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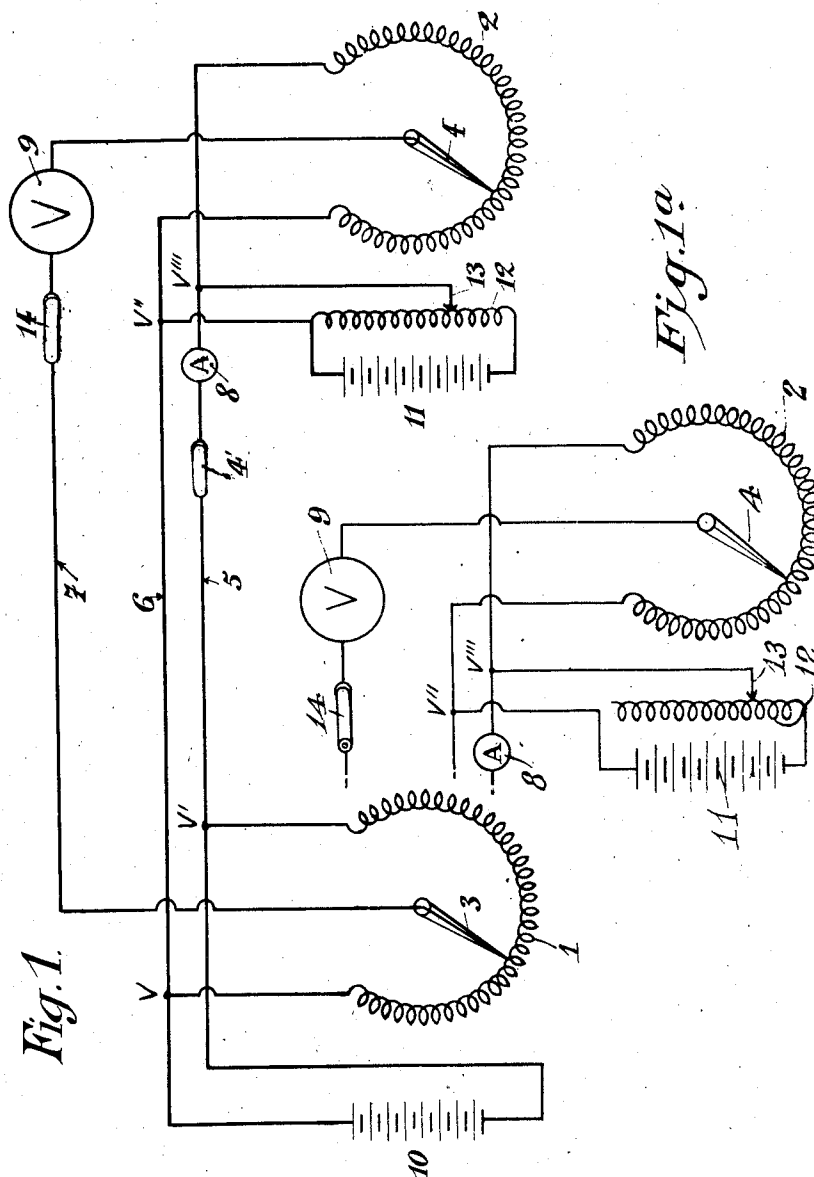
J. L. ROUTIN

1,471,708

ELECTRICAL APPARATUS FOR INDICATING AND REPEATING MOVEMENTS AT A DISTANCE

Filed Feb. 25, 1920

2 Sheets-Sheet 1



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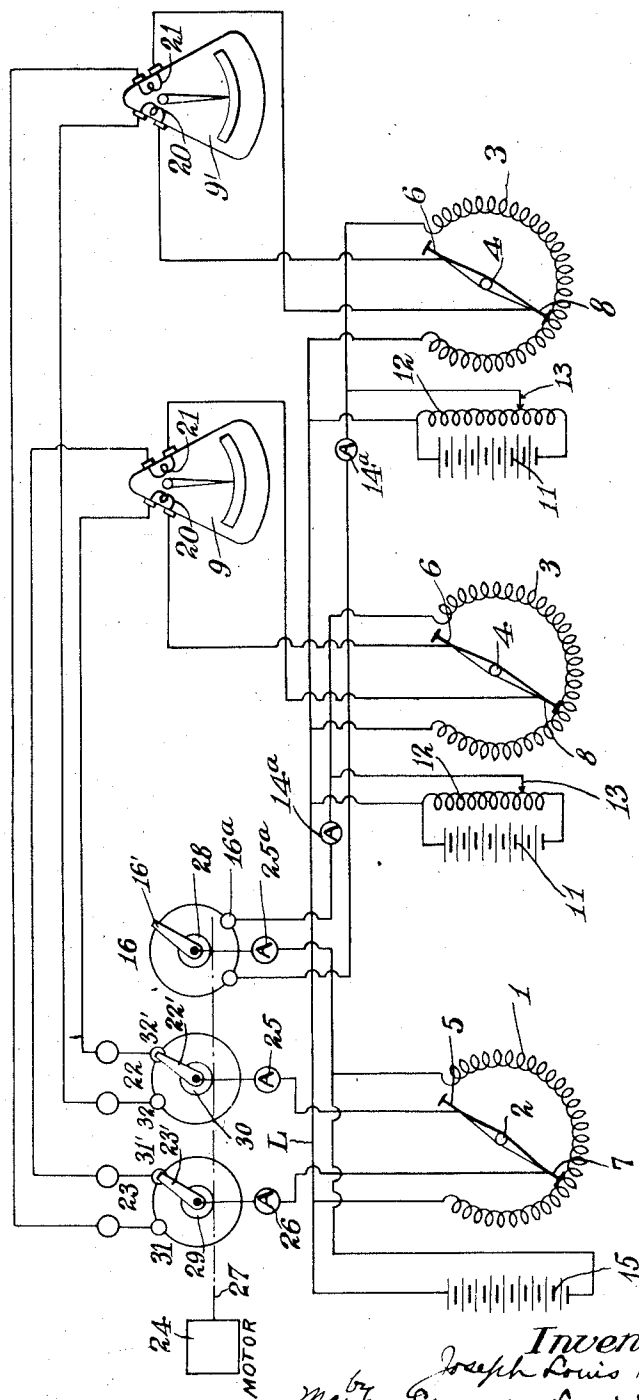
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Fig. 2.



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UNITED STATES PATENT OFFICE.

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ELECTRICAL APPARATUS FOR INDICATING AND REPEATING MOVEMENTS AT A DISTANCE.

Application filed February 25, 1920. Serial No. 361,368.

To all whom it may concern:

Be it known that I, JOSEPH LOUIS ROUTIN, a citizen of the Republic of France, residing at Paris, France, have invented new and useful Improvements in Electrical Apparatus for Indicating and Repeating Movements at a Distance, which invention is fully set forth in the following specification.

The present invention relates to improvements in electrical apparatus for indicating and repeating angular movements at a distance, and more particularly to apparatus of the above kind in which the principle of the Wheatstone bridge is employed, wherein an annular rheostat is employed at the transmitting station and is connected through a source of current to one or more like rheostats at the receiving stations, and has for its object to provide means to maintain the same difference of potential at the terminals of all the rheostats used as potentiometers.

When the distances separating the various stations do not exceed two or three hundred metres, it is always easy to satisfy that condition by inserting adjustable resistances in the circuits of the rheostats, and employing for the supply lines, a cross section sufficiently large to always render any variations that may occur in their resistivities as a result of temperature variations, negligible relatively to the proper resistance of the rheostats. These expedients are however inapplicable in practice when the distances between the stations become greater.

The present invention consists of an improvement whereby messages can be transmitted correctly irrespectively of the distance between the stations, with the use of conductors of very small cross section only. This result is accomplished by applying potential to the rheostat of each receiving station adapted to be adjusted in such a manner as to be kept equal to the voltage which is supplied to the rheostat at the transmitting station.

Fig. 1 of the accompanying drawings is a diagram illustrating the principle of the present invention.

Fig. 1^a is a diagrammatic view showing a slight modification of the circuits shown in Fig. 1.

Fig. 2 is a diagrammatic view showing a further application of the principle of my invention.

Fig. 1 shows two rheostats 1 and 2 situated

ed respectively, the first one at the transmitting station and the second one at the receiving station.

3 and 4 are two movable contacts.

5 and 6 are two conductors connecting together the terminals of the rheostats 1 and 2.

7 is a conductor connecting 3 to 4.

8 is a milliamperemeter inserted in the conductor 5 and situated at the receiving station.

9 is a voltmeter inserted in the conductor 7 and situated at the receiving station.

10 is a storage battery situated at the transmitting station, for supplying the rheostat 1.

11 is a storage battery situated at the receiving station for supplying a rheostat 12.

13 is a movable contact on the rheostat 12; it allows of adjusting at will the supply of voltage to the rheostat 2.

14 is a switch connected in series with the conductor 7.

In order to satisfy the condition as laid down above, that is to say, to supply the same voltage to the rheostats 1 and 2, it will be sufficient, after having opened the circuit of conductor 7 by opening the switch 14, to so operate the rheostat contact 13 as to bring the pointer of the milliamperemeter 8 to zero. Battery 10 applies to the terminals of rheostat 1 potentials V , V' . Battery 11, by aid of its rheostat, is adapted to place on the terminals of rheostat 2 potentials V'' , V''' equal to potentials V , V' on conductors 5 and 6. When this equality is established, no current flows in conductors 5 and 6. This condition is made known by milliamperemeter 8 registering zero. The same difference of potential is thereby obtained at the terminals of both rheostats. When this has been done, the switch 14 is closed, and the orders are transmitted from 1 to 2, by the operator operating contact 4 in such a manner as to keep the pointer of 9 at its zero.

According to a modification shown in Fig. 1^a, communication between the upper end of 12 and the battery 11 may be cut off which is equivalent to connecting the adjustable rheostat 12 in series with 11 and 2 instead of connecting it in parallel with 11.

The expedient to which recourse is had consists as will be seen in employing instead of a single central battery, as many batteries as there are stations, and in regulat-

ing individually by means of auxiliary potentiometers (or of a rheostat connected in series), the potential with which each receiving rheostat is supplied, so as to maintain the said voltage equal to that of the battery at the transmitting station.

It is obvious that the variations in the resistance of the supply lines 5 and 6 are thus without influence upon the accuracy of the transmission, and that it is possible, whilst maintaining a very low voltage (for instance 10 volts) to assure a correct transmission over a very great distance (for instance 20 kilometres).

It should be noted that it is absolutely necessary that the switch 14 shall be open during the time that the supply voltage of the rheostat 2 is being regulated because (assuming that 5 and 6 have equal resistances) when 14 is closed, 5 is traversed by half the current that can flow in 7 even in the case where the voltages at the terminals of 1 and 2 are absolutely equal to each other.

It should also be noted that once the equality of the voltages at the terminals of 1 and 2 has been attained, the circuit of conductor 5 can be opened by means of switch 14' without any inconvenience for using the apparatus for transmission at a distance, which is equivalent to making 3 and 4 agree with each other, because the conductor 6 is sufficient to assure the closing of the controlling current flowing in 7.

Fig. 2 illustrates the manner in which the improvement of the present invention can be applied to the case wherein the receiving station rheostats are connected only in a temporary manner to the contacts of the transmitter rheostat such as shown in the drawings of my Patent No. 1,409,586, issued March 14, 1922. The same letters of reference appearing in the said drawing are used to indicate the same parts in the present Fig. 2, wherein 1 designates the rheostat at the transmitting station and 3—3 the rheostats at the receiving stations, the left-hand end of rheostat 1 being permanently connected with the left-hand ends of rheostats 3—3 through line L. The right-hand end of rheostat 1 is successively connected with the right-hand ends of rheostats 3—3 through a distributor 16, the switch-arm 16' of which is rotated by means of a motor 24 through driving connections 27, 28. Rheostat 1 is provided with brushes 5, 7 revolvable on an axle 2. Brush 7 is connected through a milliamperemeter 26 with the switch-arm 23' of a distributor 23, and brush 5 is similarly connected to arm 22' of distributor 22 through a milliamperemeter 25. Arms 23', 22' are caused to rotate by motor 24 through drive connections 27, 29 and 30 respectively. Each distributor is provided with a pair of contacts 31, 31' and 32, 32' wiped by arms 23', 22'. Each re-

ceiving station is provided with a voltmeter 9, 9', each having a pair of coils 20, 21. One end of each coil has a connection terminating in a contact on one of the collectors 23, 22. The opposite ends of each pair of coils 20, 21 have connections with brushes 6, 8 of rheostats 3—3. A storage battery 15, or other source of direct current, supplies the system with current. Potential is applied to the terminals of rheostats 3—3 by means of storage batteries 11, 11, rheostat coils 12, 12, and sliding contacts 13, 13. Milliamperemeters 14^a and 25^a are inserted in the conductors connecting rheostats 3 to rheostat 1.

In order to establish the same difference of potential between the terminals of the left-hand rheostat 3, for example, as between the terminals of rheostat 1, the contact 13 is adjusted while arm 16' of distributor 16 passes over contact 16^a. By reason of the timing of contact arms 23' and 22' on distributors 23 and 22, the circuit through voltmeters 9, 9' is broken. Milliamperemeter 14^a will give zero reading when the two differences of potential at rheostat 1 and rheostat 3 are the same as previously explained. In the same manner the difference of potential can be maintained in a permanent manner at the terminals of all the rheostats, irrespective of the distances of the receiving stations from the transmitting station.

I claim:

1. Apparatus for indicating and controlling movements at a receiving station from a distant transmitting station comprising a Wheatstone bridge having one branch thereof located at the transmitting station and provided with means for applying potential thereto, the companion branch thereof being located at the receiving station and containing current detecting means, a bridge circuit between said transmitting station and said receiving station said circuit including a switch and a voltmeter and having sliding connections with its cooperating bridge branches, said receiving station branch being provided with means for applying a variable potential thereto when said switch is in open position whereby the voltage at the receiving station is kept equal by aid of said current detecting means to that at the sending station.

2. Apparatus for indicating and controlling movements at a receiving station from a distant transmitting station, comprising a plurality of rheostats one of which is located at a transmitting station and the other at a receiving station, a source of potential at the transmitting station and conductors for connecting the same in parallel with said rheostats, one of said conductors including an amperemeter, a bridge circuit including a switch, a voltmeter and sliding contacts

movable over said rheostats, a separate source of potential at said receiving station and means for adjustably applying said potential across said receiving station rheostat 5 when said first named switch is in open position whereby the voltage at the receiving station rheostat is kept equal by the aid of the amperemeter to that at the sending station rheostat.

10 3. Apparatus for indicating and controlling movements at receiving stations from a distant transmitting station comprising a plurality of rheostats one of which is located at the transmitting station and the 15 others of which are located at the receiving stations, a source of potential at the transmitting station, means adapted to connect the same in parallel with said rheostats,

means including a separate source of potential at each receiving station for regulating 20 the difference of potential across the terminals of each of said receiving-station rheostats whereby the receiving-station voltages are kept equal that of the transmitting-station rheostat, bridge means for connecting 25 said transmitting-station rheostat with each of said receiving-station rheostats, each of said means including a voltmeter and terminal sliding contacts, and current distributors for successively varying connections be- 30 tween said transmitting source of current and said bridge circuits and said receiving-station rheostats.

In testimony whereof I have signed this specification.

JOSEPH LOUIS ROUTIN.