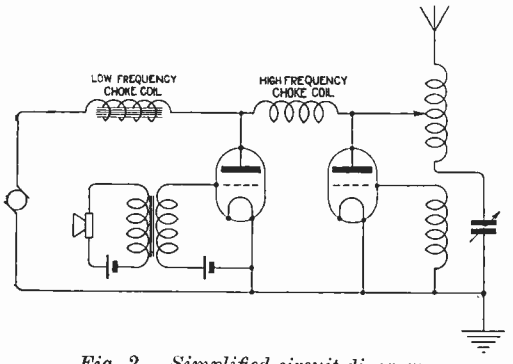


Fig. 2. Simplified circuit diagram.

If the plate supply is 300 volts, the plate potential of the oscillator tube will vary between 200 and 400 volts, in accordance with the impressed speech frequency, thus producing corresponding variations in the amplitude of the high frequency wave.

This system of modulation has a high efficiency (between 45 and 65 per cent.), and is perhaps one of the most satisfactory as far as quality and clearness of speech or music are concerned. (See Appendix I.)

MODULATION BY GRID CONTROL.

It is interesting, notwithstanding the points in favour of the system of choke control, to pursue experiments with other systems of modulation. These are numerous, many of them involving in principle low efficiencies. The author has recently been experimenting with a system of grid control. It seems quite clear that a carefully adjusted transmitting set

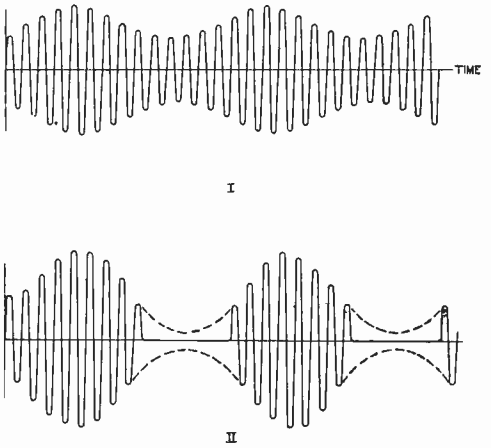


Fig. 3.

making use of " grid modulation " is able to deliver speech or music of the same grade as a set using " constant current " modulation, although the control of the former system probably requires more attention and skill than the latter.

GRID CONTROL OF THE OSCILLATOR.

It is practically impossible to obtain good modulation, with normal efficiency, using a system of direct control of the grid potential of the oscillator. If the variation of grid potential is small and the carrier wave incompletely modulated, no trouble is experienced. Speech is intelligible, if not good, but when the modulating signal is strong, oscillation suddenly ceases and then starts again (Fig. 3). Speech becomes unintelligible and music is of a very poor quality.

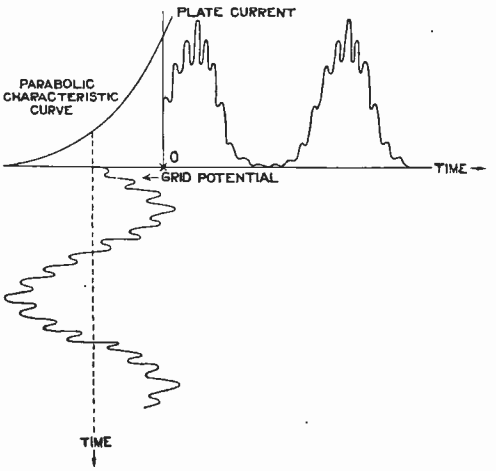


Fig. 4.

GRID CONTROL OF THE AMPLIFIER.

The idea which naturally occurs is to make use of a separate and independent oscillator and modulator, both acting on the grid circuit of an amplifier tube. This was used as far back as 1915, when speech was transmitted from Arlington to Paris, San Francisco and Honolulu. In this case, however, the amplitude of the high frequency oscillations on the grid was small compared with the amplitude of the signal at speech frequency; the modulation resulting from the parabolic shape of the grid potential space-current characteristic. When the operating point on the amplifier tube characteristic is moving up and down, the amplitude of the variation of space current is increasing or decreasing according to the slope of the characteristic at the operating point, thus producing in the output circuit, a current at radio frequency modulated according to the low frequency signal (Fig. 4).

The efficiency is determined by the amplifier and remains between 22 and 37 per cent. (See Appendix II.)

MODULATION SYSTEM IN USE.

Instead of making use of the fact that a part of the grid-potential plate-current characteristic is a parabola, let us assume now that there is a region large enough to use which is practically straight.

We can make use of a much larger oscillatory high frequency voltage, its amplitude being now equal to or greater than the amplitude of the signals at audio frequency. The combination of the modulator and oscillator current (I and II, Fig. 5) will result in a curve as represented (on III).

The resulting wave of current is impressed on the grid of the amplifier, taking care that the grid has such a steady negative potential that the operating point is at the beginning of the characteristic (*A*, Fig. 6), so that when no oscillations are impressed on the grid, the plate current will be practically zero. The amplitude of the high frequency wave must be of such a value that when the radio positive potential is at its peak value, the negative potential of the grid is halved (as shown on *B*). Now the signal at voice frequency must have a maximum amplitude equal to *A B* if complete modulation is desired, thus moving the peaks of high frequency from *A* to *C*. Consequently the output of the plate circuit and antenna current are as represented on IV and V, Fig. 5.

The quality depends to a large extent on the different adjustments and also upon the shape

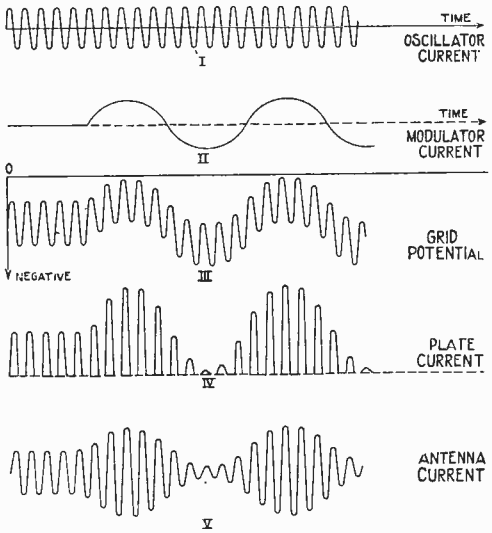


Fig. 5.

of the characteristics. This system is distortionless only to the extent that the characteristic can be assumed to be a straight line, or if some steps are taken to compensate the action of a curved characteristic.

The efficiency of this system of modulation can be raised to that of any other system (See Appendix III.)

PRINCIPLE OF THE CIRCUIT.

The circuit used for impressing both high frequency and signalling currents on the amplifier is, as a rule, as shown on Fig. 7, I. We can call this: magnetic coupling between oscillator, modulator and amplifier. The author tried a system somewhat different, which might be called a double resistance capacity coupling. Fig. 7 (II.)

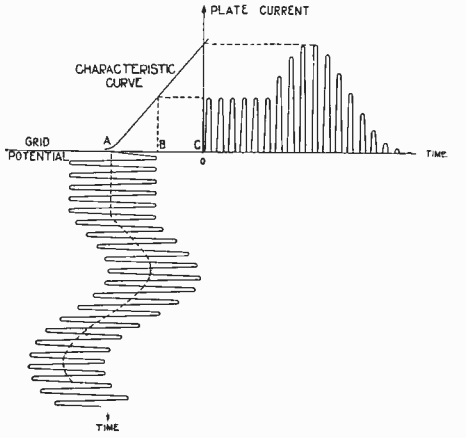


Fig. 6.

In principle we can divide this circuit into four parts :

Oscillator.
Modulator.
Amplifier.
Antenna circuit.

1. *Oscillator*. The High frequency oscillator may be of any type. It is connected in series with a condenser *C* of very small capacity and a resistance *R*. The condenser offers an easy path to the high frequency currents which are flowing through the circuit *O.C.a.b.*, thus varying the potential across *R*, as shown already in *I*, Fig. 5. These currents cannot pass through the circuit *a.L.M.b.* on account of the high impedance offered to radio frequency currents by the inductance *L*.

2. *Modulator*. The modulating circuit comprises a microphone transmitter which acts as a rule through an amplifier. Currents at voice frequency flow through the circuit *M.L.a.R.b*, thus varying the potential across *R*, as shown in *II*, but do not flow through the oscillator circuit, owing to the high impedance offered by the condenser *C* to current at voice frequency.

3. *Amplifier*. The grid is connected to the end " *a* " of the resistance *R*, the filament being connected to the other end " *b*," through the grid battery, which maintains the grid at a negative potential.

Potential variations of the grid with respect to the filament are shown in III. The plate current of the amplifier is controlled by the grid potential and has a wave shape as shown in IV.

Energy is transferred from the plate circuit to the antenna through a magnetic coupling. The modulated antenna current is represented in V.

The main advantage of this circuit is that by avoiding the use of iron core transformers, it is to a large extent free from distortion, and the efficiency of the coupling can be kept nearly constant for all frequencies above a certain minimum value.

DESCRIPTION OF THE CIRCUIT.

The circuit used is solely of the experimental type and is subjected to frequent modifications. It is shown in Fig. 6. In the photograph, Fig. 1, the part of the set near the camera is mainly for control of filament and plate circuits and of the motor generator set. Next is the oscillator, then the amplifier. Further on can be seen the modulator, the output high frequency circuits, and finally, a one-stage low frequency amplifier with meters and control.

VACUUM TUBES.

The tubes used have been of various types but particularly the 20 and 30-0 Mullard tubes, and Western Electric tubes.

The Mullard type are well known ; they have a vertical cylindrical plate made from a sheet of nickel, the grid being a spiral of molybdenum wire and the filament a straight wire of tungsten. The 0·20 valve requires a filament current of 1·5 amperes and is used with a plate voltage up to 500 volts.

The Western Electric tubes make use of oxide coated filaments. These filaments offer the most economical source of electrons at present available, that is, they give a maximum electronic emission for a given filament current. When metals are coated with certain chemical compounds their electronic emission is greatly increased. Considerations of mechanical strength, electrical resistance and non-oxidisation, led to the choice of a wire of platinum-iridium for the filament. This wire is rolled to a ribbon, to increase the surface, and the ribbon is twisted to secure better mechanical properties.

Experiments showed that a mixture of barium oxide and strontium oxide in a number of consecutive coatings give the best results.

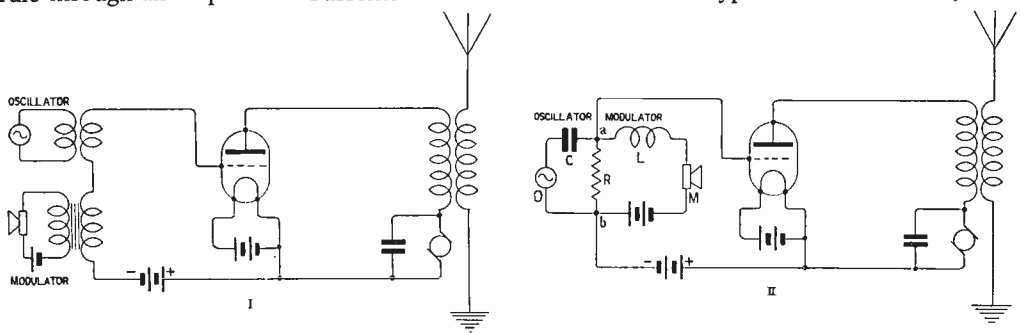


Fig. 7. Coupling arrangements.

The most commonly used process consists in mixing barium carbonate with strontium, hydroxide with resin or paraffin and repeating the coating process. After each application the wire is raised momentarily to a temperature of about a thousand degrees, thus burning away most of the organic carrier. There remains a firmly adhering layer of oxide of barium and strontium, combined with platinum and iridium.

The coated filament operates at a low temperature, corresponding only to a dull red heat. The emission from a square centimetre of tungsten at high temperature is about ten times greater than that from a square centimetre of coated filament. This greater density of emission from tungsten has the effect of requiring for a tungsten filament tube a smaller plate and grid structure than that required in the case of a coated filament tube having the same characteristics. This larger structure of tubes makes their manufacture an easier matter. The life of coated filaments, on account of their low temperature, is also longer than the life of tungsten filaments. The grid and plate of the Western Electric tube are of nickel, and are of a flat type, disposed on each side of a single or double V-shaped filament. (Fig. 9.)

The tubes of the latter type used in this

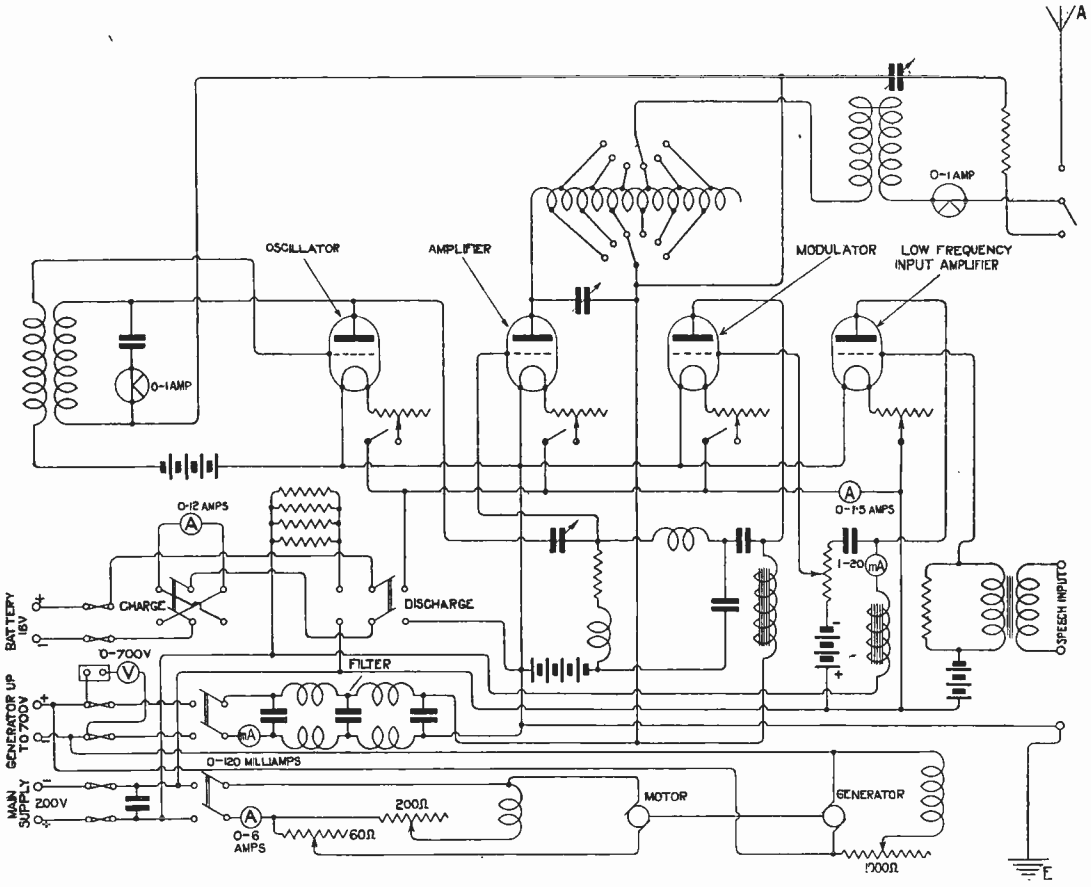


Fig. 8. Circuit diagram of the Transmitter.

circuit have the following characteristics :—

	Filament Current. Amperes.	*Plate Potential. Volts.*
Amplification ..	1.25	130
Output Power—5 watts	1.35	200
,, ,, 50 watts	3.4	up to 1000

OSCILLATOR.

For the oscillator a Mullard tube is used. It consists simply of a tuned anode circuit with reaction on the grid by mutual inductance.

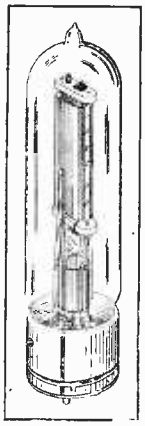


Fig 9.

MODULATOR.

A very important part in modulation is the starting point, that is, the transmitter. An ordinary solid back standard transmitter has been found to give satisfactory results. It must be remembered, however, that such a microphone is not well suited for the transmission of the higher frequencies. The voice range of frequencies is practically limited to 100 to 2,000 periods, whereas music requires a much larger range; the piano covering a range from 27 to 4,138 periods per second, the organ from 16 to 4,138. This does not include harmonics, which exceed 10,000 periods per second.

The microphone current of the solid back transmitter was able to act directly on the modulator but it was found preferable, in order to run the transmitter smoothly, to make use of one stage of low frequency amplification.

A special type of transmitter also has been tried. This is a double-button microphone made by the Western Electric Company, and intended either for radio telephone transmission, or for public address systems using loud speakers. The diaphragm is stretched till its natural frequency is raised to about 2,500 periods per second and this frequency is furthermore increased by the use of an air damping chamber. Best results are secured when the transmitter is spoken into at a distance of two or three feet. The reproduction of the speech or music is very clear, owing to the absence of resonant effects and variations in efficiency. The output of this tansmitter, however, is very small and requires amplification. A two-stage amplifier with resistance coupling increases the volume of sound to the normal standard of an ordinary microphone. (Fig. 10.)

The position of the microphone with regard to the transmitting instrument is also important. The gramophone used is an Aeolian Vocalion, with a tone control device, and this gives very good quality music. The best position of the solid back microphone was inside the horn. The double-button microphone is preferably placed at a distance of one or two feet from the horn and to the side of the gramophone as shown in Fig. 11. This position minimises any needle noise that may be present.

The modulator tube used is either a Western Electric 5-watt or a Mullard 0·20.

The oscillator and modulator act on the amplifier as previously explained. The amplitude of the voltage at radio frequency is controlled by a variable air condenser, and modulation is controlled by varying the resistance coupling between the last stage of low frequency amplification and the modulator. An inductance in series with the couplingr esistance, and a small condenser across the input of the amplifier, prevent the distortion which would be introduced by the capacities in resistance-capacity coupling.

AMPLIFIER.

The amplifier tube is a Western Electric type and has a tuned plate circuit which acts

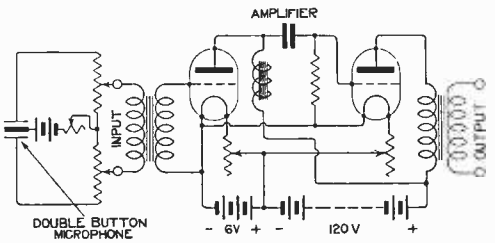


Fig. 10. Two-stage amplifier.

either on the antenna or on an absorbtion circuit.

The author does not give precise data on voltage, currents, etc., because of the experimental character of the transmissions. These were never twice under the same conditions.

PLATE CURRENT SUPPLY.

It may be of interest to amateurs to state that before making use of a motor generator set, the plate current supply was obtained as shown in Fig. 12.

The main supply at 200 volts D.C. charges a condenser of 10 microfarads. This condenser is then connected in series with the mains and across another condenser of 30 microfarads. The latter consequently becomes charged at 400 volts, and supplies the plate voltage through a filter. These operations are performed by a simple commutator driven by a small power motor. This constitutes a simple method of obtaining twice the value of D.C. potential directly available, and involves very little expense.

APPENDIX I.

If the plate voltage of the oscillator is represented by :—

$$e = E(1 + K \sin \omega t)$$

$\frac{\omega}{2\pi}$ being the frequency of the signal impressed on the modulator, the plate current of the modulator will be :—

$$i_a = I(1 + K \sin \omega t).$$

K depends on the amount of modulation and will be unity when modulation is complete.

The space current in the modulator will be:—

$$i_a = I(1 - K \sin \omega t).$$

with

$$i_a + i_a' = 2I,$$

$2I$ being the constant current supplied by the generator.

Let us call ϵ the plate efficiency of the oscillator.

The overall efficiency of the system, excluding the power dissipated in the filaments, will be equal to the oscillatory output power divided by the input power :—

$$Eff = \epsilon \frac{\frac{1}{T}\int_0^T EI(1 + K \sin \omega t)^2 dt}{E(i_a + i_a')}, \quad T = \frac{\omega}{2\pi}$$

$$= \epsilon \frac{\frac{1}{T}\int_0^T (1 + 2K \sin \omega t + \frac{K^2}{2} - \frac{K^2}{2} \sin 2\omega t) dt}{2}$$

$$= \epsilon \frac{1 + \frac{K^2}{2}}{2}$$

If modulation is complete the efficiency will be :—

$$Eff = \frac{3}{4}\epsilon$$

The efficiency ϵ of the oscillator may be 60 to 85 per cent., so that the overall efficiency of this system will be between 45 and 65 per cent.

APPENDIX II.

The modulated carrier wave may be represented by

$$i_a = I_a \sin \phi t(1 + K \sin \omega t).$$

$\frac{\phi}{2\pi}$ being the radio frequency.

If R is the effective resistance of the antenna for the frequency $\frac{\phi}{2\pi}$ the modulated power delivered to the antenna will be :—

$$p_a = RI_a^2(1 + K \sin \omega t)^2 \frac{1}{\zeta}\int_0^\zeta \sin^2 \phi t dt$$

with $\zeta = \frac{2\pi}{\phi}$

$$p_a = \frac{RI_a^2}{2}(1 + K \sin \omega t)^2.$$

The maximum value for complete modulation, *i.e.*, $K = 1$ is :—

$$p_a = 2RI_a^2.$$

This power is supplied by the amplifier tube. Consequently if ϵ is the plate efficiency of this tube, we have

$$2RI_a^2 = \epsilon EI,$$

thus

$$p_a = \tfrac{1}{4}\epsilon EI(1 + K \sin \omega t)^2.$$

The efficiency of this system is equal to the ratio of the integrated output power p_a to the input power EI.

$$Eff = \tfrac{1}{4}\epsilon \frac{1}{T}\int_0^T (1 + K \sin \omega t)^2 dt$$

$$= \frac{\epsilon}{4}\frac{1}{T}\int_0^T \left(1 + 2K \sin \omega t + \frac{K^2}{2} - \frac{K^2}{2}\cos 2\omega t\right) dt.$$

$$= \frac{\epsilon}{4}\left(1 + \frac{K^2}{2}\right)$$

Fig. 11. *The microphones used for transmissions.*

In the assumed case of complete modulation

$$Eff = \frac{3}{8}\epsilon$$

Taking again ϵ between 60 and 85 per cent. the efficiency of this system will remain between 22 and 37 per cent.

This does not include the power expended in the separate oscillator and modulator tubes, which still further lowers the overall efficiency.

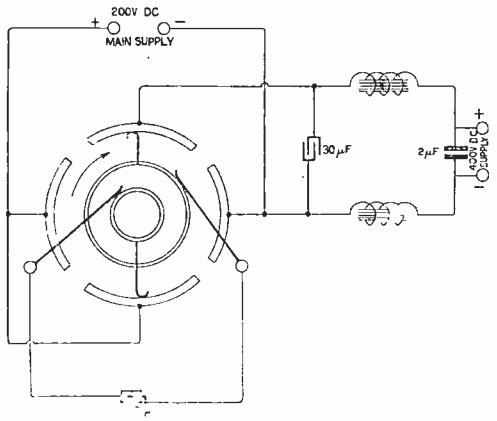


Fig. 12. Method of obtaining plate current supply.

APPENDIX III.

Let us assume the characteristic to be a straight line. In the working conditions previously described, the maximum value of impressed signalling voltage is equal to the amplitude of impressed high frequency voltage between *A* and *B*. If we take again the signalling current as a sine wave of frequency $\frac{\omega}{2\pi}$ the plate current will have an envelope :

$$i = I(1 + \sin \omega t)$$

but due to the fact that only half of the high frequency oscillation produces a flow of plate current, the mean value of plate current at signalling frequency will be :—

$$i_1 = \frac{I}{2}(1 + \sin \omega t)$$

As the plate voltage is constant, the power at signalling frequency will be :—

$$p = \frac{EI}{2}(1 + \sin \omega t)$$

and the mean power :

$$p = \frac{EI}{2}\frac{1}{T}\int_0^T (1 + \sin \omega t)dt = \frac{EI}{2}$$

The antenna current is :

$$i_a = I_a \sin \phi t \ (1 + \sin \omega t)$$

and the output energy :

$$Ri_a^2 = RI_a^2 \sin^2 \phi t \ (1 + \sin \omega t)^2$$

and at signal frequency.

$$w = RI_a^2 (1 + \sin \omega t)^2 \frac{1}{\zeta}\int_0^\zeta \sin^2 \phi t dt$$

$$\frac{RI_a^2}{2}(1 + \sin \omega t)^2$$

The maximum output energy is :

$$2\ RI_a^2.$$

This corresponds to the maximum input energy : EI. So that

$$\epsilon\ EI = 2\ RI_a^2$$

Consequently the mean output energy is :

$$W = \frac{\epsilon EI}{4}\frac{1}{T}\int_0^T (1 + \sin \omega t^2)dt = \frac{3}{8}\epsilon EI.$$

The efficiency is therefore

$$Eff. = \frac{\frac{3}{8}\epsilon EI}{\frac{1}{2}EI} = \tfrac{3}{4}\epsilon$$

The plate efficiency ϵ is about the same when using the grid control or the choke system, *i.e.*, between 60 and 85 per cent., providing the plate voltage is increased in the first case, to compensate the effect of the negative grid potential. The overall plate efficiency of the grid control system will be also between 45 and 65 per cent., so that it can compete as far as efficiency is concerned with the " constant current " system, or more generally with any other existing system.

A somewhat different method which has been suggested is to work with a very negative grid potential, so that when the high frequency currents are applied (but no signalling at voice frequency is impressed) the amplifier anode current is zero. In such a case, however, only the positive half cycle of signalling current will liberate corresponding high frequency in the antenna, and distortion results.

The Wireless Society of London

The November meeting of the Society, which will be held at 6 p.m. at the Institution of Electrical Engineers on Wednesday, November 22nd, will be a special general meeting for the purpose of authorising changes in the constitution of the Society through the alteration of certain rules. A lecture and demonstration will also be given illustrating the action of the three electrode valves by means of a mechanical model.

Electrons, Electric Waves, and Wireless Telephony—V.

By Dr. J. A. FLEMING, F.R.S.

III.—THE ARCHITECTURE OF ATOMS.

1. MOLECULES AND ATOMS.

BEFORE we can discuss the nature and properties of another type of wave called an electromagnetic wave, it will be necessary to consider briefly some of the things which modern researches have taught us concerning the structure of atoms, and the elements of which they are built up.

Twenty-five years ago no one could have given any information on this subject. In fact, even the actual existence of atoms was then in doubt. The word *atom*, derived from Greek verbal roots, signifies something which cannot be cut or divided, and any discussion on the structure of the interior of an atom would in those days have been very similar to the contents of a chapter in an old book on Natural History, headed " On Snakes in Iceland," the only information given therein being, " There are no snakes in Iceland."

So with atoms the only answer to questions as to the structure of an atom would then have been, " we know nothing about their structure and probably never shall know anything."

Although Greek philosophers twenty-five centuries ago had taught that material substances are composed of small discrete indivisible particles, no one had formulated any theory as to their inner construction, and they were only mentally pictured as extremely small spheres infinitely hard and of unknown composition. But the atomic theories of classical philosophers, such as Democritus and Lucretius, were mere speculations and had no basis in observed facts.

It was not until modern chemistry came into being by the discoveries of Cavendish, Boyle, Black, Lavoisier and Dalton, in the eighteenth and early nineteenth centuries, that valid reasons began to be given for the belief that material substance, in short, all matter is not infinitely divisible, but is composed of definite units of mass called molecules and atoms.

Suppose we consider such a substance as common table salt. We can divide it into small grains and each of these could be divided again under a microscope until we reach a particle nearly 1/100,000th of an inch in diameter, which is about the smallest size of particle visible in a good microscope. We have good reason to believe that even such a small particle would possess all the known qualities of common table salt. If we dissolve some salt in water and make a solution, no microscope yet made can show any visible particles in it, yet each drop of the liquid would taste " salt " and exhibit all the properties of common salt in chemical actions. Moreover, by an evaporation or boiling off the water we can recover the salt unaltered.

Hence we have good reason to believe that when in solution the salt is divided into particles of ultra microscopic size. But chemical experiments show that this substance can yield under the action of an agency called an electric current, the nature of which we shall consider immediately, two other substances, viz., a green poisonous gas, chlorine, and a soft metal, sodium, and therefore common table salt is called in chemical language, sodic chloride.

Moreover, effects we shall discuss later on prove that in very dilute solutions of sodic chloride, and other similar salts which conduct electric currents and are decomposed by them, the constituents, which in this case are chlorine and sodium, exist partly in an uncombined state.

Hence there is a certain small mass of sodic chloride which is the least possible mass which exhibits all the properties of common salt. It is called a *molecule* of sodic chloride.

The word molecule is derived from Latin words and means a small mass or quantity. There are various substances, about 90 in all, which have never been resolved or decomposed into any other substances and these are called *elements*. The smallest possible quantity or mass of any element which can exist as such and exhibit the chemical properties of the substance is called an *atom* of it.

Hence the molecules of complex substances are built up of atoms held together so as to form small similar bunches or groups. In certain very simple compounds such as table salt, the molecule may consist of only two dissimilar atoms, but in organic substances, such as albumen, oils, or starch, the molecule may contain many scores or even hundreds of atoms.

Even in elementary substances such as hydrogen or oxygen in the gaseous state, the constituent molecules contain two similar atoms held together.

We have been able to determine by methods which cannot here be described in detail, the mass or so-called weight and also approximately the size of molecules and atoms.

The view that small definite units of mass, called atoms, exist in the case of the elementary substances is strongly supported by the three laws of chemical combination, viz., Proust's Law of Definite Proportions, the Law of Relative Proportions and Dalton's Law of Multiple Proportions. These may be illustrated as follows: Every pure chemical compound is composed of elementary substances always in the same definite and constant proportion by weight. Thus water consists of 16 parts by weight of the gas oxygen combined with 2·016 parts by weight of the gas hydrogen, which combine and produce pure water when the gases are mixed and an electric spark sent through them. When the analysis of a pure compound is conducted with proper care it invariably yields the same proportions of its constituent elements.

The Law of Multiple Proportion may be explained as follows:—There are two known compounds of carbon (charcoal) and oxygen gas, viz., carbon monoxide (CO), a very poisonous gas, and carbon dioxide (CO_2). In the first, the ratio of mass of carbon to oxygen is 12 to 16, and in the second it is 12 to 32. The ratio of oxygen to carbon in the second is just double that in the first. It is found that whenever there is more than one compound of two elements, the ratio by weight of these elements in the two compounds is always in a simple integer proportion.

The Law of Relative Proportion is as follows: Consider three elements, hydrogen, oxygen and carbon. The first two combine in the proportion of 1 to 8 or 2 to 16, to form water. The second and third combine in the ratio of 16 to 12 to form carbon monoxide. Finally, the first and third combine in the ratio of 2 to 12 to form a gas called olefiant gas. We see then that to each element may be affixed a certain numerical value called its *chemical equivalent*, and combinations between elements always take place in the proportion by weight of the equivalents, or in some integer multiples thereof.

These facts, and many others like them, point very significantly to the conclusion that elementary substances exist in small ultimate units which are of exactly the same mass and enter into all chemical reactions without change of mass.

In short, matter is atomic in structure. Atoms unite to form molecules and molecules to form visible masses, just as letters are combined to form words and words to form sentences.

The relative mass or so-called weights of each kind of atom has been measured and is called the *Atomic weight*. It is expressed in terms either of the mass of the hydrogen atom taken as equal to 1, or of the oxygen atom taken as equal to 16. The *Molecular weight* of a molecule is the sum of the masses of the constituent atoms. Two terms, viz., *a gram-molecule* and *a gram-atom* are in frequent use. These mean respectively the quantity of a chemical substance or of an element which has a mass in grams numerically equal either to the molecular or the atomic weight. Thus the atomic weight of oxygen being 16, a quantity of oxygen weighting 16 grams is called one gram-atom of oxygen. The atomic weight of sodium is 23 and of chlorine is 35·47. Hence the molecular weight of sodic chloride or table salt is 58·47, and a mass of salt weighing 58·47 grams is called one gram-molecule of sodic chloride.

According to an hypothesis first made by the chemist Avogadro, in 1811, a gram-molecule of every kind of substance contains the same number of molecules.

In the case of permanent gases taken at standard temperature 0°C. and barometric pressure 760 mm., equal volumes therefore contain the same number of molecules and a gram-molecule occupies a volume of 22,400 cubic centimetres.

Thus 2 grams of hydrogen, 32 grams of oxygen, 28 grams of nitrogen, all have a volume of 22,400 c.c. at 0°C. and 760 mm. and contain an equal number of molecules, that number being very near to 66×10^{22} or 660,000 times a million billion in English reckoning.

This means that in one cubic centimetre there are about 30 million billion molecules. In a space of one-half of a cubic millimetre, or about the volume of a small pin's head, there are ten million times more molecules of air than there are human beings alive on the surface of our earth at present. This will give some faint idea of the exceeding minuteness and number of the molecules in the air we breathe.

Non-scientific persons are apt to imagine that these figures are mere guess work, but this is not the case. We can now count by various methods the number of molecules in a cubic inch of air with quite as close an approximation to truth as we can count the number of men, women and children in Great Britain by a census taken on the night of any given date.

2.—DIMENSIONS OF ATOMS.

As regards the sizes of atoms and molecules there are various lines of argument which lead to the conclusion that approximately speaking, the diameter of an atom is of the order of one hundred millionth of a centimetre. This means that if a million atoms were placed in contact like marbles arranged in a row, they would only occupy a length of 1/250th part of an inch, or less than the thickness of the thinnest sheet of tissue paper. To count this million atoms would take at least a week, counting without stopping day and night.

An approximate measurement of atomic diameters is derived from the study of thin films of various kinds.

Skilled gold beaters can beat out one ounce of gold until it covers an area of 240 square feet. The thickness of the sheet would then be about four-millionths of an inch.

There are three units of length which are convenient for measuring very small lengths or thicknesses and these are as follows :—

A millimetre (1 mm.) is the thousandth part of a metre and is about 1/25th part of an inch.

A micron (1μ) is the thousandth part of a millimetre.

An Angström unit (1 A.U.) is the ten-millionth part of a millimetre and therefore the ten-thousandth part of a micron or 10,000 A.U. = 1μ.

Roughly speaking, the diameter of an atom is about two to five Angström units.

It is possible to prepare gold leaf the thickness of which is about one-tenth of a micron or 1,000 A.U. Such leaf when held up to the light has a green colour, or is semi-transparent and transmits green light.

This gold leaf has, however, several hundred layers of atoms in its thickness, probably 300 to 500 atoms. We can, however, prepare thinner films of soapy water. If a soap bubble is blown with a suitable material, or better still, if a metal ring is filled with a soap film by dipping it into the soap mixture, and if this film is placed in a glass dust-free box in a vertical position, the film begins to thin away by drainage from the top part. Presently we notice certain small round black spots which look like holes, but are not holes, because in proper positions we can see an image of a bright light source, such as the sun reflected by them. It is possible to measure by several methods the thickness of the film in these black spots. It is found to be about 60 A.U. or six thousandths of a micron. This film, however, must be of a thickness equal to the diameter of several atoms.

The late Lord Rayleigh (3rd Baron) measured the thickness of still thinner films of oil floating on the surface of water and found them to be about 20 Angström units (A.U.) in thickness ($= 2 \times 10^{-7}$ cm.).

M. Devaux, by another method, produced films of oil on water of half the above thickness, viz., 10 A.U. In this last case the film is probably formed of a single layer of molecules of oil, and hence we see that molecular diameters must be between $1/10^7$ and $1/10^8$ of a centimetre, or approxiamtely be of the order of one hundred millionth of a centimetre or from one to five times this last length.

At this stage we must, however, define a little more carefully what we mean by the diameter of an atom or molecule. We shall show presently that atoms are not solid, sharply defined masses like billiard balls, but

in all probability resemble solar systems in miniature, in which a number of still smaller particles circulate round a nucleus like planets round the sun.

3.—THE KINETIC THEORY OF GASES.

It will be necessary, therefore, to sketch in outline the kinetic theory of gases or theory of the motion of gas molecules.

In a mass of air or gas the constituent molecules are not at rest, but flying hither and thither with immense and various speeds in every possible direction. We know that this must be the case from the facts of diffusion. If we have two vessels, one full of air or other gas and the other exhausted or vacuous, and if they are connected by a pipe in which there is a plug of porous clay or unglazed earthenware, we find that after a time some of the gas will have passed through the plug and diffused into the vacuous space. Also if the two vessels contain gases of different densities, but at the same pressure such as hydrogen and oxygen, then they both diffuse in opposite directions, but the lighter gas diffuses faster than the heavier gas. In a certain time the gases will have mixed completely so that each vessel will contain the same proportion of each gas.

We know that the gas in any closed vessel exerts a pressure on the walls. This pressure is a force in a dynamical sense of the word, and is due to the bombardment of the walls by these flying molecules. Let us suppose that there are N molecules in one cubic centimetre and that each molecule has a mass m and is moving with a velocity v. This velocity is not the same for all molecules, some are moving quickly and some slowly at any instant. Of the N molecules we may suppose one-third or $N/3$ to be moving at any instant perpendicularly to one surface of the cube of 1cm. in side and 1 square centimetre in area. If we take v to be an average velocity then mv is the average momentum of each molecule, and when it strikes the side of the cube and rebounds from it, its momentum $+ mv$ is changed in direction to $- mv$ in the time taken for the molecule to move over a distance of 2 cms. Hence the change in momentum is $2\,mv$ in a time $2/v$ seconds.

Force is defined as the rate of change of momentum and the time rate of change of momentum or force is in this case $\frac{2\,mv}{\frac{2}{v}} = mv^2$. Hence the pressure on the side of the cube due to the $N/3$ molecules is $\frac{1}{3}\,Nmv^2$.

Suppose we now take v to be, not the actual velocity of one molecule, but the *square root of the mean of the squares* of all the various molecular velocities, called the R.M.S. velocity, then since Nm is the mass of the gas in 1 c.c. $= d$, we have for the gas pressure p on a surface of one square centimetre the expression

$$p = \tfrac{1}{3}dv^2$$

Hence it follows that the *mean square velocity* v^2 is $3p/d$ and the root-mean-square velocity v is $\sqrt{3p/d}$, where d denotes the absolute gas density.

The pressure of a gas per square centimetre measured in absolute units of force, called *dynes*, which corresponds to a height of the barometer of 760 mm. or nearly 30 inches of mercury and at 0°C. is very nearly one million dynes, and the density of hydrogen gas is 1/11,200 because 11,200 c.c. of this gas weigh one gram. Hence the R.M.S. speed of the hydrogen molecule is $\sqrt{3 \times 10^6 \times 11{,}200}$ centimetres or 1,830 metres per second.

In the case of oxygen, which is 16 times denser than hydrogen, the R.M.S. speed of the molecule is close to 460 metres per second.

It is important that the reader should clearly understand what the above statements imply.

The gas molecules are flying in all possible directions and with very different speeds. If we could divide up the molecules into a very large number of groups of nearly equal velocity according to their speed, but without taking regard to direction of motion, we should find that a very small number of molecules had a zero or very small velocity and a very few had a considerable velocity, but the great majority approximate in speed to a certain "most probable speed," which is very nearly the same as that obtained by squaring the numerical value of the speeds of the different groups and then taking the square root of the mean of these squares, in other words, obtaining the R.M.S. speed.

Clerk Maxwell was the first to give a general law in the form of a mathematical expression and to give a curve for the distribution of velocity amongst gas molecules. The curve

shown in Fig. 35 is a curve whose equation is

$$y = x^2\epsilon^{-x^2}$$

Where $\epsilon = 2{\cdot}71828\ldots$ etc., viz., the base of

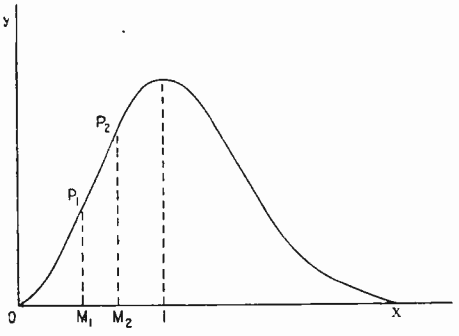


Fig. 35. Maxwell's Curve Graph of $y = x^2\epsilon^{-x^2}$

the Napierian system of logarithms. The curve is so drawn that the abscissa OI of the maximum ordinate is taken as equal to unity. The value of y is zero both for $x = o$ and $x =$ infinity. If we take two ordinates P_1M_1, P_2M_2, then it can be shown that the value of the area $P_1M_1M_2P_2$ multiplied by $4/\sqrt{\pi}$ gives the fraction of the number of gas molecules in any volume, the speeds of which lie between values denoted by the abscissæ OM_1 and OM_2.

Thus, for instance, in the case of oxygen gas molecules, whose R.M.S. speed is 461·2 metres per second, the following table taken from Meyer's *Kinetic Theory of Gases*, gives the speeds of various groups of molecules in metres per second.

	Metres per second
13 to 14 molecules have speeds from	0 to 100
81 „ 82 „ „ „ „	100 „ 200
166 „ 167 „ „ „ „	200 „ 300
214 „ 215 „ „ „ „	300 „ 400
202 „ 203 „ „ „ „	400 „ 500
151 „ 152 „ „ „ „	500 „ 600
91 „ 92 „ „ „ „	600 „ 700
76 „ 77 „ „ „ „	700 „ above

It will thus be seen that all but about 10 per cent. of the molecules have speeds which lie between half and double the R.M.S. speed of 461 metres per second.

It will thus be evident that in a mass of oxygen gas the molecules are flying about in all directions for the most part with speeds which lie between 500 and 2,000 miles an hour. A very few are moving more slowly and a few more quickly .

In the case of hydrogen gas which has an R.M.S. speed about four times greater than oxygen, the molecules are moving for the most part with speeds from 2,000 to 8,000 miles an hour or 100 times faster than express trains.

In the course of this extremely rapid motion the gas molecules collide with one another. The average distance they move over between two collisions is called *the mean free path.*

In the case of air at normal pressure and temperature the mean free path is about 1/250,000th part of an inch or 1/10,000th part of a millimetre, or 1/10th of a micron. This is roughly about 500 times the diameter of a gas molecule. The mean free path varies inversely as the pressure of gas. Hence, if we make a so-called vacuum by removing all but one-millionth of the air from a vessel, the mean free path is increased to about four inches in length.

We can now give a more exact definition of what is meant by the diameter of an atom or molecule. It is the least distance between the centres of two atoms or molecules at their closest approach during a collision.

If D is the diameter of the sphere of impact or atomic diameter as defined above, and if N is Avogadro's constant, or the number of molecules in a gram-molecule, and if V is the volume of this gram-molecule and L is the mean free path, then Clausius showed long ago that the relation between these quantities is given by the equation $\pi\sqrt{2}\,LND^2 = V$ where π is the circular constant 3·1415 . . . .

From this equation we can obtain, as given by J. Perrin in his book on " Atoms," translated by D. Ll. Hammick (Constable & Co., London), the diameters of various molecules, as below :—

Helium	1·7 by 10^{-8} cm.
Argon	2·8 „
Mercury	2·9 „
Hydrogen	2·1 „
Oxygen	2·7 „
Nitrogen	2·8 „
Chlorine	4·1 „

The reader should note that the symbol 10^{-8} means one divided by 100 millions, or 1/100,000,000.

It will be seen that the diameter lies between about 1½ and 4 Angström units, each of which is one hundred millionth of a centimetre. Since we know that Avogadro's constant is a number near to 66×10^{22}, which is the number of molecules of gas in 22,400 cubic

centimetres by volume, and since we know that this volume of hydrogen weighs 2 grams and of oxygen 16 grams, it follows that we know the absolute mass or so-called weight of a molecule of these gases; it is easy to find that the mass of an atom of hydrogen is near to $1{\cdot}63 \times 10^{-24}$ gram, where 10^{-24} means 1 divided by a billion times a billion. In other words, a billion times a billion atoms of hydrogen weigh 1·6 grams.

We know, therefore, the mass and diameter of various kinds of gas molecule and the number of them in a cubic centimetre at standard temperature and pressure. We have to realise that the molecules of the air we breathe are little particles of matter somewhere about a hundred-millionth of an inch in diameter, flying about in various directions with the velocity of a rifle bullet, or say, 1,500 feet or so per second, striking against other molecules about 5,000 million times in a second, moving on an average about four-millionths of an inch between each collision, and so numerous that about 400 million billion are contained in every cubic inch of space.*

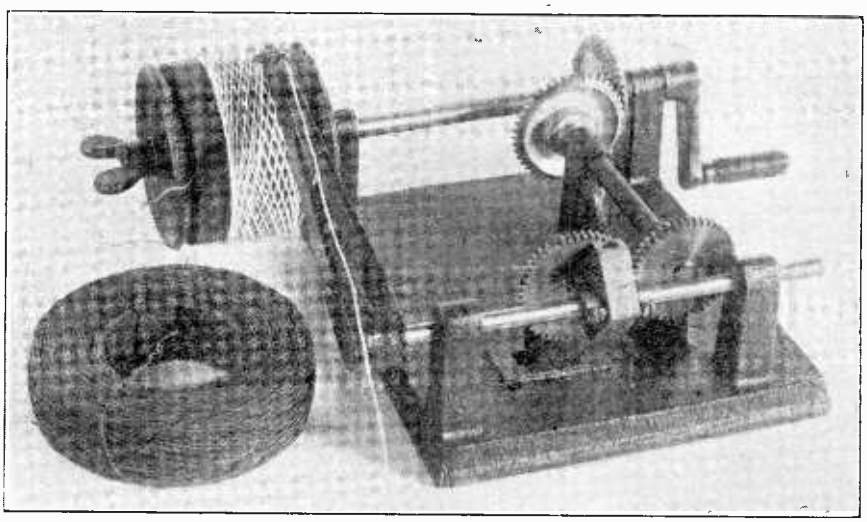
The pressure which the air exerts on the sides of a vessel containing it, which at ordinary barometric weight is about 14½ lbs. on the square inch, is due to the incessant bombardment of the inner surface of the containing vessel by these small but numerous projectiles.

Since the mass of an atom of hydrogen is $1{\cdot}6 \times 10^{-24}$ gram and the diameter of a molecule (two atoms) of hydrogen is $2{\cdot}1 \times 10^{-8}$ cm., it follows that the mean density of a hydrogen atom is about 3·3 times that of water, and that of an oxygen atom about 51 times.

* In English reckoning a billion means a million times a million, or 1 followed by 12 cyphers, but in the United States a billion means 1,000 times a million or 1 followed by 9 cyphers.

A New Coil Winder.

A new type of coil winder, possessing many novel features, has recently made its appearance. It is very robustly built, and has the advantage that the winding drum is directly driven, being on the same shaft as the handle, whilst the lighter mechanism for oscillating the guide arm is operated through substantial bevel wheels held tightly in mesh. The distance through which the guide arm moves, which controls the width of the coil, is adjusted by means of a pin set in the face of one of the wheels. Coils are built upon ebonite or strawboard cylinders, firmly gripped between two grooved cones forced together with a wing nut. The illustration shows a large finished coil wound with quite fine wire, No. 30 S.S.C. The coil partly wound is of No. 26 D.C.C., a gauge of wire which winds particularly well. The machine is heavily built and should have a long life.



Finished and partly finished coils. The utility of the machine is clearly indicated.

The Effect of Underground Metalwork on Radio Direction Finders.*

By R. L. SMITH-ROSE, M.Sc., D.I.C., A.R.C.S., A.M.I.E.E., and R. H. BARFIELD, B.Sc., A.C.G.I.

1.—INTRODUCTORY.

THE Radio Research Board for some time past has had in operation an organisation of some ten stations distributed over the British Isles for the purpose of investigating in detail all the errors, both fixed and variable, to which radio direction finders are subject when used on land. The first author of the present paper has had the responsibility of selecting the sites for these stations, installing the apparatus and supervising the entire organisation from its commencement. To avoid differences of instrumental error, all the D.F. sets were identical in every detail, and were installed in standard wooden huts in as similar a manner as possible.

The system of direction finding employed is that invented by Captain J. Robinson, and largely used by the Royal Air Force. A detailed description of this system has been given by the inventor† in a paper dealing with the principles and design of the apparatus. As described in that paper

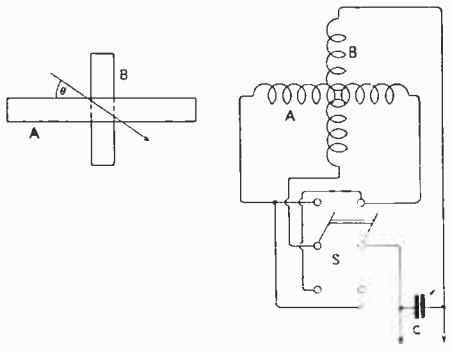


Fig. 1.

this system employs two frame coils fixed together at right angles and rotating about their common vertical axis. The two coils are connected in series through a reversing switch to a variable condenser to tune the coil system to the incoming waves (see Fig. 1). According to the position of the reversing switch the e.m.f. in one of the coils is either added to or subtracted from the e.m.f. in the other coil. Leads are taken from the terminals of the condenser to a standard form of detector-amplifier to give audible reception of the incoming signals. From a consideration of this arrangement it will be evident that in general, a change in intensity of the signal heard in the telephones will take place when the reversing switch is operated. When, however, the plane of either of the frame coils is at right angles to the direction of the incoming signals, no e.m.f. will be induced in this coil, and there will therefore be no change in signal intensity on switch reversal. A slight rotation of the system in either direction will disturb this balance, and the direction of the incoming waves can thus be determined with good accuracy, while obtaining a clearly audible signal throughout the process. To avoid a 90° ambiguity which might otherwise occur, and also to greatly increase the accuracy of the determination, one of the coils is made of much greater area-turns than the other.

In the actual sets employed the larger coil of the system is of dimensions 5 ft. by 3 ft., and wound with 30 turns of insulated copper wire with $\frac{1}{4}$ in. spacing. The small coil is similarly constructed of size 3 ft. by 2 ft. 10 ins., wound with 16 turns of wire, spaced $\frac{1}{2}$ in. These two coils are screwed together and arranged to revolve in a stand about six feet high. The four leads from the two coils are brought out to a combined tuner-switch box fixed to the side of the stand. This box contains the reversing switch, and a condenser continuously variable up to about 0·008 microfarad, being suitable to tune the coil system over the range of wavelengths from 2,000 to 9,000 metres. A circular wooden scale 2 ft. in diameter is fixed to the large coil from which the direction of the incoming signal is read. These sets have an instrumental accuracy of the order of 1 degree, a perfectly definite observation being frequently obtained to an accuracy of $\frac{1}{4}$ degree under favourable conditions.

A standard form of R.A.F. amplifier has been employed in these installations, giving amplification by three valves at radio-frequency, and two or three stages of audio-frequency amplification, with an intermediate rectifying valve.

During the first part of the investigation, the observations at all the stations were limited to "spark" or damped wave signals, but the receiving sets have now been equipped with specially designed screened oscillators§ for the reception of continuous waves.

From the regular observations carried out by these D.F. stations, many thousands of readings have been received which are now being collated for interpretation. One of the first immediately obvious results which was observed was that the majority of the D.F. stations possess permanent errors, which vary greatly not only from station to station, but also in different directions around each station. In many cases these errors are small and negligible for most practical purposes for which a direction finder might be used. In other cases, however, the errors are large and much too serious to be neglected.

*A paper read before the Wireless Society of London on Wednesday, October 25th, 1922.

†J. Robinson, "A Method of Direction Finding of Wireless Waves and its Application to Aerial and Marine Navigation."—*Radio Review*, Vol. I, pp. 213-219, 265-275, 1920.

§ R. L. Smith-Rose, "On the Electromagnetic Screening of a Triode Oscillator."—Proceedings Physical Society, Vol. XXXIV, pp. 127-138, 1922.

2.—DESCRIPTION OF ERRORS EXPERIENCED AT ABERDEEN.

In particular, it was soon observed that the results received from the station installed near the University at Aberdeen showed large errors for which it was difficult to account. These errors were found to remain reasonably constant in the day time for several months in succession, the observations made at night being subjected to large variable errors, with which the present paper is not concerned.

A summary of the permanent errors at Aberdeen being the mean day errors experienced on spark stations, between June, 1921, and April, 1922, with the addition of a few C.W. observations taken more recently, is given in the following table No. 1 :—

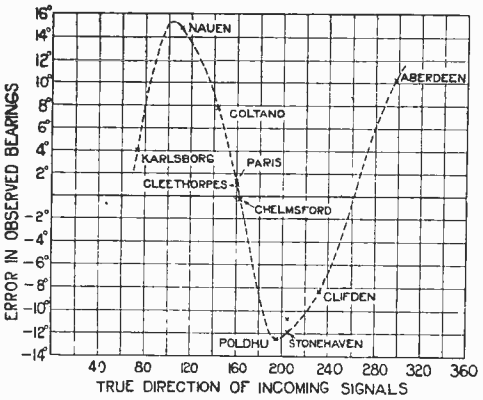


Fig. 2.

TABLE 1.

MEAN ERRORS AT ABERDEEN FROM JUNE, 1921, TO APRIL, 1922.

Transmitting Station.	Wave-length km.	True bearing	Mean error.
Aberdeen, C.W.	3·3	299·2°	+10·3°
Chelmsford, C.W.	3·8	160.6°	− 0·3°
Cleethorpes, S.	3·0	161·5°	+ 1·2°
Clifden, C.W.	5·8	233·8°	− 8·5°
Coltano, S.	4·2	144·5°	+ 7.9°
Karlsborg, S.	4·2	74·1°	+ 4·0°
Nauen, S.	3·2	111·6°	+14·8°
Nauen, C.W.	4·9	111·6°	+14·7°
Paris, S.	2·6	160·6°	+ 1·3°
Paris, S.	3·2	160·6°	− 1·3°
Paris, C.W.	8·0	160·6°	+ 1·6°
Poldhu, S.	2·8	196·1°	−12·6°
Stonehaven, C.W.	4·5	204·0°	−11·9°
Stonehaven, C.W.	5·6	204·0°	−10·7°

These results show that the errors obtained are practically independent of the wavelength used and also of the type of transmission, *i.e.*, spark or C.W.; but they vary considerably with the true direction of the station. The manner of the latter variation is best shown by a curve as in Fig. 2. This curve indicates that the error is practically quadrantal, being similar to that produced by the metal hull of a ship.

This similarity is well demonstrated by comparing Figs. 2 and 3. Fig. 3 is a graphical representation of the observations made by the first author with the same type of direction finding set installed on H.M.S. "Fitzroy" during October, 1921. The quadrantal nature of the error produced by the metal hull of the ship is well indicated, the slight distortion evident being due to the asymmetrical distribution of the metal work, stays, etc., on the ship relative to the D.F. set. It is seen that the error is a maximum for a direction of incoming waves at approximately 45° to the ship's axis, zero error being obtained for waves arriving either along or at right angles to the axis.

3.—POSSIBLE CAUSES OF THE ERROR.

Owing to the regularity of the above curve on the Aberdeen site it would appear that the cause of the error is very local, since waves coming from quite different directions are affected in a similar manner. In seeking for an explanation of the error the following points were considered.

(*a*) *Refraction due to Coast Line or other Geographical Features.*

Since waves coming from oversea are affected similarly to those arriving overland the effect cannot be ascribed to coastal refraction, *i.e.*, a deviation in the direction of propagation of a wave in crossing the boundary between media of different conductivity, such as from sea to land. The magnitude of the error also is much greater than that previously experienced due to refraction even at much lower wavelengths* As the ground in the neighbourhood is reasonably flat, particularly in the direction towards the coast at a distance of three-quarters of a mile, it may be assumed that this large error is not due to hills or mountains, which are also known to produce changes in the direction of waves passing in their neighbourhood.

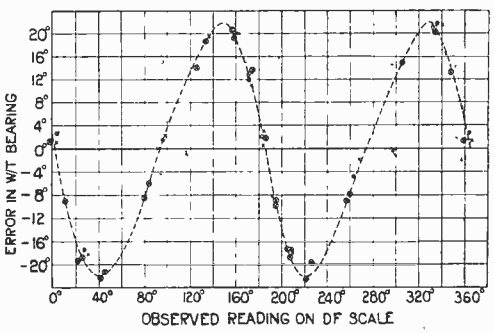


Fig. 3.

(*b*) *Overhead Wires.*

A plan of the immediate neighbourhood surrounding the hut in which the D.F. set is situated at Aberdeen is given in Fig. 6. This shows that the hut is within 55 yards of a stretch of twenty overhead telephone wires, in a direction nearly due east at this point. Previous experiments on the effect of such wires carried out by the authors have shown that at any distance

* See for example: T. L. Eckersley, "Refraction of Electric Waves," *Radio Review*, Vol. I, pp. 422-8, 1920.

greater than 40 yards the errors due to them are not greater than 2° or 3°.

It will also be observed from Fig. 6 that a wire fence passes within 14 yards of the hut. It will be shown later that this fence was not responsible for the errors.

(*c*) *Geological Features.*

In the absence of any obvious cause of the error above ground, it was reasonable to search for this below the ground. A study of the geological maps of the neighbourhood of Aberdeen showed

Fig. 4a. Photograph showing mode of carrying the D.F. set without dismantling.

the sub-soil to be fairly uniform in structure, although the survey was naturally not carried out in sufficient detail to render impossible the existence of a sudden change in structure in the vicinity of the hut.

4.—NEED FOR LOCAL EXPERIMENTS.

Owing to the absence of an explanation of the cause of the errors as indicated in the previous paragraph, it was considered desirable to carry out experiments in the neighbourhood of the D.F. station at Aberdeen to verify that the error was purely local and to trace the cause if possible. These experiments were accordingly carried out by the authors during the week ending April 29th, 1922, with a small portable single-frame direction finding set. As this instrument was specially designed for the purpose, and contained one or two novel features, a brief description of it is given.

5.—DESCRIPTION OF D.F. SET USED.

The requirements borne in mind in the design of this instrument were :—

(*a*) Moderate portability of the whole set by two persons, involving a rapid change in the position within one or two hundred yards, and not necessitating the dissembling or disconnecting of the apparatus.

(*b*) To have a good receptive power over a range of wavelengths of from 1·0 to 10·0 kms., and

(*c*) To give indications of observed bearings correct to at least 1°.

The apparatus is shown in the photographs, Figs. 4 and 5. The set was made to carry either of two box-shaped frame coils, that shown in the figure being the larger, and of dimensions 4 ft. square by 8 ins. deep. This coil is wound with 34 turns of No. 20 S.W.G. silk-covered copper wire insulated with ebonite combs at the corners with a spacing of about $\frac{3}{16}$ in. The "area-turns" of the coil are 544 square ft. turns, and its effective inductance = 3·02 millihenries. A pane comprising a variable air condenser and four fixed mica condensers with paralleling switches is mounted at the bottom inside the frame, rotating centrally with the latter. These condensers connected across the frame coil give a tuning range on the latter of from 2·0 to 10·0 kilometres, while the smaller coils gave a range with a lower limit but overlapping this. This smaller coil was 2 ft. 6 ins. square, wound with 25 turns at $\frac{1}{8}$ in. spacing. The "area-turns" of the coil are 156 square ft. turns, and the effective inductance is 1·17 millihenries. With the above condenser panel, the range of wavelengths covered is from 1·0 to 6·0 kilometres.

The small wooden platform upon which the coils were carried was mounted at the top of a brass tube 1 in. diameter, which formed the rotating

Fig. 4b. View of the set raised on the roof of the hut at Aberdeen, position 1*c*. (*See Table* 2.)

spindle of the set. This spindle passed centrally through the top of a large wooden box, and was supported on a pivot at the bottom of the box. The dimensions of the box are 23 ins. by 18 ins., by 15½ ins. high, and it is entirely covered with tinned iron sheet, one side being removable and normally

closed with about 2½ ins. tight overlap. This box serves as a shielded container for the amplifier, its associated batteries and all connecting leads. A standard R.A.F. six-seven valve amplifier was used, which gave good reception for all wavelengths between 1·5 and 9·0 kms. The batteries employed consist of a 70-volt H.T. battery comprising 50 small dry cells fitting into a compartment of the above box, and a 6-volt 50 ampere-hour accumulator battery for the valves filament current. The leads from the coil circuit are taken down the hollow brass spindle to the amplifier. The filament resistances of the latter are controlled externally through two circular holes cut in the movable side of the tin box. The telephone cord is brought out through another hole, and the external portion of the cord is encased in a metallic spiral sheath connected to the screening box. The whole set of frame coil and screened box is supported on wooden legs, the bottom of the box being 15 ins. above the ground. The box is also provided with a pair of wooden carrying handles projecting on each side to enable two persons to carry the complete outfit. (See Fig. 4a.)

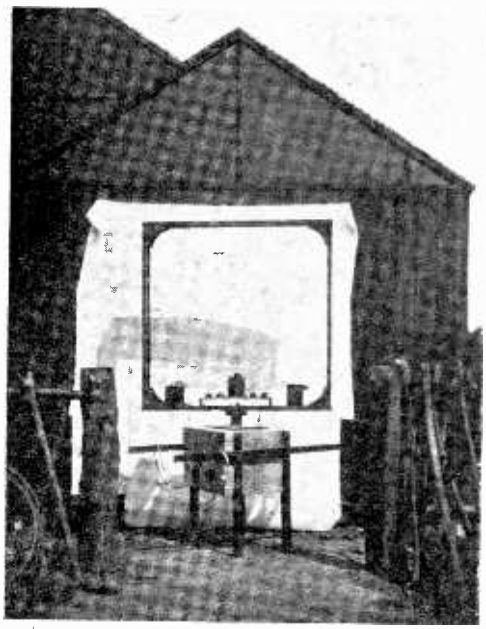


Fig. 5a. Portable single-frame direction finding set

A horizontal scale is provided on the top of the box over which moves the pointer attached to the rotating table. When the outfit is set up at any desired position it is adjusted by means of the compass so that the pointer indicates true geographical bearings when the coil is set at the minimum or zero position for received signals.

The top side of the wooden framework was covered with tin foil immediately below the wire turns. By connecting this tin foil to the shielded box below the circuit it was found that the "minimum" of the set was considerably improved, and enabled the observation of fairly accurate bearings.

Tests made on the set showed that the observed bearings were correct to 1° or 2°, which is within the limits of error experienced by a normal D.F. set on land.

6.—USE OF THE PORTABLE SET AT ABERDEEN.

The "accuracy" or angle of zero signal, to which the bearings were observed with this frame coil at Aberdeen, varied from 0·5° to 10°, the latter angles being usually due to the weakness of signals at a comparatively remote place such as Aberdeen. Signals from Poldhu and Chelmsford, for instance, were practically inaudible at Aberdeen over an angle of 10° to 20° round the minimum position, but experience has shown in both this and other experiments that such large angles do not prevent the mean reading being correct to 1° or 2°. A certain amount of difficulty was also experienced at Aberdeen due to transmissions from Stonehaven, only 16 miles distant, which practically prevented observations on any station on a neighbouring wavelength.

7.—EXPLORATION OF THE SITE.

On carrying out a careful inspection of the site in the neighbourhood of the hut containing the D.F. set, it was found that in addition to the possible causes of error mentioned in section 3, there were three other circumstances to be taken into account :—

(*a*) The first, which was judged to be the most important, was the existence of a large sewer crossing the field and passing directly under the hut. The sewer was located by the discovery of a line of manholes in this and neighbouring fields, its position being shown on the sketch map, (Fig. 6). It rises to a depth of only 1 ft. 6 ins. below the surface at a point immediately under one corner of the hut. In fact the ground in this locality is piled up to form a slight mound.

Inspection by means of the manholes showed the sewer pipe to be of egg-shaped section, varying 3 ft. to 6 ft. high and to be constructed of brick and concrete. Except at the manholes, no part of it appeared to be made of iron and enquiries made from the local surveyors confirmed this conclusion. This being the case it could not be reasonably expected to produce any errors on radio bearings.

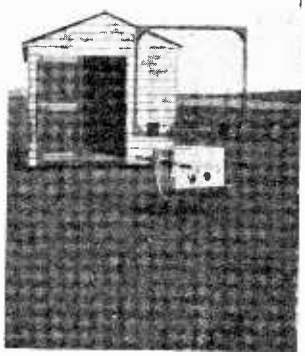


Fig. 5b. Portable single-frame direction finding set.

A survey of the direction of the sewer, however, showed this to be 170° from true North, while it will be noted that the error curve in Fig. 2 has zero error for the direction 163°, this latter being the direction of the axis of the hypothetical

mass of metalwork which would (in the manner of the hull of the ship) be required to produce a quadrantal error curve of the same general shape as the above. The approximate coincidence of these directions, therefore, could not but be regarded as suspicious in spite of the reputed absence of metalwork in the sewer.

(*b*) The second was that at the point where the sewer crossed the small brook an iron plate 3ft. 6ins. square by ⅛in. thick was discovered on inspecting one of the manholes at this point. It was also found that the brook was conducted under the sewer by means of an iron pipe about 40 ft. long.

(*c*) The third was the existence of two rubbish dumps as indicated in Fig. 6. These were found to be chiefly composed of metal cans and scrap for the lower three or four feet of their depth, being mixed and covered with cinders and clinker. As one of these dumps of size 115 by 85 yds. and 5 ft. deep was situated at only a few yards from the hut, it was not considered impossible that this comparatively large mass of metalwork might produce some errors in bearings.

8.—DESCRIPTION OF EXPERIMENTS.

In consideration of the somewhat complicated local conditions, it was decided to experiment in different positions in the neighbourhood with a view to locating the cause of the errors more definitely. In all, 18 positions were tried and a total of 350 observations were made of the bearings of various transmitting stations. A summary of these observations is given in Table 2.

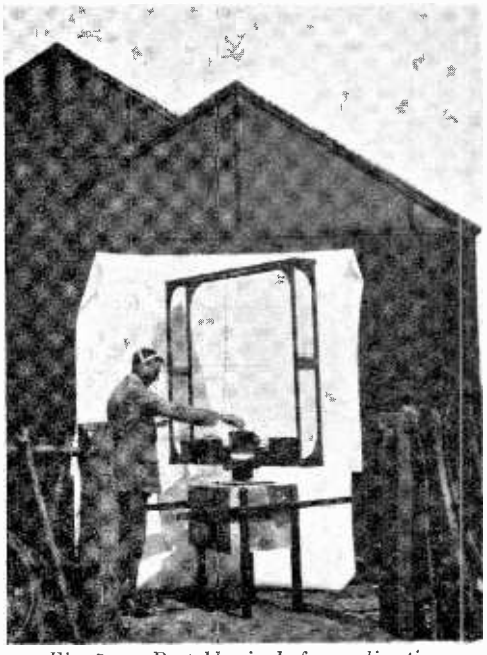


Fig. 5c. Portable single-frame direction finding set.

The positions referred to by numbers in the table are shown in the diagram Fig. 7 which is an enlargement of the central part of Fig. 6.

TABLE 2.

GENERAL SUMMARY OF RESULTS OF EXPERIMENTS. MEAN ERRORS AT EACH POSITION OF D.F. SET. (See Fig. 7.)

Station Obsvd.	(km.)	True Bearing.	1a	1b	1c	2	3	4	5	6	7	8	9	10	11	12 Fence uncut.	12 Fence cut.	13	11	15	16	17	18
Nauen	{3°1 / 4°9}	110°6	+15°	+15'	+11°	+14°	+ 8°	+9°	+6°	0°	+1°	+6°	+2°	+9°	—	+7°	+7°	−6°	−1°	−2°	0°	0°	+17°
Paris	{8°0 / 2°5}	160°6	+ 1°	—	—	—	− 1	—	—	−3	−2	+6	+1	—	—	—	—	—	—	+9	+2	+2	—
Chelmsford	3°8	163°6	0°	—	—	—	—	—	—	−4	−6	+6	+1	—	—	—	—	—	—	—	+1	−1	+1
Poldhu	2°5	196°1	−13°	—	—	—	−11	—	—	—	—	−5	—	—	—	—	—	—	—	—	—	−2	—
Stonehaven	{5°6 / 1°5}	204°0	−11	−12	− 8	−10	—	+1	—	−3	−1	+1	−1	−1	−3	−5	−5	+1	+1	+7	0	−0	− 8
Clifden	6°5	233°8	− 9	— 9	6	—	—	—	—	—	−2	—	—	—	—	−1	−1	0	0	−4	−1	−1	− 7

TABLE 3.
MEAN ERROR IN VARIOUS POSITIONS OF D.F. COIL.

Transmitter observed.	Along Sewer								Within 80′ of Sewer line.				Within 300′ of Sewer line.			
	No. 1	No. 2	No. 6	No. 10	No. 12	No. 13	No. 15	No. 18	No. 7	No. 5	No. 11	No. 14	No. 9	No. 8	No. 16	No. 17
Nauen	+15	+14	0	+9	+7	−6	+7	+17	+1	+6		−4	+2	+6	0	0
Paris	+ 1		−3				+9		−2	0			+1	+6	+2	+2
Chelmsford			−4					+1	−6				+1	+6	+1	−1
Poldhu	−13													−5		−2
Stonehaven	−11	−10	−3	−4	−5	+4	+7	−8	−1		−3	+4	−1	+1	0	0
Clifden	− 9				−1	0	−4	−7	−2						−1	−1

In positions 1b. the D.F. set was raised two feet above its situation in position 1a, whilst in position 1c it was raised nine feet above the first position by erecting it on the roof of the hut. It will be seen that only a very slight decrease in error is produced by raising it to the latter and none at all to the former position.

In position 12 the set was very close to the wire fence shown in Fig. 6 and here the opportunity was taken of investigating the effect of the fence on the bearings.

Accordingly a length of about 100 ft. of the fence nearest to the set was isolated, to effect which each wire was cut at either end of this length and a piece of string inserted in the gap. Observations taken before and after cutting the fence are recorded in the table and it will be seen that no difference in bearings could be detected. This proves conclusively that the part played by the fence in producing the errors is negligible.

The comparative freedom from errors experienced in positions 16 and 17 show equally well that the rubbish dumps do not have any appreciable effect, and the fact that large errors are experienced in positions 13 and 15 is good evidence that the telegraph wires are not alone responsible for the phenomenon since these positions are over 200 yards from the wires.

9.—INTERPRETATION OF RESULTS.

On the whole it cannot be doubted that the results are in accordance with the theory that the main distortion is caused by a part of the sewer though the distance from the sewer at which errors can still be detected is rather great.

In order to make this more clear, the results have been rearranged in Table 3, being classified

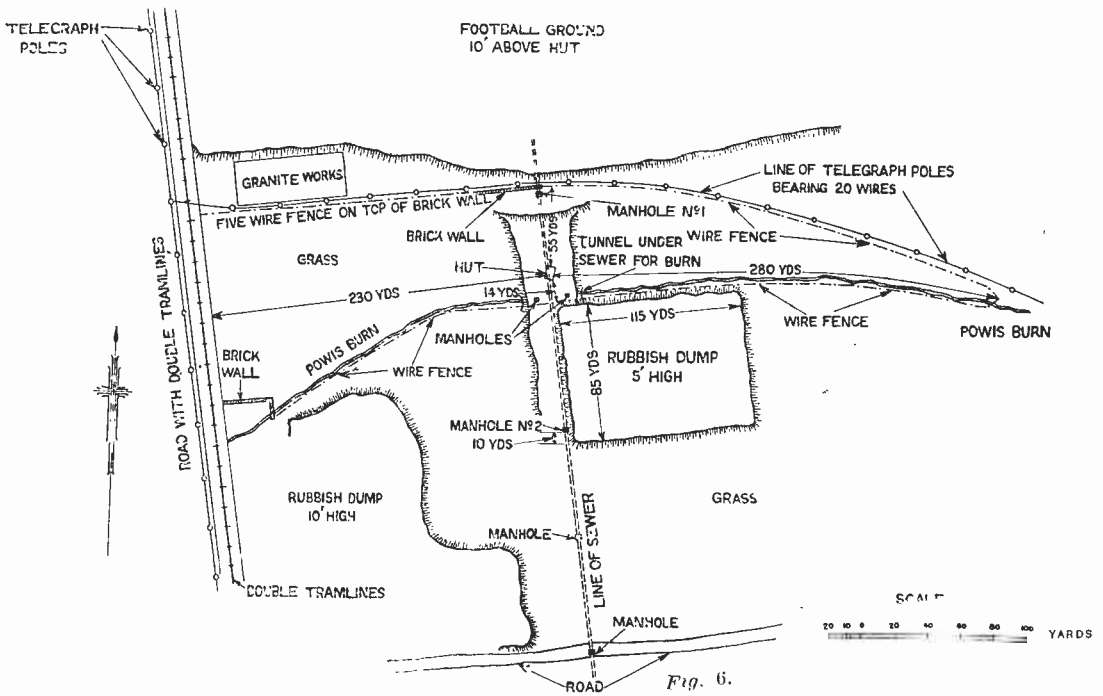


Fig. 6.

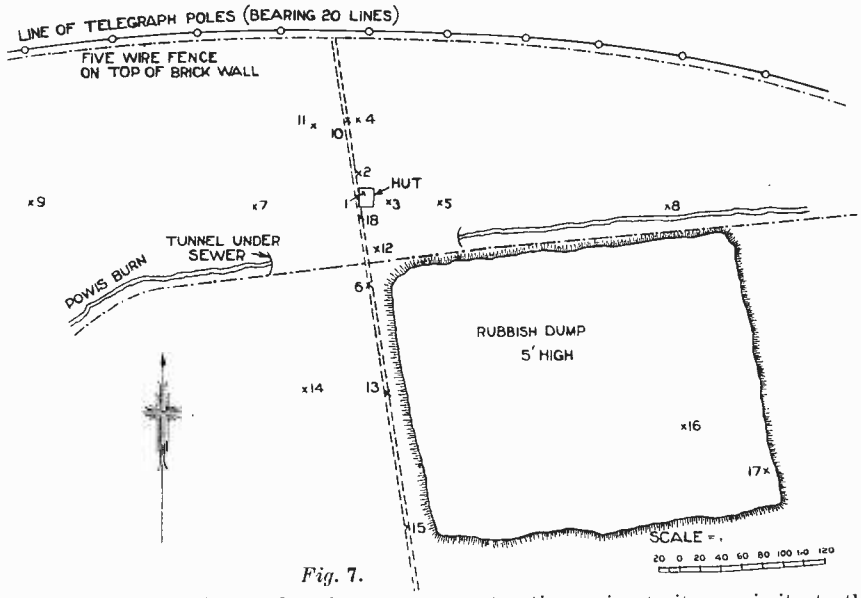


Fig. 7.

according to their position with regard to the sewer. None of the results in Table 2 which have been omitted from Table 3 will be found to contradict this hypothesis, they are merely left out on account of their irrelevancy.

Table 3 shows :—

(*a*) That in general, the errors decrease as the distance from the sewer is increased, becoming negligible at about 300 ft. from its line ; position 8, however, is an exception, as considerable errors were experienced here. It can only be concluded that these were due to the telegraph wires which are comparatively close at this point.

(*b*) It urther shows that the errors at points along the sewer are a maximum in the locality of the hut falling off on each side of it.

(*c*) That a point on the top of the sewer apparently exists (*i.e.*, near position 6) where the errors are practically negligible ; as this point is passed travelling along the sewer the errors from the majority of stations change in sign, rising to considerable values on the other side of it (positions 13 and 15).

From these facts the presence of a metallic object of length of the order of several hundreds of feet and of comparatively small width, with its length coinciding with that of the sewer, seemed undoubtedly to be indicated, and the result in (*c*) though perhaps unexpected, does not contradict this theory. This suggests the special construction of a section rather than the whole of the sewer as being responsible for the effect. Enquiries already made had obtained from the local authorities particulars of the structure of the sewer with the definite statement that it contained no metal work. In view of the general evidence, however, it was now thought necessary to obtain a check as to the reliability of this information. The authors therefore obtained access to the actual plans of the sewer, when it immediately became clear that the particular part of the sewer in the locality of the D.F. hut was, in fact, a special section with special construction owing to its proximity to the surface. Reference to the special plans which had hitherto escaped the notice of the surveyor, revealed the existence of a strip of " expanded steel " 6 ft. wide by 300 ft. long and 8 ft. below the surface at the hut, forming the foundation of this special section of the sewer.

10.—CONCLUSION.

This discovery, therefore, fully confirmed the prediction which could be made from the experiments carried out, as to the existence of a mass of metal work buried entirely beneath the surface of the ground at a depth of several feet. Owing to the several other local conditions already described, which might contribute to the errors to a small degree, it was not considered expedient to continue the investigation in any further detail. This investigation, however, serves to indicate how very difficult it is to find a site on land, particularly near large towns, which is suitable for radio direction finding, for there may literally be " more in it than meets the eye." The experiments also suggest a possible application of a radio direction finder in another sphere for the location of masses of metalwork underground, such as water and gas mains, streaks of minerals, metal ores, etc. It is not at all impossible that we shall soon be reading in the newspapers that Radio Expert Blank now offers his services for the location of gold or other hidden treasure, at a fee depending entirely on results. We may even shortly receive the prospectus of a company to be floated with a view to exploiting this application.

The authors desire to acknowledge their indebtedness to the Radio Research Board and to the Directional Wireless Sub-Committee of the Board for providing the facilities for the carrying out of these experiments, and for granting permission to publish the results. They have also to acknowledge the assistance during the experiments of Messrs. J. E. Ritchie, M.A., B.Sc., and J. Coull, the observers of the Radio Research Board at Aberdeen.

Recent Developments in Radio Telegraphy and Telephony.

MR. E. H. SHAUGHNESSY, O.B.E., M.I.E.E., M.I.R.E., of the Wireless Section of the General Post Office, will give a lecture on "Recent Developments in Radio Telegraphy and Telephony" at the Regent Street Polytechnic on Friday, November 3rd, at 6 p.m.

The chair will be taken by Mr. F. J. Brown, C.B. C.B.E., an Assistant Secretary of the Post Office, and by permission of H.M. Postmaster General, and with the co-operation of the Marconi and Broadcasting Companies, the lecture will be followed by a demonstration of wireless telephony on a scale not hitherto attempted in this country. The magnitude of the demonstration will be seen from the programme :—

7.0 to 7.5 p.m. Sir William Noble, Chairman of the Broadcasting Committee, speaking at Marconi House, will introduce, by wireless, the Lord Mayor of Bristol.

7.10 to 7.20 p.m. An address by the Lord Mayor of Bristol, given at his residence in Bristol, transmitted over the "Wired Wireless" circuit to Paddington, thence to Marconi House by wire, and there broadcasted.

7.25 to 7.30 p.m. Recital at Bristol by Mr. E. E. Aickin, of the Post Office Engineering Department.

7.30 to 8.30 p.m. Instrumental and vocal concert broadcasted from Marconi House, the names of the artistes being announced.

During the concert Major T. Worswick, Director of Education, will broadcast an address.

British Amateurs Heard at Nice.

M. Leon Deloy, president of the Radio Club de la Côte d'Azur, Nice, has sent us the following report of reception. As all the reception was done on a single valve with 40 or 80 volts on the plate and no filament rheostat or grid potentiometer, they show the excellence, he says, of the British amateur transmitters.

"**2 KF** was heard early in October on a set I had installed in Saône et Loire. Signals good and easily readable when he was radiating 0·8 amperes. The receiver was three DL coils and two condensers, the telephones Baldwin and the aerial a single wire 85 metres long, 8 metres high.

"I am now back at **8 AB**, Nice, and have already heard **2 JZ** when he was radiating 1·25; signals good; **2 ON** telegraphy QSA and telephony QSA; **2 OM** telegraphy and telephony, signals good and **2 KF** signals QSA. All this was heard with a "Tuska" receiver (variometer in the plate) and an aerial of one wire 160 metres long, 20 metres high.

"But the most remarkable result is that of Mr. Besneux, Treasurer of our Club, who heard **2 JZ** at the same time as I did, using three home-made honeycomb coils, two condensers and a single valve on an aerial ten metres long, stretched one metre from the wall, between two windows of his flat in town."

A further communication from M. Leon Deloy states that "to night I heard excellent telephony from **2MT**, and very good telegraphy from **2OD**, all on same single valve receiver. Also two stations on telephony around 440 metres unreadable under "QRM" from spark stations.

THE TRANS-ATLANTIC TESTS.

With reference to the trial transmissions conducted in America in connection with the above tests, will those who have succeeded in receiving these signals in this country or elsewhere in Europe please communicate their results to Mr. Philip R. Coursey, B.Sc., either direct or care of this office. Mr. Coursey is acting as secretary of the sub-committee appointed by the Wireless Society of London to organise the Trans-atlantic tests on this side. The only report of reception so far is received from Mr. W. W. Burnham. Details of reception will be published later.

Notes

Whale Warnings.

Warnings of the locality of whales are now transmitted from the Mosquito Bay Station, East Greenland.

Spanish Club Invites Correspondence.

In the Club Reports columns of this issue will be found an invitation to amateurs in this country either individually or collectively to correspond with the Radio Club de España, Madrid.

Royal Corps of Signals Lectures.

Lieut. D. J. Davies has arranged to give a series of public lectures at the Park Street Drill Hall, Cardiff, dealing with the theory and practice of wireless apparatus. Lieut. Davies is in charge of the Wireless Section of the Royal Corps of Signals at Park Street.

German Valve Case.

Four arrests have been made in Germany on charges of obtaining transmission valves belonging to the Telefunken Company. The valves, which were patented, were sold abroad, but we understand they have been recovered.

L.C.C. Schools to Teach Wireless.

An important step in the progress of radio education has been taken by the London County Coucil. Approval has been given for the inclusion in the curriculum of 25 schools the tuition of this branch of science. So far 13 schools have actually been given permission. We understand that the apparatus is to be constructed by the boys in the course of their training. The London County Council schools are not the first to be associated with wireless. Several provincial schools have erected sets, as we have previously mentioned in this journal, but the move on the part of the London County Council will probably arouse interest in educational circles throughout the country.

Sheffield Society and Press Experiments.

Mr. F. Lloyd's presidental address to the Sheffield and District Wireless Society was used as a means of testing the ability of the *Yorkshire Telegraph and Star* to make use of wireless as a means of rapid publication in press. At the newspaper office a reporter listened in, while at the Mappin Hall of the Applied Science Department of the University of Sheffield, Mr. Lloyd delivered his address. The speech occupied twenty-five minutes. Within an hour and three-quarters the paper containing the speech was on sale a mile away. This time could have been reduced had not a delay occurred in waiting for other matter which had to be published at the same time. The experiment was considered highly successful. It must be borne in mind that the reporter's shorthand report had to be transcribed before being handed to the compositor to be set in type.

For the coming year the following officers have been elected for the Sheffield and District Wireless Society :—President, Mr. F. Lloyd ; Hon. Secretary, Mr. L. H. Crowther ; Assist. Hon. Secretary, Mr. L. A. K. Halcombe ; Hon. Treasurer, Mr. C. H. Hainsworth ; Chairman of Committees, Messrs. W. Forbes-Boyd and H. Lloyd. The Society has 112 members, and the accounts show a credit balance.

Wireless in School.

Starbeck Council School, Leeds, is one of the schools where the installation of wireless apparatus has been added to the equipment. In order to make this possible the necessary finance has been obtained by profits on the school gardening.

Lectures at Nottingham.

A special course of fourteen experimental lectures on "Wireless, its Origin and Development," by Prof. E. H. Barton, F.R.S., and Mr. A. H. Franks, B.Sc., is to be delivered at the University College, Nottingham, commencing on Friday, November 3rd, at 7 p.m.

Aeroplane Control.

Experiments are being carried out in France as the result of which it is hoped to establish a means of controlling aeroplanes without either pilots or passengers on board. At first a pilot will ascend with a machine and only intervene should the control from the ground fail. Afterwards, if experiments are successful, an attempt will be made to control more than one machine from a master aeroplane occupied by a pilot.

Mauritius Naval Wireless Station Closed.

As the naval wireless Station at Mauritius has been closed, its service with ships is being undertaken for the present by the tug *Labourdonnais*. The call letters are **VRK**. Its location is Port Louis Harbour. The hours of service are 0400-0800, and 1200-1400 G.M.T.

New Regular Transmission.

The French high-power station at Basse-Lande near Nantes, call letters **UA**, has inaugurated a broadcast private message programme on C.W. to ships at sea which are out of the range of the ordinary coast stations in France. The times of transmissions are 2100 to 2200 G.M.T., and when necessary 1600 to 1700 G.M.T., on a wavelength of 2800m. (spark). The range of the station is 1,500 nautical miles.

Mr. E. H. Shaughnessy on Leafield.

At the Borough Technical School, Wellington, Mr. E. H. Shaughnessy, O.B.E., M.I.E.E., delivered a lecture on "The Imperial Wireless Station at Leafield." The meeting was held under the auspices of the North Wales Centre of the Institution of Post Office Electrical Engineers. Members of the Shropshire Philosophical Society and the Shrewsbury and District Radio Society were invited to attend. Permission was given by the P.M.G. for the Leafield Station to send a special message to the meeting and this was received on the apparatus of Mr. C. L. Naylor, a member of the local Radio Society. The message was as follows :—"Leafield Wireless Station. The first station of the Imperial wireless chain sends greetings to the inhabitants of Shrewsbury. Oxford Wireless Station is anxiously awaiting the arrival of its bigger brothers in the Imperial chain, but in the meantime is ready and willing to transmit messages to and receive messages from those sons and daughters of Shrewsbury dwelling in the less distant portions of the Empire." The message was in Morse code.

C

Calendar of Current Events

Friday, November 3rd.

ELECTRICAL POWER ENGINEERS' ASSOCIATION.
At 7 p.m. At the Institution of Electrical Engineers. Lecture on "The Application of Radio Methods to the Distant Control of Electrical Apparatus," by Mr. P. R. Coursey, B.Sc. (Members of Wireless Societies invited.)

FINCHLEY AND DISTRICT WIRELESS SOCIETY.
Reception of speech and concert from Bristol in co-operation with the Broadcasting Companies, via Marconi House.

RADIO SOCIETY OF HIGHGATE.
At 7.45 p.m. At the 1919 Club, South Grove, Highgate, N.6. Lecture on "Construction of H.F. Amplifiers," by Mr. G. W. Sutton, B.Sc.

BRADFORD WIRELESS SOCIETY.
At 5, Rendallwell Street, Bradford. Debate on "The Prevention of Self-Oscillation."

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.
Lecture on "The Thermionic Valve," by Mr. S. G. Meadows.

HORNSEY AND DISTRICT WIRELESS SOCIETY.
Lecture by Mr. Davy.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
At Grammar School. Lecture on "Diagram Interpretation," by Mr. D. E. Pettigrew.

REGENT STREET POLYTECHNIC.
At 6 p.m. Lecture on Recent Developments in Radio Telegraphy and Telephony by Mr. G. H. Shaughessy, O.B.E. (see also p. 172.)

Saturday, November 4th.

DEWSBURY AND DISTRICT WIRELESS SOCIETY.
At Moot Hall. Also on 6th and 7th Exhibition and Demonstration.

GLASGOW AND DISTRICT RADIO CLUB.
From 12 to 9 o'clock. At the McLellan Galleries Hall, Sauchiehall Street. Exhibition and Demonstration.

Sunday, November 5th.

DAILY MAIL CONCERT from the Hague. 3 to 5 p.m., on 1,085 metres.

SOUTHAMPTON WIRELESS TELEPHONY ASSOCIATION.
At 7 p.m. At King's Hall, London Road, S.E.1. Wireless Concert in aid of King's College Hospital.

Monday, November 6th.

NORTH LONDON WIRELESS ASSOCIATION.
Lecture on "The Elementary Principles of Radio Telegraphy and Telephony, II," by Mr. F. S. Angel.

ILKLEY AND DISTRICT WIRELESS SOCIETY.
At 7.30 p.m. At Regent Café. Demonstration and lecture on "A Speculation of the Supposed Relation Between Electricity and Matter," by Dr. J. B. Whitfield.

IPSWICH AND DISTRICT WIRELESS SOCIETY.
At 8 p.m. At 55, Fonnereau Road. Lecture on "High Frequency Currents," by Mr. E. Mould.

FINCHLEY AND DISTRICT WIRELESS SOCIETY.
Lecture on "Manufacture and Construction of Valves.

HORNSEY AND DISTRICT WIRELESS SOCIETY.
General Business and Discussion.

Tuesday, November 7th.

Transmissions of Telephony by 2 MT, Writtle, as above.

THAMES VALLEY RADIO AND PHYSICAL ASSOCIATION.
Presidential address and lecture by the President.

PLYMOUTH WIRELESS AND SCIENTIFIC SOCIETY.
At Plymouth Chambers. Lecture on "High Frequency Amplification," by Mr. L. J. Voss.

LOWESTOFT AND DISTRICT WIRELESS SOCIETY.
Lecture on "Simple Telephony Transmitters," by Mr. H. C. Trent.

EDINBURGH AND DISTRICT RADIO SOCIETY.
At 8 p.m. Lecture on "Wireless Communication," by Col. Crawley.

YORK WIRELESS SOCIETY.
At 7.30 p.m. At Grand Café, Clarence Street. Lecture on "Wireless Telegraphy, its History and Development," by Mr. V. O. Newton.

Wednesday, November 8th.

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION).
At 6 p.m. At Victoria Embankment. Lecture on "The Effect of Local Conditions on Radio Direction-Finding Installations," by Mr. R. L. Smith-Rose, M.Sc., and Mr. R. H. Barfield, B.Sc.

REDHILL AND DISTRICT Y.M.C.A. WIRELESS SOCIETY.
At Station Road, Redhill. Lecture on "Tuning"

Thursday, November 9th.

HOUNSLOW AND DISTRICT WIRELESS SOCIETY.
At Council House, Treaty Road, Hounslow. Lecture on "Wireless for the Beginner," by Mr. S. H. Nayler.

HACKNEY AND DISTRICT RADIO SOCIETY.
Special General Meeting to discuss reorganisation of membership, subscriptions, etc.

LUTON WIRELESS SOCIETY.
At 8 p.m. At Hitchin Road Boys' School. Practical work and experiments.

DERBY WIRELESS CLUB.
At 7.30 p.m. At the Court, Alvaston. Lecture on "Protection of Overhead Lines from Atmospherics," by Mr. S. J. R. Allwood.

DEWSBURY AND DISTRICT WIRELESS SOCIETY.
Lecture on "Inductance," by Mr. Skinner.

Friday, November 10th.

HECKMONDWIKE AND DISTRICT WIRELESS SOCIETY.
At 7.30 p.m. Exhibition and Demonstration. Opening by Mr. C. W. Leather, Checkheaton.

RADIO SOCIETY OF HIGHGATE.
At 7.45 p.m. At the 1919 Club, South Grove. Informal meeting.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.
Lecture on "Properties of Crystals," by Mr. H. H. Smith.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
Lecture on "Some Gadgets of a Faddist," by Mr. G. P. Kendall, B.Sc.

MANCHESTER WIRELESS SOCIETY.
Annual General Meeting.

Saturday, November 11th.

HECKMONDWIKE AND DISTRICT WIRELESS SOCIETY.
At 3 p.m. Exhibition and Demonstration. Opening by Lieut. H. W. Burbury, R.N., Crigglestone.

LIVERPOOL WIRELESS SOCIETY.
First meeting of Winter Session at Royal Institution. Address by Prof. E. W. Marchant.

Books Received

TRACKED BY WIRELESS. By William Le Queux. (London: *Stanley Paul & Co.* Cr. 8vo. 7s. 6d. net. and Fcap 8vo. 2s. net.)

RADIO FOR EVERYBODY. By A. C. Lescarboura, Editor of *Scientific American*. (London: *Methuen & Co., Ltd.* 170 illustrations.)

HOW TO RETAIL RADIO. By the Editor of Electrical Merchandising. (*McGraw-Hill Publishing Co., Ltd.* Pp. 226, illustrated. 6″ × 4″. Price 10s. net.)

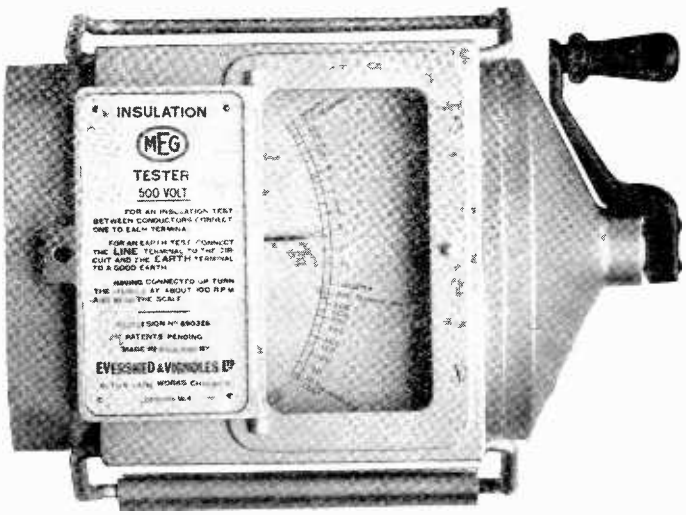
ELEMENTS OF RADIO TELEPHONY. By William C. Ballard. (London: *McGraw-Hill Publishing Co., Ltd.* Pp. 132, illustrated. 6″ × 4″.)

WORKING DIAGRAMS OF VALVE AMPLIFYING RECEIVER CIRCUITS. Arranged by H. W. Sullivan. (London: Winchester House, Old Broad Street, E.C.2. 4th Edition. 36 pp. 7″ × 4¼″. Illustrated. Price 1s.)

WORKING DIAGRAMS OF VALVE RECEIVING CIRCUITS. (London: *Radio Instruments, Ltd.*, 12, Hyde Street, Oxford Street, W.1. 21 diagrams. 7⅜″ × 4¾″. Price 1s.)

A New Testing Instrument.

Messrs. Evershed and Vignoles have recently placed upon the market a new insulation tester, called the "Meg." This instrument is of excellent design and construction, and weighs 7 lbs., about half the weight of the well-known "Megger," which



The "MEG.," an Insulation Tester.

has made the name of Evershed and Vignoles famous. Modern production methods and highly efficient testing and inspection, together enable the instrument to be moderately priced and backed by a guarantee.

A Portable Receiving Set.

On page 759 under the above title the article by Mr. A. Lovering states, "I can get down to 4,000 metres." This should have read 400 metres.

The Wireless Society of London

At the Ordinary General Meeting, held on Wednesday, October 25th, the following were elected to membership of the Wireless Society of London:—

MEMBERS:—Charles James Pratt, Eric D'Eresby Moss, Victor Delebecque, Percy Thomas Beard, Major Edward Williams, Charles Menten Benjamin, William Ross Craik, Ivan Scott Spain, Niels Nielsen Ladefoged, Harry H. Bond, Neville Ryland Davis, Egerton G. Pulford, Junr., Colonel George Frederick Handel McDonald, O.B.E., Major Phillip Albert Smith, Sir George Stuart Forbes, John H. White, Owen B. Thomas, Geoffrey E. Duveen, William Samuel James, Douglas Ashton Wade, John Eaton Monins, B.A., Gerald Marcuse, Captain K. E. Hartridge, Henry Charles Parker, William Ernest Wallis, Cyril Herbert Mocatta, Henry Arthur French, Captain Herbert Stanley Prince, M.B.E., S. Goodchild, Reginald Charles Horrocks, Edward John Bray, Lewis Henry Taylor, George Howard Nash, C.B.E., Alexander Thomas Wallace, William Smith, Henry James Cook, Dudley Sanders, George Walter Bowen, James F. Doyle, Edgar Wilfred Lindley, Frank Stanley Wates, Charles Dibdin, John Delmore Taylor, Walter Wakefield Burrowes.

ASSOCIATE MEMBERS:—Eric Cuddon, Isadore Bernard Davidson, Charles Creswick Atkinson.

LIST OF SOCIETIES AND CLUBS ACCEPTED FOR AFFILIATION:—Newport and District Radio Association, Sutton and District Wireless Society, Streatham Radio Society, The Hamilton and District Radio Society, Walthamstow Amateur Radio Society, The Bedford Physical and Radio Society, The Finchley and District Wireless Society, Hackney and District Radio Society, Cheltenham Wireless Association, London County Council Wireless Society, The Fulham and Putney Radio Society, The Belvedere and District Radio and Scientific Society, Wanstead Wireless Society, Coventry and District Wireless Association, The Aberdeen and District Wireless Society, Fulham and Chelsea Amateur Radio and Social Society.

A Wireless Doll.

"Wireless parties" were catered for at special prices at the Stratford Empire Theatre during the week ending October 28th. The programme included an act by Miss Nella Allen, who introduced a wireless doll, by means of which the singer was assisted by herself. At the close of the performance patrons of the theatre were invited to propose tests should they be sceptical as to the doll being operated by any other means than those advertised.

Wireless Club Reports

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

Finchley and District Wireless Society.*

Hon. Secretary, Mr. A. Field, 28, Holmwood Gardens, Finchley, N.3.

On October 9th the above Society elected its permanent officers, who will hold office for one year. Chairman, Mr. Trussler; Secretary, Mr. Field; Treasurer, Mr. Nicholls; and a Committee of six, Mr. Bishop, Mr. Macdonald Brown, Mr. Cannon, Mr. Wilck, Mr. Chamberlain, Mr. Cooper.

Arrangements for the grand social evening on October 30th included permission from the P.M.G. to receive musical transmissions from **2OM** and **2ON**. Application for affiliation to the Wireless Society of London was reported to have been made.

A further meeting was held on October 16th, when the good news that the affiliation was completed was made public. Mr. Trussler continued his lecture on the elementary theory of wireless, after which the Marconi Scientific Co.'s unit system wireless set was demonstrated, musical transmissions from **2KT** and **2OM** being made audible on a Brown's loud speaker, kindly lent by Mr. Cannon in conjunction with a Brown's relay belonging to Mr. Chamberlain. During the buzzer class, which was held from 9.30 till 10, the Committee met and made the final arrangements for the social evening on October 30th. Mr. Heppel was given complete charge of the catering part, and arrangements for a pianist and a violinist to come and supply the music for dancing have been completed. Mr. Wilck has kindly consented to give a lecture on November 6th; the subject of which will be announced later.

Arrangements are hoped to be completed for the reception of a wireless speech and concert from Bristol, which is to be sent by telephone from Bristol to Marconi House, and to be broadcasted from there; this is to take place at 1 o'clock on November 3rd. Mr. Turner, of Regent Street Polytechnic, is in charge of the affair, and he is to give a descriptive lecture of his apparatus to the Society before the reception.

The Hon. Secretary invites inquiries from all interested persons in the neighbourhood.

North London Wireless Association.*

Hon Secretary, Mr. V. J. Hinkley, Northern Polytechnic Institute, Holloway Road, N.7.

The 102nd meeting of the association was held on October 16th, at 8 p.m. at the above Institute. Mr. Norman Wilson was in the chair.

The Chairman pointed out the objects of the Association in assisting members over any technical difficulties they may be up against, and that they had only to ask any question relating to wireless to bring forth willing help in the matter. Attention was specially drawn to this as a new member had nearly left the previous meeting without some necessary information in connection with a set he was building.

Mr. F. S. Angel was then called upon to deliver the first paper of his series, "The Elementary Principles of Radio Telephony."

The lecturer commenced by discussing the nature of electricity as a form of energy. He then performed some experiments dealing with static electricity. After showing that different kinds of charges were produced by friction between various materials, he went on to talk about static induction. From this point he led up to the action of a condenser and showed an arrangement to illustrate the difference there is in the dielectric constant of various materials by means of weights hung at the centres of horizontal cords and rubber strips. By means of an electroscope with a plate capable of being moved nearer to the leaf system, Mr. Angel demonstrated that the capacity of a condenser increases as the thickness of the dielectric is diminished.

This being the end of the first paper a discussion then took place and Mr. Angel was able to give satisfaction to a number of questioners.

The meeting closed with a hearty vote of thanks to Mr. Angel for the interesting evening.

Full particulars of the association may be had on application to the Hon. Secretary.

West London Wireless and Experimental Association.*

Club-room: Stamford Brook Lodge, Ravenscourt Park, W.6.

Hon. Secretary, Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

On October 13th, Mr. A. O. Gibbon, of the Engineer-in-Chief's Department, G.P.O., gave a popular lecture on the present-day position of wireless telegraphy and telephony before a large gathering of members and their friends. The lecture was undoubtedly one of very great interest to all present. The speaker remarked that wireless was one of the greatest benefits to mankind, and referred to the wonders achieved since the introduction of the thermionic valve, the Aladdin's lamp of to-day; also of the vast research work being carried out in connection with the microphone. Further, the present position of broadcasting was fully explained, both in the interests of the bona fide experimenter and the simple "broadcaster," or those persons only desiring reception for entertainment only.

In connection with the lecture, Messrs. Burndept, Ltd., exhibited one of the latest pieces of apparatus manufactured by themselves, viz., their L.F. II Receiver, which was demonstrated by their representative, Mr. F. O. Read, M.I.Radio E., and all those present were delightfully entertained with speech, music and signals from many amateur, ship and land stations.

Mr. Read kindly replied very fully to all questions relating to the apparatus, which is a three-valve set, consisting of one detector and two note magnifiers, each valve being controlled by a rheostat,

so that one or two stages of note magnification can be obtained at will. Both Mr. Gibbon and Mr. Read were accorded a very hearty vote of thanks in the usual manner, and all querists were satisfactorily answered by both lecturer and demonstrator before leaving for home.

The Secretary will be delighted to hear from any gentlemen desirous of information respecting the objects, etc., of the Association.

Liverpool Wireless Society.*

Secretary, Mr. C. L. Lyons, 76, Old Hall Street, Liverpool (Telephone, 4641 Central).

A meeting of the above Society was held at The Royal Institution, Colquitt Street, Liverpool, on October 12th, Mr. J. Wainwright in the chair. There was a record attendance.

This was the first meeting of the winter session, which promised to be one of the greatest interest. After confirming the minutes of the previous meeting, the Chairman called upon Professor E. W. Marchant, D.Sc., to deliver an address.

The Professor addressed the meeting at some length, dealing with the subject, "Wireless Broadcasting," in a most able and pleasing manner. Briefly tracing the early history of wireless telegraphy point by point, right up to the latest developments of the science, he entered upon the main features of his address, which were the advantages and disadvantages of wireless broadcasting as we might expect it to develop into in the course of a very short space of time. The professor concluded his remarks amidst great applause, and Mr. Hengler proposed a vote of thanks.

The remainder of the evening was devoted to a practical demonstration by courtesy of Messrs. B. N. B. Wireless, Ltd., of Renshaw Street, Liverpool, and reasonably satisfactory results were obtained of telephony, musical items, etc., although only one stage of radio-frequency amplification was used and the apparatus was connected to an indoor aerial. The instruments demonstrated were the Marconi Scientific Instrument Company's units, and consisted of 1 H.F. stage, detector panel, and three L.F. units, the sounds being made audible to all present through a "Magnavox" loud speaker.

A vote of thanks was passed in favour of Messrs. B. N. B. Wireless Ltd., and the instruments were left for close inspection by all present.

The next meeting was held at the same address on October 26th.

Wireless Society of Hull and District.*

Secretary's Address: 16, Portobello Street, Hull.

There was a large attendance at the monthly lecture on October 9th, when Mr. Hy. Strong (acting Vice-President) gave an instructive paper entitled "Calculation of Inductance." After a brief description of what inductance really is and its varying effects, the lecturer proceeded to give in detail, and at some length, the various formulae for calculating this property when constructing different types and classes of coils such as the solenoid type, pile-wound, basket, slab and others. He had gone to considerable trouble in carefully preparing a large number of elaborate tables and calculations which he exhibited, and if his paper was perhaps a little too mathematical for some of those present, yet it cannot be denied but that a very instructive evening was spent. A number of members joined in the discussion which followed.

A hearty vote of thanks was accorded to the lecturer on the proposition of Mr. Steel, seconded by Mr. Brazendale.

The chair was occupied by the President (Mr. G. H. Strong), and six new members were elected.

All members who have any pieces of apparatus to dispose of are asked to send in particulars to the Hon. Secretary, as it is proposed to hold shortly a sale of members' surplus apparatus. New members are reminded that there is a small library of technical works in connection with the Society. For the present the library is kept at the offices of Messrs. G. H. Strong & Son, Prudential Buildings, Hull. It is free to members of the Society and it is hoped that full use will be made of this facility.

Radio Experimental Association.* (Nottingham and District.)

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

The first meeting of the new session was held in the headquarters of the Association, The People's Hall, Heathcote Street, Nottingham, on October 12th, when a considerable number of prospective members turned up.

Mr. Gosling lectured on the construction and method of using the wavemeter, and later gave a description of his home-made five-valve amplifier and tuner. The amplifier was so designed as to permit any combination of valves to be used from 1 to 5. The tuner possessed several novel features, proving beyond doubt that Mr. Gosling is fully justified in calling himself a radio experimenter. Prior to the close of the meeting, Mr. Allan, the Treasurer, read out the financial statement for the past year. The same was heartily approved by those present.

Gentlemen wishing to become members will be welcomed at the meetings.

Plymouth Wireless and Scientific Society.*

Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

At a meeting of the above on Tuesday, October 17th, at Plymouth Chambers, experiments were carried out using the electric lighting mains as an aerial. The results obtained were only fair, and it was agreed that an outdoor aerial was far superior to this method.

Buzzer practice will in future be carried out on Thursday evenings from 7.30 p.m., one of the members, Mr. B. Clark, an ex-operator, having kindly offered to carry out the instructional work. It is hoped also to have a course of elementary lectures in the near future.

Particulars of the Society may be obtained from the Hon. Secretary.

Brighton Radio Society.*

Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton.

A meeting was held at Mr. Volk's workshop, Russell Crescent, Brighton, on October 5th. Two members were elected.

On September 26th a meeting of the Amalgamation Joint Committee was held, representatives of the Sussex Wireless Research Society and of the Brighton Radio Society being present. As a result of this meeting certain recommendations

were put to the Brighton Society, and it was decided (1) To amend the Society's title to read, "The Brighton and Hove Radio Society." (2) To elect a supreme council of four members; to elect an organisation committee of six members; to elect a technical committee of six members. (3) That there be two classes of membership (*a*) full membership, fees 10s. entrance, 10s. subscription; (*b*) Associate membership, fees 5s. entrance, 5s. subscription. That all present members be full members. That any present member may become an associate member if he so desires. That before any associate member can become a full member he must satisfy the council or a person appointed by the council that he has a sufficient knowledge of valves and valve apparatus, and more especially of the circuits and apparatus used in the elimination of re-radiation and interference. (4) That the officers of the Society be—President (Chairman of the Council ex officio), Hon. Secretary, Assist. Hon. Secretary, Hon. Treasurer, Hon. Librarian. (5) That the funds and effects of the two Societies be pooled and the funds placed in a banking account. (6) That full members and associate members have the same voting power, but that associate members are not eligible for election to the technical committee.

It is thus intended to put the new Society on a superior level, and to do its utmost in the interests of the science, at the same time regarding the decision of the P.M.G. as a very wise attitude.

Newport and District Radio Association.*

Hon. Secretary, Mr. Edward R. Brown, 92, Corporation Road, Newport.

On October 12th, before a large gathering of members, Mr. W. D. Lewis Evans, M.A., Abertillery, gave a very fine address upon "The Construction of an Amateur Three-Valve Station."

Added interest was given to the lecture by Mr. Lewis Evans placing on view a three-valve instrument which he himself had built up—a highly instructional address punctuated by anecdotal references to the humorous side of the "mysteries" of wireless being thoroughly enjoyed and appreciated.

Mr. J. H. M. Wakefield occupied the chair, being supported by the Hon. Secretary, Mr. Edward R. Brown.

A hearty vote of thanks, proposed by Mr. H. W. Winslow, and supported by Mr. A. Treverton Jones, was accorded the speaker, who, in replying, said that the Association provided a long-felt want to the wireless amateurs of Monmouth.

Wanstead Wireless Society.*

Hon. Secretary, Mr. A. B. Firman, 18, Clavering Road, Wanstead Park, E.12.

A very successful meeting of the Society was held on October 12th, when Mr. Nickless, a vice-president of the Society, demonstrated the comparative values of the tuned anode circuit and the leaky grid rectifier in the reception of wireless telephony.

The Marconi concert was received very well on Mr. Nickless's apparatus, also the test records of Major Parker transmitted to the Society after the conclusion of the concert, both of which were much appreciated by the members present.

The Society meets every Thursday evening at St. Gabriel's Church Hall, Aldersbrook Road, E.12, at 8 p.m.

Fulham and Chelsea Amateur Radio and Social Society.*

Hon. Secretary, Mr. R. Wood, 48, Hamble Street, Fulham, S.W.6.

On October 17th three new members were proposed and seconded, the meeting accepting their enrolment. Mr. Hubbard offered to give a series of twelve lectures, one every alternate week; this was accepted. Another member, Mr. Cox, also gave a short lecture dealing simply with transmission and reception, explaining each part by means of apparatus. He was heartily applauded for the simple way he had expressed himself.

The Secretary was then asked to give a short lecture on reaction, its use and abuse, and the P.M.G.'s objections to the use of it. This was also simply dealt with for the benefit of junior members, and again appreciation was shown in the usual way.

A library has been started, and a librarian is shortly to be appointed.

Owing to the increased number of members it is proposed to adopt a second room at the college and divide the meetings.

The total membership is now 86.

Guildford and District Wireless Society.*

The weekly meetings of this Society recommenced on October 16th with a demonstration of the "Armstrong Circuit" by Mr. E. P. Brown (a member). Mr. Brown explained at length the advantages and disadvantages he had experienced with the circuit during his experiments and use of it, after which Mr. F. A. Love (2HX) very kindly obliged with a transmission of speech and music. The whole of the reception was received on a frame aerial. The demonstration was thoroughly enjoyed by all present.

On October 21st a party from the Society visited the Aldershot Military Wireless Station, and spent an extremely interesting and instructive time, the method of automatic transmission and reception being the chief point of interest. The visit was the last of several which have been made to neighbouring stations, both commercial and amateur, all of which proved valuable from an educational point, to those who attended.

The Hon. Secretary, Mr. Rowland T. Bailey, 46, High Street, Guildford, will be pleased to answer all enquiries regarding membership.

Radio Club de Espana, Madrid.

Secretary, Sen. F. Castana, Fernandez de los Rios 25.

The establishment of this club took place some time ago and immediately met with satisfactory results. In twenty days nearly 250 members were enrolled. As readers of this journal the members through their secretary send greetings to all English amateurs. Reciprocal correspondence is invited. Amateurs wishing to communicate with this club should write direct to the Secretary, whose address is given above.

Scarboro' and District Wireless Club.

By arrangement with Messrs. Fattorini and Preese, Bradford, Mr. R. J. Leeves (representing Mr. W. R. H. Tingey, London) gave telephony demonstrations through loud speaking instruments to the members on October 14th and 15th.

An interesting winter session is being arranged by the Committee.

Portsmouth and District Amateur Wireless Society.

Hon. Secretary, Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

The weekly meeting of this Society was attended on October 11th by a good number of members. After the usual buzzer class, a talk was given by Mr. R. G. H. Cole, the Secretary, on accumulator charging on the Noden valve system. Following discussion, Mr. Cole gave a further interesting talk on his transmitting apparatus, and also upon the various receiving sets he had experimented with at various times. A hearty vote of thanks was given Mr. Cole.

The Society was very pleased to receive Mr. Simpson, of Radiophones, Ltd., at their meeting, and this gentleman gave a very interesting talk upon broadcasting plans. Mr. Simpson very kindly offered to demonstrate his three-valve set to the Club, and his offer was gladly accepted.

The Society are still anxious to increase their membership, and all amateurs who would care to join the Society will be certain of a hearty welcome. Prospective members should address communications to the Hon. Secretary.

Wakefield and District Wireless Society.

Hon. Secretary, Mr. Ed. Swale, 11, Thornes Road, Thornes, Wakefield.

A meeting was held on October 6th in the Y.M.C.A., when Mr. R. Leedal read a paper on "Accumulators." Many useful hints on the use and care of accumulators were given by Mr. Leedal. On October 13th, another meeting was held in the Y.M.C.A., when Mr. Bateman gave a very interesting lecture on his own receiving station. Mr. Bateman had on show a good deal of his apparatus and very ably described it, drawing diagrams on the blackboard and showing how one, two or three valves could be used at will.

The Society hope to move into new quarters in the Technical and Art School in a week or two.

Tottenham Wireless Society.

Hon. Secretary, Mr. R. A. Barker, 22 Broadwater Road, Bruce Grove, N.17.

The third meeting was held on October 5th, preceded by half-hour's buzzer practice. The Chairman gave a lecture on "Retroactive Amplification," which was of great interest. Business was then discussed and it was proposed by the Chairman that the future place of meeting should be the Bruce Grove Schools, Sperling Road, and that the evening should be changed to the Wednesday of every week. This proposition was seconded by Mr. Baker and carried unanimously.

It was proposed that a General Committee should be formed, and in addition to the present four members, namely, the Chairman, Secretary, Treasurer and Mr. Bower, a further three members should be elected. These were decided by vote, and Mr. Winter, Mr. Hall, and Mr. Glyde were appointed.

It was also decided that the Society should have a library, and Mr. F. Allard was elected as librarian.

An interesting programme has been formed for the next four meetings, and intending members should join immediately.

Particulars of membership on application to the Hon. Secretary.

Hyde Amateur Radio Society.

Hon. Secretary, Mr. Alfred Stainthorpe, 5, Cheapside, Hyde, near Manchester.

The above Society holds its meetings in the Flowery Field Hotel. Favourable progress is being made and enjoyable evenings spent in "listening-in" to the various signals and telephony from Writtle on Tuesdays. The opening of the Manchester broadcasting station is eagerly waited for. It is hoped to announce an open evening very shortly.

Information regarding the Society can be obtained on application to the Hon. Secretary.

Barnsley and District Amateur Wireless Association.

Hon. Secretary, Mr. G. W. Wigglesworth.

At the official opening night of the above Association, held on October 11th, the President, Major E. A. Barker, M.C., delivered his inaugural address at the new headquarters, Y.M.C.A. Buildings.

The address, which included a brief history of the Association from the time of its establishment in 1913, was followed by a lecture divided into two parts—the first part on "Heterodyning," and the second part on "Directional Wireless." In his remarks upon Heterodyning, *i.e.*, of beat reception without an oscillating aerial, the President emphasised the necessity for eliminating interference with other people's reception, and pointed out the great assistance which could be rendered by the Association, by instructing its members in the theory of wireless, so that they may be real *bona fide* experimenters, and not merely "dabblers." To this end the President stated his intention of presenting to the Association a "Heterodyne" wavemeter.

The President's lecture on Directional Wireless was based upon his extensive experience during the war. This was clearly elucidated by means of a large map, and appliances for tracing both land and air transmitting stations. A series of lantern slides greatly added to the illustrative part of the lecture. At the conclusion, a hearty vote of thanks was passed to Major Barker.

A programme of the future work of the Association is being prepared, the chief items being a series of lectures on elementary Wireless Theory by the Secretary, Mr. G. W. Wigglesworth.

Guildford and District Wireless Society.

Hon. Secretary, Mr. Rowland T. Bailey, 46, High Street, Guildford.

On October 7th the above Society arranged for a party of Boy Scouts to "listen in" to the Prince of Wales's speech. The speech was heard with wonderful clearness, and the party were keenly interested. The weekly meetings of this Society recommenced on October 16th with a demonstration of the Armstrong Circuit, by Mr. E. P. Brown. With the rapidly increasing numbers of wireless enthusiasts it is hoped the membership will swell proportionately. The invitation is again extended to all who are interested to visit the rooms at 46, High Street, Guildford, on any Monday at 7 p.m., or communicate with the Hon. Secretary at the same address.

Portsmouth and District Amateur Wireless Society.

Hon. Secretary, Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

The usual monthly business meeting of the Society was held at the John Pile Rooms on October 18th. There was a good attendance of members, and further new members were elected. Various other matters were dealt with, and it was suggested that the Society should hold a social evening at an early date, a committee being elected to deal with this matter.

After the meeting an address was given by a member, Mr. Harrold, on "Detectors." Mr. Harrold dealt with the earliest form of detectors used, and various diagrams were passed among the members to illustrate these detectors. Unfortunately there was no time for Mr. Harrold to complete his lecture with regard to valve detectors, but it is hoped the conclusion will be delivered subsequently. A very hearty vote of thanks was given Mr. Harrold.

Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

A meeting of the above Society held on October 4th resulted in a pleasant evening being spent. Arrangements were made for a visit from the Signalling Section, R.E. "Wireless Section," Capt. Grist, M.C., and various other officers attending. This is the opening of a series of visits being arranged by the Secretary. The Society will shortly pay a visit to the "R.E." also the University College. Mr. C. E. Chester, of the University College, is a member of the above Society, and will, during the winter months, give several lectures.

At a general meeting held on October 11th, rules, etc., were drawn up, and judges appointed for the single valve competition. Substantial prizes are offered, and quite a large number of members have entered. Closing date for entry first week in November.

The Society have made application for a transmitting licence, and hopes in a short time to erect the same. Anyone in Southampton district can have full particulars of rules, etc., on applying to the Hon. Secretary.

Stockton and District Amateur Wireless Society.

Hon. Secretary, Mr. W. F. Wood, 4, Birkley Square, Norton-on-Tees.

The monthly meeting of the above Society was held in the concert hall of the Malleable Workmen's Institute, Norton Road, Stockton, on October 12th. The Chair was taken by Mr. J. Mulcaster. The Secretary announced that the aerial was nearly ready for erection, and would be in use in a very short time.

The President stated that during the evening a member had come forward and had kindly arranged to provide the Society at once with a very handsome receiving set. A set of rules was submitted to the members and accepted. The question of entrance fees, etc., was left in the hands of the Committee.

The membership is steadily growing, and now numbers over 80.

After the meeting a lecture was given by Mr. R. King, of the Middlesbrough Wireless Society, on "The Application of the Three Electrode Valve to Receivers."

Votes of thanks to the lecturer were given for his very interesting lecture, to which he suitably replied.

Bromley Radio and Experimental Society.

Hon. Secretary, Mr. J. Fergusson-Croome, 26, Wendover Road, Bromley, Kent.

Another successful meeting of the above Society was held at the White Hart Hotel on October, 17th when some 30 members attended.

The Marconi Concert from Writtle (2 MT) was remarkably well received on a four-valve set constructed by Mr. Allen, which was amplified further by a "Brown" Microphone Amplifier and rendered audible to all present by a "Brown" loud speaker.

The Secretary announced that the weekly meetings of the Society would in the future be held at the Ex-Service Men's Club, where the usual lectures and demonstrations would be preceded by a Morse buzzer class conducted by Mr. Allen.

Mr. Allen was then called upon to give a brief description of his set, which proved both interesting and instructive.

Some further music was received from Blackheath (2 FQ).

As a result of the meeting several new members were enrolled, bringing the total membership to nearly 50.

The rapid growth of the Society is in no small way due to the manager of the White Hart Hotel, who has so generously given accommodation to the Society and to whom the Society tender their best thanks.

Cowes District Radio and Research Society.

Hon. Secretary, Mr. L. Ingram, 1, Mill Hill Road, Cowes, I.W.

The Society held the first meeting of the second year at the headquarters, East Cowes, on October 4th. The evening was devoted to an exhibition of receiving sets owned and mostly made by the members. A numerous and varied assortment of apparatus was exhibited, ranging from a four-valve amplifier to a tiny crystal set, measuring two inches by one inch, and capable of receiving signals on three separate wavelengths. Several unique and useful components were on view also. The different circuits were explained by the members and demonstrations were given, providing a most interesting evening to all concerned.

On October 7th the Society entertained about thirty members of the local Scouts' organisation, including representatives of the Boy Scouts, the Sea Scouts, and the Rovers, enabling them to "listen in" to the Prince of Wales's message. The Prince's voice was heard distinctly by all, thanks to Mr. Ball, who kindly brought along his four-valve set and a loud speaker for this occasion. The musical items which followed were thoroughly enjoyed. At the conclusion, Capt. W. Matthews, thanked the Society on behalf of the Scouts for a most interesting and instructive demonstration.

On October 11th the Society enjoyed a splendid lecture upon "Direction Finding," given by Mr. C. Mugliston. The lecturer explained the apparatus used and the methods adopted in a very clear manner, also the uses to which it was put. The questions which followed the lecture proved how much it was appreciated.

Mr. Mugliston has kindly promised to give other lectures during the present session.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required, every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

"A.S." (Morecambe) *asks (1) What is the difference between rectifying, note magnifying, H.F. amplifying, L.F. amplifying, detecting and audio-frequency panels. (2) If wiring of his panel is correct. (3) For a diagram using the three panels, and using basket coils or duolateral coils.*

(1) Without going into details, the function of each panel is indicated by its name. (2) The diagram (Fig. 1) shows how to connect the panels together. It appears from your sketch, that the transformers are connected outside the panel. (3) See the articles on "Experimental Station Design," appearing in alternate issues.

"G.G." (Sydenham).—The diagram to which you refer shows the connections of a very simple set. No. 39 S.W.G. enamelled wire is not suitable which it is at present fitted. A reacting valve circuit, of course, would produce good results, but is liable to cause interference. If you are not satisfied with your present receiver, the only useful fitment which it includes being the variometer, we suggest that you commence to build a three-valve receiver, making use of the non-radiating arrangement described in our issue of September 30th.

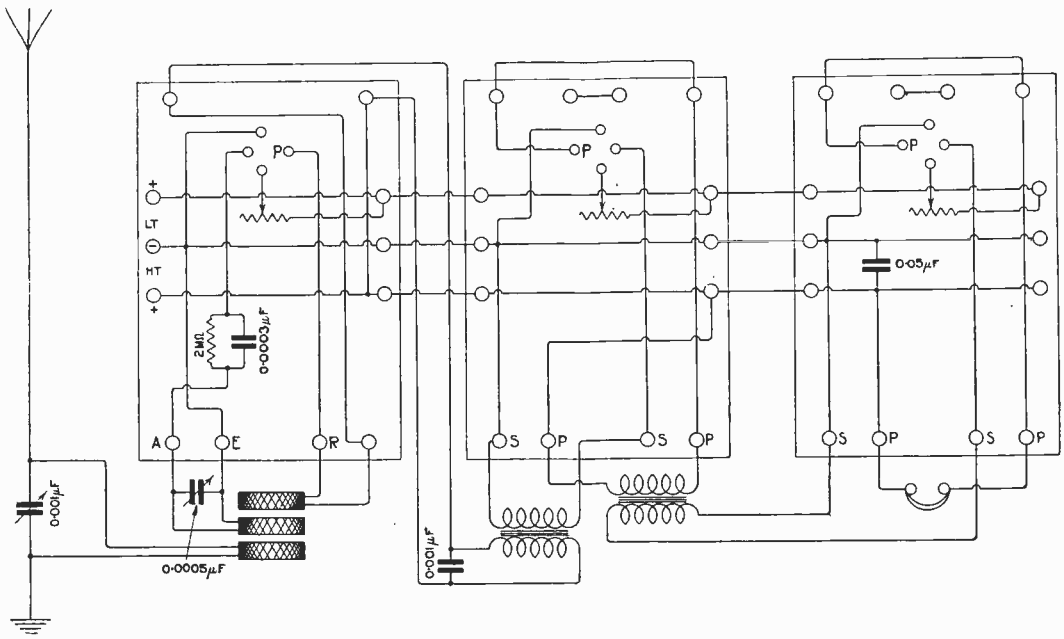


Fig. 1.

"D.H." (Beckenham).—It will be quite easy, of course, to convert your "Metro-Vickers" crystal receiving set to a single-valve set, though it is doubtful if a single valve arranged as a detector would give better results than the crystal with for winding intervalve transformers, and we suggest you make the transformer exactly as shown in the issue of August 19th, 1922. Full constructional details are given, and you should meet with no difficulty.

"**G.E.T.**" **(Harrow).**—We do not like your diagram. We understand you are using a set comprising 1 H.F. transformer, coupled valve, 1 detector valve, and 2 L.F. coupled valves. We suggest you rewire the apparatus to Fig. 2, page 880, September 30th issue, or if you would like to use switches to cut in or out valves at will, try the circuit on page 883, September 30th issue, but omitting the first valve.

"**G.G.**" **(France)** *asks various questions.* (1) The wavelength of your aerial circuit cannot be reduced much below half the natural wavelength of the aerial, which in your case would be half 300 metres. (2) We suggest for short wavelengths you make up a coil 3" diameter, 4" long, wound with No. 22 D.C.C., taking, say, 6 tappings, and use a series tuning condenser of maximum value 0·0015 mfds. (3) High resistance telephones must be used when you wish to connect directly with the anode and +H.T. When you wish to use the low resistance telephones, a telephone transformer must be employed. Each have their advantages, and we prefer to use the L.R. telephones and transformer.

"**A.J.H.**" **(Bexhill-on-Sea).**—As to the use of an artificial aerial for transmission purposes, we would point out that an aerial of this sort is specially authorised by the Postmaster General for laboratory test purposes, on the express understanding that it is specially arranged to have a very limited transmitting range—say not more than a few yards. If your intention is to aim at transmitting over a distance of two or three miles, a frame aerial is quite unsuitable, and from the wording of your permit it is obvious that the Post Office is not desirous that you should transmit over this range. You should have stated your requirements when making application, supporting your request by evidence that transmission over two or three miles would be helpful to you in your experimental work.

"**R.E.W.**" **(Camberwell).**—We consider the connections shown in your diagram "C" to be best for your purpose, although a switch to join the A.T.C. in series or parallel with the A.T.I. is recommended. It is very desirable that variable coupling be provided between coils C1 and C2, and the provision of this adjustment will amply repay in result any slight effort required to use it. If the inductance of the reaction coil C1 is made suitable for broadcast reception, external inductance will have to be added when you wish to receive transmissions on longer wavelengths. Two coils could therefore be connected up to the switch as indicated in the sketch, one suitable for the Hague transmissions and the other for Paris. It is quite possible to arrange for the inductances to be fixtures, but in that case switches will be required, and it is for you to decide whether to use a number of switches, or to use a few plug-in coils. We suggest you use plug-in coils, which are easier to build and use than dead-end switches.

"**B.A.**" **(Thetford)** *asks* (1) *The best way of erecting a 80′ telescopic mast.* (2) *What sort of set should be used to get the Hague, Paris and broadcasting stations.* (3) *If a microphone amplifier would give better results than two valves added to a single valve set.*

(1) The only satisfactory way of erecting a mast of this size is by means of a derrick, itself about 20 to 25 ft. high. Three of four guys should be run from the top of the derrick to their proper places on the mast, while the latter is lying on the ground. The mast is then pulled up by pulling down the derrick, side guys being used to prevent either the mast or the derrick falling over sideways while the mast is being pulled up. See page 261, May 27th, 1922; also "Mast and Aerial Construction for Amateurs," by Ainsley (1s. 6d.). (2) A three-valve set with reaction back to the anode of the first valve would probably give the desired results with the stated aerial. (3) No; two valves properly arranged will be superior to a microphone amplifier, and will give you much less noise in operation.

"**HOME-MADE**" **(Barrow-in-Furness)** *asks* (1) *How much No. 40 wire would be needed for a telephone transformer, and what other wire to use with it.* (2) *Whether a sample of mica is suitable for making condensers.* (3) *Capacity of a condenser with 59 plates 9 cms. in diameter, using* $\frac{1}{8}$*" spacing washers.*

(1) 3 ozs. of No. 40 may be used for the H.R. winding, with 6 ozs. of No. 32 for the L.R. winding. (2) The sample referred to has not come to hand, but any grade of mica will be of good enough quality for the construction of receiving condensers. (3) 0·0028 mfds.

"**R.S.**" **(Grimsby).**—We cannot state the exact number of turns which should be wound in the slots, as you have omitted to tell us what range of wavelengths you wish to cover, and we suggest you experiment a little until best values are obtained. We suggest you wind each slot with 100 turns of No. 40 S.S.C. copper wire. Only a few ounces of wire is required.

"**H.W.**" **(Harrogate).**—Without entering into a discussion as to the relative merits of amplifiers recommended by various writers, we think you would be well advised to leave the suggested amplifier alone, and construct Bull's "Broadcast Receiver" (described in the issues of August 26th and September 2nd). Full constructional particulars are given, and you can easily arrange to cover wavelengths up to 2,000 metres. We suggest you employ the coils exactly as described in the article.

"**E.H.R.**" **(Pirbright).**—There is not of necessity something wrong with your set because you hear Paris without an A.T.I. Paris is employing such a large amount of power that sometimes a crystal receiver not connected to the aerial will pick up sufficient energy to produce an audible signal. The probable reason for not having received short wave telephony is that your set will not tune down to the wavelength. The A.T.C. should be in series with the A.T.I., and short wave H.F. transformers must be used. The values of the four condensers are quite suitable. We think it is very improbable that your aerial is radiating energy. When the reaction coil is coupled with the H.F. transformer, the only energy which could be radiated is that produced by the small grid circuit flowing in the grid filament circuit of the first valve. This is so small as to be almost negligible.

"**G.S.**" (**Edinburgh**).—Without discussing the merits of any particular make of H.F. transformer, one has to remember that if untuned H.F. transformers are used, the number of tuning adjustments are reduced; hence tuning is not in any way critical. If, on the other hand, each H.F. transformer is tuned, the number of adjustments is increased, tuning is critical, and the set requires more careful handling. To receive telephony properly it is essential that critical adjustments are provided, but, of course, they should not be so numerous that tuning in becomes a difficult operation.

"**C.B.**" (**Liverpool**) *asks* (1) *For a diagram of connections making use of apparatus already in his possession.* (2) *Wavelength range of set.* (3) *Nearest Broadcasting Station.* (4) *For advice.*

(1) See Fig. 2. (2) and (3) Wavelength range 250 metres to 1,500 metres. You will have no trouble in hearing the nearest broadcasting station (Manchester). (4) Write to the Secretary, Post Office, pointing out the alteration.

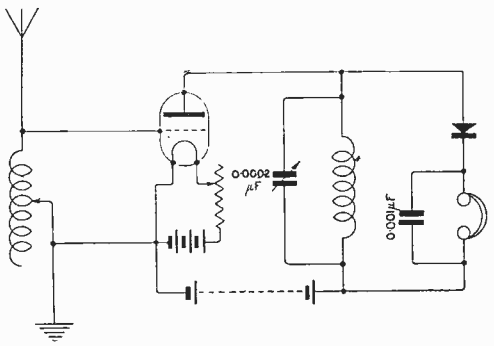


Fig. 2.

"**G.R.**" (**Shrewsbury**).—We cannot criticise the action of the Postmaster General with regard to withholding from you an experimental receiving licence, and moreover, we are unable to offer you very much advice as to supporting your claim, without knowing the reasons you have stated as to why you wish to conduct experiments in wireless telegraphy. The Post Office are prepared to authorise experimenters to use wireless apparatus where it is apparent that they have some serious theme of research in view, and they are qualified in the manipulation of wireless apparatus. We would recommend that you become a member of a Wireless Society which is affiliated to the Wireless Society of London, in order to show that you have a serious interest in the subject. You might then draw the matter to the notice of the local Secretary, who might, if he considers necessary, endorse your application and pass it to the Wireless Society of London for recommendation.

"**L.J.W.**" (**Middlesex**).—(1) As you wish to receive the broadcast transmissions only, a cylindrical tapped coil is the best form of inductance. A coil 3" in diameter and 4" long, of No. 22 D.C.C., with nine or ten tappings, will be quite suitable for the aerial inductance, while a coil 2½" diameter and 4" long, of No. 26 D.C.C., with, say, six tappings, will be suitable for the closed circuit. The aerial tuning condenser should be in series with the A.T.I. while receiving short wave signals. (2) If you possess a set of coils, you might try a small coil in the aerial circuit, the next larger for the closed circuit, and the biggest for the reaction coil. (3) We regret we cannot give you a layout, panel dimensions, etc., and we suggest you look through recent issues of our journal, and we think you will have no difficulty in choosing a suitable design.

"**E.R.S.**" (**Bredbury**).—We have frequently stated in this journal that the arrangement you propose to adopt is, in our opinion, unsatisfactory, and will cause interference to other amateurs receiving on the wavelength to which your set is adjusted. If you hold an experimental licence you are permitted to use just whatever circuit you like, and it is assumed that you are sufficiently skilled to know whether or not your circuit is likely to cause interference. We recommend you to read the Questions and Answers section of the last few issues, and also to read the article under the heading "Experimental Station Design" in the issue of September 30th last. A statement has now been made by the Postmaster General, as no doubt you are aware, regarding oscillating receiving sets. This statement is reprinted in our issue of October 21st.

"**H.N.**" (**Huddersfield**).—The Postmaster General is not likely to approve the use of the circuit shown on page 780 for reception on broadcasting wavelengths. If you hold an experimental licence you are privileged to use any circuit you like, using your own discretion as to whether you think it is likely to cause interference. A circuit likely to be approved by the Post Office is given on page 867 of September 30th issue, and the conditions concerning the types of circuits used in broadcasting apparatus have been recently stated in the press, and further information appears in the issue of this journal of October 21st.

"**W.C.B.**" (**Birmingham**).—The grid tuning condenser is very necessary when tuning to short wavelengths. You may try the circuit without it, but you will find it is better to tune the grid. A grid leak is not necessary in a circuit of this description. Actually the secondary of the microphone transformer acts as the leak. To apply negative potential to the grid, dry cells may be used, but it is usual to employ a leaky grid condenser. The value of the grid leak and condenser required depends on the anode potential, and is for the purpose of holding the mean grid potential at the most suitable value.

"**M.S.**" (**Ireland**).—The basket coils should each be wound with No. 22 D.C.C. wire. About six will be necessary, and each should have a mean diameter of 3½". The coils should not be laid together so that they touch each other; about ¼" space between each coil is necessary. The reaction coil may consist of coils 3½" mean diameter, wound with No. 28 D.C.C. We are afraid we cannot help you much, as you do not state the type of receiver you propose building.

"DON BEN" (Southall).—If the plates are 2½" diameter, the spacing washers 1/8" thick, and the plates 24 mils. thick, 47 plates will give you a capacity of 0·0005 mfds.

"S.B." (Hanwell) *asks* (1) *Whether he may use a circuit given in answer to another correspondent.* (2) *Resistance of a potentiometer.*

(1) You may certainly use the circuit given in reply to the question of another correspondent. The aim kept in mind when giving answers to queries is to make the answers as generally useful as possible. (2) The connection may be made at the negative L.T. terminal. If you wish to use a potentiometer, employ one with a resistance of about 400 ohms.

"E.M.W." (Cheshire) *asks* (1) *Questions about his set.* (2) *If proposed H.F. transformer is suitable.* (3) *Who is* **2 RC.** (4) *For criticism of his diagram of connections.*

(1) We think if you add 1 H.F. valve to your set the troubles will disappear. (2) We suggest you employ a tuned anode coil; one coil will then suffice. However, if you prefer the H.F. transformer arrangement, couple the two coils together. It would be better to make up a H.F. transformer exactly as described in the issue of September 3rd, page 715. (3) We have no information. (4) The proposed arrangement will do quite well, but the reaction coil should be connected between the anode and transformer.

"J.E." (Birmingham).—We think the transformers might suit your purpose, and you should certainly try them, and compare them with the results obtained from a standard transformer.

"R.B." (Ireland).—There is no critical value for the anode choke coil, and we suggest you wind a coil 1" diameter, 3" long, with No. 28 D.S.C. wire. The anode blocking condenser may have a value of 0·001 mfds. This value is not at all critical and the only point in connection with it is that its insulation must be capable of withstanding three or four times the voltage of the high tension supply. The aerial tuning inductance may consist of 40 turns of No. 16 D.C.C. wire on a 3½" diameter former, tappings being taken at every turn at the aerial end; and the grid coil may consist of 60 turns on a former 3" in diameter. We notice you have not shown the key connected in circuit. It is usually convenient to key directly in the high tension supply lead, but if the high tension voltage is above three or four hundred volts, we suggest you use a grid leak and condenser, then join the key so that when it is depressed the grid leak is connected across the grid condenser. We are afraid we cannot give you much information, as the diagram submitted does not show the valves or power you propose using.

"O.P.S." (Dingwall).—The sample of wire submitted is No. 42 S.S.C. copper wire. We suggest you make the low frequency intervalve transformer of the closed core type, making use of a bundle of iron wires. The core should be ½" diameter and 3" long; the primary winding should be 10,000 turns of No. 42, and the secondary 15,000 turns of No. 42. The primary winding should be wound on first. About 6 ozs. of wire will be required.

"S.S." (Leyton).—We do not care for the circuit as jacks are used in the H.F. circuits. A diagram of a 5-valve set, exactly as you require, is given on page 883, September 30th issue. The values of the components are marked in. The vernier condenser is joined in parallel with the A.T.C.

"M.V.D.T." (Southampton). *asks* (1) *A question about an instrument he has bought.* (2) *How to charge his accumulator off 200 D.C. wires.*

(1) We regret we cannot help you, since we have no particulars of the apparatus to which you refer. (2) We suggest you join the accumulator in series with 200-volt, 32 candle power carbon filament lamps. The lamps are joined in parallel.

"J.A.F." (Ayrshire) *asks various questions about his set.*

(1) You will hear ship stations, broadcast transmissions certainly, and local transmissions. (2) We suggest you fix a mast to the stunted tree as tall as convenient, and run the aerial from the mast to the chimney stack. Use a double wire aerial.

"JUMPER" (Woking) *asks* (1) *For a diagram of a 3-valve set using 1 H.F., 1 Detector, 1 L.F.* (2) *For particulars of a reaction coil.* (3) *Range of set.*

(1) The diagram to which you refer (page 883, September, 30th issue) is very easily followed, and we think you will be able to modify the diagram yourself. (2) The reaction coil may consist of 100 turns of No. 38 S.S.C. wire, inductance being added in the reaction circuit for longer wavelengths. (3) You may hear **PCGG** and should hear all British broadcasting stations.

"J.H." (Edgbaston) *asks* (1) *For criticism of his set.* (2) *Why set howls.* (3) *What coils to use.* (4) *For suggestions to improve set.*

(1), (3) and (4). The reaction coil is shown coupled to the aerial coil, and no closed circuit is employed. This is wrong. We suggest you use a closed circuit, and couple the reaction coil to the anode coil of the first valve, as explained in recent issues. The A.T.C. should be in series with the A.T.I. when receiving on short wavelengths. The batteries are correctly connected. (2). The howling is probably the result of too much reaction, and with a circuit of this type you will in all probability be causing interference and spoiling the enjoyment of others.

SHARE MARKET REPORT.

Prices as we go to press on October 27th are;—

Marconi Ordinary	£2	6	3
,, Preference.. ..	2	2	6
,, Inter, Marine ..	1	7	3
,, Canadian		10	10½

Radio Corporation of America:—

Ordinary	1	0	0
Preference..		14	3

THE
WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

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The Transatlantic Communication Tests.

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

THE main object of the forthcoming transatlantic communication tests between American, Canadian, and European radio amateurs is not only to pick up signals from the other side of the Atlantic as was done last year, but also, if possible, to establish communication in both directions across the ocean solely between amateur stations, and using the amateur wavelengths. While arrangements are well in hand for the use of specially equipped transmitting stations in this country during these tests, there are doubtless also many other amateur stations which have established long-distance signalling ranges, and which could therefore take part in the tests with some chance of success. It is very desirable that this country should have several transmitting stations in operation during the tests in order to give the Americans plenty of signals to listen for. Several French stations will also be transmitting.

TRANSMISSION TO AMERICA.

In order to avoid confusion it will be necessary to arrange a special programme of transmissions, so that each station taking part has a special period allotted to it, and also a special set of code letters so that the receptions in America can be checked up.

Every amateur transmitting station that has an authentic record of having transmitted signals over at least 400 to 500 miles is therefore asked to communicate with the writer of this note as soon as possible, if they are willing to take part in the tests. The exact dates of the transmission tests from this side have not yet been settled, but they will follow the transmissions from the United States, which are to take place in December.

The particulars required are :—

Name and Address of Licensee of station, and exact location of the station.

Call Letters.

Wavelength to be used.

Maximum ranges already attained (telegraphy).

These transmission tests will continue for several nights, each station taking part being allotted a different time for transmission on successive nights, and being requested to adhere strictly to these times and not to transmit on other periods. Owing to the time difference between the United States and Great Britain it will not be practicable to commence the tests until midnight or 1 a.m. G.M.T.

In order to allow time for the completion of the final arrangements it is requested that everyone willing to take part in these tests will notify the writer before November 22nd, at the address stated below. The special code letters, and details of what is to be transmitted during the tests will be sent by post to each entrant shortly before the commencement of the tests, the dates of the commencement of which will be announced later in these columns.

RECEPTION FROM AMERICA.

As in last year's tests the transmissions from America and Canada will be sent on the usual American amateur wavelengths in the neighbourhood of 200 metres, and also on the special wavelengths in the neighbourhood of 365 metres, which are licensed to some of their stations. Transmissions will take place during a period of approximately five hours on each

night, the stations taking part being allotted a different portion of the five hours period on successive nights. The wavelength of the transmissions at any given time will therefore be different on successive nights, but it will be possible to circulate a list of the wavelengths of the transmissions to be made during each period each night a short time before the commencement of the tests.

In order that any information of this kind which may possibly arrive too late for publication in these columns may be circulated to all those who wish to listen in for the signals, it is requested that every one desiring to take part in the reception tests notify their name and address to the writer before November 22nd.

Last year's tests again emphasised the necessity of asking everyone possessing wireless apparatus to refrain from using it during the periods of the tests unless they are actually using it for listening in. Except in the most favourable circumstances the signals from the other side will on the whole not be of great strength, so that any local jamming may completely spoil the tests. There is already so much interference on these wavelengths by the harmonics from high power stations that all other avoidable interference must be eliminated if success is to be attained. The radiation from oscillating receiving sets on these short wavelengths is so large that a single oscillating receiver may spoil the chances of many others for several miles round.

Too great an emphasis cannot therefore be laid on the necessity of avoiding the use of such apparatus during the tests, and the substitution therefor of a separate heterodyne to pick up the C.W. transmissions. The use of one or more high-frequency amplifying valves in front of the detector valve is helpful in this direction too, since not only is the receiver thereby rendered more sensitive, but also the radiation from the aerial is also reduced should the set accidentally be brought into the oscillating state. Any of the recognised forms of tuned high frequency amplification can be used for this purpose with great advantage, but precautions must be taken to prevent the set oscillating, as there is a great tendency to do so in these arrangements unless additional damping is provided in the circuits, either by inserting high resistances in the oscillating circuits, or by appropriate *reversed* reaction, or by increasing the damping of the grid circuits by impressing a positive potential upon the grids of all the amplifying valves.

The separate heterodyne oscillator should be coupled to the plate circuit of the detector valve rather than to the aerial or associated circuits, so as to remove the point at which the oscillations are impressed upon the system as far from the aerial as possible. In this manner the harmful effects of heterodyne radiation from the aerial will be minimised.

Details for the construction of a heterodyne oscillator suitable for the shorter wavelengths of these tests, *viz.*, around 200 metres, have been given by the writer in these columns. (Vol. IX. pp. 461-464 and 493-497.), while other patterns of similar instruments have also been described at a later date which can be used over a wider range of wave-lengths so as to include the longer transmission wavelengths as well. One of these patterns of instrument suitable for the use of plug-in coils for any wavelength that was described in the *The Wireless World and Radio Review* for May 6th (p.161), May 13th (p.194) and May 27th (p.252) should prove quite suitable, while the heterodyne wavemeter described in the issue for September 30th last, is also suitable since it covers all the wavelengths that are to be used in these tests, as well as the longer waves.

For the benefit of those readers who have not the above issues, an article giving constructional details of a suitable instrument will be published next week.

As in connection with last year's tests there has already arisen a demand for the transmission of testing signals to enable prospective listeners-in to properly adjust their sets. Arrangements are being made for these, and it is expected that an announcement with regard to them will be made in next week's issue of *The Wireless World and Radio Review.*

The arrangements made by the American Radio Relay League for their preliminary tests to determine their best transmitters were recently announced in these columns, and have led a number of amateurs to listen-in for them. Reports already to hand indicate that several American stations have been heard, so that the main tests next month should be productive of even better results than were obtained last year.

BROADCASTING OF RESULTS.

It will be remembered that during last year's tests a broadcast report was made each morning by Carnarvon radio station, which report was repeated slowly by New Brunswick station for the benefit of the American amateurs, giving the results of the receptions made by

Mr. Godley, the representative of the American Radio Relay League who was listening-in in Scotland. Through the kindness of the Marconi Company, and of the Radio Corporation of America, it will again be possible to broadcast such daily reports from Carnarvon, so that every amateur in the country will be able to obtain information of the progress of the tests by listening in to these reports each morning. They will be sent specially at twelve words per minute to make it easy for everyone to pick them up.

The French Committee which is arranging the part to be taken by the French amateurs both in listening and in transmitting, has also arranged for daily transmissions to be made from Sainte Assise station (near Paris), which reports will be repeated by Marion Station in the United States. These reports will be sent from Sainte Assise immediately following the reports from Carnarvon, the times being 0700 G.M.T. for Carnarvon, and 0710 G.M.T. for Sainte Assise.

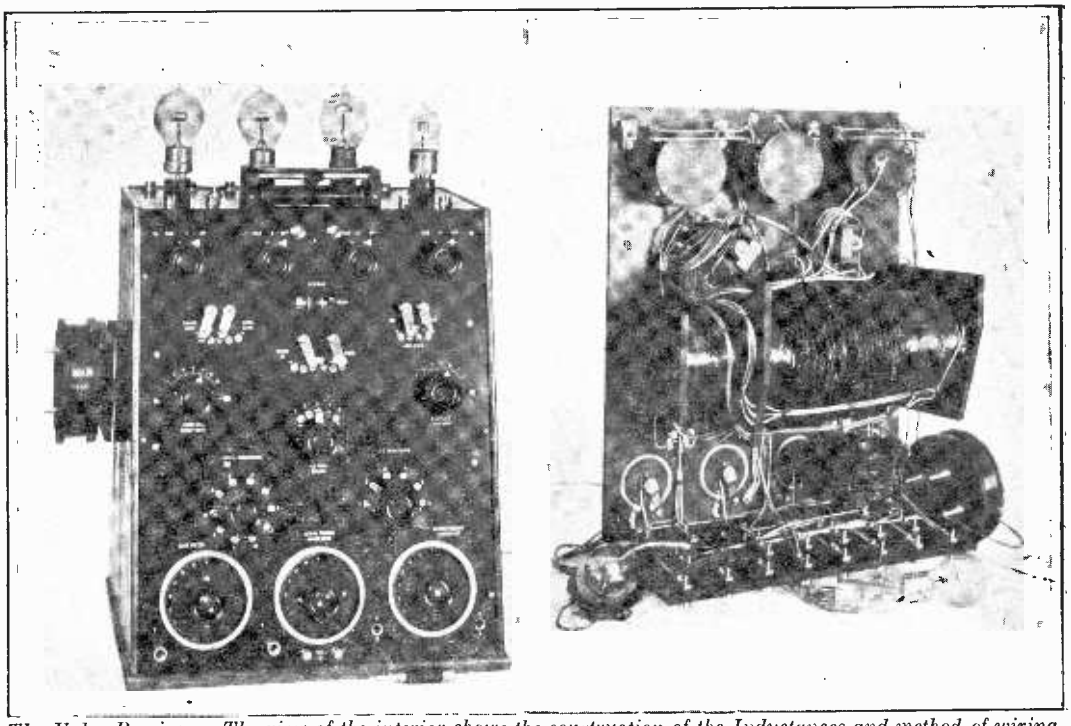
In order to enable these daily reports to be prepared, it is requested that everyone taking part in the reception tests will make a report each day as far as possible setting out the results that they have obtained, so that they can be included in the next report.

Further details of the codes, etc., that will be used for these daily broadcast transmissions will be given in a later issue.

It is requested that all enquiries and communications relative to these tests be addressed to the writer *c/o The Wireless World and Radio Review.*

A Universal Receiver.

THE receiver shown in the accompanying photographs is designed for reception on all wavelengths, and arranged so that any combination of valves can be thrown in circuit. The sloping front panel is secured to the top, which carries terminals, valves, and potentiometer, and as is seen, can be removed entirely from the box-work without deranging the connections. The terminals are of the screw type in order to avoid the unpleasant effect which is produced by employing a large number of tall terminals.



The Valve Receiver. The view of the interior shows the construction of the Inductances and method of wiring.

The aerial circuit is tapped out on to a ten-point switch, and in moving the arm over the contacts, the rotating spindle operates a barrel switch arranged to entirely disconnect the inductances not in use. The closed circuit has a six-point switch similarly arranged. This closed circuit can either be used as a secondary, tuned anode, or reaction coil, by operating the two-arm switch in the middle of the instrument. A five-stud switch taps out singly the end turns of the aerial inductance, and is very convenient for fine tuning. The short wave portion of the aerial inductance, which tunes up to about 1,000 metres, consists partly of a single layer and partly two-pile winding. For longer wavelengths the inductance consists of two, three, or four-pile winding followed by spaced basket coils—an arrangement which gives a minimum of self-capacity.

High frequency amplification is provided on the tuned anode principle, and rectification is either effected by the second valve or the perikon detector, which can be seen on the front of the panel.

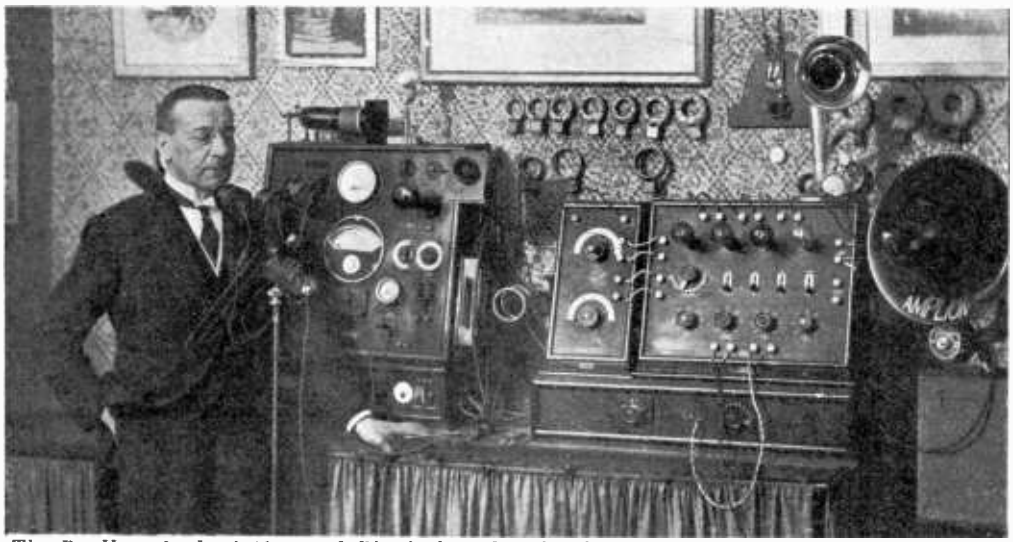
The condenser on the left forms part of a heterodyne wavemeter circuit, arranged to cover the full wavelength range and varied by plug-in coils shown on the left in the front view. A hinged platform varies the extent of coupling between the aerial circuit and the wavemeter coil.

Aerial tuning and closed circuit condensers are provided, also terminals for connecting up a five-plate vernier condenser.

A low frequency amplifier can be thrown in circuit by a switch. The other switches are so arranged that not only can any combination of valves be used, but also the valves can be abandoned altogether and simple crystal reception made use of. The telephones are connected in circuit by plugs and jacks.

The wiring up is effected with bare wire in insulating sleeving, carefully arranged and bundled in order that no detrimental effects are produced. F.H.H.

Broadcast from 2 KO Birmingham.



The Rt. Hon. the Lord Mayor of Birmingham Broadcasting an Appeal in aid of Hospitals from the experimental station of Mr. C. S. Baynton (2 KO).

Amateur Transmissions in the London Area.

It is obvious to everyone that the time has come when some further organisation is desirable amongst amateurs holding transmitting licences in the London area. With this end in view the Committee of the Wireless Society of London have arranged for a private Meeting of such amateurs to be held at the Institution of Electrical Engineers on November 13th at 6.30 p.m Certain schemes will be suggested, and it is desired that there should be the fullest possible discussion on the matter Mr. Maurice Child will be in the chair.

Electrons, Electric Waves, and Wireless Telephony—VI.

By Dr. J. A. FLEMING, F.R.S.

The articles appearing under the above title are a reproduction, with some additions, of the Christmas Lectures on Electric Waves and Wireless Telephony given by Dr. J. A. Fleming, F.R.S., at the Royal Institution, London, in December and January, 1921-1922. The Wireless Press, Ltd., has been able to secure the serial rights of publication, and any subsequent re-publication. The articles are therefore copyright, and rights of publication and reproduction are strictly reserved.

4.—ATOMIC STRUCTURE.

We are then naturally led to consider the very important question of atomic structure and architecture to which all the foregoing discussion has been only preliminary.

The first step in this knowledge was taken about 1898 or 1899, when Sir Joseph Thomson began his epoch-making work which led to the discovery of the *corpuscle* or *negative electron* as a constituent element of all atoms. This work grew, very naturally, out of the previous researches of Sir William Crookes on electric discharge in high vacua, and the discovery in 1895 by W. Röntgen of the so-called X-rays, which marked the beginning of a new era in physics.

Crookes had found that when a glass bulb exhausted to a very high vacuum had one platinum electrode, called the cathode, sealed through the glass connected to the negative terminal of an induction coil, and another similar electrode, called the anode, connected to the positive terminal of the coil, then when the induction coil was in action, not only was the glass rendered fluorescent, but particles of some kind were projected from the cathode, which moved away in straight lines, normal to the surface of the cathode, could produce fluorescence in many substances placed in their path, could cause little mica vanes to rotate like a windmill, and also could cast shadows of metal objects on the glass wall of the tube (see Fig. 36). Crookes showed that these particles each carried a charge of negative electricity.

Crookes named these particles "radiant matter," but they were subsequently called "cathode rays" or "cathode ray particles." Up until 1895, this high vacuum electric discharge hardly possessed more than a purely scientific interest, but in that year W. Röntgen made a discovery of great practical importance. He found that when such a high vacuum tube was in operation and the glass fluorescent, paper or wood coated with a fluorescent material such as barium platinocyanide, was also made fluorescent, even outside the vacuum tube, when held near it, and, moreover, that some substances, such as heavy metals, stopped the radiation producing fluorescence, whereas this radiation passed freely through wood, paper, leather and other materials opaque to light rays.

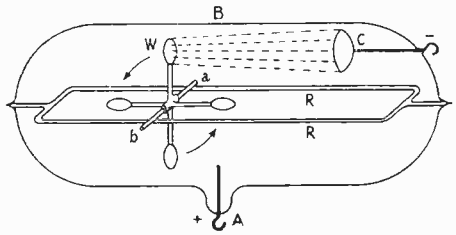


Fig. 36. Crooke's Electron Mill.

B—Highly exhausted bulb.
C— Cathode or negative cathode.
A— Anode or positive electrode.
W—Little Rotor with mica waves which rotates and rolls along glass rails R.R. under impulses of electrons radiated from cathode.

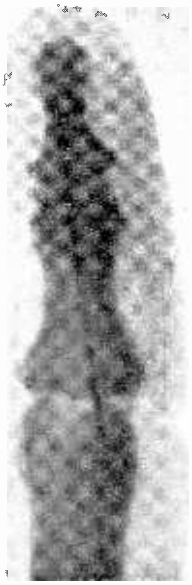
The great sensation of that day was, however, the discovery that the new rays, then called X-rays, from their unknown nature, passed freely through the fleshy tissues of the living human hand, but were more or less stopped by the bones. Also that since these rays could affect a photographic plate enclosed in a black paper envelope, it was possible to photograph the bones in the living hand and unerringly fix the position of any metallic bodies, e.g., bullets, needles, etc., in the flesh

(Fig. 37). Again, it was found that these X-rays produced a certain degree of temporary electric conductivity in air or other gases through which they passed.

Fig. 37. X-ray photograph of a hand with shot embedded in it.

The investigation of the nature of the cathode rays and of the X-rays was taken up very carefully about the end of last century. Two views had previously been held as to the cathode rays. Crookes and his followers maintained that they were material particles of some kind projected from the negative electrode in the high vacuum tube. Other physicists regarded them as some form of ætherial vibration.

Sir Joseph Thomson settled the question by experiments of a remarkably ingenious and important character. If an electrified particle is made to move across the space between the poles of a powerful magnet in a direction at right angles to the line adjoining these poles, it experiences a deflecting force which is at right angles to the direction of its motion and that of the so-called magnetic force which last lies in the direction of the line joining the magnetic poles. This magnetic force is a quantity measurable in certain units. Let us denote by the letter H the magnitude of this magnetic force. Let the velocity of the electrified particle be v centimetres per second, and let it carry an electric charge, denoted by the letter e, as regards amount. Then when the particle carrying an electric charge of e units moves with a velocity v in a direction at right angles to a magnetic force



X-ray photograph of finger with a needle embedded in it.

H, it experiences a deflecting force numerically equal to the product Hev, which is in a direction at right angles to the direction of H and v.

Under these conditions the electrified particle of mass m is being continually acted on by a force at right angles to its direction of motion and hence it moves in a circle of radius v, such that $Hev = mv^2/r$.

Therefore we have the relation

$$\frac{m}{e} v = Hr.$$

Suppose in the next place that we cause an external electric force to act on the electrified particle having an electric charge e. Let the magnitude of this electric force be denoted by E. Then a force measured by the product Ee acts on the particle. Let the direction of the impressed electric force E be so adjusted that the deflecting force produced by it on the electrified particle is exactly opposite in direction and equal in amount to the deflection produced by the magnetic force. We can then equate the two expressions for the deflecting

force acting on the particle and have the equation

$$Hev = Ee$$

or

$$v = \frac{E}{H}$$

Hence, if we measure, as we can do, the magnetic force and the electric force, we can determine from their numerical ratio the velocity v of the cathode particle.

Again, having found the velocity v we can from the previous equation, viz., $Hev = mv^2/r$ or $Hev = mv$, find the ratio of e/m or of electric charge to mass of the cathode particle. For from the above equations we see that

$$\frac{e}{m} = \frac{E}{H^2 r}$$

Hence, if we measure the radius of the circular path of the cathode particle when deflected by the magnetic force H, and also the electric force E, at right angles to H, which is necessary just to annul the deflection, we can calculate the value of E/H^2r and thus determine the ratio e/m. This ratio is an extremely important number and the investigations for its exact determination have been very numerous. The apparatus generally used is shown in Fig. 38. It consists of a glass tube about two inches wide, ending in a large bulb B, 10 or 12 inches in diameter. At the extreme end is sealed in a platinum wire, ending in an aluminium dish C, which forms the cathode or negative electrode. The positive electrode A is another wire sealed into a short side tube. When these electrodes are connected to the secondary circuit of an induction coil, or better still to the poles of an electrostatic generator such as a Wimshurst electrical machine, which keeps the cathode negatively electrified, a torrent of cathode particles are projected from it, when the tube is highly exhausted of its air so as to make a good vacuum in it.

In the vacuum tube are placed a pair of baffle plates, E, with small holes in them, which allows a thin stream of cathode particles to pass. These fall on the spherical end of the tube, which is coated inside with a phosphorescent material called willemite, or with powdered zinc blende. The cathode particles impinging on this screen make a bright green spot of light on it. Within the tube are also placed a pair of metal plates, pq, which can be electrified, one positively and the other negatively, so as to create the required deflecting electric force we have denoted by E. Also that same part of the tube is placed between the poles of a powerful magnet so as to supply a deflecting force Hev in the contrary direction, but in the same line as the electric force E.

From the deflection caused by the magnetic force alone we can find the radius r of the curve along which the cathode particle moves, and we can thus determine both the velocity v and the ratio e/m.

When these experiments are carefully conducted, it is found that the velocity of the cathode particle will vary with the potential difference, as it is called, of the electrodes, but in a high vacuum tube may be of the order of 100 million feet per second, or about one-tenth of the velocity of light. This is an enormous speed, and it is due to this immense

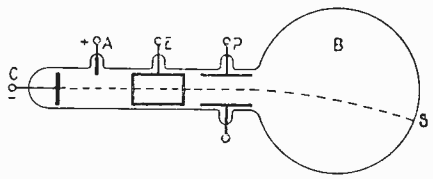


Fig. 38. Cathode Ray Tube and Bulb.

C—Cathode or negative electrode.
B—Highly exhausted bulb with fluorescent screen on its spherical end S.
A—Anode.
E—Baffle plates.
P—Deflecting plates.

velocity that the cathode particles are able to make a luminous spot on the phosphorescent screen.

Sir Joseph Thomson found, in 1899, that the ratio of e/m for the cathode particle was quite independent of the metal of which the cathode was made or of the residual gas in the tube. Under all circumstances exactly the same ratio was obtained. The numerical value was nearly $1{\cdot}77 \times 10^7$ when the charge e is measured in the so-called electromagnetic units. This electromagnetic unit of quantity is the quantity of electricity conveyed by a current of 10 amperes when flowing for one second or one ampere when flowing for 10 seconds, or about the quantity of electricity which passes through the filament of a 16 candle-power 200-volt lamp in a minute and a half.

This constancy in the ratio of e/m for all particles indicates that they are identically the same in every case.

B

We must make a little digression to explain the manner in which this ratio can be determined for the hydrogen atom and what conclusions can be drawn from it.

If we place two platinum or gold plates in water which is slightly acidulated and connect these plates with a storage battery of a couple of cells, we see bubbles of gas arising from both plates. By collecting these gases in separate tubes we can prove that the gas arising from the plate in connection with the positive pole (marked red) of the storage cell is oxygen and the gas collected at the other plate is hydrogen. By measuring the volume of these gases collected we can find that the passage of a current of one ampere for one second through the acidulated water liberates 1·04 ten-thousandths of a gram of hydrogen in the form of gas. These two gases are produced by the electro-chemical decomposition of the acid which is mixed with the water. Suppose for the sake of simplicity that we consider the water to have been acidulated with hydrochloric acid. Each molecule of this acid consists of an atom of hydrogen united to an atom of chlorine and the chemical formula is therefore *H Cl*.

Absolutely pure water is not a conductor of electric current, or at least a very bad one

If we put into this water a little hydrochloric acid the water causes a number of the hydrochloric acid (*H Cl*) molecules to become separated into atoms of hydrogen which are positively electrified and atoms of chlorine which are negatively charged. In this state the electrified atoms are called *ions* and the acid is said to be partly *ionised*. The word *ion* means a wanderer and they are so called because they wander about in the liquid. When a hydrogen ion collides with a chlorine ion they may become reunited into a hydrochloric acid molecule for a short time, but presently the ions are detached again. If then we place in the acid water two metal plates which are electrified the negative plate attracts and draws to it at the instant when it is free the positively charged hydrogen ion and the positive plate similarly attracts the chlorine ions.

The cholorine ions, however, have a strong affinity for hydrogen ions and they even take these away from molecules of water thus reforming *HCl* and liberating oxygen ions against the positive plate. These hydrogen ions then take negative electricity from the negative plate and the oxygen takes positive electricity from the other plate, re-forming hydrogen and oxygen atoms which in turn unite, pair and pair, to form molecules, and these constitute the bubbles of gas liberated.

We see, therefore, that the electric current which passes through the electro-chemical vessel, consists of charges of electricity which are carried by hydrogen and chlorine ions. To every hydrogen atom there corresponds a certain electric charge. If, therefore, we wish to determine the ratio of charge to mass for a single hydrogen atom or ion we have only to determine how much electricity passes, corresponding to the liberation of one gram of hydrogen at the negative electrode. Now, exact experiment shows that a current of one ampere flowing for one second, conveys a quantity of electricity called one coulomb, which is one-tenth of an absolute unit of electric quantity, and this liberates 0·0000109 grams of hydrogen. Hence, the ratio of charge to mass or e/m for the hydrogen ion is a number near to 10,000 or 10^4. We have seen, however, that the ratio of charge to mass or e/m for the cathode particle is $1{\cdot}77 \times 10^7$ or $1{,}770 \times 10^4$ or 1,700 to 1,800 times greater than e/m for the hydrogen ion.

The question then at once arose: is this difference due to a difference in charge or to a difference in mass between the cathode particle and the hydrogen atom or ion?

5.—CATHODE PARTICLES OR ELECTRONS.

Sir Joseph Thomson gave a reply to this question in 1899 by experiments of extraordinary skill and ingenuity.

It was found that particles in every way similar to cathode particles are liberated from the surface of polished zinc and some other metals when they are illuminated by ultra-violet light or light rays of very short wavelength. Also they are liberated from Radium and the X-rays of Röntgen liberate them from molecules of air.

When produced by either of these methods these cathode particles have the power of condensing round themselves water vapour present in air and forming a minute water spherule or drop of water.

The white clouds we see floating in the sky are composed of such small water drops. All air, unless specially dried, has in it a certain proportion of water vapour which is an invisible gas. If, however, the air is cooled below a certain point it cannot hold as much water vapour in solution and it gets rid of

and deposits the excess by forming a cloud or mist. This is the explanation of the early morning mists in the atmosphere which are really formed during the night, when the atmosphere is cooled and the excess of water vapour condensed to water spherules. These small drops of water fall very slowly through the air owing to the friction or viscosity of the air.

Many years ago Sir George Stokes gave a formula connecting together the diameter (d) of the drop with viscosity (q) of the air and the final or constant velocity (v) which the falling drop attains. This formula is $v = \frac{1}{18}\frac{gd^2}{q}$ where g stands for the acceleration of gravity and is nearly 981 in centimetres and seconds as units.

When moist air is chilled by being suddenly expanded it has been found that the excess of moisture is not readily converted into droplets or mist unless there are dust particles in the air. These, however, assist the condensation by affording nuclei round which the water vapour condenses. Many years ago it was discovered by Mr. C. T .R. Wilson that cathode particles could act in the same manner in perfectly pure dust-free air.

If such pure air is suddenly expanded and cooled a cloud does not form but the air becomes supersaturated with moisture. If then cathode particles are introduced a cloud forms at once. Wilson found that if the supersaturation did not exceed a certain amount only the negative or cathode particle acted as a nucleus or core for the condensation of water vapour round it, and a cloud or mist is formed in the vessel in which the moist air is suddenly expanded.

Sir Joseph Thomson and Prof. H. A. Wilson applied this method to determine the cathode particle electric charge as follows :

He suddenly expanded pure dust-free air in a glass vessel and thus supersaturated the air with moisture. He then introduced into this air a number of cathode particles either by allowing ultra-violet light to fall on a zinc plate in the vessel or else by exposing the air to the X-rays. The expansion was performed in a glass vessel having in it two metal plates, an upper and a lower, which could be connected at pleasure to a voltage battery of a certain number of cells so as to make the upper plate positive and produce a certain electric force in the space between the plates. When the cloud was formed by the condensing action of the cathode particles each of the latter condensed round itself a drop of water and began to fall downwards. The rate of falling, by Stokes' law, is determined by the size of the drop, and from the observed rate of sinking of the upper sharp surface of the cloud we can calculate the diameter of the minute drop of water from the formula given above and hence the mass of the drop. When the cloud has sunk a certain distance the upper metal plate is given a positive electric charge and this produces an electric force E in the space between the plates which can be adjusted until it just arrests the fall of the drops.

We then know that since each drop contains a cathode particle of electric charge e we must have the equation

$$Mg = Ee$$

Where M is the mass of the drop and g the acceleration of gravity. From this equation e can be determined.

Some admirable measurements of the same kind, only using oil or mercury vapour in place of water vapour, have been carried out by Professor R. A. Millikan in America. The best and final result is that the cathode particle carries a negative electric charge of $4{\cdot}774 \times 10^{-10}$ electrostatic units or $1{\cdot}591 \times 10^{-20}$ electro magnetic units. In other words, six million billion cathode particles carry between them a quantity of electricity equal to that conveyed by a current of one ampere in one second.

It was thus found that this very small quantity of negative electricity is a natural unit which cannot be divided, and is in short an *atom of electricity*. Electricity was thus seen to be a commodity like cigars or cigarettes or things of the kind that are supplied only in multiples of some finite unit.

To this atom of negative electricity the late Dr. Johnstone Stoney gave the name of *the electron*, but the term electron is now applied to the cathode particle, or negative corpuscle as a whole.

It became clear, therefore, that identical electrons were constituents of all material atoms and could be extricated from them.

6.—ELECTRONS AS CONSTITUENTS OF ALL ATOMS.

It was not then a long step from this point to the suggestion that atoms consisted of groups of electrons, arranged in a certain way and held together by the attraction of some

form of charge of positive electricity. The first suggestion was that this positive charge of electricity, the nature of which was unknown, existed in the form of a sphere of the size of the atom and that the negative electrons were distributed through it like pips in an orange, but able to circulate about or revolve in it.

The late Lord Kelvin made this suggestion first, and its consequences were mathematically developed by Sir J. J. Thomson.

If we suppose the sphere of positive electricity to be composed of stuff which attracts electrons external to itself with a force which is inversely proportional to the square of the distance, then it can be shown that a sphere of such positive electricity would attract an electron embedded in it, towards its centre, with a force proportional to the distance of the electron from the centre. If then by any means the electron is set in motion, it will revolve round the centre of the sphere of positive electricity in a circular orbit included within the boundary of that positive sphere.

If a number of such electrons are included in the sphere they will arrange themselves in certain rings or orbits, certain arrangements being stable and others unstable. An illustration of this sort of structure is found in an interesting experiment due to Mayer.

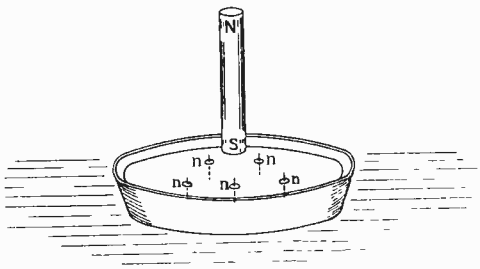


Fig. 39. Mayer's Magnet Experiment. Little magnetised needles floating vertically in water and caused to arrange themselves in a pattern by a magnet NS held over them.

A large number of sewing needles are thrust through little discs of cork. The needles are all magnetised and then, if placed in water in a basin with the cork button slid along to one end, the needles will all float vertically in the water. If then the upper ends are all similar magnetic poles, the needles will repel each other like electrons, and if left to themselves will get as far apart as possible.

If the opposite pole of a bar magnet is now held near the surface of the water the needles will be drawn to it but will be mutually repelled. Under this double action they will arrange themselves in certain forms (see Fig. 39). Thus three needles will set themselves at the angular points of an equilateral triangle, four at the corners of a square, five at corners of a pentagon. Certain arrangements are, however, unstable, especially if the needles or electrons are in rotation round the centre, and when more than a certain number of needles or electrons exist in the group the arrangement is not stable unless they are arranged in two or more rings.

Certain facts discovered by Sir Ernest Rutherford, and strongly supported by the theoretical investigations of Professor N. Bohr, of Copenhagen, seem to militate against the view that the positive electric charge is diffused over a sphere the size of the atom, but strongly support the view that it is concentrated in a small centre or nucleus which is very small compared with the size of the material atom itself, and perhaps not large even compared with the size of a negative electron.

The theory of atomic structure now somewhat widely held, called the Rutherford-Bohr theory, is that a chemical atom consists of a nucleus which is composed of negative electrons, held together by still smaller positive electrons, the positive electrons predominating in number so that the whole nucleus has a resultant charge of positive electricity if we assume that the charges of positive and negative electrons taken singly are equal.

Thus, for instance, the nucleus of the Helium atom is supposed to contain four positive electrons and two negative, which are bound by mutual attraction and repulsion into a compact mass, which Rutherford concludes has a diameter of not more than one ten-thousandth part of that of the whole atom, which we have seen to be of the order of one-hundred-millionth of a centimetre. This nucleus has, therefore, a resultant positive charge equal to two units, taking the unit to be the electron charge. Around this nucleus circulate two negative electrons like planets round the sun and the atom, taken as a whole, is therefore electrically neutral.

The atom, on this theory, is a solar system in miniature. The nucleus corresponds to the central sun and the negative electrons to the

planets circulating round it. The electrons need not revolve in the same plane nor even all in the same directions, and each orbit may have not only one planet but two, three, or more, even up to eight, as the case may be.

It will be seen, therefore, that an atom forming what we usually call solid matter is in fact a very open or porous structure, consisting of a certain number of very dense and extremely small particles distributed throughout a certain space, otherwise unoccupied, which we call the volume of the atom.

7.—A MODEL OF AN ATOM.

Thus if we desired to make a model, say, of a helium atom, we might place a sphere, say, the size of a football at a certain position to represent the positively charged nucleus. Then at distances of about $1\frac{1}{4}$ miles, we should have to locate two golf balls to represent the two negative electrons and to assume that these were revolving round the football like planets round the sun, but not necessarily in the same plane nor in the same direction as regards rotation.

In the case of an atom of hydrogen, the nucleus consists of a single positive electron and a single negative electron, the two revolving round their common centre of mass. When two atoms of hydrogen unite to form a molecule, we have two positive electrons at a certain distance apart, and two negative electrons revolving in a circle, the plane of which is perpendicular to the line joining the two positive electrons and its centre on that line.

The two negative electrons are at opposite ends of a diameter of the circle in which they revolve (see Fig. 40).

It appears from certain considerations that the diameter of this circle may be different in different molecules of hydrogen, so that these molecules are not in all cases of exactly the same volume.

We have seen that the mass of the negative electron is only about 1/1,700th of the mass of the positive electron and this leads to the conclusion that the true mass or gravitative mass of the atom resides almost entirely in

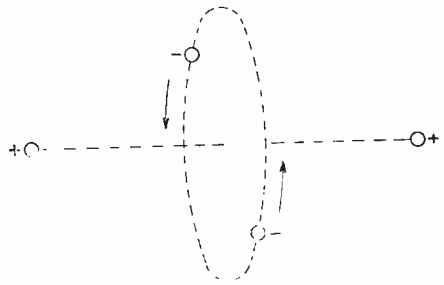


Fig. 40. Model of a Hydrogen Molecule.

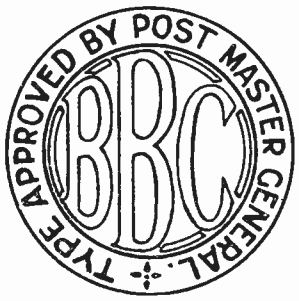
the positive electrons. The reason for this may be in the much greater density and smaller size of the positive electron.

In addition to this Rutherford-Bohr theory of the structure of the atom, another view has been advanced and supported by Langmuir, which regards the negative electrons assembled round the nucleus as stationary and not in revolution. We shall not enter into the discussion of this theory because it entails much greater mathematical difficulties than the Rutherford-Bohr theory, in that we have to account for the fact that there must then be localities round the nucleus to which the forces acting on the negative electrons converge in all directions so as to produce stability.

(To be continued.)

The Sign of Official Approval.

The accompanying illustration is reproduced from a seal issued by the British Broadcasting Co., which, according to Post Office regulations, must appear on every wireless set used by Broadcast licencees.



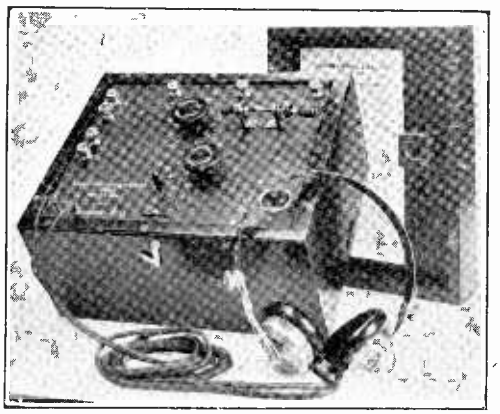
As already stated, manufacturers of broadcast apparatus are required to submit specimen instruments to the Post Office for inspection, and each set approved will be sealed and returned to the manufacturer, who will retain the sealed approved set for reference when necessary. Each set sold will be stamped or bear a transfer similar to that shown, and these sets will be reproductions, as far as possible, of the sealed instrument, the electrical conditions being carefully reproduced.

Only sets bearing this mark can legally be used when broadcasting starts.

New Type Broadcasting Receiver

Messrs. Siemens Bros. & Co., Ltd., have recently introduced a new type of receiver designed essentially for reception of broadcasted telephony. It embodies the use of both crystal detector and valve note magnifier, and by means of a simple change-over switch, can be arranged for employing (*a*) crystal reception only; (*b*) single valve reception only; (*c*) crystal reception with note magnifying valve.

The instrument embodies several novel features; for instance, it is impossible to close the instrument and leave the batteries in circuit, for the battery circuit is broken by the act of replacing the lid. Also, to save the trouble of disconnecting leads every time the instrument is put away, slots are cut in the lid to permit of the leads passing through.



Siemen's Broadcasting Receiver, Type C.V.

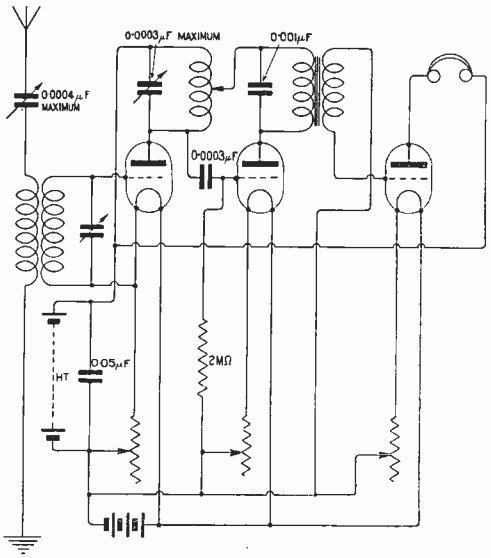
The finish is particularly good, and the arrangement of the controls makes an instrument which is particularly durable.

An Approved Circuit.

Now that the Postmaster-General has authorised the introduction of reaction into receiving circuits, when it is arranged between the plate circuit of the first valve and an inductance in a subsequent valve circuit, the problem of the best method of utilising this arrangement presents itself.

Tuned anode high frequency amplification means the fitting of an additional tuning condenser and introduces the complication of adjusting a number of circuits simultaneously.

This circuit shows a very simple way of ensuring the setting up of oscillations without the introduction of an additional inductance in the plate circuit of the second valve. A few turns are tapped off along the inductance



according to the degree of reaction coupling required, these turns being common to the tuned anode circuit and the plate circuit of the second valve.

A New Variometer

Igranic Variometer.

This variometer, manufactured by the Igranic Co., is of a particularly novel design, its two coils remaining in shape solely by the system of winding, which is such as will give an absolute minimum of self-capacity.

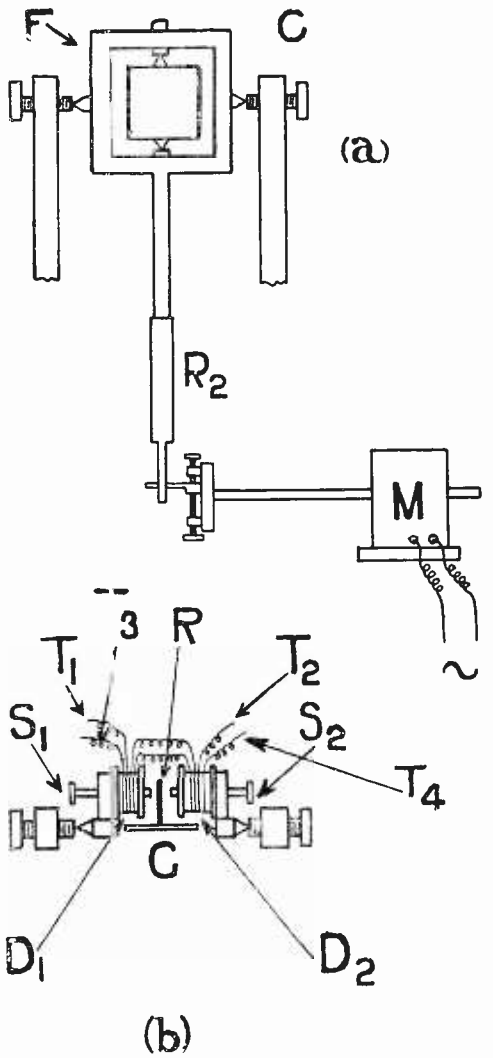
A Development in the Problem of Television.

By NICOLAS LANGER.

The following article, contributed from Hungary, describes experimental work in connection with the problem of Television. Whilst the actual process described does not include transmission by wireless, yet this being a logical development from line transmission, the subject as presented should be of great interest to wireless experimenters.

THE purpose of the following article is to describe a development in methods for enabling objects at a distance to be seen by the eye by means of electrical circuits or by wireless, in much the same manner as the ear is enabled by means of these methods to hear sounds at a distance. The problem of television has been already partly solved by the methods adopted by Professor Korn. Professor Korn's apparatus, however, relates only to the transmission of photographs, and the process takes from six to fifteen minutes, and the method is not a direct one, but one which necessitates taking a photograph in the ordinary way and afterwards reproducing it by means of the Korn apparatus. The following article will describe apparatus by means of which distant objects can be made visible without the necessity of the use of the intermediary of the camera, and it is even possible to represent at the receiving end pictures in motion in a similar manner to the cinematograph. It is claimed that in this system it is possible to transmit a picture at a speed exceeding that of the Korn transmitter by 10,000 to 20,000 times. The very interesting nature of the problem attracted my attention many years ago. The results of my investigations are no doubt of interest, and I will therefore give here a short *résumé* of this work in order to introduce the subject intelligibly.

Every picture (if we disregard the colours) may be regarded as consisting of a combination of black and white spots, and for the sake of simplicity, throughout this article, we shall term these spots "picture elements." It is easily understood that these picture elements vary in brightness from black down through gradations of tone to white. In order to set about transmitting a picture, we must first analyse the picture into elements, and the area of each element or spot must be sufficiently small so that no difference in tone would



Figs. 1a *and* 1b.

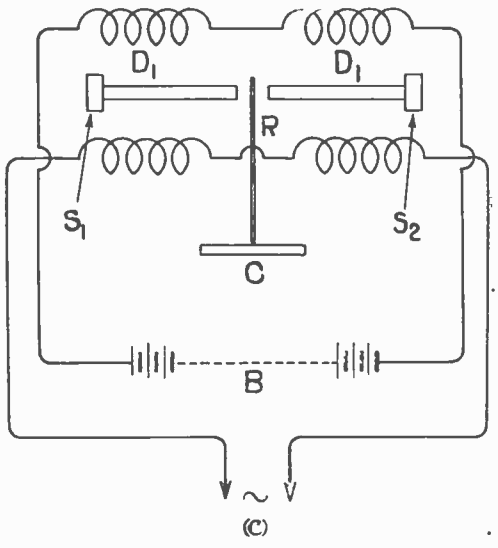


Fig. 1c.

be apparent to the eye by any further subdivision. The next process is to translate the picture which has been subdivided into elements into some form for transmission by telegraph. This is done by running on the picture elements by various degrees of tone, one after the other in a continuous stream and in their correct order, and translating the variations in tone into variations in electric current in the transmitting line. As the picture elements in the form of electrical impulses of varying intensity are received at the receiving station, they are rearranged back into their correct order, and the process gradually builds up a picture which resembles the original. If it is arranged that at any point of the receiving station the stream of picture elements can be observed by the eye, it will be realised that only a single picture element is visible at one time, but nevertheless, the whole picture may appear to the eye at once, since the process of transmission under the present system is arranged to take place within the space of one-tenth of a second. It is well known that the human eye suffers from a limitation which is commonly called the lag of the eye, and it is this limitation of the eye which is made use of in practical application of the cinematograph. The eye can only record impressions of light of about one-tenth of a second duration, as any changes in light value of shorter duration than one-tenth of a second are recorded as one impression only.

With this introduction we may now proceed to divide the process of the transmission of a picture under five headings :—

(1) Analysis of the picture into picture elements.

(2) Translating the varying tones of the picture elements into a varied stream of electrical impulses by aid of light-sensitive cells, such as selenium.

(3) The transmission of the stream of varying electrical impulses to the receiving station.

(4) The rearrangement back into their original formation of the picture elements.

(5) The composition of the picture from the elements so obtained.

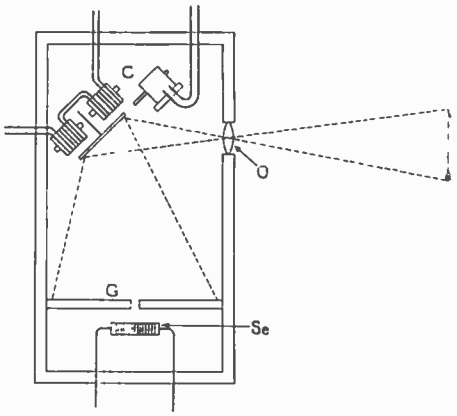


Fig. 2.

It may be seen, therefore, that the process resolves itself into a kind of transference of energy. For the sake of convenience in transmission, the light energy is converted into electrical energy, and at the point where reception is carried out the electrical energy is caused to revert to light energy.

We will now proceed to consider in detail the various headings under which we have subdivided the problem.

As already mentioned, this process consists in passing the picture elements one after the other in correct order past the light-sensitive apparatus (selenium cell or other apparatus) in order to convert the changes in light values into changes in electric current.

This process is illustrated in Fig. 1 (a), (b) and (c). The principal portion of the apparatus is the mirror C, which has a tongue R, and is supported between delicate points

so that it is free to move between the poles of the electro-magnets D_1 and D_2. The amplitude of the movement of the mirror is controlled by the spacing of the two soft iron cores, S_1 and S_2. The mirror is set in motion in the following manner. The electro-magnets are composed of two coils, T_1, T_2, T_3 and T_4, two of which are in series. The first circuit is in series with a direct current battery B, whilst the other is connected in series with an alternating current supply, the frequency of which is 500 a second. The battery B supplies the polarising voltage for the electro-magnets, the two adjoining poles of which are north. The alternating current passing through the other coils results in oscillation of the tongue R, and consequently the mirror, back and forth at a frequency depending upon the frequency of alternation of the current.

In addition to this motion, the mirror must be made to swing in a vertical plane, and to accomplish this the frame is supported between pivots, and is provided with a tongue R_2. This frame is caused to oscillate by means of the synchronous motor M, on the shaft of which is a disc carrying an eccentric coupling. During the period that the motor makes five revolutions a second, the frame and the mirror C make five double movements in a second, so that the mirror C accomplishes

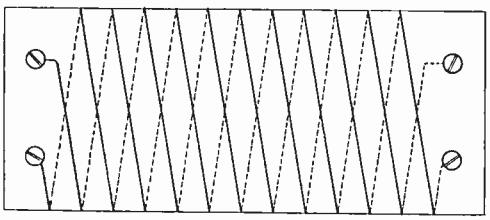


Fig. 3.

two motions in different planes at the same time with different speeds. The first is a motion on its axis at a frequency of 500 a second, and the second is a motion on the axis of the frame F at a frequency of 5 a second.

Fig. 2 illustrates the operation performed in translating the picture elements into variations of e.m.f.

The apparatus is set up in a dark room, and an inverted and reduced image of the picture is projected by the lens O on to the mirror C, from whence it is reflected on to the diaphragm G, in the centre of which is an aperture about 1 millimetre in area. On the other side of the diaphragm is located the selenium, or other light sensitive cell, Se, the electrical conductivity of which varies with varying degrees of illumination.

In the period of one-tenth of a second the mirror makes 100 single (half) oscillations in the plane of the diagram (Fig. 2), so that a beam of light passes back and forth past the aperture in the diaphragm one hundred times. During the same period the mirror also makes one swing in a perpendicular direction so that the beam is displaced in a perpendicular direction at a speed 100 times slower than the other movement.

A little consideration will show that at every movement a different picture element appears through the diaphragm aperture, and in one-tenth of a second the light sensitive cell Se receives, so to speak, the entire picture. The whole process repeats itself ten times a second, so that even the transmission of moving pictures becomes a possibility.

As light-sensitive cells it is usual to employ selenium, which is highly sensitive, but possesses a disadvantage in that it has a "lag," *i.e.*, the change in the electrical conductivity of the selenium cell does not take place instantaneously under the influence of light, and with darkness there is an interval before the cell reverts to its original state of non-conductivity. Whilst other types of light-sensitive cells may have less lag, yet selenium cells are recommended for the purpose of this article as their high resistance is a property which can be made good use of in valve circuits, and they are also convenient in many ways.

Fig. 3 illustrates a well-known type of selenium cell. A porcelain or marble tablet is covered with a very thin layer of selenium and two thin platinum wires are then wound on parallel to one another and in close

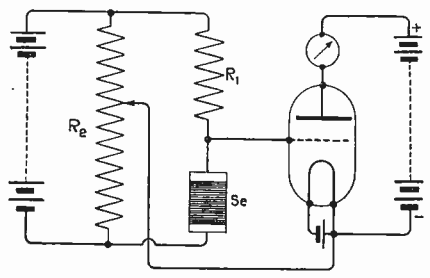


Fig. 4.

proximity. The cells are then subjected to a sensitising process, which consists of heating for about one hour at a temperature of 210° C., and then slowly allowing to cool. Then the cell is painted over with a transparent varnish for the purpose of protecting the cell from damp. A cell constructed in this manner has in the dark a resistance of 10,000 to 500,000 ohms., and a moderate illumination will change the conductivity of a good cell by 10 per cent.

Selenium cells were for many years the principal obstacle in the way of the development of telephotography, chiefly on account of its high resistance, but with the advent of the valve this objection disappears, and in fact becomes an advantage.

A circuit first used by T. Nemes is given in Fig. 4. The principle of this circuit is somewhat on the lines of a bridge. Se is the selenium cell, R_1 and R_2 are non-inductive resistances of equal value. The movement of the sliding contact on R_2 the potential on the grid of the valve can be controlled so that the best point of the valve characteristic can be utilised.

Now it is desired that the selenium cell should be responsive to rapid changes in light values. Glatzel, who worked with Korn, obtained lag curves when very rapid changes in light values were made. Fig. 5 shows a curve obtained by Glatzel employing a selenium cell and a Siemen's oscillograph, the cell being subjected to intermittent illumination, the duration of each illumination being about 0·02 second, and a similar period of darkness.

As can be seen from the curve, there is a sharp rise at first, after which a steady oscillation takes place.

Some years ago I myself had the opportunity of conducting research along these lines.

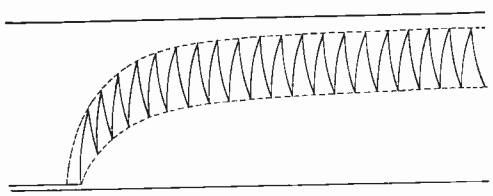


Fig. 5.

I employed intermittent illuminations of a higher frequency, viz., 0·0001 to 0·000025 second, and I endeavoured to ascertain the limit of speed of change which a selenium cell was capable of recording.

I thought that along these lines it might be possible to induce the selenium cell to "self-oscillate," so to speak.

The experimental arrangement (simplified for convenience) is shown in Fig. 6.

A narrow beam of light is projected from the source of illumination L on to the mirror M of a Carpentier oscillograph (shown only in cross-section), and is reflected on through the aperture in the diaphragm K on to the selenium cell Se, which is connected in series with a battery and the oscillograph. When a beam of light thus reflected falls on the cell Se its conductivity is increased, resulting in an increased e.m.f. through the windings of the oscillograph and the movement of the mirror M. As the mirror moves, the beam of light is diverted from the aperture in the diaphragm K and the cell Se returns to its former state of non-conductivity.

Now, the frequency at which the mirror will oscillate is dependent chiefly upon the

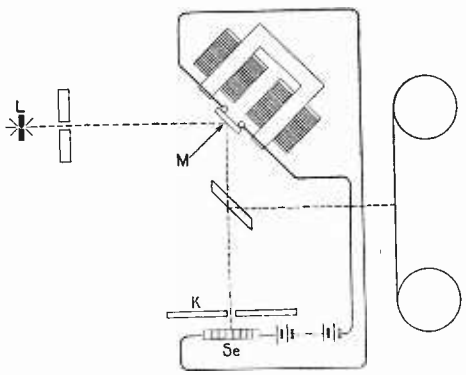


Fig. 6.

lag of the selenium cell, which can be estimated in this matter, other considerations which affect the frequency, such as the intensity of illumination, or the lag of the oscillograph being calculated and allowed for.

Very critical experiments have not yet been conducted, but results so far obtained show—

(1) That selenium cells are capable of responding to variations in light at a frequency of 10,000 per second.

(2) That with an increase of speed the sensitivity of the cell is greatly reduced.

(3) That by the use of valve amplifiers it is possible to compensate largely for the loss in sensitivity at high speeds.

These observations are sufficient to show that the selenium cell is applicable to the experiments under discussion in this article. We must remember, however, that the number of picture elements will exceed this frequency of 10,000 per second, and if, as in the case of moving pictures, it is desired to transmit ten pictures per second, then this may represent as many as 100,000 picture elements

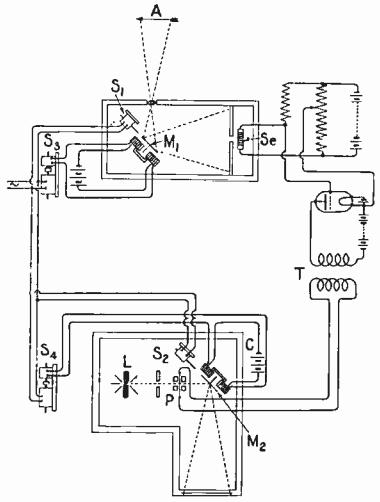


Fig. 7.

in one second. However, it is seldom that a picture element is of a tone which stands out isolated from its neighbours, the gradations of tone being almost in every case very gradual, so that the actual number of changes in illumination to be registered are greatly reduced. In general we can take 5,000 to 20,000 frequency to be quite sufficient for the transmissions.

At the receiving end of the apparatus, in order to reconvert the variations of e.m.f. back into picture elements, the following arrangement is made. A dead beat string galvanometer is required. Between the poles of a powerful electro-magnet is suspended a fine platinum thread, which carries a small and light aluminium plate at its centre. The poles of the electro-magnet are drilled through so as to provide for the passage of a beam of light. A current passing through the thread diverts it at right angles to the lines of force, and consequently the aluminium plate moves so as to intercept to a greater or lesser degree the passage of the beam of light through the drilled hole in the poles. This is illustrated at P, Fig. 7.

The diagram Fig. 7 shows the arrangement of the complete apparatus, both transmitting and receiving. The upper half of the picture represents the transmitter and the lower the receiver. If, for example, it is desired to transmit the picture seen at the arrow A through the lens of the camera, an inverted and reduced image appears on the mirror M_1, which oscillates in two planes as already explained. The picture elements are reflected, one after the other, on to the selenium cell Se, the conductivity of which is thereby varied. The variations in e.m.f. are amplified through the valve circuit, which should give several stages of amplification, though only one stage is shown in Fig. 7. The amplified currents are then passed to the receiving circuits by means of the transformer T. The next step is that the incoming oscillations are passed through the fine platinum wire at P of the galvanometer, which is diverted in proportion to the amplitude of the incoming oscillations in the process already described. The mirror M_2 on which the beam of light controlled by the incoming oscillations falls, must be exactly synchronised with the mirror M_1 at the transmitting end, and herein lies the greatest obstacle to a practical solution of the problem.

The method of producing this synchronisation in experimental work was by means of synchronous motors S_1, S_2, fed from the same A.C. supply. S_3, S_4, are generators supplying the 500 cycle frequency for the oscillation of the mirrors M_1 M_2.

In conclusion I may say that in the foregoing article I have endeavoured to indicate the lines along which we may look for a solution of the problem. I feel that it may be of interest to other experimenters to have these suggestions put forward. The solution of the problem from a wireless point of view must be looked for as a logical outcome of television by line wires.

Personally, I look forward with confidence to the time when we shall not only speak with, but also see those with whom we carry on telephone or wireless telephone conversations, and the distribution of cinematograph films will be superseded by the direct transmission from a central cinema.

The Effect of Underground Metalwork on Radio Direction Finders.*

DISCUSSION.

Mr. A. A. Campbell Swinton.

I think we are all very much indebted to the readers of this paper for the very clear way in which they have brought the matter before us. I recollect that about a year ago there was an Italian gentleman over here with some kind of apparatus which was intended for the purpose of finding minerals. I think his experiments took place in the neighbourhood of Florence. There is no doubt that there are people who claim to be able to find minerals, and not only minerals, but water also, by means of wireless apparatus.

The President.

Mr. Fogarty, I believe you were introduced to the Italian gentleman who was interested in this subject. Can you say anything about his work?

Mr. L. F. Fogarty.

The gentleman whom I had the pleasure of meeting was the Hon. Umberto Bianchi, the President of the Radio Club of Italy. He was in this country for the express purpose of finding someone who would make certain special apparatus he wanted to enable him to carry on his work of locating metallic masses and metallic ores underground. I believe he is at present in this country, and as a matter of fact, I sent him an invitation a few days ago to be present here this evening, but I presume he could not attend.

Mr. C. F. Phillips.

With regard to Mr. Bianchi's researches, I might say that they did not in any way concern location by deviation of the bearings taken with a direction finder. It is an entirely different system. It involves a search for a displacement of an electro-magnetic field, and it is not a question of locating any error by means of bearings taken on some station.

I should like to ask the lecturer whether in noting the deviation of bearings obtained with the direction finding apparatus from the true bearings, whether there was any really noticeable difference in signal strength, and whether he thinks that any considerable absorption by the mass of metal took place.

Mr. W. H. Lawes.

I should like to ask whether any attempt was made to correct the error in the same way that ships' compasses are corrected.

Mr. R. L. Smith-Rose (*in reply*).

I was very interested to learn that a method is being developed for the actual detection of hidden metal. Of course we did not start out with that object. We were certainly successful in finding hidden metal, but whether this would be possible on a commercial scale is another matter.

I do not know anything of this gentleman's method, but the method we have used in detecting an error in bearings or deviation in the observed bearings is essentially an exploration of the electromagnetic field in the neighbourhood. What we are doing is to find the resulting deviation which is due to an incoming wave and secondary current set up in the metalwork by that wave. It is quite true that we do not generate the electromagnetic field ourselves, but that is the principle of the method, and in that way I should imagine it has a somewhat similar relationship to any other method of detecting the electromagnetic field. With regard to signal strength, the mere fact that the error exists as a secondary effect due to the presence of the metal and currents set up in the metal work by the incoming wave, these currents necessarily mean an absorption of energy, but I must admit that this absorption was surprisingly small in these experiments and the range of direction finding at Aberdeen was not appreciably diminished by the existence of the metal work. We were able to get Moscow (over 1,600 miles away), and this compares very favourably with conditions in other parts of the country.

It is of course very difficult, when using an amplifier, to compare signal strength in different places and under different conditions, unless special precautions are taken to maintain constancy of amplication. Also signals may vary from day to day from other causes.

With regard to making compensation for this error, this could be arranged in much the same manner as the quadrantal error of a ship or aeroplane is corrected, *i.e.*, by the arrangement of suitable coils near the D.F. set. By adjusting the position and electrical constants of these an approximate correction for the error can be obtained.

In this particular case it was not considered worth while to make a correction because, having located the source of the permanent error, we were not so interested in this as in the variations which, compared with this error, are of much greater magnitude. The whole object of this research is essentially to get at the variable errors of the order of 60°, and this permanent error, although it is fairly large, is not now of the first importance.

The President.

Ladies and Gentlemen, I ask for a vote of thanks to Mr. Smith-Rose and Mr. Barfield for their able enunciation of these facts. There is no doubt that the experiments are a triumph for direction finding. We of the Radio Research Board used to hear every month from Mr. Smith-Rose about this iron, although he could not locate it, and was informed by the surveyor that there was no iron about. But at last his tenacity had the desired effect, and the surveyor looked up his plans and it was found that the surveyor was wrong and Mr. Smith-Rose was right. It is quite likely that this method will be adopted in other cases, and it is well to let people know that direction finding has other uses besides the location of a station.

* Discussion on a paper read before the Wireless Society of London on October 25th, 1922. See pages 165 to 171 of issue for November 4th.

If any of you use direction finders in London you will observe that you get errors in any house. When I find that Paris is about seven degrees off what it ought to be, I know Paris is perfectly correct, but I am perfectly correct also, because I have a permanent error of seven degrees. I get no error on Horsea, and yet on Ongar, which is almost reciprocal, I get an error of five degrees.

It is well worth while remembering, in using direction finders in London, that with water-pipes, electric light leads, telegraph and telephone wires and iron balcony rails you cannot expect to get true bearings. You know the error is not due to the stations, therefore you should plot out your curve and see what the errors are, and you will know what the correcting factor should be.

Notes

A Wired Wireless Demonstration.

On Friday evening, November 3rd, a demonstration of wired wireless took place at the Regent Street Polytechnic as previously announced in this journal.

Mr. E. H. Shaughnessy, head of the Wireless Section of the General Post Office, gave a lecture on recent developments in radio telegraphy and telephony, when he dealt with the work which was being done at Leafield. In the course of his lecture, he mentioned that the daily news service maintained from Leafield to Halifax, Nova Scotia, was regarded by Americans as the fastest Transatlantic service in existence.

During the evening, by permission of the Postmaster-General and with the co-operation of the Marconi Company and the British Broadcasting Company, a demonstration of wireless telephony was given. Sir William Noble, speaking from Marconi House, introduced the Lord Mayor of Bristol, who delivered an address from his own home. This was transmitted by "wired wireless" to Marconi House, and thence broadcasted.

An instrumental and vocal concert was afterwards broadcasted from Marconi House.

African Stations.

Tete station, Lourenço Marques, is now almost completed. Direct communication with Lisbon is to be established. Smaller stations have already been erected at Inambane and Chai-Chai on the coast.

American Call Signal WWAA.

The general call signal **WWAA** has been assigned for all vessels operated and controlled by the Radio Corporation of America. This general call signal will be used by Radio Corporation of America ships or coast stations desiring to ascertain whether there is an R.C.A. ship within range, and any R.C.A. vessel hearing another ship or coast station calling **WWAA** should answer. Also this general call signal will be used in broadcasting messages to R.C.A. ships.

Wireless Apparatus in Aircraft.

At the first public session of the International Commission for Aerial Navigation consideration was given to the report of a Sub-Committee on the use of wireless apparatus on aircraft. It was agreed as a general principle that all aircraft engaged in public transport must carry wireless apparatus. At present this provision is applied only to aircraft able to carry ten or more persons. Aircraft carrying fewer than ten persons, and flying more than 100 miles over land without landing, or more than 15 miles over sea, must carry wireless apparatus within two years.

Messages to Aeroplanes.

Haren **(OPVH)** telephones frequently to aeroplanes flying between Brussels and Paris, Brussels and London, and Brussels and Amsterdam. Messages on 900 metres are usually transmitted at twenty minutes past each hour from 11.20 to 4.20. Weather reports are given in French and English.

Telephony from Eiffel Tower.

The Eiffel Tower Station now transmits telephony at 7.20 a.m., 11.15 a.m. and 5.10 p.m. It is anticipated that the power will be increased in the near future.

Belgian Meteorological Transmissions.

Transmissions from the Brussels Meteorological Institute **(OPO)** are made on (C.W.) 1,500 metres at so slow a rate that amateurs are easily able to read the messages, which are in Morse code.

Königswusterhausen.

Daily transmissions of telephony from Königswusterhausen, Berlin, are on a wavelength of 2,800 metres, and the times are 6 to 7 a.m., 11 a.m. to 12.30 noon and 4 to 5.30 p.m.

Address of 2 ZY Required.

Reception of **2 ZY** has been reported, and excellent telephony recorded. We have been asked for the address of this station.

Wireless Insurance Policy.

Liverpool Marine and General Insurance Company, Ltd., have issued a comprehensive policy covering all risks in connection with an amateur wireless installation at a premium of 7s. 6d.

Canadian Government Radio Director in London.

Mr. C. P. Edwards, O.B.E., Director of Radio for the Canadian Government, arrived in London on the 30th October. He is to advise the Hon. Ernest Lapointe, M.P., Canadian Minister of Marine, in connection with the conference between the Canadian and Imperial Authorities in regard to the Imperial Chain.

Wireless at St. Bride's Institute.

At St. Bride's Institute, Ludgate Circus, E.C., a lecture and demonstration on "Broadcasting" is to be given on November 14th. The lecturer, Mr. H. A. Hankey, is an ex-Fleet Wireless Officer. By arrangement with Marconi's Wireless Telegraph Company, the event is being held under the auspices of the National Association of Supervising Engineers. Tickets are obtainable from Mr. A. Brammer, 63, Queen Victoria Street, E.C.4.

The New Licence for Broadcast Reception

BROADCAST LICENCE.

A 41602

WIRELESS TELEGRAPHY ACT, 1904.

Licence to establish a wireless receiving station.

Messrs. The Wireless World & Radio Review
(Name in full)

of 12/13 Henrietta St. London W.C. is hereby
(Address in full)

authorised (subject in all respects to the conditions set forth in the Schedule hereto) to establish a wireless station for the purpose of receiving messages at [illegible] Henrietta Street, [illegible]
(Address)

for a period ending on the [illegible] next.
(Day of month)

APPARATUS USED UNDER THIS LICENCE MUST BE MARKED

The payment of the fee of ten shillings is hereby acknowledged.

Dated 3rd day of November 192[illegible]

Issued on behalf of the Postmaster-General

[illegible]
(Name)

Signature of Licensee WIRELESS WORLD & RADIO REVIEW.

If it is desired to continue to maintain the station after the date of expiration a fresh Licence must be taken out within fourteen days. Heavy penalties are prescribed by the Wireless Telegraphy Act 1904, on conviction of the offence of establishing a wireless station without the Postmaster-General's Licence.

2801 G & S 194

Stamp of Issuing Office.

BEDFORD ST. STRAND. B.O. 3 NO 22 W.C.

CONDITIONS.

1. The Licensee shall not allow the Station to be used for any purpose other than that of receiving messages.

2. Any receiving set, or any of the following parts, vizt.:—Amplifiers (valve or other), telephone head receivers, loud speakers and valves, used under this licence must bear the mark shewn in the margin.

3. The Station shall not be used in such a manner as to cause interference with the working of other Stations. In particular valves must not be so connected as to be capable of causing the aerial to oscillate.

4. The combined height and length of the external aerial (where one is employed) shall not exceed 100 feet.

5. The Licensee shall not divulge or allow to be divulged to any person (other than a duly authorised officer of His Majesty's Government or a competent legal tribunal) or make any use whatsoever, of any message received by means of the Station other than time signals, musical performances and messages transmitted for general reception.

6. The Station shall be open to inspection at all reasonable times by duly authorised officers of the Post Office

This Licence may be cancelled by the Postmaster-General at any time either by specific notice in writing sent by post to the Licensee at the address shewn hereon, or by means of a general notice in the London Gazette addressed to all holders of wireless receiving Licences for broadcast messages.

N.B.—Licences may only be held by persons who are of full age, and any change of address must be promptly communicated to the issuing Postmaster.

2801

At the top will be seen a reproduction of the front of the licence. The Conditions are on the back of the form.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In a book of Standard Tables for Radio, published in London, there is given a formula for finding the distance between two points on the earth's surface. The example worked out is :—

	Latitude.	*Longitude.*
San Francisco ..	37°44′40″ N.	122°24′40″ W.
Choishi	35°44′08″ N.	140°51′12″ E.

and is not as simple as it could be.

Compare with the following way of making the calculation, in which *d*.lon. is the difference of longitude, and *d*.lat. the difference of latitude :

lat. 37°44′40″	log. cos	9.89804
lat. 35°44′08″	log. cos	9.90941
d.lon 96°44′28″	log. hav	9.94717
	log.hav	9.55462 = N.hav 0.35860
d.lat 2°00′32″		N.hav 0.00031
Distance = 73°36′35″		N.hav 0.35891

$73 \times 60 = 4380$
$+ \quad 36\frac{1}{2} = 4416\frac{1}{2}$ nautical miles.

Las Heras, 1960. JUAN CHRISTENSEN.
Buenos Aires,
Argentina.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to the Proceedings of the Wireless Society of London, reported in your issues of October 14th and 21st, I regret to notice the apathy shown to the experimenter as distinct from the receiver of "broadcasting."

The prohibition of the use of reaction (which if pressed to its logical conclusion implies that transmitting would not be allowed) on wavelengths from 300 to 500 metres, during the hours 5 to 10 p.m. on weekdays, and all day on Sundays (the very times when many experimenters are obliged to work) seems grossly unfair.

I would ask why this prohibition should be extended beyond the upper limit of the broadcasting band, viz., 425 metres. It is further proposed that the experimenter shall pay an increased fee for an "entertainment" which is to debar him from carrying out any experiments he may wish to do. I trust that the wireless societies, in their present prosperity, will do all in their power to maintain the privileges of those who were early members.

Trinity College, "EXPERIMENTER."
Cambridge.
October 24th, 1922.

Books Received

DISPOSAL BOARD RADIO INSTRUMENTS AND THEIR APPLICATION TO EXPERIMENTAL USES. By P. R. Coursey, B.Sc. (London : *Messrs. Leslie McMichael, Ltd.*, Providence Place, West End Lane, N.W.6. Illustrated. Price 1s. 6d.)

Calendar of Current Events

Friday, November 10th.

HECKMONDWIKE AND DISTRICT WIRELESS SOCIETY.
At 7.30 p.m. Exhibition and Demonstration. Opening by Mr. C. W. Leather, Checkheaton.

RADIO SOCIETY OF HIGHGATE.
At 7.45 p.m. At the 1919 Club, South Grove. Lecture by Prof. E. Mallett, M.Sc.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.
Lecture on "Properties of Crystals," by Mr. H. H. Smith.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
Lecture on "Some Gadgets of a Faddist," by Mr. G. P. Kendall, B.Sc.

MANCHESTER WIRELESS SOCIETY.
Annual General Meeting.

Saturday, November 11th.

HECKMONDWIKE AND DISTRICT WIRELESS SOCIETY.
At 3 p.m. Exhibition and Demonstration. Opening by Lieut. H. W. Burbury, R.N., Crigglestone.

LIVERPOOL WIRELESS SOCIETY.
First meeting of Winter Session at Royal Institution. Address by Prof. E. W. Marchant.

Sunday, November 12th.

Daily Mail Concert from the Hague, 3 to 5 p.m., on 1,085 metres.

Monday, November 13th.

NORTH LONDON WIRELESS ASSOCIATION.
Lecture on "Telephone Working : External Routine," by Mr. A. G. Hill.

WIRELESS SOCIETY (HULL AND DISTRICT).
At the Signal Corps Headquarters. Lecture on "Calculation of Capacity," by Mr. Hy. Strong.

IPSWICH AND DISTRICT WIRELESS SOCIETY.
At 8 p.m. At 55, Fonnereau Road. Annual General Meeting.

FINCHLEY AND DISTRICT WIRELESS SOCIETY.
Lecture by Mr. Wilck.

Tuesday, November 14th.

Transmissions of Telephony by **2 MT**, Writtle, as above.

Wednesday, November 15th.

EDINBURGH AND DISTRICT RADIO SOCIETY.
At 8 p.m. At Headquarters. Lecture on "Need for International Language in W.T." By Mr. A. Boyd Anderson, F.B.E.A.

Thursday, November 16th.

LUTON WIRELESS SOCIETY.
At 8 p.m. At Hitchin Road Boys' School Exhibition and Demonstration (Messrs. Radio Instruments Co.).

DERBY WIRELESS CLUB.
At 7.30 p.m. At "The Court," Alvaston. Informal meeting.

Friday, November 17th.

BRADFORD WIRELESS SOCIETY.
Cinema Display.

BIRMINGHAM EXPERIMENTAL WIRELESS CLUB.
At Digbeth Institute, Birmingham. Lecture by Mr. P. R. Coursey, B.Sc. (All members of Federated Midland Wireless Societies invited.)

The Wireless Society of London

Report of Proceedings at the Ordinary General Meeting held on October 25th.

An ordinary general meeting of the Society was held on Wednesday, October 25th, at 6 p.m., at the Institution of Electrical Engineers.

After the minutes of the previous meeting had been read and confirmed, the **President** said:—

The list of members proposed for election is being distributed in the usual way, to be collected at the end of the meeting. It is very satisfactory to note the very large increase at every meeting of the number of members joining us, and also the lists of Societies and Clubs becoming affiliated.

Before calling upon our lecturers, Mr. Smith-Rose and Mr. Barfield, to give their paper, there are a few matters of business to go through. The first is that a letter has been received from Messrs. Bertram Day & Co., thanking our Society for associating itself with the late Exhibition. We, in our turn, may well congratulate Mr. Bertram Day on a very great success.

Now I have a very important announcement to make to you, and I feel very proud that, as President, I should have to do it. The announcement is that His Royal Highness the Prince of Wales has graciously consented to become the Patron of the Wireless Society of London and the affiliated Societies, and he notices that we intend to change our name to the Radio Society of Great Britain. I think, ladies and gentlemen, that this is a very great honour for the Society. (Applause.)

There is another matter which I have to bring to your notice. I have had an appeal from Captain Ian Fraser, who is in charge of St. Dunstan's Hostel for Blinded Soldiers and Sailors. Captain Fraser is himself a blind man. He is interested in wireless, and was an amateur before the war. He asks me to bring to the notice of those connected with the Wireless Society of London suggestions whereby they can help individually blinded men all over the country, who wish to take up wireless. I visited St. Dunstan's, and had a long talk with him, and he has written me a letter explaining what he wants. He has his own wireless apparatus, which he practically built up with his own hands, with very slight assistance from one of our members. I will ask the Secretary to read his letter, which will be published later on, and I may say that His Royal Highness wishes to associate himself as his first act as Patron of this Society, with this appeal for St. Dunstan's. I think that alone will be sufficient to push it. We all have sympathy with these men in their darkened lives, and if they can be helped by us individually, I think we shall be glad to assist.

The following is the text of the letter which was then read:—

The Council of the Wireless Society of London have had under consideration a request from Captain Ian Fraser, the Chairman of St. Dunstan's, that they should bring to the notice of wireless amateurs a direction in which they can contribute very materially to the instruction and entertainment of blind people who are, or will be, interested in radio-telegraphy and telephony. Captain Fraser was himself blinded in the war, and has, both before and since he lost his sight, made a hobby of the study of radio and allied sciences. He states from his own practical experience that it is possible for a totally blind person, with no more knowledge of the subject than the average ordinary amateur, to look after his instruments, accumulators, batteries, etc., and manipulate them with great accuracy and without any sighted assistance. He further claims that with a little more knowledge of the subject, the connecting up of instruments, experimenting with various circuits, and even the building up of simple apparatus, is not outside a blind man's reach. In his appeal to the Council Captain Fraser points out that, in spite of the above, there are initial difficulties such as the fitting up of an aerial, leading-in tube, etc., which the most skilful blind man cannot undertake, and that in the case of absolute beginners unusual difficulties present themselves in connection with the choice of suitable apparatus to purchase, learning how to use it, etc.

Since a blind man is deprived of many forms of enjoyment which are available for those who can see, Captain Fraser asked the Council if it would consider these points on behalf of its members, and take steps to place them before the Councils or Committees of all associated or affiliated societies with the following objects: (1) To obtain an indication as to whether or no the societies would be willing to make a special point of arranging for one or more of their members to make a particular friend of any blinded soldier or other blind person who might qualify for membership of the society, and undertake to give him the personal assistance which is obviously required in the directions outlined above; and (2) if it is indicated that the affiliated societies are willing to help in this way, it is suggested that a notice should be printed in the *St. Dunstan's Magazine*, and in the *Braille Press*, and that all other suitable steps be taken to let blind people know that if they apply to either the Wireless Society of London or to Captain Fraser they will be put in touch with their local society, the members of which (if the blind person qualifies in all other respects for membership) will be willing to welcome him and give him special assistance.

It is understood that no financial assistance is asked for in connection with this scheme, but merely personal service and interest, and the Council of the Wireless Society of London unanimously resolved to ask all affiliated societies to consider this matter and indicate to the Council, or direct to Captain Fraser, Headquarters of St. Dunstan's Work, Inner Circle, Regent's Park, N.W., if they are willing to co-operate.

There are 35,000 blind persons in the United Kingdom, of whom 2,000 are blinded soldiers. Probably only a relatively small number will be interested, but by them the help asked for will be greatly appreciated, and already Captain Fraser has the names of a few blind people who would welcome assistance on the lines indicated.

I take it that those present here approve of this appeal to the members of our Society.

I will now ask the Chairman to make a few remarks.

Mr. F. Hope-Jones (*Chairman*).

Ladies and Gentlemen: One announcement which ought to be made to-night is that we propose to call the next monthly general meeting (on the fourth Wednesday in November) a *special* general meeting, the object being that it may be competent to make alterations in our constitution by certain changes in our rules. We try to keep the rules. There are very precise regulations bearing on them. The last three state how the other rules can be amended. Rule 42 states in effect that if the alterations emanate from the general body of the membership apart from the Committee they must be signed by ten members, and must be in our hands a month before the meeting, and it must be either an annual meeting or a special general meeting. Rule 43 states that any alterations are to be sent by the Honorary Secretary to all members at least a fortnight before that annual general or special general meeting. It will mean that you will get your notices a fortnight before the next meeting, rather earlier than usual. Rule 44, the last rule in our constitution, provides that no amendments shall be adopted unless at least three-fourths of the votes are in favour of such action. I will briefly mention the subjects of change. One has already been referred to in the minutes which have just been read, that is the new class of membership called Associates. It may strike you as a little bold that action of that kind should be taken in advance of an alteration of the rules, but I can assure you that we only break our laws in the interest of the Society when occasion or emergency really demands it. In this case, as you know, broadcasting and the announcement that there should be two classes of licences created a new class that ought to be taken under our wing, and if we had not done so, perhaps other people would have thought it necessary to start associations for that purpose.

And then the change of name. Did you notice the terms in which the President announced the great honour of our royal patronage? Apparently His Royal Highness the Prince of Wales has gone out of his way to note that the name of the Society is to be changed from the Wireless Society of London to the Radio Society of Great Britain.

It was mentioned in the minutes of the last meeting which you have just heard read that that matter was still only mooted and would receive further serious consideration. All I can tell you, gentlemen, is that it *has* received further serious consideration, and practically a chorus of approval There has been, I think, no voice raised against the proposal, certainly none in the provinces among our affiliated Societies, who are most concerned. I will not trouble you with the precise alterations now because you will find them with the notice calling the next meeting.

Another matter which I am desired to mention is the proposal that we should institute some prizes. We have had the suggestion knocking at our door for some time, but the Council has been so much engaged with other important matters that they have not been able to do justice to it. They have received an enterprising offer from a prominent member who suggests that we might announce a prize for the most efficient Armstrong Super-Regenerative Circuit. The Americans are setting themselves very closely to work on that subject, and this gentleman feels keenly that we should not be beaten on the other side of the Atlantic, and has made a generous offer of a ten-guinea first prize. The Committee proposes to issue the conditions forthwith, and there will very likely be a second prize.

The President.

I am sorry to take up so much time from the lecture, but it is necessary to bring these things before your notice. I will now ask Mr. Smith-Rose and Mr. Barfield to give their lecture on "The Effect of Underground Metalwork on Radio Direction Finders." (*See pages* 165-171 *of issue of November 4th*, 1922.)

At the conclusion of the paper and discussion (*see page* 202 *of this issue*) the **President** said:—

All the large number of members and associate members up for ballot have been elected, and the list of the Societies accepted for affiliation. (*For list see page* 176 *of issue of November 4th.*) In addition a large number of Associates have joined the Society.

There are also several other members in addition to those in the printed list and passed by the Committee who will be put up for ballot next month.

The next meeting will be on the fourth Wednesday in November. You have heard already that it will be a special one. There will also be a lecture.

The meeting adjourned at 7.15 p.m.

Wireless in Schools.

Mr. R. J. Hibberd, Grayswood School, Haslemere, is compiling a list of Primary, Secondary and Public Schools which possess wireless apparatus. Particulars would be gladly received by him as follows:—(1) Name and type of school. (2) Date apparatus was installed or made. (3) Nature of work carried on.

New Station at Phuto.

At Phuto, near Saigon, the Compagnie Générale de Télégraphie sans Fil has erected a new station. Direct communication with Saint Assise, and also with Tananarivo, Madagascar, is to be effected.

New Station at Lausanne.

At Lausanne a new station has been erected. Transmissions are on 900, 1,400 and occasionally 2,610 metres. Telephony on 900 is transmitted from the station to aeroplanes leaving Le Bourget. Messages are also sent to Dijon on 1,400 metres between 11 a.m. and 12 noon.

Chess Played by Wireless.

An interesting experiment conducted by the local wireless club at Guildford consisted of a chess match in which the moves were communicated by wireless. The match was played by the Guildford Chess Club.

Wireless Club Reports

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

Willesden Wireless Society.*

Hon. Secretary, Mr. G. D. Wyatt, 70, Craven Park, Harlesden, N.W.10.

Several changes in the administration of the Society have recently taken place, and the Society has now settled down in its new headquarters at The Harlesden Public Library, Harlesden, N.W.10.

A very interesting programme has been arranged for the winter session. Regular meetings are held every Tuesday evening from 8 p.m. to 10 p.m. Owing to the kindness of several of the long-standing members who have volunteered their services as instructors, provision has been made for the less experienced members to gain knowledge through the medium of elementary lessons. These lessons will precede the ordinary meeting on Tuesday evenings, commencing promptly at 7 p.m. Lectures by well-known people will be a feature of the Society's future programme and, as the club apparatus has been enlarged, it is confidently anticipated that adequate demonstration of the principles involved in the lectures will be possible. A new twin-wire aerial is shortly to be erected.

Hamilton and District Radio Society.*

Hon. Secretary, Mr. James M'Killop, 22, Dalziel Street, Hamilton.

The above Society is now in full swing.

Lectures have been arranged for every Friday evening at 8 p.m. by members and others who have knowledge of the subject. Already lectures have been given by Mr. Jas. Brawn (Vice-President) on different types of receivers for beginners; Mr. D. Miller, on "Electricity and Magnetism"; Mr. S. B. Becket (President), on "Possibility of Communication with Mars," and Mr. McCammond on "Accumulators." The Vice-President has kindly loaned a three-valve transformer-coupled receiver for use in the Society's room until the instrument under construction is completed.

Bradford Wireless Society.*

Hon. Secretary, Mr. G. Bever, 85, Emm Lane, Heaton, Bradford.

A meeting was held in the club-room at Randall-well Street, on October 20th, with Mr. A. Liardet in the chair. The minutes of the previous meeting having been passed as correct, and three new members elected, the Chairman called upon the Secretary to give his lecture on "Telephony." In an exceedingly able manner Mr. Bever dealt with the various circuits appertaining to telephony transmission, illustrating his remarks by numerous diagrams. At 9 p.m. a demonstration of telephony was given from the lecturer's station (2QK) and rendered audible all over the hall by means of his four-valve receiving set in conjunction with a Magnavox loud speaker and power amplifier. Reception was exceedingly good, both from 2QK and other stations. A vote of thanks was accorded to Mr. Bever for the lecture and demonstration. Thanks were also expressed to Mr. Longbottom who had kindly loaned the Magnavox apparatus.

The arrangements for the Society's annual exhibition are now in hand, to be held at the end of January. The Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds, will be glad to hear from any firms desirous of exhibiting apparatus. Communications will receive prompt attention.

Aberdeen and District Wireless Society.*

Joint Secretary, Mr. James S. Duthie, M.A., 148, Forest Avenue, Aberdeen.

The Society met in new quarters at Aberdeen Grammar School, on October 20th. Dr. Fyvie, Marischal College, occupied the chair.

The following gentlemen being duly elected accepted office:—President, Dr. Fyvie; Vice-President, Dr. McLeod; Secretary and Treasurer, Mr. W. W. Inder, M.I.R.E.; Joint-Secretary, Mr. James S. Duthie, M.A. General Committee: Messrs. John Miller, Cumming, Walker, Shearer, James Miller, Watson. Technical Committee: Dr. Fyvie, Messrs. Inder, John Miller.

It was unanimously decided that ladies would be eligible for membership.

Mr. G. W. G. Benzie was presented with a leather suit-case, on his leaving for India to take up an appointment. Mr. Cumming, in making the presentation, thanked Mr. Benzie for the great interest he had taken in the Society, and wished him every success in his new sphere of work. Mr. Benzie, in a happy reminiscent speech, thanked the members of the Society for their great kindness.

The meeting terminated with an inspection and demonstration of the Society's five-valve set.

Wireless and Experimental Association.*

Hon. Secretary, Mr. Geo. Sutton, 18, Melford Road, S.E.22.

On October 18th, at the Central Hall, Peckham, the scheme of the "Agenda Committee," was considered. Five members were elected whose sole duty on that committee is to ascertain the special needs of the other members in the various stages of wireless progress.

Should a member desire to know how to construct a crystal set, the committee member for the elementary grade would ascertain the special circumstances of his case and report to the Secretary, who then would take steps to ensure that at an early "elementary" meeting, that member's difficulties would be fully gone into.

Should an advanced member desire to know whether a separate heterodyne will meet his special needs, the pros and cons would be gone into by one of the valve specialists for the benefit of the whole meeting, and if the younger members did not receive immediate benefit they would probably make notes for the future.

The Radio Society of Highgate.*

Hon. Secretary, Mr. J. F. Stanley, B.Sc., A.C.G.I., 49, Cholmeley Park, Highgate, N.6.

An informal discussion was held at the 1919 Club, Highgate, on October 13th, when several interesting points were raised by members. Mr. Andrews explained the results of some experiments on the damping of an oscillatory circuit caused by the introduction of a crystal detector and pair of telephones. Messrs. Hogg and Grinstead contributed some useful remarks on the value of the ratio, "Inductance to Capacity," in an oscillatory circuit.

Mr. Stanley emphasised the necessity of thoroughly insulating the units of a high tension battery when made up of pocket lamp batteries.

It is unfortunate that at these discussions nearly all the talking is confined to the more advanced members. New members and novices are urged to take a more active part in the discussions.

On October 20th, Mr. Grinstead gave an instructive lecture on "Valve Characteristics and Design." Mr. Grinstead is an expert on this subject, and the theory of valve design was very ably dealt with. Both transmitting and receiving valves were discussed, and the differences in their design carefully explained.

All members are urged to do their utmost to ensure the success of the Radio Dance to be given at the Gate House, Highgate, on Saturday, November 25th. There are still a number of tickets to be disposed of in order to cover expenses. Single tickets, 7s. 6d. and double tickets 12s. 6d. inclusive, may be obtained from the Hon. Secretary.

Birmingham Y.M.C.A. Wireless Club.

Hon. Secretary, Mr. R. Jenkinson, Y.M.C.A., Dale End, Birmingham.

The winter programme commenced on October 17th, a demonstration being given by Mr. H. H. Whitfield (**2 LG**), of Messrs. Cook & Whitfield Wireless, Ltd.

Telephony by Mr. Baynton (**2 KO**) was heard with remarkable clearness by about 100 people.

The equipment at present consists of a three-valve receiving set. Lectures are to be given fortnightly.

Birmingham Experimental Wireless Club.*

Hon. Secretary, Mr. Frank S. Adams, 110, Ivor Road, Sparkhill, Birmingham.

The first Conference of Midland Wireless Societies convened by the Birmingham Experimental Wireless Club, was held at the Y.M.C.A., Dale End, Birmingham, on October 14th.

Dr. J. R. Ratcliffe, M.B., F.R.C.S., President of the Birmingham Club, took the chair.

The following Societies were represented:—Birmingham Experimental Wireless Club, Birmingham Y.M.C.A. Wireless Club, Burton-on-Trent Wireless Society, Coventry Wireless Association, Smethwick Wireless Society, Wolverhampton and District Wireless Society.

A telegram was received from the Stoke-on-Trent Wireless and Experimental Society, regretting that their delegate was unavoidably detained, and would be unable to attend.

A letter from the Rugby and District Wireless Club was read in which the Hon. Secretary expressed his regret that the Club would be unable to send a delegate.

The formation of a Federation of Midland Wireless Societies was formally approved. It was also resolved that a periodical should be published as the official organ of the federation.

The title and objects of the Federation have not been finally decided upon, this being left to a further conference which will be held shortly.

The proceedings terminated with votes of thanks to Dr. Ratcliffe and Mr. F. S. Adams

Brighton and Hove Radio Society.

Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue.

The first general meeting of the above Society was held on October 11th, 1922, at 7.30 p.m. After electing a chairman for the evening, the election of officers and committees took place.

Capt. C. Hoghton (late President of the Sussex Wireless Research Society) was unanimously elected President for the ensuing year. A supreme council of four and executive and technical committees of six members were elected. The Society's

Demonstration at Birmingham Y.M.C.A. Wireless Club.

very energetic Secretary, Mr. D. F. Underwood, was elected Secretary of the new Society, and Mr. Phelp, the past Assist. Secretary of the Brighton Radio Society, Assist. Secretary of the new Society. A new Treasurer, Mr. Mons, was elected, and the Brighton Society's librarian elected to the new post.

Smethwick Wireless Society.*

Hon. Secretary, Mr. R. H. Parker, F.C.S., Radio House, Wilson Road, Smethwick, Staffs.

A successful meeting of the above Society was held at the Technical Institute on September 22nd, when Mr. Saunders gave his lecture on "Electric Waves and Radio Activity." The lecture proved to be very interesting, and a hearty vote of thanks was accorded to Mr. Saunders.

At a meeting on September 29th, Mr. S. D. Waltho in the chair, after the usual buzzer practice instructed by Mr. Headley on this occasion, it was decided to hold weekly meetings; one week to be given to lectures and the other week for experimental purposes on the Society's apparatus.

Mr. Headly was elected to represent the Society at the Conference of Midland Wireless Societies.

Fulham and Putney Radio Society.*

Hon. Secretary, Mr. J. Wright Dewhurst, 52, North End Road, West Kensington, London, W.14.

At a meeting held on October 20th, which was well attended, a considerable amount of business was done. The Society's headquarters are being moved to Fulham House, Putney Bridge, which is the headquarters of the 47th (2nd Lon.) Div. Signal Company, and the wireless room has been placed at the Society's disposal one evening each week by the commanding officer.

There is a very fine aerial fixed and the room is equipped with 120-watt and 30-watt C.W. sets, also a 20-watt spark set, and the Society has a collection of apparatus of its own.

It was also arranged that a technical committee of the following members, Messrs. Hart-Smith, Wooding, Calver, Houstoun and Galton be formed to deal with the arranging and making of apparatus and most of the members present promised to assist by giving apparatus or component parts to the Society.

It was proposed that the Secretary write to the Wireless Society of London stating that the Society was in full sympathy with their views regarding the change of title and the amalgamation of all Societies.

The Secretary was asked to write stating the Society's views regarding the broadcasting restrictions.

Regarding the transatlantic tests for amateurs the Society intend to apply for special permission to transmit for these tests.

Mr. Calver gave the first of a series of lectures on the elementary principles of wireless; the first lecture was entitled "Ether Waves and Rays." Mr. Calver treated the subject very fully and the members were very appreciative.

A very hearty vote of thanks was accorded to Mr. Calver.

The outlook for the Society is very promising and with a fully equipped club-room membership should increase.

Belvedere and District Radio and Scientific Society.*

Hon. Sec., Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

The eighth general meeting of the above Society was held at the Erith Technical Institute on October 20th.

The usual buzzer practice took place from 7.30 to 8.0 p.m., members making good headway at five words per minute.

The Secretary informed the meeting that the Postmaster-General's receiving permit had arrived. He read a letter from The Wireless Society of London, stating that The Belvedere and District Radio Society had been approved for affiliation, which places it as the recognised Society for Erith and Belvedere.

At 8.15 Mr. A. G. Norman spoke on the subject of choosing a type of receiver. He classed wireless amateurs in three groups: (1) The broadcaster; (2) the serious experimenter, and (3) the man who was satisfied with his set, *i.e.*, the non-progressive man, outlining the type of receiver most suitable for each group. For the broadcaster, crystal receivers were suitable on well designed aerials for moderate distances from the broadcasting centres, valve receivers being used for longer distances. The serious experimenter would, of course, have no fixed arrangement, but would always be trying something different, or working on some fresh "gadget," therefore the set for him must be very flexible in its adaptation.

Mr. R. G. Herschell gave a short elementary lecture on "Resistance, Inductance and Capacity," explaining the fundamental actions of these three important properties of the electrical circuit. Although the lecture was necessarily brief, quite a deal of information was gained by beginners, and was appreciated by all.

Finchley and District Wireless Society.*

Secretary, Mr. A. E. Field, 28, Holmwood Gardens, N.3.

On Monday, October 23rd, a lecture on "The Principles of the Valve" was given by Mr. Trussler. At the close of his lecture, which was exceedingly clear to even the absolute novice, a demonstration was given on a three-valve home-made set by Mr. Heppel, on which excellent results were obtained.

Radio Experimental Association (Nottingham and District).*

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A meeting of the above Association was held in the People's Hall, Heathcote Street, Nottingham, on October 19th. Mr. Gill, having taken the Chair in the unavoidable absence of Mr. Thornton, informed the meeting that the lecturer for the evening was unable to attend through illness. Mr. Ford, however, stepped into the breach and gave an interesting lecture on "Aperiodic Transformers," setting forth clearly the essential points to be borne in mind when designing such transformers to function efficiently over a comparatively large band of wavelengths. Following the lecture an interesting discussion took place.

Will all members please note that commencing Thursday, November 2nd, meetings will be held weekly at Messrs. Bennett's Garage, Shakespeare Street, Nottingham, where an ideal room, with aerial already installed, has been secured for the use of members.

Glasgow and District Radio Club.*

Hon. Secretary, Mr. W. Yuill, 93, Holm Street, Glasgow.

In the club-room on October 19th, Mr. W. K. Dewar presided before a very large attendance, and remarked that he thought the club would soon require larger premises.

After the usual preliminaries, the Chairman called on Mr. Yuill to open a discussion on the best circuit to use for a valve broadcasting reception set to comply with the P.M.G. Regulations, and the following gentlemen took part:—Messrs. Quinn, Todd, Wright, McDade, Nicholson and Morrison. After a show of hands Mr. Morrison was declared the winner of a M.O. "R" valve, kindly presented by the General Electric Company, Ltd., 71, Waterloo Street, Glasgow, for the best reply. This was a new innovation, and the Chairman asked for a show of hands to see if the members would like a similar night later in the session, and this seemed to be the unanimous opinion.

The next meeting was held on October 26th, when a full discussion of the arrangements for the exhibition on November 4th took place.

Hornsey and District Wireless and Model Engineering Society.

Hon. Secretary, Mr. H. Davy, 134, Inderwick Road, Hornsey, N.8.

At a meeting on October, 13th, 1922, the chair was taken by Mr. H. J. Pugh. The usual business was gone through and one new member was elected. The Chairman then called on Mr. H. Davy to give his lecture as per programme.

Mr. H. Davy gave an interesting lecture on "The Thermionic Valve as a Detector," after which many questions were asked which showed that the large attendance had taken particular interest in the subject which was so ably explained by the lecturer.

The meeting was then thrown open, and discussion took place on the merits of high and low frequency amplification. A new programme of interesting lectures, etc., has been arranged. Particulars may be obtained from the Hon. Secretary on receipt of stamped envelope.

Mount Pleasant Radio Society.

Hon. Secretary, Mr. Walter R. Fleming, 156, Upton Park Road, Forest Gate, E.7.

A meeting of the above Society, which was held on October 19th, was opened with buzzer instruction under Mr. G. H. Vine. Very satisfactory progress is being made.

This was followed by a lecture on the "Rudiments of Wireless," by Mr. W. D. Keiller, technical adviser to the Society. He dealt very ably with the subject, explaining the molecular theory of magnetism, electrons, atoms, positive and negative currents, etc. After answering several questions the lecturer was accorded a hearty vote of thanks.

New headquarters have been obtained at John Street Chapel, John Street, Theobalds Road, W.C.1, and a splendid series of lectures will be given during the winter session.

Particulars of affiliation to the Wireless Society of London have been received and it is hoped to become a member in the near future.

Full particulars as to membership, etc., may be obtained from the Hon. Secretary.

Clapham Park Wireless Society.

Hon. Secretary, Mr. J. C. Elvy, A.M.I.E.E., 12, Tavistock Street, Strand, W.C.2.

The eighth general meeting was held at headquarters on October 18th.

There was the usual crowded attendance which promised a lively discussion. Mr. A. E. Radburn was again elected Chairman for the evening.

After election of new members, the Hon. Secretary reported that he was still awaiting further information to facilitate the passage of the Society towards affiliation with the Wireless Society of London.

Several copies of flashlight photographs of October 4th evening's proceedings were secured by members.

Mr. C. W. Richardson opened the discussion on "Aerials and Cognate Matters" by a lecturette delivered in a pleasing and instructive manner with the aid of blackboard diagrams and apparatus he had brought along with him.

All present were ably conducted through the so-called mysteries of aerials, wavelengths, inductances, condensers, aerial oscillations, the latter two items being regarded by the lecturer as misnomers. The course adopted by the lecturer was in tabloid form, showing how the principles of wireless were made easily understandable by following the first principles of force, inertia and capacity. As a measure of appreciation by his audience he was prevailed upon by them to continue his lecture and demonstration on November 1st.

An interesting discussion was entered into by Messrs. Beedle, Hon. Secretary, Hon. Treasurer, Daniels, R. McCue, Hurst, Bruce, and the Chairman, introducing "Transposition of Energy, Heat, Skin effect of A.C. versus Resistance."

A hearty vote of thanks was accorded the lecturer.

The Hon. Secretary reported a gracious offer on the part of Mr. F. H. Haynes to describe the building up of "An Amateur Three-valve Receiving Set," to be followed by demonstration and discussion, which offer the members gladly accepted. Mr. F. H. Haynes agreeing to come to the next meeting, October 25th, for that purpose.

Proposed Gorton (Manchester) and District Wireless Society.

Hon. Secretary (*pro tem*), Mr. G. Sykes, 13, Longford Street, Gorton.

Amateurs, experimenters and all interested in wireless matters within the Gorton district of Manchester, are asked to communicate with the gentleman whose name is given above. Mr. Sykes, together with Mr. T. E. Rowe, 8, Fairhaven Street, Hyde Road, W. Gorton, hopes to receive sufficient support to enable them to inaugurate a society.

Rhyl and District Amateur Wireless Society.

Hon. Secretary, Mr. C. Mitchell, 24, East Parade, Rhyl.

At the meeting on October 18th, a lecture was given by Dr. Goodwin. His subject was "Induction." Dr. Goodwin prefaced his remarks by saying that although induction was his subject, yet he intended it to cover a very wide field, as so many electrical forces came under the title of induction. Dr. Goodwin then explained the meaning of the term as far as it was possible. He dealt with the mysterious happenings when certain electrical forces were let loose, no matter how minute, and explained the result. From the scientist's point of view it might be comparatively clear, but the lay mind had difficulty in understanding why the universe was not a heap of dust after listening to some of the happenings which were possible, with limitations, which the lecturer dealt with. But the system of electrical induction was so closely allied to wireless that it would be almost impossible to either transmit or receive telephony without it. Why it was that we should have two coils, separated by space with no connection, yet, when one is charged with electricity the other takes a charge also, seemed almost beyond comprehension. All these things were dealt with by Dr. Goodwin in a lecture which created profound interest.

St. Helens Radio Club.

Hon. Secretary, Mr. C. Hodgson, Crescent House, Liverpool Road, St. Helens.

Meetings of the above club will be held in the Y.M.C.A. Buildings, North Road, every Tuesday night at 7.30 p.m.

Arrangements are being made to provide interesting and instructive meetings.

Applications for membership should be made to the Hon. Secretary.

Paddington Wireless and Scientific Society.

Hon. Secretary, Mr. L. Bland Flagg, 61, Burlington Road, Bayswater, W.2.

The fourth general meeting of the Society was held at the Institute under the Chairmanship of Vice-President Dr. J. H. Vincent, and the attendance created quite a record. The business of the Society included the minutes of the last meeting and the presentation of the monthly accounts, after which the recommendations of the Committee were put before the members. The recommendations included a Sale and Exchange and the election of the following hon. members :—Messrs. Clements, Alexander, Sutton and Styles.

A crystal receiver was very kindly presented to the Society by Mr. A. Hoban, which was acknowledged by a very hearty vote of thanks from the chair, and endorsed by the meeting. A working committee of four was formed to take over the erection of the new aerial, which it is hoped to see in service very shortly.

A new section was opened under the heading of "Student Membership" to cater for the second year day students of technical institutes and grammar schools in the immediate neighbourhood of the Institute, particulars of which can be obtained from the Hon. Secretary.

Mr. A. L. Beak, A.M.I.E.E., read a very interesting paper entitled "High Frequency Amplification." Mr. Beak dealt mainly with resistance capacity, coupled amplifiers, the intricacies of which he elucidated very fully. A short discussion followed, after which the meeting closed with a vote of thanks to the lecturer.

Enquiries re membership should be addressed to the Hon. Secretary.

Ayr and County Radio Society.

Hon. Secretary, Mr. J. Blair, Rosebank, Marchfield Road, Newton-on-Ayr.

Following a public invitation, the above-named Society was formed. The undernoted officers were elected :—President, Mr. D. M. Sproat ; Vice-President, Mr. Rich Currie ; Hon. Treasurer, Mr. W. Robertson, jnr. ; Hon. Secretary, Mr. J. Blair. Committee : Miss Jean Raince, Messrs. Auld, Cassells, Headley, Oliver, Robertson, Lamont and Ross. Members are now being enrolled.

The newly formed Society has six fully qualified holders of P.M.G.'s Certificates, and of these one is Miss Raince.

The Society is greatly indebted for its being to the Vice-President, Mr. R. Currie, of Messrs. Reid & Co., and also to the valuable information received from Mr. W. Yuill, Hon. Secretary, Glasgow and District Club, who honoured the meeting with his presence.

The Society wish to express their appreciation to Mr. M. Miller, **2MG**, for his transmissions of telephony which were picked up, but owing to ship stations jamming it was only heard intermittently. Classes will be formed for each class of member, viz., Morse, Construction and Technical. It is fully anticipated that a very prosperous Society has been inaugurated.

The Society meets every Friday at 8 p.m., beginning October 27th, in the show rooms of Messrs. Reid & Co., High Street, Ayr.

Communications should be addressed to the Hon. Secretary.

Eastbourne Amateur Wireless Society.

Hon. Secretary, Mr. W. F. G. West, 11, Bolton Road, Eastbourne.

The above Society has been formed and the Secretary will be glad to reply to and give full particulars of the Association's objects and terms of subscription to all gentlemen who are interested and desire to seek membership. Several lectures have already been given, and have been well attended.

A programme for the winter session is being arranged for, and members will be notified in due course. The Secretary would be very grateful to hear of any gentlemen who can give a lecture or otherwise contribute to the programme.

It is hoped very shortly to announce that permanent headquarters have been obtained, where it is proposed to erect a wireless set for the use of members.

A lecture was arranged for October 31st.

Bolton Wireless Society.

Secretary, Mr. D. Walford-Druequer, 4, Bold Street, Bolton.

At a Special General Meeting held on October 13th the following members were elected to hold office :—

Chairman, Mr. C. Kershaw ; Vice-Chairman, Mr. R. C. Walch ; Hon. Secretary, Mr. D. Walford-Druequer ; Hon. Treasurer, Mr. J. Waller ; Committee : Mr. J. McLeod, Mr. G. T. Woodley, Mr. C. Andrews, Mr. C. H. Smith.

The meeting was devoted to general discussions on the way the Society had been run in the past and many things were promised by the new Committee, and everybody looks forward to a very good season.

The new Committee met on October 17th, and the following business was dealt with :—(1) That the Society becomes affiliated with the Wireless Society of London. (2) That the subscriptions be reduced to 10s. 6d. per year for full members and 5s. per year for junior members. Entrance fee for junior members to be 2s. 6d. Same to come into force forthwith. (3) That membership cards be issued to all members. (4) That a dance be arranged to be held the week preceding Xmas. (5) That two whist drives be arranged ; one to be held in the first week in November and the other in the first week in December. (6) That the Society goes in for transmitting. (7) That the Society obtains a new five-valve receiving set. (8) That the Society join the Relay League. (9) That the Secretary take charge of the winter entertainments and that he arranges a good programme including some interesting lectures. (10) That the Annual General Meeting be held on the last Tuesday in September each year instead of December, as at present. (11) Alterations were made in the rules to be brought up at the next General Meeting. (12) Mr. McLeod was asked to take charge of the arrangements with reference to transmitting, and he asked Mr. Andrews and Mr. Smith to form a sub-committee under him to carry out this work.

All the above were resolved, and after about an hour's general discussion on the running of the Society, the meeting was declared closed by the Chairman.

The new Committee ask for new members to the Society, and can promise them a real good programme.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:—(1) Each questions should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required, every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

"P.T." (Maldon).—(1) The precise details for converting a single valve panel into a two or three-valve set conforming with the regulations of the Postmaster-General, were given on page 865 of our issue of September 30th last. (2) One is not permitted to construct or instal wireless apparatus without first obtaining permission from the Post Office. We cannot advise you on the qualifications required by the Post Office in the award of an experimental licence, but we understand that you have to satisfy them that you have a serious interest in experimental wireless work. Why not pass your question to the Post Office, and ask them for a statement as to the qualifications which they are desirous you should hold.

"I.C.B." (W.2.).—Certainly it is possible to render ordinary land-line telephone messages audible in a loud speaker, or strongly magnified in headgear telephone receivers. We should recommend you to use a three-valve note magnifier connected as shown in Fig. 1, on which all necessary values are given. Before connecting this apparatus to your telephone, we would advise you to obtain permission from the Post Office.

"H.S.F." (Greenock).—An experimental licence authorising you to construct your own apparatus will be probably awarded by the Postmaster-General if you make it clear to him that you have some definite theme of research in view, and that you are fully qualified to use wireless apparatus in such a way as not to cause interference. However, why not write to the Secretary of the Post Office and obtain the necessary forms, and if you have any difficulty, then write to us.

"C.G.S." (Brighton).—Circuits which are not capable of energising the aerial to a serious extent have been repeatedly given in this journal for the past six weeks. We would refer you in particular to the instalment on Experimental Station Design in our issue of September 30th last, which has apparently escaped your notice. With regard to the unit system, it must be capable of being assembled in such a way that the circuit cannot be easily modified by the user. Anyhow, submit your proposed designs to the Post Office.

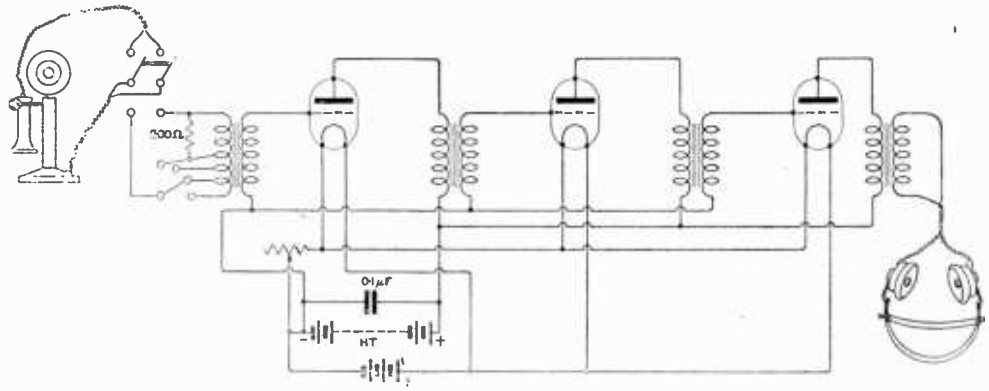


Fig. 1.

"G.F.P." (Hayes).—(1) Yes, but reacting back to the tuning circuits in this way is liable to lead to oscillation and seriously interfere with the pleasure of other listeners in your neighbourhood. (2) About 2,000 metres. (3) 0·00065 mfds. (4) You should certainly be able to get 2MT with a single valve as H.F. amplifier followed by a crystal, but we doubt if this arrangement will be sensitive enough to give PCGG unless your aerial is a very good one.

"E.H.W." (Twickenham).—(1) The diagram of a single valve receiver which accompanied your letter will certainly not meet with the approval of the Post Office. The conditions specified by the Post Office are clearly stated in a recent issue, and very many circuit diagrams of arrangements which will not cause serious interference have been given in our issues for the past six weeks. Removal of the variometer from the aerial circuit will in no way reduce the extent of radiation which your proposed circuit would produce. (2) The Post Office, we understand, are prepared to authorise the use of a set in which the reaction coupling is fixed, and is arranged so loosely as not to seriously energise the aerial inductance. However, why not make up a two-valve set with tuned anode high frequency amplification and couple the plate circuit of the second valve with this anode inductance, and add a third valve if necessary.

"SPARKS" (Morecambe) *asks* (1) *For a diagram of a two-valve set to meet certain conditions.* (2) *Parts required for this set.* (3) *If he will get* **2 LO, 2 MT** *and* **PCGG.**

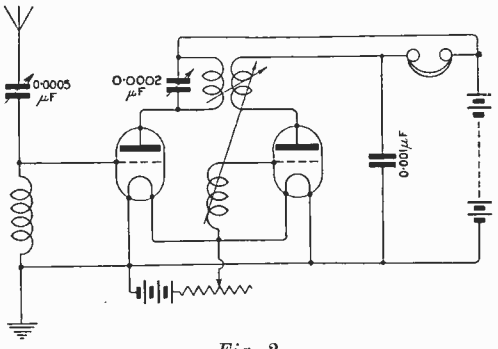


Fig. 2.

(1) See diagram (Fig. 2). (2) Two variable condensers. Aerial tuning inductance reaction coil. H.F. transformer. Two valve holders. One filament resistance. H.T. and L.T. batteries. One pair of telephones. (3) It is very doubtful whether you will get any of these stations.

"F.S." (Hants) *asks* (1) *For a diagram of connections using* 2 *H.F.,* 1 *Detector and* 2 *L.F. valves with switches to cut out any valves.* (2) *Whether capacity reaction should be substituted for direct reaction into the aerial circuit.*

(1) The circuit given on page 883, September 30th issue, is just the diagram you require. (2) Reaction of the type you suggest should not be used. We suggest you couple the reaction coil to the first H.F. transformer secondary. There will then be little possibility of energy being radiated from your aerial.

"SPARKS" (Ilkley) (1) *Proposes to install an experimental spark transmitter.* (2) *Asks whether the formula, watts = volts × amperes, is correct when applied to a circuit connected to an accumulator.*

(1) The circuit submitted will not be satisfactory, and apparatus joined up as you suggest would seriously interfere with other experimenters working on a wavelength anywhere near your own. We understand transmittimg licences are issued to experimenters for specific purposes, and we suggest you apply for a licence before commencing experiments. (2) The formula, watts = volts × amperes, is quite correct. If the current is 5 amperes, and the voltage drop across the apparatus is 2 volts, 10 watts are being used in the circuit.

"S.O.H." (Eastbourne).—(1) The method of modulating at the transmitting stations enters largely into this question. Where the modulation is good, no difficulty should be experienced. If the transmitted oscillations are very slightly modulated the result of using reaction to hear the weak signals is to cause the set very easily to oscillate, and so you hear the carrier wave. (2) We cannot say with any degree of certainty what causes the trouble you mention. You might try removing the condenser, when the self capacity of the winding will probably be sufficient to by-pass the H.F. current. The more likely cause of the trouble, however, is probably to be found in the grid condenser and leak. The grid leak may have become faulty. (3) As your aerial tuning condenser has a rather low value, we think you will have to use a larger coil in the aerial circuit than in the closed circuit when using the series connection. Try the arrangement, aerial condenser in series, No. 150 coil in aerial circuit, and No. 75 in closed circuit, and choose the most suitable value of reaction coil. (4) The arrangement for parallel working which you suggest is quite satisfactory, but it will be necessary to take care not to use too much reaction. The aim should be to alter the positions of the coils until best results are obtained. Generally the reaction coil has to be well away from the closed circuit coil. The connections of your set are quite correct and in every way are suitable. We assume the grid condenser has the correct value—0.0003 mfds.

"AMATEUR" (Northants) *asks* (1) *How to make the most advantageous frame aerial with the highest efficiency.*

As you do not state the wavelength range over which you wish to receive, we cannot give you much useful information. However, frame aerials are fully described in "Mast and Aerial Construction for Amateurs," by Ainsley, price 1/6.

"C.L." (Huddersfield) *asks* (1) *Why a certain circuit sketched gives no better results with two valves than it does with one.* (2) *How to add another valve to the set as an H.F. amplifier with the minimum alteration to the wiring.*

(1) We do not know which of your two panels was the original. The L.F. panel appears to be quite all right, but the detector fails through not having a complete grid circuit. The lower end of the A.T.I. should be connected to the filament of the valve. Possibly the failure of your note magnifying valve is due to the fact that the transformer is incorrectly wound or introduced into the circuit. The windings should be about 3,000 ohms in the anode circuit of the first valve, and 6,000 ohms in the grid circuit of the second. (2) The circuit might become similar to that of Fig. 5, August 5th, page 608, with the omission of the reaction back to the aerial there shown. The method of using transformers for part of the range and resistance capacity coupling for the rest is shown on page 705, August 26th issue.

"**W.G.W. (London)** *asks* (1) *Whether a set ketched is satisfactory.* (2) *Whether it will radiate, nd if so, how much.* (3) *How it can be prevented from radiating.* (4) *If it will receive* **PCGG, 2 MT** *and* **FL.**

(1) Yes, except that a parallel condenser is not at all efficient on short wavelengths. (2) This set will certainly radiate unless the reaction coil is very small indeed. (3) The only way to stop it from radiating is to make the reaction coil very small and to fix it in one position. It is not possible to say how bad the radiation will be as this will depend on the constants of the aerial, etc., but if the couplings are made at all tight the radiation may be as bad as with reaction back direct on the aerial. (4) The set should receive **FL** and **2 MT**, but is not likely to be sensitive enough to receive **PCGG.**

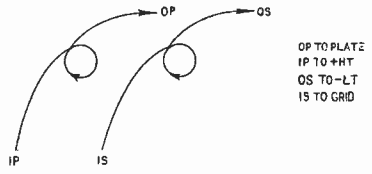


Fig. 3. Windings in a groove. Secondary over Primary.

"**J.B.**" **(Yarmouth).**—The method of connecting up **H.F.** transformers depends entirely upon the direction in which the coils are wound. Figs. 3 and 4 show clearly, we hope, the correct method of joining up. We cannot say how the transformers to which you refer are wound, and we suggest you connect them up according to the manufacturer's instructions.

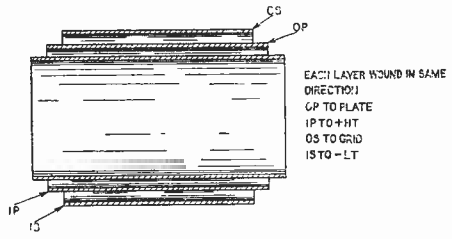


Fig. 4. Single layer windings.

"**A.M.**" **(Ryde)** *asks* (1) *Whether it is possible to use any other type of battery than an accumulator for the filament of a single valve set.* (2) *Whether it is better to have a long aerial lead-in, and a short earth lead, or vice-versa.* (3) *What he is likely to get with a single valve set.* (4) *Wavelength range with certain coils.*

(1) With some types of valve, as for instance the Marconi-Osram "DEV," which only takes 0·2 amps, a dry cell may be used; but we do not recommend the use of dry cells for any valve taking more than 0·5 amps. In any case the cells used should be of large size, and the cost of operation will be considerably more than with accumulators. (2) Long aerial lead-in and short earth lead is much preferable. (3) Most European high power stations, and ships up to perhaps 250 miles, but probably not **2 MT, 2 LO,** or **PCGG** unless conditions are particularly favourable. (4) Up to 700-800 ms.

"**M.E.G.**" **(New Brighton).**—The coils you mention would tune the circuit to about 2,000 metres with a 0·001 mfds. parallel condenser, but the use of a condenser of this size would be very inefficient, and we should strongly recommend you to use about four times as much inductance, and only a quarter of the capacity.

"——" **(Rochester)** *asks* (1) *Whether the American short wave tuner of the June 3rd issue will receive C.W.* (2) *Whether the wavelength range could be increased to* 1,000 *metres without loss of efficiency.* (3) *Whether a certain pair of coils could be used as A.T.I. and reaction coil.*

(1) If made exactly on the lines of the article it is probable that the set will receive C.W., but if it does so it will radiate badly. (2) This could be done, but if the wave were increased in this way any especial merits that the set may have would probably be lost. (3) Yes, but coils used in this way are liable to radiate badly, and therefore are to be discouraged in the interests of others receiving.

"**DADDY LONG EARS**" **(Paris)** *asks* (1) *For a criticism of a set.* (2) *For values for some of the components.* (3) *If he can use honeycombs, and if so, what sizes to use.* (4) *If he will hear* **FL, 2 MT,** *and* **PCGG.**

(1) Satisfactory except that strictly speaking all the grid resistances should be connected to some point which does not change in potential when the polarity of the filament battery is reversed, but in practice this refinement is hardly likely to be necessary. In any case we do not think that very much gain in life of receiving valves is actually obtained by reversing the filament battery. (2) (*a*) 0·0005 mfds; (*b*) 0·0002 mfds; (*c*) 50,000 ohms; (*d*) grid leak 2 megohms; (*e*) preferably 6 volts; (*f*) about 60 volts. (3) Yes, but particulars will depend on the waverange required, which is not specified. Turns may vary from about 50 for very short waves up to about 1,500 for long waves. The gauge may be about 0·5 mms., and the mean diameter about 5 cms. (4) **FL** certainly, **PCGG** very likely, **2 MT** not at all likely, as the resistance capacity coupling shown is very inefficient on such short wavelengths as are used by this station. For this purpose H.F. transformers should be substituted.

"**NOVICE**" **(Torquay)** *asks what would be the minimum requirements for a set to receive* **2 MT,** *preferably with fixed tuning, or still better with one adjustment for throwing over to a Plymouth station.*

It is rather difficult to specify suitable apparatus for use at such a distance, as at long ranges the local characteristics alter the question very considerably. If we were undertaking the work ourselves we should try a three-valve set, with one stage of high frequency amplification and one of low frequency. We should hope to get fairly good results in this way, but we should not be very surprised or disappointed if we found after test that a couple of extra valves were required. This, of course, is for telephone reception. If a loud speaker were required, two or three additional L.F. valves would be necessary, but we should hardly expect to get very good results. We should ourselves confine our activities to the new Plymouth station, as **2 MT** is hardly likely to continue in operation after the broadcasting stations commence operations.

T.G." (Coventry) *asks* (1) *Questions about his set.* (2) *For a diagram using six valves efficiently.*

(1) It is unfortunate that you have not sent us a sketch showing the diagram of connections of your set and the values of the components. Without this information we can only offer suggestions for the improvement of your set. It is better to employ H.F. valves than L.F. valves when there are stray electric fields which may induce voltages into the set. In addition, L.F. iron coil transformers generally cause distortion. It is, therefore, better to use the minimum number of L.F. stages of amplification. (2) We prefer, when using six valves, to employ three as H.F. amplifiers, one as detector, and two as L.F. amplifiers. The tuned anode method of H.F. amplification is generally accepted as the best, and we suggest you continue to use this method. You will find the tuning critical, and there should be no difficulty whatever in eliminating stations transmitting on a wavelength which is only slightly different to that which you wish to receive. When receiving short wavelengths, the A.T.C. should be in series with the A.T.I., and a switch for connecting the A.T.C. in series or parallel would be a useful attachment to your set. Fig. 5 shows the connections, and usual values for the parts are marked in. We suggest you see the articles on "Experimental Station Design," which appeared in our issues of September 2nd, 14th and 30th.

"V.H.G." (Bolton).—(1) The gauge of the wire submitted is No. 20 S.W.G. (2) Approximately 1,500 metres without the addition of a parallel condenser. (3) 0·0005 mfds., which may be obtained approximately by the use of plates of glass 0·1 cms. thick, with an overlap of foil of 25 square cms., and a total of 5 plates. (4) Approximately 0·0008 mfds.

"S.E." (Southampton) *asks* (1) *How the Brown patent telephone works.* (2) *The number of "The Wireless World" in which an article on the Johnsen-Rahbek loud speaker appeared.* (3) *If the Armstrong super-regenerative circuit can be regarded as a practical proposition and likely to give good results in the hands of an average amateur.*

(1) Detailed information is given in various textbooks, including Eccles' Handbook. Briefly, a light steel reed is supported in the field close to the poles of a permanent magnet of roughly horse-shoe shape, carrying the windings for the operating currents. To the reed is attached a light diaphragm by which the air is set in motion, giving rise to the sound. (2) Nos. 34, 35 and 36, Vol IX; also May 6th, 1922. (3) No; the adjustment and the proportioning of the parts is very critical. Every set put up needs elaborate experimental work to determine suitable values for the constants to make it function at all, and we think that no one but a skilled experimenter is likely to get satisfactory results with it.

"H.E.N." (Watford) *asks* (1) *For windings for a telephone transformer for use with* 1,300 *ohms telephones.* (2) *If it is possible to receive C.W. with a valve set with ordinary reaction, without giving out enough radiation to affect other receivers.* (3) *If the circuit of Fig.* 4, *page* 636, *August* 12*th issue, is capable of receiving C.W.*

(1) Telephones of this resistance may be used without a telephone transformer. Transformer may consist of open core 3" in length by ½" diameter, with 2 ozs. No. 44 S.S.C. for primary, and 1½ ozs. No. 38 S.S.C. for secondary. (2) This can be done quite easily if more than one valve is used in the set. It can be done in any way which involves taking the reaction coupling back to any point which is not nearer to the aerial than the anode of the first valve. If only a single valve is used there is no safe way. (3) Certainly.

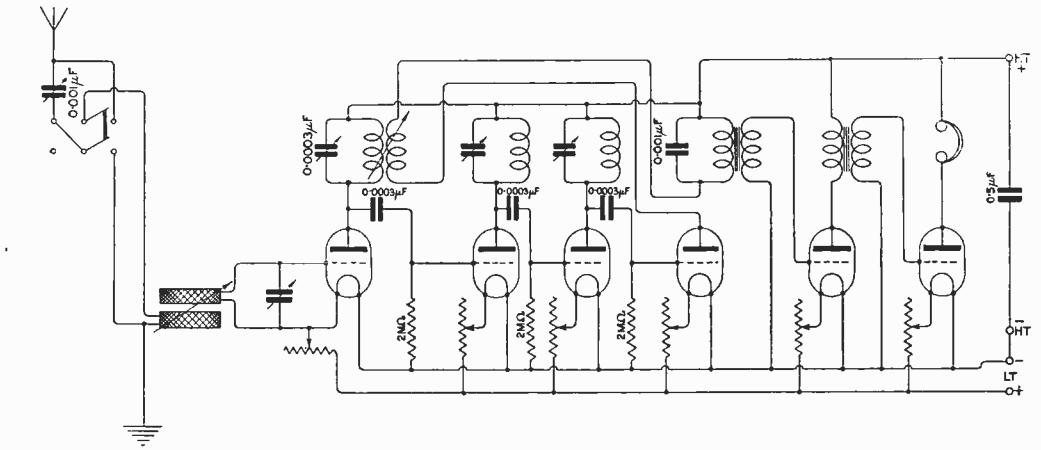


Fig. 5.

"WAVELET" (Keighley).—(1) You do not give us any information about the tuning condenser, but if this has a normal value for a set of this type, say 0 0005 mfds., you should be able to tune up to nearly 3,000 metres, and down to somewhere in the neighbourhood of 300 metres. (2) L.R. telephones with a telephone transformer may certainly be used with a crystal set. (3) 0·0005 mfds. is quite big enough for the tuning condenser, and 0·001 to 0·002 mfds. for the blocking condenser. (4) The buzzer, key, and cell should be connected across a few turns of the A.T.I.

"W.W." (Brighton) *asks* (1) *The number of turns to wind in a basket coil to tune in* 2,700 *metres.* (2) *How many turns to tune in* 360-425 *metres.* (3) *How many turns to tune in* 180-360 *metres.* (4) *For diagram of a single valve set using a three-coil holder in his possession.*

(1), (2) and (3) It is not possible to give the exact number of turns to wind a basket coil to give

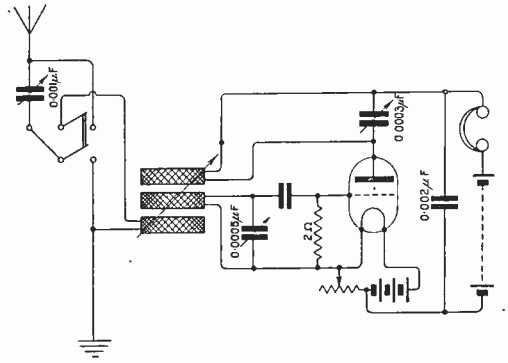


Fig. 6.

a certain inductance. The inductance varies with the spacing, method of winding, etc. Assuming you will use a 0·001 coil A.T.C. in parallel with the coils to tune in 2,700 metres, we suggest you wind five coils of No. 30, each coil having 80 turns. With the tuning condenser in series on the short wavelengths, two coils in series, each coil having 50 turns of No. 20, will tune in 360-425 metres, and one coil with 60 turns of No. 20 will tune in 180-360 metres. (4) See Fig. 6.

"J.F." (Berks) *asks* (1) *For a criticism of his circuit.* (2) *Whether a broadcast licensee is only permitted to receive broadcast signals.* (3) *Can a holder of a broadcast licence use reaction above* 500 *metres.*

(1) We have examined your diagram of connections, and we are afraid you will be unable to use reaction in this circuit. We suggest you cut out the reaction coil altogether. We think you would get much better results if you added one high frequency valve. Reaction could then be provided for. The reaction coil would be connected between the anode and telephones, and would be coupled to the tuned anode of the first valve. A large number of circuits have recently appeared in this journal. (2) and (3) We understand that the holder of a broadcast licence is not restricted in so far that he may receive signals of any wavelength. The restriction applies to the use of reaction and the employment only of apparatus approved by the Post Office. The set must be so designed that under no circumstances will the aerial circuit oscillate.

"F.J.W." (Leyton) *asks whether he can connect a transformer to his set, and so strengthen the signals.*

Unfortunately a transformer cannot be connected to increase the strength of signals. and we suggest you add a valve as note magnifier, using the connections given in several recent issues of this journal.

"SOLDIER" (Woodseats).—The addition you suggest can certainly be made; the valve or valves being added as low frequency amplifiers. To do this it is not necessary to alter your set in any way. It is merely necessary for you to introduce the one winding of an input transformer in front of your first valve in place of the telephones. Many diagrams of one and two-valve low frequency amplifiers will be found in recent issues.

"C.A.S." (Ealing) *asks* (1) *If it is desirable to earth-wire garden poles against lightning.* (2) *Should lightning arresters be fitted at point of entry of aerial wire into the house.* (3) *Would a vacuum type lightning arrester affect reception.*

(1) Poles are not generally earth-wired, but there certainly is no harm in so doing. A No. 12 galvanised iron wire should be twisted around the bottom of the pole, and run up the side of the pole. At the top end it may project 6 or 8 inches. (2) and (3) A vacuum type lightning arrester will suit your purpose very well, and should be fitted across the aerial and earth at the point of entry of the aerial into the house. A switch should be provided, so that when the set is not being used the aerial may be directly connected with earth. These precautions should be taken, otherwise damage to the set may result from the effect of static charges, as well as the effect of lightning. Sometimes a highly inductive leak is connected across the aerial condenser as a protection against static charges, but this will largely be unnecessary if you adopt the other arrangements. No loss in reception efficiency will result through the use of the above protective apparatus.

"W.K.N." (Hounslow).—We cannot give you precise windings, and it would be much more satisfactory if you wound the coils exactly as described, and then experiment yourself until the best results are obtained.

"G.L.E." (Woolwich) *asks* (1) *For a two-valve circuit suitable for use with certain apparatus.* (2) *For windings for a transformer suitable for use with* 300 *ohm. telephones.*

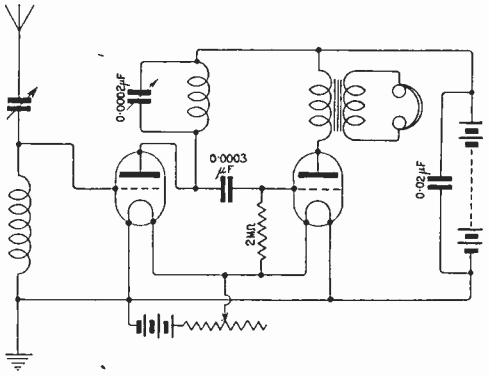


Fig. 7.

(1) See diagram (Fig. 7). (2) Core ½" diameter of iron wires, about 4" long, primary wound with 3 ozs. of No. 44, and secondary wound with 6 ozs. of No. 34.

D

"R.V.J." (Brixton) *asks for the issues in which appeared a description of a set which will receive broadcast.*

We suggest you see the articles entitled "A Broadcast Receiver," which appeared in the issues of August 26th and September 2nd.

"N.N.L." (Cheam).—(1) The diagram submitted is not quite correct, and we suggest you use the circuit shown in Fig. 8. Care must be exercised in the selection of suitable jacks. The springs must be very well spaced and robust. (2) A suitable frame aerial for your purpose would be a frame 4' square with 16 turns of No. 18 wire with 6 tappings, the wires being spaced ¼" apart.

"H.P.H." (Herts) *asks* (1) *The range of a crystal set.* (2) *For an explanation of "Dead-end" effects.* (3) *If he may add one L.F. valve.* (4) *Where to obtain books dealing with wireless.*

(1) We are afraid you will only receive local signals when using a crystal set. (2) "Dead-end" effect is the name given to the loss of efficiency which arises when, for example, only a small portion of a big coil is in use. It is overcome by breaking up the coil into sections. The proposed coil is far too large for short wavelengths, and we suggest you wind another coil making it 4" diameter, 5" long, and using No. 22 D.C.C. wire, taking 8 tappings. The A.T.C. should be in series with the A.T.I.

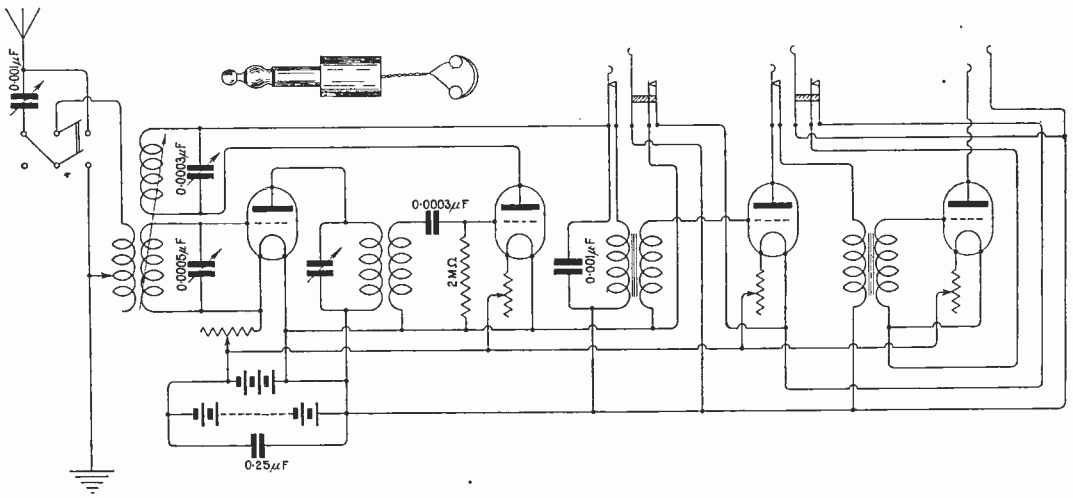


Fig. 8.

"ENQUIRER" (Chelmsford) *asks* (1) *The number of turns of wire to wind in a 2½" diameter former for use as a reaction coil.* (2) *Values of condensers in microfarads and inductances in microhenries to tune to 360 metres.* (3) *Whether his set is suitable for operating a loud speaker.*

(1) Wind 100 turns of No. 38 S.S.C. wire. (2) The aerial condenser should have a maximum value of 0·001 mfds., and should be in series with the A.T.I. The closed circuit condenser may have a maximum value of 0·0005 mfds. The aerial coil should possess an inductance of 450 microhenries, and the closed circuit 220 microhenries. The waverange will be from 600 metres to 2,000 metres. (3) We think your set is suitable to operate a loud speaker. However, if you cannot get sufficient signal strength, add one L.F. valve.

"G.A.Q." (Birmingham).—The suggested coils are suitable, but it is just as well to use a single layer coil, which you can make yourself. Wind a coil 4" diameter and 5" long, of No 22 D.C.C. and take 8 tappings. The circuit given on page 60, April 8th issue, will be quite suitable if you connect the primary of the transformer in place of the telephones, and join the telephones to the secondary side of the transformer.

"A.B." (Staffs.) (1) *Submits a circuit for criticism.* (2) *and* (3) *Asks the wavelength range of coils.* (4) *Whether a proposed arrangement is correct.*

(1) The diagram is correct, except that the plate and grid connections are reversed. This we presume to be merely a clerical error. (2) We cannot say without a knowledge of the size of the coil. (3) 2,600 metres with condenser in parallel and 800 metres with the condenser in series. (4) The arrangement will work very well.

SHARE MARKET REPORT

Prices as we go to press on November 3rd, are :—

Marconi Ordinary	£2	5	0
,, Preference	2	2	9
,, Inter. Marine.. ..	1	7	7
,, Canadian		10	10½
Radio Corporation of America ;—			
Ordinary		18	0
Preference		13	6

THE
WIRELESS WORLD
AND RADIO REVIEW

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No. 170 [Vol. XI. No. 7] NOVEMBER 18TH, 1922. WEEKLY

The Amateur Position.

HOW BROADCASTING AFFECTS THE EXPERIMENTER.

IT has already been mentioned in these columns that no surprise should be felt at the fact that many new situations have arisen with the introduction of the proposed schemes for broadcasting, but we do not think that at the time that statement was made it was realised that the problems arising therefrom would present themselves so rapidly and forcibly as has been the case. And in this connection reference is made only to the amateur problems, by which is meant the matters which affect in particular those who were experimenters before broadcasting was talked of, or who will join the ranks of the experimenter proper in the future. There is not space in this issue to make reference to the other problems, which have confronted the Postmaster-General and those who have been responsible for bringing the British Broadcasting Company into being.

Only a year or two ago practical amateur wireless was illegal in this country, and for some time the authorities would not give way on the question of the re-issuing of licences after the war. The struggle to win back for the amateur some of his pre-war rights and generally to reinstate the wireless experimenter was a long and arduous one which required much hearty co-operation on the part of all amateurs throughout the country and many interviews and petitions to the Post Office Authorities. These concessions, or rights (it is of no material importance by which name they are described) having once been obtained are not likely to be permitted to be encroached upon or modified without some sign of a struggle to resist any such attempt.

A well established precedent in law is often as good as a statute, and undoubtedly the status of the amateur has been very well established within the last two years.

Perhaps before going any further it would be well to emphasise that in writing these lines there is not the least intention to adopt an antagonistic attitude towards broadcasting. On the contrary, the amateur wants broadcasting. and would have been very disappointed if it had not come. If any support of this statement is necessary the reader need only be referred to the fact that it was entirely through the agency of a very forceful petition to the Authorities from the amateurs of this country as a body that broadcasting first came into being, when the Postmaster-General authorised the regular weekly transmissions from Writtle.

Broadcasting is a very good thing indeed, and should receive every encouragement from everyone concerned, but at the same time it should be remembered that it is possible to have too much even of a good thing, and if there is any danger of the amateur and experimenter being " crowded out," so to speak, of his rights, then there must and certainly will be objections raised.

Broadcasting, it is understood, will take place from 5 p.m. to 11 p.m. daily, and throughout the day on Sunday, and the official regulations state that reaction must not be used at all during these times over the range of wavelengths

covered by the broadcasting stations. This means that no reception of continuous wave telegraphy may be conducted between these times on the amateur wavelength of 440 metres. Since the hours to be covered by broadcasting are literally the only times during which the true experimenter (unless he is engaged on commercial experimental work, or is a person of leisure) can conduct his experiments, the regulation is equivalent to banishing the amateur to the shorter wavelengths below the broadcasting band, and depriving him altogether of the use of the 440 metre wavelength as soon as broadcasting commences. The chief danger that threatens the amateur position is that in the near future he must expect to find himself in the minority as far as the general users of wireless are concerned, and a minority may often be overruled by a majority vote however well established and just may be the claims of the minority. Perhaps the position of those amateurs who have transmitting licences is even less envious, since their work on 440 metres will apparently have to cease altogether, although many of them are pioneers in amateur work, and may be regarded as some of the most serious investigators in this country.

So much consideration then for the immediate situation which confronts the amateur and experimenter who has already established his claim to consideration in so far as he has obtained an experimental licence. There is also to be considered the position of those would-be experimenters, who, on account of the unhappy accident of the date of their applications for experimental licences find that their applications are turned down, and they are recommended to content themselves with a broadcast reception licence. Unfortunately, the number of these disappointed enthusiasts is increasing daily, and it is therefore not altogether surprising that, in spite of the fact that as a whole we are a law-abiding nation, rumours should reach us of the possibility of the illegal establishment of unlicensed receiving stations, despite the very serious penalties that are risked in so doing.

It is of course appreciated that the whole question is a very difficult one for the Authorities, who could not under any circumstances be expected to issue experimental licences to all and sundry without any guarantee that the shrieks and howls of radiation would not compel every sane experimenter and broadcast listener-in to close down in disgust. We feel, however, that it should be possible to arrive at some happy medium when those who genuinely desire to join the ranks of the experimenter should be allowed to do so provided that reasonable guarantees could be given that the recipients of licences would conduct their experiments in a proper manner, with due respect for other users of the aether, and would not earn for themselves the title of "aether hogs." There must be some hundreds, though still a small proportion of the total future users of wireless, who are attracted to the science entirely on account of its fascination as a hobby, in the practice of which the construction of their own apparatus and the possibilities which experiment with all kinds of circuits may present, would form the chief interest.

There is yet another side to this question. We refer now to the development of the industry of manufacturing wireless apparatus which has taken place as a result of the proposals for broadcasting, and the stimulus which this has given to public interest in the subject. The retailing of wireless apparatus parts is now confined to those users who will construct apparatus for themselves or conduct experiments, whilst the broadcast licensee is accommodated with complete sets of approved design. The majority of those firms who undertake to provide complete sets for the broadcast licensee will produce their own parts for incorporation in their sets, and this leaves to the manufacturer of parts only, no outlet for the disposal of his goods except through retail sales to the experimental licence holder. The net result is that many manufacturers who would otherwise have been content to leave the manufacture of the complete sets to the larger firms, are finding themselves compelled to assemble complete sets in order to come into the field and share in the industry.

Some readers, perhaps, are reminding themselves that broadcasting has as yet scarcely started, and that these questions are therefore brought forward prematurely. To this we would reply that it is better to face the facts beforehand and look for a remedy. We feel sure that the delay in broadcasting is due to the honest desire on the part of the Authorities and the Broadcasting Company to present broadcasting to the country with as many as possible of the problems which it has brought with it solved to the satisfaction of all parties.

H.S.P

A Separate Oscillator for the Transatlantic Tests.

(Wavelength Range, 170-440 metres.)

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

AS was mentioned in last week's note on the subject of the forthcoming Transatlantic tests which are to take place in conjunction with the American Radio Relay League, it is essential that a separate heterodyne be employed when listening for C.W. signals, in order to avoid interference between the various stations listening-in in this country.

The mere employment of a separate heterodyne unit, however, is not of itself sufficient unless proper precautions are taken in its use. For instance, in many receiving stations direct coupling between the aerial circuit and the heterodyne is used, with the result that on short wavelengths the radiation from the aerial is practically as strong as if an autodyne receiver were employed. The conditions are slightly improved if the heterodyne is coupled to the secondary circuit of a loose-coupled receiving tuner, but for short waves the improvement is not great, because the heterodyne has to be so slightly detuned from the frequency of the incoming signal in order to keep the beat note frequency within the audible limits that to all intents and purposes the heterodyne and the aerial are in tune as regards the transfer of energy between them. On long wavelengths the much larger frequency difference between the two circuits limits very considerably this transfer of energy, so that the heterodyne radiation is reduced by this method.

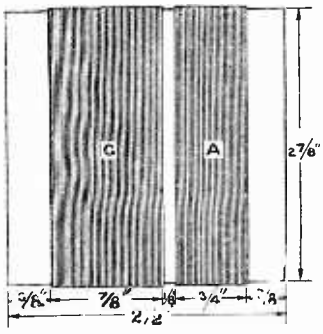


Fig. 1. The coils for the separate oscillator.

For the short waves to be used during these tests some other means must be employed for reducing radiation from the receiving aerial. The most practicable method is to keep the separate heterodyne unit as far away as possible from the aerial circuit, and also from the tuned secondary circuit coupled to the aerial, and to couple it on to some other part of the receiving circuit, so that there is at least one valve between the aerial and the part of the circuit to which the heterodyne is coupled. The best arrangement is to couple the separate heterodyne oscillator to the detector valve itself, either to its grid or to its plate circuit. It will generally be found sufficient for this purpose to place the separate heterodyne unit near to the detector valve, although if preferred, it may be placed much further away (but not near the aerial circuit) and coupled to the detector valve by means of an aperiodic circuit consisting of a coil of a few turns of wire, placed near the heterodyne and connected by a pair of leads close together to a similar coil coupled to either the grid or the anode circuit of the detector valve.

To couple the heterodyne in this way to the anode circuit of the detector valve of the receiving set a special coupling coil may be built up consisting of some six or eight turns of No. 22 S.W.G., D.C.C. copper wire, wound on an insulating tube about three inches in diameter. In the centre of this tube a similar smaller tube about two inches in diameter, and having wound on it about six turns of the same wire, should be pivoted in such a way that it can be rotated so that the planes of the two coils can be placed at any angle to one another between 0 and 90 degrees. By this means the coupling between the two coils can be varied from zero up to a maximum value. A fixed condenser of about 0·001 microfarad should be joined across the primary of the intervalve transformer coupling the detector valve to the first L.F. valve when this arrangement is employed.

The receiving sets for use during the Transatlantic tests are preferably built up with at least one or two stages of H.F. amplification, the intervalve coupling of these stages being tuned, as only by this means

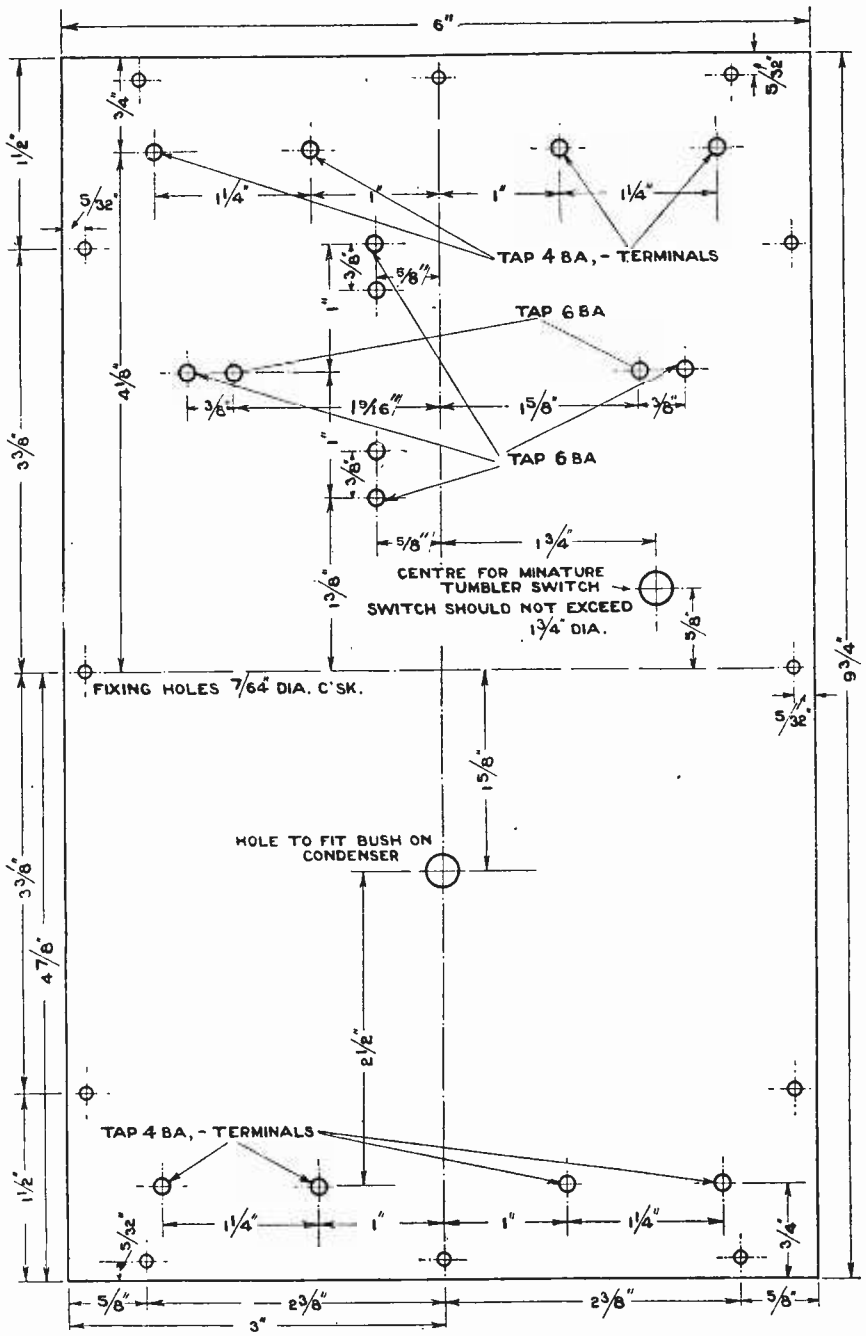


Fig. 2. Drilling diagram for ebonite top.

can efficient amplification of the short wavelengths be secured. High frequency intervalve transformers of the plug-in type, with variable condensers for tuning them to the desired range of wavelengths (which is approximately 180 to 400 metres), may be employed,

or the anode circuit of each H.F. valve may be tuned by a variometer or fixed coil with a variable condenser in parallel with it, using a fixed condenser to couple the successive stages together, as is customarily done in the well-known tuned-anode-reactance-capacity-coupled method of H.F. amplification. When either of these arrangements is employed some means of stabilising the whole receiver is necessary to prevent self-oscillation. This can be effected either by providing a definite reverse coupling between the plate circuit of the detector valve and the input or grid circuit of the first H.F. valve, this coupling being in the reverse direction to that normally required to produce oscillations, and being adjusted to such a

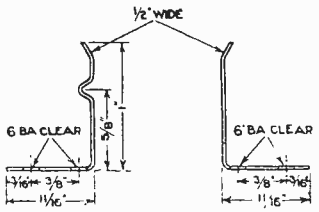


Fig. 3. Details of side clips for valve holder.

value that oscillations just cease, or by damping the H.F. valves by applying a positive potential to all the grid circuits by means of a suitable potentiometer connected across the filament battery.

The separate heterodyne can be fed from the same filament battery as is used for the main receiving set, but it is better to employ completely separate L.T. and H.T. batteries for the separate heterodyne, especially since only four volts is required for the filament of the heterodyne and six volts for its H.T. supply.

A convenient heterodyne unit for use in 200-metre reception, such as is required for the arrangements outlined above, may be constructed in the following manner. The anode and grid coils may be wound on the same former, closely adjacent to each other, as indicated in Fig. 1, in which G represents the grid coil and A the anode reaction coil. If the diameter of the winding former—which may be a waxed cardboard, or an ebonite tube—is $2\frac{7}{8}$ ins., and its length $2\frac{1}{2}$ ins. as shown, the grid coil G should have 45 turns of No. 28 S.W.G. double silk-covered copper wire, wound with the turns touching so as to occupy a length of $\frac{7}{8}$ in. A space of $\frac{1}{8}$ in. is left between the windings, and the anode coil A of 38 turns then put on, using the same wire. A variable condenser, having a maximum value of approximately 0·00025 microfarad is used for tuning purposes, and should be connected across the grid coil G. For convenience the whole instrument may be mounted in a wooden

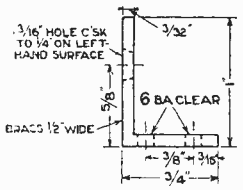


Fig. 4. Fixed end clips for valve holder.

box, with an ebonite top on which the valve holder, and the terminals for the H.T. and L.T. batteries are mounted. Convenient dimensions are indicated in Fig. 2, which also gives the positions of holes for drilling. This ebonite top should be $\frac{3}{16}$ in. to $\frac{1}{4}$ in. thick.

The outside dimensions of the box are $9\frac{3}{4}$ ins. by 6 ins. by $4\frac{3}{4}$ ins. deep, and it is constructed of wood $\frac{1}{4}$ in. thick. Any convenient wood may be used, although, of course, the appearance of the instrument is improved

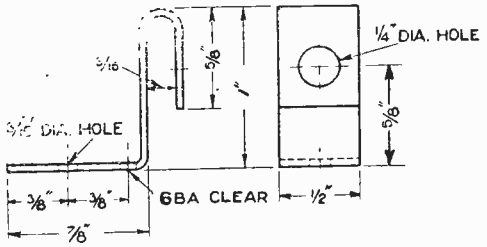


Fig. 5. Springy end clip for valve holders.

by using a hard wood such as mahogany or teak.

The ebonite top is fastened in place with $\frac{1}{2}$ in. brass screws (size No. 4), using the outer holes, marked in Fig. 2. These are shown as $\frac{7}{64}$ in. diameter, and are suitable for No. 4 countersunk or raised head brass screws. They should be countersunk so that the bevelled parts of the screw heads sink in flush with the surface of the ebonite.

Details of the dimensions of other parts required for the construction of the instrument are given in Figs. 3 to 8. It will be noted from this that provision is made for using a V 24 type of valve, which is a very convenient one to use for an instrument of this type, since

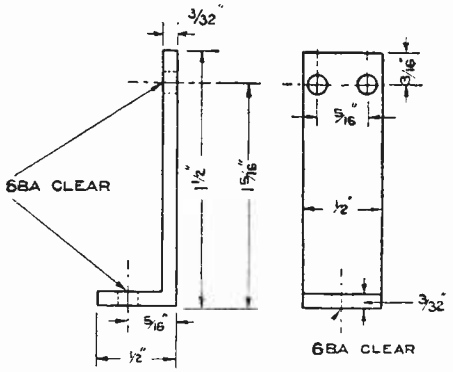


Fig. 6. Supports for coil former.

only a low value of H.T. voltage is necessary. When completed with one of these valves the instrument will usually oscillate with only six volts in the high tension battery. If preferred, a holder for a four-pin valve of the standard French or " R " type may be fitted, instead of the spring clips for the V 24 valve, so that an " Ora " type of valve may be used with but trifling alteration to the general layout of the apparatus. The low capacity of the V 24 valve, however, is advantageous for this short wave instrument.

Fig. 3 gives the details of the side-clips for the V 24 valve. They are bent up from thin springy phosphor-bronze strip, $\frac{1}{2}$ in. wide, to the dimensions shown in that sketch. These are the clips marked A and G in Fig. 9.

The end clips for the valve are shown in Figs. 4 and 5, the former being of $\frac{3}{32}$ in. brass strip, $\frac{1}{2}$ in. wide, and the latter, the flexible one, of thin springy phosphor-bronze

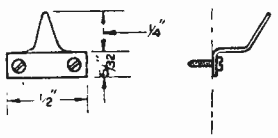


Fig. 7. Pointer for condenser scale.

strip. The thickness of this strip should not much exceed about $\frac{1}{64}$ in. These two clips are those mounted on the right and left-hand ends of the valve in Fig. 9 respectively. In Fig. 6 will be found details of the two brass angle brackets used to support the former on which the coils (Fig. 1) are wound. This is made of $\frac{3}{32}$ in. brass strip, $\frac{1}{2}$ in. wide. Two are required to the dimensions given.

The pointer for the condenser scale (shown mounted on the right-hand side of the condenser, in Fig. 9) is shown in Fig. 7. This is made of thin brass strip about $\frac{1}{32}$ in. thick. Fig. 8 indicates the dimensions of the brass strip used to short-circuit the " phone " terminals when telephones are not required connected to the set. This, of course, is usually the case when the instrument is used purely as a separate heterodyne, but the terminals are very convenient in some cases since the instrument can also be used for many other purposes, such as a C.W. wavemeter, and for carrying out many simple high-frequency measurements.

In Fig. 9 will be found a diagram of the layout of the top of the instrument, with the lettering of the various terminals, and in Fig. 10 a diagram of the connections of the instrument between these terminals, the labelling of the terminals in this diagram corres-

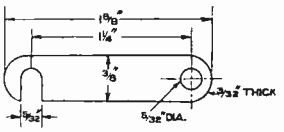


Fig. 8. Short-circuiting link.

ponding with that in Fig. 9. In Fig. 9 it will be noticed that a miniature tumbler switch is shown, to provide a filament switch for the set. The position of the centre only of this switch is indicated in Fig. 2, as the exact position and size of the holes necessary for fixing this switch in position, and for allowing the connecting wires access to its terminals, will depend upon the particular pattern of switch used. The position of these holes should therefore be marked out after the purchase of this switch. Its outside diameter should not exceed about $1\frac{3}{4}$ ins.

The terminals used (4 BA) should be screwed into the ebonite, and provided with washers and nuts on the underside for the connections. The wiring is most conveniently carried out with bare No. 18 copper wire, covered with insulating sleeving where necessary.

The former on which the anode and grid coils are wound is supported from the under side of the ebonite top by means of the brass brackets, of which the dimensions are given in Fig. 6.

The variable condenser has a maximum capacity of approximately 0·00025 microfarad. A suitable condenser for this purpose is most conveniently purchased ready made, but if it is preferred to build it up from standard component parts which are purchaseable at somewhat cheaper rates than the complete article,

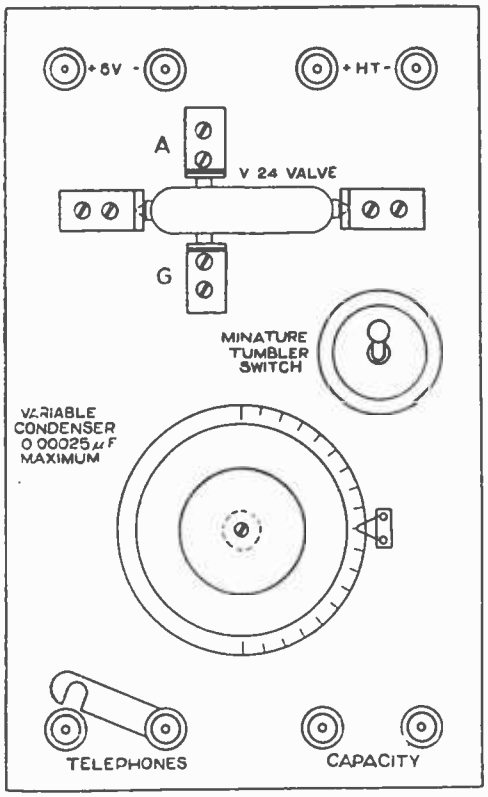


Fig. 9. Lay-out of instrument top.

it will be found convenient to use six fixed and five moving plates of diameters of $2\frac{7}{8}$ ins. and $2\frac{1}{4}$ ins. respectively. If the plates are $\frac{1}{32}$ in. in thickness the spacing washers used to separate both the fixed and the moving plates should be about $\frac{1}{16}$ in. thick.

The fixed bypass condenser of 0·01 microfarad capacity shown in Fig. 10, may be built up of tinfoil with paraffined paper, or mica, for the dielectric. More conveniently a small Dubilier Type 577 condenser of this capacity may be employed, and fixed in place on the underside of the ebonite top by two small screws.

If a four-volt accumulator is connected to the L.T. terminals of this heterodyne set no filament resistance will be necessary for the V 24 valve, but if preferred, a six-volt accumulator may be employed with a fixed resistance of about $1\frac{1}{4}$ ohms, mounted inside the heterodyne box.

An instrument constructed on these lines with a V 24 valve should oscillate readily over the whole range of the condenser scale with six volts connected to the H.T. terminals.

The negative lead of the H.T. battery is joined to the positive of the filament battery so that the two combine together in the plate circuit of the valve, giving an effective voltage of 10 in that circuit. With this arrangement care must be taken to keep the grid circuit joined up to the negative end of the filament. This will be the case if the wiring diagram given in Fig. 10 is adhered to. With such an instrument a tuning range of about 170 to 440 metres should be obtained. Care should be taken that the two windings are put on in the same direction, and that the outer end of the 45-turn coil is joined to the grid of the valve, and the outer end of the other coil to the anode—thus making the anode and grid connections to the two extreme ends of the coils. When in use as a normal heterodyne unit the telephone terminals are not required and should be short-circuited by the link provided. They are only fitted to the instrument to enable telephones to be joined in circuit as a help for calibration purposes, and for other measurements.

The two terminals marked " capacity," in Figs. 9 and 10, are connected directly across the ends of the variable condenser. A very small single plate or vernier condenser can be joined across these terminals when desired to aid in fine adjustments of the wavelength. Such an addition is particularly desirable when heterodyning these short wavelengths, as the tuning range for maintaining the beat note within the audible limits is very restricted at these high frequencies. Such an addition, however, will, of course, alter the calibration of the instrument should it be desired to use it as a wavemeter.

The readings of the instrument may be calibrated against a standard wavemeter, so as to obtain the approximate wavelength corresponding to any scale reading of the condenser. Such a calibration, however, will vary slightly with all changes in the filament and H.T. batteries, and will usually also vary somewhat when the valve is changed. It must be carried out, of course, without any additional fine adjustment or vernier condenser connected to the " capacity " terminals, as such an addition, although very convenient for use, would constitute a serious disturbing element.

An important point to note when joining up the leads inside the instrument is that the wire from the grid of the valve should be joined to the *fixed* plates of the variable condenser, the movable vanes being connected

to the filament of the valve. The potential of the movable vanes will then be lower, and the presence of the hand when making

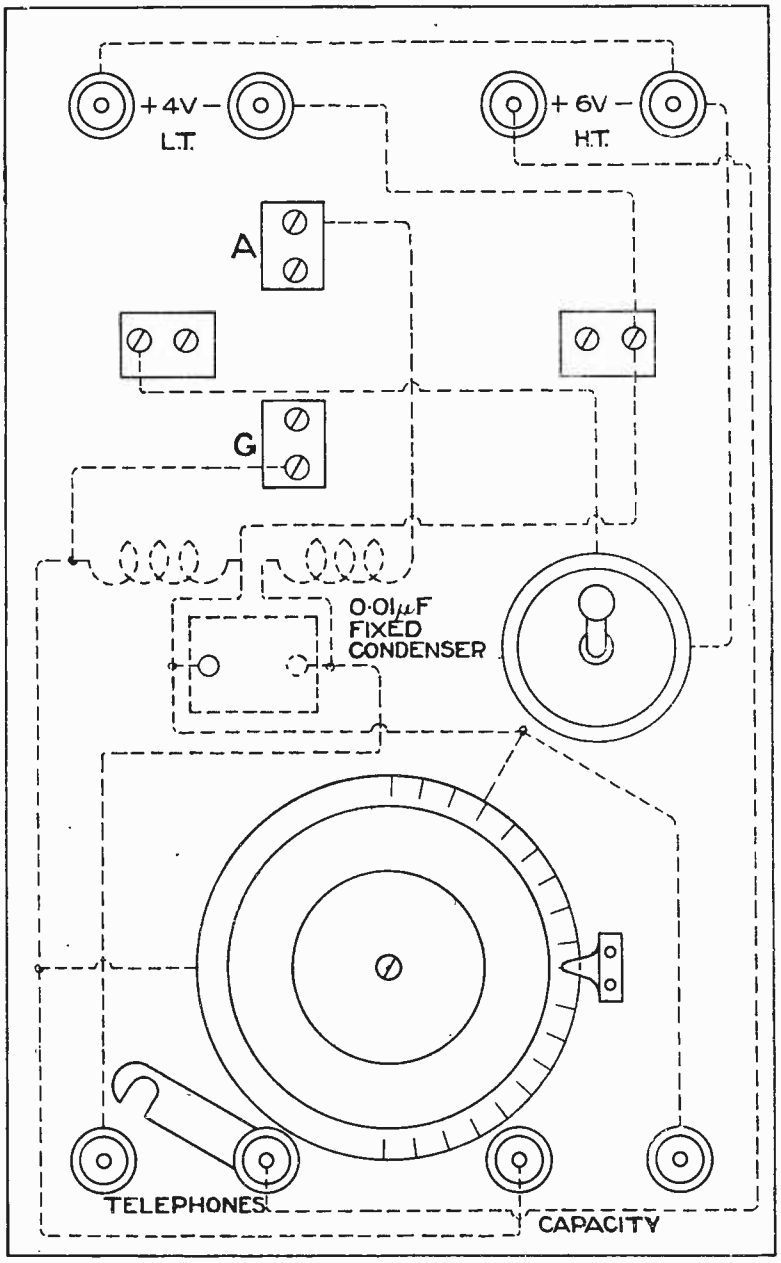


Fig. 10. *Wiring Diagram.*

adjustments will be less serious. This precaution will be found of particular value when calibrating the instrument.

When accurate work is necessary with an oscillator of this kind it is very desirable to fit a long handle to the condenser so as to enable the hand to be kept further from the instrument. Any convenient form of such handle can readily be added to this instrument, and will aid considerably the ease of its operation.

Signal Rectification

A CONSIDERATION OF THE METHODS OF DETECTION.

IT is the purpose of these notes to discuss the possible methods of rectification, using the three-electrode valve.

The high frequency energy input to the detector is always modulated, that is, high frequency and audible frequency components are present together in the signal.

The function of the detector is to transform high frequency energy to low frequency energy; therefore the circuit connected to the input of the detecting apparatus is tuned to the wavelength of the high frequency energy, and the output circuit is tuned to the low frequency energy. But the output power is not entirely in the signal. A high frequency component is present. The output circuit of the detecting valve must, then, contain a capacity which will carry this component of the signal. This capacity is present in all output circuits—sometimes in the form of self-capacity, but generally in the form of a shunt condenser which has a reactance high to audible frequencies, but low to radio frequencies. A condenser of 0·001 mfds. is suitable. Its reactance at a frequency of 1,000,000 cycles per second, corresponding to a wavelength of 300 metres, is 160 ohms, and its reactance to a frequency of 1,000 cycles per second is 160,000 ohms.

The method of rectification which is most easily understood makes use of the curvature of the plate current curve. The grid potential is adjusted roughly by connecting small cells in the grid circuit, or a finer adjustment is made possible with the aid of a potentiometer. Arising from the fact that any appreciable grid current causes damping and a lowering of the input voltage, the grid is usually made negative, and adjustments of anode potential and filament current are made to bring the mean grid potential to the point on the bottom of the plate current grid voltage curve where a given signal impressed across the input circuit produces the greatest *mean increase* in the filament anode current. The rectifying action takes place because a given positive potential increment to the grid produces a larger increase in anode filament current, than an equal negative potential caused reduction, and it is this balance of energy which is available to operate the instrument connected in the anode circuit. It is to be expected that some types of valve will, for a given input voltage, produce a larger strength of signal than others. A suitable choice should be made

Since the apparatus in the anode circuit is an *energy* operated device, its impedance at the signal frequency should approximate to that of the anode-filament circuit of the valve.

Sometimes, when damping is not objected to, the upper bend of the plate current grid voltage curve is used. The mean grid potential is fixed, and the filament current is charged until maximum response is secured. A low plate potential is necessary in this case.

Now that hard valves are easily procured, the method of rectification which employs a grid condenser and leak is used. In this method the grid voltage—grid current characteristic of the valve is made use of, and the input circuit is proportioned so that grid currents flow.

Considering the grid condenser connected to the grid without the leak resistance, the negative half wave of a signal will produce a positive potential on the plates of the condenser joined to the grid. A current will flow from the filament to the grid, and will charge the condenser plates negatively. The positive half cycle of the signal will further reduce the negative potential of the grid and succeeding pulses of energy will likewise increase the negative charge held on the condenser plates connected to the grid. This reduction of grid potential causes a reduction in the normal filament anode current at audio frequencies, and the instrument in the plate circuit responds. The grid condenser should, then, have a small capacity, in order that the energy which it receives may result in the largest possible voltage fluctuations, which in turn will give maximum signal energy in the anode circuit. On the other hand, it should not be so small that an appreciable radio-frequency voltage drop takes place across it. When "R" valves are used, 0·0003 mfds. is suitable. To restore the grid potential to its normal value, a leak is provided which will allow the charge to leak away to the filament during the intervals between signals. Obviously the leak should have no lower resistance than is necessary for it to perform its function properly.

Two methods of connection are available. The leak resistance may be joined directly across the grid condenser, or it may be joined from the grid directly with the filament. The latter method is preferable.

Several adjustments for maximum audible energy are possible. The grid potential should be adjusted so that input potentials will cause the largest possible filament grid current to flow, and the anode potential and filament current should be chosen so that the steepest portion of the anode current grid volt curve will be utilised. The latter adjustments may also be made to give a steep grid-current grid voltage curve. Maximum signal strength will then be secured.

Using hard valves, the grid leak and condenser method of rectification gives results superior to any other.

Adjustments based upon conclusions reached after a study of the static characteristic curves will not be far wrong. W. J.

The Size of Accumulator to Buy

WHEN buying an accumulator there are several points to which due consideration must be given if the battery is to give satisfactory service. First, one must decide whether one prefers a small and comparatively light affair which must be frequently charged, or a large and ponderous one which will hold a month's supply. This question must be settled by such individual considerations as distance to charging place, strength of one's arms, and so on. Supposing that a small cell is decided upon, the point to be settled next is the safe minimum size, and this demands a knowledge of the current required by valves, and also of the meaning of the term "ampere hour capacity." This last may be best understood from an example. If a battery is said to have a capacity of 20 ampere hours it means that it will give a current of 1 ampere for 20 hours, 2 amps. for 10 hours, 4 amps. for 5 hours, and so on, before requiring recharging. The matter is complicated somewhat by the common practice of rating accumulators at "ignition" capacity, which is twice the "actual" or "continuous" capacity. Thus, if the cell is said to be of 60 A.H. capacity, base your calculations upon 1 amp. for 30 hours, not 60, unless it is definitely stated to be "60 A.H. actual."

To find the minimum size for a given number of valves allow $\frac{3}{4}$ amp. of current for each valve, and an eight hours discharge rate, since that is the shortest time in which an accumulator should be discharged, whether in one spell of eight hours or in separate shorter ones totalling eight in all.

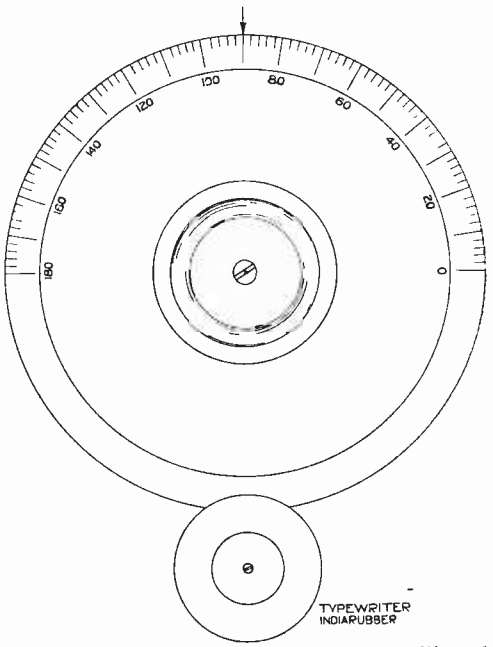
Example :—What is the smallest capacity to supply 4 valves satisfactorily?

Four valves require 3 amps.

$$3 \times 8 = 24 \text{ amp. hours.}$$

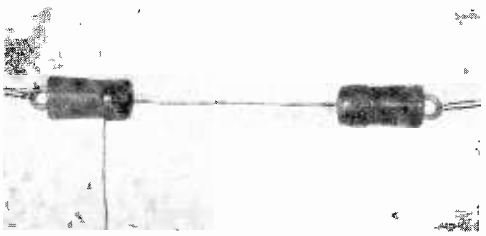
Answer :—24 A.H. actual, or say, 50 A.H. ignition. G. P. K.

Critical Adjustment of Condensers



An easily fitted device for critically controlling the setting of a condenser. The typewriter rubber makes a friction contact on the bevel of the condenser scale.

Aerial Insulators



A Novel type of Aerial Insulator with screw cap, providing a convenient method of terminating and adjusting length of aerial.

Electrons, Electric Waves, and Wireless Telephony—VII.

By Dr. J. A. FLEMING, F.R.S.

IV.—ELECTROMAGNETIC FIELDS, FORCES AND RADIATION.

1.—LINES OF ELECTRIC AND MAGNETIC FORCE.

Before dealing at greater length with the problem of atomic structure, it will be necessary to enter into certain elementary expositions of the nature of electromagnetic fields and forces and of electromagnetic or so-called electric waves.

Theory shows that when an electrified sphere or electrically charged body is set in motion in any direction it not only exerts a force on other electrified bodies near it, called electric force, but also when moving, acts on magnets or exerts a magnetic force along certain directions. In the case of a small charged sphere in uniform linear motion, the lines of electric force are radial and the lines of magnetic force are circles whose centres lie on the line of motion and planes are perpendicular to it. The regions near electrified bodies or magnets are called *electric* or *magnetic fields*, and in these fields forces of attraction or repulsion are exerted on other electrified bodies or magnets which are called electric and magnetic forces respectively. These forces are exerted along certain straight or curved lines called lines of electric or magnetic force. Faraday considered that these lines of force are not merely ideal lines like lines of latitude and longitude, but that they have some actual physical existence and are regions in which some special actions in a universally diffused medium called æther, are taking place.

Hence we may say that an electric or magnetic field has a certain discreteness or atomic structure, and that the space within a small tubular region surrounding a line of force is in some way different from the space outside.

In the case of an electrified sphere the lines of electric force radiate from the sphere as from its centre, being equally distributed in all directions, provided the sphere is at rest. Faraday showed by numerous experiments that it is impossible to create a charge of electricity of one kind without creating also an equal quantity of the opposite kind. Hence we must consider that a line of electric force must be either an endless line or, if not, must have its ends terminated by charges of electricity of opposite sign, say, by ending on positive and negative electrons respectively, or else must start from an electron and be extended to an infinite distance.

There is, however, an interconnection between lines of electric and lines of magnetic force which may be explained as follows:—

If a line of electric force is moved parallel to itself or in a direction at right angles to its own direction it creates a line of magnetic force which runs in a direction at right angles to that of the line of electric force and to that of the motion of the latter.

The relation of the directions may be memorised by means of a "hand rule," as follows: Hold the thumb, forefinger and middle finger of the *right* hand in positions mutually at right angles like three co-ordinate axes. Then let the direction of the forefinger denote the direction of a line of electric force, and that of the thumb the direction of the motion of this line at right angles to its own direction. Then the direction in which the middle finger points will be the direction of the magnetic force produced by its motion. It should be remembered that by usual conventions the direction of an electric line of force is the direction in which it would cause

a free positive electron or positively charged particle placed on it, to move. Hence for a negative electron the lines of electric force are directed *towards* the electron.

If then we consider an electron carrying its system of radial lines of electric force to be *in motion*, we see that the result is to surround the electron with a family of circular lines of magnetic force which all have their centres on the line of motion and all have their planes perpendicular to it (see Fig. 41).

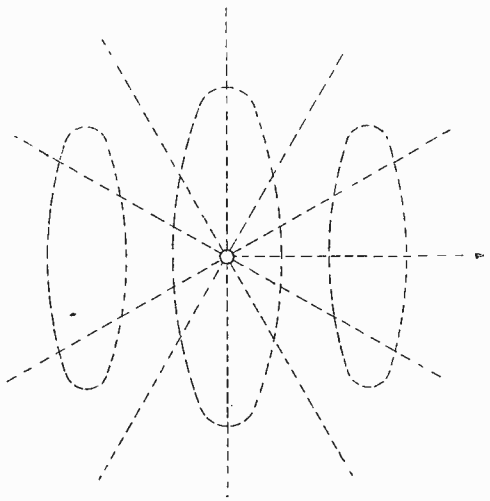


Fig. 41. *Lines of Electric and Magnetic Force round an Electron.*

The magnetic force at any point is proportional to the velocity and also to the resolved part or component of the electric force which is at that point perpendicular to the direction of motion. It can be shown mathematically that when the velocity or speed of the electron approaches that of light, viz., 300,000 kilometres per second, the radiating lines of electric force all crowd up into the equatorial plane, which is a plane through the centre of the electron and perpendicular to its direction of motion (see Fig. 42).

The radial lines of electric force and embracing circular lines of magnetic force then form a sort of spider's web pattern in that equatorial plane. This is called the electromagnetic field of force of the electron. This electromagnetic field represents a store of energy. If a substance of mass m, whether a bullet or a railway train, to be in motion with a velocity v, it has energy called kinetic or motional energy associated with it, which is in amount equal to $\frac{1}{2}mv^2$ or to half the mass multiplied by the square of the speed. It can be proved, though the proof is somewhat difficult, that when an electrified sphere moves with velocity v it has energy associated with it measured by

$$\tfrac{1}{2}\left(m + \frac{4}{3}\frac{e^2}{d}\right)v^2$$

where e is the electric charge, which in the

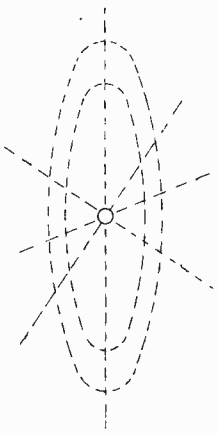


Fig. 42. *Lines of Electric and Magnetic Force around an Electron moving with high velocity.*

case of an electron is $1{\cdot}6 \times 10^{-20}$ electromagnetic units, or $16/10^{20}$ Coulombs, and d is the diameter of the sphere or electron. The letter m signifies the ordinary mass and $4e^2/3d$ is called the electrical mass.

2.—Size and Mass of an Electron.

The question has been much discussed whether the electron has any mass other than the electrical mass, and certain experiments by Kaufmann strongly indicate that it has not. If this is the case then the whole mass m of the electron is represented by the value of $4e^2/3d$ and the diameter d is equal to $\frac{4}{3}\frac{e}{m}e$. But now we have seen that the ratio of charge to mass or e/m for an electron is nearly $1{\cdot}774 \times 10^7$ electromagnetic units and that the electric charge e is $1{\cdot}6 \times 10^{-20}$ electromagnetic units. Hence the diameter of an electron is $\frac{4}{3} \times 1{\cdot}774 \times 1{\cdot}6 \times 10^{-13}$ of a centimetre or $0{\cdot}38 \times 10^{-12}$ cm, that is about one-third

of a billionth of a centimetre. A million times a million electrons, put in a close row, would only extend a distance of about one-sixth of an inch. A negative electron is therefore very small compared with an atom, about one hundred thousandth part of the diameter of an atom. Small however as is the negative electron, the positive electron is probably still smaller We have seen that in a Hydrogen atom, consisting probably of a single positive and single negative electron, the negative electron contributes only 1 1,700th part of the mass. This implies that if the charge of the positive electron is the same as that of the negative the diameter of the former is only 1 1,700th part of that of the latter. We see, therefore, that the negative electron has a diameter of only about a hundred thousandth part of that of the whole atom and that the positive electron is perhaps 2,000 times smaller. We are now able to make a pretty clear mental picture of what an atom of matter is like according to the above theory. Imagine a cricket ball suspended in the air. At a distance of 100 or 200 feet or so from it let there be a few dozen grains of dust each not more than 1/100 inch in diameter. Let these grains, representing electrons, revolve round the cricket ball, representing the nucleus in circular orbits, the grains being arranged in shells or groups of 2, 3, 4 to 8, in various orbits, up to say 100 feet radius This would suggest what an atom would look like if it

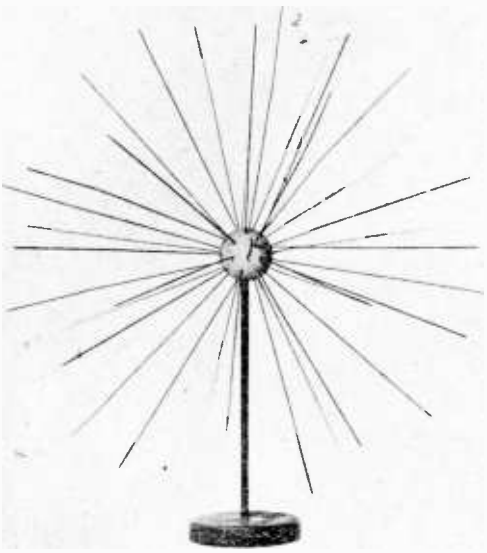
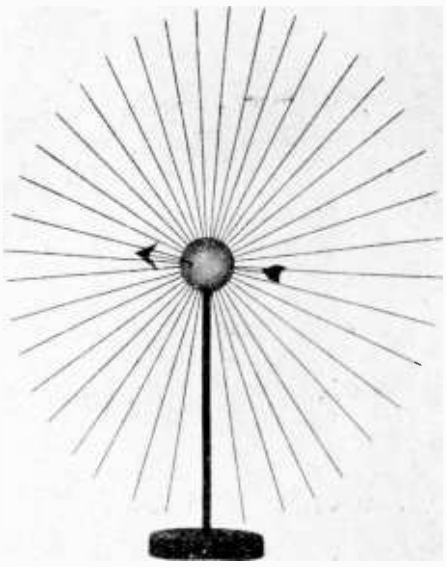


Fig. 43. A golf ball with radial wires in it to represent an electron with its electrolines.



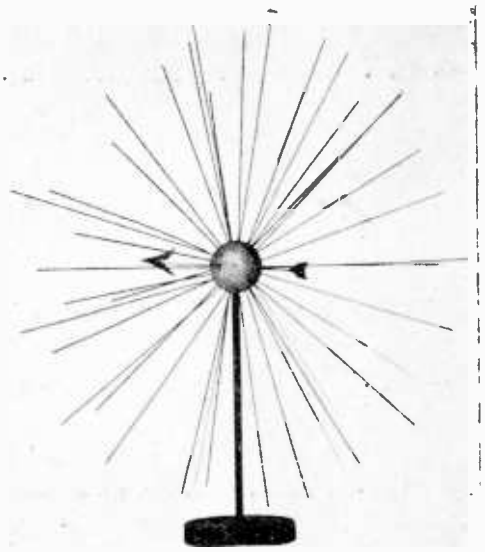


Fig. 44. A golf ball with radial wires in it to represent an electron in motion. The electrolines crowd up into the equatorial plane.

could be magnified a billion times and be then viewed from a distance of several hundred yards.

3 —ELECTROMAGNETIC WAVES.

Before considering the problems of atomic structure at any greater length it may be well at this stage to outline our present views on the nature of an electric or electromagnetic wave. We have seen that from an electron we consider lines of electric force to radiate. These lines may for the sake of brevity be called *electrolines*, and we may therefore picture to ourselves an electron as something like a golf ball in which have been stuck very long straight wires radiating equally in all directions, which wires represent the electrolines. These electrolines possess an elasticity of a certain kind. They resist stretching and endeavour to make themselves as short as possible. In fact the attraction between positive and negative electrons may be regarded as the result of the endeavour of these lines to shrink up in the direction of their length. Also these lines possess a quality equivalent to mass or inertia and the so-called electric mass of the electron to which we have already referred is merely the mass of the entirety of these electrolines and of the magnetolines produced by their motion.

Suppose then that an electron at rest is caused to make a sudden jump forward. It carries with it the ends of the electrolines which terminate on it, but the inertia of the line causes the rest of the line to be left behind for a moment and the result is the production of a *kink* or dislocation in the lines (see Fig. 45). This kink, however, travels outwards along the lines as the whole electroline picks up the motion. We have, however, seen that the lateral or sideway motion of an electroline gives rise to a magnetic force at right angles to itself and to the direction of its motion. Hence, as the " kink " in the electroline travels outwards it is accompanied by lines of magnetic force or magnetolines created by the motion of the electrolines.

These two sets of lines are at right angles to each other and to the direction of motion. Experiment shows that this kink travels outwards with a velocity of 300,000 kilometres per second in empty space or with the velocity of light in any medium in which the electron is placed.

This movement of electric and magnetic lines of force in the same plane is called an *electromagnetic pulse* or solitary wave and is also called *electric radiation.*

The same kind of electric radiation will be produced if an electron in uniform motion is suddenly stopped or has its velocity changed or suffers acceleration. There are, however, two kinds of acceleration. Velocity may be changed in amount, but not in direction, as when a stone is falling towards the earth,

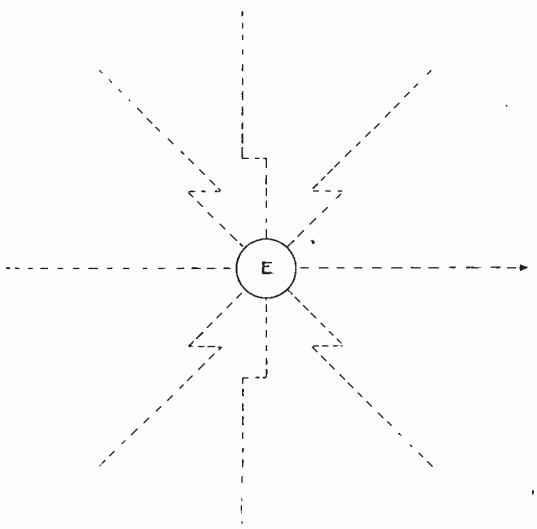


Fig. 45. Kinks produced on radial electrolines of an electron E when the latter suddenly jumps forward. The dotted lines denote the electrolines.

or the velocity may be continually changed in direction but not in magnitude as when a mass revolves with uniform speed in a circle. It appears, for reasons too long to give at this point, that an electron when revolving with constant speed in a circle round a nucleus, although in one sense of the term experiencing an acceleration towards the nucleus, is yet not radiating electromagnetic waves and therefore not losing energy. On the other hand if an electron jumps backwards and forwards in a straight line it does radiate, although the direction of its motion is always in one line. If then we imagine a number of electrons to be placed in a row in one line and all to jump to and fro in that line through a small range simultaneously, the whole lot of them would radiate and would produce an electromagnetic wave, the wave surface of which would be a co-axial cylindrical sheath or

surface to the line of electrons. We shall see, when we come to discuss the subject of wireless telephony, that this is just what happens in the case of the aerial of a wireless telephone transmitter.

Before proceeding further with the consideration of the problem of electric radiation by the atoms and electrons, it will be necessary to return to the discussion of a few more matters connected with the architecture of atoms.

(To be continued.)

The Switching of L.F. Valves.

By G. P. KENDALL, B.Sc.

WHEN a set includes one or more stages of low frequency amplification it is extremely desirable to use just the necessary number of valves to produce the desired signal strength. The switching arrangements to permit of this being done must be designed with some care to avoid loss of efficiency from dead-end effects and interaction between circuits. In most cases the best solution of the problem is the use of two-pole plug and four-spring break jack, provided that they are correctly used.

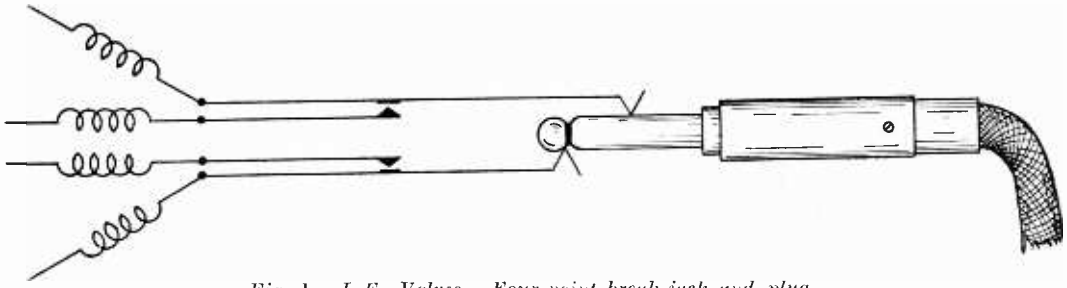


Fig. 1. L.F. Valves. Four-point break jack and plug.

Fig. 1 shows the arrangement of plug and jack. The four spring-strips of which the jack is composed may be conveniently referred to as the outer and inner springs, two of each. The outer ones are of unequal length and have their ends bent in such a way as to facilitate the introduction of the plug, and to cause one of them to make contact with the ball, and the other with the tubular part. The inner springs make contact through two pairs of platinoid points with the corresponding outer ones when the plug is out of the jack. When the plug is inserted the outer springs are pushed apart and thus disconnected from the inner ones. If, then, a jack is placed in the plate circuit of each valve, with one outer spring connected to the plate and the other to the H.T. positive, and the two inner ones to the intervalve transformer primary, it is clear that if the phones are connected to a plug we have the desired system of switching. When the plug is inserted in a given jack the phones are connected into the plate circuit of the valve, while the intervalve transformer is disconnected, thus cutting off the succeeding (unused) valves. When the plug is withdrawn the intervalve transformer primary is brought back into the plate circuit and the next valve comes into action. This will be readily understood from Fig. 2.

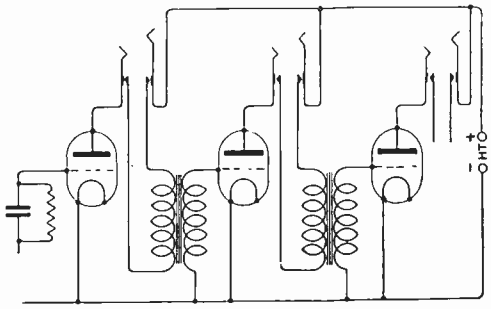


Fig. 2. Method of connecting jacks in L.F. Amplifier Circuit.

Some Recent Developments of Regenerative Circuits.*

By EDWIN H. ARMSTRONG.

IT is the purpose of this paper to describe a method of amplification which is based fundamentally on regeneration, but which involves the application of a principle and the attainment of a result which it is believed is new. This new result is obtained by the extension of regeneration into a field which lies beyond that hitherto considered its theoretical limit, and the process of amplification is therefore termed *super-regeneration*.

Before proceeding with a description of this method it is in order to consider a few fundamental facts about regenerative circuits. It is well known that the effect of regeneration (that is, the supplying of energy to a circuit to reinforce the oscillations existing therein) is equivalent to introducing a negative resistance reaction in the circuit, which neutralises positive resistance reaction, and thereby reduces the effective resistance of the circuit. There are three conceivable relations between the negative and positive resistances: namely—the negative resistance introduced may be less than the positive resistance, it may be equal to the positive resistance, or it may be greater than the positive resistance of the circuit.

We will consider what occurs in a regenerative circuit containing inductance and capacity when an alternating electromotive force of the resonant

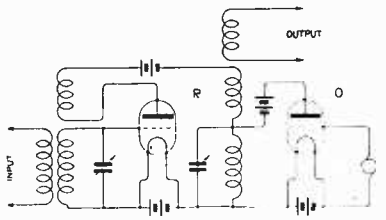


Fig. 1.

frequency is suddenly impressed for each of the three cases. In the first case (when the negative resistance is less than the positive), the free and forced oscillations have a maximum amplitude equal to the impressed electromotive force over the effective resistance, and the free oscillation has a damping determined by this effective resistance. The steady state is attained after the initial free oscillation dies out and continues until the impressed E.M.F. is removed, when the current dies out in accordance with a second free oscillation. The maximum amplitude of current in this case is always finite; it reaches this maximum amplitude in a finite time, and when the impressed E.M.F. is removed the current dies away to zero. This is the action of the circuits which are now in everyday practical use.

In the second case the negative resistance is equal to the positive resistance, and the resultant effective resistance of the circuit is therefore zero. When an E.M.F. is suddenly impressed in this case, the current in the circuit starts to increase at a rate which is directly proportional to the impressed electromotive force and to the square root of the ratio of the capacity to the inductance of the circuit (for a given impressed frequency). If the force is impressed for an infinite time, then the current in the circuit reaches infinity. If the E.M.F. is impressed for a finite time, then the current reaches some finite value. When the im-

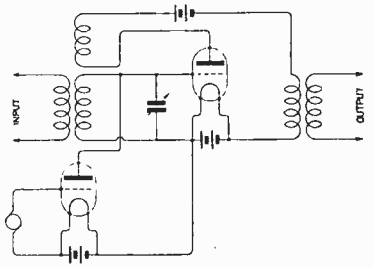


Fig. 2.

pressed E.M.F. is removed, the current in the circuit at that instant continues indefinitely with unchanged amplitude as a free oscillation. Theoretically, this is the limiting case for regeneration; practically it is always necessary to operate at some point slightly below this state at which the circuits have a definite resistance.

It is important to note here that although the circuit of this case has zero resistance, oscillations will not start unless an E.M.F. is impressed upon

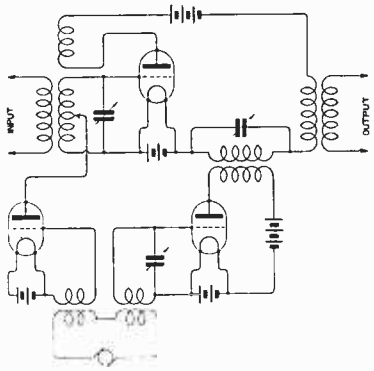


Fig. 3.

the circuit; furthermore, that oscillations once started continue with undiminished amplitude indefinitely. This state cannot be attained in practice, because the negative resistance furnished

* Abstract of a paper read before THE INSTITUTE OF RADIO ENGINEERS, New York, June 7th, 1922.

by the tube is dependent on the amplitude of the current and for stable operation decreases with increasing amplitude.†

In the third case the negative resistance introduced into the circuit is greater than the positive resistance, and the effective resistance of the circuit is therefore negative. When an E.M.F. is impressed upon a circuit in this condition, a free and a forced oscillation are set up which have some interesting properties. The amplitude of the forced oscillation is determined by the value of the impressed E.M.F. divided by the resultant resistance of the circuit. The free oscillation starts with an amplitude equal to the forced oscillation, and builds up to infinity regardless of whether or not the external

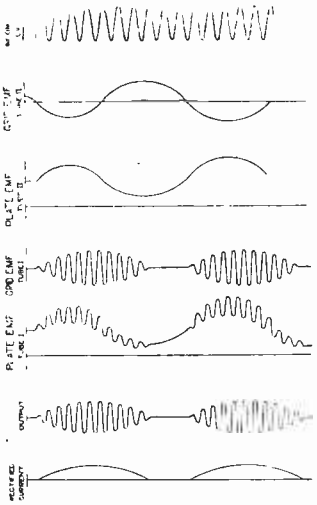


Fig. 4.

E.M.F. is removed. This free oscillation starts with an amplitude which is proportional to the impressed force, and this proportionality is maintained throughout any finite time interval (with constant impressed electromotive force).

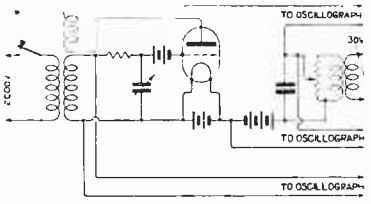


Fig. 5.

† It is very important at this point to distinguish between this purely theoretical state and the state which exists in oscillating tube circuits. In the various forms of self-heterodyne circuits a free oscillation of constant amplitude is maintained in the system and the circuit may be considered as having zero resistance, *but only for that particular amplitude of current.* An external E.M.F. impressed on the circuit always encounters a positive resultant resistance, assuming, of course, that the existing oscillation is stable. This is due to the non-linear characteristic of the tube.

It is important to note that although the negative resistance of the circuit exceeds the positive, and the effective resistance of the circuit is negative, oscillations will not occur until some E.M.F. is impressed. *Once an E.M.F. is impressed, however, no matter how small it may be, the current in the circuit builds up to infinity regardless of whether or not the external E.M.F. is removed.*

The fundamental difference between the case in which the resistance of the circuit is positive and the case in which the resistance of the circuit is negative may be summed up as follows: in the first, the forced oscillation contains the greatest amount of energy and the free oscillation is of very minor importance‡ (after a short interval of time), in the second, it is the free oscillation which contains the greatest amount of energy and the forced oscillation which is of negligible importance.

It is of course impossible, owing to practical limitations, to set up a system in which the negative resistance exceeds the positive without the production of oscillations in the system, since any irregularity in filament emission or impulse produced by atmospheric disturbances is sufficient to initiate an oscillation which builds up to the carrying capacity of the tube. It is, however, possible, by means of various expedients, to set up systems which avoid the production of such a paralysing oscillation and which approximate the theoretical case in the use of a free oscillation to produce amplification.

The first use of the free oscillation in a regenerative system for the amplification of signals appears to have been made by Turner§ in his valve relay system. Briefly, Turner prevented the regenerative circuit from producing oscillations when no signals

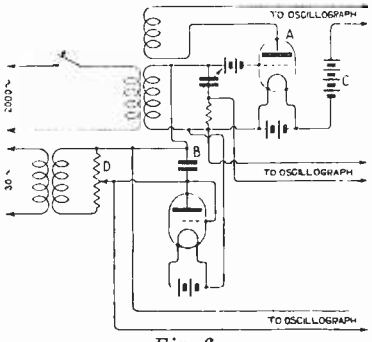


Fig. 6.

were being received by placing a negative potential on the grid of sufficient value to hold it just below that point on the characteristic curve at which self-oscillation would start. The impressing of a small electromotive force of sufficient value would carry the potential of the grid over the "threshold" value and a free oscillation would start which would build up to the limiting value

‡ This is strictly true when dealing with continuous waves which we have been considering. It is not true in the regenerative reception of spark signals, particularly of short wavelength, large damping, and low spark frequency. In this case the energy in the free oscillation exceeds the energy in the forced oscillation.

§ British Patent, 130,408.

of the tube. The system was returned to its initial sensitive state by means of a relay operated by the increase in the plate current of the tube. This relay short-circuited the feed-back coil, thereby cutting off the supply of energy and permitting the potential of the grid to drop back below the "threshold" value. As Turner explains, the device is a relay with a low limit (as distinguished from an amplifier), but it appears to be the first device in which the free oscillation set up by an impressed electromotive force produced the magnified result.

Bolitho* contributed an important improvement by replacing the mechanical relay of Turner which operated only upon the receipt of a signal by a valve relay which was continuously operated by independent means. Briefly, this was accomplished by connecting a second valve to the oscillating circuit of the Turner arrangement with a reversed feed-back connection and supplying the plate circuit of this second valve with alternating current. When the "threshold" value of the first tube was overcome and a free oscillation started in the system, the reversed feed-back of the second tube comes into action and at that time when the voltage supplied to the plate is positive, damps out the free oscillation and permits the grid of the first tube to return below the "threshold" value. This represents the second step in the utilisation of the free oscillation for the production of amplification.

It is the purpose of this paper to describe a principle of operation based on the free oscillation which is quantitative and without a lower limit. This new method is based on the discovery that if a periodic variation be introduced in the relation between the negative and positive resistance of a circuit containing inductance and capacity, in such manner that the negative resistance is alternately greater and less than the positive resistance,

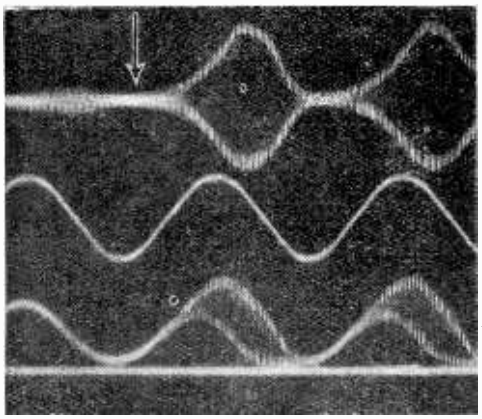


Fig. 7.

but that the average value of resistance is positive, then the circuit will not of itself produce oscillations, but during those intervals when the negative resistance is greater than the positive will produce great amplification of an impressed E.M.F. The free oscillations which are set up during the periods of negative resistance are directly proportional in amplitude to the amplitude of the impressed E.M.F. The variation in the relation between the negative and positive resistance may be carried out by varying the negative resistance with respect to the positive, by varying the positive resistance with respect to the negative, or by varying both simultaneously at some frequency which is generally relatively low compared to the frequency of the current to be amplified.

These three methods of producing the super-regenerative state are illustrated respectively by Figs. 1, 2, and 3, which figures indicate the general scheme of the system and the methods of varying the relation between the negative and positive resistance. Fig. 1 shows a method of varying the negative resistance produced by the regenerative system by varying the voltage of the plate of the amplifying tube by means of a second tube, the grid of the second tube being excited by an E.M.F. of suitable frequency.

Fig. 2 illustrates a method of varying the positive resistance of the circuit with respect to the negative. This is accomplished by connecting the plate

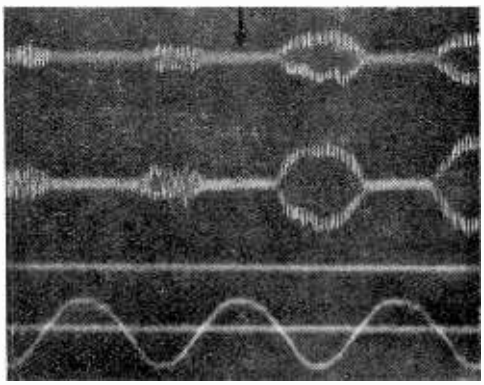


Fig. 8.

circuit of a vacuum tube in parallel to the tuned circuit of the regenerative system and exciting the grid by an E.M.F. of suitable frequency. Fig. 3 illustrates a combination of these two systems in which simultaneous variations are produced in both the negative and positive resistances and provision made for adjusting the relative phases of these two variations.

A general idea of the phenomena occurring in these systems when an E.M.F. is applied to the input circuit will be obtained from the diagram of Fig. 4, which applies specifically to the circuit of Fig. 1. This figure illustrates the principal relations existing in the system in which the positive resistance is constant and the variation is introduced into the negative resistance. It will be observed that the frequency of variation appears as a modulation of the amplified current so that the output circuit contains currents of the impressed frequency plus two side frequencies differing from the fundamental by the frequency of the variation.

Oscillograms of the essential current and voltage relations existing in the systems of the type illus-

* British Patent, 156,330.

trated by Figs. 1 and 2 were obtained with the apparatus connected as shown in Figs. 5 and 6, respectively. In the arrangement of Fig. 6, in order to produce sufficient variation in the positive resistance of the tuned circuit, which was of large capacity and low inductance, it was necessary to use a two-electrode tube in series with the auxiliary E.M.F.

Figs. 7 and 8 are oscillograms respectively for a negative resistance variation and a positive resistance variation. The signalling E.M.F. was impressed about half way along the film, the exact point at which the key was closed being indicated by the arrow. These oscillograms show phenomena which are in accordance with the explanations already given, but, in addition, show evidence of self excitation. It has been stated in the preceding pages of this paper that the basis of super-regeneration was the discovery that a variation in the relation between the negative and positive resistances prevented a system which would normally oscillate violently from becoming self-exciting. An examination of the oscillograms will show that this is not strictly true, as a free oscillation starts every time the resistance of the circuit becomes negative. It will be observed, however, that this free oscillation is small compared to that produced by the signal, and therein lies the complete explanation of the operation of the system. The free oscillations produced in the system when no signalling E.M.F. is impressed, must be initiated by some irregularity of operation of the vacuum tubes, and must start at an amplitude equal to the amplitude of this disturbance. This initial value is of infinitesimal order, and hence, in the limited time interval in which it can build up the locally excited oscillation, never reaches an amplitude comparable to the oscillation set up by a signal of any ordinary working strength.

phenomena involved will be analysed in a later part of the paper.

The rate of variation in the relation between the negative and positive resistance is a matter of great importance. It may be a sub-audible, audible, or super-audible frequencies. In radio

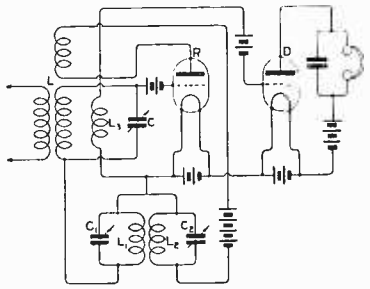


Fig. 11.

signalling, for the reception of telephony, the variation should be at a super-audible frequency. For modulated continuous wave telegraphy and spark telegraphy, to retain the tone characteristics of the signals, it must be well above audibility; for maximum amplification a lower and audible rate of variation should be used. In continuous wave telegraphy, where an audible tone is required, the variation is at an audible rate; where the operation of an indicating device is required, a sub-audible frequency may be best. The choice of frequency is a compromise, particularly in telephony, since obviously the lower the frequency the greater the amplification, and the higher the frequency the better the quality.

Some practical forms of circuits are illustrated by Figs. 9, 10 and 11, which illustrate respectively the three types of variation. Fig. 9 shows a method

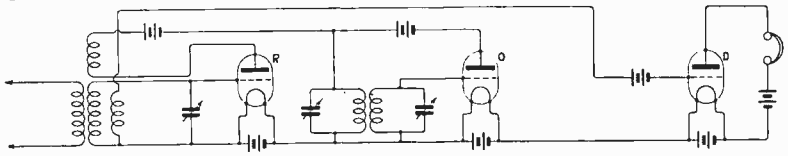


Fig. 9.

of varying the plate voltage of the amplifying tube *R* by means of the vacuum tube oscillator *O* coupled into the plate circuit. In this arrangement a third tube *D* acts as a detector. This is essential when an audible frequency is employed; when a super-audible frequency is used the telephones can be placed directly in the plate circuit of the amplifying tube.

There is a second point of interest which is most evident from the curves of Fig. 7. It will be observed that there is a decided lag in the maximum value attained by the free oscillation set up by a signal and maximum value of plate voltage (negative resistance) of the amplifying tube. This is most evident from the plate current curve. It is a point of considerable interest, and the

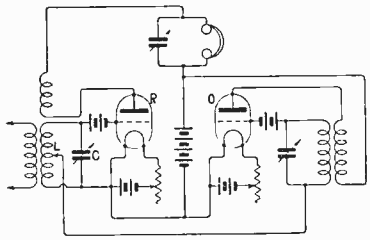


Fig 10.

Fig. 10 shows the second case in which the variation is introduced into the positive resistance of the tuned circuit. This is done by means of an oscillating tube *O*, the grid circuit of which is connected through the tuned circuit *LC* of the amplifying tube *R*. The variation in the resistance of the circuit is effected through the variation in potential of the grid of the oscillating tube. During that half of the cycle, when the grid of the oscillating tube is positive, energy is withdrawn from the tuned circuit in the form of a conduction current from the grid to the filament of the oscillating tube, thereby increasing the effective resistance of the circuit. During the other half of the cycle,

when the grid of the oscillating tube is negative, no conduction current can flow through the grid circuit of the oscillating tube, and hence no resistance is introduced into the tuned circuit of the amplifying tube. In this case the amplifying tube serves also as the detector for any frequency of variation, as the tuned circuit forms a sufficiently good filter even for an audible frequency to prevent a disturbing audible tone in the telephones.

Fig. 11 illustrates the case of a simultaneous variation in both positive and negative resistances. This is accomplished by providing the amplifying tube R with a second feed-back circuit L_1C_1 and L_2C_2 adjusted to oscillate at some lower frequency, thereby introducing a variation in the negative resistance through the variation of the plate potential of the amplifier and a variation in the positive resistance by means of the variation of the grid of the amplifier. The proper phase relations between the negative and positive resistance are obtained by adjustment of the capacity of condensers C_1 and C_2 and the coupling between

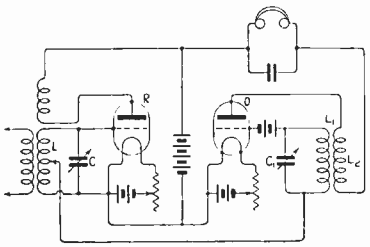


Fig. 12.

L_1 and L_2. In operation this system is very critical, and extreme care is necessary in order to obtain the super-regenerative state.

In each of the preceding cases the detecting function has been carried out either by a separate tube or by means of the amplifying tube. When a super-audible frequency of variation is employed, it is sometimes of advantage to perform the detecting function in the oscillating tube, and an arrangement for carrying this out is illustrated in Fig. 12. The operation of this system is as follows: incoming signals are amplified by means of the regenerative action of the amplifier tube R and the variations of potential across the tuned wave frequency circuit LC impressed upon the grid of the oscillating tube O. These oscillations are then rectified, and two frequencies are produced in the circuits of the amplifier tube. One of these frequencies corresponds to the frequency of modulation of the signalling wave. The other corresponds to the frequency of the variation and contains a modulation in amplitude corresponding to the modulation of the transmitted wave. This second frequency is then impressed upon the circuits of the oscillating tube with which it is in tune, amplified by the regenerative action of the system $L_1C_1L_2O$, and then rectified. The amplification obtainable with this form of system is considerably greater than that of the single amplification circuits, but is naturally more complicated to operate.

When a super-audible variation is employed in a system such as illustrated in Fig. 1, it is generally necessary to introduce a certain amount of resistance in the tuned circuit to insure the dying out of the free oscillation during the interval when the resistance of the circuit is positive. This is most effectively carried out by means of the arrangement illustrated in Fig. 13, in which a secondary coil L_1 of large inductance and high resistance is coupled to the tuned circuit LC and the energy withdrawn thereby from the oscillating circuit stepped up and applied to the grid of the tube. In the operation of this system, a curious phenomena is encountered. This is the manifestation of an inductive reaction by the plate circuit of the amplifying tube to the auxiliary frequency E.M.F. supplied the plate circuit by the oscillating tube, which comes about in the following way: When the auxiliary E.M.F. is impressed upon the plate of the amplifying tube, a current is produced in this tube in phase with the E.M.F. across the tube. Now suppose the plate voltage is at its maximum positive value. This means that the negative resistance of the circuit is a maximum in amplitude. This in turn means that the average value of the grid is becoming more positive and the current in the plate circuit is likewise increasing. Since the free oscillation in the system will increase in amplitude as long as the resistance of the circuit is negative, it will reach its maximum amplitude after the maximum positive voltage is applied to the plate. Hence the component of current corresponding to the frequency of the variation set up in the plate circuit by the rectification of the radio frequency oscillations lags in phase behind the auxiliary E.M.F. impressed on the plate. Hence the plate circuit of the tube manifests an inductive reaction to the auxiliary E.M.F. It was found that this inductive reaction could be tuned out by means of the parallel condenser C_1 with a great improvement in the stability of the operation of the system and increase in the signal strength. The resonance point is pronounced, and once the other adjustments of the system have been correctly made is as readily found as any ordinary tuning adjustment.

The problem of cascade amplification with these systems is a rather involved one on account of a great number of effects which are not encountered in ordinary methods of cascade amplification. The principal trouble is the reaction of the second

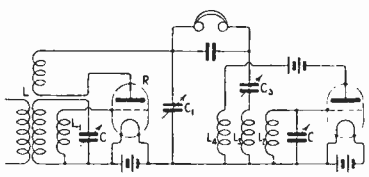


Fig. 13.

amplifying system on the first, and the difficulty of preventing it in any simple way on account of the high amplification per stage. While this difficulty is not insuperable, a simple expedient may be employed which avoids it. On account of the large values of radio frequency energy in these amplifying systems, the second harmonic is very strong in the plate circuit of the amplifying tube and is of the same order of magnitude as the fundamental if the tube is operated with a large negative voltage on the grid. Hence by arranging the second stage of a cascade system to operate at

double the frequency and to amplify this harmonic, the difficulty is avoided. The general arrangement of such a system is illustrated by Fig. 14, in which the positive resistance of the circuits LC and L_1C_1 of a two-stage amplifier are varied synchronously by a single oscillator. The circuit L_1C_1 in this case is tuned to the second harmonic of the circuit LC, but the combinations of circuits which may be arranged on this principle are very numerous.

One of the curious phenomena encountered with the super-regenerative system is found when it is attempted to secure sharp tuning by the use of tuned circuits placed between the antenna and the amplifying system. The free oscillations set up in these circuits by the reaction of the amplifying system continue in these circuits during the interval when the resistance of the amplifier circuit is positive, re-excite the amplifier when the resistance becomes negative, and hence the entire system is kept in a continuous state of oscillation. The effect is most critical, and may be produced with most extremely weak couplings between the amplifier circuit and the second tuned circuit. The simplest solution of the difficulty is to perform the function of tuning at one frequency and amplification at another, and this is best accomplished by means of the super-heterodyne method illustrated by Fig. 15. This may be adapted to work on either the sum or difference frequencies, but when the higher frequency is used, care should be taken that it is not near the second harmonic of the local heterodyning current. In the particular arrangement illustrated, LCD represents, together with the heterodyne, the usual agency for changing the incoming frequency, and A represents the super-regenerative amplifier which may be of any suitable type.

Some of the results obtained in practice with super-regenerative systems compared to simple regenerative systems may perhaps be of interest. In general, it may be stated that the amplification which can be obtained varies with the frequency of the incoming signal and with the radio of the wave frequency to the auxiliary frequency. The higher the signalling frequency and the greater the ratio of this frequency to the auxiliary frequency, the greater the amplification. Other things being equal, it appears that the energy amplification varies as the square of the ratio of the signalling frequency to the auxiliary frequency. Hence it follows that for telegraphic signals where an audible auxiliary frequency is used, much greater amplification can be obtained than in the case of telephony, where a super-audible auxiliary frequency must be employed. Using the arrangement of Fig. 11 for a signalling frequency of five hundred thousand cycles, an energy amplification several million times greater than that obtainable with a simple self-heteorodyne circuit is readily secured. Where a super-audible frequency is used for the reception of telephone signals, amplification of fifty thousand to one hundred thousand times energy can be obtained.

In a practical way the relative amplication of the new system with respect to the standard

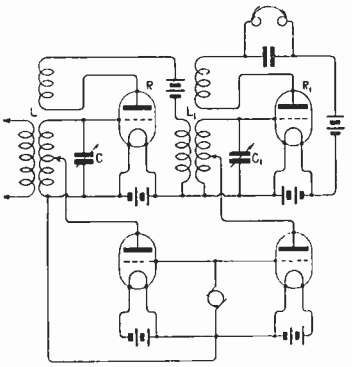


Fig. 14.

regenerative system for reception of telephone signals may be visualised as follows. With a signal so extremely weak that only the faintest of beat notes can be heard in the ordinary regenerative receiver, the super-regenerative receiver will give clearly understandable speech. For signals of sufficient strength to be understandable with the ordinary regenerative system with zero beat adjustment but not audible without local oscillations, the super-regenerative receiver will produce signals loud enough to be heard throughout the room.

Perhaps the most surprising characteristic of the system, apart from the amplification, is its selectivity with respect to spark interference when a super-audible frequency of variation is used. The explanation of this selectivity with respect, for example, to the ordinary regenerative receiver, lies in the periodic suppression of all free vibrations

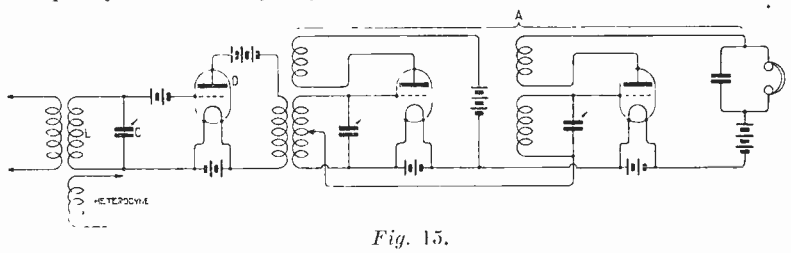


Fig. 15.

in the system. In the ordinary regenerative system spark interference approximates a form of shock excitation setting up a free vibration in the system which, because of the low damping existing therein, continues for a long period of time. An examination of the character of the oscillation set up will show that the energy existing in the free vibration after the initial impressed electromotive force is removed, is far greater than the forced vibration. In the ordinary system this free vibration may exist for a thousandth of a second or more. In the

super-regenerative system this free vibration is damped out before it has proceeded more than one twenty thousandth of a second as a maximum. Hence the interference from spark signals is greatly reduced. This phenomenon opens up a new field for the suppression of interference produced by shock excitation.

At the present time, on a three-foot loop antenna located twenty-five miles from the station WJZ at Newark, New Jersey, and a system of the type illustrated in Fig. 12 with one stage of audio-frequency amplification (three tubes in all) the announcements and musical selections are clearly audible five hundred yards from the receiver. With the same loop at the same distance, using the arrangement of Fig. 11 without the separate detector tube, that is with the telephones directly in the plate circuit of the amplifier tube, it is possible to operate a loud-speaking telephone so that the programme from the Newark station is plainly heard through a large size room. The signals with the arrangements of either Figs. 11 or 12 are still heard loudly if the loop is discontinued from the receiver, the coils and wires of the receiver itself collecting sufficient energy to produce response.

While the new system does not amplify the ordinary spark signal with anything approaching its efficiency on continuous wave signals, one example of spark reception may be of interest. During the past winter an amateur spark station located at Cleveland, Ohio, and operating on a wavelength of about 340 metres was received nightly at Yonkers, New York, on a three-foot (1 metre) loop, and the arrangement of Fig. 13 with sufficient intensity to enable the signals to be read throughout the room.

In conclusion, I wish to express my very great indebtedness to Professor L. A. Hazeltine for much valuable aid in connection with the theoretical side and to Mr. W. T. Russell for his assistance throughout the experimental side of this development.

Broadcasting Commences.

The following statement was issued by the Broadcasting Committee on Monday, November 13th.

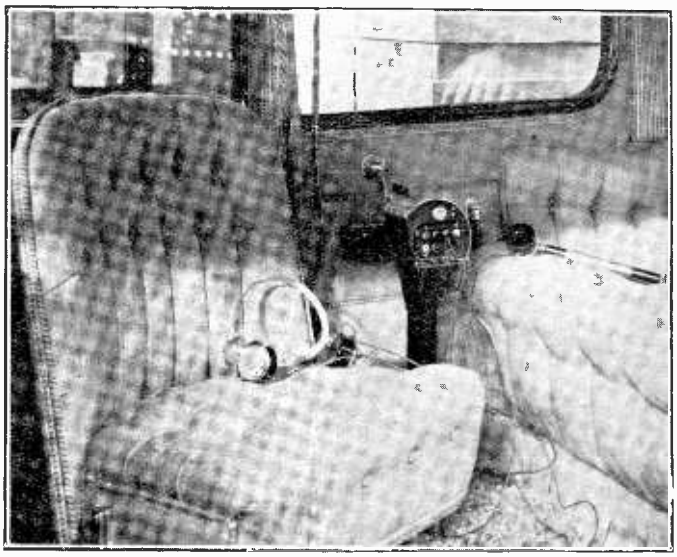
"Pending the formation of the British Broadcasting Company, which will be completed in a few days, the Broadcasting Committee has decided to commence a limited nightly programme from the London Station. This will consist of two copyright news bulletins and official weather reports, broadcast at 6 and 9 p.m. on a wavelength of 360 metres.

"The first two bulletins will be broadcast to-morrow, Tuesday evening. Special messages indicating the progress of the General Election will be broadcast as received on Wednesday and Thursday evenings."

Broadcasting and the Lord Mayor's Show.

The accompanying photograph shows the interior of a Daimler car fitted with wireless receiving apparatus by the Marconi Company. This car took part in the procession of the Lord Mayor's Show on Thursday, November 9th. During the procession communications were sent from **2 LO** (Marconi House) and being received on the car were broadcasted from a loud speaker in the car.

We understood from reports of the reception of these transmissions in different parts of this country that the band music of the procession was also distinctly audible during the time that the procession was passing in the neighbourhood of Marconi House.



The Receiving Set, which was connected to a frame aerial carried on the roof of the car.

Notes.

Manchester Society and Transatlantic Tests.

Manchester Wireless Society is conducting four special tests during November with a 1 kW. spark set. The times are from 1 a.m. to 7 a.m. G.M.T. each Sunday morning, the actual transmissions being for the duration of the first 15 minutes in each hour. **5 MS** is the call sign.

Six New Canadian Stations.

With the primary object of keeping Federal officials in touch with one another, six new wireless stations are proposed to be erected by the Government of the Dominions of Canada. The following sites are mentioned: Fort Smith, Fort Resolution, Fort Simpson, Fort Norman, Fort Macpherson (all Mackenzie River), and Dawson City.

Messages from Amundsen.

It is reported that the arrangement with Captain Amundsen and a chain of wireless stations for the transmission of daily messages has not been carried out. Amundsen's ship, the "Maud," was to transmit via Nome, Alaska, and the East Coast of America, to the Eiffel Tower. Messages were to be received by the Norwegian Meteorological Institute from October 15th onward. A few messages were received, and have been duly passed on by the Eiffel Tower. Investigation is being carried out with a view to finding the break in the chain.

Glasgow Exhibition.

A highly successful exhibition was held by the Glasgow and District Radio Club, in the McLellan Galleries, Sauchiehall Street, Glasgow, on Saturday, November 4th. The special features were the large Trade Show, the latest apparatus being exhibited by about twenty firms, the local firms being very prominent. The Club Members' Show was also fairly large, all types of ancient and modern apparatus were on view, and the workmanship of some was of high order.

Special transmissions from Paris and Northolt were received at 4 and 7 p.m., both wishing the Club every success. The set used for the reception of these messages was built by one of the Club members who is totally blind. It is in the form of a bureau with lid, and has a three-valve set containing one H.F., one detector and one L.F. The workmanship and general finish of the set is splendid, and gives particularly good signals.

Concerts were transmitted at regular intervals all day from an adjoining hall, and received in loud speakers and head phones at a number of the exhibitors' stands in the main hall. By 3 o'clock the hall was so packed that it was found necessary to stop admitting visitors for a short time. Professor Howe's lecture on "Wave Transmission" was a great success.

During the day about 100 names were taken, practically doubling the Club membership.

The office bearers and Committee beg to thank all members and others who contributed to the success of the exhibition, especially the artistes who so kindly gave their services in the transmitting room.

An Interesting Photograph.

The photograph on this page shows Dr. Charles P. Steinmetz, chief consulting engineer of the General Electric Company, with Mr. Thomas A. Edison. Dr. Steinmetz is showing his fellow

Dr. Charles P. Steinmetz and Thomas A. Edison examining a shattered High-Tension Insulator.

scientist some broken porcelain insulators and broken pieces of a tree limb which a few minutes before he had shattered during special high voltage tests. The demonstration took place on October 18th, at Schenectady, during Edison's first visit in 25 years.

Royal Air Force Wireless School and Squadron.

A Re-Union Dinner for Past and Present Officers of the Wireless School and Squadron will be held at the Holborn Restaurant, London, at 7 p.m. for 7.30 on Wednesday, December 6th, 1922. Full particulars and tickets, price 15s., may be obtained from F/O E. Taylor, Electrical and Wireless School, R.A.F., Winchester, Hants.

Public Demonstration at Birmingham.

At the Solihull Public Hall, Birmingham, on November 18th, a public demonstration of telephony is being given in aid of Solihull Allotment Holders' Association and the *Birmingham Mail* Christmas Tree Fund.

Mr. A. P. M. Fleming at the Manchester School of Technology.

Mr. A. P. M. Fleming lectured before an audience of over 600 on November 3rd at the Manchester School of Technology. His subject was "Radio Telephony, with Special Reference to Broadcasting."

Calendar of Current Events

BROADCASTING.—An important announcement concerning the commencement of Broadcasting appears on p. 240.

Friday, November 17th.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.

Lecture on "Valve Control," by Mr. W. F. Ellis.

SUTTON AND DISTRICT WIRELESS SOCIETY.

At the Sutton Adult School, Benhill Avenue. Demonstration in aid of London Hospitals. Transmissions by Marconi House, at 5 to 7 p.m.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

At 7.0 p.m. At the Grammar School. Lecture on "Inductance and Capacity," Part 1, by Mr. W. G. Marshall.

BRADFORD WIRELESS SOCIETY.

Cinema Display.

Sunday, November 19th.

Daily Mail Concert from the Hague, 3 to 5 p.m. on 1,085 metres.

Monday, November 20th.

ILKLEY AND DISTRICT WIRELESS SOCIETY.

At 7.30 p.m. At Regent Café. Lecture on "Maritime Wireless Communication," by Mr. D. E. Pettigrew.

NORTH LONDON WIRELESS ASSOCIATION.

Lecture on "Telephone Headgear: Constructional," by Mr. H. Norman Wilson.

Tuesday, November 21st.

Transmission of Telephony at 8 p.m. on 400 metres, by **2 MT** Writtle.

PLYMOUTH WIRELESS AND SCIENTIFIC SOCIETY.

At the Technical School. Lecture on "The Armstrong Super-Regenerative Circuit," by Mr. P. Arberry.

RADIO SOCIETY OF BIRKENHEAD.

At 8 p.m. At 36, Hamilton Square. Opening meeting and Demonstration.

LOWESTOFT AND DISTRICT WIRELESS SOCIETY.

Lecture and Demonstration on the "Armstrong Super Circuits," by Messrs. Burcham and Garrood.

Wednesday, November 22nd.

WIRELESS SOCIETY OF LONDON.

At 6 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Special Meeting to consider change of name, and other business. Following, Mr. G. G. Blake will give a short paper on "A Mechanical Model Illustrating the Action of the Three-Electrode Valve." Mr. Maurice Child will also give a short paper on a "Five-Valve Selective Amplifier."

MANCHESTER WIRELESS SOCIETY.

At 7.30 p.m. In the Council Chamber, Houldsworth Hall. Discussion.

REDHILL AND DISTRICT Y.M.C.A. WIRELESS SOCIETY.

At 111, Station Road, Redhill. Lecture on "Operating," by Mr. Ross.

HALIFAX WIRELESS CLUB AND RADIO SCIENTIFIC SOCIETY.

At 7.30 p.m. Lecture.

MALVERN WIRELESS SOCIETY.

Lecture on "Electro Magnetism and Inductance," by Mr. H. J. B. Martin.

Thursday, November 23rd.

LUTON WIRELESS SOCIETY.

At 8 p.m. At Hitchin Road Boys' School. Practical Work and Experiments.

NEWCASTLE AND DISTRICT AMATEUR WIRELESS ASSOCIATION.

At 7.30 p.m. At Armstrong College. Lecture on "The Singing Arc," by Dr. Thornton (Members of other local societies welcome).

DERBY WIRELESS CLUB.

At 7.30 p.m. At "The Court," Alvaston. Lecture on "H. F. Currents," by Mr. F. J. Allen.

Friday, November 24th.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

At 8 p.m. Demonstration of "Burndept Apparatus," by Messrs. Townend and Phillips.

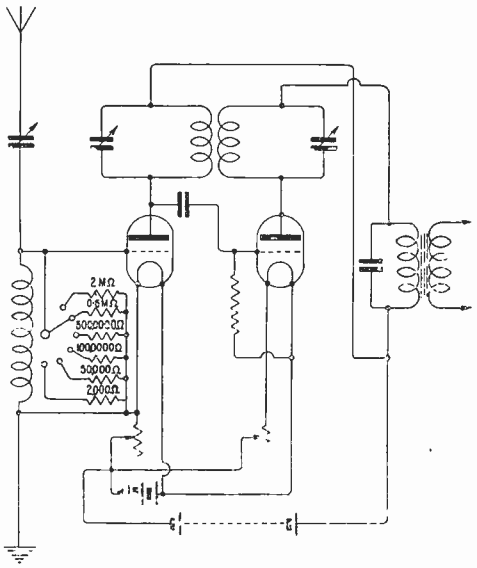
WIRELESS SOCIETY OF HULL AND DISTRICT.

At 7.30 p.m. Sale of Surplus Apparatus at the Signal Corps H.Q., Park Street.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I believe the simple circuit shown will be helpful to many of your readers who possess powerful receiving sets.



Capt. Wood Smith also shows the leak circuit connected between the aerial and earth leads.

These multivalve sets, admirably adapted for the reception of weak signals and telephony, are hard to reduce in tone volume (and sometimes oscillation) when receiving powerful transmissions at short distance. R. F. WOOD SMITH, F.C.S.

Wireless Club Reports

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

Fulham and Chelsea Amateur Radio and Social Society.*

Hon. Secretary, Mr. R. Wood, 48, Hamble Street, Fulham, S.W.6.

The attendance on October 24th was very satisfactory. New members continue to enroll.

The Secretary gave the members a diagram of a single valve circuit that produces louder signals and is devoid of all "howl," the oscillations themselves being hardly audible.

A short but interesting lecture was given by Mr. Hubbard, a member, on "Elementary Electricity." The remaining part of the evening was devoted to humorous wireless stories ranging from "Firegrate Aerials" to "Dustbin Earths."

Total membership now numbers 87.

HALIFAX EXHIBITION.

A corner of the Exhibition Room.

Wireless Society of Hull and District.*

Secretary's Address, 79, Balfour Street, Hull.

There was only a fair attendance at the monthly Questions and Answers evening, October 27th.

Mr. Hy. Strong (acting Vice-President) was in the chair. Routine business was transacted, and matters arising from written questions discussed. The question of the restriction of reacting circuits directly coupled to the aerial was considered, and the opinion of most members was that the Phillips rejector circuit was a good one to use. By request the Chairman made a rough blackboard sketch of this circuit. Other questions were satisfactorily dealt with. Two new members were elected during the evening, bringing the present membership to over 80. The Society consider that the number should be at least 200, and that it would pay every experimenter to join.

Members are specially asked to note that on November 24th a sale of members' surplus apparatus will be held at 7.30 p.m.

In view of a suggestion of the Wireless Society of London with regard to a change of name and constitution, the question of obtaining a supply of printed rules and membership cards is in abeyance pending further information on this point.

The Belvedere and District Radio and Scientific Society.*

Hon. Secretary, Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

At the Erith Technical Institute on Friday, October 27th, the ninth general meeting was held.

Morse instruction and practice preceded a short lecture on "Graphs and their Application," by Mr. T. E. Morriss. Mr. S. Burman also spoke on "The Detector and Low Frequency Unit," giving many valuable hints on the practical construction of this unit.

North London Wireless Association.*

Assist. Hon. Secretary, Mr. Frank S. Angel, Northern Polytechnic, Holloway Road, N.

On October 23rd, a lecture was delivered by Mr. Power on "Microphones."

Commencing with a description of the early instruments such as the Bell type and those making use of loose contacts between metal rods or carbon pencils, he proceeded to describe the various improvements which had led up to the instruments of to-day.

Mr. Power had brought with him several kinds of modern microphones, including inset and solid-back types, which he took to pieces and passed round for inspection, at the same time explaining their construction and action.

Several questions were asked by members and answered by the lecturer, who received a vote of thanks.

At a meeting on October 30th Mr. Reading delivered an interesting lecture on Short Wave Aircraft Sets in use at the time he was in the Air Force.

The speaker divided his lecture into three parts —Transmitters, Receivers and Amplifiers—each of which he treated very fully, giving diagrams of all circuits used and details of the results obtained with them.

The transmitters described were all of the spark type, some being excited by batteries and some by alternators. In many cases tuning was effected by fixed condensers.

The receivers demonstrated were all crystal receivers in which provision was made for the addition of L.F. valve amplifiers.

Two types of amplifiers were shown by Mr. Reading—a three-valve L.F. resistance capacity coupled amplifier, and one using iron-cored transformers. The latter was found to be the most efficient.

The following lectures have been arranged :— Monday, November 27th, "Elementary Principles of Radio Telegraphy and Telephony III," Mr. F. S. Angel. Monday, December 4th, "The Mark III Tuner and its Adaption to Various Circuits," Mr. G. D. Meyer. Monday, December 11th, "A Compact Receiver," Mr. L. Hirschfeld. Monday, December 18th, "Elementary Principles of Radio Telegraphy and Telephony," IV, Mr. F. S. Angel.

A special section of the Association has been formed for juniors up to the age of 18, the annual subscription to which is 5s. per annum.

Wireless and Experimental Association.*

Hon. Secretary, Mr. Geo. Sutton, 18, Melford Road, S.E.22.

At the Central Hall, Peckham, on November 1st, the Vice-Chairman, Mr. Sam Middleton, opened the proceedings with buzzer instruction. The new members showed commendable progress.

Mr. Chapman, of the staff of *Amateur Wireless*, gave some exceptionally good hints on the erection and use of short aerials and direction finding apparatus, and other members joined in the debate.

Mr. Voigt, member, discoursed on ebonite dielectrics in variable condensers and charging batteries off direct current mains. The Chairman and the Secretary took part in the latter part of the debate.

Many new members are joining.

Wolverhampton a District Wireless Society.*

Hon. Secretary, Mr. J. A. H. Devey, 232, Gt. Brickkiln Street, Wolverhampton.

At the meeting on October 25th, a most instructive lecture was given by Mr. Harvey-Marston on "Transmission." The lecturer brought forward many interesting points and covered a wide area in the limited time at his disposal. Mr. Marston made a special feature of small power transmission, which proved of great value to the many experimenters present. Very lucid diagrams were used, and the discussion following was exceedingly beneficial.

The Society hopes to secure the services of Mr. Harvey-Marston again in the new year.

Sheffield and District Wireless Society.*

Hon. Secretary, Mr. L. H. Crowther, 18, Linden Avenue, Woodseats, Sheffield.

The second meeting was held on November 3rd, when an exhibition of cinematograph films, kindly lent by The Western Electric Co., Ltd , was shown in the Mappin Hall at the University, Sheffield, to a large audience.

The films, which were of an educational character, were entitled "The Audion" and "Telephone Inventors of To-day."

The meeting was presided over by Mr. F. Lloyd, the new President, and a vote of thanks was passed to Messrs. The Western Electric Co., Ltd.

Fulham and Putney Radio Society.*

Hon. Secretary, Mr. J. Wright Dewhurst, 52, North End Road, West Kensington, London, W.14.

On October 27th Mr. Calver described his visit to the meeting of the Wireless Society of London, and pointed out the benefits derived by affiliation. He also drew attention to the appeal from St. Dunstan's for assistance to the blinded soldiers in matters relating to wireless. It was proposed that the Secretary write to Capt. Ian Fraser, and also the local Secretary, offering to assist any local member of St. Dunstan's in wireless matters by putting him in communication with one of the members residing nearest, also the Society offers free membership.

Mr. Houstoun had on view a very compact three-valve set, and during the interval of winding a frame aerial Mr. Calver gave a graphic description of the daylight signalling apparatus used during the war. He also explained a code system, and went on to give a few of his experiences of wireless work during the war.

The membership is still on the increase, and now the Technical Committee has been formed it is hoped in a very short time to have an experimental unit set of such a design that members can try out any wiring scheme they wish.

Stoke-on-Trent Wireless and Experimental Society. *

Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley.

At the Y.M.C.A., Hanley, on October 26th, details of an interesting competition were announced. Mr. Bew, a member, offered a prize of wireless apparatus to the value of £1. Latest date for receiving entries is November 16th.

It is proposed to form a buzzer class from 7 p.m. to 7.30 p.m. on Thursdays.

A variable condenser was constructed, and some coils wound the following week.

Finchley and District Wireless Society.*

Hon. Secretary, Mr. A. E. Field, 28, Holmwood Gardens, Finchley, N.3.

The social evening on October 30th, when about 140 people were present, was a great success. The M.C. was Mr. Macdonald Brown. The dance band was excellent, a special vote of thanks being given to them as they had given their services entirely free, and also to several excellent artists whose services made the evening the success it was. There were several musical transmissions received on a four-valve set kindly brought up by Mr. Cannon, music from 2 OM—2 OM being clearly heard all over the hall—transmitted specially to the Society and his music was excellent. Mr. Heppel arranged refreshments, the service of which was excellent. Another social evening is being arranged. An Experimenter's Licence for the Society has now been obtained, and the work of making a set and of erecting a permanent aerial is being started at once.

Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

At the Grammar School on October 20th, a lecture entitled "Diagram Interpretation" was delivered by the Hon. Secretary. The lecturer explained the numerous difficulties that beset a beginner where circuit diagrams were concerned, and how these could be greatly reduced by strict standardisation of symbols. Symbols were sketched and explained, and combined to form simple crystal and valve receiving circuits. The diagrams were then extended to valve and crystal combinations, two and three-valve sets, etc., the function of each component being briefly explained. A diagram submitted showed a five-valve set, four different types of intervalve coupling, with a separate heterodyne for beat reception of C.W. Discussion followed, and the Hon. Secretary was accorded a hearty vote of thanks.

A general meeting was held on October 27th, Mr. T. Brown Thomson taking the chair. Six new members were then elected. Mr. H. F. Yardley, M.I.R.E., Managing Director of the British Wireless Supply Co., Ltd., gave a demonstration of "Britwire" apparatus.

Mr. Yardley was received with loud applause.

Music was received from the amateur experimental station (2 LA) on a multi-valve set and a Magnavox loud speaker. The music, etc., was clearly audible up to 100 yards distance away. During the intervals of the transmission, numerous "Britwire" products were submitted to the meeting for examination. The apparatus included the Mark I tuner, the Mark III three-valve receiver, the Mark IV four-valve receiver, "Britwire" L.F. magnifiers, coils, etc.

Mr. A. M. Bage (President) proposed a vote of thanks to Mr. H. F. Yardley and his assistants, this being duly carried, after which Mr. A. F. Carter, A.M.I.E.E., was elected Chairman at the next general meeting.

Woolwich Radio Society.*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

At the Woolwich Polytechnic on October 27th, in a lecture room kindly lent by the Governors, the monthly meeting was held, there being a good attendance, including several welcomed visitors.

Mr. McPherson, B.Sc., Chairman, introduced Mr. Bartle, of Blackheath (2 LT), who lectured on "Broadcast Reception." First taking aerials, he said that the most efficient aerial for broadcast reception was a single wire 60 ft. long for earth; a counterpoise wire strung round the garden fence was even better than the usual waterpipe earth. He also showed how the gaspipes or electric lighting wires could be used, and were extremely efficient—second only to an outdoor aerial. Then simple valve circuits were touched upon, the lecturer insisting upon the necessity of amateurs preventing their sets from oscillating while receiving telephony, and showing how one could tell if their set was oscillating or not. Then the Armstrong Super-Regenerator was dealt with, illustrated by a very beautiful and neat set that Mr. Bartle had constructed and brought with him. He showed on the blackboard the current employed, and gave constructional details and figures for the various components. He used with it a frame aerial—9 turns of spaced wire on a 26-in. loop. Though the high-pitched whistle characteristic of this circuit was easily obtained, it completely refused to amplify telephony, and it was not possible to form any idea of its power. Later, telephony was obtained on an Ethophone II, kindly lent by Messrs. Burndept. Questions were answered by Mr. Bartle, who was then accorded a hearty vote of thanks.

Weekly meetings of the Society are held at headquarters, Y.M.C.A., Thomas Street, every Wednesday evening at 7.30.

Mr. Houghton's elementary talks to beginners on the construction and manipulation of simple crystal and valve sets are being continued weekly from 8 to 8.30 p.m.

The recent sale of surplus gear was very satisfactory.

Newport and District Radio Association.*

Hon. Secretary, Mr. Edward R. Brown, 92, Corporation Road, Newport.

On October 26th, Mr. H. W. Winslow (Newport) gave illustrations of the various methods of jointing. He showed that although "soldering" and "jointing" seem somewhat elementary, it is surprising how different they appear after being carried out by a practical hand, and how easy it is to throw out of gear a whole instrument by the lack of knowledge or care upon some very small matter in this respect.

It was clearly indicated to the members that other evenings could be well spent by similar demonstrations.

This Association has now been affiliated with the Wireless Society of London.

Ilkley and District Wireless Society.*

Hon. Secretary, Mr E. Stanley Dobson, "Lorne House," Richmond Place, Ilkley.

A well attended meeting of the above Society was held on October 23rd, at the Regent Café, Ilkley. The minutes of the previous meeting were read, and a new member enrolled.

Mr. L. E. Overington addressed the meeting on the subject of "Electro-Magnetic Induction."

The assembling of the Society's receiving set is well in hand, and it is hoped to have it in working order by next month.

A good programme of lectures has been drawn up for the next few months, and a particularly interesting announcement will be made in the near future.

Halifax Wireless Club and Radio Scientific Society.

Approximately 800 people visited the exhibition held last month. Thanks are due to the Stewards, especially Messrs. L. H. Carter and H. Alroyd, also to **2 QK, 2 AW** and **2 YF**.

Mr. H. W. Sullivan sent a splendid collection of high-class components. Exhibits were sent from the following firms:—Radio Instruments, Ltd., The Mainwright Manufacturing Co., Wates Bros., The Barlow Engineering Co., Hart Accumulator Co., E. E. Rosen & Co., The General Electric Co., Marconi-Osram Lamp Co., Western Electric Co., S. G. Brown, Ltd., Burndept, Ltd., The Wireless Press, Ltd., and the Radio Press, Ltd. Two local dealers, The Electrical Supply Stores and Denison Bros., also exhibited.

Membership of the Club is conditional on abiding by the terms of the P.M.G. licences as amended from time to time

Mr. P. Denison is preparing diagrams of receiving sets which do not contravene the regulations and these are to be circulated among the members

A lecture is to be given by Mr. J. R. Halliwell on November 22nd, at 7.30 p.m.

Malvern Wireless Society.

Hon. Secretary, Mr. N. H. Gwynn Jones, Burford House, Gt. Malvern.

A good attendance marked the opening of the Society's first meeting on October 25th at the Drill Hall. A lecture was given by Mr. L. H. Mansell on "The History and Progress of Wireless."

He touched upon the earliest discoveries of Hertz, Marconi's early experiments and the rapid strides which have since been made. Pioneer apparatus, coherers, crystals, etc., were exhibited.

An excellent demonstration was given with the help of another member, Mr. M. Jeynes, on Mr. Mansell's five-valve set and loud speaker.

Mr. R. Green then gave a talk on the easiest way of learning Morse. Great interest was displayed by the lady members present.

Mr. Mansell-Moullin, F.C.S., the Society's Vice-President, was heartily welcomed.

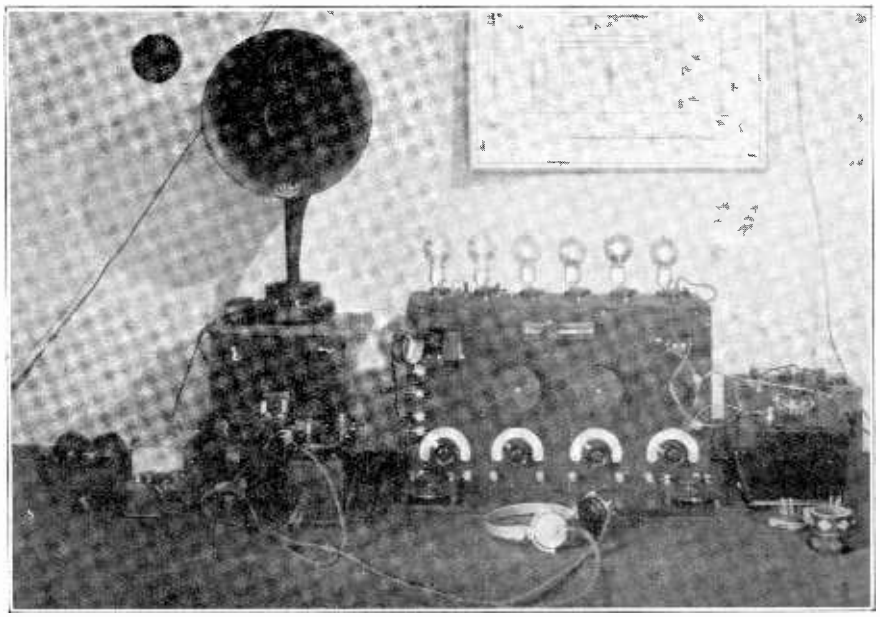
The Society has had an aerial and fittings presented to them by Messrs. L. H. Mansell and M. Jeynes, and hopes to have the set of apparatus at an early date.

Meetings are to be held each Wednesday evening at 8 p.m., at the Society's headquarters at the Drill Hall, Albert Road.

Membership to date totals 57.

The second meeting was held on November 1st, when Mr. R. Green lectured on "Wave Motion in Air, Water and Æther," illustrated with blackboard diagrams.

HALIFAX EXHIBITION.



The Short Wave Receiver specially built for the Exhibition by Mr. J. R. Clay, Treasurer of the Club. Received the Marconi House Transmission perfectly at 200 miles away. (The two coils in the coil holder are not primary and resistance.)

Dewsbury and District Wireless Society.

Hon. Secretary and Treasurer, Mr. A. Horsfall, Willow Grove, 34, Lee Street, Ravensthorpe.

The winter session first lecture took place on October 12th. Mr. F. Dransfield, B.Sc., of Dewsbury, spoke on "Capacity." Discussion followed.

On October 19th, Mr. J. Bever, of Bradford, **(2 QK)** lectured on "The Electron Theory and the Thermionic Valve."

On November 4th, 6th and 7th, a Wireless Exhibition and Demonstration was held in the Moot

Hall. Various wireless receiving sets, both professional and amateur made, were exhibited.

Mr. Skinner, of Batley, lectured on November 9th, on "Inductance."

Nottingham and District Radio Experimental Association.

Hon. Secretary, Mr. D. F. Robinson, 99, Musters Road, West Bridgford, Notts.

On October 26th, the Chairman, Mr. J. Thornton, announced the resignation, for business reasons, of the Hon. Secretary, Mr. F. E. Bailey. The members expressed their regret, and a very hearty vote of thanks for his services was proposed and carried with enthusiasm.

The following appointments were made:—Hon. Secretary, Mr. D. F. Robinson; Assist. Hon. Secretary, Mr. Old.

Three short papers were given by Messrs. Ley, Gill and Thornton on "The New Method of Reception."

Great stress was laid upon the point that amateurs must follow the P.M.G.'s new regulations.

Mr. N. Jackson Ley showed a method of reacting upon a novel type of plug-in H.T. transformer, and gave full particulars as to windings, etc.

Mr. J. H. Gill explained his method of H.F. aperiodic coupling using a reaction coil, and suggested an interesting line of experiment.

Mr. J. Thornton gave full particulars of a circuit which he was using with excellent result. An interesting discussion followed.

The Chairman announced that the receiving set was practically complete, and reminded members that the new headquarters were Bennett's Garage, Shakespeare Street, from November 2nd.

Proposed Society at Lee.

Mr. A. H. Kidd, A.M.Inst., R.E., "Woodlands," 39, Burnt Ash Road, Lee, S.E.12, asks for correspondence from amateurs in his district who are willing to co-operate in the formation of a Society.

East Ham and District Amateur Radio Society.

Hon. Secretary, Mr. W. Vice, 5, Thorpe Road, East Ham.

A meeting was held at 709, Manor Park, Broadway (over Lipton's shop) with the result that a new Society has been formed to take the place of the club previously held at that address.

Mr. Judge was elected Deputy Chairman; Mr. Vice was unanimously elected Secretary. A Committee was elected, and business was discussed with encouraging results.

It was decided to hold a meeting at the same address on November 1st to discuss the Club set.

The membership is at present about 25.

The Committee wish it to be known that this club has no connection with the Radio Supply Shop at that address.

The club-rooms are open each evening from 8 till 10 p.m. Meeting night every Wednesday at 7.30.

Watford and District Radio Society.

Hon. Secretary, Mr. F. A. Moore, 175, Leavesden Road, Watford.

This newly-formed Society commenced activities on October 30th.

An aerial has been erected at the Society Room, the National Schools, Watford, and apparatus loaned by members was used for demonstration purposes.

The Society has a membership of nearly 40, and it is desired to still further increase this number.

Clapham Park Wireless Society.

Hon. Secretary, Mr. J. C. Elvy, A.M.I.E.E., 3, Fontenoy Road, Bedford Hill, S.W.12.

The Ninth General Meeting was held at Headquarters, 67, Balham High Road, at 7.30 p.m. on Wednesday, October 25th, 1922.

The Hon. Secretary made a very interesting announcement to the effect that he had received definite acceptance of the Presidency of the Society by Sir Alfred Butt.

Members present vociferously manifested full appreciation, and expressed confidence as to the welfare of their Society in such able hands, and look forward to the time when general election activities will allow of their formally installing Sir Alfred in the Chair.

Mr. J. H. Daniels is to present to the Society a single valve panel, and Mr. M. P. Prout a valve for same, together with head-phones.

The Hon. Secretary reported that he had been in telephonic communication with Mr. Leslie McMichael, of the Wireless Society of London, regarding expediting of affiliation.

The Chairman then called upon Mr. F. H. Haynes, who gave a description, illustrated by diagrams and apparatus he had brought for the occasion, on "The Building of an Amateur Three-Valve Receiving Set."

Mr. Haynes dealt very fully with the operation and construction of every component, and explained in detail the reasons for recommending the circuit arrangement he described. A keen interest was taken in certain types of apparatus employed. The lecturer connected up a set to the particulars he gave as he proceeded with the explanation of the action of the various parts. The circuit embodied a loose coupled aerial circuit with tuning condensers, high frequency amplifier, using the "tuned anode" arrangement and detector valve, followed by a low frequency amplifier.

The discussion that followed was entered into by the Chairman, Mr. Beedle, Mr. Daniels, the Hon. Secretary, the Hon. Treasurer, Mr. R. H. J. McCue, Mr. C. D. Richardson, and Mr. Hurst.

A very hearty vote of thanks to the lecturer concluded.

An interesting impromptu discussion arose at the conclusion of the evening's programme, which affects all wireless enthusiasts, namely, the formation of a Society distinct from the Wireless Society of London, but promoted probably by manufacturers and others having commercial interests, and likely to bring into conflict the interests of the true experimenter and the manufacturer.

Southwark Wireless Telephony Association.

Hon. Secretary, Mr. W. Helps, King's Hall, London Road, S.E.1.

The first meeting of the month was held at headquarters, on October 1st, when Messrs. A. O. Gibbons and Winstone gave a very instructive lecture, illustrated by slides, on "Elementary Wireless." Interesting discussion followed. A vote of thanks to the lecturers concluded the meeting.

The second meeting of the month was held on October 15th, when Mr. Dibben gave a lecturette on the functions of a condenser, also aerials and their faults, followed by discussion.

Portsmouth and District Amateur Wireless Society.

Hon. Secretary, Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

Mr. Gull, on October 25th, gave his lecture on "Broadcasting." He dealt with the present regulations made by the Postmaster-General, and various diagrams were drawn to demonstrate the requirements. Mr. Gull further explained the various American methods of receiving, and drew diagrams to illustrate how a first-class set could be made, although keeping within the regulations. An interesting talk followed, and an animated discussion arose as to the various methods that could be employed should any person have the intention of defrauding the P.M.G. or his inspectors. A further discussion arose with regard to licences, and it was gratifying to note the number of members who preferred experimenting licences, and were not merely taking up the cult of wireless for the sake of the long-delayed broadcasting concerts.

Hornsey and District Wireless and Model Engineering Society.

Hon. Secretary, Mr. H. Davy, 134, Inderwick Road, Hornsey, N.8.

A meeting of the above Society was held on October 16th, and was largely attended. One of the members brought his set to the club for the purpose of demonstrating the possibilities of a single valve receiver. The meteorological report from **GFA** at 8 o'clock was utilised as practise in Morse reception, and later some musical telephony from **2 ON** and **2 KT** was received, this being particularly enjoyed by new and prospective members.

At 9 p.m. the club "went into committee" for the purpose of general business. It was decided to raffle a crystal set made by one of the members in order to raise extra funds for the purchase of the club's set. An interesting discussion followed on the subject of "Broadcasting and its relation to the Amateur Experimenter."

Several new members were enrolled. Applications for membership are cordially invited by the Hon. Secretary, who will be pleased to send full particulars on receipt of stamped addressed envelope.

Meetings were held on October 20th and 23rd.

Both meetings were well attended. On the 20th Mr. H. J. Pugh lectured on "Magnetism and Electricity as Applied to Wireless." On the 23rd a short lecture was given by Mr. Hunting on "The Morse Code," dealing in detail on its many and varied uses.

Afterwards members practised in sending and reading. Several new members were elected.

It is not necessary to be in possession of a licence or wireless apparatus, or have a good knowledge of wireless before joining this Society. A stamped envelope should accompany request for further particulars.

Felixstowe and District Radio Society.

Hon. Secretary, Mr. E. Cork, 3, Highfield Road, Felixstowe.

This recently-formed Society held its first annual general meeting on November 4th at Headquarters, St. Andrews' Hall, Gainsboro' Road.

The agenda included adoption of rules for constitution of Society and election of officers for the year.

A very interesting and enthusiastic time passed all too quickly. The winter programme is now being carried out. The Club hope shortly to get a receiving licence and install a club set.

The Hon. Secretary will be pleased to get in touch with wireless amateurs in the district.

Bromley Radio and Experimental Society.

Hon. Secretary, Mr. J. Fergusson-Croome, "Gowrie," Wendover Road, Bromley, Kent.

The Society now holds its weekly meetings at the Ex-Services Club, London Road, Bromley, where an aerial has been erected.

A meeting was held on Monday, October 23rd, when a four-valve set designed by Mr. L. R. Stephens was demonstrated. Music was received by a "Brown" microphone amplifier and loud speaker.

A Morse class was conducted by Mr. L. F. Allen.

The Society's membership is 50 strong.

York Wireless Society.

Hon. Secretary, Mr. A. E. White, The Grand Buildings, Clarence Street, York.

At a Committee meeting held on October 17th, it was proposed to run a series of lectures on "Wireless Telegraphy and Telephony" on the first Tuesday of each month during the winter.

A lecture was given on "Wireless Telegraphy, its History and Development," by Mr. V. O. Newton, York, at 7.30 p.m., in the Grand Café, Clarence Street, on November 7th.

Taunton School Radio Society.

Hon. Secretary, Mr. H. W. Hamblin, Taunton School, Taunton.

An inaugural meeting of the above Society was held at Taunton School on October 17th. There were about 40 people present.

The following gentlemen were duly elected for the coming session:—Chairman, Mr. D. Pean, B.Sc.; Hon. Treasurer, Mr. A .E. Viccars, B.Sc.; Hon. Secretary, Mr. H. W. Hamblin.

The first formal meeting of the Society was held on October 24th; there was an attendance of 42 members.

The Headmaster, Mr. H. Nicholson, M.A., kindly accepted the position of President. Mr. J. C. Tyler was duly elected Vice-Chairman; a Committee of five members was also elected.

The proceedings terminated with a lecture upon "Waves," by the Hon. Secretary.

Eastern Enfield Wireless and Experimental Society.

Hon. Secretary, Mr. Arthur I. Dabbs, 315, High Road, Ponders End.

The question of affiliation to the Wireless Society of London was discussed on October 26th, and it was decided to take a referendum of every member of the Society on the subject.

Members are making good progress in Morse practice, and the Society's three-valve set is now installed and is in good working order. Most of the evening was spent in working and experimenting on the set and discussions on items of general interest.

The Society has been of assistance in helping members over licence questions.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required, every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

"DOLLY TREBOR" (Cornwall) *asks (1) Number of turns required for honeycomb coils to tune with 0·001 mfd. condenser from 1,000-30,000 metres. (2) Size of wire. (3) Wavelength range of coils. (4) Which is most efficient method of H.F. amplification (a) for short waves: (b) for long waves.*

(1) and (3) You will require 6 coils. Wind the smallest coil with 40 turns, and the largest coil with 500, and the others in proportion. We cannot say exactly, because the method of winding spacing, etc., are deciding factors. (2) No. 28 D.C.C. wire is rather fine for the smaller coils, but you should try it. (4) Reactance capacity coupling will be found most efficient for all wavelengths, but it is more convenient from the point of view of minimum adjustments to use resistance capacity or wavelengths above 2,000 metres.

circuit is not permitted, we suggest you couple the reaction coil to the tuned anode coil. No electrical connections need be altered, only the coupling need be shown. The circuit is to be thoroughly recommended for wavelengths in the neighbourhood of 400 metres, and we would advise you to use the tuned anode arrangement up to a wavelength of about 2,000 metres. Above this wavelength use the resistance capacity connection. We do not recommend the use of resistance capacity for wavelengths so low as 500 metres. The values of the condensers in your diagram are correct. The anode resistance should be of the order of 70,000 w.

"F.A.P." (Walton).—The connections shown in Fig. 8, page 812, September 16th issue, will meet your requirements.

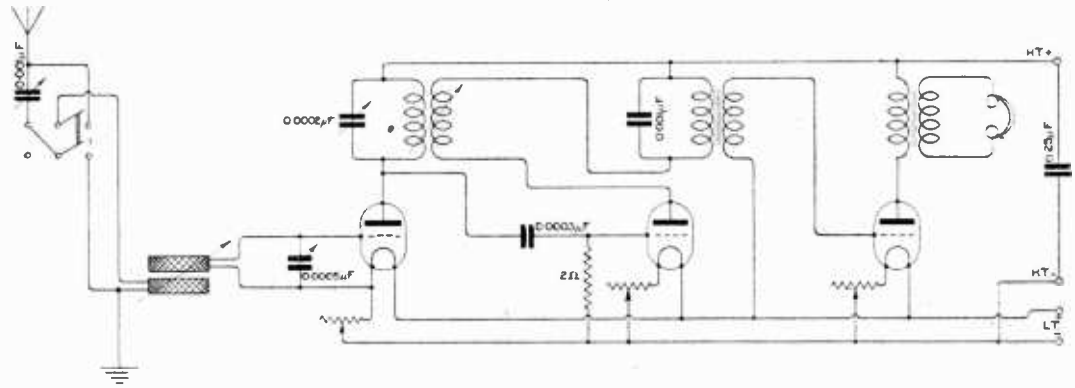


Fig. 1.

"SOTTO VOCE" (Dartford) *asks for a three-valve circuit with loose coupler.*

See Fig. 1. The H.F. amplifying valve has a tuned anode, and you will find the three-valve combination shown very effective.

"V.H.B." (Hampstead).—We have examined the diagram submitted, and we consider it is quite suitable. We suggest you apply for an experimenter's licence, submitting the diagram, which we think will meet with approval. If the

"C.O.B." (Manchester).—The anode coil will have to be a little larger than the aerial coil because the anode tuning condenser is smaller than the aerial tuning condenser. If you are using the A.T.C. in series with the A.T.I., the anode coil will probably be about the same size as the A.T.I. coil. The reaction coil will be a little smaller than the A.T.I. generally, but you should find by trial which coil gives most satisfactory results when connected in the reaction circuit.

"G.F.W." (Windsor).—(1) You could try and use the coils suggested, but it is better to keep to the values given in the article. (2) We cannot name any particular manufacturer who will supply a variometer, and we suggest you look through the advertisement pages of the journal. (3) We think you will find your queries with regard to the super-regenerative circuit answered in the issue of October 28th.

"IKANOPIT" (Bedford) *asks* (1) *For criticism of his circuit.* (2) *What length of No. 25 Eureka wire to use in a filament resistance.* (3) *Whether to rewind a L.R. earpiece.* (4) *Particulars of a telephone transformer.*

(1) The diagram is quite correct. You will not magnify the signals much with a single valve: in fact a single valve detector without reaction is little better than a crystal. (2) Use four yards, and take evenly spaced tappings. (3) It is difficult to advise whether to rewind the receiver or not without all dimensions of the receiver. However, you could rewind, using No. 36 S.S.C. The sample of wire submitted is No. 30 S.S.C. (4) The telephone transformers could be made as follows:—Core of iron wire $\frac{1}{2}$" diameter and 3" long; primary winding, 3 ozs. of No. 42 (sample wire is No. 42) and secondary winding, 4 ozs. No. 34.

"VALVES" (Regent's Park) (1) *and* (2) *has a former* $4\frac{3}{4}$" *diameter and* $4\frac{1}{8}$" *long, and wishes to tune from* 300 *to* 5,000 *metres, using a tuning condenser of* 0·0005 *mfds. capacity.* (3) *The number of turns to wind for a reaction coil.* (4) *Whether diagram submitted is correct.*

(1) and (2) We suggest you wind the former full, using the two-pile method of winding described recently in this journal. If you wind with No. 26 D.S.C. wire, and take 10 tappings, you will cover the wavelength range desired. (3) The reaction coil could be 100 turns of No. 28, with a mean diameter of $2\frac{1}{2}$". (4) The diagram is correct, and also the method of connecting the transformer. We suggest, however, you increase the capacity of the H.T. by-pass condenser to 0·02 mfds.

"D.H.B.McC." (Leicester) *asks* (1) *For particulars of basket coils.* (2) *Whether there is any difference in the coupling schemes submitted* (3) *How to construct a L.F. choke coil.* (4) *How to use the formula wavelength* $= 1885 \sqrt{LC}$ *when there is no condenser.*

(1) We suggest you make use of the No. 22 S.W.G. wire and wind 40 turns for the smaller wavelength, and other coils of 80 and 130 turns, connecting them in series for the larger wavelength. (2) The two schemes are identical. (3) You could make use of an old L.F. transformer, or you could build one to the following particulars:—Core, iron wire $\frac{1}{2}$" diameter, 3" long. Winding, 2 ozs. No. 40 S.S.C. wire. (4) The formula cannot be applied unless there is capacity. Coils do not possess capacity in any useful sense, and you cannot very well predict the natural wavelength of a coil you construct.

"A.L." (Liverpool).—You should use an ordinary three-valve L.F. amplifier, the input side of the first transformer being tapped for adjustment purposes. We cannot help you much, without information as to the particulars of the experiments you propose to conduct.

"G.H.R." (Ilkley).—(1) The crystal arrangement shown is useless, this should be as in Fig. 2. (2) X, 0·0005 mfds. and V, 0·0005 to 0·001 mfds. (3) The complete circuit including X and N would have to be tunable, but if this could be done by the condenser only, there would be no need to tune the coil as well. (4) No, the present arrangement is preferable. The type of set suggested is quite good.

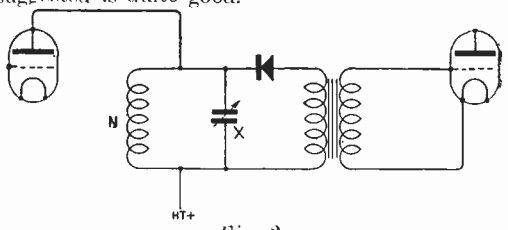


Fig. 2.

"RED ALMOND" (Leicester) *asks range or wavelength variometer most suitable for a Super-regenerative receiver.* (2) *How many plates, average thickness* $2\frac{1}{2}$" *diameter, moving plates,* 1/8" *washers, should be used for* 0·001 *mfd. condenser.* (3) *If there is any advantage in having a large number of turns on a frame aerial instead of* 12 *or so.*

(1) We suggest you make the rotor about 5" in diameter and the stator sufficiently large for the rotor to revolve. Wind with No. 22 S.W.G., D.S.C. (2) If the moving plates are $2\frac{1}{2}$" diameter and 23 mils. thick, and the spacing washers are 1/8" thick, about 93 plates will be required to give a capacity of 0·001 mfds. (3) There is no advantage in having a large number of turns on your frame aerial; 15 is usually sufficient, and about 5 tappings should be made.

"——" (Hong Kong).—(1) The variometer receiving transformer you suggest could undoubtedly be used for the A.T.I. and reactance coil of a set, but if this were done we do not think you will be able to get good results except at comparatively short wavelengths. (2) We should not recommend using finer wire than about No. 38 for rewinding these coils, and if this were done we do not think that the wavelength reached would be in excess of 2,000 metres. (3) The same tappings as on the original windings might be used. (4) Use about 8 ozs. of No. 30 for the L.R. winding, and 3 ozs. of No. 44 for the H.R. winding.

"W.S." (Wembley) *asks for winding for a coil with Litzendraht wire to tune up to about* 450 *ms., and if it is possible to use a former* 3"×6" *for the purpose.*

There is not a lot to be gained by the use of wire of this type for receiving on short wavelengths, as under such conditions the resistance of the coil is in general considerably less than that of the aerial. There is no objection to its use, however, if desired. We do not know the exact gauge of the wire which you propose to use, but you will probably find that 60 turns will be sufficient on the former you suggest, if you use the 0·0005 mfds. condenser in series with the coil to tune the aerial. It is not possible to predict the exact points for tappings for particular wavelengths, but if you put three or four taps in, evenly spaced, you should be able to tune all wavelengths up to your maximum without difficulty.

"A.G.P." (Swinton).—(1) We cannot give you a single valve circuit with reaction which will meet with the approval of the Post Office. We suggest you use the valve as a H.F. amplifier, and use a crystal for rectification. See Fig. 3. (2) The A.T.I. could consist of a coil 5" diameter. 6" long, full of No. 22 D.C.C. with 10 tappings, and the A.T.I. could be a coil 4" diameter and 6" long, full of No. 26 D.C.C. with 6 tappings.

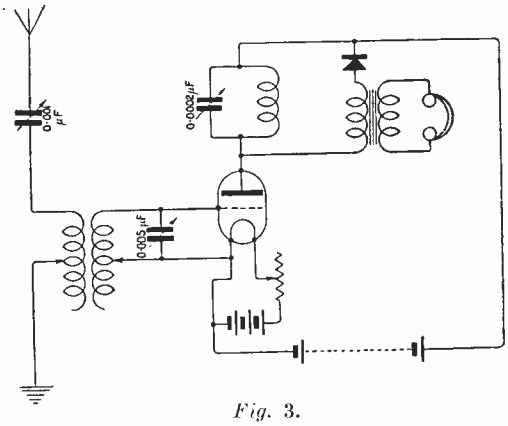


Fig. 3.

"D.H." (Nottingham) *asks* (1) *Whose call letters are* **2 GR.** (2) *For particulars of the "spade" method of tuning by means of a fixed coil.*

(1) We regret we have no particulars of this station. (2) The method of tuning to which you refer makes use of a fixed coil, and a movable piece of copper plate. Changing the position of the plate changes the inductance of the coil.

"A.B." (Manchester) *asks* (1) *Whether it is possible to hear the Dutch concerts on a three-valve set in his district.* (2) *If not, what we recommend.*

(1) and (2) The reception of this station is always rather uncertain at such distances, and can only be done by the use of critical reaction adjustment, with its attendant risks of radiation. In any case the results are not often good. If, as you say, you can get weak signals we should recommend you to add another L.F. valve, and at the same time take every possible precaution to increase the efficiency of your aerial.

"W.V.H." (Walthamstow) *asks whether a certain three-valve set sketched is correct and suitable for the reception of the Dutch concerts.*

The circuit sketched is correct in its general lines, but is not likely to be efficient enough to give results with the Dutch station. Firstly it would be better to use a stage of H.F. amplification. Secondly, the use of a parallel A.T.C. is unnecessary and undesirable on such short wavelengths. And thirdly, the use of reaction coupled directly back on to the aerial circuit in the manner shown leads to serious trouble from radiation, and is to be strongly deprecated.

"B.M.G." (Paddock Wood) *asks* (1) *Whether he is allowed to use more wire for a frame aerial than he is for an outdoor aerial.* (2) *Whether he can use a 1" spark coil for a transformer with a 200 ohm loud speaker.*

(1) We do not think that there is any restriction as to the amount of wire that may be used on a frame aerial. For short wavelengths the 100' allowed for an open aerial is quite sufficient for a frame, but for long waves a greater length of wire is generally used. (2) This coil cannot be used as it stands, as the windings will certainly not be correct. It might be made some use of by rewinding with a new primary of about 6 ozs. of No. 30. covered with a rewinding of the older thin wire. Whether this would be satisfactory depends on whether the old winding could be stripped without damage, and whether there is sufficient quantity of wire in it.

"H.F.C." (Wimbledon) *asks for details for a frame aerial for use with an Armstrong super-regenerative circuit with a range of* 300-10,000 *metres. and whether loading coils can be used with such a frame.*

Your proposal to use an Armstrong circuit over such a range of wavelengths indicates that you have not grasped the principles under which it works, in which case you are extremely unlikely to obtain any useful results whatever with this exceedingly tricky circuit. It is only intended for and suitable for the reception of signals over a restricted band of short wavelengths, and we can assure you that the difficulties to be overcome under even these conditions are sufficiently formidable. The frame should be that normally suitable for say 300-600 metres, *e.g.*, 12 turns of about 3" diameter. No loading coil will be necessary. See the articles by P. W. Harris in the issues of November 21st and 28th, 1922.

"W.S.B." (Daisy Bank).—(1) Zincite and copper pyrites in combination is a well known and quite satisfactory variation of the perikon type of crystal. The term perikon is generally applied to the combination zincite-bornite. (2) The arrangement of your apparatus is quite correct, and we have no fault to find with the set, except perhaps that you would find it easier to tune on short wavelengths with coils of a less diameter. (3) The aerial circuit will tune to about 2,300 metres with the condenser in the parallel position, and probably about 1,000 metres with it in series with the A.T.I. The closed circuit will in any case tune to at least 3,000 metres.

"C.L." (Huddersfield) *asks* (1) *Certain questions with regard to the permitted dimensions of an aerial.* (2) *The reason why on a certain occasion he heard European C.W. stations with his set adjusted in such a way that it could not possibly have been oscillating.* (3) *The best all-round valve for H.F. amplification with a filament battery of not more than 4 volts.*

(1) Post Office Form No. 43 states that the combined *height* and *length* shall not exceed 100 feet. (2) This was evidently due to your set having picked up some continuous oscillation all the time, either from a local receiver in a state of oscillation, or possibly from a harmonic of the spacing wave of some arc station standing by at the time. (3) Impossible to say. Most valves by the foremost makers have some specially good points, and we cannot undertake to discriminate between the brands.

"H.W.C.M." (Clapham).—(1) With "Q" valves the plate voltage should be about 40 for detecting with a potentiometer, without extra volts, 60-200 for most purposes of amplification, and about 200 in an oscillator. (2) There is very little to choose. Personally we have a slight preference for the potentiometer method with these valves. (3) For the inductance of lattice wound coils the following rather formidable looking formula gives fairly good approximations to the correct result. In actual practice its use will not be found to present any great difficulty :—

$$L\ mhs = \frac{1}{1{,}000} \times \frac{4\pi^2 a^2 N^2}{b + c + R} \times F_1 \times F_2$$

where a = mean radius of the winding
b = axial length of coil
c = thickness of winding
R = outer radius
N = total number of turns
} all in cms.

$$F_1 = \frac{10b + 12c + 2R}{10b + 10c + 1{\cdot}4R}$$

and $F_2 = 0{\cdot}5\ log_{10}\left(100 + \frac{14R}{2b + 3c}\right)$

"IMI" (Huddersfield).—(1) Almost any valve in use at the present time will detect efficiently with 60 volts on the plate. A French type valve would, among others, be very suitable. (2) The circuit of Fig. 4, page 739, September 2nd issue, is of the type specified. This circuit has a switch for cutting out the note magnifier valves; this may of course be omitted if desired. (3) At present we do not think you will get anything, but you should get Manchester and probably Newcastle when the stations in these towns come into operation. (4) We do not understand the results you describe. It is quite likely that signals from ships will be less strong than those from the higher powered long wave stations. The crackling effect may be due to tram interference, which is often found to be troublesome on some wavelengths and not on others.

"FUZZ" (Glasgow) *asks for data for the construction of a five-valve set, saying nothing about the purpose he wishes to use it for, or giving any other information.*

These columns are intended for helping readers with specific difficulties, and lack of space, etc., prevents us from undertaking the complete design of complicated sets for individual readers. You will find a diagram of a very good type of set in Fig. 4, page 706, August 26th issue. For details of the construction of the various parts see recent articles on the construction of sets, as the construction of condensers, coils, transformers, etc., is very much the same whatever set they are to be used on.

"K.D." (Manchester).—The wiring of the four-valve set as shown in the issues of July and August to which you refer is correct, and the replies to which you draw our attention are answers to meet the requirements of correspondents. The diagram in Fig. 4, page 508, is also correct, and if you wire your set according to this diagram you may be sure the connections are correct.

"D.C.R." (Egham).—(1) All right, but we do not think that you will get permission to use reaction in this way. (2) See Fig. 3, page 738, September 2nd issue. (3) Yes; both windings are intended to be of the same wire. (4) Gauges are approximately No. 36, 44 and 42 S.W.G.

"J.W.W." (Essex) *asks for a diagram of a valve and crystal combination.*

See Fig. 4.

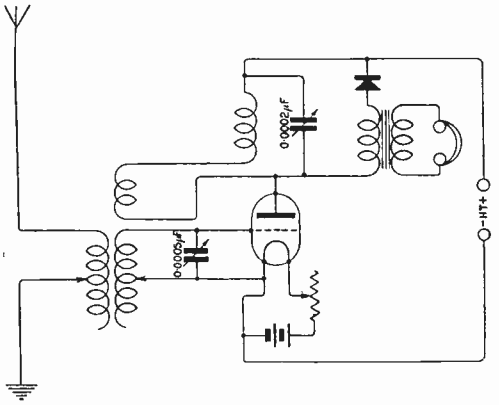


Fig. 4.

"H.H.S." (Yorks).—You will require several basket coils to use in conjunction with a tuning condenser of maximum value 0·0003 mfds. We suggest you use 8 coils, making coils of 40, 80 and 150 turns for the shorter wavelengths, and then adding coils in series for the longer wavelengths. The exact values cannot be given, as the inductance of basket coils varies greatly with the method of making, and tightness of winding. A resistance of 50,000 w. is quite suitable for use in the anode circuit of a H.F. amplifying valve, but you may secure a little greater amplification if you use a 70,000 w. resistance. The H.F. voltage should be increased to allow for the voltage drop in the resistance. The potential variations which occur at the anode of the H.F. amplifying valve should be applied to the grid of the following valve by joining a condenser between the anode and grid. A grid leak is connected between the filament and grid of this valve to provide the grid with a mean potential which is suitable for the best operation of the valve. We suggest you use basket coils for the reaction coil, and you will probably find a coil a little smaller than the anode coil is quite suitable. When receiving longer wavelengths, inductance should be connected in series with the reaction coil.

SHARE MARKET REPORT

Prices as we go to press on November 10th, are :—

Marconi Ordinary	£2	4	9
,, Preference	2	3	1½
,, Inter. Marine	1	7	3
,, Canadian		10	6
Radio Corporation of America :—			
Ordinary		19	9
Preference		14	0

THE
WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

No. 171 [No. 8 Vol. XI.] NOVEMBER 25TH, 1922. WEEKLY

Critical Tuning Devices.

SOME METHODS FOR OBTAINING FINE ADJUSTMENT.

UNDOUBTEDLY many experimenters, when tuning to weak telephony, have sometimes been annoyed to discover,

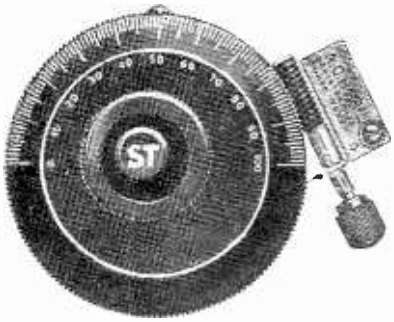


Fig. 1. An American device.

upon removing the hand from the tuning instrument, that signals decreased in strength or vanished entirely.

Many variable condensers and coil holders in use are of such a design as to permit of only coarse adjustment, while others are provided with separate vernier control. Those of the latter design are a step in the right direction, but they become somewhat tiresome in operation when rapid tuning is desired over a wide range. Without vernier adjustment it often happens that signals are entirely missed, owing to the rapid rate of change that is produced when operating the tuning instrument.

With regard to critical condenser adjustment, it is now becoming common practice to fit a worm or geared drive to the dial, or to a separate pinion. Fig. 1 shows a device which is now on the market, though when critical adjustment is not required, the worm spindle has to be swung out of use. Another arrangement is shown in Fig. 2, where by means of reduction gear, the small knob below the dial gives critical adjustment, whilst the large knob on the dial can be turned when it is desired to widely change the wavelength of reception.

Another scheme for providing critical condenser adjustment is to arrange separate control for a few of the moving plates. Fig. 3 shows a condenser so designed, where by withdrawing the knob the main plates of the condenser are disconnected from the moving spindle when the approximate adjustment has been obtained, whilst a few moving plates are still carried, and can be critically set by turning the knob.

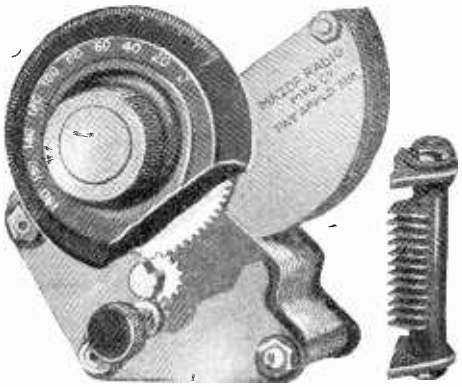


Fig. 2. Condenser with gearing.

To be of real use, the vernier device must permit of instant change from coarse to vernier

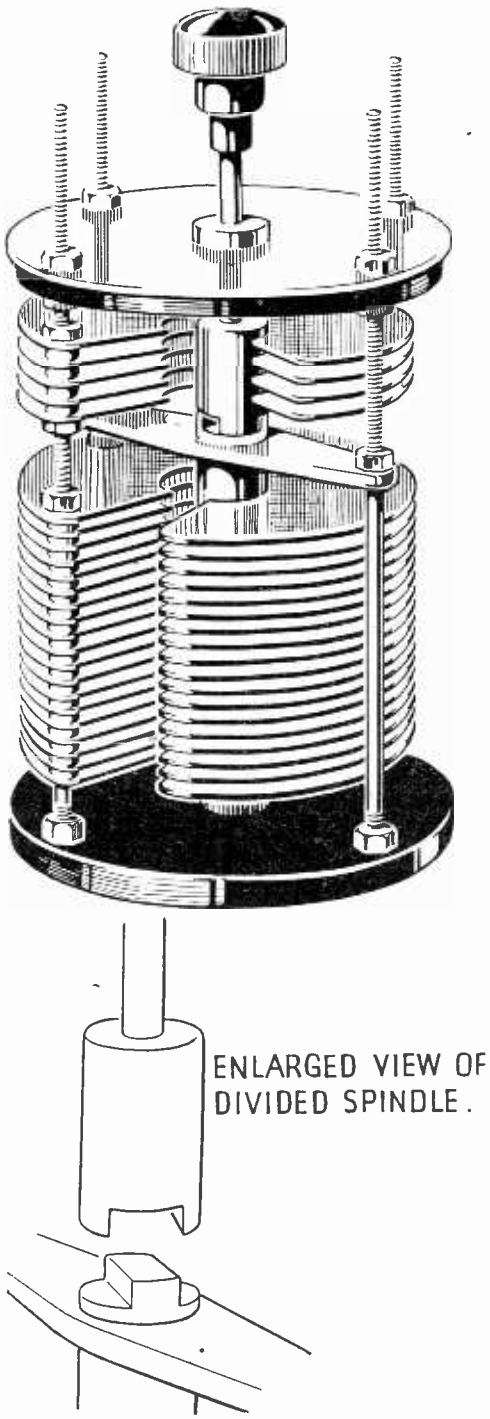


Fig. 3. A condenser in which provision is made for moving only a few of the plates.

control, and if possible, the design should permit of the change being made without resort to the operation of a third control. The fitments shown in Figs. 4 and 5 are assembled in such a way that the wheel D is only in friction contact with the spindle of the condenser, though this friction, whilst insufficient to prevent the condenser being adjusted when the wheel is held, has sufficient grip to revolve the plates when the worm wheel is revolved. The parts shown have been specially designed for use with the type of condenser which is usually fitted in the Mark III. tuners. The collar E, fits on the square spindle, whilst the wheel D, resting on this collar, has a clearance hole. A and C are washers, which

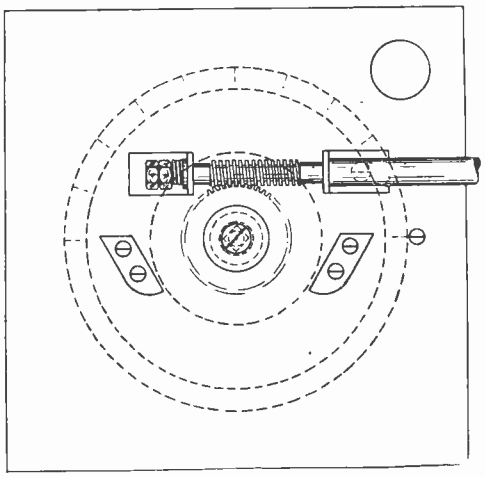


Fig. 4. Friction driven critical control designed by Mr. A. J. Bull. (Condenser dial removed.)

hold between them the spring washer B. The screw in the head of the condenser clamps these parts down on the spindle, slightly compressing the spring washer. This causes sufficient grip between the wheel D and the spindle, so that when the worm wheel revolves, the spindle of the condenser turns also.

For rapidly changing the setting, however, the friction is not so great as to impede the turning of the condenser spindle, whilst the wheel D remains in mesh with the stationary worm-wheel. Fig. 5 is another view of the same mechanism. The assembling of the parts beneath the dial of the condenser will of course raise it away from the top of the instrument, and consequently it is necessary to fit a screw, the slot in the head of which serves as an indicator for the calibrations on the dial.

This principle can with equal convenience be applied for the critical adjustment of tuning

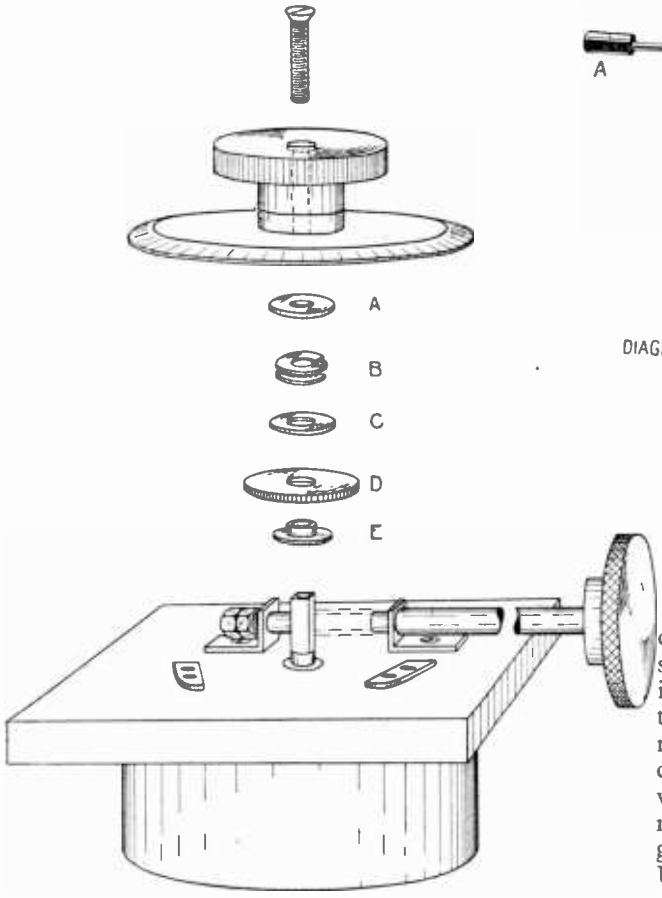


Fig. 5. Details for assembling a friction critical control.

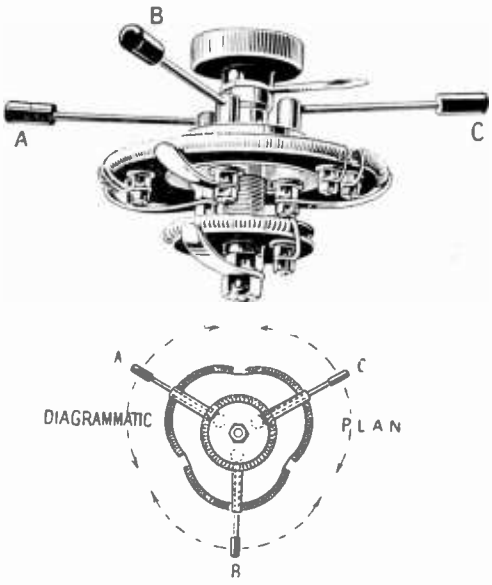


Fig. 7.

Filament rheostat with separate critical control for three valves.

coils, mounted in the usual form of swing-about holder. Fig. 6 shows in detail the method of assembling the components on the spindles, and requires no further explanation. The coils can easily be pushed through a wide range, whilst when fine adjustment is required, the extension handles give a useful degree of critical control. Using this method of vernier adjustment, it is surprising how well

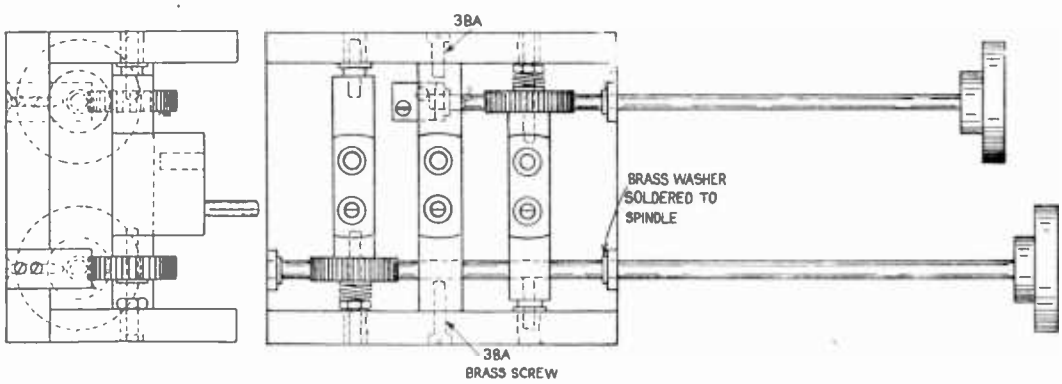


Fig. 6. Critical control for inductances with friction clip for wide movement.

many stations can be brought in, which without this device are so difficult to tune to, that their signals are quite unreadable.

Vernier adjustment has also been applied to filament current control—not perhaps so much in this country, where hard valves are available, but in America, where valves are less hard and critical rheostat control is necessary. Fig. 7 shows a novel form of rheostat intended for controlling the filaments of three valves. The main adjustment is obtained by turning the knob in the centre, whilst the extension handles each operate levers working on resistances which are connected separately in the valve filament circuits. This device is particularly useful when three similar valves are employed to function in different ways, such as high frequency amplifier, detector, and note magnifier.

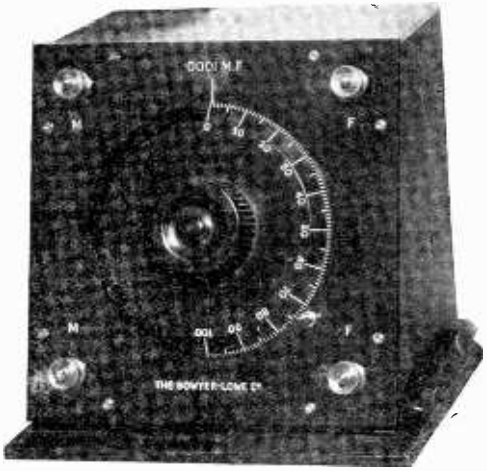


Fig. 8. The ebonite stem seen in the clips on the right can be put in mesh with teeth on the rim of the condenser.

The Wireless Society of London.

PRIZE COMPETITION.

AT the last meeting of the Wireless Society of London, held on October 25th, the Chairman announced that it was proposed to offer prizes for the most efficient Armstrong super-regenerative circuit produced by a member of the Society or of an affiliated Society, and that conditions with regard to the competition would be issued later.

Two prizes are offered as follows :—

A first prize of £15, and a second prize of £10. The amount of these prizes is contributed by three members of the Society who prefer to remain anonymous.

The conditions for the competition are as follows :—

(1) In the award of the prizes the ruling of a sub-committee of the Wireless Society of London will be final.

(2) The instrument made up must not employ more than three valves, and the set must work on a loop aerial which should accompany the instrument when sent in for judging. A diagram of connections and a written report as to what the set claims to accomplish should accompany the instrument.

(3) The actual assembly of the apparatus to be carried out by the competitor.

(4) The competition to be open to members or associate members of the Wireless Society of London or members of an affiliated Society.

The closing date of the competition to be January 15th next. All apparatus to be sent to the Hon. Secretary of the Wireless Society of London.

(5) Each competitor may demonstrate his own set if he so desires, or may depute someone to do this for him, failing which the Committee will make their own tests according to the written instructions which accompany the set submitted.

In the tests to be conducted some constant source of transmission will be employed. The winner of the prize will be expected either to lecture, or prepare a lecture on the instrument, to be read before the Wireless Society of London, on which occasion the prize-winning instrument will be demonstrated.

In awarding the prizes the following points will be taken into consideration :—

(A) General design.

(B) Adjustment to maximum efficiency for four or five different ranges of wave-length from 200 to 600 metres in minimum time.

The names of those who desire to enter for this competition should be sent without delay, and in any case within a fortnight of the date of this announcement, to the Hon. Secretary, 32, Quex Road, West Hampstead, N.W.6.

History of The Wireless Society of London.

"Look into the seeds of time,
And say which grain will grow and which will not."
—MACBETH.

THE Wireless Society of London now changes its name to the "Radio Society of Great Britain," and comes under Royal Patronage. We have represented to its founders that it is on occasions like this that one may legitimately look backward as well as forward, and we have asked them to revive their memories of the early days to indulge in retrospect for the benefit of our readers.

The first meeting was held on July 5th, 1913, at the house of Mr. René H. Klein, on his initiative, in West Hampstead. Mr. Klein was then a well-known wireless amateur who foresaw the difficulties which no doubt would arise through the lack of co-operation between amateurs, and more especially as to their position with regard to the Government regulations.

Mr. A. A. Campbell Swinton, F.R.S.,
First President.

Among the five other gentlemen who were present were Mr. Leslie McMichael and Mr. L. F. Fogarty, A.M.I.E.E., who became Vice-Chairman and Hon. Treasurer respectively, whilst Mr. Klein assumed the Hon. Secretaryship. These three have held the offices ever since, save that Mr. Klein became a Vice-President in 1919, and Mr, McMichael took his place as Hon. Secretary; so if it is ever possible to speak of individuals as Founders of a great Institution created by the loyal and disinterested services of many influential men, to them must the honour be accorded.

The following announcement appeared in the *English Mechanic* of July 11th, 1913.

THE LONDON WIRELESS CLUB

At a meeting of wireless-telegraphy amateurs held on Saturday, the 5th inst., an association was formed, under the title of the London Wireless Club, having for its object the bringing together of all amateurs interested in wireless telegraphy and telephony. The need of such a club has been apparent for some time, and, judging from the support promised and given, will no doubt prove a success. This meeting being of an informal nature, it was decided to elect a temporary honorary secretary and treasurer, leaving the proper election of the committee to the general meeting, which will be held early in September next. The honorary secretary will be glad to hear from amateurs intending to join the club as soon as possible, and will forward forms of application for membership. His address is: Mr H. Klein, Hon Sec (pro tem.), 18, Crediton-road, West Hampstead, N.W.

A similar notice appeared in the *Wireless World* for August 1913, and to these invitations there was considerable response, for among those that attended the next meeting or who sent in their names as would-be members were the following, who constituted the first Committee:—Mr. H. F. Brand, M.A., B.Sc.; Mr. E. W. Kitchen, A.M.Inst., C.E.; Mr. W. J. Fry; Mr. W. J. Shaw; and Mr. V. W. Delves Broughton and Mr. A. G. Hansard. Enterprising and ambitious for the success of the Society as these gentlemen were, it is doubtful whether in these first few months the great possibilities were quite realised; even the title then selected, "The London Wireless Club," indicated a domestic rather than a national policy. It was at the third meeting, held at Mr. Klein's house on September 13th, 1913, that Mr F. Hope-Jones, M.I.E.E., first appeared on the scene. He, in common with every first accession to the ranks, was impressed with the ability and enthusiasm of the group, and advocated a Society founded on a more ambitious scale than that of the Wireless Clubs then springing up all over the country, a Society which would secure the confidence of the authorities at St. Martin's le Grand, and capable of wresting from them a charter of freedom for the wireless amateur.

FIG. 12.—THE SIPHON PEN, ON THE RIGHT, TRACING OUT IN MORSE ALPHABET, THE FIRST WORD—"LE"—OF COMMANDANT FERRIÉ'S MESSAGE

The signals are photographically reproduced from the original tape record, which is slightly enlarged

FIG 13.—THE THIRD WORD—"FERRIÉ"—OF THE MESSAGE

Photographically reproduced from the original tape record, which is slightly reduced in size

Reproduction of a reprint of the first Presidential Address illustrating General Ferrie's Message.

With this object in view he suggested the appointment of men of eminence in the science of wireless telegraphy as Vice-Presidents, from whom a President should be selected, and advocated a change of name. These views proving acceptable, he was asked to become its Chairman and carry them into effect. His inventions in "electric clocks" had brought him in touch with a large circle of friends in the world of science, and he was then launching a campaign against the Post Office on his own account to secure freedom for the watch and clock maker to take the Paris time signals. Within a few weeks Vice-Presidencies were accepted by Dr. Silvanus Phillips Thompson, F.R.S., Sir John Macpherson Grant, Bart., Mr. Wm. Duddell, F.R.S. and Mr. Russell Clark, all now unhappily deceased during the War, but gratefully remembered for their prompt support. The Hon. Stuart P. Bouverie, Dr. W. H. Eccles, F.R.S., Dr. Erskine Murray, Col. Hippesley and Sir Charles Bright followed closely on their heels, as also did Prof. Fleming, F.R.S., Prof. Osborne Howe, Prof. Ernest Wilson, Prof. E. W. Marchant and Mr. S. G. Brown, F.R.S. The late Sir William Crookes F.R.S., became an honorary member and also Sir Oliver Lodge, F.R.S., while more recently the Society has been further honoured by Senatore Marconi accepting a similar position.

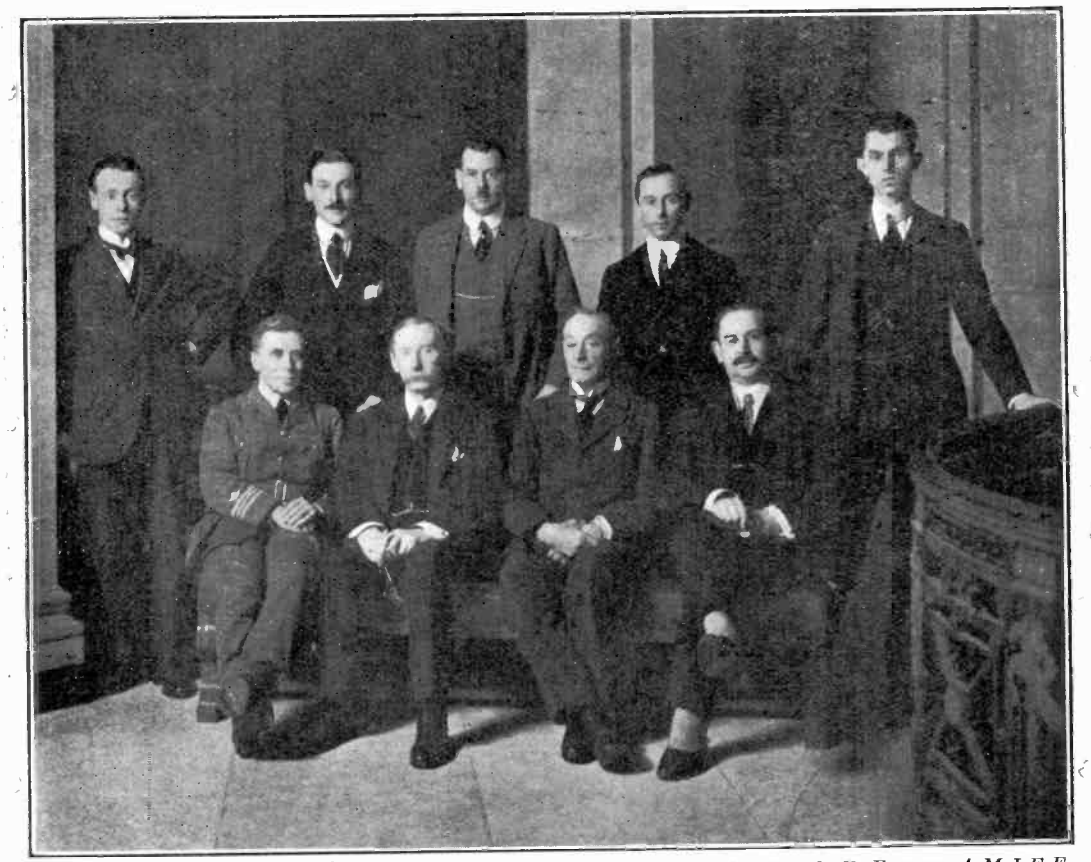
The Presidency was first offered to Dr. Silvanus P. Thompson, but he declined in view of the heavy burden of his other similar responsibilities. It was however, accepted by Mr. A. A. Campbell Swinton, F.R.S., and no better choice could have been made. He held the office for seven years, during four of which the Society was in a state of suspended animation owing to the War. When finally his resignation was accepted in January, 1921, he was presented with an illuminated address and by special resolution was made a member of the Committee for life. His handsome offices n Victoria Street are still most generously placed at the service of the Society for its Committee meetings. He created many valuable precedents,

General Ferrié, a Vice-President.

not the least important of which was that he was a *working* President, attending Committees as

well as presiding at the monthly general meetings, and his successors have always done the same.

His first Presidential Address, given in the lecture hall of the Institution of Electrical Engineers on January 21st, 1914, will long be remembered, with its special wireless message of greeting transmitted from the Eiffel Tower by Commandant Ferrié (already a Vice-President of the Society), received on a syphon recorder, projected on to the screen by an epidioscope, and duly interrupted by Admiralty transmissions from Whitehall! The Rt. Hon. Sir Henry Norman, Bart., M.P., also addressed the large and distinguished company, and the Society may then be said to have been fairly launched upon its prosperous career.



Group of Officers of the Society taken October 1919. *Back row (left to right), Mr. L. F. Fogarty, A.M.I.E.E., Mr. R. H. Klein, L.S.C., Mr. H. L. McMichael, Mr. M. Child, Mr. E. W. Kitchen, A.M.I.C.E. Front row. Dr. J. Erskine-Murray, M.I.E.E., Mr. A. A. Campbell Swinton, F.R.S., Admiral Sir Henry B. Jackson, G.C.B., K.C.V.O., F.R.S., Mr. F. Hope-Jones, M.I.E.E.*

In the meantime, the best type of wireless amateur had been attracted. Among the earliest members were Dr. F. C. Knight, G. G. Blake, H. H. Harrison, Tingey *père et fils*, Philip Coursey, Maurice Child, W. H. Shortt, Leslie Miller, Basil Binyon, G. P. Mair, A. W. Sharman, A. E. Dean, Rickard Taylor, H. W. Scott, and H. R. Rivers-Moore, many of whom have since served on the Committee or in Offices, and have contributed to the Proceedings.

In those days when instruments were not so easily made and the manufacture of wireless apparatus, as we know it, had not begun, club-rooms equipped with a first-class receiving set were considered essential. After some hesitation, due to the fear of apparent alliance with a business firm, a generous offer from Mr. A. W. Gamage of rooms at 107, Hatton Garden, was accepted. An "Instrument Fund" was opened, and £100 quickly raised. The premises were furnished, equipped and opened before the close of the year 1913. Morse classes were held and expert advice on all technical matters was generally available, but the aerial was of course dismantled on the outbreak of war, and the instruments officially sealed up.

The Society may be justly proud of its war services. Its younger members, ready trained, flocked to the wireless units of the Navy, Army and Air Forces, which they served with distinction those who stayed at home set a good example by shutting down their own installations and offering their services in the detection of illicit installations. Assistance in the latter direction was not required, but practical help was given to several innocent victims of spy mania!

When it was desired to resume activities after the war, the authorities seemed reluctant to allow us to use our ears again, and it was not until July,

1919, that the Committee came together to formulate their plans for re-opening. They found that the valve had arrived, and the stay-at-homes envied the service men their knowledge of it.

One of the first matters taken in hand was the Affiliation of the Provincial and Suburban Societies. The direct advantages of affiliation from the point of view of the individual Provincial Society were not self-evident, and it was recognised that the success of the scheme depended upon public spirit and their recognition of the fact that union is strength. Fortunately this was not lacking. The immediate response was sufficient to justify calling the first Conference in February, 1920, when fifteen Societies were represented. Next year there were fifty affiliated, at the last Conference—the third—there were 78, and at the time of going to press there are upward of 120.

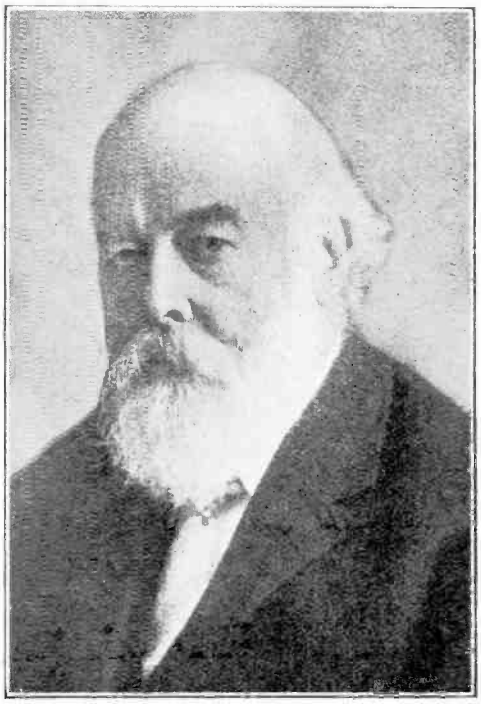
It has been and still is the one Parliament of the Wireless Amateur in this country, and it has

Senatore G. Marconi, G.C.V.O., LL.D., D.Sc., M.I.E.E., Honorary Member.

enabled the President to speak to the authorities in no uncertain voice in the demand for freedom, subject, of course, to reasonable control. They on their part have welcomed the representative voice, for it must be remembered, though the public do not see it, that the constant desire of the civil servant engaged in executive duties is to give all the freedom that can safely be granted, and in administrating such an indefinite law as the Telegraph Acts, to find out what is wanted and what can be given without detriment to important interests and services. Hence, a representative of the Postmaster General has always attended the Conferences, happily in the person of Captain

Dr. J. A. Fleming, F.R.S., a Vice-President.

F. A. Loring, R.N., one of the Vice-Presidents of the Society. It was assumed by some that the Conference would degenerate into indignation



Sir Oliver Lodge, F.R.S., an Honorary Member.

meetings, but such fears have always evaporated in an atmosphere of sweet reasonableness.

H.R.H. The Prince of Wales, Patron of the Society.

The results have been achieved instead by peaceful penetration or by the iron hand in the velvet glove. Take for instance the origin of broadcasting. The lay press and public ought to be told that broadcasting has been in operation for three years in the form of transmissions by some dozens of amateurs, members of the Society, in all parts of the country. In the London district there have been few evenings in the week since 1920 without entertainment of some kind, so much so that the Society had to call together the holders of transmitting licences in the London District in July, 1921 in order to regulate their programmes to avoid interference. But all this was on low power, and in so far as it was broadcasting it was technically against the law. In March, 1921, the second Conference, held under the Presidency of Dr. J. Erskine Murray, asked that permission should be granted to the Marconi Company (who were ready and willing to do it) to transmit a weekly concert. A certain mental backwardness or lack of vision which we are accustomed to in Bureaucracies took six months to make up its mind about this request, and then refused the music. They were invited to face music of another kind, and did so with a good grace when the Secretary presented at St. Martin's le Grand on December 29th, 1921, the Broadcasting Petition signed by the Presidents of 63 Societies representing most of the amateurs in the country, and the Postmaster-General's representatives were told by the Chairman that "the Society's only constitutional means of access to Authority was through the Postmaster General, and it was their intention to urge their plea with all

Admiral of the Fleet Sir Henry B. Jackson, G.C.B., K.C.V.O., F.R.S., President.

Major J. Erskine Murray, D.Sc., Past President, 1921.

the force of which they were capable consistent with the constitutional methods."

Mr. F. Hope-Jones, M.I.E.E., Chairman 1913 to date.

Within a fortnight permission was granted for Writtle to begin its Tuesday evening concerts, and three months later Mr. Kellaway made his broadcast announcement in the House of Commons.

Mr. L. F. Fogarty, Honorary Treasurer.

Yes, there is no doubt that the authorities have been "gingered up." There is equally no doubt that they like it. It is all a matter of how it is done. A reasonable demand, properly formulated and backed by a thoroughly representative body, strengthens the hands of the administrators against conservative influences; perhaps in this case the overcautious representations of the defensive services of the Realm.

The interviews at St. Martin's le Grand have always been of a most cordial nature, and the Committee have invariably been made to feel that the Society was valued by the Department as a means of control and as a channel for the expression of collective views. The Committee has felt it to be a great privilege to assist the Department in determining who were fit and proper persons to be granted licences. Membership of the Wireless Society of London or of an Affiliated Society has been accepted as *prima facie* evidence of fitness for a receiving licence, whilst the more difficult

Mr. R. H. Klein, Vice President, and Founder of the Society.

matter of transmitting licences has been dealt with by an Advisory Committee on technical qualifications consisting of Mr. Campbell Swinton, Dr. Eccles, Professor Howe and Professor Ernest Wilson.

But perhaps the greatest service that the Society has yet been able to render to the Government is in connection with the revision of the terms of transmitting licences. This question originated at the last Conference when wavelengths, working hours, and free communication were discussed, and Captain Loring stated that recommendations would be welcomed, indicating that they should be accompanied by an assurance that they represented also the views of the Provincial Societies. A Control Committee, consisting of Mr. Maurice Child, Mr. Klein, Mr. G. P. Mair, Mr. Frank Phillips and the Secretary, happened to be sitting at the

time, and it fell to them to draft the recommendations. After consideration by the Main Committee they were submitted to the Committee of each one of the affiliated Societies and unanimously approved.

These recommendations may be cited as a typical example of the value of collective bargaining. They took a complete grip of the position of the amateur throughout the country, and basing their considerations on a broad view of the present condition and future congestion of the ether, the authors unfolded the anomolies and inconvenience of the existing licences whilst making practical suggestions which were shown to be to the benefit of the authorities as well as the individuals. So complete and forceful was this document that its recommendations were accepted *en bloc*, and it was the subject of unofficial, but none the less sincere commendation from individual members of the Wireless Board. Nothing short of a Conference of the Affiliated Societies could have given a mandate for such drastic recommendations and none but those accustomed to deal with such matters from a National point of view could have formulated them.

Mr. L. McMichael, Honorary Secretary.

It only remains to add that the Wireless Society of London has been welcomed in a very friendly way by the old established Societies and Institutions. The Institute of Civil Engineers and the Royal Society of Arts have granted the use of their lecture halls on many occasions, while the Institute of Electrical Engineers has never lost an opportunity of showing its goodwill. When the Wireless section of that Institution was being established, its first President, Dr. W. Eccles, F.R.S., attended the Committee Meetings of the Wireless Society of London in order to ensure that there should be no overlapping nor appearance of rivalry. The monthly meetings have always been held in their lecture hall since the building was recovered after the occupation of the Government.

A history can never be up to date, so no attempt will be made to deal with the current events under the Presidency of the Admiral of the Fleet Sir Henry Jackson, G.C.B., F.R.S. His distinguished services to the Society would require another chapter.

Tuned Anode Coils.

NOW that the use of the tuned anode system of high frequency amplification is gaining favour, the following two devices are of special interest.

Fig. 1 shows a spool designed by Mr. V. R. Mills, turned in ebonite, wth grooves for carrying the inductive winding. Threaded holes are made

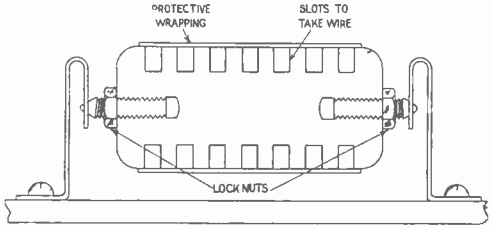


Fig. 1.

in the ends to carry 3 BA screws, and lock nuts hold them secure. The ends of the windings are soldered to the screws, and a little spare solder is allowed to flow round the nuts. Spring connectors may be made from bronze spring or hard brass.

Very little experimental work is required to find a suitable number of turns for the various wavelengths. The number of turns in use need only be approximate, of course, as the inductance is bridged with a variable condenser having a maximum value of about 0·0001 mfds.

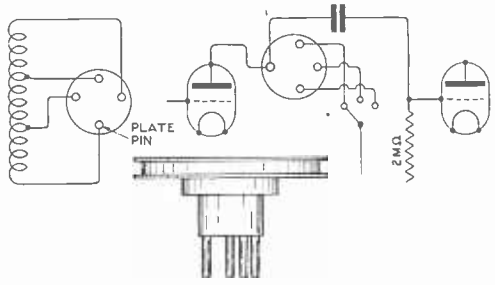


Fig. 2.

Fig. 2 shows a simple arrangement for substituting tuned anode in the place of intervalve transformers. Two tappings are taken out on the winding as it is put on, and the fitting of a three-way switch on the receiving instrument panel provides a tuned anode coil having a wide range.

Electrons, Electric Waves, and Wireless Telephony—VIII.

By DR. J. A. FLEMING, F.R.S.

The articles appearing under the above title are a reproduction, with some additions, of the Christmas Lectures on Electric Waves and Wireless Telephony given by Dr. J. A. Fleming, F.R.S., at the Royal Institution, London, in December and January, 1921-1922. The Wireless Press, Ltd., has been able to secure the serial rights of publication, and any subsequent re-publication. The articles are therefore copyright, and rights of publication and reproduction are strictly reserved.

4.—THE PERIODIC LAW OF ATOMIC PROPERTIES.

It was long ago pointed out by the English chemist Newlands, and the Russian chemist Mendelejeff, and by Lothar Meyer, that if the names of the elements are written down in the order of their atomic weights, the same kind of properties repeat themselves at regular intervals in the series.

It is now usual to arrange the elements in a table called the Periodic Series, which brings out these points clearly.

If we rule up a sheet of paper into nine columns and twelve rows, we can write in each of these spaces, or in nearly all of them, the names of the elements in order of their atomic weights, proceeding from left to right in each row and downwards in each column.* We then find that when arranged as shown in the table on p. 265, all the elements of similar character fall into the same column or group.

The atomic weight of hydrogen is 1·008, when that of oxygen is taken as equal to 16.

The columns are numbered 0 to 8. In column 0 we find all the elements like helium, argon, neon, etc., which are non-valent and do not form any chemical compounds. In column 1 we have the mono-valent highly electro-positive alkaline metals like lithium, sodium, potassium, etc. In column 7 the haloid elements, like fluorine, chlorine, bromine, iodine, and in column 8 certain groups of three metals.

At the end of the series we come to the radio-active elements, radium, thorium and uranium, this last being the heaviest atom, with an atomic weight of 238·2.

We can also attach to each element a number called its *Atomic Number*, given in italics in brackets in the table, which represents its numerical order of the elements in the series. The atomic number of hydrogen is 1 and that of uranium 92.

It is seen that at the beginning of the series the atomic weight is about double the atomic number, or at least differs only by zero or a small number. At the end of the series there is, however, a great difference between the atomic weight and double the atomic number.

Mr. Stephen Miall, in his little book on "The Structure of the Atom" (Benn Bros., London), has pointed out that the atomic weight w is related to the atomic number n in the manner expressed by the formula $w = 2n + b$, where b may be called the dead weight or ballast.

Van der Broek made the suggestion adopted now very generally, that the atomic number represents the resultant number of positive electrons in the nucleus, or what is the same thing, the number of planetary electrons circulating round it in a neutral atom.

Thus the nucleus of the helium atom consists of four positive electrons bound together by two negative electrons. The resulting positive charge is then 2 units. The atomic number of helium is two, and its atomic weight is 3·99 or nearly 4. It has two negative electrons which circulate round the nucleus. In this case the "ballast" weight is zero. In the case of uranium, however, the atomic number is 92, the atomic weight is 238·2. Hence the "ballast" is 54·2.

One important thing discovered is that the chemical properties of the atom are more closely related to the atomic number than to the atomic weight. In short, it is possible to

* The Table on next page has been taken from an article by Dr. Saul Dushman on "The Structure of the Atom" published in *The General Electric Review*.

MENDELEJEFF'S PERIODIC SYSTEM OF THE ELEMENTS

Containing Atomic Weights, Atomic Numbers and Isotopic Radioactive Elements

Group 0	Group 1 E_2O	Group 2 EO	Group 3 E_2O_3	Group 4 EO_2 EH_4	Group 5 E_2O_5 EH_3	Group 6 EO_3 EH_2	Group 7 E_2O_7 EH	Group 8 EO_4
	$H_{1.008}$ (1)							
He 3.99 (2)	Li 6.94 (3)	Be* 9.1 (4)	B 11.00 (5)	C 12.00 (6)	N 14.01 (7)	O 16.00 (8)	F 19.0 (9)	
Ne_1 20.2 Ne_{11} (10) 22	Na 23.00 (11)	Mg 24.32 (12)	Al 27.1 (13)	Si 28.3 (14)	P 31.04 (15)	S 32.07 (16)	Cl 35.46 (17)	
Ar 39.88 (18)	K 39.10 (19)	Ca 40.07 (20)	Sc 44.1 (21)	Ti 48.1 (22)	V 51.0 (23)	Cr 52.0 (24)	Mn 54.93 (25)	Fe 55.84 (26) Co 58.97 (27) Ni 58.68 (28)
	Cu 63.57 (29)	Zn 65.37 (30)	Ga 69.9 (31)	Ge 72.5 (32)	As 74.96 (33)	Se 79.2 (34)	Br 79.92 (35)	
Kr 82.92 (36)	Rb 85.45 (37)	Sr 87.63 (38)	Yt 89.0 (39)	Zr 90.6 (40)	Cb† 93.5 (41)	Mo 96.0 (42)	- (43)	Ru 101.7 (44) Rh 102.9 (45) Pd 106.7 (46)
	Ag 107.88 (47)	Cd 112.40 (48)	In 114.8 (49)	Sn 119.0 (50)	Sb 120.2 (51)	Te 127.5 (52)	I 126.92 (53)	
Xe 130.2 (54)	Cs 132.81 55)	Ba 137.37 (56)	La 139.0 (57)	Ce 140.25 (58)				
			Pr 140.6 (59) Nd 144.3 (60) (61) Sa 150.4 (62) Eu 152.0 (63)					
			Gd 157.3 (64) Tb 159.2 (65) Ho 163.5 (66) Ds 162.5 (67) Er 167.4 (68)					
			Tm_1 Tm_{11} 168.5 (69) (70) Yb‡ 172.0 (71) Lu 174.0 (72)		Ta 181.5 (73)	W 184.0 (74)	- (75)	Os 190.9 (76) Ir 193.1 (77) Pt 195.2 (78)
	Au 197.2 (79)	Hg 200.6 (80)	(81) Tl 204.0; Ac D 207.2; Th D 208.2; $Ra C_2$ 210.2	(82) Pb 207.15; Ra D 210.2; Ac B 211.2; Th B 212.2; $Th D_2$ 208.2; Ra B 214.2; $Ra D_2$ 210.2	(83) Bi 208.0; Ra E 210.2; Ac C 211.2; $Th C_1$ 212.2; Ra C 214.2	(84) Ra F 210.2; $Ac C_1$ 211.2; Ac A 215.2; $Th C_2$ 212.2; Th A 216.2; $Ra C_1$ 214.2; Ra A 218.2	• - (85)	
AcEm 219.2 ThEm 220.2 RaEm 222.2 (86)	- (87)	AcX 223.2; Th X 224.2; Ra 226.2; Mes Th_1 228.2 (88)	Ac 227.2; Mes Th_2 228.2 (89)	Rd Ac 227.2; Rd Th 228.2; Io 230.2; Th 232.2; Ux_1 234.2 (90)	Ux_2 234.2 (91)	U_{11} 234.2; U_1 238.2 (92)		

* Be = Gl
† Cb = Nb
‡ Neoytterbium = 173.5

Atomic Weights listed in Bold figures.
Atomic Numbers listed in *Italics* in parentheses.

have atoms of identical chemical properties but different atomic weights. These atoms have been named by Professor Soddy *isotopes*. Thus there appear to be several different kinds of atoms of the metal lead of slightly different atomic weights, but all having the atomic number 82 and all the same chemical properties.

It was long ago suggested by Prout that all atoms were built up of multiples of a certain primordial element, and hence that atomic weights should all be integer multiples of some unit. As, however, analytical chemistry progressed it was found that this was not the case. Enormous skill and knowledge have been brought to bear of late years upon the determination of the atomic weights and it has been found that Prout's hypothesis is not supported by facts.

Take, for instance, the atomic weight of chlorine, which is 35·46, when that of oxygen is 16. The weight of the atom chiefly resides as we have seen in the positive electron, and there must be an integer number of these positive electrons in the nucleus. The suggestion has therefore been made that there are two kinds of chlorine atom or two isotopes, one with atomic weight of 35, and the other with an atomic weight of 37. They both have the same chemical properties and ordinary chlorine gas is a mixture of these two kinds of chlorine atoms in such proportions that the average atomic weight is 35·46.

The explanation of this may lie in the fact that small variations in the ballast weight of the atom may take place without variation in the atomic properties. Thus the atomic number of chlorine is 17. One kind of chlorine atom has an atomic weight of $35 = 2 \times 17 + 1$ and the other isotope is $37 = 2 \times 17 + 3$, and 1,300 atoms of ordinary chlorine gas comprise about 1,000 atoms weighing 35 and 300 weighing 37 units, equivalent to 1,300 in all, weighing 35·46 on an average.

It is a singular fact that taking the oxygen atom to weigh 16, the following atoms have nearly exact interger atomic weights, helium = 4, carbon = 12, nitrogen = 14, fluorine = 19, sodium = 23, phosphorus = 31, sulphur = 32, arsenic = 75, iodine = 127, and cæsium = 133.

On the other hand, Dr. Aston, of Cambridge, working with improved methods originated by Sir Joseph Thomson, has determined with great exactness that the following elements comprise two isotopes: lithium of atomic weight 6 and 7, boron 10 and 11, neon 20 and 22, chlorine 35 and 37, argon 36 and 40, potassium 39 and 41, bromine 79 and 81. Whilst krypton, tin, xenon, mercury, magnesium and lead, have many more than two isotopes.

It appears quite clear therefore that the atomic number which gives us the total number of negative electrons circulating round the nucleus in the neutral atom is the determining factor in the chemical behaviour of the atom. It is now considered that these planetary electrons are arranged in rings or shells, one outside the other.

Thus in the carbon atom of atomic number 6, there are six resultant positive units of charge in the nucleus and two shells or rings of planetary negative electrons, the inner containing two and the outer layer four negative electrons, making six electrons in all. In the oxygen atom there are eight electrons in all, viz., 4, 2, and 2 in three shells, and in the sulphur atom there are 16 in all, arranged in four shells of 8, 4, 2 and 2, reckoning from within outwards.

The electrons in these shells or zones are in rapid rotation round the nucleus, but the different groups do not necessarily all revolve in the same direction nor in the same plane.

The outer shell or layer of negative electrons in the atom is that which chiefly determines the type of chemical compound formed with other atoms and these are termed the *valency electrons*. Some of these valency electrons are easily detached in the case of the metallic atoms. In a mass of metal, say, copper, there are, therefore, free electrons which are jumping about from atom to atom and moving in the inter-atomic spaces with a velocity of approximately 50 miles per second.

5.—Electric Conductivity and Electric Currents.

These free electrons bestow upon the metal its electric conductivity because when an electromotive force, due say to a Voltaic cell, is applied to the metal, these free negative electrons are caused to drift or move as a whole towards the positive end of the conductor.

The electrons have superimposed upon their irregular motion a drift in one direction, just as a swarm of gnats, in which each insect is flying hither and thither in an irregular manner, might be blown as a whole down a street by a gentle wind. This drift of electrons constitutes what we call an electric current.

Hence our usual convention as to the direction of the electric current in a conductor is wrong. We commonly say that the direction of the current in a wire is the direction of movement of positive electricity in the wire. But, in fact, there is no movement of positive electricity, only a drift of negative electrons in one direction in the wire. Hence all our usual mnemonic rules involving the direction of the current and that of the embracing magnetic field require to be restated and reversed.

A negative electron revolving in an orbit is therefore equivalent to an electric current and produces a magnetic field. Hence atoms in which the negative electrons revolve in the same direction and nearly in the same plane, will exhibit magnetic polarity, and this may account for the magnetic properties of the oxygen and iron and nickel atoms.

6.—RADIO ACTIVITY.

A brief reference must then be made to the special qualities of the so-called radio-active elements, of which the most remarkable is the element radium.

It is found that certain of the atoms of high atomic number break up spontaneously and gradually are transformed into atoms of lower atomic number and weight. In the case of an atom like uranium, of atomic weight 238·2, the nucleus is a very bulky thing relatively to that of the hydrogen atom, which, according to a prevalent view, consists simply of a single positive electron, with a single negative electron revolving round it. The uranium atom, on the other hand, has 92 planetary electrons, and 92 effective and probably about 240 actual positive electrons packed into its nucleus, and perhaps about 148 negative electrons as well.

As the planetary electrons revolve round the nucleus they may set up strains in it or tidal actions, which may increase to such a point that the nucleus breaks up. When this is the case, we have thrown off from it either one or more negative electrons called β-particles or else one or more helium nuclei called α-particles. The helium nucleus consists of a group of four positive electrons and two negative electrons, having thus two effective positive charges. These six electrons must be bound together very tightly because the helium nucleus appears to be a remarkably permanent and indestructible article.

When the nucleus is ruptured or broken up these α and β-particles are shot off with immense velocity approximately to that of light waves, viz., 300,000 kilometres per second. In addition to this the impact of a β-particle against other molecules gives rise to the production of certain very short electromagnetic waves called γ-rays, which are like the X-rays in properties.

The atoms of which the nuclei can break up in this way are called *radio-active* elements. Prominent amongst them are radium itself, thorium and uranium, all of which are atoms of large atomic weight and relatively bulky or heavy nuclei.

We all know that when a heavy flywheel is in rapid rotation it contains a store of energy measured by half the product of its so-called moment of inertia and the square of its angular velocity.

If the flywheel bursts, the fragments are flung away far and wide, generally with disastrous results. In the same manner when the nucleus of a radio-active atom breaks up its α and β-particles are hurled away with such enormous velocity that they break up or ionise other atoms in their neighbourhood. The nucleus may therefore be in extremely rapid rotation.

The break up of a radio-active nucleus, however, is not exactly like the bursting of a flywheel. It proceeds by many stages and the various intermediate atoms which are successfully formed have "lives" of very different duration, varying from a few minutes to many thousands of years.

Thus for instance, beginning with the atom of uranium, with atomic weight 238·5, its average life is 5,000 million years. It throws off an α-particle, thus reducing its atom weight by four units, to 234·5, and is then transformed into a substance called uranium X_1. This, however, only lasts a few days (about 25) and is then transformed into uranium X_2. The latter gives off a β-particle, which does not sensibly alter the atomic weight, and is thus transformed into a far more permanent atom called uranium II, which has a life of about two million years. This, by the loss of two successive α-particles thus becomes ionium and finally radium, with an atomic weight of 226·5. This in turn gives off a gaseous "emanation," which has an atomic weight of 222·5, and is often called niton. Finally, by further losses of α and β-particles, this last substance is transformed into metallic lead, with an atomic weight of 206·5.

There is another chain or series of atomic transformations starting from uranium II which, in the end, also yields lead, but with an atomic weight of 210. Finally, from the thorium atom, there are a series of descendants ending also in lead, with an atomic weight of 208. Hence the lead atom exists in several isotopic forms, and there are atoms, all of which, chemically speaking, are lead, but have different atomic weights. Accordingly, some part at least of the atomic weight of lead, viz., that over and above twice its atomic number, which is 82, has no influence on the chemical properties, for all these varieties of lead atom have the same atomic number.

Thus, in a certain sense, the dreams of the old alchemists have been realised. Although we have not been able to transform lead into gold, as they hoped, we now know that the element uranium is slowly and spontaneously changed into radium and finally into lead.

It appears therefore as if the nuclei of all atoms are built up in part of the extremely permanent helium nuclei, held together in some way by negative electrons, into a very compact mass. Possibly also free positive electrons or hydrogen nuclei may be present as well.

From certain experiments made by bombarding nitrogen and oxygen gas with α-particles, Sir Ernest Rutherford has shown that nuclei or atoms of an atomic weight of three carrying two, or it may be one, positive electric charges, are liberated. It seems as if these nuclei were composed of three positive electrons, held together by one negative electron or perhaps two.

It has been long known that the atomic weights of many elements which are integers can be represented by the general formula $w = 4n$ or $w = 4n + 3$, where n is some integer. This seems to support the view that the atomic nuclei in these cases are built up of helium nuclei of mass four and of the unnamed nuclei of mass three, the atomic number being then given by $a = 2n$ or $2n + 1$.

Harkins has suggested that all atomic nuclei are built up of hydrogen nuclei, helium nuclei, and the above unnamed nucleus of mass three, but having one positive charge and not two.

When the helium nuclei or α-particles are expelled from the disrupted nucleus of a radio-active atom, they are flung off with velocities which may be of the order of 20,000 kilometres per second, or, say, 12,000 miles per second, a velocity which would take them round the earth in two seconds. Since the mass of a helium nucleus or α-particle is about four times that of a hydrogen atom, or, say, nearly 6×10^{-24} of a gram, the energy of the α-particle is about

$$\frac{1}{2}\ \frac{6}{10^{24}}\ 4 \times 10^{18} = 12 \times 10^{-6}$$

ergs, or, say, 12 microergs.

On the other hand, the β-particles are thrown off from radio-active atoms with a velocity of about 0·9 of that of light, or, say, 270,000 kilometres per second. Since, however, the mass of an electron is only 9×10^{-28} gram, we have the kinetic energy of a β-particle given by

$$\frac{1}{2}\ \frac{9}{10^{28}} \left(\frac{9}{10} \times 3 \times 10^{10}\right)^2 = \frac{1}{3} \times 10^{-6} \text{ nearly}$$

or nearly one-third of a microerg. Therefore the single α-particle has 30 to 40 times the kinetic energy of the single β-particle.

In consequence of their very small size and of the very porous or open structure of atoms generally, the chances of a β-particle being stopped when fired through a volume of air, is much smaller than that of the larger α-particles. The β-particles scarcely lose half their velocity in passing through a thickness of air of one metre, whereas the α-particles are stopped completely by a few centimetres.

Owing to the very open or skeleton structure of atoms, which has already been mentioned, it is possible for the α-particles to pass through thin sheets of metal, but the β-particles can pass through plates of several millimetres, or even inches, in thickness.

In the passage of the particle it will come into close proximity with other atoms of the metal plate and be deflected from its path. Thus an α-particle may come close to some other atomic nucleus and will then whirl round it and be flung off in a hyperbolic path just as a comet is affected when passing round the sun. Similarly a β-particle will be deflected by atomic electrons.

When an α-particle strikes a screen covered with fluorescent material, such as zinc blende, its impact gives rise to a tiny flash of light which can be observed through a lens or microscope. This fact was utilised by Sir William Crookes in the construction of an instrument he called a *spinthariscope*, in which a minute fragment of a radium salt on the head of a pin was held near a small fluorescent screen and the little flashes due to the bombardment of this target by the α-particles was observed through a lens.

Sir Ernest Rutherford and many other investigators have made use of this method in a highly ingenious manner to determine a maximum limit to the size of the nucleus of atoms by calculations made from observations of the deflection of an α-particle by a thin plate of metal.

By bombarding molecules of hydrogen gas in this manner with α-particles, it has been found that the centres of the hydrogen and helium nuclei must approach within a distance of $1{\cdot}7 \times 10^{-13}$ centimetre. Hence the sum of the radii of these nuclei must be if anything *less* than the above number.

We can conclude, therefore, that the diameter of a single positive electron such as forms probably the nucleus of a hydrogen atom, is *less* than $0{\cdot}8 \times 10^{-13}$ centimetre. Now this is less than the diameter of a negative electron. Moreover, since we know the mass of the hydrogen nucleus, which is $1{\cdot}65 \times 10^{-24}$ gram, we see that the density of the hydrogen nucleus or positive electron must be of the order of 7×10^{15}, an enormous number when compared with the mean density of atoms themselves, or masses of matter.

Hence we arrive at the conclusion that atoms are very open or porous structures, but the particles, viz., the positive and negative electrons of which they are made, have a stupendous density.

From experiments made by the deflection of α-particles in passing through sheets of various metals, Sir Ernest Rutherford has concluded that the diameters of the nuclei of atoms are of the order of 10^{-12} centimetre, or one billionth part of a centimetre.

(To be continued.)

Of Interest to Inventors—"Licences of Right" Patents.

By a BARRISTER-AT-LAW.

IT has always been a matter of difficulty for what may be termed the non-professional inventor, once he has succeeded in passing his specification safely through the Patent Office, to find a suitable channel through which he can either dispose of his patent rights or in some way or other get his invention manufactured and marketed.

In practice there are many reasons which may operate to prevent the proper exploitation, even of a really meritorious invention. The fact that it will supply a long-felt want, or that it will enable a given article to be produced more efficiently or economically, is by no means a sure passport to commercial success.

For example, a manufacturer who, say, has recently laid down expensive plant to produce an article of a given design is approached by an inventor with plans for the production of a better article at a less cost. If the patentee is a poor man, or one who does not know the ropes, he may sell his patent rights for some quite inadequate sum. The purchaser promptly "pigeonholes" the patent. He will not make the improved article himself, for it involves the scrapping and replacement of his new machines, and he is now in a position to prevent anyone else from making it under the penalty of infringement.

This is a great injustice to the inventor, who naturally wants to see his idea upon the market where it will earn him royalties. He has probably stipulated for some return on each article made or sold, but unless he has been very wary he will find himself without any remedy should the purchaser actually decline to manufacture.

There are many instances of such "blocking" methods in which patents are maintained by one firm simply and solely to *prevent* some other firm from putting the article upon the market. The holder of such a patent adopts a dog-in-the-manger policy. He will not make himself, because it pays him better not to do so, and he abuses the monopoly grant he holds by forbidding others to manufacture.

The consuming public in general are, perhaps, the greatest sufferers in such circumstances. They have the right to expect that the system of protecting invention by Letters Patent shall result in a meritorious invention being at once utilised and marketed. The inventor is an asset to the community only so far as he succeeds in producing something that fulfils a want, either in the form of a new or improved commodity, or by the more economical production of an article already in use.

This form of abuse therefore strikes at the very roots of the Patent System. The State does not give a monopoly grant in order that it shall be bottled up to suit certain vested interests.

The Patents Act of 1919 is very clear on this

point. It says very distinctly and specifically, " Patents for new inventions are granted not only to encourage invention but to secure that new inventions shall so far as possible *be worked on a commercial scale* in the United Kingdom without delay."

In an attempt to prevent such abuses the Patents Act in question has created what is in effect a new kind of Letters Patent, which possesses certain advantages over the ordinary grant. It is intended more particularly to serve those non-professional inventors who neither possess the necessary capital to market their own ideas nor have direct access to interested manufacturers.

The new form of patent is distinguished from the ordinary grant by being labelled or endorsed " Licences of Right." The procedure, so far as obtaining the grant is concerned, is presisely the same as before, and the initial stamp fees are identical, *i.e.*, £5 up to and including the sealing fee. When the grant has been sealed, it may be endorsed " Licences of Right " on the payment of a single further fee of £1.

This endorsement is a formal notification to all concerned that the invention so protected may be manufactured under licence, which can be obtained from the patentee *as a matter of right*. The terms of the licence involve, of course, the payment of a reasonable royalty to the inventor. In the case of dispute between the patentee and a would-be licensee, the points at issue are referred to the arbitration of the Comptroller of the Patent Office, who is directed by the Act to decide them in accordance with the guiding principles that the inventor is to secure the maximum reward consistent with the largest possible manufacture within the United Kingdom.

There may, of course, be more than one licensee, but since there is always the Comptroller of the Patent Office as referee, the grant of subsequent licences must be made on such terms as are equitable and fair to the interests of existing licensees, and at the same time must not endanger an adequate return in the shape of royalties to the inventor.

When a thoroughly sound invention is thus, as it were, advertised in the open market, it is fairly certain to attract the scrutiny of interested manufacturers. Each knows that he may get a licence to work, simply by agreeing to pay a reasonable royalty, and will hesitate to lose an opportunity that may be seized by a competing firm. Naturally the first-comer will get the better terms.

Obviously it is impossible for anyone to " bottle up " such a patent so as to prevent it from getting on the market.

Once a patent has been labelled " Licences of Right " it is only liable to pay half the normal renewal fees, which means a saving of more than £60 spread over the full term of 16 years. This represents a considerable sum to the inventor of small means.

Finally it is by no means an uncommon thing for a " poor " inventor to find his patent rights filched from him simply because he has not the necessary means to fight an action for infringement in the High Courts. In the case, however, of a Licence of Right Patent, the interests of the licensees are involved just as much as those of the patentee, and all parties will join forces in resisting any such attempts upon their common property.

The Transatlantic Tests.

INVITATION TO CONTRIBUTE TO THE PRIZE FUND.

ON the last occasion of the Transatlantic Tests, when British amateurs were successful in the reception of American amateur transmissions, prizes were offered by a number of manufacturers of wireless apparatus in this country. The names of those firms contributing to these awards were published in various issues of this journal, and the conditions under which the prizes were offered were stipulated by the firms individually.

Now that further tests are shortly to be conducted, manufacturers are again invited to contribute, should they desire to do so, to the prize fund which is being started.

Manufacturers are specially asked to interest themselves in these tests, whether in the matter of offering prizes or by giving their support in other directions.

At the present time most interests are naturally concentrated on the question of the development of the industry springing up as a direct result of broadcasting. The work of the scientific amateur should not suffer eclipse on this account, but rather a keener public interest should be felt in any such enterprise as that contemplated in the forthcoming transatlantic tests.

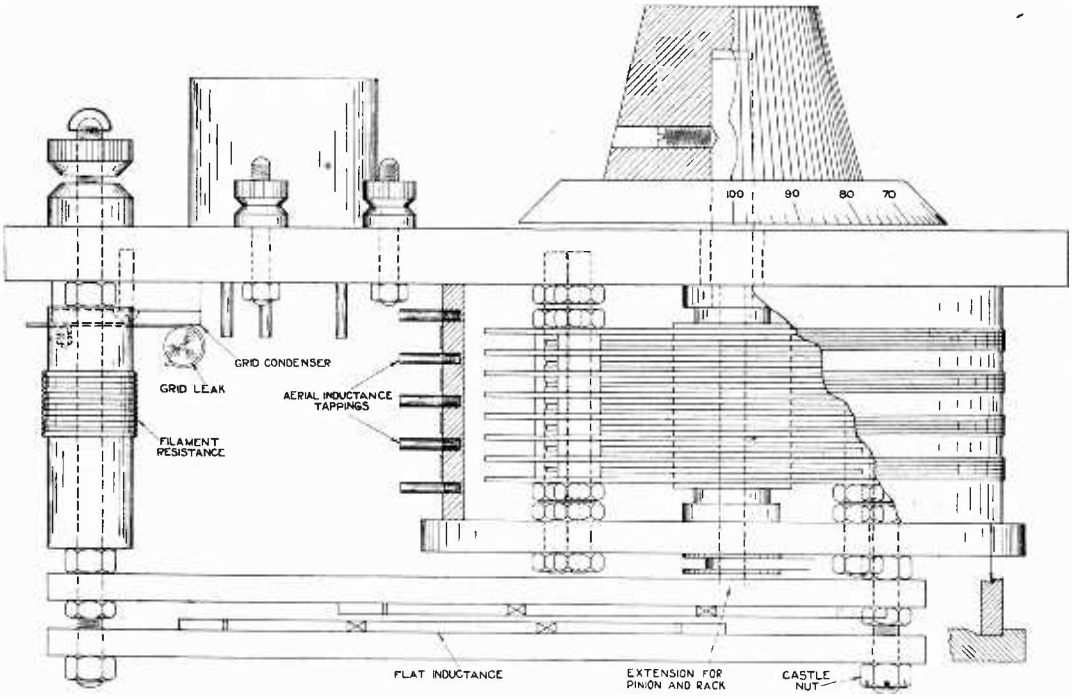
Experimental Station Design

(*Continued from page* 130, *October* 28, 1922.)

XVI.—A SINGLE VALVE BROADCAST RECEIVER.

THE regulations of the Post Office permit of the use of reaction for broadcast reception, providing that the plate circuit inductance is only loosely coupled to the aerial circuit, so that the oscillations which are set up are of so small an amplitude that interference is considered to be negligible. In order that the inexperienced user, who is unacquainted with the interference effects produced by tight reaction coupling, may not operate his receiving apparatus in a way that is likely to spoil reception at near-by stations, the Post Office state that reaction coupling to the aerial circuit, when provided, must be fixed, and arranged in such a manner that it cannot be varied by the user without dismantling his receiver. To fulfil these requirements in a receiver that may be connected to an aerial having a wide range capacity value, and for use on aerials of all dimensions, presents many difficulties, as the extent of reaction coupling that can safely be used depends entirely upon the constants of the aerial to which the instrument is connected.

Of course, the tuning range of the instrument is limited, and the reaction coupling that is provided must be suitable for the band of wavelengths on which reception is desired. It is found in practice however, that the extent of reaction coupling needs to be altered as the value of the capacity in the aerial tuning circuit is changed. If the full advantage of the use of reaction is to be obtained, an arrangement by which the extent of reaction coupling is automatically altered as the value of the aerial tuning condenser increases, may partly serve as a solution of these difficulties. In practice such an arrangement presents many difficulties. The desired increase in reaction coupling does not vary proportionately as the value of the condenser is increased to vary through a given range of wavelengths. The only way to accomplish this is to so shape the condenser plates that the capacity variation



Suggested Design for a Single Valve Broadcast Receiver. The condenser spindle may be extended to carry a pinion to engage on rackwork to increase reaction coupling as the capacity of the tuning condenser advances.

for a given turning of the condenser spindle gives a suitable amount of movement for increasing the reaction coupling. The stem of the condenser is then of course extended, and a portion of the aerial inductance is moved in the field of the reaction coil. Referring to the diagram, this arrangement can be provided by extending the spindle to a plate carrying the flat inductance. This inductance would be moved over the reaction inductance by rack work as the condenser spindle is turned. A suitable setting depending upon the capacity of the aerial circuit would be obtained when installing the instrument by disengaging the rack work and sliding the inductances to the required position, or alternatively the stationary inductance might be slipped along to the desired extent.

Here it might be pointed out that the degree of reaction coupling of course depends upon the amplitude of the currents produced in the plate circuit, which in turn varies with the type of valve employed, filament birghtness, and the value of the high tension battery. It is presumed that with receiving instruments of this sort, the type of valve to be used will be specified, and also the variety of high tension battery of definite voltage. In instruments of this sort it becomes essential, of course, that the filament current cannot be varied by the user, and consequently fixed filament resistance must be provided for use on a particular voltage. The filament resistance is shown wound on an ebonite, fibre or china tube held on one of the rods which support the platform carrying the flat inductances. This rod may also serve as a stem for the aerial terminal, and for bringing the aerial connection through to the base of the instrument, for connecting to one of the flat inductances. Another similar terminal arranged symmetrically on the other side of the instrument should also carry a piece of ebonite, on which may be wound, non-inductively, about 400 turns of No. 38 single silk-covered "Eureka" wire. This non-inductive resistance is shunted across the aerial circuit, and tends to make the point of oscillation less critical. To provide for differences in aerial length, the loading aerial inductance, which is wound on a tube which forms a cover for the variable condenser, is tapped out, so that connection can be made to the most suitable point on the inductance at the time of installing the instrument, to give the broadcasting wavelength by a mid-position setting of the condenser scale. The value of the aerial tuning condenser should not exceed 0.00025 mfds. The circuit to which the instrument is wired is that usually employed for single-valve reacting receivers, excepting, of course, that the aerial circuit is shunted with the resistance as stated above.

So many difficulties are encountered in designing an efficient single-valve non-radiating receiver which is not provided with variable reaction coupling, that it is probably wise to entirely abandon the use of reaction in a single-valve receiving set. The usual type of British valve, when used as a detector without reaction, is usually very little better than a crystal, and hence it is probable that the only application of a single valve is that of a note amplifier following a crystal detector.

It is with satisfaction that we learn that reaction may be used in single-valve broadcast receiving apparatus; but until the problem as to a method of using fixed reaction has been solved, the privilege is of little value. The Post Office, whilst giving authority for the use of reaction, should lay down some standard or specified test which could be applied, so that the manufacturer may know whether the apparatus that he is designing is likely to meet with official approval.

XVII.—AN IMPROVEMENT IN THE USE OF A TUNED ANODE CIRCUIT.

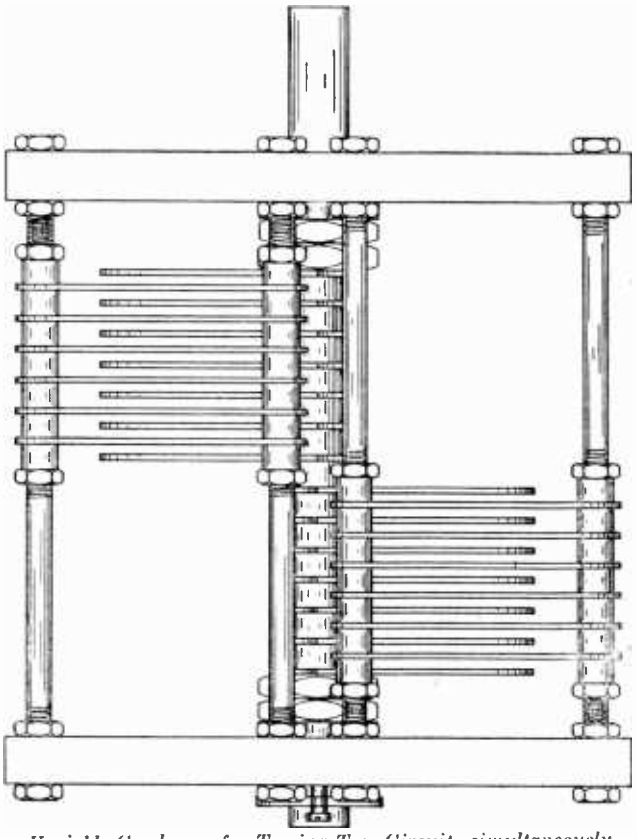
THE use of the tuned anode system of high frequency amplification brings with it the difficulty of adjusting a number of circuits simultaneously. This difficulty is a serious one, and unless each circuit is carefully tuned with a wavemeter, the efficiency of the receiver is considerably impaired. The difficulty increases with the number of tuned anode circuits in use, though even with only one such circuit, rapid tuning is by no means simple.

It is the general practice, when using this system of high frequency amplification, to use a secondary inductance in the aerial circuit. Now, if this inductance is of identical value to the inductance inserted in the plate circuit of the first valve, it follows that the condenser which bridges its ends must be of the same value as that used for bridging the anode coil, and consequently the two condensers must be adjusted together. The accompanying diagram represents a condenser built with its

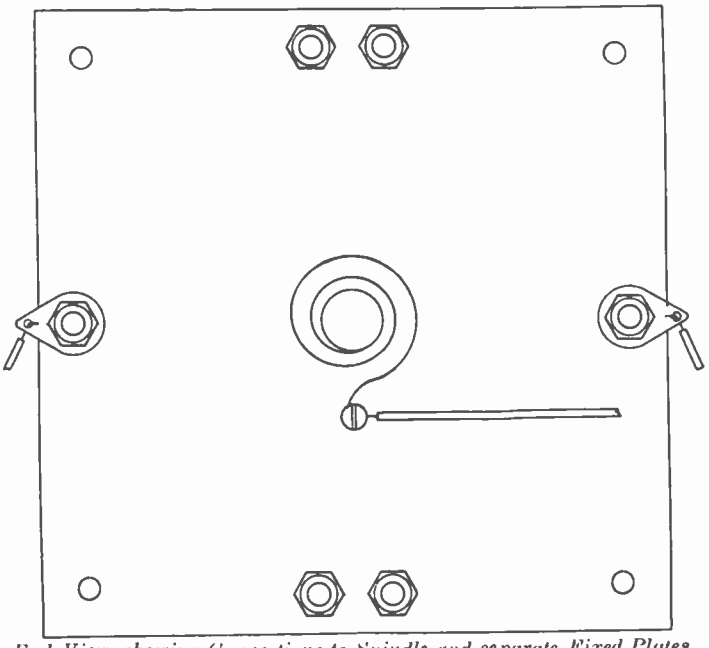
moving plates divided on to two sides of a common spindle, whilst the two sets of fixed plates are insulated from one another as indicated in the view of the under side.

This condenser consists of two sections, each of which gives precisely similar values. The spindle is connected in the circuit to the H.T. +, whilst one set of plates is joined to the grid end of the closed circuit coil, and the other set of fixed plates to the plate of the first valve. This method of connecting up necessitates the use of a suitable grid condenser and leak in the grid lead. Great care must be taken in building up a condenser of this sort to ensure that all of the moving plates are centrally spaced between the fixed ones, as even one plate a little out of place will considerably increase the capacity. With care it is possible to build up a pair of condenser units similar to the one described, and to couple the spindles together for the purpose of tuning a number of high frequency tuned anode coils. Alternatively one double condenser can be used for tuning two anode inductances, whilst a separate single condenser may be used for tuning the aerial closed circuit. This single condenser should have an ebonite coupling with the spindle of the double condenser, if it is not desired to use a grid condenser and leak with the first valve.

It is essential that the inductances with which these condensers are connected should have equivalent values, and with short wave working this is quite a simple matter if the inductances are wound as single layers on an ebonite former.



Variable Condenser for Tuning Two Circuits simultaneously.



End View, showing Connections to Spindle and separate Fixed Plates.

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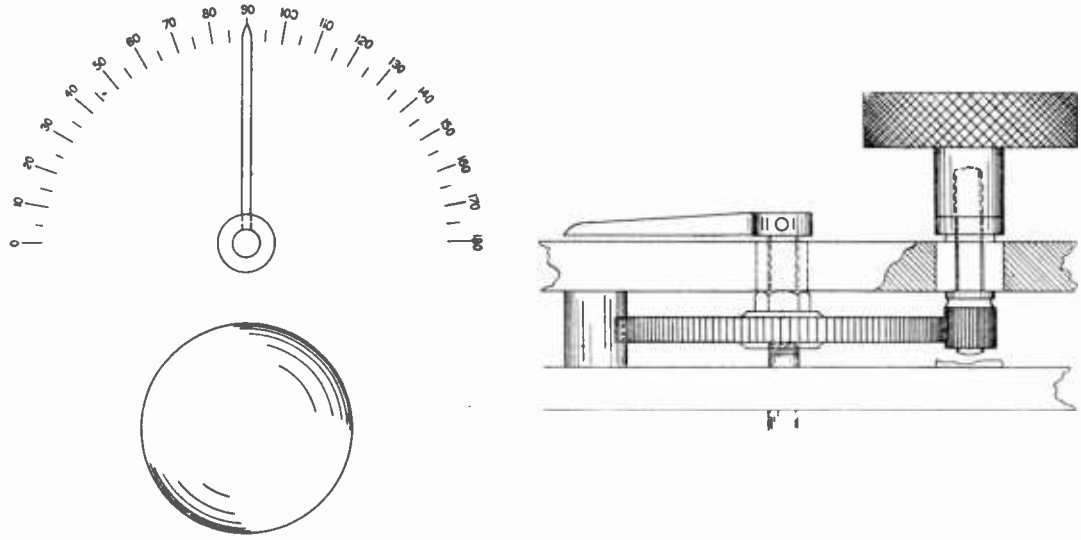
For critically adjusting the condenser, it is helpful to adopt some such arrangement as shown above. As well as providing the critical tuning usually necessary in high frequency circuits, this arrangement a'so overcomes any excessive friction that may occur on the bearings when two condensers are coupled together, and perhaps very slightly out of alignment.

F.H.H.



Geared Condenser Control to revolve coupled Condensers.

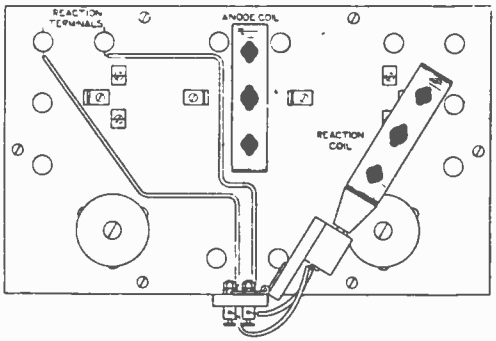
Further Notes on a Four-Valve Station

HOW TO COMPLY WITH THE LATEST P.M.G. REGULATIONS.

By PERCY W. HARRIS.

IN some recent articles contributed to this magazine (beginning July 15th last) the present writer described in detail the construction of a four-valve receiving set embodying a tuning unit, a H.F. amplifying and detecting unit, and a two-valve note-magnifying unit. Provision was made for single-circuit tuning with reaction coupling to the aerial, and for two-circuit tuning with similar reaction.

At the time when this set was designed the Postmaster General's regulations regarding reaction were scarcely defined. Many of these four-valve sets have been constructed by readers and no doubt are being used with the reaction coil acting on a loosely coupled secondary. This method, however, is liable to cause interference in the immediate vicinity of the station. The present article describes a simple method by which the reaction coil can be made to act on the anode coil behind the first valve, thus limiting the extent of radiation. At the same time the rapid change from stand-by to tune is still possible, tuning is facilitated, and C.W. can be received by the autodyne method, with either direct or inductive coupling to the aerial. In short, the set retains its efficiency, while complying with the latest regulations of the Postmaster-General.



Pivoted coil holder in position.

Very little constructional work is necessary, and there is no interference with existing connectings or fittings. Briefly, the method consists in fixing a support to the front of the H.F. and amplifying unit, the support carrying a hinged piece which in turn carries a standard coil plug. Into this plug a suitable plug-in coil is fitted and can be swung nearer to or farther away from the anode coil on which it reacts. No new coils are needed, as one simply transfers the reaction coil form the tuner to the new fitting. The materials needed are one standard coil plug, two terminals, one hinge, and some odd strips of ebonite from the scrap-box. Wood can be used instead of ebonite for the main support, if preferred. Ebonite, however, looks well, and is recommended to those who like their set to have a well-finished appearance.

First cut a strip of $\frac{1}{4}$-inch ebonite to the dimensions shown in the diagram. Then cut a further strip of the same width, but $1\frac{7}{8}$ ins. long. Obtain from the ironmonger one brass hinge (as used for bureau flaps), one inch wide and $\frac{3}{4}$ in. across when folded. It should be of the type with parallel sides.

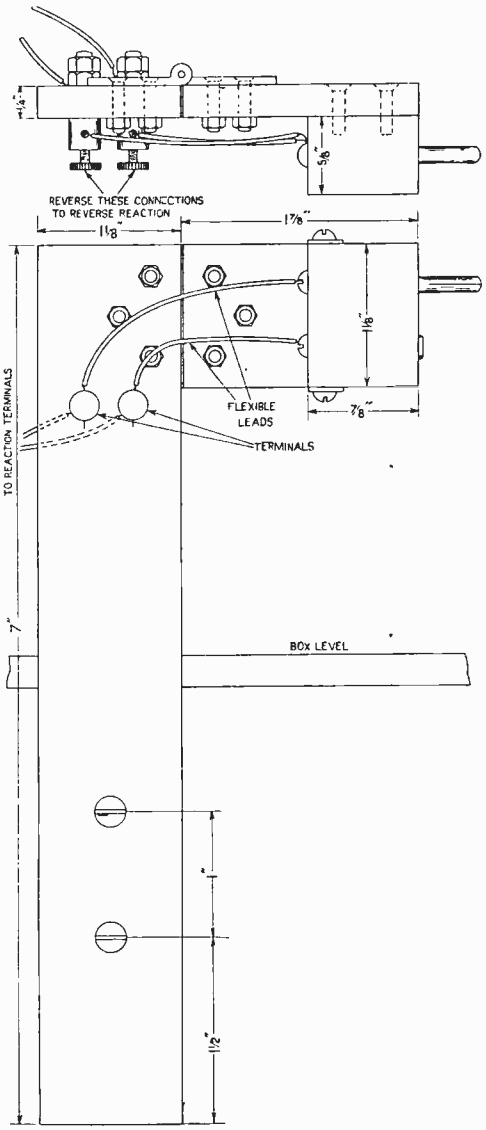
Drill the support and the swinging arm each with three clearance holes for 6 BA metal screws, $\frac{7}{16}$ in. long. Fit the hinge with these screws and secure them at the back with suitable nuts, as shown. The plug should next be secured to the swinging arm by two 6 BA metal screws about $\frac{1}{4}$ in. long, clearance holes being drilled in the arm and tapped holes in the ebonite of the plug. Drill holes also in the support for the two terminals and fit them with nuts.

In the lower portion of the upright support drill two countersunk holes to take a pair of wood screws. These will secure the upright to the wood of the box.

The upright should not be screwed to the box until the rest of the device is finished, as then it can be placed easily by plugging in any suitable coil and moving it about until the correct point is found If the swinging coil extends too far forward, a slip of wood should be inserted between the upright and the box. It will stand up about three and a half inches above the top of the box. Stiff wire can be used from reaction terminals to support terminals, and flexible leads from the latter to the coil plug.

The smaller diagram shows the top of the H.F. amplifying and detecting unit, with the new device in place. If desired, an extension handle can be fitted to facilitate moving the coil, but in practice it does not seem necessary.

The writer strongly recommends this form of reaction to all who have made up the four-



Details of construction of bracket and arm.

valve set. It is easy to manipulate, is efficient and is also simple to construct. As it now stands, the set is proof that one can comply with all the P.M.G. regulations, in letter and in spirit, without losing that efficiency we all aim to attain.

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The Transatlantic Communications

FURTHER INFORMATION.

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

FROM the latest information received from America in connection with these tests, it appears that even greater enthusiasm is being shown there on this occasion than last year. As has already been announced, in these columns, the American Radio Relay League has imposed stiffer conditions this year for their transmitters. They have stipulated that in order to qualify for an individual transmission period in the final tests, transmitting stations must have signalled over a range of at least 1,200 miles. These preliminary tests were held at the end of last month and a few British amateurs have reported reception of signals from some of the American stations during these tests. This result gives hope for the success of the main tests next month.

RECEPTION FROM AMERICA.

The main transmission tests from the United States will continue for 10 nights and will last from midnight, G.M.T., to 6 a.m., on each occasion. This 6-hour period will be divided up into a "free-for-all" period lasting for 2½ hours commencing at midnight, followed by individual transmission periods for the remaining 3½ hours. The "free-for-all" period will be divided up into shorter periods which will be allocated to the various districts of the United States and Canada, much as was done last year. Before the commencement of the tests, details will be published of these time allocations, as a guide to listeners in this country.

The wavelengths to be used during each of the individual transmission periods will also be published as soon as they are received from the American Radio Relay League; but should they reach this country too late for publication in this way, they will be circulated by post to all amateurs who have registered their names with the writer as desirous of listening-in for the signals.

DAILY REPORTS.

Through the kindness of Marconi's Wireless Telegraph Co., and the Radio Corporation of America, arrangements have been made for the transmission at 0700 G.M.T. each morning during the tests of a report addressed to the "American Radio Relay League," giving details of any receptions that are reported here. In order to enable these reports to be prepared by the Sub-Committee of the Wireless Society, which is making the necessary arrangements, every amateur hearing signals is requested to report their reception immediately by telegraph or telephone to the writer. Such reports will be verified by comparison with the special code letters which will be sent over by the American Radio Relay League, before inclusion in the daily reports.

These daily reports will be sent by Carnarvon **MUU** at 0700 G.M.T. on a wavelength of 14,200 metres, at approximately 12 words per minute, and will be repeated five minutes later by New Brunswick **WII**.

Similar arrangements have been made by the French Transatlantic Signals Committee for the daily transmission of reports of the reception of American signals by French amateurs. These reports will also be addressed to the American Radio Relay League and will be sent by Sainte Assise Radio Station at approximately 0710 G.M.T. on a wavelength of 15,000 metres. They will be repeated five minutes later by Marion station, in the United States.

During the transmission tests to America from this country and from France, similar daily reports will be made by the A.R.R.L. from New Brunswick Station, **WII**, on a wavelength of 13,600 metres, at 2000 G.M.T. (8.0 pm.). These reports will be addressed to "Coursey, London," and will be repeated by Carnarvon **MUU** on a wavelength of 14,200 metres five minutes after reception there.

All wireless amateurs in the country will therefore be able to follow the progress of the tests from day to day by listening in to these transmissions from Carnarvon at 0700, and from Sainte Assize at 0710 G.M.T., during the reception tests here, and to the Carnarvon reports at 2000 G.M.T. during the transmission tests from this side.

SPECIAL TESTING SIGNALS.

In order to help listeners here to adjust their sets to the maximum sensitivity arrangements have been made for the transmission each evening of special testing signals from a station near London on a low power and using wavelengths approximately covering the band to be used by the Americans.

These signals will be sent on wavelengths of 200, 230, 275 and 325 metres, commencing at 2000 (8 p.m.) on Thursday, November 23rd. The signals will be in the following form :—

"TEST TEST TEST de **2 VK 2 VK 2 VK.** XXXXXX ———— XX. WAVE-LENGTH . . . . . METRES."

The transmission on each wavelength will last for 10 minutes, and the change over from one wavelength to the next in the above order will be made as quickly as possible, so that the transmissions will be as follows :—

From 8 p.m. to 8·10 p.m. on 200 metres.
From 8·15 p.m. to 8·25 p.m. on 230 metres.
From 8·30 p.m. to 8.40 p.m. on 275 metres.
From 8·45 p.m. to 8·55 p.m. on 325 metres.

A low power will be used for transmission in order to make the signals a real test of the receiving apparatus. Reports of the reception of these signals are invited, particularly in order to compare the relative transmission qualities of the various wavelengths. These transmissions will not take place on Saturday and Sunday unless otherwise announced on Friday, November, 24th These test signals will continue until the evening of December 11th.

TRANSMISSIONS FROM EUROPE.

These transmissions from Europe will be made from this country and from France. They will extend from December 22nd to December 31st inclusive and will last from midnight to 6.00 a.m. in each case. Three hours each night have been allocated to the British transmitters, and three to the French, the periods alternating on successive nights, commencing with British transmissions from midnight to 0300 on December 22nd, followed

by French transmissions from 0300 to 0600 on the same night. The next night the French will have the first three hours, and the British the second period; and so on alternately. This arrangement should give a very fair distribution of the transmitting periods to the two countries.

In order to meet the desires of many of the ordinary low powered transmitters here, it has been decided to reserve the first half-hour of both British transmission periods for a "free for all" transmission, during which any licensed transmitting station in Great Britain may transmit on their licensed power and wavelength without registration in any way. These calls should simply be in the form of "TEST TEST TEST the call letters, 3 lines." repeated as often as desired. These transmissions should preferably all be made on the shorter licensed wavelengths in the 150 to 200 metres band.

To those transmitting stations which comply with the conditions recently announced in these columns, and have registered their names with the writer, special individual transmitting periods will be allocated, with special code letters to be used. Details of what is to be transmitted by these stations will be forwarded by post shortly before the commencement of the transmission tests.

AVOIDANCE OF INTERFERENCE.

It is hoped that every amateur in the country will co-operate to make these tests a success by avoidance of interference during the periods of listening for American signals between December 12th and 21st. Not only should transmitters be kept quiet after midnight between these dates, but receiving sets also should not be used so as to avoid jamming other listeners in the vicinity. In particular also all those who intend to listen for the signals are urged to take every possible precaution against radiation from their signals by using a separate heterodyne far removed from the aerial circuit, in the manner that has already been outlined in recent issues of the *Wireless World and Radio Review*.

Notes.

London University Union.

On November 7th, Lord Haldane opened the University Union. A wireless concert was part of the programme.

Broadcasting in Argentina.

Transmissions from the Coliseo Theatre, Buenos Aires, have been greatly increased in power. An Italian Company recently rendered "The Geisha," which was an excellent transmission and highly appreciated by the wireless enthusiasts and others who listened in. The number of amateur transmissions in the Buenos Aires district has increased and now some commercial firms give regular transmissions. A suggestion has been made that British apparatus might find a market in Argentina.

550 Pairs of 'Phones Used at one Reception.

When the Finchley and District Wireless Society listened in to the Lord Mayor of Bristol's broadcast speech, two halls were used and 550 pairs of 'phones were used. The reception was effected on an indoor aerial. A demonstration and lecture was part of the programme, and loud speakers were used.

A Boys' Club Station.

A small receiving station has been established at St. Michael's Schools, Buckingham Palace Road, for the benefit of St. Michael's Boys' Club.

Local Demonstration at Gt. Crosby.

Mr. S. Frith, founder of the Liverpool Wireless Association, assisted by Messrs. J. A. Barton and C. Pellak, conducted a demonstration at a Bazaar at St. Luke's Church, Gt. Crosby. A temporary aerial had been erected. Mr. J. Jardine, Hall Road, transmitted excellent telephony and telegraphy.

French and North African Meteorological Services.

The following changes and additions have been made in the French and North African Meteorological Services, with effect from October 15th last:—

Eiffel Tower (FL) daily transmissions.—1. The French collective (synoptic report) messages at 0220, 0820, 1420 and 1920 G.M.T. are now sent on a 7,300 m. wave (C.W.). 2. The International collective report (including American stations) is now sent at 1005 G.M.T. on 2600 m. spark. 3. Additional reports (synoptic) from European and North African stations, and from ships in the Atlantic, are now sent out at 0400, 1600, 2100 G.M.T., wavelength 7,300 m. C.W. 4. "Agricultural meteors" are now sent daily at 0640, 1115, 1710, 2210 G.M.T. by telephony on 2,600 m.

Nantes (UA).—A meteorological report giving the general situation in North America, the Atlantic and Western Europe, with probable changes, is now sent at 1230 G.M.T. on 2,800 m. spark.

Médiouna (CNM). — Observations from five stations in Morocco, sent at 0845, 1430, 1945 G.M.T., on 5000 m. C.W.

Oran (FUK).—Messages at 0300, 0900, 1445, 2000 G.M.T. Now sent on a wave of 3,500 m. c.w. instead of 3300 m. C.W.

Bizerta (FUA).—Messages at 0315, 0920, 1520, 2020 on 5,150 m. C.W.

Transmissions of Telephony by the Eiffel Tower.

The following transmissions of telephony by the Eiffel Tower Station now take place on a wavelength of 2,600 metres:—

G.M.T.

0640 Weather forecasts, by districts, for France.

1115 Reports of General Meteorological situation, General Forecasts, and forecasts for Winds on French Coasts.

1710 General Forecast by Districts.

2210 General Meteorological Report,
General Forecasts,
Forecast of Winds for the French Coasts.

1720 After the forecast message (1710) a Radio Concert is transmitted.

Commencing on November 25th the 1710 transmission and the Concert at 1720 will be changed as regards times to 1820 and 1830 hours respectively. The duration of the Radio Concert is half an hour maximum.

Change of Address.

Messrs. Burndept, Ltd., have removed their Leeds Offices to larger premises at London Assurance House, Bond Place, Leeds.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Recently I suspected that the dual amplification (two-valve and crystal) circuit I was using was not as efficient as it ought to be. The circuit in use is described by me in *The Wireless World and Radio Review* of May 27th, 1922.

As a test for sensitiveness I tried on October 15th to receive **PCGG** on my 4-ft. frame with 17 turns, in order to compare the strength with the strength I used to get a year ago. **PCGG** was so loud that it was just audible all over the room with the telephones hooked on to the trumpet. This was so encouraging that I changed over to the single valve dual and crystal circuit (described in the issue of *The Wireless World and Radio Review* previously referred to), and succeeded in receiving **PCGG** with only a single valve.

To make sure that the reception on October 15th was not a freak, I repeated the experiment to-day, and again received **PCGG** on the frame quite easily with a single valve, so loud that even the voice of the speaker could be recognised.

On the 100-ft. aerial, using the two valve dual and crystal circuit plus one valve note magnifier, and hanging the loud speaker out of the window, **PCGG's** music was audible 100 yards from the loud speaker.

It would be interesting to know if the above results are records or not.

London, S.E.23.

P. G. A. H. VOIGT.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I notice in your current issue some details of transmission from English amateurs being heard at Nice. If it is of any interest, we have been working regularly for some weeks, to a man at Geneva, who reports signals very strong, audible all over the room. Current in aerial from 0·75 to 0·9 ampere. Receiver, three valves (detector and two note magnifiers). Also received very strong in Paris on a single valve, the aerial there being very short and badly screened by high buildings all round.

H. H. T. BURBURY (**2 AW**).

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—As a Wireless amateur who has been very much interested in and derived considerable pleasure and mental profit from the telephonic transmissions of **FL**, and in pursuance of an idea which had been in my mind for several months, I wrote to General Ferrié on the 25th October, suggesting that it would be a fine thing if he could see his way to grant permission for a wireless Commemoration Service to be transmitted from the famous station on the evening of Armistice Day, November 11th, so that the wireless amateurs of the Allies, with their circles of friends—ex-Service and civilian—could join in simultaneous homage to the great ones who gave their lives for freedom in 1914-1918.

With the suggestion, I send a proposed programme.

I was delighted to receive a kind letter from the General, under date of 31st October, expressing his warm approval of the idea and conveying the intimation that he would communicate with Commandant Jullien, Chief of the Eiffel Tower Wireless Service.

On the 10th inst., I received a letter from Commandant Jullien in which he intimated that he would be happy to organise the transmission which would commence at 21·30, but unfortunately, the intimation came too late for announcement in the *Wireless World and Radio Review*.

I presume that many of your readers were, like myself, privileged to join in the fine wireless service which was transmitted, and trust that I echo the wishes and sentiments of them all when I express the wish that the service, which one might characterise as of international character and significance, will be only the first of a series.

VERNON I. N. WILLIAMS.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I see in the last issue of the *Wireless World and Radio Review* that Mr. Deloy has heard several British amateurs—using an aerial wire of 160 metres.

As I wrote it to the owner, Mr. Burbury of Wakefield, I hear the station **2 AW** very easily with the following apparatus: aerial 20 metres long, *steel* wire (0.6 m.m. diameter) well under the level of the surrounding roofs.

My set is home-made and consists of a Reinartz Tuner (modified) or an ordinary regenerative receiver (tuned plate circuit), and *only one detecting valve* (French "Metal").

Mr. Burbury told me his output is only 0.9 in the aerial.

I very often hear British amateurs on telegraphy and telephony but they are hardly readable, due to very marked fading. (My station is located in the centre of Paris and a big railway station is between England and my aerial—fading due to smoke ?).

So, you see that the reception in France of British amateurs transmissions is not such a difficult job.

Paris.

J. PERROUX, ENG. E.S.E.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I am very happy to give you the following report of reception of British amateurs.

My receiving set consists of:

Aerial loop 2.50 metres × 2 metres consisting of *one* turn of 12/10 copper wire, variable condenser 0.0005 mfds., Detector valve with reaction coil and note magnifying valve.

40 volts high tension battery was used and no filament rheostat or grid potentiometer.

The telephones are "Ducietet" make. On November 1st, between 8 p.m. and 9 p.m. I could hear **2 KF**, who came in very loud and clear, and **2 NM, 2 AF, 2 AW** (telegraphy).

On November 5th, **2 DO** (not very constant.)

I would be very much obliged to you if you would congratulate the British amateurs I heard so well. I am situated in the centre of Paris, between a great number of very high buildings and without any external aerial, on the first floor of the house.

I hope to answer the British amateurs in a few weeks, and I look forward to the opportunity of speaking to them by telegraphy and telephony.

P. BUTEY.

Paris,
November 7th, 1922.

Wireless Society of London Accounts.

The Treasurer of the Wireless Society of London states that the account and receipt books are closed for annual audit until December 1st. He is, therefore, unable to answer queries relating thereto until after that date.

Calendar of Current Events

Friday, November 24th.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
At 8 p.m. Demonstration of "Burndept Apparatus," by Messrs. Townend and Phillips.

WIRELESS SOCIETY OF HULL AND DISTRICT.
At 7.30 p.m. Sale of Surplus Apparatus at the Signal Corps H.Q., Park Street.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.
Lecture on "The Armstrong Super-Regenerative Receiver," by Mr. C. E. Morris.

SMETHWICK WIRELESS SOCIETY.
Lecture on "Alternating Current Applied to Generating Stations," by Mr. R. H. Parker.

Saturday, November 25th.

THE RADIO SOCIETY OF HIGHGATE.
At 7.30 to 11.30 p.m. At the Gate House, Highgate, N.6. Radio Dance. Fancy dress optional. Prizes. Tickets 7s. 6d. (double 12s. 6d.).

Sunday, November 26th.

Daily Mail Concert from the Hague, 3 to 5 p.m.

Monday, November 27th.

IPSWICH AND DISTRICT WIRELESS SOCIETY.
At 8 p.m. At 55, Fonnereau Road. Lecture by Mr. Mellor.

Tuesday, November 28th.

Transmission of Telephony at 8 p.m. on 400 metres, by **2 MT** Writtle.

PLYMOUTH WIRELESS AND SCIENTIFIC SOCIETY.
Lecture on "Elements of Alternating Current Theory," by Mr. E. W. Pinney.

Wednesday, November 29th.

MALVERN WIRELESS SOCIETY.
Lecture on "Electrostatics and Condensers."

EDINBURGH AND DISTRICT RADIO SOCIETY.
At 8 p.m. At R.S.S.A. Hall. Lecture on "Some Notable Inventions," by Mr. J. S. Smith.

PLYMOUTH WIRELESS AND SCIENTIFIC SOCIETY.
Demonstration of Reception at Y.M.C.A., Union Street.

Thursday, November 30th.

HACKNEY AND DISTRICT RADIO SOCIETY.
At Y.M.C.A., Mare Street. Lecture on "Electrical Units and Ohms Law," by Mr. F. G. Francis.

OLDHAM LYCEUM WIRELESS SOCIETY.
Lecture on "Amplifier Characteristics," by Mr. A. T. Howes, of Manchester.

LUTON WIRELESS SOCIETY.
At 8 p.m. At Hitchin Road Boy's School. Lecture on "Valves," by Mr. R. Cox.
Daily Mail Concert from the Hague 8 to 9 p.m.

DERBY WIRELESS CLUB.
At 7.30 p.m. At "The Court," Alvaston. Informal Meeting.

ILFORD AND DISTRICT RADIO SOCIETY.
Lecture on "Reaction and how to keep within the P.M.G.'s Restrictions," by Mr. J. F. Payne.

Friday, December 1st.

BRADFORD WIRELESS SOCIETY.
At 5, Randallwell Street. Lecture by Mr. Liardet.

MANCHESTER WIRELESS SOCIETY.
At 7.30 p.m. At Houldsworth Hall. Lecture on "Radio Measurements and Measuring Instruments," by Mr. Bertram Hoyle, M.Sc.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
At 7 p.m. Lecture on "Construction of Condensers—Fixed and Variable," by Mr. S. Kniveton.

NEWCASTLE AND DISTRICT AMATEUR WIRELESS ASSOCIATION.
At 7.15 p.m. At Engineering Theatre, Armstrong College. Lecture on "Some Observations on Distortion in Wireless Telephony," by Mr. W. Owen.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.
Lecture on "Common Faults in Receiving Circuits," by Mr. A. H. Norman.

Saturday, December 2nd.

CROYDON WIRELESS AND PHYSICAL SOCIETY.
At 7.30 p.m. Annual General Meeting and lecture on "Small Rectifiers for Charging from A.C."

Books Received

DIRECTION AND POSITION FINDING BY WIRELESS. By R. Keen, B.Eng.(Hons.). (London: *The Wireless Press, Ltd.*, 12/13, Henrietta Street. W.C.2. Illustrated. Price 9s.net.)

WIRELESS: POPULAR AND CONCISE. By Lt.-Col. C. G. Chetwode Crawley, R.M.A. (London: Hutchinson & Co., Paternoster Row, E.C. Illustrated. 92 pp. Price 1s. 6d. net. $7\frac{3}{4}'' \times 5''$.)

WIRELESS TELEPHONY SIMPLY EXPLAINED. By R. W. Hallows. (London: C. Arthur Pearson, Ltd., Henrietta Street, W.C.2. Illustrated. 125 pp. Price 2s. 6d. nett. $7\frac{1}{4}'' \times 4\frac{3}{4}''$.)

Official List of Radio Stations of Canada.

We have just received from the Radio Telegraph Service, Department of Marine and Fisheries, Ottawa, a copy of the official list of radio stations of Canada.

This list includes not only the commercial stations, but also all amateur experimental stations and broadcasting stations, and, in addition, it contains particulars of the procedure of working of direction-finding stations, together with a list of International Morse Code abbreviations.

Supplements to this list can be obtained by filling in a postcard with accompanies each book. Being of the loose-leaf pattern, these supplements can easily be added from time to time as they are issued.

The price of the list is 5s., and copies are obtainable from the publishers of this journal.

Wireless Club Reports

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

Walthamstow Amateur Radio Club.*

Hon. Secretary, Mr. R. H. Cook, 30, Ulverstone Road, Walthamstow, E.17.

On October 15th, Mr. Nickless, **2 KT**, gave a very successful demonstration of telephony reception on his five-valve set with loud speaker.

2 LO came through splendidly, as did also **2 ON**, who kindly transmitted music and speech for this occasion. At the end of the demonstration Mr. Nickless replied to many questions.

Mr. A. J. Smith gave a lecture the week previous on "Alternating Current and the Thermionic Valve" ably assisted by Mr. Allen, he cleared up many debateable points.

The Club is now affiliated to the Wireless Society of London and membership is steadily increasing. The Club was originally formed on October 1st, 1920.

Hackney and District Radio Society.*

Hon. Secretary, Mr. E. R. Walker, 48, Dagmar Road, Hackney, E.9.

An informal meeting was held at the new headquarters (the Y.M.C.A., Mare Street, Hackney, E.8), on November 2nd. The first unit of the Society's wireless set, made entirely by amateurs of the Club, was installed. It permits of the use of valve or crystal detection. Further units are in the course of preparation. With the aid of a three-valve Mark III L.F. amplifier, kindly lent by a member, telephony was very well received. The Society's set is as far as possible being built by means of contributions in the form of money or apparatus.

On November 9th, a special General Meeting was held.

On November 16th a debate on valves and crystals took place between Mr. Valins and Mr. Bell.

Mr. F. G. Francis will lecture on "Electrical Units and Ohms Law" on November 30th. Visitors are cordially invited.

Luton Wireless Society.*

Hon. Secretary, Mr. W. F. Neal, Hitchin Road Boys' School, Luton.

The third winter session was opened on October 5th by a public lecture and demonstration by Mr. W. B. Cole, of Marconi Company, on "Modern Wireless Telegraphy and Telephony," and a large public hall was filled. The Mayor of Luton was Chairman. Lantern slides were used. During the evening telephony and music were received and highly appreciated.

A Practical Class for instruction and experiment is held fortnightly under the direction of Messrs. A. E. King, F. W. Pellant, and the Hon. Secretary, a workshop being available on the premises through the courtesy of the local Education Authority. A single valve receiver is being constructed and experiments on different circuits, etc., are conducted.

On October 19th Messrs. B. & A. Wireless Company, of St. Albans, exhibited and demonstrated with a Burndept Ultra 4.

The second monthly lecture was given by Mr. C. S. Dunham, of the Wireless Society of London, on "H.F. Transformers and Couplings." This lecture was one of the most technical and instructive the Society has had the pleasure to hear. Very excellent results were heard on a three-valve receiver.

Morse practice under the direction of Mr. R. H. Cox, precedes all meetings from 7.30 to 8 p.m.

By an amendment to the rules, membership is forfeited when the annual subscription of 5s. is one month overdue. Membership increases steadily, new apparatus has been added to the club set, and a loud speaker is now available for members' private use.

Radio Experimental Association. (Nottingham and District).*

Hon. Secretary, Mr. D. F. Robinson, 99, Musters Road, West Bridgford, Nottingham.

At the new headquarters, Bennett's Garage, on November 2nd, Mr. Thornton occupied the chair, and Mr. Carpenter lectured on "The Valve as a Detector," assisted by Mr. Ford, who demonstrated.

Mr. Carpenter dealt with spark transmission, spark rectification, and the valve as a detector. Experiments were made with potentials applied to the grid, also various values of grid leaks and condensers, using Marconi-Osram "R" type and Mullard "Ora" valves.

Meetings are held every Thursday.

Borough of Tynemouth Y.M.C.A. Radio and Scientific Society.*

Hon. Secretary, Mr. Geo. J. S. Littlefield, 37, Borough Road, North Shields.

The third session opened on October 2nd, when the Hon. Secretary gave a short talk on "Aerial Construction." He described the different kinds of aerials in use and explained why certain types were to be preferred for given conditions. He showed specimens of various kinds of insulators and wires, and gave a great deal of valuable information to beginners. A number of questions were asked and answered.

On October 9th, Mr. W. G. Dixon, of the Newcastle and District Amateur Wireless Association was to have lectured, but owing to unforeseen circumstances was unable to do so. Mr. Littlefield stepped into the breach and gave a very interesting talk on the "Sterling No. 1 Aircraft Transmitter." The instrument was described in detail.

The lecture was followed by an interesting practical demonstration.

Mr. Scott demonstrated the "Ducon" appliance.

On October 16th, Mr. E. C. Lythgoe gave an exceedingly interesting talk on "Trench Communication." He described and illustrated with blackboard sketches, the various means employed during the war for maintaining communication between the front line trenches and headquarters. A hearty vote of thanks was accorded Mr. Lythgoe.

Belvedere and District Radio and Scientific Society.*

Hon. Secretary, Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

The tenth general meeting was held at the Erith Technical Institute, on November 3rd.

Recommendations of the Committee meeting held on October 31st were confirmed, viz. :— That ladies should be admitted as members of the Society on the same terms as gentlemen members, and that "Broadcast" members should be included at a reduced subscription.

It was decided to purchase a loud speaker. The equipment engineer was asked to proceed with the construction of a wavemeter.

Mr. S. G. Meadows delivered his paper on "The Electron Theory as Applied to the Thermionic Valve." The lecturer dealt with the structure of the molecule, and of the atom according to the now generally accepted electron theory, demonstrating his points as he went along on suitable apparatus.

At the conclusion of the lecture, the Chairman (Mr. T. E. Morriss) added a few appropriate remarks and accorded a vote of thanks for such an interesting and instructive paper.

Coventry and District Wireless Association.*

At the Club Rooms, 128, Much Park Street, on November 1st, Mr. Sidley, the President, gave a short address on general subjects connected with wireless telegraphy, which was followed by discussion.

Mr. Sidley appealed to all members using reactance to revise their circuits. The only permissible arrangement was, he said, to couple the reactance coil with a secondary coil of a closed circuit inductively coupled to the aerial coil. He offered to deal with any difficulties which might present themselves to members in converting their apparatus to the standard permissible form.

Mr. Sidley referred to his experiments in "wired wireless."

These remarks led to some interesting discussions.

Considerable interest was shown in the President's remarks upon apparatus embodying the Armstrong regenerative principle, and it was hoped to give fuller particulars of this apparatus at a subsequent meeting. Discussion on the use of frame aerials followed.

Manchester Wireless Society.*

Hon. Secretary, Mr. Y. W. P. Evans, 2, Parkside Road, Princess Road, Manchester.

A very interesting lecture was given by Mr. P. C. Stephens on "Electricity, Past and Future," in which he dealt with electrical progress from its earliest inception. An interesting discussion followed.

On November 1st, Mr. Y. W. P. Evans gave the first of his series of elementary lectures and dealt thoroughly with simple crystal circuits and also combinations of crystal and valve.

All technical matter was entirely eliminated and the various actions explained in everyday language, suitable for those just taking up wireless experimenting.

The high power transmitting valves for the transatlantic tests have been received and are being tested preparatory to erection. Four special tests with a 1-kW. spark set are being carried out on each Sunday morning in November from 1 a.m. to 7 a.m., G.M.T., the actual transmission being for a duration of the first 15 minutes in each hour. Call letter, **5 MS.**

Extraordinary results are being obtained with the Society's 10-watt set, and the benefit thus gained will be used in conjunction with American tests.

A special section of the Society is being devoted to "Broadcasters," for whom lectures are being arranged at a special fee, with a view to training them to become real experimenters.

East London Radio Society.*

Hon. Secretary, Mr. W. G. Simmonds, 60, East Ferry Road, E.14.

On October 17th Mr. Keens was unable to give the second half of his lecture on "Coils," being unavoidably absent, and October 24th was fixed for this event. Members listened in to **2 MT** and other transmitters. **2 FQ** was received very well.

Mr. W. C. Wells explained the Society's apparatus in detail to new members and visitors. Visitors are welcomed on Tuesdays and Fridays, from 7.30 p.m. to 10 p.m.

Fulham and Chelsea Amateur Radio and Social Society.*

Hon. Secretary, Mr. W. Wood, 48, Hamble Street, Fulham, S.W. 6.

A satisfactory and instructive meeting was held on October 31st.

The Secretary gave a lecture on "Elementary Inductance," and Mr. Whitts, assisted by the Secretary, gave an explanation of the cause of "dead spots" found in different countries. A hearty vote of thanks was passed to the Secretary.

A reception set for the use of the Society is in course of construction, and the necessary licence applied for.

Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford.

An informal meeting was held on November 3rd. A discussion took place on the "Evils of the Oscillating Valve." The principal speakers were Mr. A. Liardet and Mr. J. Bever, who both dealt very ably with the subject and explained the various methods by which "howling" could be avoided. Questions were invited and ably dealt with.

Arrangements are now in progress for the Society's Exhibition, which is to be held in January. Any firms desirous of exhibiting should communicate as early as possible with the Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds. All applications for space will be promptly dealt with.

Sutton and District Wireless Society.*

Hon. Secretary, Mr. E. A. Pywell, Stanley Lodge, Rosebery Road, Cheam, Surrey.

The Society is now affiliated with the Wireless Society of London, and the membership is steadily increasing.

At the meeting held on November 1st, the President, the Rev. F. C. Lees, gave an interesting account of his experiences with a Mark III* tuner in conjunction with a high frequency amplifier and tuned anode coupling, with which he obtained some very remarkable results.

An attractive programme is being arranged for the winter months, and it is hoped that a good attendance will result.

Bishop's Stortford and District Amateur Wireless Association.*

Hon. Secretary, Mr. J. Cooper, Halfacres, Bishop's Stortford.

The monthly meeting was held at the Institute, Bishop's Stortford, on November 3rd, the Vice-President, Councillor E. F. Cooper, occupying the chair. The President, Mr. W. A. Field, gave an address on "Aerials." Various types of aerials were described and shown in diagram, and their erection, construction, capacity, directional properties, etc., dealt with. The materials best suited for the purpose were indicated, and methods of jointing demonstrated. Specimens of the best types of insulators were passed round for inspection, and a special form of lead-in tubing shown.

The Chairman announced that the Society had become affiliated with the Wireless Society of London. A vote of thanks was accorded Mr. Field.

General meetings are held on the last Friday in every month.

Radio Society of Highgate.*

Hon. Secretary, Mr. J. F. Stanley, A.C.G.I., B.Sc., 49, Cholmeley Park, Highgate, N.6.

Mr. L. Grinstead, on October 20th, lectured on "Valve Characteristics and Design," illustrating by means of characteristic curves.

On October 27th a paper was read by Mr. S. Croneen on "The Magnavox Equipment." The general features and internal construction of the loud speaker and amplifier were described.

A lecture on "A Simple Wavelength Calculator" was given by Mr. F. Stanley on November 3rd. This calculator is in the form of a chart which shows at a glance the solution of the expression

$$\lambda = 1{,}885 \sqrt{CL}$$

There are still a few tickets left for the Radio Dance (see Calendar).

Finchley and District Wireless Society.*

Hon. Secretary, Mr. A. E. Field, 28, Holmwood Gardens, Finchley, N.3.

On November 3rd the broadcast speech of the Lord Mayor of Bristol was received. Two halls were used, one holding 300 people and the other 250. The Marconi Telegraph Company sent a representative with apparatus, and the Stirling Telephone Company supplied two Magnavox loud speakers. Mr. Turner, of Regent Street Polytechnic, conducted the demonstration, giving two lectures, one before and one after. Every person present had a pair of 'phones, the wiring being entirely done by members. A Marconiphone U.2. and a Marconi amplifier were used in conjunction with an indoor aerial for the reception. The Society met on November 6th, when Mr. Grinstead, of the Mullard Radio Company, lectured on "The Valve and its Applications."

Southend and District Wireless Club.*

Hon. Secretary, Mr. C. G. Jackson, Lynncroft, Leigh Hall Road, Leigh-on-Sea.

Meetings are held every Friday at 8 p.m. at 51, Princes Street. On October 6th, Mr. Mayer **(2 LZ)** lectured on the "Elimination of Reradiation." He pointed out the trouble caused by the careless use of reaction, and explained that the three-circuit tuner may reduce interference considerably provided the reaction coil is coupled to the secondary.

At a subsequent meeting Mr. Mayer gave a lecture on "The Reinartz Tuner."

Mr. R. Brockbank gave a very interesting discourse on "Valves and their Characteristics" at the meeting held on October 27th. The lecturer showed how the characteristics were obtained, and explained their use.

Ilford and District Radio Society.*

Hon. Secretary, Mr. A. E. Gregory, 77, Khedive Road, Forest Gate, E.7.

Under the auspices of the above Society, demonstrations of wireless telephony were given in aid of Church Funds at the Seven King's Baptist Church, on November 2nd, 3rd, and 4th. Telephony was successfully received from Marconi House, **2 ON** and **2 JX.** The loud speaker was loaned by Messrs. Radio Instruments, and the necessary batteries by Messrs. Fullers.

Bedford Physical and Radio Society.*

Hon. Secretary, Mr. C. W. Clarabut, 194, Castle Road, Bedford.

Meetings were held as follows:—

May 27th. Mr. R. W. L. Phillips was Chairman. The name of the Society was decided upon. It was then proposed by Mr. Craddock and seconded by Mr. Tearle, that Mr. R. S. Allen be asked to be President.

The following officers were then elected:—Vice-Presidents: Messrs. L. Bolton, Willmer Phillips, C. W. Hansel, R. W. L. Phillips. Hon. Secretary, Mr. C. W. Clarabut; Hon. Treasurer, Mr. C. E. Craddock; Committee: Messrs. B. F. Skinner, R. T. Rolfe, P. S. Hudswell, W. S. Pyrah, L. G. Noble, W. S. Tearle, A. H. Mackley, P. H. S. Kempton.

The subscription was fixed at 10s. per annum.

It was resolved: That the Society should meet fortnightly on such day or days as may be fixed at a later meeting; That the Society be devoted entirely to radio work for the present; That the Society be affiliated to the Wireless Society of London; That Mr. R. W. L. Phillips be deputed to approach Messrs. Wilton & Co., with a view to their abandoning the project of a new club, and the intending members joining this existing Society.

A vote of thanks was passed to Mr. Phillips.

June 24th, 1922. The Rev. H. W. Evans took the chair.

The minutes of the meeting held May 27th were confirmed and signed. The rules were taken as read, and unanimously approved. An amendment that S.1., Rule 3, be altered to include ladies as members, was lost.

It was resolved that a lecture and demonstration be arranged for July 11th, admittance to be by invitation tickets.

A lecture and demonstration by Captain H. Anthony Hankey, of Marconi's Wireless Telegraph Company, Ltd., took place on July 11th in the Bedford Modern School. Over 400 were present. A special concert was received from **2 LO,** also music from **2 MT.** The lecturer used his own apparatus. The President, Mr. R. S. Allen, proposed a vote of thanks to the lecturer, which was seconded by Sir George Royle, O.B.E.

There were 48 members present on July 25th. Mr. R. W. Phillips took the chair. Mr. W. S. Pyrah and Mr. W. S. Tearle lectured on tuning and elementary valve practice. Mr. C. W. Clarabut transmitted musical items from his experimental station **2 WD.**

Hoylake, West Kirby and District Wireless Association.

Hon. Secretary, Mr. Roper Brattan, 14, Kirby Park, West Kirby.

A general meeting was held on October 23rd, at the Green Lodge Hotel, Hoylake. In the unavoidable absence of Mr. Welding, the chair was taken by Mr. S. Evans, Technical Adviser to the Association, who announced in the course of his opening address that a stage of H.F. amplification, designed by Mr. Brattan, was being added by the Committee to the three-valve set then in use, and it was hoped that this would be in action by the next meeting.

Mr. Roper Brattan, with the aid of blackboard diagrams, then gave a very helpful list of various symbols used in wireless work, together with a particularly clear explanation of the variometer type of tuning and of crystal and single valve sets. Specimens of the latest Marconi valves were very kindly loaned by a member for inspection.

A vote of thanks was accorded the lecturer. Individual difficulties were then dealt with, a member's inductance coil being discussed and valuable improvements suggested by Mr. Brattan.

Newton-in-Makerfield and District Radio Society.

Hon. Secretary and Treasurer, Mr. R. W. Mayhew, 220, Earle Street, Earlestown.

A meeting took place in the All Saints' Mission Room, Crow Lane, Newton-le-Willows, on October 25th, Mr. Goff being in the chair.

The Chairman reported success in obtaining the use of a room in the Newton-le-Willows Cricket Pavilion for the winter months, and that the weekly meetings would commence there on Wednesday, November 8th, at 7.30 p.m. A discussion followed as to the programme, and Mr. Norman, the Vice-President of the Society, kindly consented to give a short address on "The General Principles of the Theory of Wireless Telegraphy and Telephony," and Mr. Goff a short address on "The Various Types of Circuits Suitable for Beginners' Use."

Mr. Smith gave an informative speech on "Wireless Licences," and pointed out that there were two kinds, the Experimental and the Broadcasting, and dwelt on the fact that in the case of the latter no changing of the circuit could be contemplated, and a ready-built set must be purchased made by a firm associated with the Broadcasting Company. He strongly advised all members to apply for experimental licences, by the possession of which they would be able to make their own sets and experiment with different circuits. Mr. Newall gave his personal experience in the matter of experimental licences and correspondence he had had with the Postmaster-General on the subject of aerials.

Mr. Goff gave a brief idea of the capabilities of one or two types of circuits, and said the Broadcasting Station would be open at Manchester very shortly, and should be received quite well on a good crystal set.

New members were enrolled.

Radio Society of Birkenhead.

Hon. Secretary, Mr. R. Watson, 35, Fairview Road, Oxton, Birkenhead.

The opening night of the above Society was held on Tuesday, November 21st, at 8 p.m., at 36, Hamilton Square (top floor), Birkenhead. A demonstration of telephony was given, and various parts of radio apparatus belonging to members were exhibited and demonstrated.

Application forms for membership were handed round during the meeting. Affiliation to the Wireless Society of London is being applied for. Subscriptions are: 10s. for members over 18, 5s. for members under 18, and 2s. 6d. for lady members. All subscriptions should be sent direct to the Hon. Treasurer, Mr. G. A. King, 17, Kingsland Road, Birkenhead.

Hartlepools and District Wireless Society.

Hon. Secretary, Mr. Robert L. Howey, 33, Grange Road, West Hartlepool.

On October 10th a very interesting lecture was given on "Wireless Control," by Mr. G. Wenn. A model ship contructed by Mr. Wenn was used to demonstrate. This ship was built and worked nearly fourteen years ago.

The lecturer also mentioned the wireless control of airships.

Mr. Patterson, President of the Society, proposed a hearty vote of thanks to Mr. Wenn, and congratulated him upon building his model ship.

The proposal was carried with applause.

An interesting syllabus of lectures and events has been prepared for the coming winter.

The Society asks for lecturers.

Manchester Radio Scientific Society.

Hon. Secretary, Mr. H. D. Whitehouse, 16, Todd Street, Manchester.

The Annual General Meeting was held on October 13th, Mr. G. G. Boullen being in the chair. After the minutes of the last annual general meeting, October 19th, 1921, had been read and passed, the Secretary gave his report of the year's work, and also read some correspondence of the Wireless Society of London. Questions on the subject matter were then invited and duly answered. The meeting proceeded with the revision of rules, and also discussed the question of how to meet the coming wireless boom. The election of officers for the forthcoming session was taken in hand, and the following gentlemen were re-elected:—Chairman, Mr. G. G. Boullen: Hon. Secretary, Mr. H. D. Whitehouse; Hon. Treasurer, Mr. J. R. Halliwell; Press Secretary, Mr. J. W. Hand.

An ordinary meeting was held on October 25th. The minutes of the annual general and the last ordinary meeting were read and passed, the new rules formulated coming into force. Four new members were duly elected. Suggestions were received by the Committee for the holding of meetings weekly instead of fortnightly as hitherto, every alternate Wednesday being left open for new members, especially those just beginning, to receive help and advice from older experimenters. The Society is laying itself out to assist the newcomers, and hopes that interested people will not fail to communicate with the Secretary. Mr. J. R. Halliwell then gave "His Impressions of the All-British Wireless Exhibition," which proved of great interest. The lecturer concluded with a frame aerial demonstration, using a three-valve set. The Metropolitan Vickers Station, Manchester **(2 ZY)** came through very well.

Bromley Radio and Experimental Society.

Hon. Secretary, Mr. J. Furgusson-Croome, Gowrie, Wendover Road, Bromley, Kent.

A meeting was held on November 1st at the Club-room, Ex-Service Men's Club, London Road (permanent headquarters). Meetings will be held on Mondays, at 7.30 p.m. An interesting lecture or demonstration has been arranged for every meeting this year.

The Secretary introduced Mr. L. Stopes (Chairman of the Society), who gave an instructive and interesting lecture on "Primary Cells and Accumulators." A representative collection of cells kindly loaned by Messrs. Siemens Bros., of Woolwich, showed the practical application of the lecturer's remarks.

Plymouth Wireless and Scientific Society.

Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

A joint meeting of the Society and of the Junior Institute of Engineers was held on October 31st. A lecture was given by Mr. G. H. Lock on "Wireless Reception." The lecturer referred to the pioneer work of Carl Hertz, Branley and others. The principles of tuning were explained, and the magnetic and crystal detectors dealt with. The Edison effect, the Fleming two-electrode valve, and, ultimately, the three-electrode valve followed. A typical characteristic curve was shown, and the rectifying and amplifying points explained. Magnetic reaction and the reception of continuous waves completed the lecture. A demonstration followed, during which, by means of a seven-valve set, the lecturer was able to illustrate the principles of "beat" reception.

Ealing and District Radio Society.

Hon. Secretary, Mr. W. F. Clark, 52, Uxbridge Road, Ealing, W.5.

The new series of lectures has proved to be a valuable asset in attracting new members. On October 27th, the Society unanimously decided to forward a protest to the responsible authorities against the inadequate representation that the wireless experimenter has received at the meetings of the British Broadcasting Company held recently. They asked that the position of the *bona fide* wireless experimenter be more explicitly defined.

Sale, Altrincham, and District Radio Society.

Hon. Secretary, Mr. H. Fowler, Alston, Old Hall Road, Sale.

A Society has now been formed with headquarters at the Reform Club, Sale. It is proposed to form a ladies' section and also a junior section.

Portsmouth and District Amateur Wireless Society.

Hon. Secretary, Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

The fortnightly business meeting was held on November 1st. There was a fair attendance. Discussions took up considerable time, and the lecture by Mr. Harrold on "Wireless Telegraphy, Telephony Broadcasting," had to be curtailed.

Mr. Harrold is a master of his subject. He conveyed to the members the system of the earliest forms of transmitters. A hearty vote of thanks was accorded the lecturer.

Croydon Wireless and Physical Society.

Hon. Secretary, Mr. B. Clapp, "Meadmoor," Brighton Road, Purley.

At the Central Polytechnic, Croydon, on November 4th, Mr. S. H. Naylor lectured on "Hints to the Student and Teacher of Wireless Telegraphy." Mr. Naylor explained the easiest ways to study the subject, and emphasised his points with several analogies and demonstrations with simple models.

A keen discussion then followed, and the meeting terminated with a hearty vote of thanks to Mr. Naylor.

The next meeting, which will take place on Saturday, December 2nd, at 7.30 p.m., being the annual general meeting, it is requested that all members will endeavour to be present. There will be a lecture on "Small Rectifiers for Charging from A.C."

Wembley Wireless Society.

Hon. Secretary, Mr. W. R. Mickelwright, 10, Westbury Avenue, Alperton, Wembley, Middlesex.

On November 2nd, Mr. H. E. Comben gave a most interesting lecture on "Inductance and Capacity," and demonstrated with analogous mechanical apparatus. On November 9th, Mr. H. E. Wallis lectured on "Tuning and Tuners," and on November 16th members queries and difficulties were dealt with in a general discussion. The Society now has over 80 members, and a Junior Section has just been formed for the education and assistance of boys starting wireless. The age limit is 12 to 16 years.

A social evening is being arranged for Dec. 8th.

Plymouth Wireless and Scientific Society.

Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

At a meeting of the above, held on November 7th at Plymouth Chambers, a lecture on "High Frequency Amplification" was given by Mr. L. J. Voss. Starting with a lucid explanation of the amplifying region of the characteristic curve of a normal valve, the lecturer proceeded to describe the various methods of communicating the amplified impulses to the grid of the succeeding valve.

Seven new members were elected, bringing the present total membership up to forty-two.

Thames Valley Radio and Physical Association

Hon. Secretary, Mr. Eric A. Rogers, 17, Leinster Avenue, East Sheen, S.W.14.

Meetings now take place every fortnight at the Hut, Wigan Institute (one minute from Mortlake Station, L.S.W.R.) and interesting lectures are given each evening. Morse code is taught and through the kindness of several members, a four-valve set will shortly be installed.

Major-General Shaw and Dr. Mackintosh have just consented to become Vice-Presidents.

Broadcasting is specially catered for and every help given to beginners.

Trafalgar Wireless Society.

Hon. Secretary, Mr. F. H. Stanlake, Trafalgar Hotel, Greenwich, S.E.10.

The eighth weekly meeting took place on October 30th, at the above address. It was decided to proceed with the erection of an aerial and receiving apparatus for demonstration purposes. Mr. R. J. Stanley, the Society's instructor, gave a lecture entitled "Valve Reception and Amplification," which proved exceptionally interesting and instructive to beginners. Amateurs are welcomed every Tuesday evening at 8 p.m.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each questions should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

"E.S.W." (Manor Park) *asks (1) For a circuit employing 1 H.F. valve, crystal detector, and 1 note magnifier. (2) Which coils are the best to use in a circuit of this type.*

(1) See Fig. 1. The tuned anode method of H.F. amplifying is employed, and the crystal detector and L.F. transformer is connected across the anode and reaction coil, in order that the maximum amount of potential is available for the input circuit of the note magnifier. (2) You will find it very convenient to use a three-coil holder for the tuning and reaction coils, and for the anode coils we suggest plug-in honeycomb coils.

"B.H.R.S." (London) *asks (1) For a criticism of a set. (2) If it will respond to telephony. (3) The capacity of the variable condenser. (4) The wavelength of* **2 LO** *under various conditions.*

(1) The circuit is all right, except that 50 megohms is much too high for an anode resistance. It should be of the order of 50,000 ohms. Also, the leak

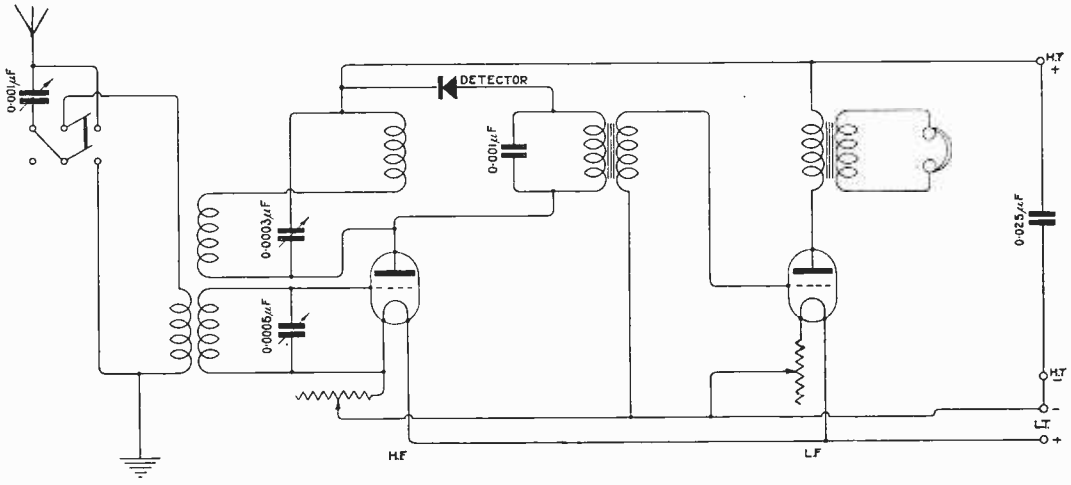

Fig. 1.

"A.W." (Harrogate)—We are afraid you cannot wind the transformer core to deal with 1 kW. if the frequency of supply is 50 cycles and the voltage is 200 volts. To ensure a reasonably small no load current you will require 600 turns of No. 18 D.C.C. wire, and this winding would more than fill up the window area available.

We suggest you use a transformer core with an area of cross section about 4 square inches, and if you would send us further particulars, we shall be pleased to calculate a suitable winding. We do not think you will be able to pass a current of over 2 amperes through the rectifier, and the safe voltage across each is about 40 volts. We suggest you connect four 200 volt 50 candle-power carbon filament lamps in parallel, and join the rectifier output in series with the lamps.

(1) The circuit is all right, except that 50 megohms is much too high for an anode resistance. It should be of the order of 50,000 ohms. Also, the leak resistance of the second valve should be taken to the filament of the valve instead of back to the plate of the first valve as shown. The choke coil in the anode of the second valve is not really necessary. (2) Yes, but as we have repeatedly pointed out, it is undesirable to use a parallel condenser on such short wavelengths. (3) The condenser should be about 0·0005 mfds. (4) The wavelength used by this station is always 360 metres. It is not changed at different hours of the day, as you appear to suppose.

"**SEEKER**" **(Holloway)** *asks for criticism of circuit submitted, and whether it is covered by patents.*

The circuit submitted is quite correct, and of course is covered by patents.

"**J.F.E.**" **(Cape Verde Isles)** *asks* (1) *For criticism of transmitting circuit submitted.* (2) *Range.* (3) *If set could easily be altered to transmit telegraphy.*

(1) We do not care for the arrangement. (See Fig. 2. (2) The range would be about 25 miles under the best conditions. (3) Unfortunately you have not much apparatus at your disposal, and we suggest you couple the microphone and a few turns of wire to the aerial inductance, or you could tap the microphone across a portion of the A.T.I.

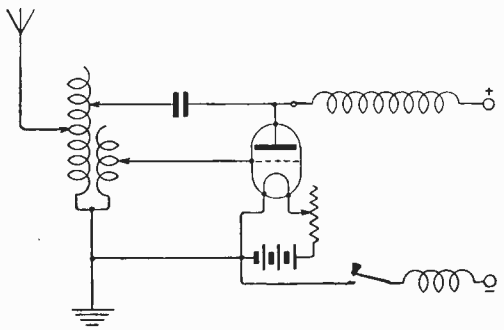

Fig. 2.

"**FRAME AERIAL**" **(Leicester).**—We suggest you employ the first aerial arrangement. It would be better if you could use an outdoor aerial, but you should receive signals with the proposed arrangement, although another H.F. valve will be required to make the signals of satisfactory strength. We think a three-valve set, using 1 H.F., 1 detector and 1 L.F. valves, will be required, and a suitable diagram is Fig. 4, page 147, October 28th issue.

"**SPARKS**" **(Swansea)** *is about to build a five valve amplifier set, and asks for an efficient wiring diagram.*

You will be able to obtain back numbers of this journal from the Mail Order Department, The Wireless Press, Ltd., 13, Henrietta Street, London, and we think you will experience no difficulty in choosing a circuit using five valves.

"**A.B.**" **(Bloomsbury)** *asks whether it is possible to obtain five-electrode valves such as described in Mr. Prangnell's article in our issue of June 24th last, and, if so, where they can be bought.*

We believe it is possible to get these valves, and we suggest you write to the valve manufacturers.

"**H.R.B.**" **(Holloway)** *asks* (1) *For correct values of condensers C2 and C3 described on page 714 of our September 2nd issue.* (2) *Whether a low temperature valve would be suitable for the super-regenerative circuit.*

(1) See reply to "**A.R.T.**" **(Derby)** *below.* (2) Low temperature valves are useless for this purpose. It is always better to use the valves for which the set is designed. Full constructional articles have appeared in the issues of October 21st and 28th.

"**A.R.T.**" **(Derby)** *asks* (1) *Correct values of condensers described on page 714 of our issue of September 2nd.* (2) *Whether inductance coil having 600 turns of S.W.G. wire round 3½" tube, and reactance having 145 turns of 30 S.W.G. will give good results.* (3) *Criticism of arrangement.* (4) *Whether his circuit is likely to receive sanction from the Post Office.*

(1) The correct value for the condenser is 0·0005 mfds. (2) The values proposed for L and L2 will do very nicely. (3) The proposed arrangement will not give any results. The loop should consist of 12 or 14 turns, spaced ¼" on a 3' former. (4) The loop is small, and although there may be oscillating energy in it, the energy radiated will be small. Considerable skill and experience is necessary before you can hope to successfully make satisfactory use of the Armstrong super-regenerative circuit. (4) We cannot say whether the Post Office will grant you permission to use this circuit.

"**G.N.W.B.**" **(Wisbech)** *asks questions about a transmitter.* (1) *Capacity of condensers.* (2) *Resistance of grid leak.* (3) *Size of frame aerial for 400 metres.*

(1) Grid condenser, A=0·002 mfds. Tuning condenser B=maximum value 0·001 mfd. By-pass condenser C=0·001 mfd. (2) The grid leak resistance should be about 30,000 w. (3) A suitable frame aerial for your purpose would consist of 12 turns of No. 16 wire, spaced ¼ in., wound on a frame 4 feet square.

"**J.B.B.**" **(Wolverhampton)** *asks* (1) *For criticism of his circuit.* (2) *The best ratio of L.F. transformer windings.* (3) *Best values of H.T. voltage.*

(1) The diagram submitted is correct, except that the reaction terminals should be between the anode and L.F. transformer primary. (2) The best ratio for L.F. intervalve transformers is 1 to 2 or 1 to 3. A high ratio transformer is useless if the primary impedance is low. (3) We suggest you use 60 volts, but you can alter this value if a little experimenting shows another voltage is suitable.

"**MACK**" **(Brixton).**—To connect up the amplifier to your single valve set, take out the telephones, connect the input transformer in the plate circuit of the single valve. If you have any difficulty, consult the diagrams which have recently appeared showing low frequency valves connected together.

"**P.B.**" **(Blackheath).**—(1) The suggested values are quite correct. (2) The disadvantage of a semi-aperiodic coil is tuning is broadened. (3) The first arrangement is better, and you should adjust the distance yourself, finding by experiment the most suitable position. (4) No condenser is required across the reaction coil, but a few tappings will be useful. We suggest you wind 60 turns of No. 38 D.S.C. wire.

"**E.T-B.**" **(Malta).**—(1) The number of turns of wire in the H.F. transformer is too low, and we suggest you make the transformers described in the issues of September 2nd, 16th and 23rd. For wavelengths above about 2,000 metres it is more convenient to use the resistance-capacity method. (2) The manufacturers do not publish the amplification factor of the valves to which you refer. (3) A full constructional article appeared in the issues of October 21st and 28th.

"A.S." (Southport) *asks certain questions about a crystal set.*

(1) About ½ lb. will be sufficient for the purpose. (2) The coil described will easily tune the circuit up to 4,000 metres with the value given below for the parallel condenser. (3) No. 1, 0·001 mfds.; No. 2, 0·0005 mfds.; No. 3, 0·002 mfds. (4) The circuit shown is quite good for a simple set. Somewhat better results would of course be obtained with a loose coupler, but this is by no means essential.

"J.M.P." (Euston).—(1) The type of set sketched is not at all efficient. Apart from various details, the arrangement of the crystal is almost useless. If used, it should be connected into the circuit as shown in Fig. 1, page 670, August 19th, and many other cases. Any ordinary receiving valve will be all right for this circuit. (2) There is no definite formula to determine the relation between the tuning coil and the reaction coil. The size of the latter depends chiefly on the electrical constants of the aerial, particularly its resistance, and those of the valve. (3) For a closed circuit wavelength in metres $= 1885 \sqrt{L \text{ mhys } C \text{ mfds.}}$ For an aerial circuit, in which the capacity of the aerial itself has to be reckoned with, the formulæ are not so simple. Formulæ applicable to a variety of cases will be found in various text-books, notably Nottage's "Calculation of Inductance and Capacity." (4) Apply to the Wireless Press, Ltd., for a full list of their publications.

"J.G." (Edinburgh).—(1) A circuit of the type sketched should work quite satisfactorily on all wavelengths, and those that you should be able to obtain are therefore only limited by the set of slab coils which you possess. (2) This behaviour is not very unusual. Coupling up the aerial adds damping to the circuits, which may quite possibly be sufficient to extinguish oscillations. All the evidence points to your aerial having rather a high resistance, and you should endeavour to improve this. (3) The wavelengths with the smaller condenser will be in each case approximately 4/5ths of the values with the larger condenser. (4) The only alteration necessary to improve results on wavelengths as short as are projected for broadcasting is the substitution of a series condenser for that shown in parallel with the A.T.I.

"C.M.L." (Deal) *asks* (1) *If successful results could be obtained in London with a loud speaker attached to a two-valve set.* (2) *What is the cost of a transmitting licence.*

(1) Such a combination should give quite useful results on **2 LO.** and possibly on amateur stations in the immediate neighbourhood, but it should not be expected to give loud speech from a large number of stations. The valves should preferably be used as detector followed by a stage of L.F. amplification. (2) £1 per annum.

"ENQUIRER" (London) *asks* (1) *Why it is that wireless signals have a greater range at night than they have in the daytime.* (2) *Where he can find an explanation of the phenomenon.*

(1) The generally accepted explanation is that during the day the upper layers of the atmosphere are in a state of disturbance owing to the action of the sun's rays. At night this disturbance no longer exists, and the upper layers settle down into more or less level strata, which have the property of reflecting back to the earth a great part of the signals which are dissipated and lost in the upper regions of the air during the day. A fuller treatment of this point will be found in most good text-books, and in particular the new book on directional wireless by Keen, recently published by the Wireless Press, Ltd.

"P.G." (Ireland).—(1) You should have as good a chance of getting this station with the set you mention as with anything on the market, but we doubt whether the reception is possible at the distance. (2) You might get Paris, and probably the broadcasting stations in the West of England when these come into operation.

"L.C.J.B." (Ealing) *asks* (1) *For a criticism of two sets.* (2) *Approximate current consumption of an "Ora" valve.* (3) *What the range of the sets mentioned above will be.* (4) *If either of the circuits are capable of receiving* **2 MT** *and the Dutch concerts.*

(1) The single valve set is all right except for the facts which we have to call attention to in nearly 50 per cent. of the criticisms which we give, viz., use of a parallel condenser on short waves is inefficient, and reaction back on to the aerial leads to serious radiation. The crystal arrangement in the other set is useless (see Fig. 3, page 537, July 22nd issue). (2) About ½ ampere. (3) They will not be allowed in the form shown. With reaction suitably modified they will give telephonic ranges of approximately 30 and 50 miles. Telegraphic ranges depend entirely on the power of the transmitting station.

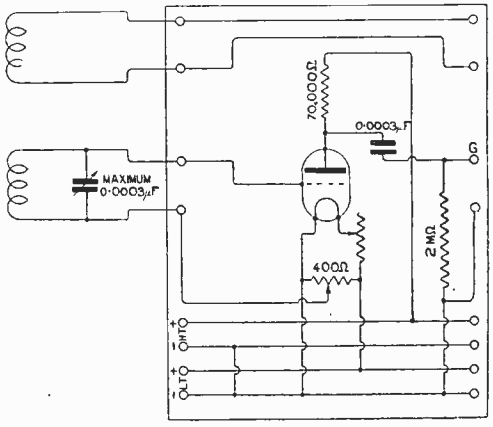

Fig. 3.

"ARUNDEL" (Liversedge) *asks* (1) *Whether circuit submitted will be approved by the Post Office.* (2) *Criticism of circuits.* (3) *Circuit for 440 m. wave spark transmitter using motor spark coil.* (4) *For circuit.*

(1) We do not think the Post Office will approve this circuit. The values suggested are correct. (2) The circuit (*a*) is better than circuit (*b*), because interference can be reduced. (3) We cannot give you details for a spark transmitter without further particulars. (4) See Fig. 3.

"J.S.F." (S.E.24).—The variometer which the author of the articles describing a super-regenerative receiver used was a simple variometer of American pattern. We suggest you write to manufacturers who advertise American pattern wireless components in the columns of this journal, stating your requirements.

"COUE" (Peebles) *asks* (1) *For criticism of his aerial and receiving set.*

(1) The aerial is quite suitable, and is in a very favourable position. The sketch of your receiving set submitted shows several wrong connections, and we suggest you rewire the set, using Fig. 4. The V.24 valves are clearly marked, and you should be sure to fit them to the valve holders correctly.

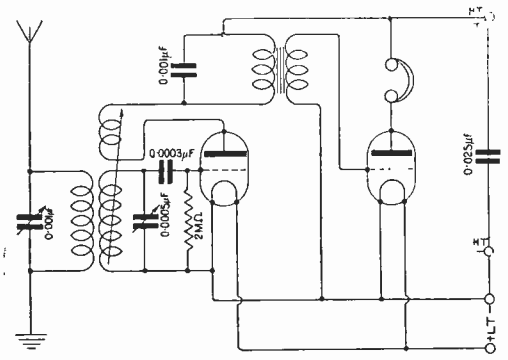

Fig. 4.

"INTERFERENCE" (Sheffield).—(1), (2) and (3). See recent issues. A good method is to use the reaction coil coupled with the anode coil, or secondary coil of the H.F. transformer. Several diagrams have been given, and you should choose one which suits your requirements.

"S.F.W." (Berwickshire).—(1) We suggest you use a four-valve set, 2 H.F., 1 detector, and 1 L.F. valve, as shown in Fig. 3, page 111, October 21st issue. (2) You will be able to make up a list of parts required, and estimate the cost yourself. (3) Your suggestion is correct, and we think if you make up the set as shown in page 111 you will be satisfied with the results. (4) We cannot say, but you should protect yourself by purchasing guaranteed apparatus from firms of standing. See our advertisement pages, and make a careful selection.

"A.C.R." (Twickenham).—(1) It is better to wire up your set with tinned copper wire, and not use the lighting flex. (2) When receiving short waves you should cut out a good deal of the reaction coil. Your reaction coil is apparently made for use on long waves, and you will not, therefore, require such a large reaction coil when receiving short wavelengths.

"J.A.P." (Yorkshire) *asks* (1) *The number of plates required for a variable condenser of capacity 0·001 mfd., 0·0005 mfd. and 0·0003 mfds. The moving plates are 2½" diameter, 0·028" thick, and spacing washers 0·125".* (2) *The capacities of condensers he has constructed.*

(1) You will require 93 plates for the 0·001 mfd. condenser, 47 for the 0·0005 mfd. and 29 for the 0·0003 mfd. (2) The condensers you have made will have capacities of 0·0005 mfd., 0·0003 mfd., and 0·00006 mfd.

"BUZZ" (Bexhill-on-Sea) *asks* (1) *How to add a valve to the circuit given to* **"W.V." (Fulham),** *September 19th issue.* (2) *What are suitable condenser values.* (3) *Whether the above circuit is capable of energising the aerial circuit.*

(1) We suggest you add one H.F. valve, using the tuned anode method of coupling. See Figs. 4 and 5, page 147, October 28th issue. (2) Suitable valves for the condensers are marked in the above figures. (3) The circuit referred to is capable of energising the aerial, and you will notice in Fig. 4, page 147, October 28th issue, the reaction coil is not coupled to the closed circuit, but to the tuned anode coil. Energy cannot be radiated to any serious extent from the aerial circuit when this arrangement is used.

"MAGNUS SPES" (Hornsey) *asks for a criticism of his circuit submitted.*

The proposed arrangement is quite suitable, and the connections are correct. The reaction coil may consist of 100 turns of No. 40 S.S.C. wire. Should you wish to receive long wavelength signals, you may find it necessary to add a small coil in series with the reaction coil.

"H.C.P." (Kent).—We suggest you abandon the scheme and use a normal method of switching. It is very bad practice to include jacks in H.F. circuits, unless the jacks are specially constructed to possess low capacity. Why not use the method of connecting shown on page 883, September 30th issue.

"W.G.P." (E.11) *asks us to criticise the diagram of connections submitted.*

The general arrangement of the apparatus is satisfactory, but we do not care for the method of using reaction. The reaction coil should couple with the anode coil of the first valve. You would also find it better to use a closed circuit. The circuit is easier to operate when the grid leak is joined to the + L.T.

"REGULAR READER" (Birmingham) *asks* (1) *For criticism of circuit submitted.* (2) *The capacity of a variable condenser.* (3) *Whether the condenser will give fine tuning.* (4) *Whether the electric light will affect reception.*

(1) The circuit connections are correct, but we suggest you couple the reaction coil to the secondary of the H.F. transformer. (2) and (3) Unfortunately you do not give us sufficient particulars to enable us to calculate the capacity, but the condenser probably has a capacity of 0.0003 mfds., and therefore is suitable for fine tuning. (4) The supply, if direct current, will not affect reception, but if A.C., you may hear a disagreeable hum which will be difficult to remove.

SHARE MARKET REPORT

Prices as we go to press on November 17th, are :—

Marconi Ordinary	£2	6	3
,, Preference	2	0	3
,, Inter. Marine	1	7	0
,, Canadian		9	0
Radio Corporation of America :—			
Ordinary		18	0
Preference		13	3