G. MARCONI.

WIRELESS TELEGRAPHY.

APPLICATION FILED MAY 15, 1909.

954,641. Patented Apr. 12, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

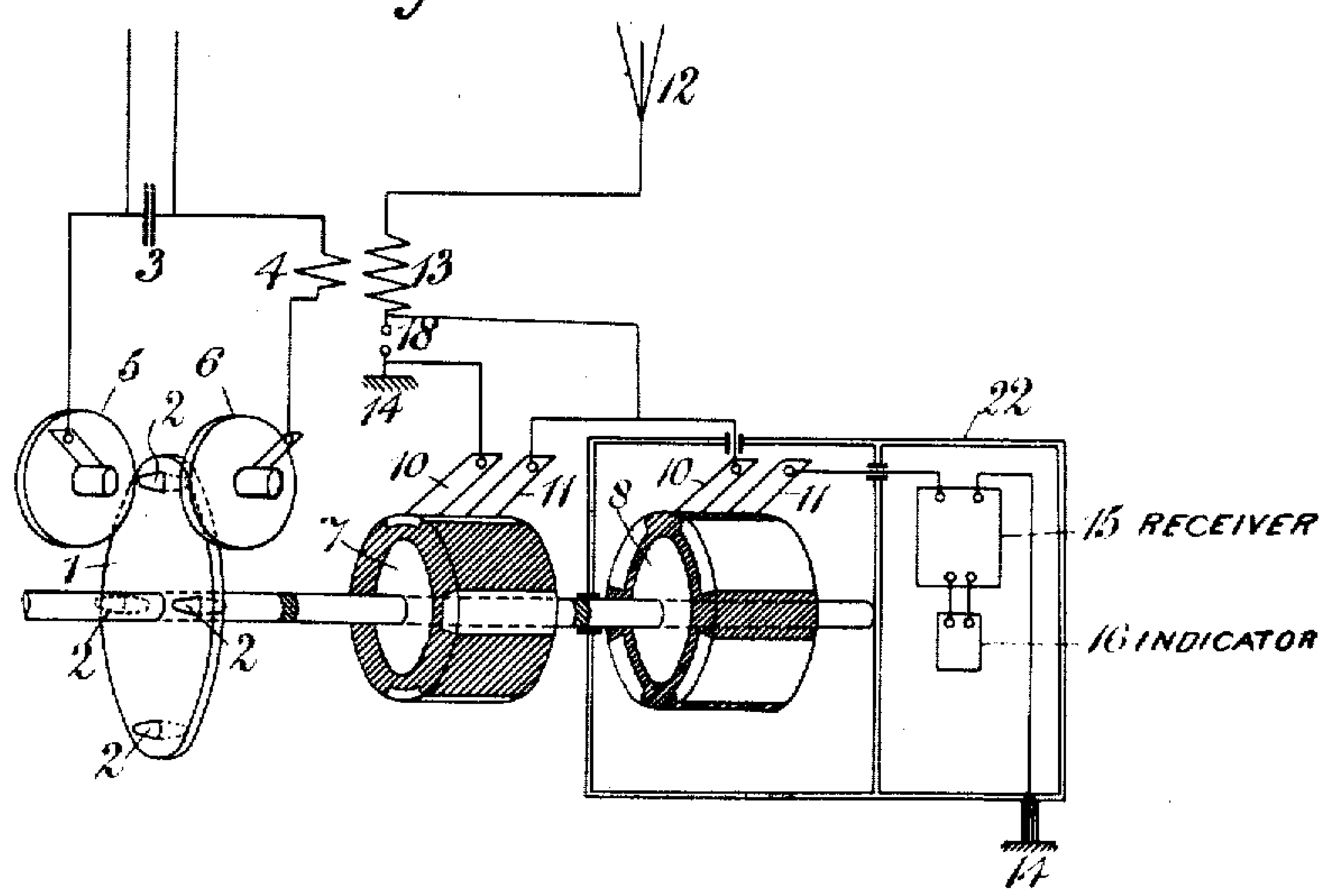
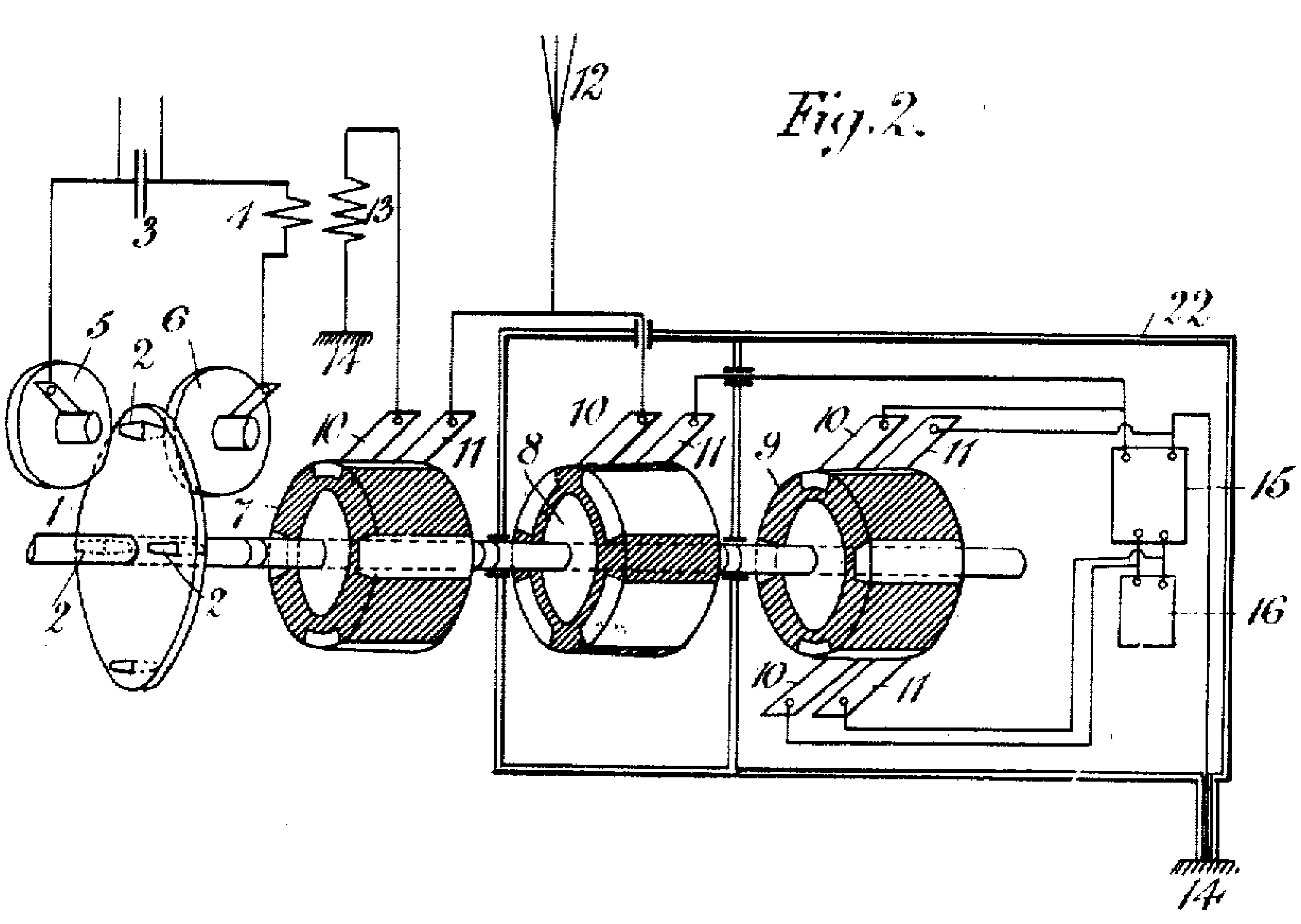


Fig. 2.



Witnesses.
John W. Peters
E. Adams Boyce

Inventor
Guglielmo Marconi
By Betts Sheffield Bentley & Betts
Attys

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2 SHEETS—SHEET 2.

Fig. 3.

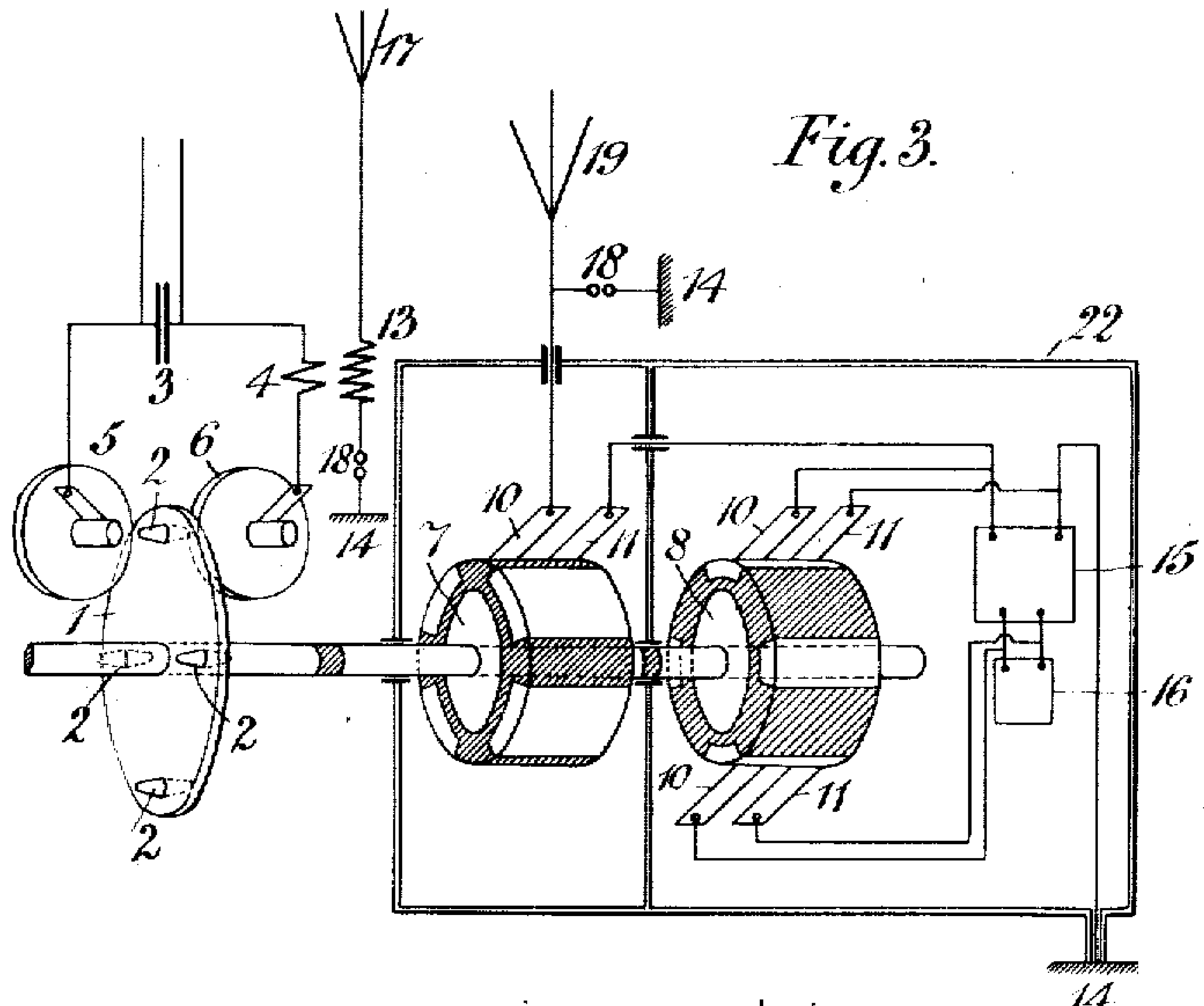
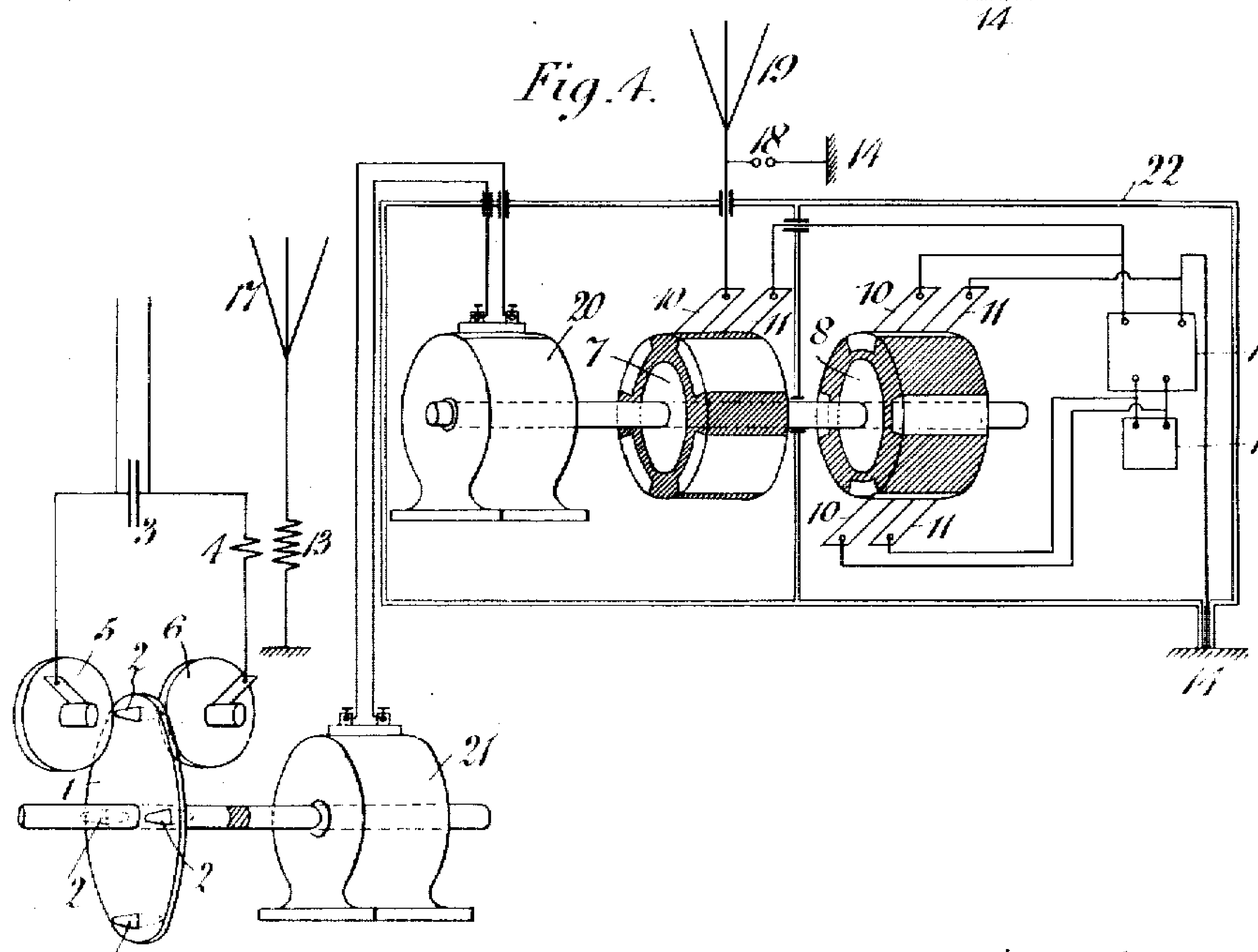


Fig. 4.



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Attys

UNITED STATES PATENT OFFICE.

GUGLIELMO MARCONI, OF LONDON, ENGLAND, ASSIGNOR TO MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

WIRELESS TELEGRAPHY.

954,641. Specification of Letters Patent. **Patented Apr. 12, 1910.**

Application filed May 15, 1909. Serial No. 496,095.

To all whom it may concern:

Be it known that I, GUGLIELMO MARCONI, LL. D., D. Sc., a subject of the King of Italy, residing at Watergate House, Adelphi, London, England, have invented new and useful Improvements in Wireless Telegraphy, of which the following is a specification.

It has before been suggested to connect the aerial of a wireless telegraph station to the transmitting and to the receiving circuits for small portions of a second alternately and successively for the purpose of duplex telegraphy but heretofore it has been necessary to synchronize the instruments at the two stations in such a manner that when at one station the transmitter is operative and the receiver inoperative at the other station the receiver shall be operative and the transmitter inoperative.

The object of this invention is to avoid all necessity of synchronism which is very difficult to attain in practice, and for this purpose there is provided at each of two or more stations, transmitting and receiving apparatus which are rendered operative and inoperative alternately to each other in rapid succession, the operative periods of the transmitting apparatus being considerably shorter than those of the receiving apparatus, while the transmitting apparatus is such that the making of each sign occupies several operative periods and that such operative periods do not synchronize with those of the apparatus at any of the other stations.

In carrying out the invention it is preferred to employ for transmitting, the known apparatus which consists of a rotating disk having teeth or studs which cause groups of electrical oscillations to be generated at regular short intervals and for the purpose of the present invention one or more commutators are rotated synchronously with the studded wheel in such a way that they cause the receiving apparatus to be rendered operative only during the intervals between the discharges and to be rendered inoperative during the short periods when the discharges are taking place.

The commutators may be made to rotate synchronously with the studded wheel or disk either by coupling them mechanically or by driving them by a synchronous motor which is worked from an alternator mechanically coupled to the disk. The commutators may render the receiver periodically inoperative either directly or indirectly as by periodically making or breaking a local circuit or an intermediate circuit which renders the receiver inoperative or by any combination of these local or intermediate circuits. Or the commutators may render the receiver periodically inoperative by causing the aerial to be connected alternately to the transmitting and receiving apparatus. Or an entirely separate aerial at any convenient distance from the transmitting aerial may be used for receiving and the commutator made to periodically disconnect the receiving apparatus and if desirable earth the receiving aerial during the short periods the transmitting aerial is radiating.

Whether using one or two aerials the commutator is preferably caused to render the receiver periodically inoperative either by disconnecting or by short circuiting the receiver and indicator which it actuates or by any combination of these methods the exact method employed depending mainly upon the nature of the receiver and indicator used. It is evident that if the two discharges which generate the electrical waves at two stations occur simultaneously neither station will be able to receive from the other, but this will hardly ever occur in practice if the speeds of the disks are unequal the periods of time during which the receiver is operative being of much longer duration than those during which the oscillations are produced. By making the ratio of the speeds of the disks at the stations the same or nearly the same as the ratio of the time between two discharges to the time between two discharges plus the time of one discharge and also by making the speeds of the disks at the stations sufficient to insure that more than one discharge takes place for every dot signaled interference at either station from its own commutator can be entirely avoided. Thus supposing the interval between two discharges is nine times the duration of one discharge and the speeds of the disks at the stations are as ten is to nine the station with the faster disk will only miss one out of nine discharges from the station with the slower disk and the station with the slower disk will miss one out of ten discharges from the station with the faster disk. If therefore every signal consists of more than one discharge neither station will ever miss a signal from the other.

It is sometimes desirable to inclose the receiving instruments and connections in metallic casings and tubes connected to earth in order to prevent the electric waves generated at the same station from directly affecting the receiver. It is well known that by suitable tuning, signals of different wave lengths may be transmitted or received simultaneously and independently by any one station, and therefore any such arrangement may be used in conjunction with the herein described method for simultaneous transmission and reception of signals at the same station to enable several messages to be transmitted and received simultaneously and independently at any one station either to or from one or several other stations.

The accompanying figures show four systems of connections in accordance with this invention. In all of these figures 1 represents a disk carrying studs 2 which discharge the condenser 3 through the primary 4 of an oscillation transformer at regular intervals when passing between the side disks 5 and 6. The disk is driven at any desired speed by a suitable motor which is not shown in the drawings.

7 and 8 in the Figures 1, 3 and 4 and 7, 8 and 9 in Fig. 2 are commutators which may conveniently consist of bars of copper or any suitable conductor mounted on a drum of suitable nonconducting materials.

In the drawings the nonconducting portion of the commutators is indicated by shading. Each commutator has the same number of bars as there are studs on the disk and each is provided with one or more pairs of brushes 10 and 11 each pair being connected together at regular intervals by the commutator bars.

In practice each brush is mounted upon a holder which can be rocked forward or backward upon the shaft and thus advance or retard the time of contact of the brush with the commutator bar. Fig. 1 shows two commutators 7 and 8 mechanically coupled to the disk 1 through an insulating coupling. 12 is the aerial, 13 the secondary of the oscillation transformer, 14 the earth. The brush 11 of the commutator 7 is connected to the bottom of the oscillation transformer secondary 13 and the brush 10 is connected to earth.

The brush 10 of the commutator 8 is connected to the bottom of the secondary 13 and the brush 11 is connected to the receiver 15.

The commutator 7 has narrow bars and the commutator 8 has wide bars as indicated.

The brushes of the commutator 7 are adjusted so that they are connected together by the commutator bars just before and disconnected just after the studs 2 pass between the side disks 5 and 6. The brushes of the commutator 8 are adjusted so that they are connected together by the commutator bars just after the brushes of the commutator 7 are disconnected and are disconnected just before the brushes of 7 are connected. The result is that the aerial is connected through the secondary 13 to earth and disconnected from the receiver 15 during the time a stud 2 is passing between the side disks 5 and 6 that is during the time of discharge and connected through the secondary 13 to the receiver 15 during the intervals between the discharges.

Fig. 2 shows three commutators 7, 8 and 9 mechanically coupled to the disk 1 through an insulating coupling. The commutator 7 connects the aerial 12 through the transformer secondary 13 to earth during the time the studs are passing between the side disks 5 and 6. The commutator 8 connects the aerial directly to the receiver 15 just after it is disconnected from the oscillation transformer secondary 13 by the commutator 7 and disconnects it from the receiver just before it is connected again to the oscillation transformer secondary. The commutator 9 short circuits the receiver 15 and the indicator 16 during the time the commutator 7 connects the aerial to the transformer secondary that is during the time the discharges are taking place.

Fig. 3 shows two commutators 7 and 8 mechanically coupled to a disk 1 through an insulating coupling. In this system the transmitting aerial 17 is permanently connected through the oscillation transformer secondary 13 and through a small spark gap 18 to earth. A separate aerial 19 is used for receiving. The commutator 7 disconnects this receiving aerial from the receiver 15 during the time the discharges are taking place and connects it to 15 during the interval between the discharges. The commutator 8 short circuits the receiver 15 and the indicator 16 during the periods the aerial 19 is disconnected from the receiver 15 by the commutator 7.

Fig. 4 shows two commutators 7 and 8 coupled to a synchronous motor 20 driven from an alternator 21 which is mechanically coupled to the disk 1 through an insulated coupling. A separate aerial 19 is used for receiving and the commutators 7 and 8 perform the same operation as in Fig. 3.

The receiving apparatus and any commutators connected to it are inclosed in a metal room or box indicated by 22 which is earthed to protect the receiving apparatus from the powerful inductive effects of the aerial when radiating. All the necessary wires are taken into this room or box through insulating tubes.

The disk may be replaced by any suitably moving terminals such as by bars or rods reciprocated by cams or eccentrics on a rotating shaft. Similarly the commutators may be replaced by any reciprocating mechanism which can be made to reciprocate synchronously with the mechanism controlling the discharges in the condenser circuit inductively coupled to the aerial and which will perform the same operations as the commutators described and render the receiving apparatus operative only during the interval between the discharges.

What I claim is:—

1. In a station for duplex wireless telegraphy, the combination of a transmitter having a gap in the oscillation circuit, bridging pieces, means for very rapidly moving the bridging pieces in such manner that they bridge the gap at regular intervals, a receiver and means for rendering the receiver inoperative when the gap is bridged and rendering it operative when the gap is not bridged.

2. The combination of a plurality of stations for duplex wireless telegraphy each comprising a transmitter having a gap in the oscillation circuit, bridging pieces, means for very rapidly moving the bridging pieces in such manner that they bridge the gap at regular intervals, a receiver and means for rendering the receiver inoperative when the gap is bridged and rendering it operative when the gap is not bridged.

3. In a station for duplex wireless telegraphy, the combination of a transmitter consisting of a disk having studs around its periphery, an oscillation circuit, terminals in the oscillation circuit, and means for rotating the disk rapidly between the terminals, a receiver, a commutator and means for rotating the commutator synchronously with the disk in such manner that it renders the receiver inoperative during the times the studs bridge the gap between the terminals and render it operative during the times the studs are not bridging the gap.

4. The combination of a plurality of stations for duplex wireless telegraphy each comprising a transmitter consisting of a disk having studs around its periphery, an oscillation circuit, terminals in the oscillation circuit, and means for rotating the disk rapidly between the terminals, a receiver, a commutator and means for rotating the commutator synchronously with the disk in such manner that it renders the receiver inoperative during the times the studs bridge the gap between the terminals and render it operative during the times the studs are not bridging the gap.

GUGLIELMO MARCONI.

Witnesses:
C. J. Ketteridge,
P. H. B. Saunders.