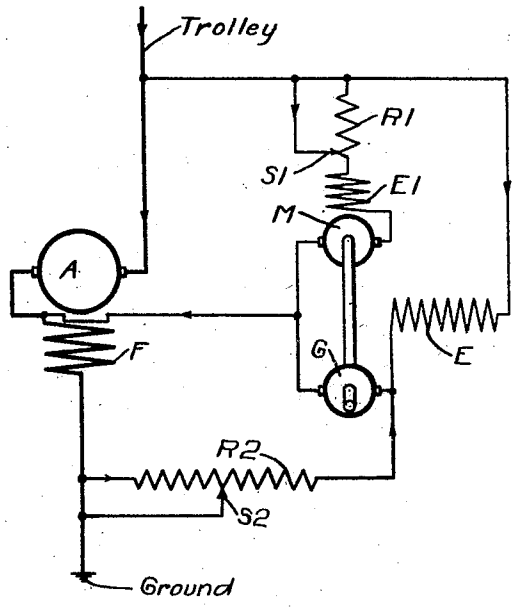
R. E. HELLMUND AND R. E. FERRIS.

SYSTEM OF CONTROL.

APPLICATION FILED OCT. 30, 1918.

1,323,272. Patented Dec. 2, 1919.



WITNESSES:

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RUDOLF E. HELLMUND AND RALPH E. FERRIS, OF SWISSVALE, PENNSYLVANIA, ASSIGNORS TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

SYSTEM OF CONTROL.

1,323,272. Specification of Letters Patent. Patented Dec. 2, 1919.

Original application filed May 4, 1915, Serial No. 25,714. Divided and this application filed October 30, 1918. Serial No. 260,273.

To all whom it may concern:

Be it known that we, RUDOLF E. HELLMUND, a citizen of the German Empire, and a resident of Swissvale, in the county of Allegheny and State of Pennsylvania, and RALPH E. FERRIS, a citizen of the United States, and a resident of Swissvale, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Systems of Control, of which the following is a specification, this being a divisional application of application, Serial No. 25,714, filed May 4, 1915, patented Apr. 1, 1919, No. 1,298,943.

Our invention relates to systems of control, and it has special reference to the control of direct-current motors for electric railway vehicles and the like.

One of the objects of our invention is to provide a system of the above-indicated character which shall be effective and reliable in operation and which shall embody certain automatic or inherent regulating characteristics to prevent undesirable current surges and to maintain a substantially constant operating current.

Another object of our invention is to provide a system of the class in question which may readily be adapted for use during the accelerating periods of the motors to reduce the current peaks and to produce a relatively smooth acceleration of the vehicle.

In the copending application of R. E. Hellmund, Serial No. 860,612, filed September 8, 1914, forfeited and renewed Apr. 19, 1919, S. No. 291,410, and assigned to the Westinghouse Electric & Manufacturing Company, is shown and described a system for obtaining a negative compound effect during regenerative operation, such effect being secured by connecting a portion of the field-winding turns to be negatively or oppositely energized with respect to the remaining field-winding turns and the armature, thereby inherently causing a relatively rapid weakening of the effective field flux upon an increase of the regenerated current. However, in motors of the field-control type, the system in question sometimes requires still further subdivision of the field winding to provide proper accelerating conditions, thus leading to undesirable and expensive complications in the motor connections. Moreover, in case an exciting machine is employed for the main motor-field excitation during the motoring period, if a battery is used to energize the exciter field winding, it becomes impossible to make use of such negative or oppositely-energized field-winding turns in the exciter. Where a dynamotor is used as an exciter, if such negative turns are utilized in its field winding they act only temporarily, upon a change in the operating current, until the dynamotor has readjusted its speed to the new conditions.

According to our present invention, therefore, we provide a system for accomplishing the above-stated objects while obviating the disadvantages mentioned, as hereinafter more fully set forth.

In the accompanying drawing, the single figure is a simplified diagrammatic view of the main circuits of a system of regenerative control embodying our invention.

Referring to the drawing, the system here shown comprises a plurality of suitable supply-circuit conductors respectively marked "Trolley" and "Ground"; a dynamo-electric machine, such as an electric-vehicle motor, having an armature A and a series-connected field-magnet winding F; a motor-generator apparatus, preferably of the familiar dynamotor type, having a motor-armature winding M and a series-connected generator-armature winding G, the dynamotor being provided with a common exciting field-magnet winding E that is connected across the two armature windings M and G and with a series-connected field-magnet winding E1, and a plurality of translating devices, such as resistors R1 and R2, that are respectively provided with suitable gradual-short-circuiting switching devices S1 and S2.

The resistor R1 and the motor-armature winding M of the dynamotor are connected in parallel relation to the main armature A, while the generator armature G is adapted to energize the main field winding F through the resistor R2 to supplement the excitation supplied by the main armature.

Assuming that the main field winding F normally receives a portion of its current from the supply-circuit conductor trolley through the armature A and an additional portion from the generator armature G, and that the system has been started into opera-

tion in any suitable manner so that the resistor R1 is short-circuited, while the resistor R2 is included in circuit, the operation of the system, in so far as our invention is concerned, may be described as follows: if the motor current traversing the armature A is suddenly increased, for any reason, the immediate effect is to increase the voltage across the terminals of the field winding F and, consequently, reduce the current traversing the resistor R2 from the generator-armature winding G. However, this action results in a decreased ohmic drop in the resistor R2, and the final effect is such as to increase the portion of the voltage of the generator G that is impressed upon the terminals of the field winding F, thereby strengthening the main-motor excitation and preventing an undesirable surge of current. In this way, an increase of the main current traversing the armature A, in turn, indirectly produces an increased exciting voltage across the field winding F, thus giving the accelerating motor a compound operating characteristic.

The same result may be obtained if the resistor R2 is short-circuited while the resistor R1 is actively connected in circuit. Provided the motor current increases under such conditions, the instantaneous value of current traversing the generator-armature winding G will be correspondingly decreased for the reasons recited above, with the immediate result that the current in the motor-armature winding M of the dynamotor will be correspondingly reduced, accompanied by a corresponding decrease of the ohmic drop in voltage across the resistor R1. However, the final result of such changes is to increase the voltage impressed upon the motor-armature winding M from the main supply circuit by reason of the reduced ohmic drop across the resistor R1, which action, in turn, will increase the speed of the dynamotor and the voltage delivered by the generator armature winding G thereof, to finally effect a predetermined increase of the excitation of the main motor field winding F.

We do not wish to be restricted to the specific circuit connections or arrangement of parts herein set forth, as various modifications thereof may be made within the spirit and scope of our invention. We desire, therefore, that only such limitations shall be imposed as are indicated in the appended claims.

We claim as our invention:

1. In a system of control, the combination with a supply circuit, and a dynamo-electric machine having series-connected armature and field-magnet windings, of a motor-generator adapted to be driven from said supply circuit and to supplement the excitation of said field winding, and a resistor connected in circuit with the motor of said motor-generator, whereby an increase of armature current inherently effects an increase of field excitation.

2. In a system of control, the combination with a supply circuit and a dynamo-electric machine having an armature and a field-magnet winding, of a translating device, a motor-generator adapted to be driven from said supply circuit to excite said field winding through said translating device, and a second translating device connected in circuit with the motor of said motor-generator.

3. In a system of control, the combination with a supply circuit and a dynamo-electric machine having series-connected armature and field-magnet windings, of a plurality of translating devices, and a dynamotor driven from said supply circuit and having its motor and generator elements respectively connected through said translating devices across the main armature and the main field winding.

4. In a system of control, the combination with a main source of energy, and a dynamo-electric machine having series-connected armature and field-magnet windings, of a separate source of energy for supplying the difference between the load current and the total exciting current, and an impedance external to said source and permanently connected to carry a current varying in accordance with said difference and influencing the total excitation in accordance with changing load current.

In testimony whereof we have hereunto subscribed our names this 17th day of Oct. 1918.

RUDOLF E. HELLMUND.
R. E. FERRIS.