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PROVISIONAL SPECIFICATION.

"Improvements in Receiving Apparatus for Wireless Telegraphy."

We, MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED, and CHARLES SAMUEL FRANKLIN, both of 18, Finch Lane, in the City of London, Electricians, do hereby declare the nature of this invention to be as follows:—

Our invention relates to improvements in receiving apparatus for wireless telegraphy whereby we obtain very accurate tuning and therefore great freedom from interference and at the same time measure the wave length of and the power received from the sending station, the latter forming, when the power transmitted by the sending station is known, an approximate measure of the distance of the sending station, and *vice versa*.

It is well known that if an instrument sensitive to the electric oscillations used in wireless telegraphy (hereinafter called a receiver) be placed in a closed circuit inductively coupled to an aerial circuit and if both circuits be put in resonance with (that is to say be adjusted to have the same natural frequency of oscillation as) the received wave the looser the coupling between the circuits the freer is the receiver from interference by waves of other lengths. Similarly if an aerial circuit be inductively coupled with a closed intermediate circuit and this intermediate circuit be inductively coupled with a closed circuit containing a receiver, and all three circuits be put in resonance with the received wave, the receiver is still more free from interference by waves of other lengths and this freedom is further increased by decreasing either of the couplings between the circuits. Increasing the number of circuits and decreasing the couplings between the circuits increases the freedom of the receiver from interference but at the same time decreases the strength of the signals in the receiver; we have however found that in an instrument containing an aerial circuit, an intermediate circuit and a receiver circuit such as described above great freedom from interference without great loss in the strength of the signals is obtained by making the two couplings simultaneously and equally variable, and we have further found that the best form of intermediate circuit for this purpose is one in which the inductance is divided into two equal and similar parts and connected in parallel across a condenser in such a way that one part forms the coupling with the aerial circuit and the other part the coupling with the receiver circuit.

The natural frequencies of these circuits may be adjusted by varying their capacities or inductances or both, but the method we find most convenient for adjusting the frequencies of the intermediate circuit and the receiver circuit is to vary their capacities only while keeping their inductances constant; but for the aerial circuit we vary both the capacity and the inductance and we divide this inductance also into two parts, both of which are variable, in such a way that one part forms the coupling with the intermediate circuit while the other part is entirely independent of that circuit, and that the first mentioned part may be adjusted to be a definite proportion of the inductance of the whole aerial circuit, because we have found that if only the part last mentioned be varied, other things being equal, the strength of signals in the receiver decreases with an increase of the wave length, and *vice versa*. It is evident

[*Price 8d.*]

that when the three circuits are in resonance with the received wave (that is when they are adjusted to give the strongest signals in the receiver) the length of the received wave may be ascertained from the value of the capacity and inductance of any one of the circuits, but as these properties will be different for different aerials and for different receivers we find it most convenient to determine the length of the received wave from the value of the capacity and inductance of the intermediate circuit, and since as above stated we prefer to keep the inductance of this intermediate circuit constant we are able to calibrate the variable capacity thereof directly in wave lengths.

The couplings between the circuits may be varied by any known means such as placing a coil in one circuit within a coil in another circuit and rotating either of the coils about a line at right angles to its axis, but the method we find most convenient for varying the two couplings simultaneously and equally is to mount the two coils of the intermediate circuit upon a slide in such a manner that they may be simultaneously moved in and out of the two coils in the aerial and receiver circuits respectively. Since the strength of the signals in the receiver varies with the coupling and therefore with the position of the slide it is evident that the position of the slide which gives a definite strength of signals in the receiver when the circuits are in resonance with the received wave will be a measure of the power received from the sending station, and therefore a measure of the distance of that station if the power transmitted be known and *vice versa*.

In practice we have found it difficult to construct condensers finely adjustable over the wide range of capacities required by the widely differing wave lengths commonly used in wireless telegraphy, and therefore in an instrument constructed in accordance with this invention we may place a condenser finely adjustable over a comparatively small range of capacity in each of the three circuits, and in order to render the instrument useful for widely differing wave lengths we may provide a switch whereby other condensers of definite constant capacity can be placed in series or parallel with the variable condensers as required. We may also provide a switch whereby the receiver can be disconnected from its closed circuit and directly connected to the aerial, thus cutting out all the tuned circuits and permitting the detection of waves of any length.

Dated this 3rd day of June, 1907.

MARCONI'S WIRELESS TELEGRAPH CO. LTD.

HENRY S. SAUNDERS,
H. CUTHBERT HALL,
Directors.
HENRY W. ALLEN, Secretary.

C. S. FRANKLIN.

COMPLETE SPECIFICATION.

"Improvements in Receiving Apparatus for Wireless Telegraphy."

We, MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED, and CHARLES SAMUEL FRANKLIN, both late of 18 Finch Lane, in the City of London, but now of Watergate House, York Buildings, Adelphi, in the County of Middlesex, Electricians, do hereby declare the nature of this invention and in what manner

the same is to be performed to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in receiving apparatus for wireless telegraphy, whereby very accurate tuning is obtained and therefore great freedom from interference; at the same time the wave length employed by the sending station and the power received can be measured, the power received thus giving, when the power transmitted is known, an approximate measure of the distance of the sending station, and *vice versa*.

It is well known that if an instrument sensitive to the electric oscillations used in wireless telegraphy (hereinafter called a "receiver") be placed in a closed circuit inductively coupled to an aerial circuit and if both circuits be put in resonance with (that is to say be adjusted to have the same natural frequency of oscillation as) the received wave, the looser the coupling between the circuits the freer is the receiver from interference by waves of other lengths. Similarly if an aerial circuit be inductively coupled with a closed intermediate circuit and this intermediate circuit be inductively coupled with a closed circuit containing a receiver, and all three circuits be put in resonance with the received wave, the receiver is still more free from interference by waves of other lengths and this freedom is further increased by decreasing either of the couplings between the circuits. Increasing the number of circuits and decreasing the couplings between the circuits increases the freedom of the receiver from interference but at the same time decreases the strength of the signals in the receiver; it is however found that in an instrument containing an aerial circuit, an intermediate circuit and a receiver circuit such as described above great freedom from interference without great loss in the strength of the signals is obtained by making the two couplings simultaneously and equally variable, and it is further found that the best form of intermediate circuit for this purpose is one in which the inductance is divided into two equal and similar parts and connected in parallel across a condenser in such a way that one part forms the coupling with the aerial circuit and the other part the coupling with the receiver circuit.

The natural frequencies of these circuits may be adjusted by varying their capacities or inductances or both, but the method found most convenient for adjusting the natural frequencies of the intermediate circuit and the receiver circuit is to vary their capacities only while keeping their inductances constant, but for the aerial circuit both the capacity and the inductance are varied and this inductance also is divided into two parts, both of which are variable, in such a way that one part forms the coupling with the intermediate circuit while the other part is entirely independent of that circuit, and that the first mentioned part may be adjusted to be a definite proportion of the inductance of the whole aerial circuit, because it is found that if only the part last mentioned be varied, other things being equal, the strength of signals in the receiver decreases with an increase of the wave length, and *vice versa*. It is evident that when the three circuits are in resonance with the received wave (that is when they are adjusted to give the strongest signals in the receiver) the length of the received wave may be ascertained from the value of the capacity and inductance of any one of the circuits, but as these properties will be different for different aerials and for different receivers it is found most convenient to determine the length of the received wave from the value of the capacity and inductance of the intermediate circuit, and since as above stated it is preferred to keep the inductance of this intermediate circuit constant, it is possible to calibrate the variable capacity thereof directly in wave lengths.

The couplings between the circuits may be varied by any known means such as placing a coil in one circuit within a coil in another circuit and rotating either of the coils about a line at right angles to its axis or sliding one of the coils in or out of the other coil, but the method found most convenient for

varying the two couplings simultaneously and equally is to mount the two coils of the intermediate circuit upon a spindle at right angles to their axes in such a manner that they may be simultaneously rotated within the two coils in the aerial and receiver circuits respectively. Since the strength of the signals in the receiver varies with the coupling and therefore with the angle through which the spindle is turned it is evident that the angle which gives a definite strength of signals in the receiver when the circuits are in resonance with the received wave will be a measure of the power received from the sending station, and therefore a measure of the distance of that station if the power transmitted be known and *vice versa*.

In practice it has been found difficult to construct condensers finely adjustable over the wide range of capacities required by the widely differing wave lengths commonly used in wireless telegraphy, and therefore in an instrument constructed in accordance with this invention there may be placed a condenser finely adjustable over a comparatively small range of capacity in each of the three circuits, and in order to render the instrument useful for widely differing wave lengths there may be provided a switch whereby other condensers of definite constant capacity can be placed in series or parallel with the variable condensers as required. There may also be provided a switch whereby the receiver can be disconnected from its closed circuit and directly connected to the aerial, thus cutting out all the tuned circuits and permitting the detection of waves of any length.

In the accompanying diagram *a* is an aerial, *e* an earth, and *r* a receiver such as are commonly used in wireless telegraphy, *b* is the part of the aerial circuit inductance which is independent of the other circuits, *c* is the part that forms the coupling with the intermediate circuit (these inductances being adjustable by means of the contacts *d* and *f* respectively) and *g* is the adjustable condenser in the aerial circuit. *h* and *k* are the two equal parts of the intermediate circuit inductance and *l* is the adjustable condenser in this circuit. *m* is the fixed inductance and *n* the adjustable condenser in the receiver circuit. The coils *c* and *m* are of a larger diameter than the coils *h* and *k*, and these latter are both capable of adjustment with regard to the former being carried on a slide or preferably mounted on a spindle (not shown) in such a manner that they can be rotated together within the coils *c* and *m* respectively.

The method of working in the latter case is as follows:—The axes of the coils *h* and *k* being parallel to the axes of the coils *c* and *m* the capacity *g* and the inductances *b* and *c* of the aerial circuit are first adjusted to give the strongest signals in the receiver *r*, and then the capacities *l* of the intermediate circuit and *n* of the receiver circuit are in turn adjusted to give the strongest signals in the receiver. The two coils *h* and *k* are now rotated within the coils *c* and *m* until the strength of the signals is reduced to a convenient amount when it is generally found that all interference is eliminated. Should any remain, the aerial circuit, the intermediate circuit and the receiver circuit may in turn be again carefully adjusted and the couplings then further decreased as already described, when it will be found that the receiver is free from interference by practically all but the desired wave length. In order to determine the power received from the sending station, the above adjustments having been made, the inductance *c* is adjusted by means of the contact *f* to the value required for the particular wave length of the sending station (which is ascertained from the value of the capacity of the condenser *l* in the intermediate circuit) and the inductance *b* is adjusted by means of the contact *d* to compensate for the change in the inductance *c* and keep the total inductance of the aerial circuit constant. The couplings are then adjusted by rotating the spindle to give a particular strength of signals in the receiver when the angle through which it has been rotated indicates the power received from the sending station as already described.

Improvements in Receiving Apparatus for Wireless Telegraphy.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim in connection with wireless telegraph receivers containing an aerial circuit, an intermediate circuit coupled thereto, and a receiver circuit coupled to the intermediate circuit, is:—

1. Apparatus whereby the couplings can be varied simultaneously substantially as described.

2. In apparatus covered by Claim 1, constructing the intermediate circuit of two equal and similar inductances connected in parallel across a condenser in such a manner that one inductance forms part of the coupling with the aerial circuit and the other inductance forms part of the coupling with the receiver circuit substantially as described.

3. The apparatus substantially as described and illustrated in the drawing.

Dated this 23rd day of December, 1907.

MARCONI'S WIRELESS TELEGRAPH CO. LTD.

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HENRY W. ALLEN, Secretary.

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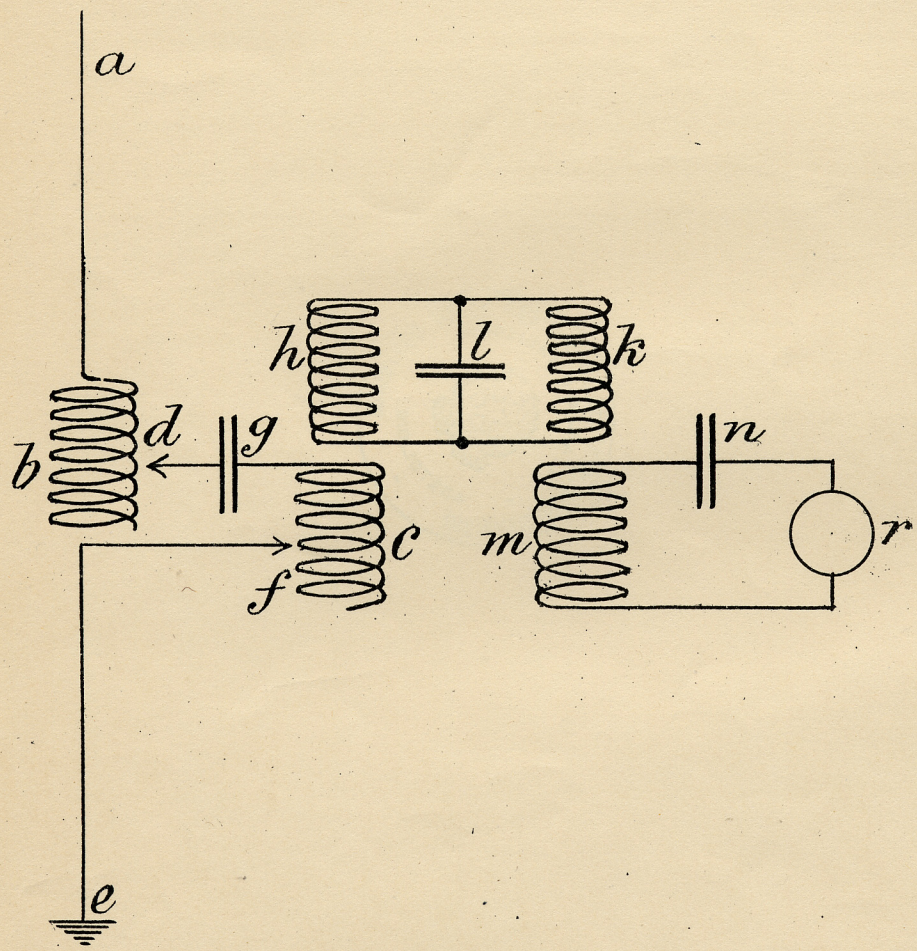

[This Drawing is a full-size reproduction of the Original.]

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