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A.D. 1907

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PROVISIONAL SPECIFICATION.

“Improvements in Transmitting Apparatus for Wireless Telegraphy.”

We, GUGLIELMO MARCONI, LL.D., D.Sc., and MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED, both of 18 Finch Lane, in the City of London, do hereby declare the nature of this invention to be as follows:—

5 It has before been proposed to employ for wireless telegraphy alternating currents generated without the use of a spark gap, but such attempts have not heretofore resulted in practical success, because owing to the type of apparatus employed the current was insufficient to transmit signals to any considerable distance.

10 It has also been proposed to transform a continuous current into an alternating current by successively charging a condenser the direction of the charging current being reversed after each charge by means of a commutator, but it has been impossible with apparatus of this class to produce alternating currents of a frequency high enough to ensure efficient radiation.

15 According to this invention a novel form of apparatus is employed which is particularly suitable for producing alternating currents of sufficiently high frequency and power efficiently to radiate electric waves.

The arrangements which we have successfully employed are as follow:—

20 A revolving toothed commutator of special construction which may be termed a generator wheel is employed, every alternate tooth of which is connected to one pole of a source of current such as a direct current dynamo, whilst the other teeth are connected to the other pole.

25 The generator wheel is formed of two metal discs, with equally spaced teeth projecting radially outwards from their peripheries. These discs are fixed side by side but are insulated from each other, the teeth of one disc being spaced midway between the teeth of the other, and the bodies of the discs are respectively connected to the two poles of the current generator.

30 With this mode of construction the generator wheel can be rotated at a very considerable speed without danger of damage or of distortion of the teeth which might otherwise result from the action of centrifugal force, and the insulation between the oppositely charged sets of teeth can be made very efficient.

35 Revolving in the same plane and in the same direction as the generator wheel and in close proximity to it but not in contact with it is a toothed collector consisting of a plain metal disc the outer rim of which is broad enough to carry teeth which will project over the teeth of both discs of the generator wheel, the distance between the teeth on this collector wheel being the same as that between the teeth of either of the two discs of the generator wheel.

40 The collector wheel is connected through an inductance to one plate of a condenser, (called the working condenser) the other plate of which is connected to the middle point of a pair of condensers (called the reservoir condenser) placed as a shunt across the terminals of the dynamo, the capacity of the reservoir condenser being preferably larger than that of the working condenser.

If the reservoir condenser is omitted the working condenser should be connected to a point in the winding of the generator or source of electricity where

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the potential between the said point and one of the poles is half that existing between the poles.

The electromotive force of the source of electricity employed should be sufficient to cause the current to jump the small air space between the teeth of the generator wheel and the teeth of the collector wheel as these pass each other when revolving close together, and in order to prevent short circuits between the teeth of the generator wheel as they pass the collector it is desirable that the space between the teeth should be large compared to the space between the edges of the teeth of the collector and generator wheels.

A generator current of higher electromotive force may be employed if the generator wheel and collector are placed in a casing containing compressed air or if a jet of compressed air from a suitable nozzle is directed on to that point or position where the collector teeth come into close proximity with the generator teeth.

By using such generator and collector wheels alternating currents of very high frequency can be produced, but if desired the generator wheel may be omitted and the collector wheel rotated close to two or more fixed contacts spaced and connected as described for the teeth of a generator wheel. In like manner the generator wheel alone may be employed if rotated close to a fixed contact or contacts spaced and connected as described for the teeth of a collector wheel.

In place of the above described forms of generator and collector wheels we may employ a stationary generator disc consisting of a circle of contacts or teeth each alternate contact being connected to one pole of the source of electricity, while the other contacts are connected to the other pole, and a rotating collector (connected in the same manner as the already described collector wheel) consisting of a light bar or rod which is caused to revolve rapidly about the centre of the circle of contacts in such a manner as successively to pass in close proximity to the oppositely charged contacts.

As it is necessary to rotate the above described bars or discs at a considerable speed these should be constructed in such a manner and of such material as safely to allow of a high peripheral speed such as is obtained in high speed turbine wheels.

The discs can be advantageously coupled or geared to rapidly revolving electric motors or steam turbines, and the collector and generator discs or contacts should be electrically insulated from earth and from the motor by which they are rotated.

It has been found practicable to obtain a peripheral speed of over 400 metres per second on a collector wheel and 200 metres per second on a generator wheel, and by using teeth sufficiently closely spaced an alternating current of over 100,000 periods per second can be obtained.

An inductive or conductive connection is made between the circuit containing the collector or generator wheel and the transmitting antenna.

The inductance of the circuit and the capacity of the working condenser should be such that at the speed at which the generator and collector wheels are driven it is just charged in the period of time during which the collector is taking current from each tooth of the generator.

By means which are now well known the period of oscillation of the aerial should be brought into resonance with the period of the alternating currents circulating in the above mentioned circuit.

The oscillations transmitted through space can be detected at a receiving station by means of the well known receivers or detectors employed for wireless telegraphy, it being especially desirable when using the waves generated in the manner described to utilise to the utmost the principle of resonance in the receivers. The receivers should preferably contain a responsive oscillation circuit with as little damping as possible.

In consequence of the fact that the oscillations emanating from the transmitter may be continuous it will in that case be desirable to arrange means,

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such as a short circuit or make and break, by which the detector only intermittently forms part of the receiving oscillation circuit.

The transmitting apparatus may be arranged to transmit regular groups of oscillations instead of a continuous stream, in which case the teeth of the discs are arranged in groups alternately with blank spaces, and in this case the receivers may be tuned to respond to the periodicity of these groups of oscillations as well as to the periodicity of the oscillations which go to constitute each group.

In place of employing a continuous current dynamo, an alternator or transformer may be employed, but in this case the periodicity of its current should be low compared with that of the current produced as above described.

Dated this 25th day of February 1907.

G. MARCONI,
MARCONI'S WIRELESS TELEGRAPH CO. LD.

By G. MARCONI,
Director.

Carpmael & Co.,
Agents for Applicants,

24 Southampton Buildings, London, W.C.

COMPLETE SPECIFICATION.

"Improvements in Transmitting Apparatus for Wireless Telegraphy."

We, GUGLIELMO MARCONI, LL.D., D.Sc., and MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED, both late of 18 Finch Lane, in the City of London, but now of Watergate House, York Buildings, Adelphi, in the County of Middlesex, 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:—

It has before been proposed to employ for wireless telegraphy alternating currents generated without the use of a spark gap, but such attempts have not heretofore resulted in practical success, because owing to the type of apparatus employed the current was insufficient to transmit signals to any considerable distance.

It has also been proposed to transform a continuous current into an alternating current by successively charging a condenser the direction of the charging current being reversed after each charge by means of a commutator, but it has been impossible with apparatus of this class to produce alternating currents of a frequency high enough to ensure efficient radiation.

According to this invention a novel form of apparatus is employed which is particularly suitable for producing alternating currents of sufficiently high frequency and power efficiently to radiate electric waves.

The arrangements which we have successfully employed are as follow:—

A revolving toothed commutator of special construction which may be termed a generator wheel is employed, every alternate tooth of which is connected to one pole of a source of current such as a direct current dynamo, whilst the other teeth are connected to the other pole.

The generator wheel is formed of two metal discs, with equally spaced teeth projecting radially outwards from their peripheries. These discs are fixed side by side but are insulated from each other, the teeth of one disc being spaced midway between the teeth of the other, and the bodies of the discs are respectively connected to the two poles of the current generator.

With this mode of construction the generator wheel can be rotated at a very

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considerable speed without danger of damage or of distortion of the teeth which might otherwise result from the action of centrifugal force, and the insulation between the oppositely charged sets of teeth can be made very efficient.

Revolving in the same plane and in the same direction as the generator wheel and in close proximity to it but not in contact with it is a toothed collector 5 consisting of a plain metal disc the outer rim of which is broad enough to carry teeth which will project over the teeth of both discs of the generator wheel, the distance between the teeth on this collector wheel being the same as that between the teeth of either of the two discs of the generator wheel.

The collector wheel is connected through an inductance to one plate of a condenser, (called the working condenser) the other plate of which is connected to 10 the middle point of a pair of condensers (called the reservoir condenser) placed as a shunt across the terminals of the dynamo, the capacity of the reservoir condenser being preferably larger than that of the working condenser.

If the reservoir condenser is omitted the working condenser should be connected to a point in the winding of the generator or source of electricity where 15 the potential between the said point and one of the poles is half that existing between the poles.

The working condenser may also be omitted the reservoir condenser in this case becoming in effect a pair of oppositely charged condensers which are discharged alternately. 20

The electromotive force of the source of electricity employed should be sufficient to cause the current to jump the small air space between the teeth of the generator wheel and the teeth of the collector wheel as these pass each other 25 when revolving close together, and in order to prevent short circuits between the teeth of the generator wheel as they pass the collector it is desirable that the space between the teeth should be large compared to the space between the edges of the teeth of the collector and generator wheels.

A generator current of higher electromotive force may be employed if the generator wheel and collector are placed in a casing containing compressed air 30 or if a jet of compressed air from a suitable nozzle is directed on to that point or position where the collector teeth come into close proximity with the generator teeth.

By using such generator and collector wheels alternating currents of very high frequency can be produced, but if desired the generator wheel may be 35 omitted and the collector wheel rotated close to two or more fixed contacts spaced and connected as described for the teeth of a generator wheel. In like manner the generator wheel alone may be employed if rotated close to a fixed contact or contacts spaced and connected as described for the teeth of a collector wheel.

In place of the above described forms of generator and collector wheels we may 40 employ a stationary generator disc consisting of a circle of contacts or teeth each alternate contact being connected to one pole of the source of electricity, while the other contacts are connected to the other pole, and a rotating collector (connected in the same manner as the already described collector wheel) consisting 45 of a light bar or rod which is caused to revolve rapidly about the centre of the circle of contacts in such a manner as successively to pass in close proximity to the oppositely charged contacts.

None of these modifications however are recommended and they are unsuitable for high powers because undue heating of the contacts takes place.

As it is necessary to rotate the above described bars or discs at a considerable 50 speed these should be constructed in such a manner and of such material as safely to allow of a high peripheral speed such as is obtained in high speed turbine wheels.

The discs can be advantageously coupled or geared to rapidly revolving electric motors or steam turbines, and the collector and generator discs or contacts 55 should be electrically insulated from earth and from the motor by which they are rotated.

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It has been found practicable to obtain a peripheral speed of over 400 metres per second on a collector wheel and 200 metres per second on a generator wheel, and by using teeth sufficiently closely spaced an alternating current of over 100,000 periods per second can be obtained.

5 An inductive or conductive connection is made between the circuit containing the collector or generator wheel and the transmitting antenna.

The inductance and resistance of the circuit and the capacity of the working condenser should be such that at the speed at which the generator and collector wheels are driven it is just charged in the period of time during which the collector is taking current from each tooth of the generator. A variable non-inductive
10 resistance in the circuit also facilitates the adjustments.

By means which are now well known the period of oscillation of the aerial should be brought into resonance with the period of the alternating currents circulating in the above mentioned circuit.

15 The oscillations transmitted through space can be detected at a receiving station by means of the well known receivers or detectors employed for wireless telegraphy, it being especially desirable when using the waves generated in the manner described to utilise to the utmost the principle of resonance in the receivers. The receivers should preferably contain a responsive oscillation
20 circuit with as little damping as possible.

In consequence of the fact that the oscillations emanating from the transmitter may be continuous it will in that case be desirable to arrange well known means, such as a short circuit or make and break, by which the detector only intermittently forms part of the receiving oscillation circuit.

25 The transmitting apparatus may be arranged to transmit regular groups of oscillations instead of a continuous stream, in which case the teeth of the discs are arranged in groups alternately with blank spaces, and in this case the receivers may be tuned to respond to the periodicity of these groups of oscillations as well as to the periodicity of the oscillations which go to constitute each
30 group.

In place of employing a continuous current dynamo, an alternator or transformer may be employed, but in this case the periodicity of its current should be low compared with that of the current produced as above described.

The drawings show the form of apparatus it is preferred to employ.

35 Figure 1 is a diagram of the complete arrangement; Figure 2 is a section. Figure 3 a plan, and Figure 4 a side elevation of the generator wheel. Figure 5 is a plan and Figure 6 a side elevation of the collector wheel.

a and *b* are solid discs of metal having teeth *a*¹ *b*¹ cut on their peripheries. These discs are insulated from each other by a ring of mica or vulcanite *c*. The
40 discs are fixed together by bolts *d* which are insulated from the discs by insulating washers and bushes. As will be seen the teeth *a*¹ and *b*¹ alternate with each other. The discs have bolted to them shafts *a*² *b*² the bearings of which are mounted on insulating plates. The corresponding collector wheel *e* is made in one piece of metal, its teeth being at the same distance apart as the teeth *a*¹
45 or *b*¹ and the bearings of its shaft are mounted on insulating plates.

f is a continuous current dynamo having its poles connected to brushes *g* and *h* in contact with the discs *a* and *b* respectively. *j* is a brush in contact with the collector wheel and connected to one plate of the working condenser *k* the other plate of which is connected to a neutral plate in the reservoir
50 condenser *l* in a shunt across the poles of the dynamo *f*. *m* and *n* are the primary and secondary of an ordinary jigger employed in wireless telegraphy and *o* is the antenna.

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
55 what we claim is:—

1. A transmitter for wireless telegraphy in which the discharge takes place

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across a small gap between discontinuous metal surfaces in relative motion at a very high speed, substantially as described.

2. The employment in transmitters for wireless telegraphy of alternating currents of high frequency produced by successively charging a condenser, the direction of the charging current being reversed after each charge, or successively discharging a pair of oppositely charged condensers, substantially as described. 5

3. The combination with a generator wheel every alternate tooth of which is given an opposite polarity, of a revolving collector wheel, substantially as described. 10

4. The employment in transmitters for wireless telegraphy, of alternating currents of high frequency produced by successively charging a condenser to opposite polarities by means of another condenser connected to the source of current, substantially as described.

5. Transmitting apparatus for wireless telegraphy substantially as described and illustrated at Figure 1 of the drawings. 15

6. Generator wheels substantially as described and shown at Figures 2, 3 and 4 of the drawings.

Dated this 22nd day of August, 1907.

G. MARCONI,

MARCONI'S WIRELESS TELEGRAPH CO. LTD. 20

H. CUTHBERT HALL,

HENRY S. SAUNDERS,

Directors.

F. S. TOMKINS, 25

Acting Secretary.

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Fig. 1.

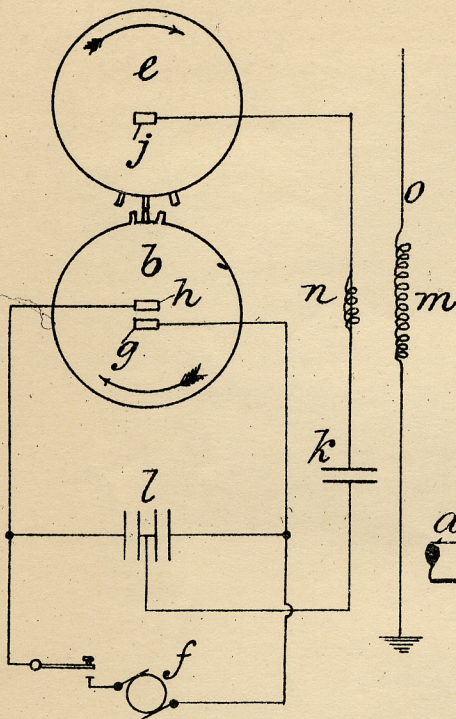


Fig. 2.

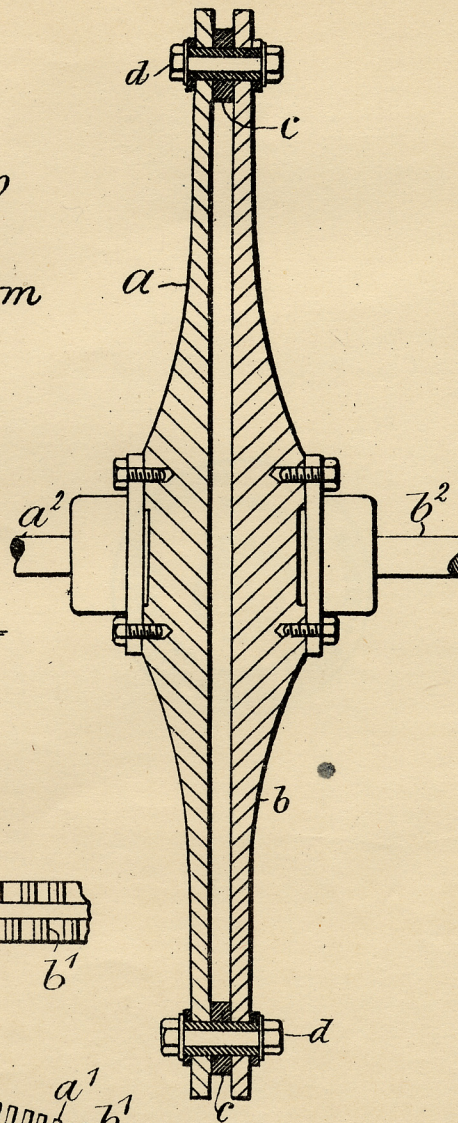


Fig. 3.

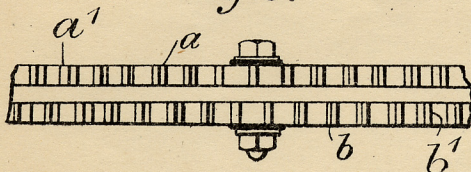


Fig. 4.

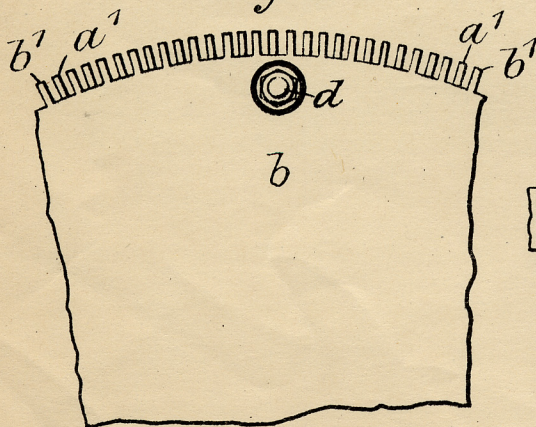


Fig. 5.

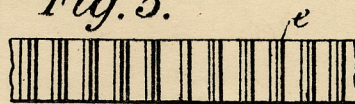


Fig. 6.

