H. W. CHENEY.

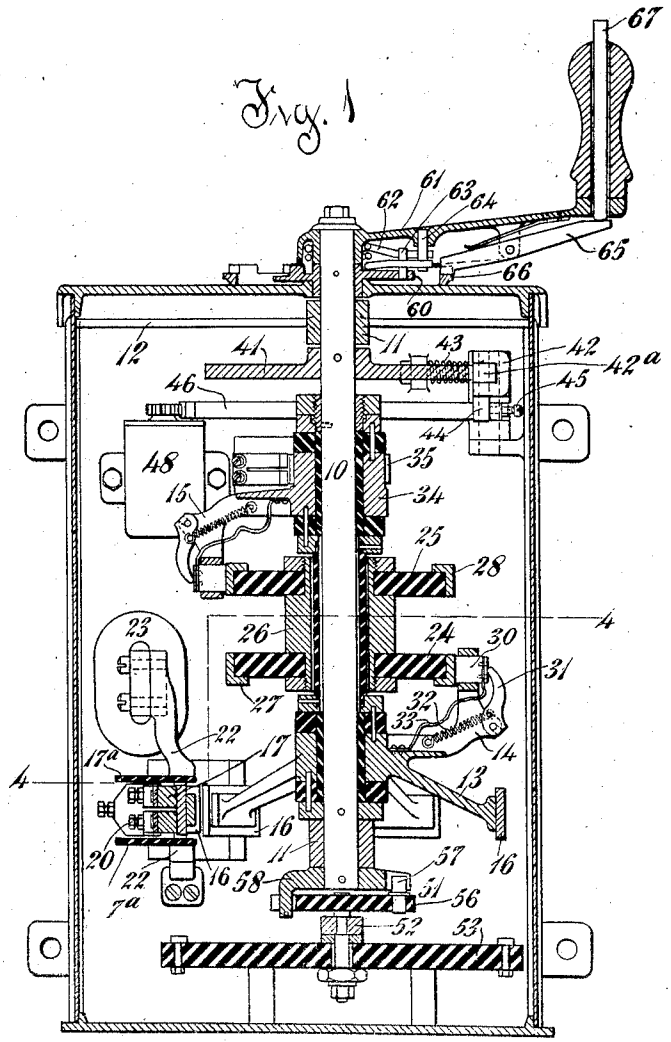
MULTIPLE VOLTAGE CONTROLLER.

APPLICATION FILED OCT. 5, 1908.

987,698. Patented Mar. 28, 1911.

5 SHEETS—SHEET 1.

Fig. 1



Witnesses

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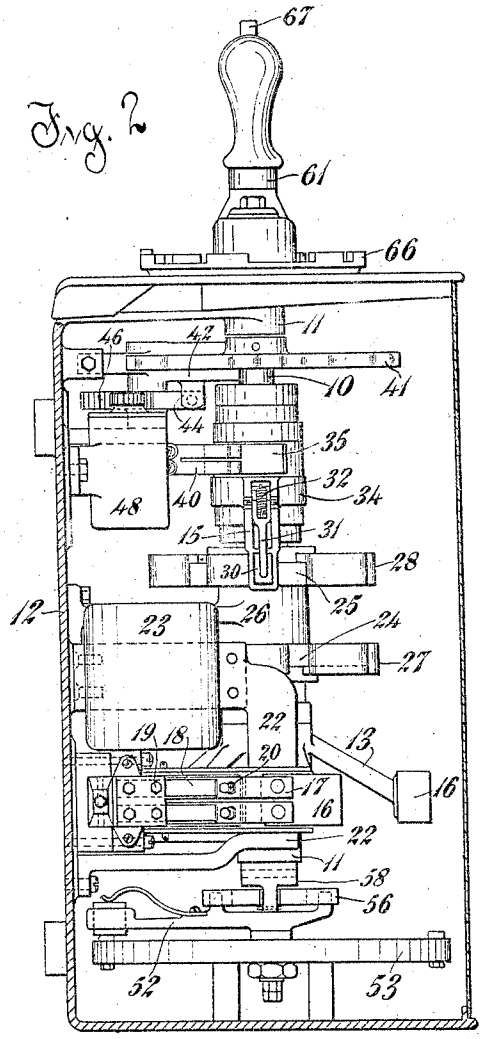
5 SHEETS—SHEET 2.

Fig. 2.



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5 SHEETS—SHEET 3.

Fig. 4

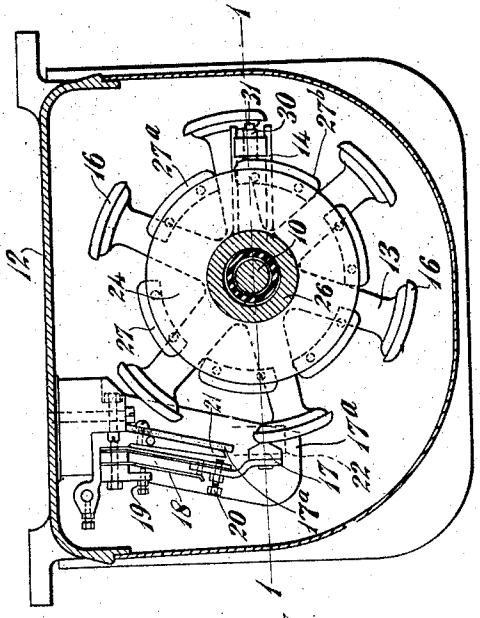
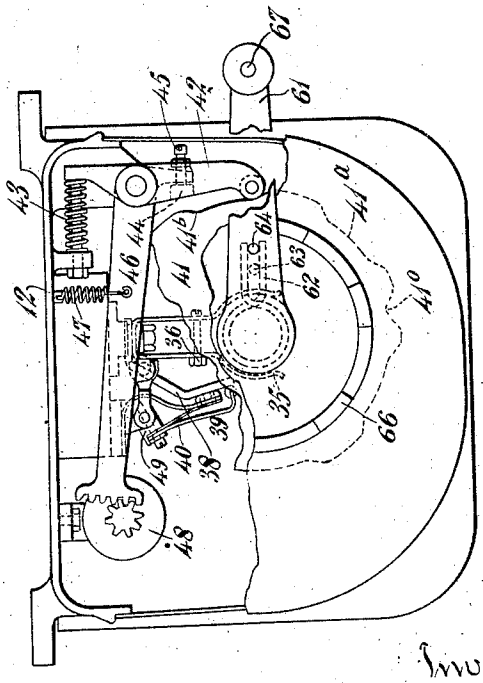


Fig. 3



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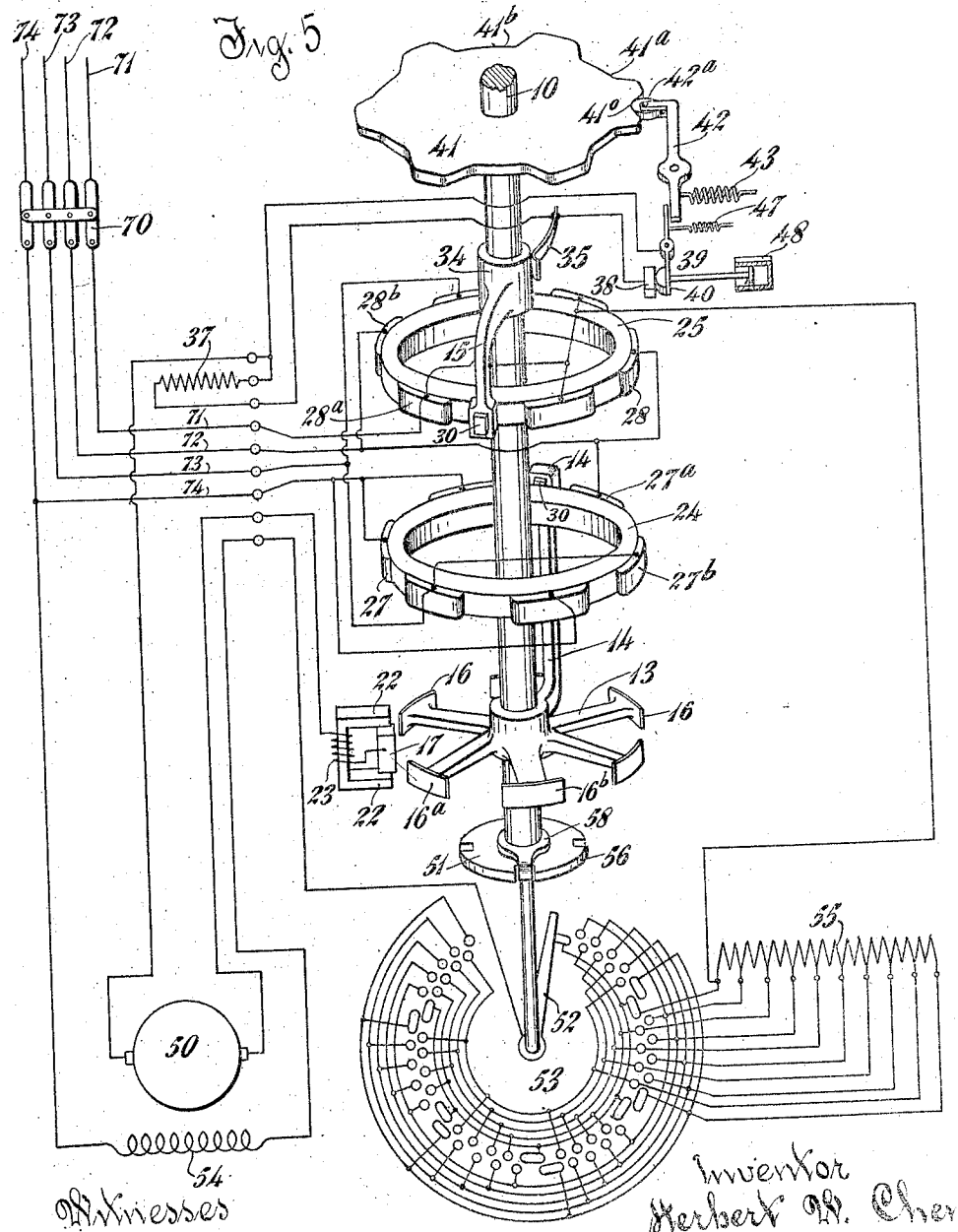
5 SHEETS—SHEET 4.

Fig. 5



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5 SHEETS—SHEET 5.

987,698.

Fig. 6.

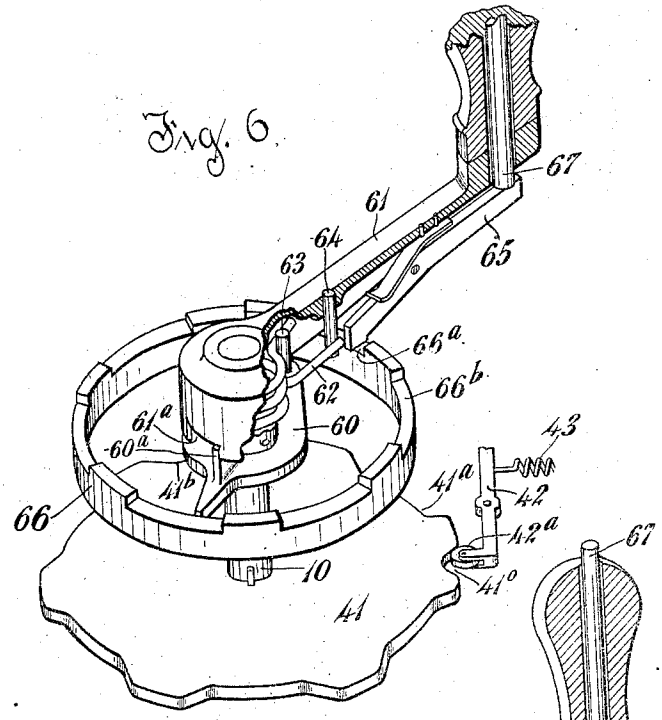
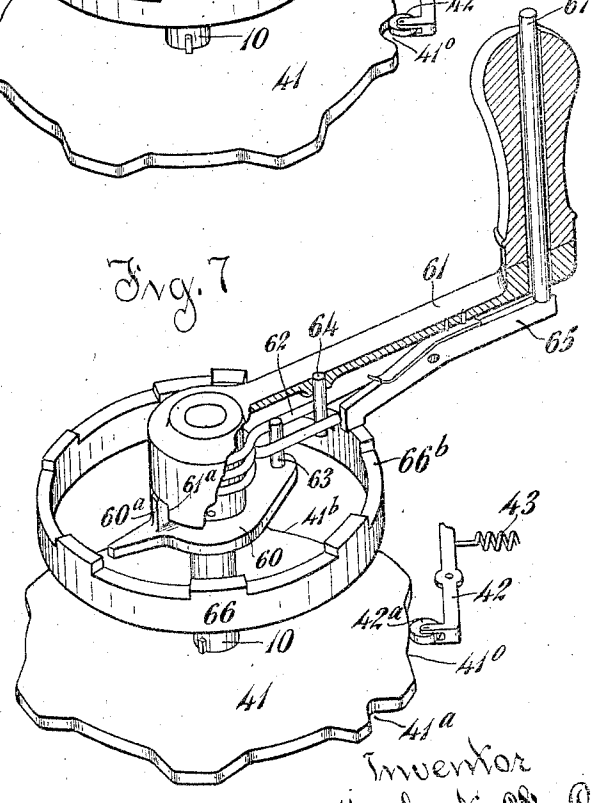


Fig. 7.



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UNITED STATES PATENT OFFICE.

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MULTIPLE-VOLTAGE CONTROLLER.

987,698. Specification of Letters Patent. Patented Mar. 28, 1911.

Application filed October 5, 1908. Serial No. 456,162.

To all whom it may concern:

Be it known that I, HERBERT W. CHENEY, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Multiple-Voltage Controllers, of which the following is a full, clear, and exact specification.

My invention relates to controllers for electric motors, and particularly to multiple voltage controllers.

It is the object of my invention to provide a controller which is simpler in construction than those heretofore used for the same purpose, which will give more satisfactory results than any hitherto known, and which will stand up under the hardest conditions of use.

In carrying out my invention, I have departed entirely from the traditional forms of controller building. The motor armature terminals are connected to the several sets of mains of a multiple voltage distribution system by the rotation of two fingers around the peripheries of two stationary drums respectively. The contacts on the stationary drums are properly connected to the conductors of the system. The shaft which carries the two fingers also carries a rotatable drum, which has its contacts all in one plane so that they coöperate with a single fixed contact. The contacts of the rotatable drum are all connected to one of the aforesaid rotatable fingers, and the contacts on the rotatable drum and on the two stationary drums are so located relatively that the motor armature circuit is always made and broken at the fixed contact finger which coöperates with the rotatable drum. Thus any arcing which takes place will occur at this fixed contact finger, which is provided with a simple but effective blow-out.

The shaft which carries the rotatable drum and contact fingers may be mechanically connected, through a simple separable coupling which I have devised, to the movable arm of a face plate controller for the field of the motor. The contacts of this face plate controller are preferably so arranged that the field of the motor is strengthened as each increase in voltage is made by the parts mounted on the shaft and is weakened as the shaft is moved forward without changing the armature connections, and vice versa.

The shaft of the controller carries a notched plate supplied with cam surfaces which operate to open a switch to include a buffer resistance in the motor armature circuit upon each change of armature connections. The closure of this switch is retarded by a dash pot. The controller shaft is operated by a handle or other means through which a snap action is obtained when the armature connections are changed, while a non-snap action is obtained when the shaft is rotated to vary the motor field resistance without changing the armature connections. The handle is provided with a push-button controlling a latch for preventing the controller from being moved too far upon its snap actions.

The various novel features of my invention will appear from the description and drawings, and will be particularly pointed out in the claims.

Figure 1 is a vertical sectional view of my improved controller, taken on the line 1—1 of Fig. 4; Fig. 2 is an elevation thereof, being taken at right angles to Fig. 1; Fig. 3 is a plan view of the controller with the casing, handle, and some other parts partially broken away; Fig. 4 is a section on the line 4—4 of Fig. 1; Fig. 5 is a diagrammatic isometric view showing the relative positions and the electrical connections of the several parts of the controller. Figs. 6 and 7 are isometric views showing the handle and cam wheel in two positions.

The controller shaft 10 is mounted in bearings 11, or otherwise supported from the frame 12 of the controller casing. The bearings 11 are split in the usual manner, and are preferably removable. The shaft carries a rotatable drum 13, and two arms 14 and 15, all of which are insulated from the shaft and from one another, save that the arm 14 is connected to the drum 13 and

its contacts 16. These contacts 16 coöperate with a stationary contact finger 17, the two parts of which are pressed against the contacts 16 by springs 18. The pressure of the springs 18 may be adjusted by screws 19, while the extent of the inward movement of the finger is adjustable by screws 20 coöperating with a stop 21. All of the arcing which takes place occurs between the contacts 16 and the finger 17. Therefore this finger is located between the poles 22 of a blow-out magnet 23, which, since it is required to furnish a magnetic field only around the contact finger 17, may be comparatively small. The magnetic circuit of the blow-out is furnished partly by the controller casing 12. Insulating plates 17ª may be placed between the finger 17 and the poles 22 of the blow-out magnet, and between the finger and those adjacent parts of the drum with which it is not directly coöperating. The finger 17 is connected to one terminal of the motor armature 50.

The contact fingers 14 and 15 coöperate with two stationary drums 24 and 25 respectively. These drums are concentric with the shaft 10, which passes through them, but they are mounted independently of the shaft on a bracket 26 extending from the main casing. The contacts 27 and 28 of the drums 24 and 25 respectively are mounted on insulating disks, and are properly connected to the conductors of a multiple voltage distribution system, as best indicated in Fig. 5. The contacts of these drums subtend greater angles than corresponding contacts of the drum 13, so that all circuit making and breaking takes place at the last mentioned drum and its coöperating contact finger 17. The contact fingers or arms 14 and 15 each carry a brush 30 in a radial opening at its outer end. The brush 30 is pressed against the contacts of the coöperating stationary drum by a finger 31 and spring 32. The finger 31 can be swung back beyond its dead center in order to allow the removal of the brush 30, and will be held in such position by the spring 32. A shunt 33 may be provided for connecting the brush 30 directly to its arm.

The arm 14 is integral with the spider or drum 13, and is therefore connected to one terminal of the motor armature when any one of the contacts 16 is in engagement with the finger 17. The arm 15 is mounted on a metal hub 34, which turns within the curved portions of the leaf spring 35. The pressure of this spring on the hub is regulated by the bolt 36. The spring 35 is connected to the second motor armature terminal through a buffer resistance 37, and is also connected to the stationary member 38 of a switch 39, the other member 40 of which switch is connected to the other end of the buffer resistance 37. When the switch 39 is closed, the resistance 37 is short-circuited.

The switch 39 is operated by a cam wheel 41 on the shaft 10. The cam surfaces on the periphery of this wheel operate a lever 42, which is pressed by a spring 43 firmly into engagement with the cam wheel. A lug 44 on the lever 42 coöperates with a screw 45 in one arm of a bell-crank lever 46, biased in a clockwise direction by the spring 47. The long arm of the bell-crank lever 46 operates a rotary dash-pot 48, which retards the movement of the lever 46 in a clockwise direction only. This long arm of the bell-crank lever also operates a second bell-crank lever 49, which carries the movable member 40 of the switch 39. The lower end of the shaft 10 is connected by a coupling 51 to the arm 52 of a face plate controller 53 for the field 54 of the motor. The contacts of this controller are connected among themselves and to the resistance 55 as best illustrated in Fig. 5. By means of this arrangement the field is gradually varied in strength only during those parts of the movement of the controller in which the motor armature connections are not changed, while whenever the motor armature connections are changed it is suddenly brought back to the strength it had before such gradual variation.

The coupling 51 between the shaft 10 and the arm 52 is rather peculiar. There is a plate 56 provided with three notches in its periphery and carrying a pin 57. These three notches and the pin are spaced 90° apart. The arm 52 of the field rheostat 53 is provided with two fingers which project upward respectively into the two diametrically opposite notches of the plate 56. A dog 58, attached to the lower end of the shaft 10, has a finger which projects downward into the third or middle notch of the plate 56, which notch is directly toward the front of the controller when the latter is in off position and then only, and a notch which is adapted to receive the pin 57. The notch and finger on the dog 58 are diametrically opposite. By means of this arrangement, the shaft 10, bracket 26, and the parts carried thereby may be slid forward out of the controller casing without disturbing the parts mounted on the shaft. In order thus to remove the shaft 10 and bracket 26, it is necessary that the controller as a whole be in off position. It must be in the same position in order to replace them.

On the upper end of the shaft 10 is mounted the operating handle. This handle consists of a part 60 fixed to the shaft and a part 61 movable relatively to the shaft. A spring 62 is coiled about the shaft and engages pins 63 and 64 on the parts 60 and 61 respectively. When the part 61 of the handle is turned, the part 60 is given a bias in

the same direction. The part 61 of the handle carries a pawl or dog 65, which is spring-pressed into engagement with the upper surface of the notched ring 66. By depressing the push-button 67 in the handle, the dog 65 may be lifted out of the notches of the notched ring 66. The notched portions of the ring 66 correspond to those parts of the controller movement in which the armature connections of the motor are changed. The unnotched portions of the ring 66 correspond to those parts of the controller movement in which only the motor field strength is varied.

The operation of the controller is as follows: When the controller is in off position, the dog 65 is in the extreme counter-clockwise end of the notch 66^a of the notched ring 66, and the roller 42^a of the lever 42 is in the notch 41^c of the cam wheel or notched plate 41. The fingers 14 and 15 are out of engagement with any of the contacts of their respective coöperating stationary drums, the switch 39 is closed, none of the contacts 16 engage the finger 17, and the arm 52 is in its extreme counter-clockwise position, thus putting all of the resistance 55 in the motor field circuit. If the line switch 70 is now closed, the motor to be controlled may be started. Without depressing the push button 67, the part 61 of the handle is moved in a clockwise direction. This winds up the spring 62, the shaft 10 and the parts carried thereby remaining stationary because of the engagement of the roller 42^a with the notch 41^c. The springs 43 and 62 are properly adjusted to obtain this result. But when the side of the notch 61^a strikes the lug 60^a, the part 60 of the handle is moved positively, and the cam surface of the notch 41^c forces the roller 42^a and lever 42 outward. This is shown in Fig. 6. As soon as the roller 42^a passes beyond the cam surface of the notch 41^c, the shaft 10 and the parts carried thereby, being freed from the restraining action of the spring 43, are moved by the spring 62 in a clockwise direction with a snap action. In this snap movement, the fingers 14 and 15 practically simultaneously engage the counter-clockwise ends of the contacts 27^a and 28^a respectively, and a little later the clockwise end of the contact 16^a engages the finger 17, completing the motor armature circuit and connecting it between the mains 71 and 72 of the multiple voltage distribution circuit. The motor armature circuit now includes the resistance 37, for the outward movement of the lever 42 has caused a counter-clockwise turning of the bell-crank lever 46 to open the switch 39. The part 61 of the handle, and consequently the shaft 10 and the parts carried thereby, are prevented from moving too far during this movement by the engagement of the dog 65 with the clockwise end of the notch 66^a of the notched ring 66. Upon such engagement, the notched plate 41 has reached such a point that the roller 42^a drops into the clockwise end of the notch 41^a, the roller 42^a and lever 42 moving inward under the pressure of the spring 43, and making the bell-crank lever 46 free to move in a clockwise direction to close the switch 39. But this closing movement is retarded by the dash pot 48, and the switch 39, therefore, does not close until a predetermined time after the inward movement of the lever 42. Upon depressing the push button 67, the handle 61 in its entirety and the shaft 10 and parts carried and operated thereby may be moved forward or in a clockwise direction. There is no snap action in this movement, the spring 62 being of such strength that the various controlling parts follow the movement of the part 61 of the handle. This movement is limited in extent by the length of the notch 41^a, and serves merely to cut the field resistance 55 gradually into circuit without in any way varying the motor armature connections. Fig. 7 shows the handle and notched plate 41 at about the middle of this movement. The push button 67 should be released at this point to allow the dog 65 to drop into the second notch 66^b of the notched ring 66. Upon further clockwise movement of the part 61 of the handle, the shaft 10 and parts carried thereby are held against movement by the counter-clockwise end of the notch 41^a. But upon sufficient movement of part 61 of the handle, the engagement of the side of the notch 61^a with the lug 60^a causes the part 60 of the handle, and therefore the shaft 10, to be moved forward positively, the cam surface at the counter-clockwise end of the notch 41^a forcing the lever 42 outward and opening the switch 39. As soon as the roller 42^a has reached the top of this cam surface, the controller is moved forward with a snap action by the spring 62. In this movement, the armature circuit is broken at the finger 17 and contact 16^a, then the fingers 14 and 15 are moved off of the contacts 27^a and 28^a and upon the contacts 27^b and 28^b respectively, thus changing the armature connections from the mains 71 and 72 to the mains 72 and 73 of higher voltage; and then the armature circuit is completed by the engagement of the contact 16^b with the finger 17. Also during this movement the entire field resistance 55 is again cut out of the motor field circuit to strengthen the motor field. The resistance 37 is cut into the motor armature circuit by the opening of the switch 39, and is cut out by being short-circuited when said switch closes a predetermined time after the engagement of the contact 16^b with the finger 17. The roller 42^a has now dropped

into the clockwise end of the notch 41[b] of the notch plate 41. The engagement of the dog 65 with the clockwise end of the notch 66[b] prevents this movement from continuing too far. In Figs. 1, 2, 3, and 4, the controller is shown with the parts in this position. By continuing the forward movement of the handle, the motor armature may be successively connected between mains of successively higher voltage, six voltages being obtained with the controller shown. Whenever the voltage is increased, the field resistance is cut out of circuit to strengthen the motor field, and the buffer resistance 37 is cut into the armature circuit. During those parts of the controller movement when the voltage impressed on the armature circuit is not changed, the resistance 55 is gradually cut into circuit to decrease the strength of the motor field. A predetermined time after being cut into circuit, the resistance 37 is cut out by the closing of the switch 39. Whenever the armature voltage is changed, the controller has a snap action. During all other parts of this controller movement there is no snap action. The snap movement is prevented from being too great by the dog 65 and the notches in the notched ring 66.

The controller can be moved backward from any point to diminish the motor speed. The same snap action is obtained in the backward movement as the voltage impressed on the motor armature is changed as in the forward movement, while as in the forward movement there is no snap action when only the field resistance is varied. In this backward movement the motor field is suddenly weakened whenever the armature voltage is changed and is gradually strengthened between the changes of armature voltage. As in the forward movement, the buffer resistance 37 is cut into the armature circuit whenever the armature connections are changed, and is cut out again after a predetermined time. The cutting in of this resistance serves during the forward movement of the controller to prevent a too sudden increase of current in the armature, and during the backward movement of the controller to prevent surges of current to the line from the motor armature operating as a generator. In both the forward and the backward movement, the armature circuit is always made and broken at the finger 17, and therefore all arcing takes place at this finger. This arcing is very slight on account of the blow-out magnet 23.

In many cases, some of the features of the controller above described may be omitted. For instance, it is desirable to vary the connections of but one of the motor terminals, in which case the other motor terminal, say the left hand one in Fig. 5, may be permanently connected to one of the mains, say 71, either directly or through the resistance 37 and switch 39. In such case the arm 15 and stationary drum 25 would simply be omitted.

Many modifications may be made in the precise arrangement here shown and described, and all such which do not depart from the spirit and scope of my invention I aim to cover in the following claims.

What I claim as new is:

1. In a multiple voltage controller, the combination of a rotatable member comprising a drum and two contact fingers, two sets of stationary contacts with which said contact fingers respectively coöperate to connect a motor armature to different sets of multiple voltage mains, a stationary contact finger with which said drum coöperates to make and break the circuit, and a blow-out magnet energizing a magnetic field in which said stationary contact finger is located.

2. In a controller, the combination of a rotatable member comprising a drum and two single contact fingers, two sets of stationary contacts with which said contact fingers respectively coöperate, and a single stationary contact finger with which said drum coöperates.

3. A multiple voltage controller having coöperating fixed and movable contacts arranged and connected so that all arc-producing interruptions of the armature circuit of the motor to be controlled occur at one fixed point.

4. A multiple voltage controller having coöperating fixed and movable contacts arranged and connected so that all arc-producing interruptions of the armature circuit of the motor to be controlled occur at one fixed point, and a blow-out magnet which energizes a magnetic field at that point.

5. In a multiple voltage controller, the combination of a finger movable over a plurality of contacts to vary the voltage impressed on a motor armature, a rotatable drum provided with contacts and movable with said finger, and a contact finger cooperating with the contacts of said drum and at which all interruptions of the armature current occur.

6. In a multiple voltage controller, the combination of a rotatable member comprising a drum and two contact fingers, two sets of stationary contacts with which said contact fingers respectively coöperate to connect a motor armature to different sets of multiple voltage mains, and a stationary contact finger with which said drum cooperates to make and break the circuit.

7. In a controller, the combination of a rotatable member comprising a contact finger and a drum having a plurality of contacts, a plurality of fixed contacts with

which said finger coöperates, and a fixed contact finger with which the contacts of said drum coöperate.

8. In a multiple voltage controller, a plurality of fixed contacts connected to the mains of a multiple voltage system, a contact finger movable over said fixed contacts, a plurality of contacts movable with said contact finger, and a fixed contact finger with which said movable contacts coöperate and at which all interruptions of the circuit to be controlled are made.

9. In a multiple voltage controller, a plurality of fixed contacts connected to the mains of a multiple voltage system, a contact finger movable over said fixed contacts, a plurality of contacts movable with said contact finger, a fixed contact finger with which said movable contacts coöperate and at which all interruptions of the circuit to be controlled are made, and a blow-out magnet energizing a magnetic field in which said fixed contact is located.

10. A controller for electric motors, comprising means for varying the voltage impressed on the motor armature and for varying the strength of the motor field, and means for causing said controller to have a snap action when it varies the voltage impressed on the motor armature and a non-snap action when it varies only the strength of the motor field.

11. In combination, a controller for electric motors, and means for giving said controller a snap action and a non-snap action during alternate control-effecting parts of its movement.

12. A multiple voltage controller, comprising means for connecting a motor armature to different sets of multiple voltage mains, means for varying the resistance of the field circuit, and means for giving the controller a snap action when the motor armature connections are changed and a non-snap action at other times.

13. In a multiple voltage controller, the combination of means for giving the controller a snap action when the motor armature connections are changed from one set of mains to another and a non-snap action when only the field resistance is varied, and means for inserting a buffer resistance in the armature circuit for a predetermined time after each change of armature connections.

14. In a controller for electric motors, a controlling part mounted on a shaft, a face plate controller comprising a series of contacts and an arm movable over said contacts, and a coupling between the shaft and the arm of the face plate controller which makes each rotate with the other but permits the separate removal of one without the other.

15. A multiple voltage controller comprising a rotatable shaft, parts mounted thereon and coöperating stationary parts for connecting a motor armature to different sets of multiple voltage mains, a face plate controller for varying the resistance of the field circuit of the motor, and a separable coupling between said shaft and said face plate controller.

16. A controller for electric motors, comprising a rotatable member, means for giving said rotatable member a snap action during part of its movement and a non-snap action during another part thereof, and a push button controlled stop for preventing the snap action from being too great.

17. In a controller, the combination of two relatively rotatable contacts, a spring pressing one of said contacts toward the other, and means for independently adjusting the pressure of said spring and the limit of the movement caused by said spring.

18. In a motor controller, the combination of means for giving the controller a snap action at certain points of its movement and a non-snap action at other points, and means for inserting a buffer resistance into the circuit of the motor to be controlled at each snap action of the controller.

19. In a multiple voltage controller, the combination of two co-axial circular rows of contacts connected to the mains of a multiple voltage system, a shaft rotatable on the axis of said rows of contacts, and two contact arms carried by said shaft and coöperating with said two rows of contacts respectively.

20. In a multiple voltage controller, the combination of two series of fixed contacts for connection each to mains of a multiple voltage system, and two contact arms which are movable together and coöperate with said two series of contacts respectively to connect a motor armature across different sets of the multiple voltage mains.

21. In a multiple voltage controller, the combination of two series of fixed contacts for connection to the mains of a multiple voltage system, two contact arms which are movable together and coöperate with said two series of contacts respectively to connect a motor armature across different sets of the multiple voltage mains, and means for giving said contact arms a snap action as they make a change in the motor armature connections.

22. In a controller, the combination of a rotatable drum, a contact finger coöperating with said drum, a spring pressing said contact finger toward said drum, and two independent means for adjusting the pressure of said spring and the limit of the movement caused by said spring respectively.

23. In a controller for electric motors, an armature controlling part mounted on a shaft, a field-controlling part comprising a

series of contacts and an arm movable over said contacts, and a separable coupling between the armature-controlling part and the field-controlling part which permits the separate removal of one of said parts without the other only when the controller is in off position.

24. In a controller for electric motors, two rotatable parts, and a coupling between said two parts which makes each rotate with the other but permits the separate removal of one without the other.

Milwaukee, Wis., September 24, 1908.

In testimony whereof I affix my signature, in the presence of two witnesses.

HERBERT W. CHENEY.

Witnesses:
H. C. CASE,
CHAS. L. BYRON.