[Second Edition.]

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PROVISIONAL SPECIFICATION.

"Improvements in Apparatus for Wireless Telegraphy."

We, GUGLIELMO MARCONI, LL.D., D.Sc., and MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED, both of Watergate House, York Buildings, Adelphi, in the City of Westminster, do hereby declare the nature of this invention to be as follows:—

This invention relates to improvements in apparatus for wireless telegraphy whereby simultaneous transmission and reception of signals at any one station is rendered possible. In the Specification of our former Patent No. 20119 of 1907 we have described apparatus whereby a rotating disc having teeth or studs causes groups of electrical oscillations to be generated at regular short intervals and our present invention consists in rotating a commutator synchronously with the studded wheel in such a way that it causes the receiving apparatus to be connected to the aerial only during the intervals between the discharges and to be disconnected from the aerial or otherwise rendered inoperative during the short periods when the discharges are taking place. The commutator may render the receiver periodically inoperative either directly or indirectly as by periodically making and breaking a local circuit which renders the receiver inoperative or by both. Or the commutator may render the receiver periodically inoperative by causing the aerial to be connected alternatively to the transmitting and receiving apparatus but owing to the high potential of the aerial when transmitting we prefer to connect the receiving apparatus to the aerial in the manner described in the Specification of the former Patent No. 21640 of 1904 and to cause the commutator to render the receiver periodically inoperative either by disconnecting or by short circuiting the 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 discs 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. It is sometimes desirable to enclose the receiving instruments and connections in metallic casings or 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 such as for example described in the Specification of the Patent No. 7777 of 1900 signals of different wave lengths may be transmitted or received simultaneously and independently by any one station and we may therefore use any such arrangement in conjunction with our herein described method for the simultaneous transmission and reception of signals at the same station to enable us

[*Price 8d.*]

to transmit and receive several messages simultaneously and independently at any one station either to or from one or several other stations.

Dated this 5th day of August, 1908.

G. MARCONI.
MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED.

H. JAMISON DAVIS,
G. MARCONI,
Directors.
HENRY W. ALLEN,
Secretary.

COMPLETE SPECIFICATION.

"Improvements in Apparatus for Wireless Telegraphy."

We, GUGLIELMO MARCONI, LL.D., D.Sc., and MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED, both of Watergate House, York Buildings, Adelphi, in the City of Westminster, 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 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 synchronise 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 we provide 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 synchronise with those of the apparatus at any of the other stations.

In carrying out the invention we prefer to employ for transmitting the apparatus described in our former Specification No. 20119 of 1907 which consists of a rotating disc 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 we rotate one or more commutators 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 disc either by coupling them mechanically or by driving them by a synchronous motor which is worked from an alternator mechanically coupled to the disc. 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. When using one aerial owing to the high potentials when transmitting we prefer to connect the receiving apparatus to the aerial in the manner described in the Specification of the former Patent No. 21640 of 1904, and whether using one or two aerials to cause the commutator 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 discs 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 discs 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 discs at the stations sufficient to ensure that more than one discharge takes place for every dot signalled 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 discs at the stations are as ten is to nine the station with the faster disc will only miss one out of nine discharges from the station with the slower disc and the station with the slower disc will miss one out of ten discharges from the station with the faster disc. 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 enclose 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 such as for example described in the Specification of our Patent No. 7777 of 1900 signals of different wave lengths may be transmitted or received simultaneously and independently by any one station and we may therefore use any such arrangement in conjunction with our herein described method for simultaneous transmission and reception of signals at the same station to enable us to transmit and receive several messages simultaneously and independently at any one station either to or from one or several other stations.

The accompanying diagrams show four systems of connections in accordance with this invention. In all of these diagrams D represents a disc carrying studs S which discharge the condenser K through the primary T P of an oscillation transformer at regular intervals when passing between the side discs S D^1 and S D^2 as described in the Specification of our Patent No. 20119 of 1907. The disc is driven at any desired speed by a suitable motor which is not shown in the diagrams.

C^1 and C^2 of diagrams 1, 3 and 4 and C^1 C^2 and C^3 of diagram 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 diagrams the nonconducting portion of the commutators is indicated by shading. Each commutator has the same number of bars as there are studs on the disc and each is provided with one or more pairs of brushes B^1 and B^2

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 backwards upon the shaft and thus advance or retard the time of contact of the brush with the commutator bar. Diagram 1 shows two commutators C^1 and C^2 mechanically coupled to the disc D through an insulating coupling. A is the aerial, T S the secondary of the oscillation transformer, E the earth. The brush B^2 of the commutator C^1 is connected to the bottom of the oscillation transformer secondary T S and the brush B^1 is connected to earth.

The brush B^1 of the commutator C^2 is connected to the bottom of the secondary T S and the brush B^2 is connected to the receiver R.

The commutator C^1 has narrow bars and the commutator C^2 has wide bars as indicated.

The brushes of the commutator C^1 are adjusted so that they are connected together by the commutator bars just before and disconnected just after the studs S pass between the side discs S D^1 and S D^2. The brushes of the commutator C^2 are adjusted so that they are connected together by the commutator bars just after the brushes of the commutator C^1 are disconnected and are disconnected just before the brushes of C^1 are connected. The result is that the aerial is connected through the secondary T S to earth and disconnected from the receiver R during the time a stud S is passing between the side discs S D^1 and S D^2 that is during the time of discharge and connected through the secondary T S to the receiver R during the intervals between the discharges.

Diagram 2 shows three commutators C^1 C^2 and C^3 mechanically coupled to the disc D through an insulating coupling. The commutator C^1 connects the aerial A through the transformer secondary T S to earth during the time the studs are passing between the side discs S D^1 and S D^2. The commutator C^2 connects the aerial directly to the receiver R just after it is disconnected from the oscillation transformer secondary T S by the commutator C^1 and disconnects it from the receiver just before it is connected again to the oscillation transformer secondary. The commutator C^3 short circuits the receiver R and the indicator I during the time the commutator C^1 connects the aerial to the transformer secondary that is during the time the discharges are taking place.

Diagram 3 shows two commutators C^1 and C^2 mechanically coupled to a disc D through an insulating coupling.

In this system the transmitting aerial T A is permanently connected through the oscillation transformer secondary T S and through a small spark gap E S to earth. A separate aerial R A is used for receiving.

The commutator C^1 disconnects this receiving aerial from the receiver R during the time the discharges are taking place and connects it to R during the interval between the discharges.

The commutator C^2 short circuits the receiver R and the indicator I during the periods the aerial R A is disconnected from the receiver R by the commutator C^1.

Diagram 4 shows two commutators C^1 and C^2 coupled to a synchronous motor P driven from an alternator V which is mechanically coupled to the disc D through an insulated coupling. A separate aerial R A is used for receiving and the commutators C^1 and C^2 perform the same operation as in diagram 3.

In all the diagrams the receiving apparatus and any commutators connected to it are enclosed in a metal room or box indicated by M 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.

It is stated in the Specification of our Patent No. 20119 of 1907 that the

disc 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.

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 is:—

1. A station for duplex wireless telegraphy provided with transmitting and receiving apparatus 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 and the transmitting apparatus being such that the making of each sign occupies several operative periods substantially as described.

2. The combination of two or more stations each such as is defined by Claim 1.

3. A station for duplex wireless telegraphy provided with a transmitter in which a gap in the oscillation circuit is bridged at regular intervals by means of bridging pieces in very rapid movement and a receiver which is disconnected from its aerial or otherwise rendered inoperative during the periods when the gap in the oscillation circuit of the transmitter is bridged and is connected to its aerial or otherwise rendered operative during the periods when the gap in the oscillation circuit of the transmitter is not bridged the operative periods of the transmitting apparatus being considerably shorter than those of the receiving apparatus substantially as described.

4. The combination of two or more stations each such as is defined by Claim 3.

5. A station for duplex wireless telegraphy provided with a transmitter comprising a disc having studs round its periphery and means for driving the disc rapidly between the terminals of the oscillation circuit and with one or more commutators which are coupled mechanically or electrically so as to rotate in synchronism with the disc and disconnect an aerial or otherwise render the receiver inoperative during the times the studs on the disc bridge the gap in the oscillation circuit of the transmitter but connect an aerial or otherwise render the receiver operative during the times the studs on the disc are not bridging the gap in the oscillation circuit of the transmitter, the latter times being considerably longer than the former substantially as described.

6. The combination of two or more stations each such as is defined by Claim 5.

7. Wireless telegraph apparatus substantially as described and illustrated in the diagrams.

Dated this 5th day of February, 1909.

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(2nd Edition) SHEET 1

Diagram 1.

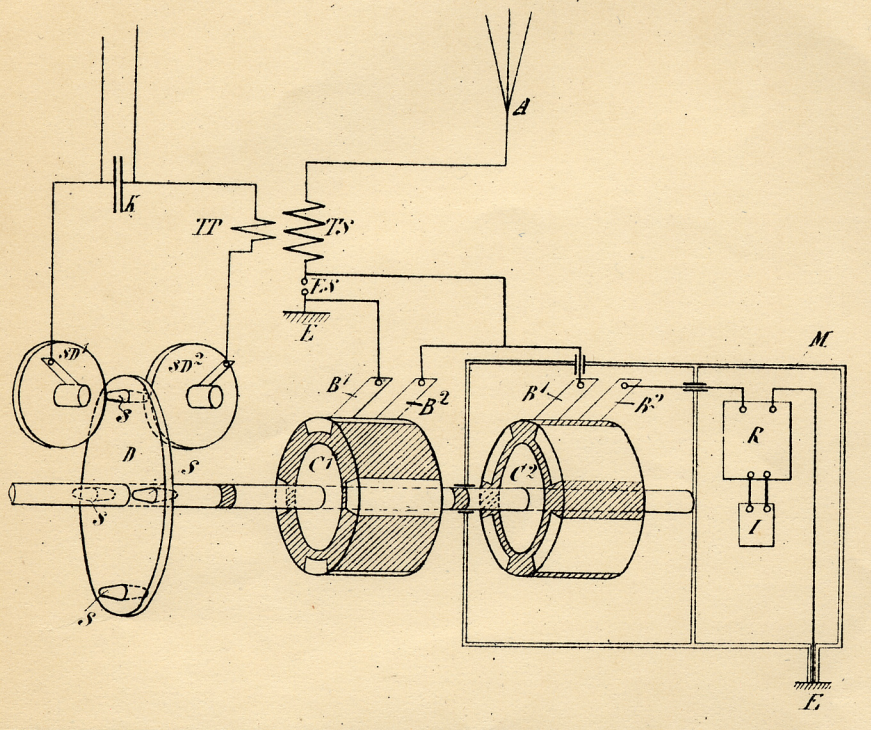
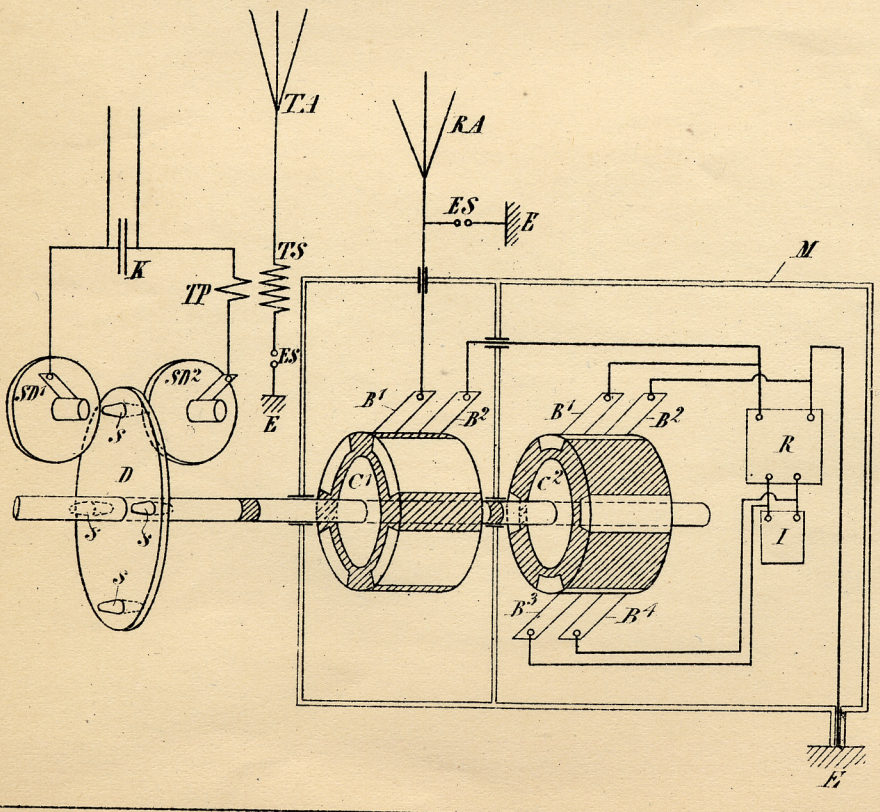


Diagram 3. SHEET 3



[This Drawing is a reproduction of the Original on a reduced scale.]

Malby & Sons, Photo-Litho.

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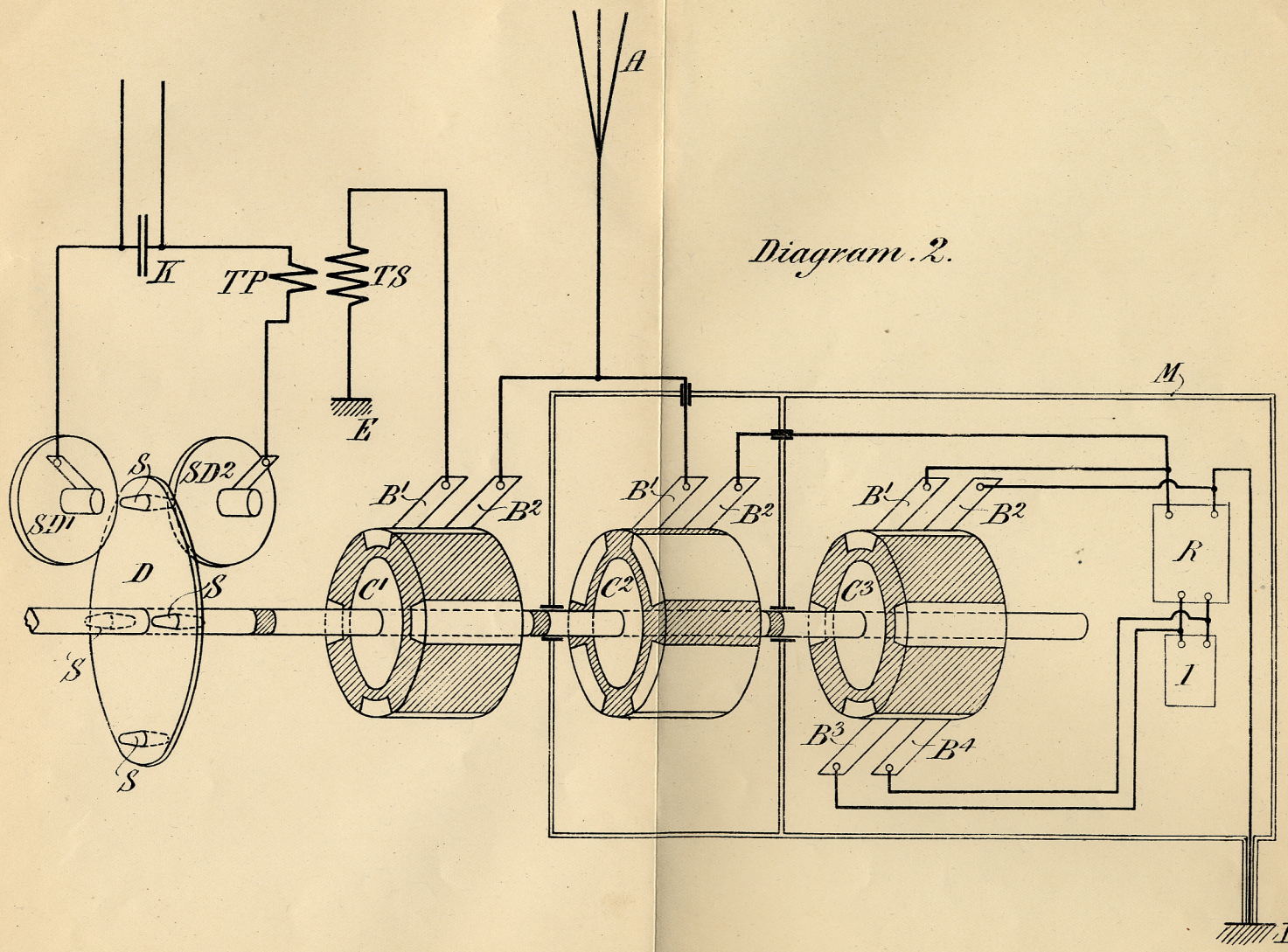

Diagram 2.

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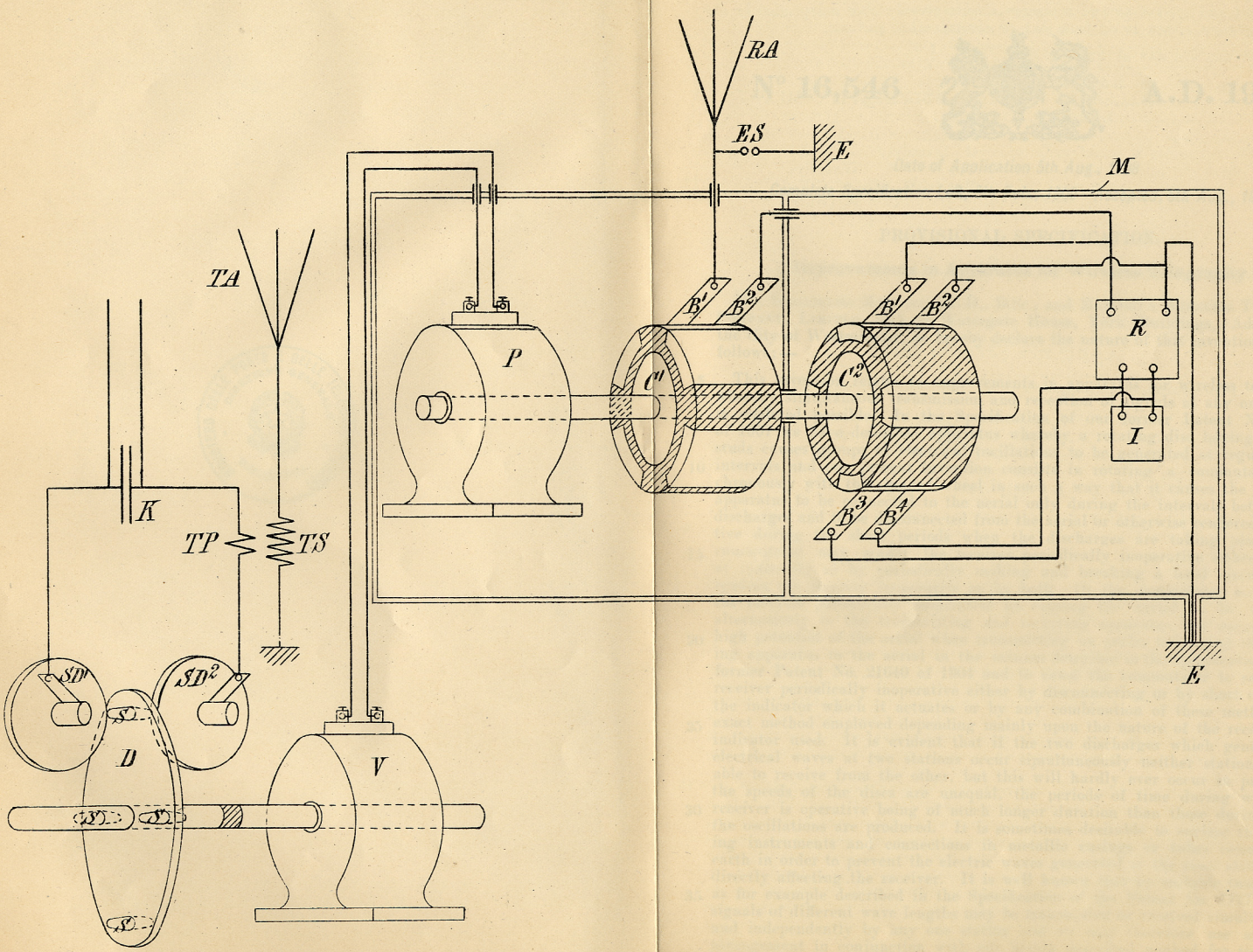
Diagram 4



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