R. P. JACKSON.

MULTIPLE VOLTAGE SYSTEM OF CONTROL.

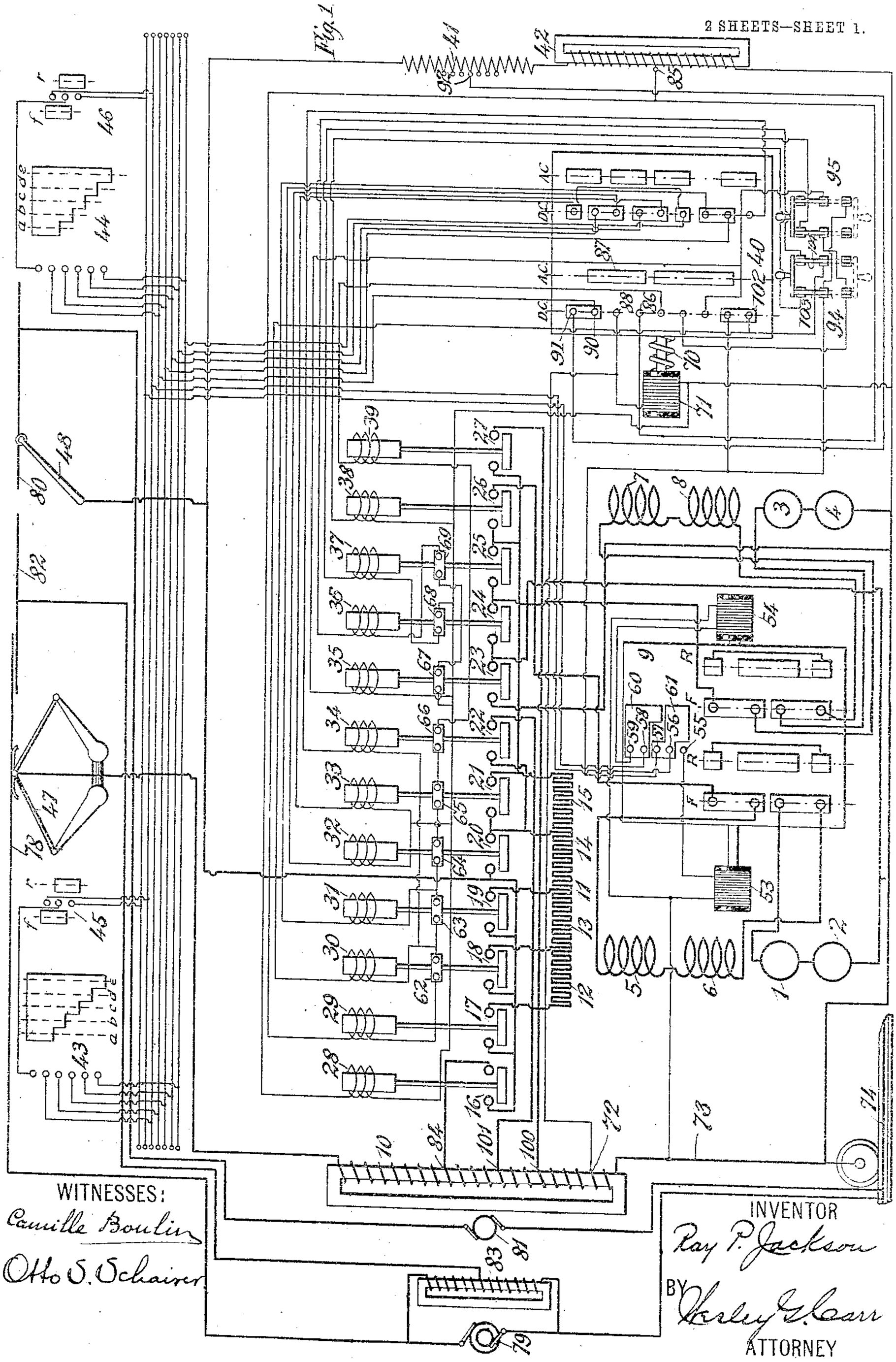
APPLICATION FILED MAR. 3, 1906.

911,011.

Patented Jan. 26, 1909.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

Camille Boulin

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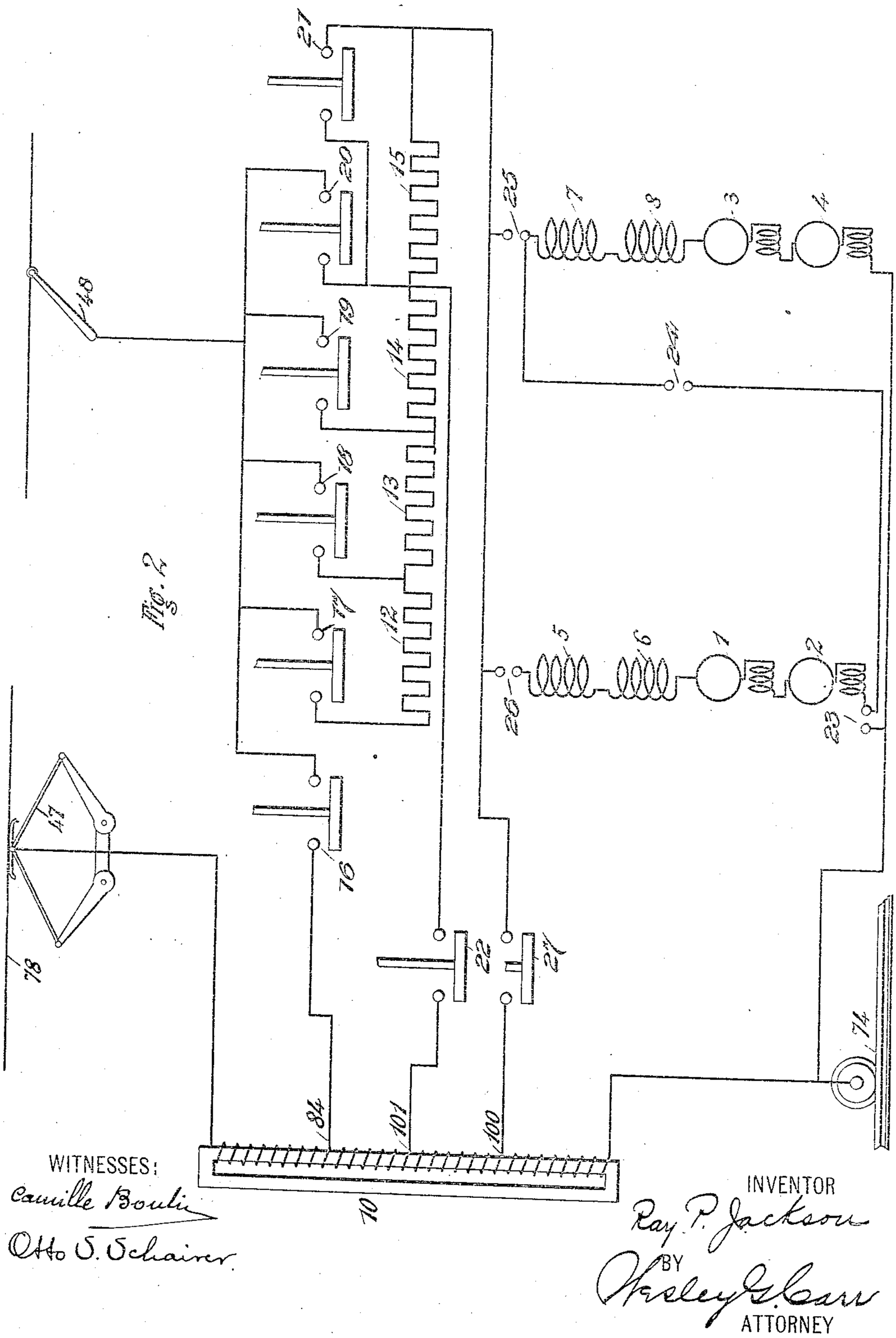

Fig. 2.

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MULTIPLE-VOLTAGE SYSTEM OF CONTROL.

No. 911,011. Specification of Letters Patent. Patented Jan. 26, 1909.

Application filed March 3, 1906. Serial No. 304,024.

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 Multiple-Voltage Systems of Control, of which the following is a specification.

My invention relates to systems of control for electrical translating devices and particularly to systems that are adapted to be supplied with either alternating or direct current and with alternating current at two or more voltages.

The object of my invention is to provide means whereby the circuits of the system may be adjusted automatically in accordance with the character and voltage of the current that is supplied thereto.

In the application of alternating current motors of the commutator type to the propulsion of railway vehicles, it has generally been found necessary to so construct the motors and arrange the circuits of the control system, that the vehicles may be operated by direct current over existing lines. It has also been found expedient or necessary, in some instances, to supply lower voltages to certain sections of the distributing system than to others because of restrictions imposed by operating conditions or by local ordinances. In such systems it has been proposed to employ a specially constructed trolley, that is preferably of the bow type, for the collection of high voltage alternating current and to employ an ordinary wheel trolley for the collection of low voltage alternating current and direct current. In an application, Serial No. 292,234, filed by me December 18, 1905, I have set forth a system in which the circuits are arranged automatically in a novel and improved manner, in accordance with the character of energy that is supplied thereto and in which manually-operated means are also provided, whereby the circuits of the system may be changed when the alternating voltage supplied to the system is changed. My present invention provides means whereby the circuits of such a system may be arranged automatically in accordance with the voltage supplied thereto.

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

The system comprises, as important elements, motors having armatures 1, 2, 3 and 4 and field magnet windings 5, 6, 7 and 8 that are arranged, respectively, in series-connected pairs, a reversing switch 9 for governing the direction of rotation of the motors, a main transformer 10, a sub-divided resistance 11 that comprises sections 12, 13, 14 and 15, switches 16 to 27 inclusive whereby the active length of the main transformer 10, and the amount of the resistance 11 to be included in the motor circuits, may be varied and whereby the motor circuits may be otherwise adjusted, controlling magnet windings 28 to 39 inclusive for the switches; a change-over switch 40 that is interposed in the circuits of the magnet windings 28 to 39 inclusive for the purpose of governing the operation of the switches 16 to 27 inclusive and thereby causing the motor circuits to be adjusted in accordance with the character of energy that is supplied to the system, an auxiliary resistance 41 in shunt to which the magnet windings 28 to 39 inclusive are adapted to be connected when the system is supplied with direct current, an auxiliary transformer 42 from which the magnet windings 28 to 39 inclusive are supplied when operating by alternating current, master switches 43 and 44 for controlling the circuits of the magnet windings 28 to 39 inclusive and adapted to occupy positions indicated by broken lines *a*, *b*, *c*, *d*, *e* and *g*, direction-controlling switches 45 and 46 for governing operation of the reversing switch 9 and adapted to occupy positions indicated by broken lines *f* and *r*, a trolley collector 47 that may be of the bow type or otherwise especially constructed for the collection of high voltage alternating current and a trolley collector 48 of the ordinary wheel type or other structure for the collection of low voltage alternating current and direct current.

The reversing switch 9 is adapted to occupy one or the other of the positions indicated by the broken lines F and R corresponding, respectively, to forward and backward motion of the vehicle to which the system here shown may be applied. The reversing switch is controlled in its operation by means of magnet windings 53 and 54 that may serve either to operate the switch directly or to control

other means, such as electro-pneumatic devices for effecting its operation. The circuits of the magnet windings 53 and 54 are governed primarily by the direction-controlling switches 45 and 46 and secondarily by means of interlocking switches that comprise a set of stationary contact terminals 55, 56, 57, 58 and 59 and conducting segments 60 and 61 which are adapted to engage therewith and are carried by the reversing switch. After the reversing switch has been moved to the one or the other of its positions by reason of the energization of the one or the other of magnet windings 53 and 54, the circuit of the magnet winding that has been utilized for causing such movement is interrupted by the interlocking switches and the circuit of the other magnet winding is arranged so that it may be established by operation of the direction-controlling switches 45 and 46. The interlocking switches also serve to interrupt the circuits of magnet windings 29, 36 and 38 when the circuits of the system are arranged for direct current operation and of magnet windings 35, 37, 38 and 39 when the circuits of the system are arranged for operation by alternating current so that the corresponding switches 17, 24 and 26 in the one case and switches 23, 25, 26 and 27 in the other case cannot be closed for the purpose of establishing the motor circuits, except when the reversing switch occupies the one or the other of the positions indicated by the broken lines F and R. The manner in which the interlocking switches thus control the circuits of these windings will be understood from a consideration of Fig. 1 when it is pointed out that one terminal of each of these magnet windings is connected to stationary contact terminal 57.

The main switches 18 to 25 inclusive are provided, respectively, with interlocking switches 62 to 69 inclusive whereby the circuits of the magnet windings 28 to 39 inclusive are governed for the purpose of preventing the main switches from closing except in a predetermined order.

The change-over switch 40 is normally maintained in the position shown, *i. e.*, in the position indicated by broken lines D—C, by means of a spring 70, in which position the circuits of the system are arranged for direct current operation, and it may be operated or caused to operate to the position indicated by the broken lines A—C by means of a magnet winding 71, the circuits of the system being then arranged for operation by alternating current. The magnet winding 71 is connected between suitable points in the winding of the main transformer 10 such, for example, as a point 72 and the terminal 73 thereof that is connected by means of the vehicle wheels to the grounded track rail 74, so that the winding is energized when the main transformer is energized.

The trolley collector 47 is adapted to be connected to the other terminal of the main transformer winding 10 and to engage a distributing conductor 78 that may be supplied with high voltage alternating current from any suitable source, such as that shown at 79. The trolley collector 48 is adapted to engage a conductor 80 in another section of the distributing system that may be supplied with direct current from any suitable source, such as that shown at 81, and it is also adapted to engage a conductor 82 in still another section of the system which may be supplied with low voltage alternating current, through a lowering transformer 83, from the source 79 or from any other suitable source. The switch 16 serves to connect the trolley 48 and one terminal of the motor circuit to a suitable point 84 in the transformer 10, controlling magnet winding 28 of the switch being connected between a suitable point 85 in the auxiliary transformer 42 and the grounded track rail 74.

Auxiliary resistance 41 and auxiliary transformer 42 are connected in series between the trolley 48 and the grounded track rail 74 so that when the trolley 4 is moved into engagement with the low voltage distributing conductor 82, the magnet winding 28 will be immediately energized and the switch 16 will close thereby connecting the trolley 48 to the point 84 in the main transformer 10. The terminal of the magnet winding 28 that is connected to the point 85 in the auxiliary transformer 42, is also connected to a stationary contact terminal 86 of the change-over switch 40, that is adapted to be engaged by a conducting segment 87 when the change-over switch occupies the position A—C and be thereby connected to a stationary contact terminal 88 that is connected to the point 72 of the main transformer 10. It follows that when low voltage alternating current is supplied to the system, through the trolley 48, the magnet winding 28 will be energized immediately from the auxiliary transformer 42 and the main transformer 10 will thereupon be connected in circuit by means of switch 16. The change-over switch will then be operated because of energizing of magnet winding 71. However, when high voltage alternating current is supplied to the system, the change-over switch will be thrown immediately because of energizing of the main transformer 10 and of magnet winding 71. After movement of the change-over switch, magnet winding 28 will also be energized and switch 16 will close.

One terminal of each of the magnet windings 29 to 39, inclusive, is connected to the grounded track rail 74 and the other terminals are adapted to be connected to a stationary contact terminal 90 of the change-over switch 40 by means of the master switches 43 and 44. The contact terminal 90 is adapted

to be connected to the point 85 in the auxiliary transformer 42 and to the point 72 in the main transformer 10 by means of the conducting segment 87 when the change-over switch is moved to the position A—C, and by means of conducting segment 91 to a suitable point 92 in the auxiliary resistance 41, when the change-over switch occupies position D—C. The magnet windings 29 to 39, inclusive, are therefore supplied with energy from either or both of the transformers 10 and 42, when the system is supplied with the alternating current, and they are connected in shunt to a portion of the resistance 41 when the system is supplied with direct current. The magnet windings 29 to 39, inclusive, are so constructed that but very small amounts of current are required to energize them and the auxiliary resistance 41 and the auxiliary transformer 42 are so proportioned that when operating by direct current, the greater portion of the drop of potential over the two devices will occur in the device 41, while, when operating by alternating current, practically all of the potential drop will occur in the transformer 42. Thus, the magnet windings for the individually actuated switches are supplied with direct current from the auxiliary resistance 41 and with alternating current from the auxiliary transformer 42. The mode of operation of this portion of the system is fully set forth in the application, Serial No. 292,234, above referred to, and since it forms no part of my present invention, I do not deem it necessary to describe its operation further.

In order that the one or the other of the pairs of motors may be removed from service, upon the occurrence of an injury thereto, or for any other reason, cutout switches 94 and 95 are interposed in circuit with certain of the magnet windings 29 to 39, inclusive, in such manner that, when the switch 94 is moved to the position shown in broken lines, the motors comprising armatures 1 and 2 and field magnet windings 5 and 6, will be removed from the circuit, and when the switch 95 is moved to the position shown in broken lines, the motors comprising armatures 3 and 4 and field magnet windings 7 and 8 may be removed from the circuit. Since the cutout switches form no part of my present invention and are here illustrated only for the purpose of showing a complete, operative system, I deem it unnecessary to describe, in detail, the circuits in which they are included.

Since the specific manner in which the circuits of the magnet windings 29 and 39, inclusive, are established and the resultant order of closure of the corresponding switches 17 to 27, inclusive, form no part of the present invention and are fully set forth in application, Serial No. 292,234, above referred to, I deem it unnecessary to trace each of the circuits specifically and will therefore, only state the conditions of the circuits which exist when one or the other of the master switches 43 and 44 occupies its respective positions for each position of the change-over switch. These circuits will be best understood during the description by referring to Fig. 2. When the trolley 48 engages conductor 80, that is, when direct current is supplied to the system, the change-over switch occupies the position shown and if one of the master switches is moved to the position *a* and the corresponding direction-controlling switch is moved to the position *f*, the reversing switch 9, if it does not already occupy that position, will be moved to the position F. The circuit that is established to effect the said movement of the reversing switch is from the point 92 in the resistance 41 by way of devices bearing reference characters 91, 90, 43 or 44, 45 or 46, 56, 61, 55, 53 and 73 to the ground at 74. Upon movement of the reversing switch to position F, switches 17, 26 and 24 will be closed and the motors will be connected in series, with the resistance sections 12, 13, 14 and 15 in circuit. The circuits that are established to effect closure of the said switches are, respectively, as follows: by way of devices bearing reference characters 41, 92, 91, 90, 43 or 44, 45 or 46, 56, 61, 57, 102, 29, 62, 63, 64 and 74, from 57 by way of devices 103, 38 and 74, and from 57 by way of devices 102, 104, 36, 69, 67 and 74. As the master switch is moved through positions *b*, *c* and *d*, the switches 18, 19 and 20 will be closed successively and the switches 17, 18 and 19 will open successively, thereby removing the resistance sections 12, 13 and 14 from the circuit. When the master switch is moved to position *e*, switches 20 and 21 will both be closed and the motors will be connected in series, with no resistance in circuit.

If the trolley 48 engages conductor 82, low voltage alternating current will be supplied to the system and magnet windings 28 and 71 will be immediately supplied with energy from the auxiliary transformer 42, whereupon the switch 16 will close and the change-over switch 40 will be moved to the position A—C. Similar conditions will be established in a manner which has been hereinbefore described when the trolley 47 engages conductor 78. If one of the master switches is then moved to the position *a* and the corresponding direction-controlling switch is moved to the position *f*, the magnet winding 53 will be energized and the reversing switch will be thrown to the position F. Upon movement of the reversing switch to position F, switches 23, 25, 26 and 27 will be closed and the motors will be connected in series parallel relation between the track rail 74 and a suitable low voltage point 100 in the main transformer 10. Upon movement of the master switch to the position *b* the switch

27 will open and switch 22 will close, whereupon the motors will be connected in the same relation as before but to a higher voltage point 101 in the main transformer 10 with resistance section 15 in circuit. When the master switch is moved to the position *c*, the switch 21 is also closed and the resistance section 15 is removed from the circuit. Movement of the master switch to the position *d* causes the switch 19 to close and the switch 22 to open, the motors then being connected to a high voltage point 84 in the main transformer 10 with resistance section 14 in the circuit. When the master switch is moved to the position *e* switch 20 closes and switch 19 opens, the resistance section 15 being thereby removed from the circuit.

I claim as my invention:

1. In a system of control, the combination with translating devices that may be operated by either alternating or direct current, means for arranging the circuits of the system in accordance with the character of energy that is supplied thereto but normally for direct current operation, and means for automatically causing the same to arrange the circuits for alternating current operation when alternating current is supplied to the system, of a transformer, a switch whereby the translating device may be connected thereto for alternating current operation, and means whereby the said switch may be operated automatically when alternating current is supplied to the system.

2. In a system of control, the combination with translating devices that may be operated by either alternating or direct current, and a switch for arranging the circuits of the system in accordance with the character of energy that is supplied thereto, of a transformer, a switch whereby the translating device may be connected thereto for alternating current operation, and means whereby the said switches are operated automatically when alternating current is supplied to the system.

3. In a system of control, the combination with translating devices that may be operated by either alternating or direct current and means for arranging the circuits of the system in accordance with the character of energy that is supplied thereto, of means for automatically causing the circuits to be arranged for alternating current operation when alternating current is supplied to the system, and means whereby the translating devices may be automatically connected to a source of alternating current when alternating current is supplied to the system.

4. In a system of control, the combination with translating devices that may be operated by either alternating or direct current, means for arranging the circuits of the system in accordance with the character of energy that is supplied thereto and means for automatically causing the circuits to be arranged for alternating current operation when alternating current is supplied thereto, of a transformer, a current collector that is connected thereto, another current collector, and means whereby the same may be automatically connected to the transformer when alternating current is supplied thereto.

5. In a system of control, the combination with distributing conductors for direct current and for high and low voltage alternating current, respectively, a transformer, a current collector for high voltage alternating current that is connected to the transformer and another current collector for direct and for low voltage alternating current, of means for automatically connecting the same to the transformer when alternating current is supplied to the system.

6. In a system of control, the combination with translating devices, distributing conductors for direct current and for high and low voltage alternating current, respectively, a transformer, a collector for high voltage alternating current that is connected thereto and a collector for direct current and for low voltage alternating current, of means for connecting the same and the translating devices to the transformer when alternating current is supplied to the system.

7. In a system of control, the combination with translating devices, distributing conductors for direct current and for high and low voltage alternating current, respectively, a transformer, a collector for high voltage alternating current that is connected thereto and a collector for direct current and for low voltage alternating current, of means for connecting the same and the translating devices to the transformer when alternating current is supplied to the system, means for arranging the circuits of the system in accordance with the character of energy that is supplied thereto and means for causing the circuits to be arranged automatically in accordance with the character of energy that is supplied to the system.

8. In a system of control, the combination with a source of high and low voltage currents, and translating devices, of means for automatically connecting the translating devices to the said source regardless of the voltage supplied thereby.

9. In a system of control, the combination with translating devices that may be operated by either alternating or direct current, means for automatically arranging the circuits of the system in accordance with the character of energy that is supplied thereto, means whereby high and low voltage alternating current may be supplied to the system and means whereby the same circuit relations with reference to the translat-

ing devices will be established automatically regardless of the voltage that is supplied to the system.

10. In a system of control, the combination with translating devices that may be operated by either alternating or direct current, sources of supply of direct current and of high and low voltage alternating current, respectively, a main transformer and an auxiliary transformer, of a switch whereby the circuits of the system may be arranged automatically in accordance with the character of energy that is supplied thereto, governing means therefor that are supplied from the main transformer, a switch whereby the translating devices may be connected to the main transformer and governing means therefor that may be supplied from either or both the auxiliary and the main transformer.

11. In a system of control, the combination with translating devices that may be operated by either alternating or direct current, sources of supply of direct current and of high and low voltage alternating current, respectively, a main transformer and an auxiliary transformer, of a switch whereby the circuits of the system may be arranged automatically in accordance with the character of energy that is supplied thereto, governing means therefor that are supplied from the main transformer, means whereby the translating devices may be connected to the main transformer and governing means therefor that may be supplied from either the auxiliary or the main transformer or from both of them.

In testimony whereof, I have hereunto subscribed my name this 24th day of February, 1906.

RAY P. JACKSON.

Witnesses:
R. B. INGRAM,
BIRNEY HINES.