(No Model.) 3 Sheets—Sheet 1.

W. J. POHLMAN.

CONTROLLER OR SWITCH FOR ELECTRIC MOTORS.

No. 533,318. Patented Jan. 29, 1895.

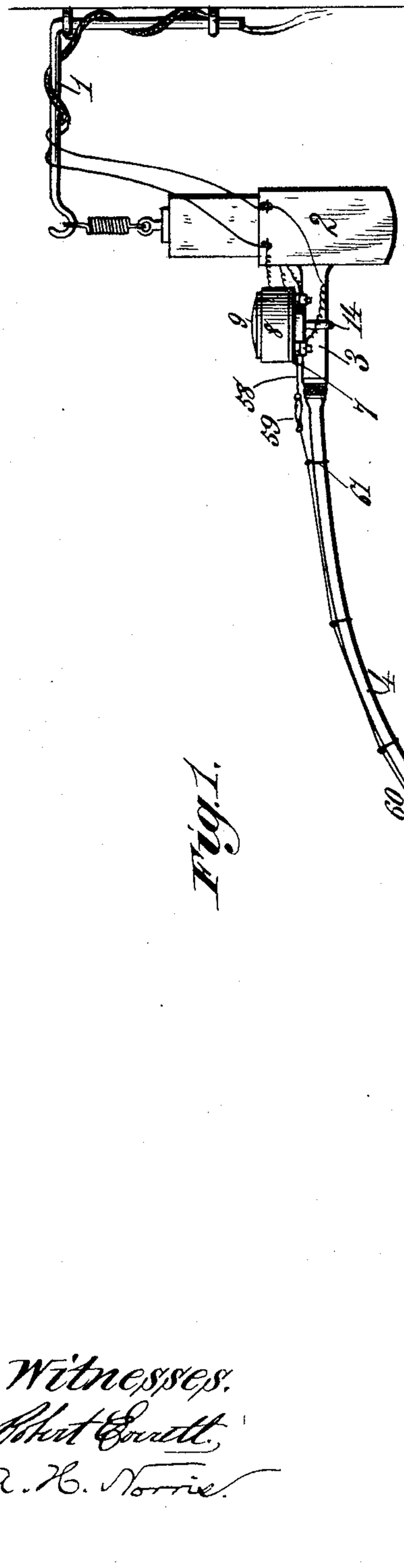

Fig. 1.

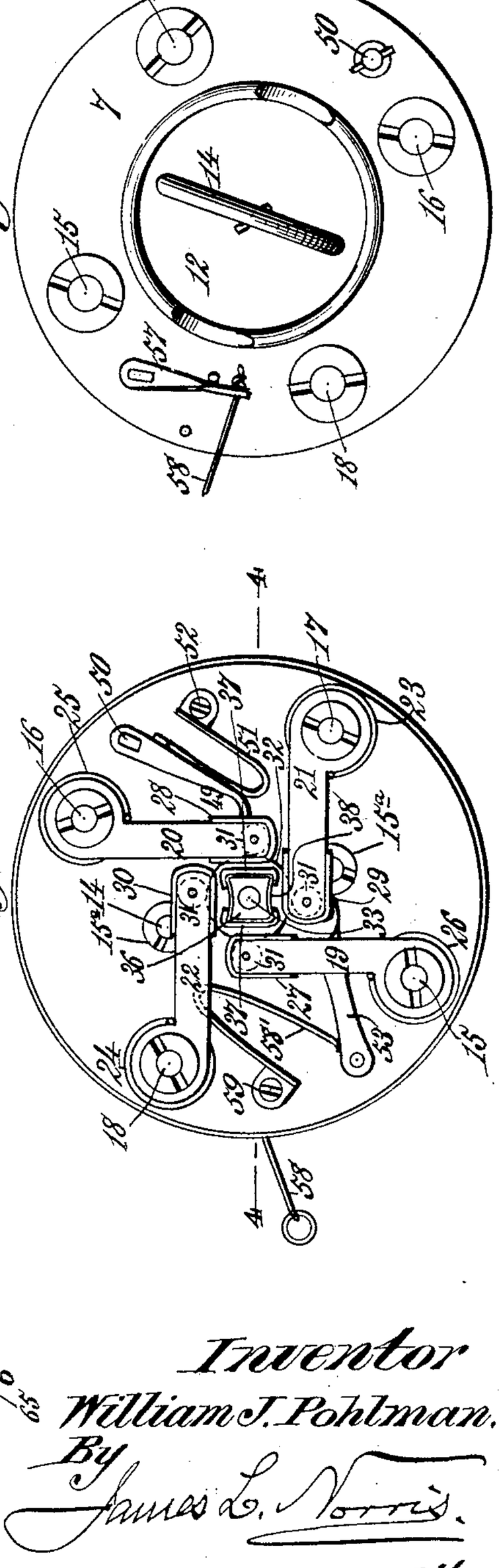

Fig. 2.

Fig. 3.

Witnesses.
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(No Model.) 3 Sheets—Sheet 2.

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CONTROLLER OR SWITCH FOR ELECTRIC MOTORS.

No. 533,318. Patented Jan. 29, 1895.

Fig. 4.

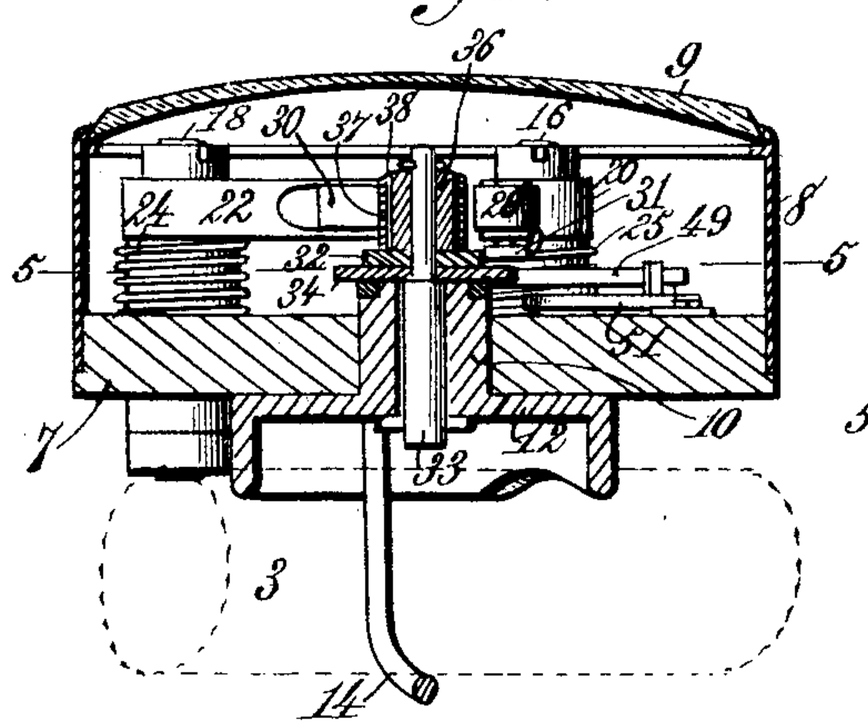


Fig. 5.

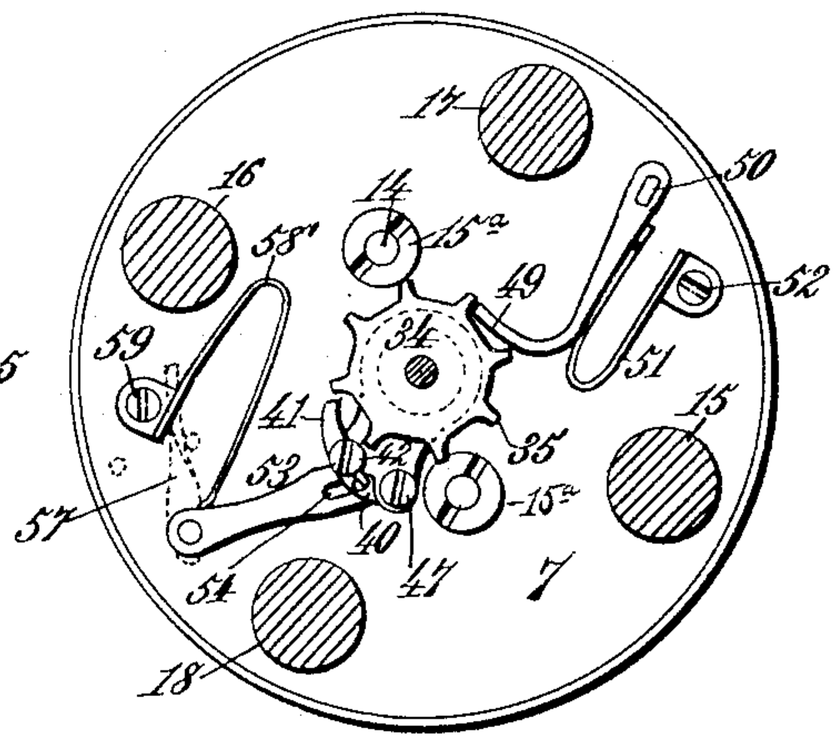


Fig. 6.

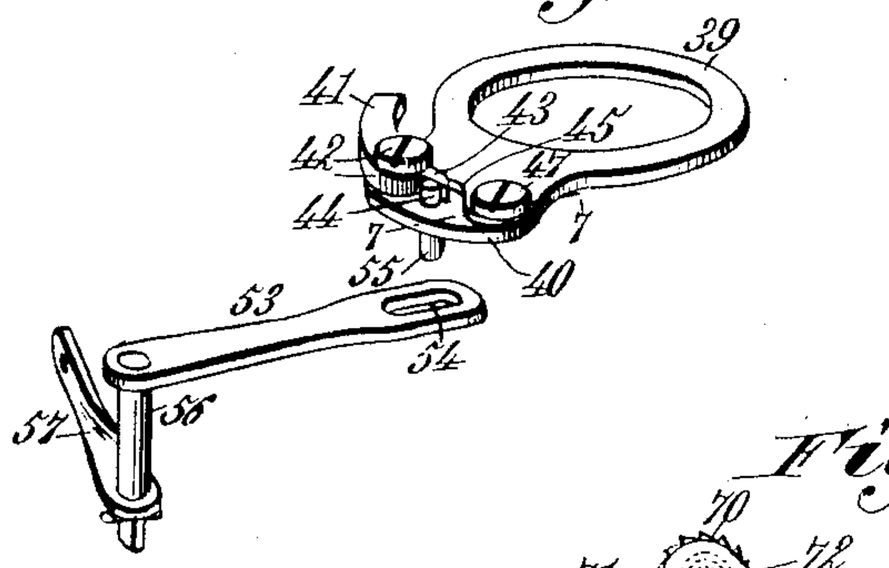


Fig. 7.

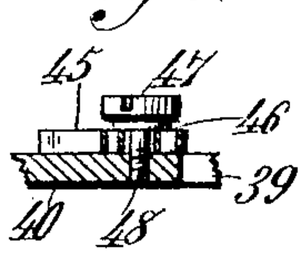


Fig. 8.

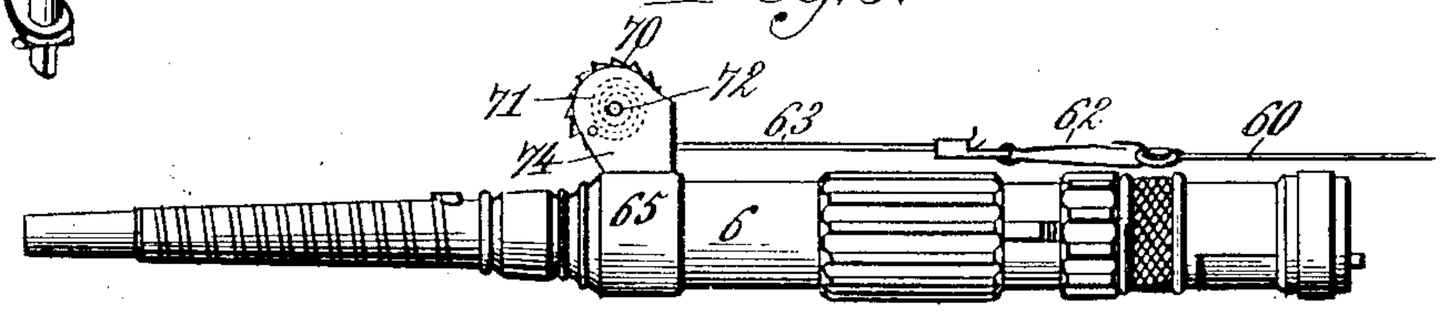


Fig. 9.

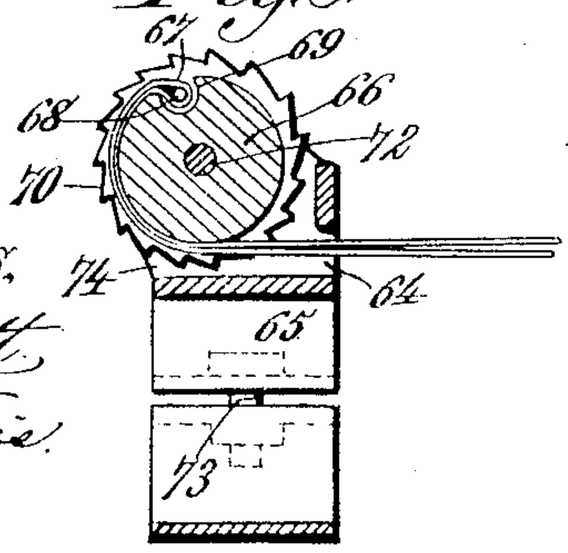
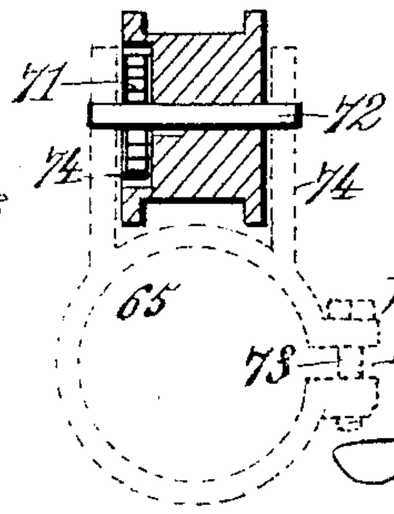


Fig. 10.



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(No Model.) 3 Sheets—Sheet 3.

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CONTROLLER OR SWITCH FOR ELECTRIC MOTORS.

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Fig. 11.

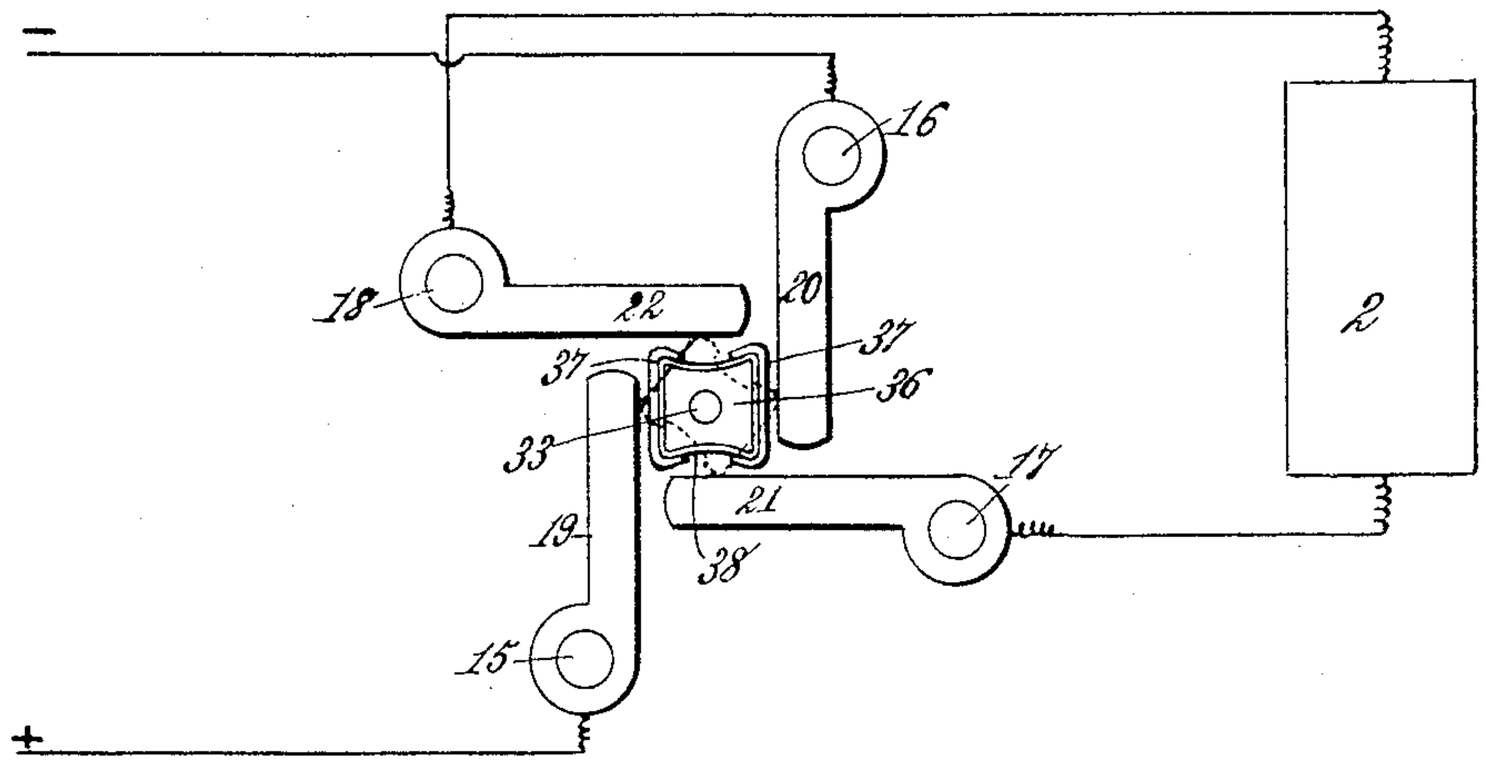


Fig. 12.

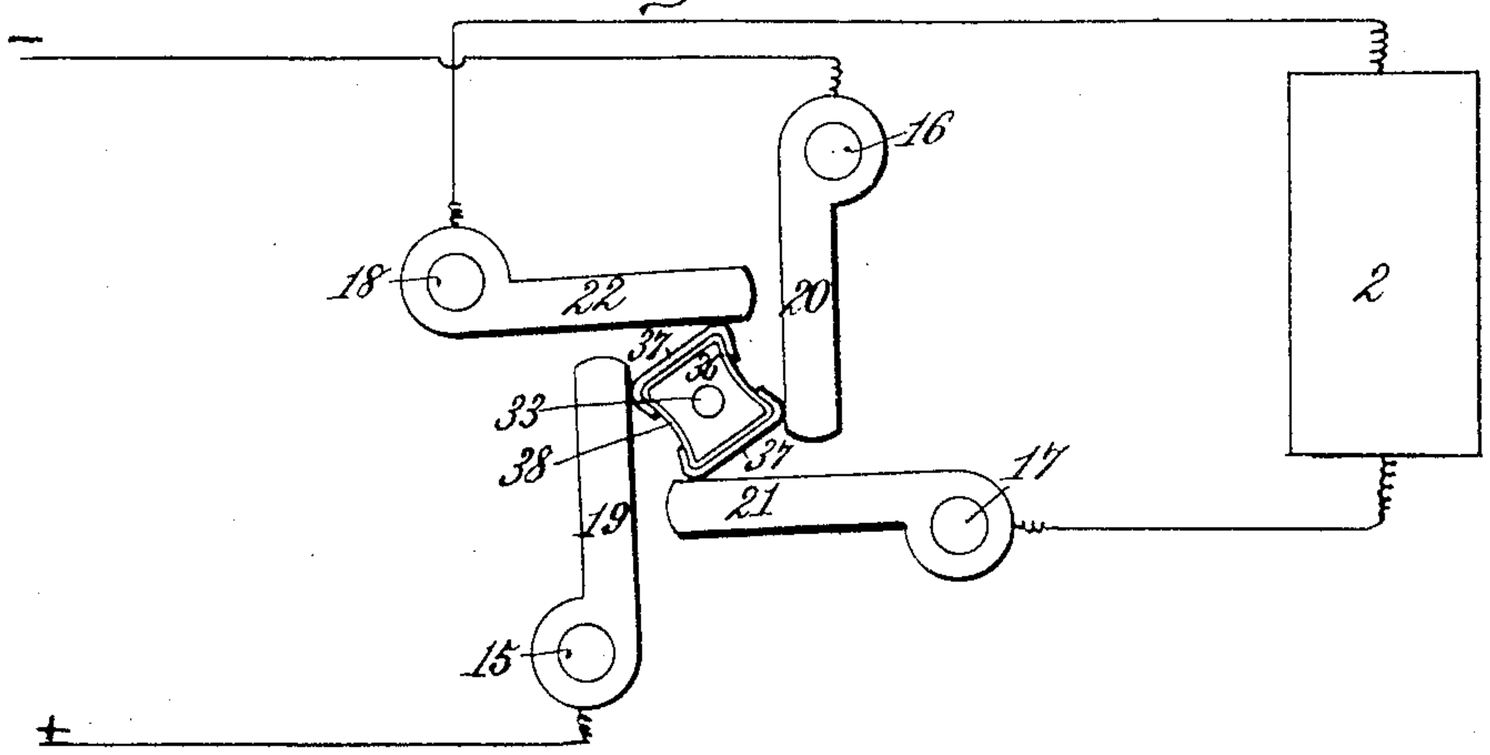
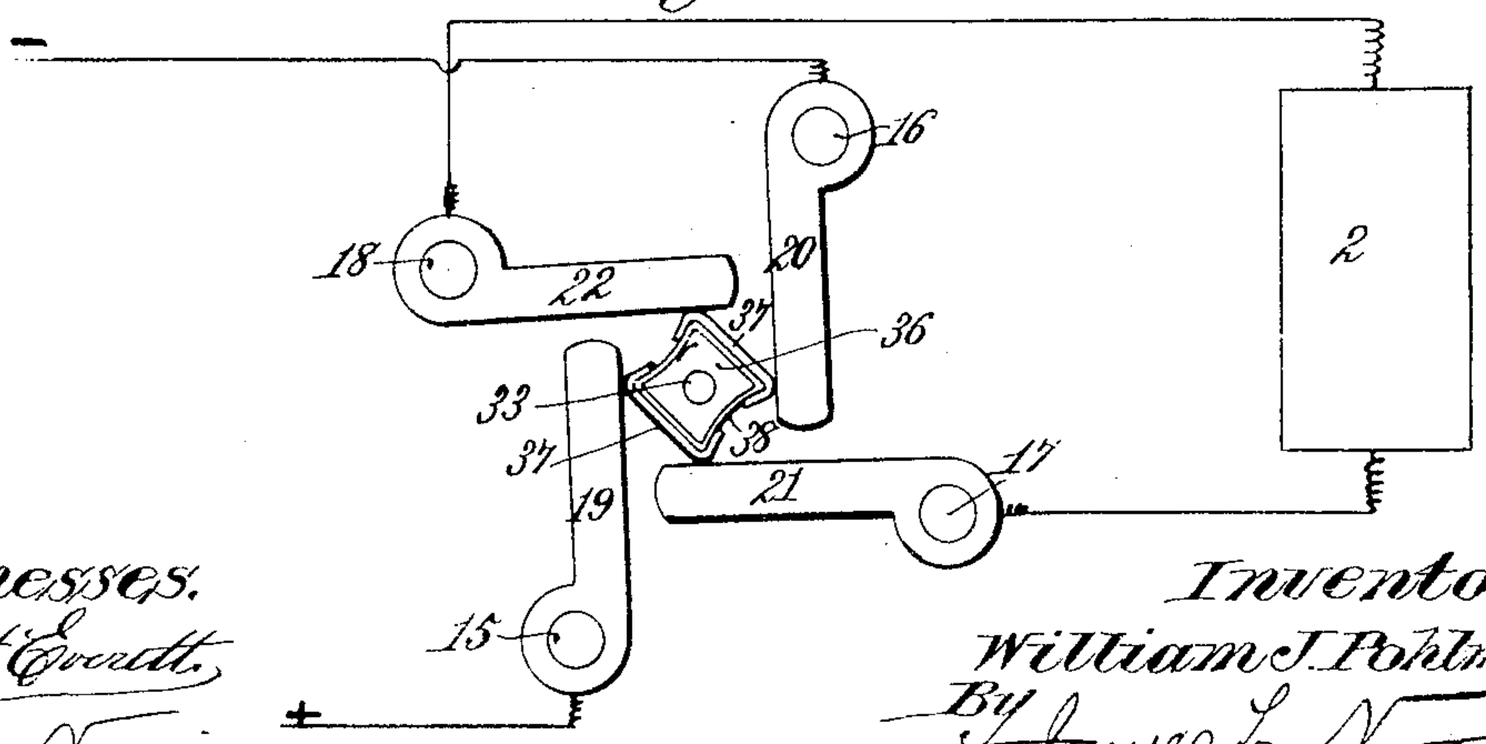


Fig. 13.



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UNITED STATES PATENT OFFICE.

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CONTROLLER OR SWITCH FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 533,318, dated January 29, 1895.

Application filed November 17, 1894. Serial No. 529,171. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM J. POHLMAN, a citizen of the United States, residing at Woodbrook, in the county of Baltimore, State of Maryland, have invented new and useful Improvements in Controllers or Switches for Electric Motors, of which the following is a specification.

This invention relates to switch devices for controlling the action of electric motors designed for transmitting rotary motion to the drills, polishing disks, and other tools of dental instruments.

In executing dental work by means of dental tools rapidly rotated by an electric motor, it is desirable to instantly stop and start the tools and to reverse the direction of rotation thereof. This has heretofore been accomplished through the medium of a governor operated by a pedal under control of the foot of the dentist, and necessarily placed in juxtaposition to the floor, which arrangement is often inconvenient and vexatious to the dentist, and is open to obvious objections.

The chief objects of my invention are to avoid the use of pedal-governors which require to be placed in juxtaposition to the floor for convenient operation by the foot of the dentist; and to provide new and improved controlling mechanism susceptible of being governed by a slight movement of a finger, or the thumb, of the hand grasping the dental instrument, for the purpose of starting the motor, or instantly stopping the same, or reversing the direction of rotation of the armature by changing the direction of the electric current through the motor for reversing the rotary motion of the dental-tool.

The invention also has for its object to simplify and improve the details of construction of controllers or switch devices designed for stopping, starting, and reversing electric motors, whereby a controller is obtained which is susceptible of being economically manufactured, and which possesses many advantages in connection with the electric motors for driving the tools of dental instruments.

The invention consists essentially in the combination of two pairs of movable contacts for connecting with the positive and negative poles of an electric-motor and the incoming and outgoing electric conductors or line wires of a source of electric energy, circuit-breaker rotating in the same direction for electrically connecting one pair of said contacts with the said conductors or line wires, and the other pair of said contacts with the positive and negative poles of the motor, and means for holding a pair of the said contacts out of electrical connection with the rotatable circuit-breaker for stopping the motor, the construction being such that the circuit-breaker can be intermittently rotated in the same direction to start and stop the motor, and also to reverse the latter when it is desired to change or reverse the direction of rotation of the device or tool driven by the motor.

The invention also consists in certain other features and in the combination or arrangement of parts hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a side elevation, showing one arrangement of my invention, in connection with an electric motor for driving the tool of a dental instrument. Fig. 2 is a top plan view of the controller-box and its contact-arms and circuit-breaker. Fig. 3 is a bottom plan view of the same. Fig. 4 is a vertical sectional view, taken on the line 4—4, Fig. 2. Fig. 5 is a horizontal sectional view, taken on the line 5—5, Fig. 4. Fig. 6 is a detail perspective view of the escapement-pawl, the pawl-carrier, and the lever for actuating the pawl-carrier. Fig. 7 is a sectional view, taken on the line 7—7, Fig. 6, to show the manner of securing the volute spring which acts upon the escapement-pawl. Fig. 8 is a detail side elevation of the dental-tool, showing the finger piece or drum mounted thereupon and connected with the cord which actuates the escapement-pawl-carrier. Fig. 9 is a detail sectional view of the finger-piece or drum and its support or clamp. Fig. 10 is a similar view, taken in a plane at right angles to the plane of section Fig. 9. Fig. 11 is a diagram, showing the parts in position to stop the electric motor. Fig. 12 is a diagram, showing the position of the parts when the motor is running in one direction; and Fig. 13 is a diagram, showing the position of the parts when the electric-motor has been reversed to change

or reverse the direction of rotation of the dental-tool.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail, reference being made to the accompanying drawings, wherein—

The numeral 1 indicates a crane or bracket from which is suspended an electric-motor 2, having a laterally projecting tube 3, through which extends the flexible shaft 4, which is rotated in the usual manner by the armature of the motor, for the purpose of transmitting rotary motion to a dental-tool 5, secured in the extremity of a hand dental instrument 6, Fig. 1.

The crane or bracket 1, electric-motor 2, flexible-shaft 4, and dental instrument 6, may be of any ordinary construction suitable for the purpose in hand, and therefore a more detailed explanation of these parts is not deemed essential.

The flexible-shaft is usually covered with a braided sheathing, and the motor is preferably suspended by a coiled spring from the crane or support, so that it can freely move to accommodate the movements of the dental instrument in the execution of dental work.

The tube 3 of the electric-motor serves as a support for the controller or switch, which constitutes one of the chief elements of my invention, but I will here remark, that while I prefer to mount the controller or switch on the tube 3, I do not wish to be understood as confining myself to this particular arrangement, as, obviously, the device can be otherwise arranged or supported.

The controller-box is composed of a disk or plate 7 of hard rubber, vulcanite, or any other insulating material, upon which is arranged a sheet-metal or other cover 8 having a glass or other transparent top portion 9 for exposing the interior of the controller-box, and rendering the internal parts visible. The disk or plate 7 is provided at its center with a circular orifice, through which extends a hub 10, rising from a metallic base-plate 12, adapted to fit the tube 3, and to be held thereupon by a clamping-yoke 14, which embraces the tube and extends through the disk or plate 7. The upper ends of the clamping-yoke 14 are secured by nuts 15ª, Fig. 2, whereby the controller-box can be rigidly clamped upon the tube 3, and be readily removed and replaced whenever occasion demands.

The controller-box is preferably circular in form, but the configuration or shape of the box can be variously modified without altering the character of my invention.

The insulating disk or plate 7 is provided with two sets of binding-posts, 15 and 16, and 17 and 18. For the purpose of illustration I will describe the binding-post 15 as connected with the incoming conductor or wire, and the binding-post 16 as connected with the outgoing conductor or wire; while the binding-post 17 is connected with the positive pole of the electric-motor, and the binding-post 18 with the negative pole of the electric-motor. The binding-posts 15 and 16 are extended above the insulating disk or plate 7 and constitute supports for radially swinging contact-arms 19 and 20; while the binding-posts 17 and 18 are similarly extended and constitute bearings for radially movable contact-arms 21 and 22. The contact-arms 19 and 20 are acted upon by spiral springs 25 and 26, and the contact-arms 21 and 22 are acted upon by spiral springs 23 and 24. The springs are each connected at one end with the insulating disk or plate 7, and at the opposite end engage one of the contact-arms, in such manner that the springs constantly press all of said arms toward the axis or center of the insulating disk or plate 7. The free extremities of the contact-arms 19 and 20 are provided with removable and replaceable metallic tips 27 and 28, and the free extremities of the contact-arms 21 and 22 are provided with similar metallic tips 29 and 30. The tips are removable so that they can be renewed whenever necessary if they should become burned out. The tips are composed of copper, or any other suitable metal, and are approximately U-shaped, so that each tip embraces one of the contact-arms and can be slid longitudinally thereupon to engage it with or disengage it from the contact-arm. The free extremities of the contact-arms are also provided on their under sides with set-screws or pendent projecting heads 31, so relatively arranged that when the circuit-breaker is in the position represented in Fig. 2, in which position the circuit is broken, the set-screws or pendent heads 31 bear against the periphery of a disk or plate 32 composed of ivory, or other insulating material, and mounted at its center on a vertical rotary shaft 33 which is journaled in the hub 10 of the base-plate 12. The rotary-shaft is also provided with an escapement-wheel 34, having not less than eight teeth 35 arranged at uniform distances apart. The escapement-wheel is arranged on the shaft 33 between the upper end of the hub 10, and the ivory or other insulating disk 32. The upper end of the shaft 33 is provided with an attached circuit-breaker, composed of a metallic block 36 having two oppositely arranged contact pieces 37, composed of copper or other suitable metal or material which is a good conductor of electricity. The contact-pieces 37 are dove-tailed to the block 36, and are insulated therefrom by interposed pieces 38 of parchment paper, or other thin insulating material. The edges of one contact-piece are separated from the edges of the other, and both contact-pieces can be slid vertically on the block 36 to remove the same if the pieces become burned out or damaged, and it is desired to renew them by substituting other pieces therefor.

The circuit-breaker is provided with parallel, or approximately parallel surfaces formed by the sides of the contact-pieces 37; while the other two sides of the circuit-breaker are recessed—this construction resulting from

the dove-tailed form of the block 36, for the purpose of dove-tailing the contact-pieces 37 to the said block.

The circuit-breaker presents four corners, or angular portions which are adapted to make contact with the copper tips mounted on the extremities of the pivoted spring-pressed contact-arms 19, 20, 21, and 22.

The upper end of the hub 10 of the base-plate 12 is reduced in diameter to constitute a cylindrical bearing for the pawl-carrier, composed of a ring 39, best seen in Fig. 6, having a lateral extension 40, on which an escapement-pawl 41 is pivoted by a pivot-screw 42.

The escapement-pawl is constructed with a tail-piece 43, adapted to abut a stop-pin 44 fixed to the pawl-carrier. The tail-piece 43 of the pawl is acted upon by one extremity of a scroll or volute spring 45. The other end of the scroll or volute spring lies centrally thereof, and is clamped in position through the medium of a collar 46, formed on the under side of the head 47 of a set-screw 48, which is screwed into the pawl-carrier 39, as best seen in Fig. 7. By this means one end of the scroll or volute spring is clamped in position and securely held without the use of brazing, soldering, or similar attaching means, which is very advantageous, in that the spring is of delicate construction, and it would be difficult, if not impossible, to secure it in a durable manner by brazing or soldering. The pawl is adapted to engage the teeth 35 of the escapement-wheel 34, for the purpose of rotating the latter, and the extent of movement of the escapement-wheel is regulated by a hook-shaped pawl 49, adapted to bear against the rear sides of the teeth 35, and pivoted at one end, as at 50, to the insulating disk or plate 7. The hooked shaped pawl 49 is acted upon by a suitable spring 51, which, as here shown, is approximately U-shaped, and is secured at one end to the disk or plate 7 by a screw 52, while the free end of the spring presses against the pawl 49, in such manner that when the pawl-carrier is moved, as will hereinafter appear, and the escapement-pawl acts upon the escapement-wheel to advance the same one step, or a distance slightly greater than the distance between the points of two of the teeth 35, so that the hook-shaped pawl 49 is pressed backward against the tension of the spring 51 until the tooth of the wheel 34 drops past the pawl 49, when the latter will spring forward and strike the next tooth 35 and turn the wheel 34 slightly backward and thus cause the circuit-breaker to stand in the position shown by full lines, Fig. 11. The extremity of the hook-shaped pawl lies against the last mentioned tooth of the escapement-wheel until the subsequent actuation of the escapement-pawl, when the pawl 49 is released from such tooth, and is immediately thrown forward to be pressed against by a succeeding tooth, in a manner above explained.

The pawl-carrier 39 is oscillated on the upper end of the hub 10 through the medium of a lever 53, best seen in Fig. 6, having a slot 54 in one end, through which extends a stud 55 projecting from the lower side of the extension 40 of the pawl-carrier 39. The lever 53 is mounted on a vertical rock-shaft 56, journaled in the insulating disk or plate 7, and projecting from the lower side thereof. The lower end of the shaft 56 is provided with an arm 57 connected with a cat-gut cord 58, or its equivalent, which serves to move the arm 57 in one direction to impart the advance stroke to the pawl-carrier to move the escapement-wheel the required distance, as before explained. When the cord is released, a spring 58′ forces the lever 53 back to its normal position and restores the pawl-carrier 39 to its normal position for a subsequent stroke of the escapement-pawl to advance the escapement-wheel another step. The spring 58′ is secured at one end to the disk or plate 7 by a screw 59, and the free end of the spring bears against the lever 53, as best seen in Fig. 5.

The escapement mechanism above described, composed of the escapement-wheel, pawl-carrier, pawl, and means for operating the pawl-carrier, serves to impart an intermittent rotary motion to the circuit-breaker, composed of the block 36 and contact-pieces 37.

The cord 58 connects by a small snap-hook 59 with the cat-gut or other suitable cord 60, which passes through eyes formed on rings 61, placed at suitable intervals on the flexible-shaft 4, as will be understood by reference to Fig. 1, in such manner that the cord 60 is always preserved in proper operative connection with the shaft 4, no matter how the latter is manipulated. The outer end of the cord 60 connects by a snap-hook 62 with a band 63, preferably composed of eel-skin, as the latter is a thin tough substance which takes up but little room, and therefore economizes in space, which is desirable. The band 63 passes through a slot 64 in a clamp 65, Figs. 9 and 10, mounted on the dental instrument 6, and said band extends partially around a cylindrical finger-piece or drum 66, and is secured thereto in any suitable manner. I prefer to attach the band 63 by doubling the same to form a loop 67, through which a pin 68 extends, the loop and the pin lying in a recess 69 in the cylindrical finger-piece or drum 66, as best seen in Fig. 9. The ends of the finger-piece or drum are preferably serrated, or provided with ratchet-shaped teeth 70, to facilitate turning the finger-piece or drum by a finger or the thumb of the hand which grasps the dental instrument.

The clamp 65 may be of any construction suitable for the purpose, so that it can be mounted upon, adjusted and held in the required position on the dental instrument.

The finger-piece or drum 66 is provided at one end with a scroll or volute spring 71, Figs. 8 and 10, mounted in a recess formed in the end of the finger-piece or drum, and having one end secured to the drum, while the other end is secured to a part of the clamp 65. The

chief object of the spring 71 is to take up any slack in the cords 60 and 58, when bending or curving the sheathed shaft 4. The spring 71 is necessarily weak in power, so that it will not overcome the power of the spring 58′. To take up the slack in the cords requires but little power. The cylindrical finger-piece or drum is secured to an axle or shaft 72, adapted to rotate in bearings forming parts of the clamp 65.

The snap-hook 59 is provided for the purpose of enabling the shaft 4 to be disconnected from the electric motor without disturbing the controller, and the snap-hook 62 is for the purpose of enabling the dental instrument to be disconnected from the shaft whenever occasion demands, thereby leaving the cord 60 in proper operative connection with the shaft.

When the various parts are in normal position, the axially rotatable circuit-breaker stands in the position represented in Figs. 2 and 11, and the pivoted swinging contact-arms are held out of contact with the circuit-breaker by the set-screws or heads 31 bearing against the periphery of the disk 32, so that no current can pass to the motor, and the latter is therefore inactive. If it is desired to start the motor, the finger-piece or drum 66 is slightly turned by a finger or the thumb of the hand which grasps the dental instrument, thereby drawing or pulling the cord 58, and causing the lever 53 to move the pawl-carrier 39 in the direction necessary to cause the escapement-pawl 41 to advance the escapement-wheel one step. The finger-piece or drum may then be released, whereupon the escapement-pawl and pawl-carrier will be restored to their normal positions, while the circuit-breaker will stand in the position shown, for example, in Fig. 12, so that the circuit is completed between the conductors or line-wires, and the positive and negative poles of the elecric motor. The electric-motor can be instantly stopped by operating the finger-piece or drum, and causing the circuit-breaker to turn to the position shown in Fig. 11, and then, by another movement of the finger-piece or drum, to further rotate the circuit-breaker, the latter is moved to the position shown in Fig. 13, for the purpose of reversing the direction of the current through the electric-motor, which has the effect of reversing the motion of the latter, and consequently changes or reverses the direction of rotation of the tool in the dental instrument.

In setting the rotary circuit-breaker to the position for breaking the circuit and stopping the motor, the circuit-breaker turns to the position indicated by dotted lines, Fig. 11, and the current is reversed for an instant, or until the cord is released, when the circuit-breaker turns back to the position shown in full lines, Fig. 11. This slight back motion is caused by the action of the pawl 49 and spring 51, and is advantageous, in that the current is reversed for an instant, and a swifter stoppage of the motor is obtained. In other words the pawl 41 is moved a distance slightly greater than the distance between the points of two of the teeth of the escapement-wheel, so that the angles or corners of the circuit-breaker pass beyond the break point to the next contact position and remain thus so long as the tension is maintained by the action of the finger or thumb on the finger-piece or drum. When the tension is released, the spring 51 and pawl 49 move the circuit-breaker back to the actual break or stop position, and this effects the instant stoppage of the motor.

It will be observed that the circuit-breaker is always rotated in the same direction; and that in one position it breaks the circuit and stops the motor, while in another position the motor will run in one direction, and in another position the motion of the motor is reversed, whereby it is possible to start the motor, or instantly stop the same, or reverse the direction of rotation of the armature of the motor by changing the direction of the electric-current through the motor for reversing the rotary motion of the dental tool.

The clamp 65 is preferably composed of a divided ring having the extremities connected by a bolt 73, by which to clamp the ring on the tube 3, and the ring is provided with side flanges or ears 74 in which the ends of the axle or shaft 72 are journaled.

The base-plate 12, yoke 14, and nuts 15ª constitute a clamp for securing the controlling-box to the tube 3, or to any other suitable support.

The axis of the pawl-carrier 39 is coincident with the axes of the escapement-wheel and circuit-breaker, and this is best accomplished by forming the pawl-carrier with a circular opening to fit on the reduced upper end of the hub 10, as in Fig. 4.

The improved controller is simple in construction, effective and swift in operation, and susceptible of being economically manufactured, and it provides for starting, stopping and reversing the electric motor whenever occasion demands, by a slight movement of a finger, or the thumb of the hand which grasps and manipulates the dental instrument, thus enabling the dentist to stand firmly on both feet and use both hands in the execution of dental work.

Having thus described my invention, what I claim is—

1. The combination of two pairs of movable contacts for connecting with the positive and negative poles of an electric-motor and the incoming and outgoing electric conductors or line wires of a source of electric energy, a circuit breaker rotating in the same direction for electrically connecting one pair of said contacts with the said conductors or line wires, and the other pair of said contacts with the positive and negative poles of the motor, means for rotating the circuit-breaker in the same direction, and means whereby the rotation of the circuit-breaker in

the same direction effects the starting, stopping and the reversing of the motor, substantially as described.

2. The combination with an electric-motor, and the electric conductors or line wires of a source of electric energy, of a controller-box having two pairs of movable contacts, one pair connecting with the positive and negative poles of the motor, and the other pair with the incoming and outgoing conductors or line wires, a circuit-breaker rotating in the same direction and interposed between the said contacts for electrically connecting all of the contacts, and means for intermittently rotating the circuit-breaker in the same direction to start, stop and reverse the motor, substantially as described.

3. The combination in a controller for an electric-motor, of two pairs of radially movable contact-arms having their free ends arranged in juxtaposition to one another, a circuit-breaker rotating in the same direction, interposed between the free end portions of the contact arms and provided with two contact-pieces insulated from each other for leading the current in either direction through both pairs of contact-arms to start, stop and reverse the motor, and means for intermittently rotating the circuit-breaker in the same direction at the will of the operator, substantially as described.

4. The combination in a controller for an electric-motor, of two pairs of pivoted contact-arms, springs acting on said arms to press their free end portions toward one another, a circuit-breaker rotating in the same direction, interposed between the free end portions of the contact-arms and provided with two contact-pieces insulated from each other for leading the current in either direction through both pairs of contact-arms to start, stop and reverse the motor, and means for intermittently rotating the circuit-breaker in the same direction, substantially as described.

5. The combination in a controller for an electric-motor, of two pairs of pivoted contact-arms, springs acting on said arms to press their free end portions toward one another, an axially rotatable circuit-breaker interposed between the free end portions of the contact-arms and provided with two contact-pieces insulated from each other for leading the current in either direction through both pairs of contact-arms, means for intermittently rotating the circuit-breaker, and devices for holding the contact-arms out of contact with the circuit-breaker to stop the motor, substantially as described.

6. The combination in a controller for an electric-motor, of two pairs of pivoted contact-arms having removable tips on their free end portions, springs acting on the contact-arms to press their tipped portions toward one another, an axially rotatable circuit-breaker interposed between the tipped ends of the contact-arms and provided with two contact-pieces insulated from each other for leading the current in either direction through both pairs of contact-arms to start, stop and reverse the motor, and means for intermittently rotating the circuit-breaker, substantially as described.

7. The combination in a controller for an electric-motor, of a controller-box provided with two pairs of pivoted contact-arms, springs acting on the arms to press the free end portions toward the center of the controller-box, a shaft journaled at the center of the controller-box, an escapement-wheel mounted on the shaft, a contact-breaker mounted on the shaft and having two contact-pieces insulated from each other, an insulating disk or plate arranged upon the shaft and acting to hold the contact-arms out of contact with the contact-pieces of the circuit-breaker when the latter is in one position, a pawl-carrier provided with a pawl for intermittently rotating the escapement-wheel, and means for oscillating the pawl-carrier, substantially as described.

8. The combination in a controller for an electric-motor, of a controller-box provided with two pairs of radially movable contact-arms, a shaft provided with a circuit-breaker interposed between the contact-arms and having two contact-pieces insulated from each other for leading the current in either direction through both pairs of contact-arms, an escapement-wheel mounted on the shaft of the circuit-breaker, an insulating-disk also mounted on said shaft, an oscillatory pawl-carrier provided with a pawl for intermittently rotating the escapement-wheel, a lever and spring for oscillating the pawl-carrier, and means for operating said lever, substantially as described.

9. The combination in a controller for an electric-motor, of a controller-box having an insulating-disk or plate, two pairs of radially movable contact-arms supported by said disk or plate, means for clamping the disk or plate to a suitable support, a shaft provided with a circuit-breaker, an escapement-wheel mounted on the shaft, means for holding the contact-arms out of contact with the circuit-breaker in one position of the latter, an oscillatory pawl-carrier provided with a spring pawl for intermittently rotating the escapement-wheel, and means for oscillating the pawl-carrier, substantially as described.

10. The combination in a controller for an electric-motor, of a series of radially movable contact-arms, a shaft provided with an escapement-wheel and a circuit-breaker, a pawl-carrier provided with a pawl for intermittently rotating the escapement-wheel, a scroll or volute spring having one end bearing against a tail-piece of the pawl, a set-screw having a projecting collar clamping the other end of the scroll or volute-spring to the pawl-carrier, and means for oscillating the pawl-carrier, substantially as described.

11. The combination in a controller for an electric-motor, of a series of contact-arms a

rotatable circuit - breaker, an escapement mechanism for rotating the circuit-breaker, a rotatable finger-piece or drum, and a cord connected with the escapement mechanism and with said finger-piece or drum, substantially as described.

12. The combination in a controller for an electric-motor, of a series of contact-arms, a rotatable circuit - breaker, an escapement mechanism for intermittently rotating the circuit-breaker, a dental instrument provided with a rotatable finger-piece or drum, a flexible shaft connecting the dental instrument with the motor, and a cord extending along the flexible shaft and connected at one end with the escapement mechanism and at the other end with the said rotatable finger-piece or drum, substantially as described

13. The combination in a controller for an electric-motor, of a series of contact-arms, a rotatable circuit-breaker, escapement mechanism for intermittently rotating the circuit-breaker, a dental instrument provided with a rotatable spring-impelled finger-piece or drum, a flexible shaft connecting the dental instrument with the motor, and a cord passing through eyes on the flexible-shaft and connected at its ends with the escapement mechanism and the rotatable spring-impelled finger-piece or drum, substantially as described.

14. The combination with a controller-box having a series of contact-arms, a circuit-breaker, and circuit - breaker operating devices, of a dental instrument provided with a clamp, a spring-impelled finger-piece or drum journaled in the clamp, a flexible-shaft connecting the dental instrument with the electric-motor, and a cord extending along the flexible-shaft and having its ends connected respectively with the finger-piece or drum and the circuit-breaker operating mechanism of the controller-box, substantially as described.

In testimony whereof I have hereunto set my hand and affixed my seal in presence of two subscribing witnesses.

WILLIAM J. POHLMAN. [L. S.]

Witnesses:
ALBERT P. GORE,
J. WILLIAM SMITH.