R. P. JACKSON.

CONTROL SYSTEM.

APPLICATION FILED JAN. 5, 1907.

999,792.

Patented Aug. 8, 1911.

2 SHEETS—SHEET 1.

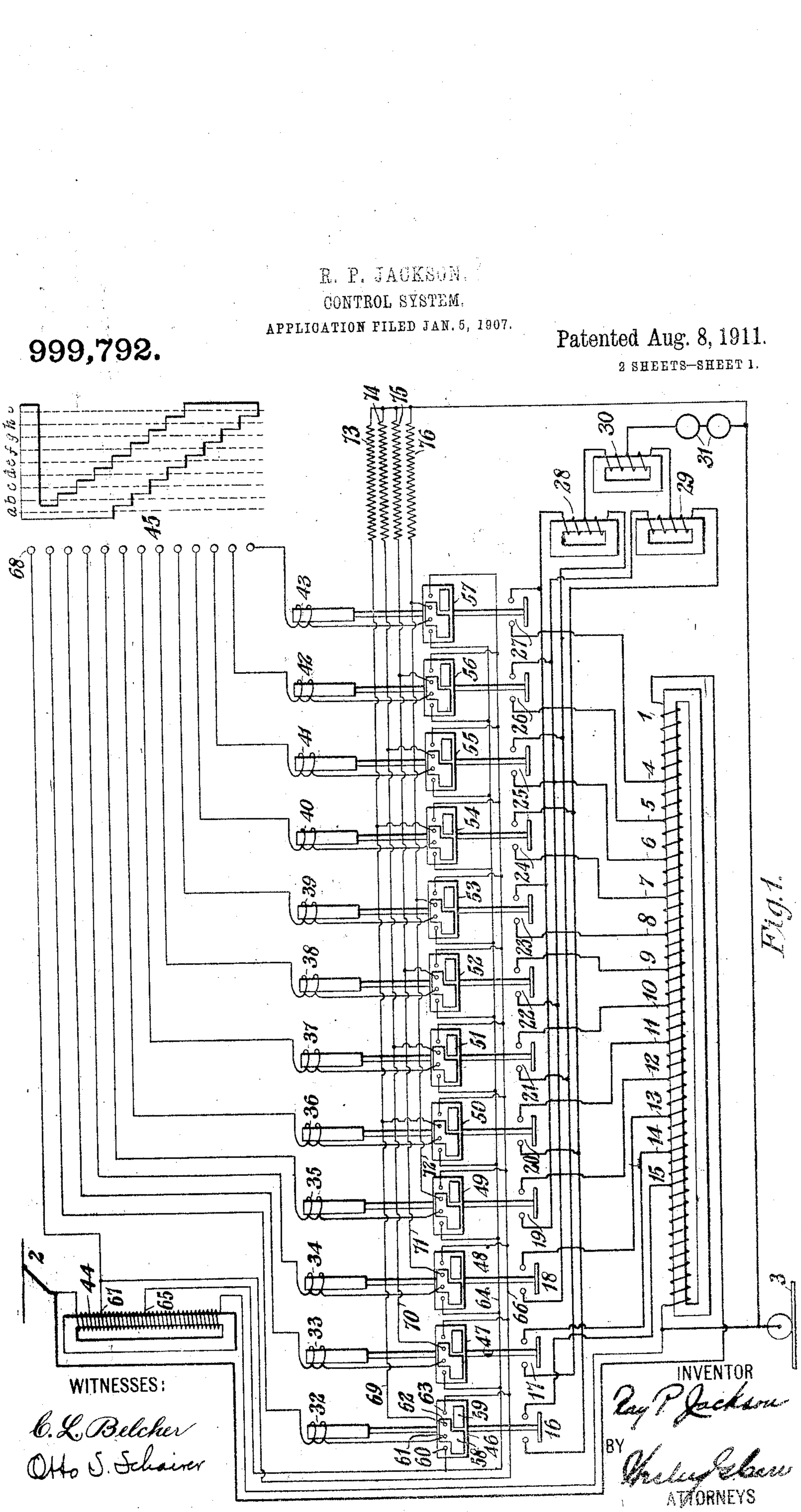

Fig. 1.

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2 SHEETS—SHEET 2.

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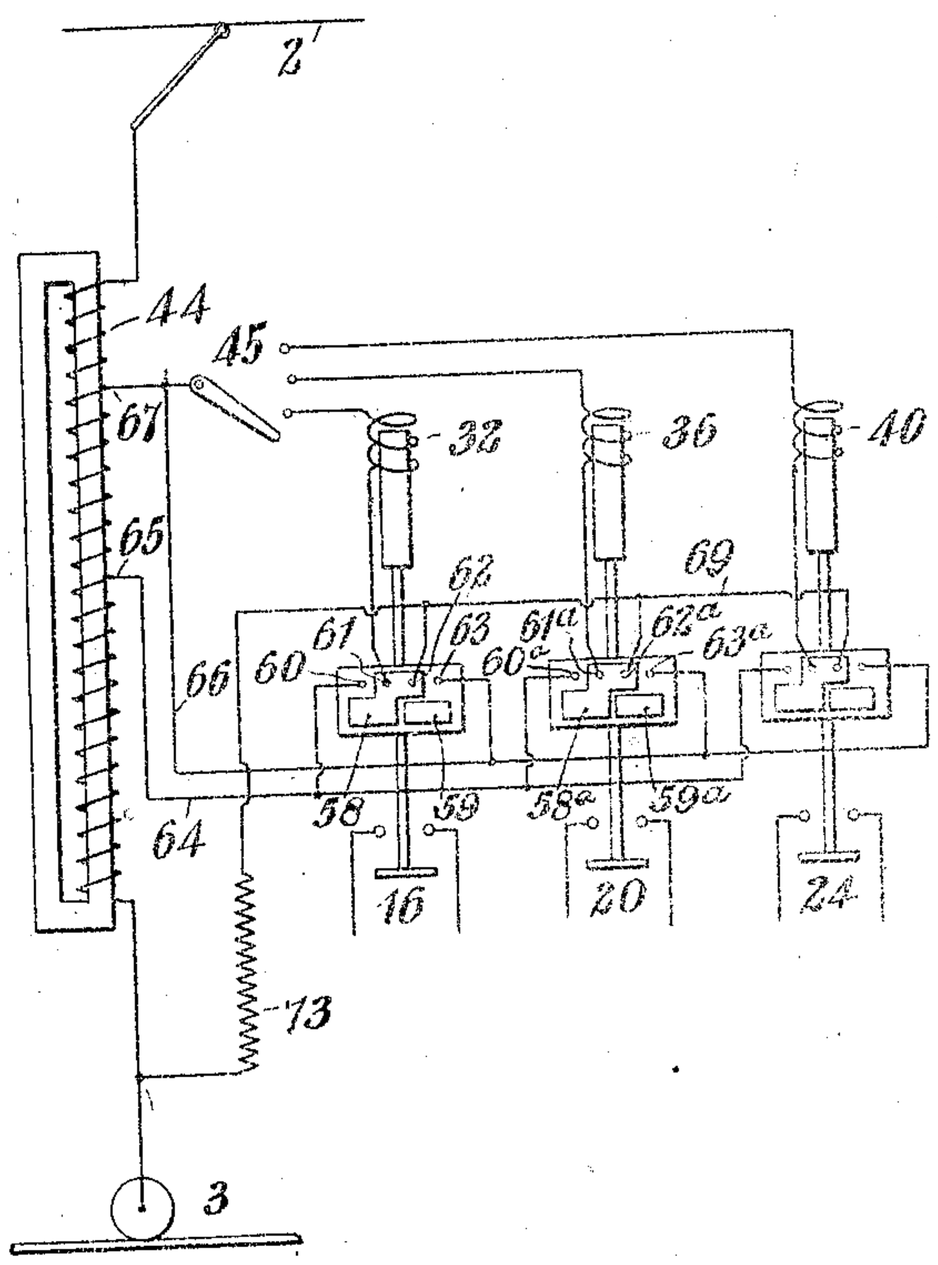
Fig. 2.



WITNESSES:

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RAY P. JACKSON, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

CONTROL SYSTEM.

999,792. Specification of Letters Patent. Patented Aug. 8, 1911.

Application filed January 5, 1907. Serial No. 350,963.

To all whom it may concern:

Be it known that I, RAY P. JACKSON, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Control Systems, of which the following is a specification.

My invention relates to electric control systems, and particularly to those in which a plurality of separately actuated main switches or other devices are employed.

The object of my invention is to provide simple and effective means for preventing simultaneous closure or operation of two or more switches or devices.

In Patent No. 834,525, granted October 30, 1906, to the Westinghouse Electric & Manufacturing Company, upon an application filed by me, is set forth a voltage-regulating system comprising a transformer having leads extending from several points thereof, two inductive windings with means for connecting the same to different transformer leads, and a third inductive winding having its terminals connected to points intermediate the terminals of the other two windings and having a point intermediate its terminals connected to the distributing circuit. In that system, each of the four terminals of the first two inductive windings is adapted to be connected to a plurality of points in the transformer winding by means of a corresponding number or group of separately actuated switches and, in order to avoid short-circuiting portions of the transformer winding, it is necessary to prevent simultaneous closure of two or more switches of each group.

When the transformer winding is provided with a large number of leads and there are, therefore, several switches in each group, the means for preventing simultaneous closure of two or more switches of a group have heretofore been unduly complicated, and it is accordingly the object of my present invention to provide a system in which an unlimited number of switches may be employed without increasing the complication over other systems in which a smaller number of switches are employed.

Figure 1 of the accompanying drawings is a diagrammatic view of a system of control that embodies my invention, and Fig. 2 is a diagrammatic view of a portion of the system shown in Fig. 1.

A main transformer 1 that is supplied from any suitable source of alternating current, such as a trolley conductor 2 and a track rail 3 of a railway system, is subdivided by means of a plurality of leads 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15, the leads being connected to the respective terminals of switches 16 to 27, inclusive. The remaining terminals of the switches are arranged in four groups that are connected, respectively, to the terminals of two inductive windings 28 and 29, the respective terminals of each winding being connected to alternate switches. Intermediate points of the inductive windings 28 and 29 are connected to the terminals of a third inductive winding 30, between an intermediate point of which and a track rail 3 are interposed suitable translating devices, such as motors 31, for the propulsion of a vehicle that may be controlled by the present system.

The switches 16 to 27, inclusive, are provided, respectively, with magnet windings 32 to 43, inclusive, that may either effect operation thereof directly or may control other operating means, the magnet windings being supplied from an auxiliary transformer winding 44. The circuits of the magnet windings are governed, primarily, by means of a master switch 45, and, secondarily, by interlocking switches 46 to 57, inclusive, that are operated, respectively, by the switches 16 to 27, inclusive. Each of the interlocking switches comprises two movable conducting segments 58 and 59 and four stationary contact terminals 60, 61, 62 and 63 that are adapted to be engaged by the conducting segments. The stationary contact terminal 60 of each of the interlocking switches is connected, by means of a conductor 64, to a point 65 in the auxiliary transformer winding 44, and each of the contact terminals 63 is connected, by means of a conductor 66, to another and higher voltage point 67 of the auxiliary transformer winding, the same point being also connected to a stationary contact terminal 68 of the master switch. Contact terminals 61 are connected to terminals of the magnet windings of the corresponding switches, and contact terminals 62 are divided into four groups of three terminals each, the respec-

tive groups being connected to conductors 69, 70, 71 and 72, in series with which are included resistances 73, 74, 75 and 76, respectively, that are each connected, at one end, to the track rail 3. The grouping of the contact terminals 62 corresponds to the grouping of the terminals of the main switches 16 to 27, inclusive, that are connected to the terminals of the inductive windings 28 and 29.

In the operation of the system, the master switch 45 is first moved to the position indicated by the broken line *a*, magnet windings 32 to 35, inclusive, being thereby connected between the high voltage point 67 and the track rail 3, with the resistances 73 to 76, respectively, in series therewith. The switches 16 to 19, inclusive, are then closed, and the inductive winding 28 is connected between transformer leads 12 and 14, while the inductive winding 29 is connected between the alternate leads 13 and 15. As interlocking switches 46 to 48, inclusive, are moved upwardly, the magnet windings 32 to 35 become connected between the points 65 and 67 of the auxiliary transformer winding 44, while the resistances 73 to 76, inclusive, are connected between the point 67 of the transformer 44 and the track rail 3, this circuit being established independently of the master switch 45. The resistances 73 to 76, inclusive, are of such value that, when they are connected in series with the magnet windings, only sufficient current is permitted to traverse the windings to cause operation of the switches and, when they are connected between the lead 67 and the track rails, only a slightly larger amount of current is permitted to flow, whereby short-circuiting of the auxiliary transformer winding is prevented. That is, the resistances of the magnet windings will usually be small as compared with that of the devices 73 to 76. If the master switch is moved to position *b*, the circuit of magnet winding 32 is interrupted thereby, and the circuit of magnet winding 36 is established, the switch 20 being thereby caused to close. If, however, the switch 16 should stick or not open readily, interlocking switch 46 will provide a low resistance shunt for the magnet winding 36 and prevent energizing thereof to a sufficient degree to effect operation of the switch 20. This may be best understood by referring to Fig. 2, in which only one group of switches and a portion of the system has been shown. As shown in this figure, if the magnet winding 32 is energized its circuit will be by way of devices bearing reference characters 67, 45, 32, 61, 58, 60, 64 and 65, the winding being connected between points 65 and 67 of the auxiliary transformer winding 44. The resistance 73 is connected between the point 67 in the auxiliary transformer winding 44, and the track rail 3 by means of a circuit comprising devices 67, 66, 63, 59, 62 and 73. When these conditions prevail, if it is desired to energize the magnet winding 36 and cause closure of the switch 20, the master switch should be moved so as to establish a circuit by way of devices 67, 45, 36, 61ª, 58ª, 62ª, 69, 73 and 3. However, if the switch 16 refuses to open or delays in opening for any reason, the magnet winding 36 becomes connected to the terminal of the resistance 73 that is connected directly to the point 67, by means of the interlocking switch 46, so that it will be shunted by a low resistance path and will not be supplied with a sufficient amount of current to effect closing of the switch 20. Thus, while any one of the switches 16, 20 or 24, comprising one of the groups of switches, remains closed, the other switches of the group cannot be closed because the magnet windings thereof are shunted. The switches of each of the groups are interlocked against each other in the same manner as the group shown in Fig. 2 and the operation of the remainder of the system is exactly similar to that of the group just described. It will, of course, be understood that the object in preventing simultaneous closure of two or more switches of a group is to prevent short-circuiting of portions of the transformer winding that might otherwise result, as will be seen from an inspection of Fig. 1, and of the above mentioned Patent No. 834,525, in which the remainder of the system is fully set forth.

While the invention has been shown and described as employed in connection with a particular system of voltage regulation it will, of course, be understood that it is not limited to such specific application, and also that it may be employed in the control of other devices than electrical switches.

I claim as my invention:

1. The combination with a plurality of separately actuated devices and controlling magnet windings therefor, of means operated by each of the said devices to provide shunts for the windings pertaining to all the other devices.

2. The combination with a plurality of separately actuated devices and controlling magnet windings therefor, of a master switch for governing the circuits of the controlling magnet windings, and means operated by each of said devices to provide shunt circuits to the circuits that may be established by the master switch through the windings pertaining to any or all of the other devices.

3. The combination with a plurality of separately actuated devices, controlling magnet windings therefor, a source having a plurality of leads extending therefrom and a resistance, of means for connecting the magnet windings in series with the resist-

ance between a pair of leads from the source, and means operated by the devices for connecting the windings between another pair of leads from the source, and for connecting the resistance alone between the aforesaid leads.

4. The combination with a plurality of separately actuated devices, controlling magnet windings therefor, a source of multivoltage and a resistance, and means for connecting the magnet windings in series with the resistance between high voltage terminals of the source, means operated by the device for connecting the windings between low voltage terminals of the source and for connecting the resistance alone between the aforesaid leads.

In testimony whereof, I have hereunto subscribed my name this 31st day of December, 1906.

RAY P. JACKSON.

Witnesses:
R. J. DEARBORN,
BIRNEY HINES.