(No Model.) 2 Sheets—Sheet 1.

H. P. DAVIS.

CONTROLLING SWITCH FOR ELECTRICALLY PROPELLED VEHICLES.

No. 503,279. Patented Aug. 15, 1893.

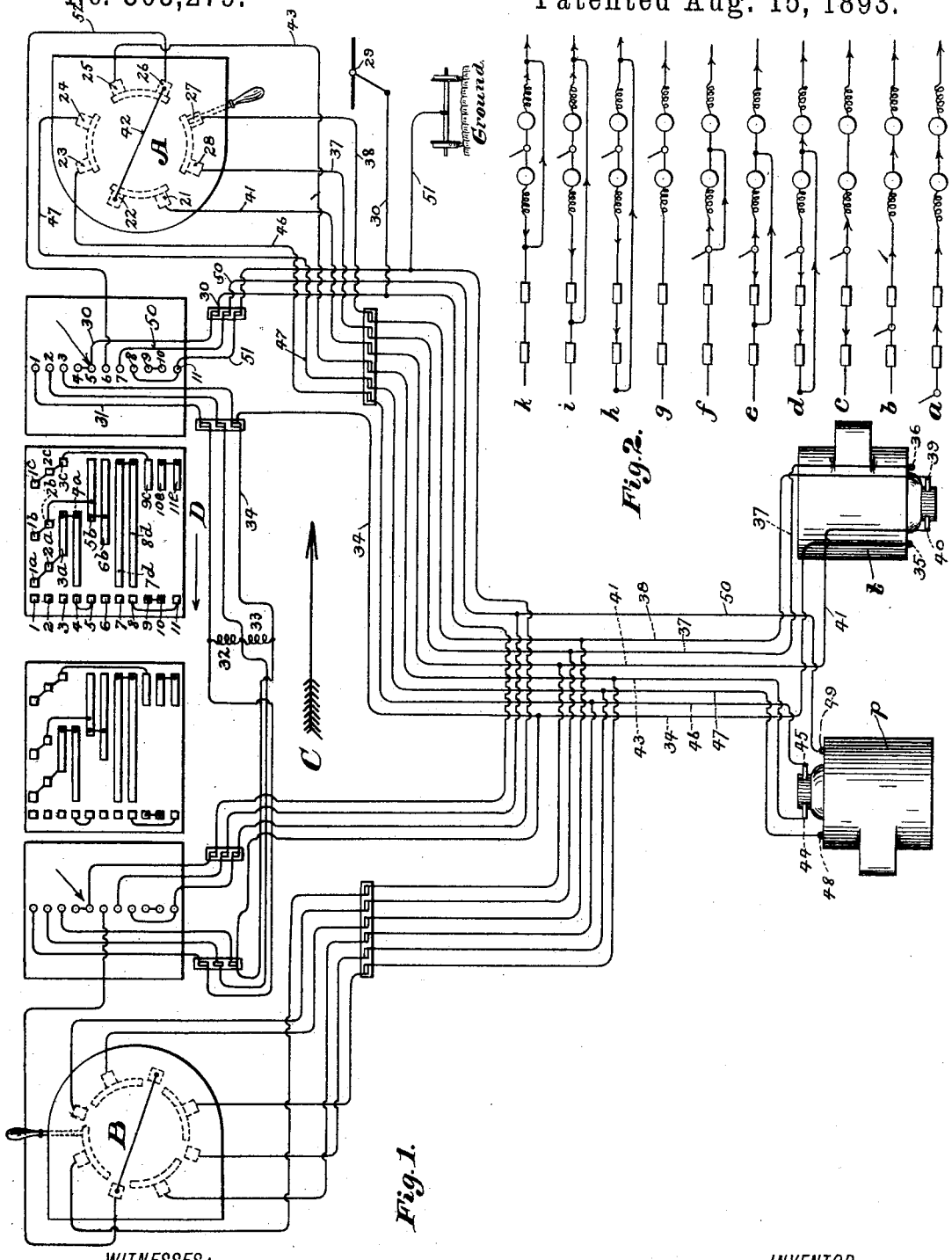

Fig. 1.

Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

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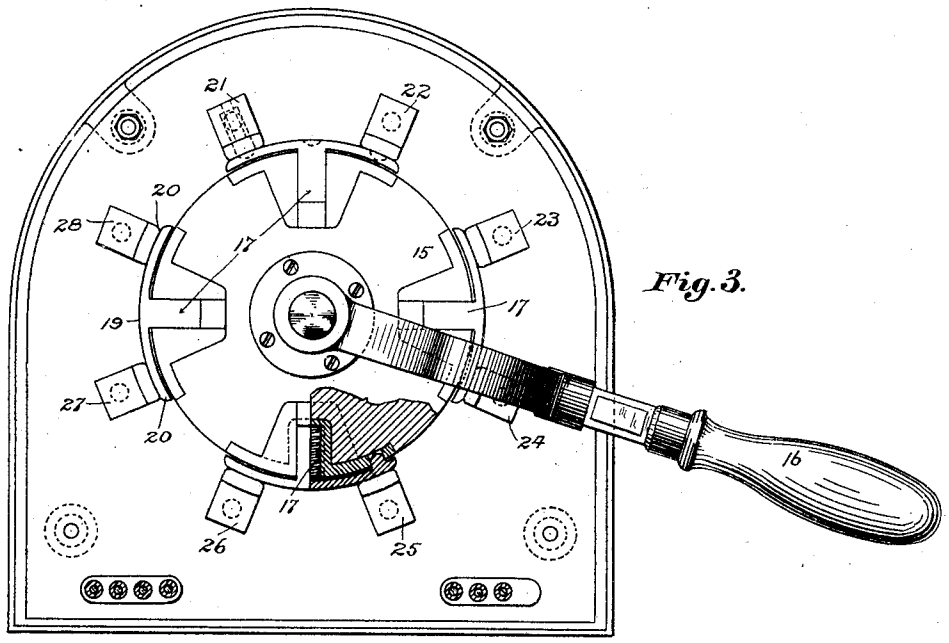

Fig. 3.

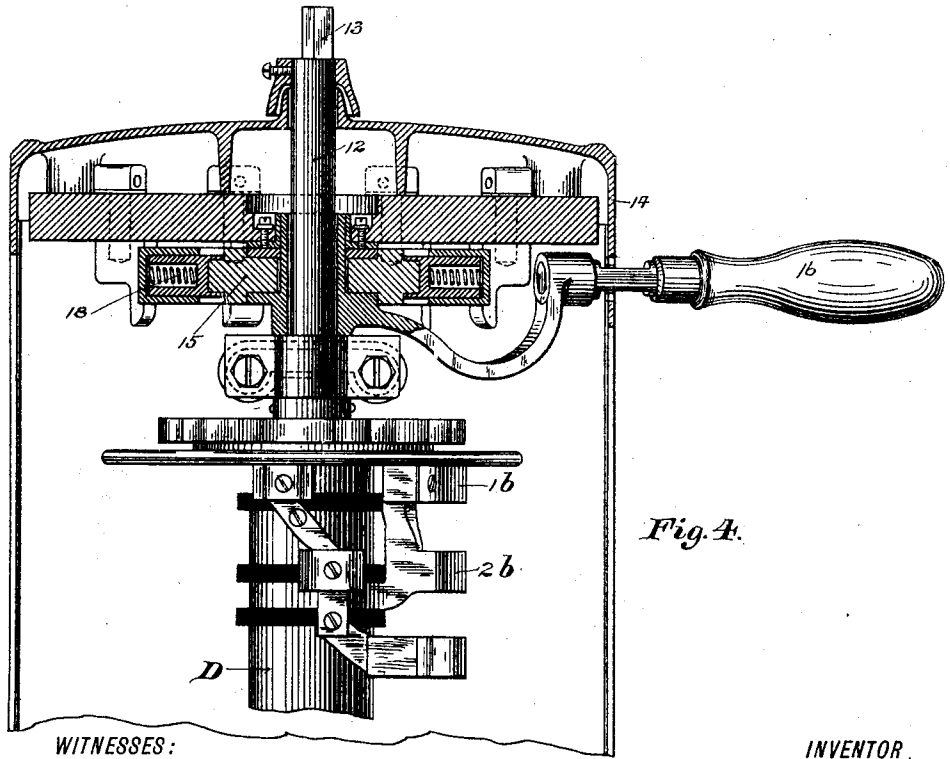

Fig. 4.

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UNITED STATES PATENT OFFICE.

HARRY P. DAVIS, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, OF SAME PLACE.

CONTROLLING-SWITCH FOR ELECTRICALLY-PROPELLED VEHICLES.

SPECIFICATION forming part of Letters Patent No. 503,279, dated August 15, 1893.

Application filed January 7, 1893. Serial No. 457,617. (No model.)

To all whom it may concern:

Be it known that I, HARRY P. DAVIS, a citizen of the United States, residing in Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Controlling-Switches for Electrically-Propelled Vehicles, (Case No. 536,) of which the following is a specification.

My invention relates to means for controlling electric motors on moving vehicles.

The object of my invention is to simplify the construction of switches and connections whereby the motor or motors on an electric locomotive may be controlled.

A further object of my invention is to render possible a greater variety of circuit changes by means taking up minimum space.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram, showing the circuits whereby two motors may be controlled from either end of the car. Fig. 2 shows in diagram the successive relations of circuits preferably employed by me. Fig. 3 is a top view of my controlling switch with the cover removed, and Fig. 4 is a vertical section of the same showing a portion of the controlling drum.

The method of manipulating two electric motors as illustrated in Fig. 2 and by means of the circuits as generally shown in Fig. 1, is no part of my invention. These circuits have been hitherto employed in connection with a controlling cylinder similar to that shown in part in Fig. 4, and with a reversing switch situated under the car and operated by gears more or less complicated from the point of control. I am also aware that controllers have been used whereby the same handle and the same controlling stand may be used to operate a circuit-changing cylinder which performs the desired commutations and reverses the motors by turning the cylinder in one direction or the other. It will, however, be immediately apparent that where the changes in circuits which are to be employed become, as in the present case, more or less complicated, it would require a cylinder of very great diameter to accommodate the strips necessarily employed for the purposes of commutation, if these strips had to be duplicated on the same cylinder for purposes of reversal of the motors. It is this use of necessarily large cylinders on the one hand and the use of a separate reversing device under the car on the other, which it is the object of my invention to avoid.

Fig. 1 shows in diagram two controlling stands A, B, either of which may be used, according as the car is moving in one direction or the other. For the purposes of this specification I will suppose the car to be moving in the direction indicated by the arrow C, and the controlling stand A to be the one in use.

At D is shown the development of a cylinder provided with commutating strips and also the series of contact buttons 1 to 11 cooperating with said strips to make and break circuit. In order to more clearly show the connections between the contact buttons 1 to 11, the trolley, motors, and ground, these buttons are duplicated on the right of D. At the other end of the car the same device is used as shown, and a description of the device used at one end of the car will suffice for the whole system.

The cylinder D is mounted on a preferably vertical axis 12, Fig. 4, which may be rotated by means of the squared end 13 in any preferred way. A casing 14, should of course, be used to protect the contacts. Between the top of the cylinder D, upon which are situated the commutating strips as shown at 1^b, 2^b, &c., is situated the reversing switch 15, shown in plan in Fig. 3 and in section in Fig. 4. This switch consists of a central body 15, pivoted upon the axis 12 of the cylinder D, and rotated by means of the handle 16, or any other preferred apparatus. Radial slots 17 are provided in the body 15, and contain springs preferably spiral, as shown at 18, Fig. 4. Movable contacts 19, having symmetrically placed flanges 20, are pressed outward by means of the springs 18 and into contact with studs 21 to 28 inclusive.

By turning the body 15 upon its axis by means of the handle, the flanged parts 19 may be brought into contact with one or with two studs, 21 to 28, as shown at A and B, Fig. 1. The position shown at B is the inoperative

one, and according as the handle is pushed forward or backward, the motors may be made to move forward or backward by reversal of circuits in the manner about to be described.

First, suppose it is desired that the car should move forward, the handle 16 is thrown in the direction shown at A in Fig. 1, thus causing the contacts 19 to bridge across pairs of studs so as to connect 21 with 22, 23 with 24, 25 with 26 and 27 with 28. Since the body 15 revolves loosely around the axle 12, the cylinder D will not have been moved. The next operation will be to turn the cylinder D in the direction shown by the arrow in Fig. 1, until the cylinder strips are brought into contact with the buttons 1 to 11. At the first contact it will be seen that the following connections are made. Between 1 and 1^a, 4 and 4^a, 7 and 7^d, and 8 and 8^d. Buttons 4 and 5 are permanently connected together and might, if desired, form one piece. The same is true of buttons 9 and 10; buttons 8 and 11 are also connected electrically as shown. This first contact will establish the following circuit: from trolley 29, by wire 30, to button 5, thence to button 4, strips 4^a, 3^a, 2^a, 1^a, button 1, wire 31, resistance 32, resistance 33, wire 34, field terminal 35, through the field-magnets, out at field terminal 36 by wire 37 to stud 28, bridge-piece 19, stud 27, wire 38, commutator brush 39, through the armature, commutator brush 40, wire 41, stud 21, bridge-piece 19, stud 22, wire 42, stud 26, bridge-piece 19, stud 25, wire 43, brush 44, through the armature of the second motor, brush 45, wire 46, stud, 23, bridge-piece 19, stud 24, wire 47, field terminal 48, through the field-magnet of second motor, through the field terminal 49, wire 50, button 7, strips 7^d and 8^d, buttons 8 and 11, wire 51 and to ground. This circuit places the two motors in series as indicated at *a* in Fig. 2, the two resistances 32 and 33 being in series with said motors. As the cylinder D is moved through each one-tenth of a revolution, the following changes in circuits are accomplished: first, as shown at *b*, resistance 32 is thrown out, the motors remaining in series. Next, as shown at *c*, the motors remaining in series, both resistances are thrown out. Next as shown at *d*, the two motors remaining in series, both resistances are thrown in shunt around the temporary motor. I use this term temporary with regard to this motor, because, unlike the other, it is not always in circuit during commutation. Next, as shown at *e*, one of the shunt resistances is thrown out. Next, as shown at *f*, the second resistance is thrown out and the temporary motor is short-circuited. Next, as shown at *g*, the temporary motor is cut out and only one motor is in circuit. Next, as shown at *h*, the two motors are placed in multiple arc, both resistances being in series with the temporary motor. Next, as shown at *i*, one of the resistances is cut out, and lastly, as at *k*, both resistances are cut out and the two motors are running simply in parallel. As before stated, this method of governing the motors is not of my invention, and is merely set forth here in order to render clear the exact position in the circuit of the reversing switch. It will be observed that in order better to understand the essential electrical relations of the various parts of the reversing switch to the two motors, it will be necessary to trace the circuit in the typical case represented at *k*, wherein the two motors are in multiple arc. This will be from trolley 29, by wire 30 to contact 5. Thence to 5^b, 6^b, contact 6, wire 52 to stud 26. Here the current will divide into two branches. First branch by wire 42, stud 22, strip 19, stud 21, wire 41, brush 40, armature of motor No. 1, brush 39, wire 38, stud 27, strip 19, stud 28, wire 37, field terminal 36, field-magnet of motor No. 1, field terminal 35, wire 34, button 3, strip 3^c, strip 9^c, buttons 9, 10, strips 10^c and 11^c, buttons 11, wire 51 to ground. Second branch from stud 26 by strip 19 to stud 25, wire 43, brush 44, armature of motor No. 2, brush 45, wire 46, stud 23, strip 19, stud 24, wire 47, field-magnet terminal 48, field-magnet of motor No. 2, field-magnet terminal 49, wire 50, button 7, strip 7^d, strip 8^d, buttons 8 and 11 to ground. By moving the handle so as to connect 21, 28; 22, 23; 24, 25; 26, 27, in pairs, the current is reversed in the armatures of both motors, the field-magnet currents remaining the same and the the direction of the motion of the car is thereby reversed. It will thus be seen that studs 23 and 25 are permanently connected to the brushes of motor No. 2 and studs 21, 27, with the brushes of motor No. 1. Stud 24 is connected with one terminal of the field-magnet of motor No. 2, and stud 28 with the opposite terminal of field-magnet of motor No. 1. The remaining terminal of motor No. 1 is connected to button No. 3 on the switch, and the remaining terminal of motor No. 2 is connected to button No. 7 on the switch. Stud No. 22 is simply connected to stud No. 26, diametrically opposite, which in turn is connected to button No. 6 on the switch. Studs 22 and 26 are therefore merely spanning studs, serving during a portion of the commutation of the moters to carry the current from one motor to the other when the two are in series, and at another period of commutation to distribute the current in two branches through the two motors. It is evident that at one period of commutation, one motor alone is taking current through the reversing switch, and I may state here that the essential elements of my switch may be used as well in a car where there is only one motor as in the car herein illustrated, wherein one of two motors is temporarily thrown out. It will be seen that my switch is divided into two symmetrical parts each of which could act alone for the reversing of a single motor. These parts will be found on either side of the line joining the spanning studs. In some of my claims I have,

therefore, not limited myself to a reversing switch in combination with two motors, nor to a switch having enough studs for governing two motors. In these claims I have alluded to the commutating drum as a single-acting drum. This is to distinguish it from drums of that type wherein similar strips are symmetrically disposed and whereby reversal of the motor or motors is accomplished by reverse movements of the drum. In my claims I have called those studs which are connected to field-magnet terminals field-magnet studs, and those connected to armature terminals, brush studs. By thus placing the reversing switch upon the same axle with the commutating strips, I am able to do away with the separate reverser under the car, which takes up a great amount of room and is apt to be disordered by dirt, &c., and also simplify the means whereby the operator controls the reversals.

By preserving the reversing switch nevertheless distinct in operation from the commutating strips themselves, I am enabled to accomplish a great number of variations in circuits on a comparatively small drum, inasmuch as the same commutator strips serve for control of the motors when running in both directions and duplication upon a necessarily large drum is avoided.

What I claim is—

1. In a reversing switch, a circular series of studs, a body pivoted at the center of said circle and having half as many recesses as there are studs, bridging pieces fitting over said recesses, on the periphery of said body, and springs within said body adapted to force said bridging pieces outward, substantially as described.

2. A controller for a motor or motors, consisting of a revolving drum carrying commutating strips and contact buttons cooperating with said strips; in combination with a body loosely pivoted upon the axle of said drum, conducting bridging strips on the periphery of said body, and studs cooperating with said bridging strips, and connected with said motor or motors to reverse the direction of current in a part of the same, substantially as described.

3. In a street car, a motor or motors; in combination with a single acting controlling drum therefor, and a rotating reversing switch for said motor or motors, pivoted upon the axis of said drum, substantially as described.

4. In a car having a driving motor, a controller for said motor, and reversing switch consisting of a stud connected with one terminal of the motor field magnet, a stud on each side thereof connected each to a motor brush, said studs being placed in the arc of a circle and means for connecting either brush stud to a source of current, and the other to the field magnet stud simultaneously, substantially as described.

5. In a car having a driving motor, a controller for said motor, and a reversing switch consisting of a circular series of studs, one of the series being connected with a motor field magnet terminal, a stud on each side thereof being connected to each brush of the motor and the two outer studs being mutually electrically connected and also connected to one terminal of the car circuit; in combination with a rotating series of bridging pieces for making connection between contiguous studs in pairs, substantially as described.

6. In a reversing switch for two motors, a rotating series of bridging pieces; in combination with two pairs of motor brush studs, two field magnet studs separating the members of each pair of brush studs, and two spanning studs; in combination with bridging pieces for connecting said studs in pairs, substantially as described.

7. In combination with the two driving motors of an electric car, a reverser consisting of two sets of studs, each consisting of two brush studs and a field magnet stud between them, and means for electrically connecting said sets, substantially as described.

8. In combination with two motors for driving an electric car, a reverser consisting of two sets of studs, each consisting of two brush studs and a field magnet stud between them, and two spanning studs electrically connected and adapted to be brought into alternate connection with the brush studs of each motor, substantially as described.

In testimony whereof I have hereunto subscribed my name this 3d day of January, A. D. 1893.

HARRY P. DAVIS.

Witnesses:
JAMES WM. SMITH,
HAROLD S. MACKAYE.