

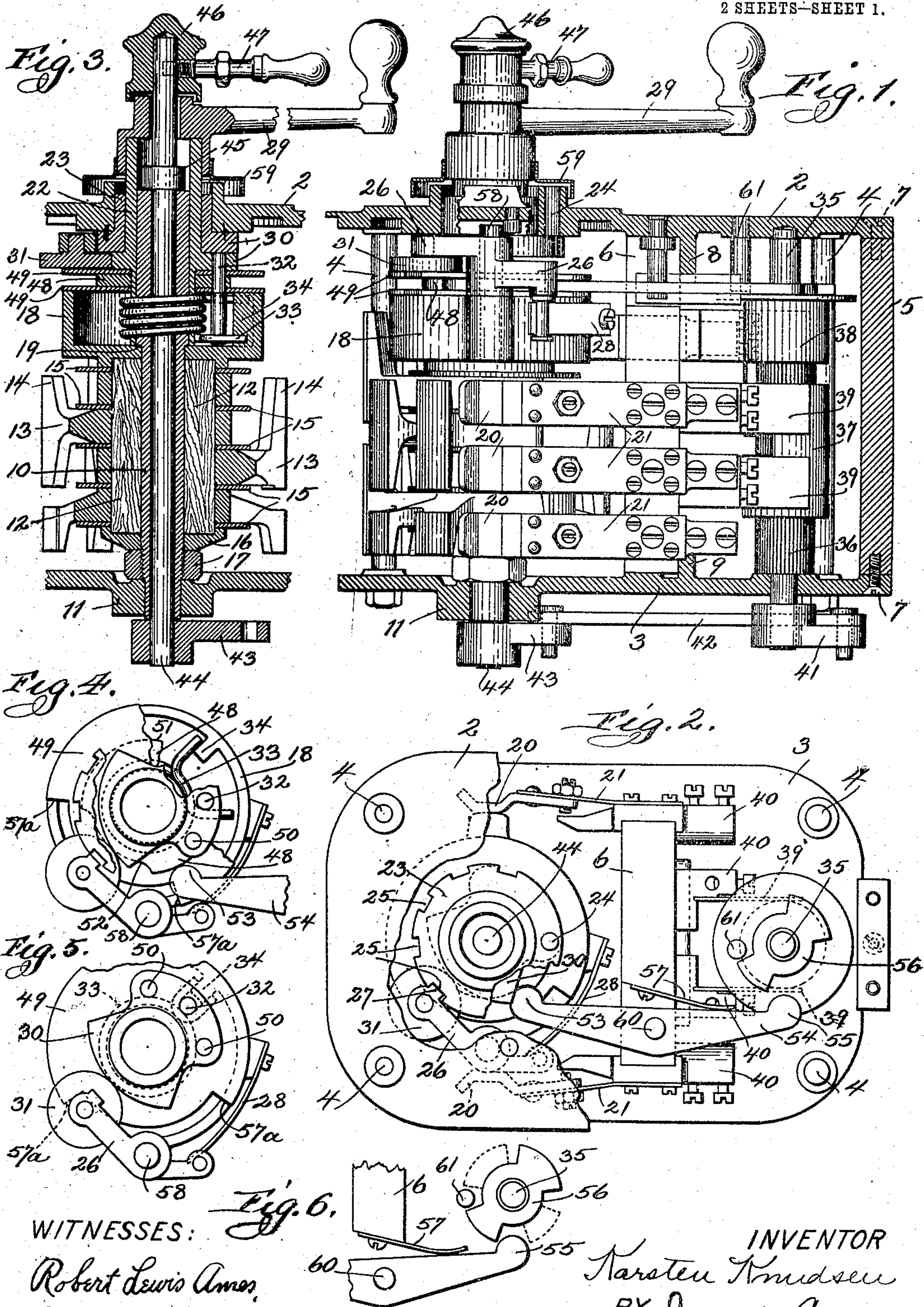
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PATENTED APR. 24, 1906.

K. KNUDSEN.  
ELECTRICAL CONTROLLER FOR ELECTRIC VEHICLES.

APPLICATION FILED JAN. 13, 1902.

2 SHEETS—SHEET 1.



WITNESSES:

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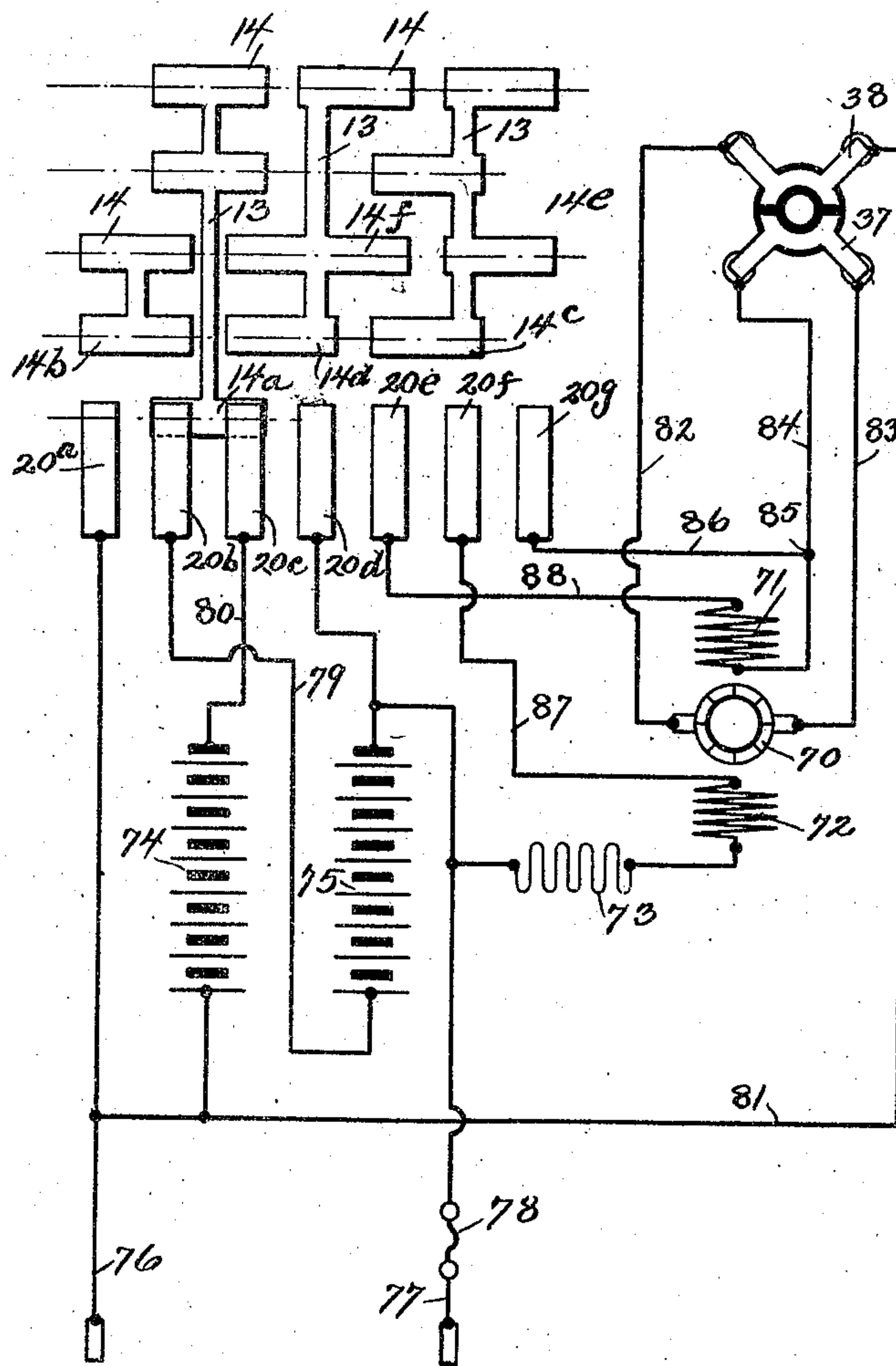
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2 SHEETS—SHEET 2.

*Fig. 7.*



WITNESSES

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# UNITED STATES PATENT OFFICE.

KARSTEN KNUDSEN, OF CHICAGO, ILLINOIS.

## ELECTRICAL CONTROLLER FOR ELECTRIC VEHICLES.

No. 818,768.

Specification of Letters Patent.

Patented April 24, 1906.

Application filed January 13, 1902. Serial No. 89,529.

*To all whom it may concern:*

Be it known that I, KARSTEN KNUDSEN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Electrical Controllers for Electric Vehicles, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to improvements in electric controllers, and has for its objects, generally speaking, the provision of means whereby with comparatively few and simple parts a comparatively large number of variations of speed of the motor may be obtained, wherein all danger from accident is guarded against, and whereby a more compact, efficient, economical, and durable device than heretofore known is obtained.

The invention relates more particularly to a controller in which the contact-segments snap from one contact position to the next independently of the motion of the operating-handle.

To these ends and such others as may hereinafter appear the invention consists in the novel parts and the combinations of parts hereinafter described, and particularly pointed out in the appended claims.

In the accompanying drawings, in which the same reference characters designate like parts throughout the several views, Figure 1 is a side elevation of my invention, the supporting-plates being shown in section. Fig. 2 is a plan view thereof with a portion of the upper plate removed. Fig. 3 is a longitudinal section through the controlling-drum and associated parts. Fig. 4 is a detail plan view of the drum-operating mechanism, together with the cam and coöperating lever for the reversing mechanism. Fig. 5 is a similar view of the drum-catch and its operating-cam. Fig. 6 is a detail view of the reversing-switch cam and lever, and Fig. 7 is a diagram of the circuit connections.

In the figures, 2 and 3 designate the upper and lower supporting-plates in which the operating parts of the mechanism are secured, the said plates being connected together by means of the rods or posts 4, located near the corners of the plates. They are further sustained by the insulating-plates 5 and 6, extending between them, the former being secured thereto by means of screws 7 7 and the

latter through the medium of lugs 8 and 9, formed on the upper and lower plates, respectively.

Near the forward end of the plates a sleeve 10 is supported in the bearing 11 at its lower end and passing through suitable supporting means, to be hereinafter described, at its upper end and is surrounded centrally by means of an insulating core or sleeve 12, upon which the controller-segments 13, having the contact-fingers 14, are mounted, suitable insulating-disks, such as 15, being placed between the several segments and outside of the outer segments. A suitable washer 16 is provided at the lower end and is adapted to be pressed against the segments by means of a nut 17, threaded upon the sleeve 10. The segments and insulating-blocks are thus pressed against a drum 18, which has a bearing against the shoulder 19, formed on the sleeve 10. The segments, of which there are only four, and the insulating-disk, together with the drum 19, are all thus securely fastened together. Suitable contact-fingers 20 are secured to springs 21, which are mounted upon the opposite edges of the insulating-plate 6, secured to the lugs 8 and 9 of the upper and lower plates. These contact-fingers are diametrically opposite each other and are adapted to suitably engage the contact-fingers 14 of the controller-segments 13 when the latter are brought into position. Suitable binding-posts 40 connect with these springs, the conductors which connect therewith being brought in through apertures in the plate 5.

The sleeve 10 has a bearing at its upper end in a second sleeve 22, which is mounted in a third sleeve 23, which is secured in an aperture in the top plate 2, a pin 24, Fig. 1, being provided to secure said third sleeve 23 from rotation. The sleeve 23 is provided with a flange into which the pin 24 extends and in which the notches 25 are formed. Upon the periphery of the drum 18 a pawl 26 is mounted, said pawl or arm having a catch 27 adapted to engage in the notches 25, formed in the plate or flange of the sleeve 23. A spring 28 is also secured to the drum 18 and presses against one arm of the pawl 26 to cause its end 27 to engage the notches in the said plate. At the upper end of the sleeve 22 a handle 29 is secured, by means of which it is adapted to be rotated. Said sleeve is provided with an eccentric cam 30, against the periphery of which a roller 31 rides, said roller being



mounted upon the end of the pawl 26. When the handle 29 is rotated in either direction, the cam 30 operates upon the roller 31 and lifts the dog 27 from the notch. A pin 32, carried by an extension of the cam 30 or by a flange formed integrally with the sleeve 22, extends into the drum 18 and its end passes between the ends of a coiled spring 33, concentrically mounted within the drum, the said ends being also adapted to engage opposite sides of a lug 34, formed upon the inner periphery of the drum 18.

With the construction so far described it will be understood that when the parts are stationary the dog 27 of the pawl 26 engages a notch 25 in the stationary notched plate 22. The drum and controller-segments *b* are held in a position corresponding thereto by means of the coiled spring 33 and pin 32. When, however, the controller-handle 29 is rotated in either direction, the sleeve 22, together with the pin 32 and cam 30, rotates therewith, the said pin serving to engage the end of the coiled spring in the path of its movement and to place said spring in tension, while the cam 30 acts upon the roller 31 and lifts the dog 27 from engagement with the notch 25, with the result that as soon as said disengagement takes place the coiled spring overcomes the friction of the parts, including that of the contact-fingers 20 upon the segments 14, and the drum is quickly rotated to the next position. It is stopped by the dog 27 catching in a notch 25, the roller 31 having reached the lower part of the cam 30 to permit such engagement. The drum and segments are therefore given a quick movement in the desired direction, which movement is sometimes termed "a snap action," and the arching between the contact-fingers and springs is thus reduced and a good contact is always insured by the stopping of the segments in the proper position.

The reversing-switch is mounted at the rear upon a shaft 35, which bears at its upper end in the upper plate 2 and extends through the lower plate. An insulating-sleeve 36 is secured to the shaft, and upon said sleeve the reversing-segments 37 and 38 are mounted, said segments being out of contact and are provided with a portion entirely surrounding the segments 36 and with an inwardly-extending portion adapted to electrically contact with the opposite springs. The springs 39, which cooperate with the reversing-segments, are mounted also upon the insulating-plate 6, suitable binding-posts 40 being provided to connect the circuit-windings therewith. In order to rotate the reversing-switch, a crank-arm 41 is provided upon the lower end thereof and is connected, by means of a rod 42, with a similar arm 43, carried upon the lower end of the shaft 44, extending through the sleeve 10 of the controller and upon the upper end of which it is supported

by means of a collar 45. Upon the upper end of the shaft 44 a crown 46 is provided, through which the reversing handle or lever 47 is threaded, with its end extending into the shaft 44, whereby when the handle 47 is operated the reversing-switch is correspondingly turned.

In order to prevent operating the reversing-switch except when the controller-handle 29 is in normal position, and current is therefore cut off from the motor, a cam 48 is provided and is mounted upon the sleeve 22, said cam being secured between a pair of safety-plates 49 by means of the pin 32, above described, and further pins 50. (Shown clearly in Fig. 4.) This cam has two concentric surfaces 51 52, with which the end 53 of a rocking lever or arm 54 is adapted to engage, the other end 55 of said arm being in the path of a notched plate 56, carried upon the reversing-shaft 35. A spring 57, mounted upon the plate 6, tends to force the end 53 of said arm into contact with the cam 48. When the controller-arm 29 is in normal position, the end 53 in the arm 54 is in engagement with the sleeves 52 of the cam 48, whereby when the reversing-lever 47 is actuated the end notched plate 56 does not engage with the end 55 of the arm 54 and permits the same to turn; but at other times when the controller-lever 29 is not in normal position the raised portion 51 of the cam 48 engages the arm 54 and places its end 55 in the path of the notched disk 56, whereby it is impossible to reverse the switch while current is passing through the motor.

While the safety-plates 49 serve to guide and support the end 53 of the arm 54, they have the additional function of positively moving the drum in case the coiled spring should fail to act. For this purpose the said plates are notched, as shown at 57<sup>a</sup> in Figs. 4 and 5, said notched or shouldered portions being adapted to engage the bearing 58 of the lever 26 and to thereby positively push the drum, and with it the controller-segments, around to the desired position. Under ordinary circumstances these shoulders do not come into action before the coiled spring actuates and quickly moves the drum and segments to the next position; but in case of failure of the spring to act these plates positively move the same.

A suitable covering 59 is secured to the sleeve of the controller-lever 29 and serves to inclose the joint or bearing in the contact-plate. The lever 54 is fulcrumed upon a pin 60, secured to the top plate 2. A stop-pin 61 for the reversing-switch is also secured to the top plate, as shown in Fig. 1.

The circuit connections are shown in Fig. 7, the segments 13 and contact-fingers 14 being shown developed and the contact-fingers 20 being placed side by side. These parts, however, are located in their proper relative



positions, and the operation can be seen by considering the segments as reciprocating up and down past the fingers 20. The reversing-segments are indicated at 37 and 38, while the motor-armature is designated by the numeral 70, the upper field-coil by 71, and the lower field-coil by 72, a resistance 73 being included in the circuit of the latter coil. Batteries 74 and 75, preferably of the storage type, are adapted to be connected with the motor and to be charged from the mains 76 and 77, a fuse 78 being included in the latter conductor. In the position shown, which is the normal position, the batteries 74 and 75 are in charging position, current from the mains being adapted to flow in series through the batteries, their positive and negative poles being connected by the conductor 79 and 80, the contact-fingers 20<sup>b</sup> and 20<sup>c</sup> resting upon the segment 14<sup>a</sup>. In the next position of the contact-segments, which is the starting position for the motor, the opposite poles of the battery will be connected together by means of the contact-fingers 20<sup>a</sup> and 20<sup>b</sup>, which rest upon contact-finger 14<sup>b</sup>. From these poles the circuit will lead over the conductor 81, through the reversing-segments 38, conductor 82, armature 70 of the motor, conductor 83, reversing-segment 37, conductor 84, through field-coil 71, over contacts 20<sup>e</sup> and 20<sup>f</sup>, which are now resting upon finger 14<sup>c</sup>, through field-coil 72, resistance 73 to the negative poles of the battery, which are connected together by fingers 20<sup>c</sup>, 20<sup>d</sup>, and 14<sup>d</sup>. The current being of low intensity and encountering the resistance of both field-coils, as well as that of the resistance 73, is comparatively small, and the speed of the motor is therefore small, so as not to endanger the same. At the next movement of the segments the batteries remain in parallel, but the coils of the motor are thrown into parallel relation. The circuit may be traced, as before, from the opposite poles of the batteries 74 and 75 through the reversing-switch and motor-armature to the conductor 84. From the point 85 it now has two paths, one through the conductor 86, contacts 20<sup>e</sup> 14<sup>e</sup> 20<sup>f</sup>, conductor 87, through the field-coil 72, and resistance 73 to the opposite pole of the batteries, while the other path is directly through fingers 20<sup>e</sup>, 20<sup>d</sup>, and 14<sup>f</sup> to the corresponding pole of the battery. Under these conditions, the resistance of the circuit being lowered, the field-coils are energized to a greater extent, as well as the armature, and the speed of the motor is therefore increased. The resistance 73 in series with the winding 72 has the effect of crowding a larger portion of the current through the field-coil 71, which exerts a greater pull upon the armature, and therefore counteracts the effects of gravity and friction upon the bearings of the latter, whereby a greater increase of speed is obtained.

At the next step of the segments the bat-

teries are connected in series with each other by the contact-segments and fingers, and the motor-coils are placed in series. Owing to the greater intensity of the current now flowing, the speed of the motor is increased, even though the resistance of the path of the current is increased by placing the several coils in series. At the next step, which corresponds to the greatest speed of the motor, the field-coils are again thrown into parallel, with the result before explained that the motor again increases its speed.

While I have described the various features of the invention with reference to the details of construction, it is obvious that the same may be embodied in many forms, and I do not, therefore, wish to be limited to the exact construction shown and described.

What I claim, and desire to secure by Letters Patent, is—

1. The combination with contact-segments, of a drum connected to rotate therewith, a coiled spring mounted in the drum and having its opposite ends normally resting upon opposite sides of a lug on said drum, a segment-rotating device mounted opposite the end of the drum and having a pin projecting thereinto and located between the ends of the coiled spring whereby when said part is rotated in either direction, the spring is placed in tension in the corresponding direction and tends to rotate the drum therewith and means to hold the drum in contact position during a portion of the travel of said part in either direction and to then release the drum whereby the segments snap from one contact position to another, substantially as described.

2. The combination with an electric motor, of a controller therefor having contact-segments, a suitable support in which the segments are mounted to rotate, a single pawl to stop the segments in the several contact positions and operative when the segments are rotated in either direction, and a single cam to release said pawl when it is desired to rotate the segments, substantially as described.

3. The combination with an electric motor, of a controller therefor having contact-segments, a suitable support in which the segments are mounted to rotate, a single pawl to stop and hold the segments in the several contact positions and operative when the segments are rotated in either direction, and a single cam to release said pawl when it is desired to rotate the segments, substantially as described.

4. The combination with an electric motor, of a controller therefor having contact-segments, a suitable support in which the segments are mounted to rotate, a single pawl to stop the segments in the several contact positions and operative when the segments are rotated in either direction, and a single cam



operated by the controller-lever for releasing said pawl to permit the segments to snap from one contact position to another, substantially as described.

5 5. The combination with an electric motor, of a controller therefor having contact-segments, a suitable support in which the segments are mounted to rotate, a single pawl to stop and hold the segments in the several  
10 contact positions, and a single eccentric cam adapted in the rotation of the controller-lever to engage and release said pawl, substantially as described.

6. The combination with contact - segments, of a suitable support in which the  
15 same are mounted to rotate, a pawl to stop the segments in the several contact positions, a roller carried by the pawl, a segment-operating handle, a single eccentric cam connect-  
20 ed with said handle and adapted to engage said roller to release the pawl when the lever is operated in either direction, substantially as described.

7. The combination with contact - segments, of a shaft upon which said segments  
25 are mounted, a pawl connected to rotate with said segments, a stationary notched plate with which said pawl engages to hold the segments in contact position, a segment-oper-  
30 ing handle supported upon the shaft of the contact-segments, and a cam connected with said handle to engage and release said pawl from the notched plate to permit the contact-  
35 segment to rotate, substantially as described.

8. The combination with segments ar-  
40 ranged to rotate, of a drum connected therewith, a pawl carried by the drum, a stationary notched plate with which the pawl engages to hold the segments in contact position, a cam concentrically mounted with refer-  
45 ence to the segments and adapted to release said pawl from the notched plate, a coiled spring connected with the drum and placed in tension in the operation of said cam, whereby when the pawl is released, the drum  
is rotated with a quick movement from one contact position to the succeeding position, substantially as described.

9. The combination with contact - segments, of a suitable support in which the seg-  
50 ments are mounted to rotate, a pawl traveling with the segments, suitable stop devices engaged by said pawl in its travel to stop the segments in the several contact positions, and means to release said pawl when it is de-  
55 sired to rotate the segments, substantially as described.

10. The combination with contact - segments, of a suitable support in which the seg-  
60 ments are mounted to rotate, a movable pawl arranged to travel with said segments, stationary stops engaged by said pawl to stop and hold the segments in the several contact positions, and means to automatically re-

lease the pawl when it is desired to rotate the segments, substantially as described. 65

11. The combination with contact - segments, of a suitable support in which the segments are mounted to rotate, a single pawl associated with the segments and adapted to  
70 travel therewith, stationary stops with which said pawl engages to stop and hold the segments in the several contact positions, and a cam operated by the controller-operating means for releasing said pawl to permit the segments to snap from one contact position  
75 to another, substantially as described.

12. The combination with contact - segments, of a pawl connected with said segments to rotate therewith, a stationary  
80 notched plate with which said pawl engages to hold the segments in the several contact positions, a segment - operating handle or means, and a cam connected with said handle or means to release said pawl from the notched  
85 plate to permit the contact-segments to rotate, substantially as described.

13. The combination with contact - segments, a drum carried thereby, a projection upon the drum, a concentrically-mounted seg-  
90 ment - operating handle, and sleeve, and a pair of safety-plates mounted upon the last-named part, and a yielding connection between said segments and said handle to permit the segments to snap from one position  
95 to the next in the operation of the handle, said plate being adapted to engage said projection in the drum and positively move the segments to the contact position in case of failure of the yielding connection, substan-  
100 tially as described.

14. The combination with contact - segments adapted to be rotated, of an operating means therefor, a cam mounted upon said  
105 means, a plate mounted on each side of said cam, reversing-segments to change the direction of the current through the motor, and an intermediate rocker-arm between said reversing-segments and the cam to prevent the operation of the reversing-segments except  
110 in the normal position of said operating means, said arm being received and guided at one end by said plates, substantially as described.

15. The combination with a contact - seg-  
115 ment - operating handle, a cam connected therewith, safety-plates mounted upon each side of the cam, reversing-segments mounted at one side of said handle, a rocker-arm extending between the said cam and reversing-  
120 segments and supported at one end by said safety-plates, said cam being adapted to cause said rocker-arm to lock the reversing-segments from movement in all except the normal position of the said handle, substantially  
125 as described.

16. The combination with a motor having two field-coils, of a generator, means for con-



necting said coils in series or in parallel relation, and a resistance in circuit with one winding of the said motor, substantially as described.

5 17. The combination with a motor having two field-coils, of a generator divided into two parts, contact-segments adapted to connect the generators with the motor in parallel with the field-coils first in series and next in  
10 parallel, and to also connect said generators in series with the motor, also with its coils in series and in parallel and a resistance connected in series at all times with one of the coils of the motor, substantially as described.

15 18. The combination with contact-segments mounted for rotation upon a sleeve, of means to rotate the same, reversing-segments to change the direction of the current through the motor mounted independent of  
20 said sleeve, a shaft passing through said sleeve means connecting said shaft with said reversing-segments, and means for rotating said shaft, substantially as described.

25 19. The combination with a sleeve, of a shaft loosely mounted in said sleeve, means independent of said shaft for rotating said sleeve, an insulated core surrounding said sleeve, a plurality of contact-segments mount-

ed upon said core and insulating-disks between said segments and outside of the outer segments, substantially as described. 30

20. The combination with a motor, of a controller therefor having contact-segments, a suitable support upon which said segments are mounted to rotate, a spring, means movable continuously in one direction for winding said spring to cause the latter to rotate  
35 said contact-segments, means to stop said segments in the several contact positions, and means operated by said spring-winding means for releasing said stopping means  
40 when it is desired to rotate the segments.

21. The combination with a motor having two field-coils, of a generator, means for connecting said coils in series or in parallel relation, and means for reducing the strength of  
45 one of said field-coils, substantially as described.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses. 50

KARSTEN KNUDSEN.

Witnesses:

E. L. MOORE,  
W. CLYDE JONES.