(No Model.)

L. IMHOFF.

APPARATUS FOR VARYING SPEED OF ELECTROMOTORS.

No. 573,979. Patented Dec. 29, 1896.

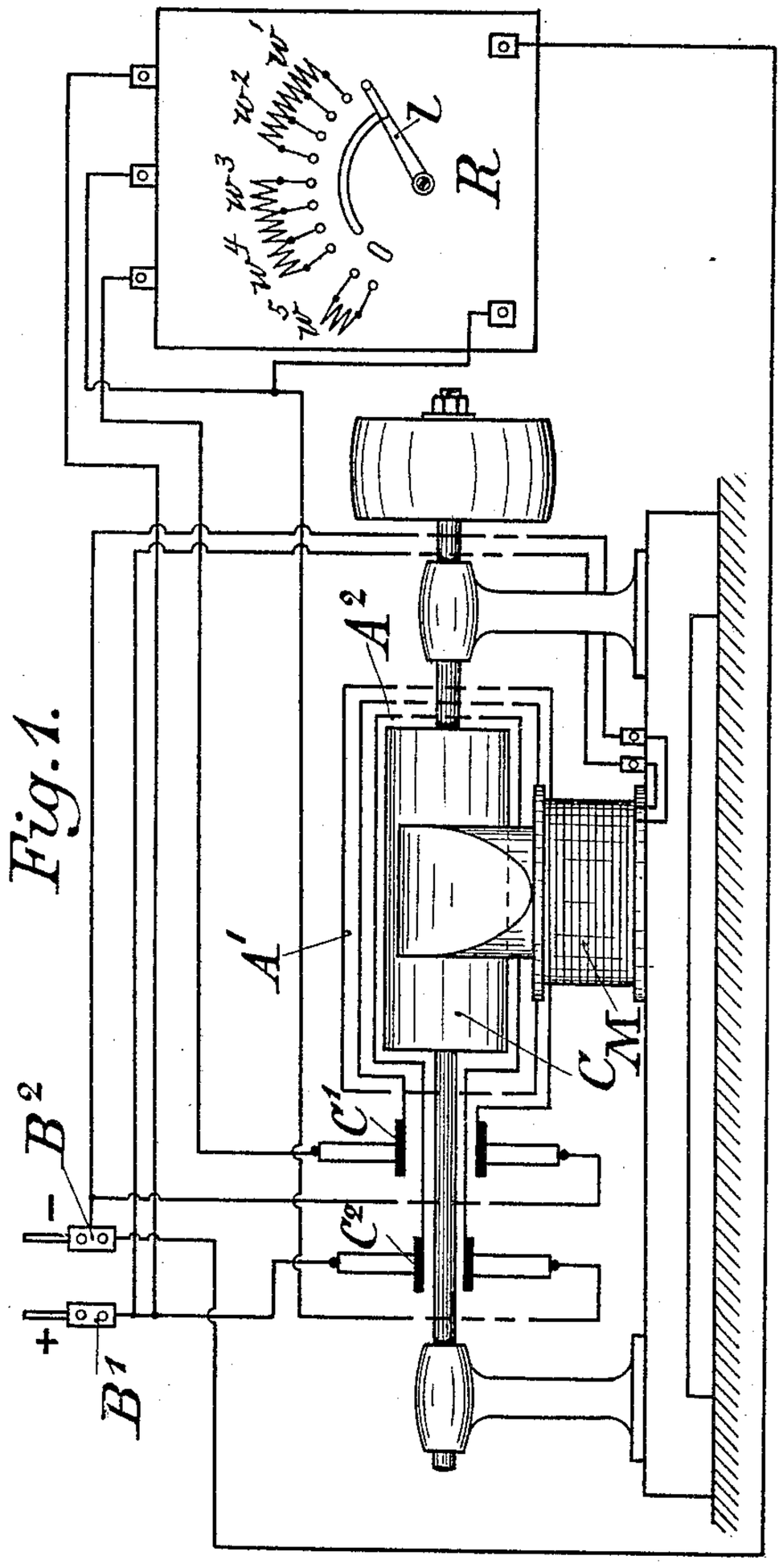

Fig. 1.

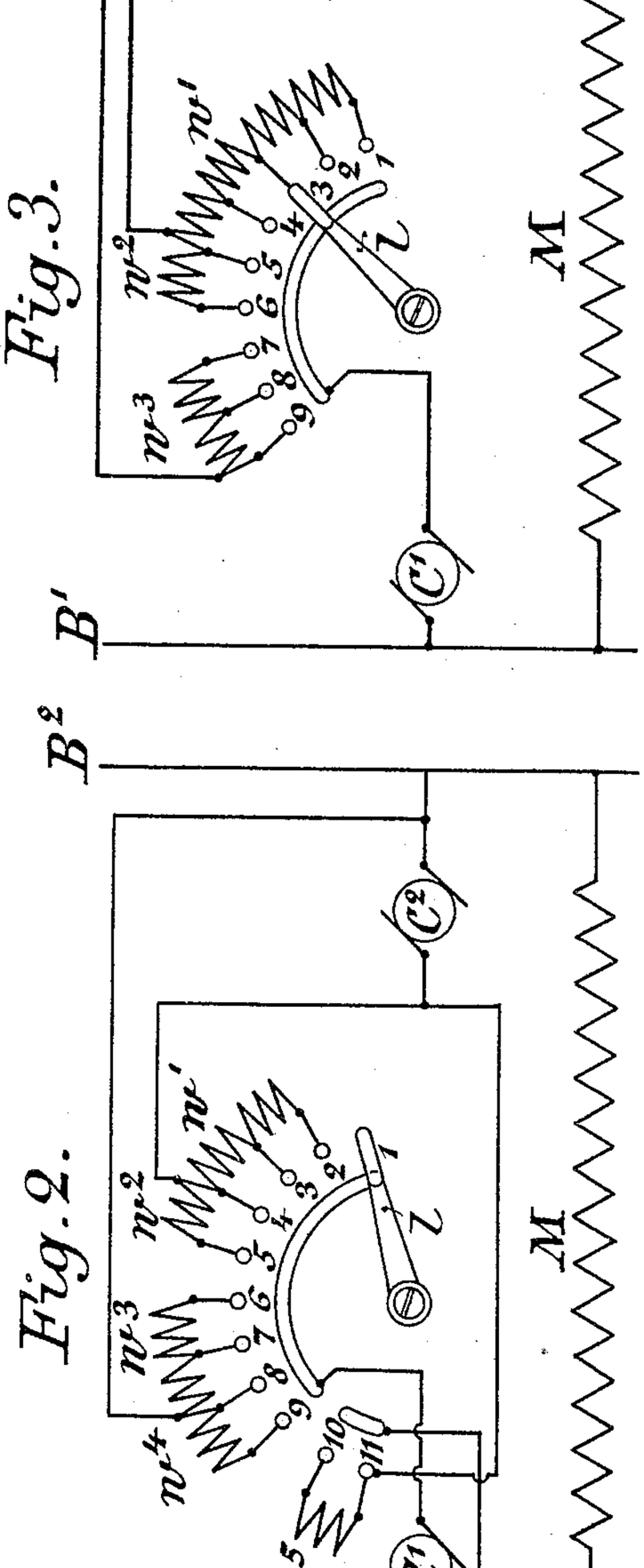

Fig. 3.

Fig. 2.

WITNESSES:
W. A. Alexander,
E. E. Vernell.

INVENTOR:
Ludwig Imhoff
BY ATTORNEYS
Fowler & Fowler

UNITED STATES PATENT OFFICE.

LUDWIG IMHOFF, OF BERLIN, GERMANY.

APPARATUS FOR VARYING SPEED OF ELECTROMOTORS.

SPECIFICATION forming part of Letters Patent No. 573,979, dated December 29, 1896.

Application filed July 3, 1896. Serial No. 597,957. (No model.)

To all whom it may concern:

Be it known that I, LUDWIG IMHOFF, a subject of the German Emperor, residing at Berlin, in the German Empire, have invented certain new and useful Improvements in Apparatus for Varying the Speed of Electromotors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to apparatus for varying the speed of electromotors.

The invention consists in certain connections of switches and resistances which make it possible to alter the number of active windings on the armature of the motor without throwing it out of connection with the source of electricity by which it is being driven.

In the accompanying drawings, Figure 1 is a diagram showing the general arrangement forming the subject of my invention. Figs. 2 and 3 are diagrams of different connections, illustrating the working of the arrangement.

In Fig. 1, C is the core of the armature of an electromotor.

A′ and A² are two armature-windings, both preferably wound upon one and the same core C. The ends of both armature-windings are carried out to separate commutators C′ and C².

B′ and B² are binding-posts supposed to be connected with a source of electricity, such as, for instance, a main carrying the necessary working current generated in a central station.

M is the winding of the electromagnet, represented in the diagrams to be simply connected as a shunt-winding that is placed between the binding-posts B′ and B², but it should be understood that if in any special case it should appear desirable to vary the excitation of the electromagnet a special rheostat would be inserted in any usual way together with the winding M, or else the winding M would be divided into a number of sections, which could be partly thrown out of connection, so as to vary the number of the windings.

R is a rheostat provided in the usual way with a lever *l*. The diagrams 2 and 3 show the way in which the rheostat R and the motor are connected. All the letters of reference correspond to the letters of reference in the more elaborate diagram Fig. 1, w', w^2, w^3, w^4, and w^5 being resistances inserted between the contact-buttons of the rheostat R.

Arrangements have become known by which the speed of an electromotor can be varied by employing more than one complete winding on the armature, thus, for instance, the arrangement described in my German patent, No. 78,789, but these arrangements imply that the motor must be thrown out of connection every time that an alteration of its speed is to be effected.

By my present arrangement all possible variations of speed can be effected while the motor is working. In Figs. 2 and 3 a constant pressure is supposed to be acting between the two conductors B′ and B². In Fig. 2 the armature-winding connected to the commutator C′ is supposed to have twice as many turns as the winding connected to the commutator C², but it should be understood that the ratio between the numbers of turns of the two windings can be given any other suitable quantity.

In the position shown in the diagram Fig. 2 both armatures C′ and C² are out of connection. When the motor is to be started, the lever *l* is moved from right to left. As soon as it reaches the contact-button 2 it will be seen that both armature-windings are now inserted between the conductors B′ and B² in series, the resistances w' likewise being placed in series between them. Thus the motor will be started in the usual way by gradually moving the lever *l* to the left and thereby throwing out the resistance w'. When the lever has reached the contact-button 4, the whole of the resistance is out of connection and the motor will now normally run at its lowest speed. To increase the speed, the lever *l* is moved farther to the left. When it reaches the contact-button 5, the resistance w^2 is placed between the two armatures. This part of the operation, however, is of no importance when the lever *l* is being moved from right to left. The importance of the resistance w^2 only comes into play when the speed of the motor is to be lowered by moving the lever *l* from left to right. Going on to button 6, it will be seen that now only the armature connected to the commutator C′ re-

mains in connection, the armature connected to the commutator C^2 being altogether thrown out. As, according to the assumption made above, the armature connected to the commutator C′ possesses double the number of windings as compared with the armature connected with the commutator C^2, and as the speed of the motor will vary inversely as the number of active windings on the armature, the speed now obtained will be one and a half times greater than the speed originally, but for the resistance w^3, which still remains inserted in series with the armature connected with the commutator C′. By continuing the leftward motion of the lever l the resistance w^3 is gradually thrown out until the lever l reaches the contact-button 8, when the motor will run normally at the speed 1.5, assuming the original speed to be 1. As the leftward motion of the lever l continues, the armature connected with the commutator C′ is thrown out in its turn and the armature connected with the commutator C^2 is inserted instead. Again a resistance, namely, w^5, is placed in series with it to avoid the shock resulting from the alteration of speed, and by continuing the leftward motion of the lever again this resistance is gradually thrown out until contact-button 11 is reached, when only the armature-winding connected with commutator C^2 remains inserted and the motor now runs normally at the speed 3.

In order to decrease the speed, the whole operation is simply reversed by turning the lever l from left to right. When this is done, however, it will be perceived that a shock would occur every time an alteration in the number of active windings inserted takes place if the resistances w^4 and w^2 were not provided. Even if the resistances w^5 and w^3 were proportioned in such a way that the transition from the employment of a lower number of active windings to a higher did not cause a jump in the speed of the motor nevertheless a shock would take place, because the potential difference acting on the motor would be suddenly increased, thus suddenly causing a serious increase of current. This is the reason why I provide the resistances w^2 and w^4 and this is the main feature by means of which my invention constitutes an improvement over similar arrangements hitherto employed and by which I obtain the possibility of varying the speed of my motor without throwing it out of connection.

Fig. 3 shows a somewhat simpler arrangement which can be employed when only one variation of speed is required. In that case both armature-windings connected with the commutators C′ and C^2 are provided with the same number of turns, and by the movement of the lever l from right to left, first, both armature-windings are connected in series, and when the lever progresses from contact-button 6 to contact-button 7 the armature-winding connected to commutator C^2 is thrown out of connection and consequently the speed of the motor varies from 1 to 2, allowing for the variable resistance w^2. In fact, the whole arrangement shown in Fig. 3 is identical with the arrangement shown in Fig. 2, with the one exception that the resistance w^5 with its contact-button is left out.

Having now fully described my invention, what I desire to claim and secure by Letters Patent of the United States is—

1. The combination with an electric motor, having a plurality of separate armature-windings preferably wound on one core, separate commutators connected to the respective armature-windings, a switch for placing one or more of the armature-windings in circuit with the source of electricity, and resistances for insertion in series with the motor at every transition from an armature-winding containing a lower number of turns to an armature-winding containing a higher number of turns, substantially as and for the purpose set forth.

2. The combination with an electric motor, having a plurality of separate armature-windings preferably wound on one core, separate commutators connected to the respective armature-windings, and a controlling-rheostat provided with the usual switching arrangements for placing one or more of the aforesaid armature-windings in circuit with the source of electricity, said rheostat having resistances for insertion in series with the motor at every transition from an armature-winding containing a lower number of turns to an armature-winding containing a higher number of turns, substantially as and for the purpose set forth.

In testimony whereof I have affixed my signature in peesence of two witnesses.

LUDWIG IMHOFF.

Witnesses:
JOHN B. JACKSON,
MAX WAGNER.