H. W. CHENEY.

CONTROLLER.

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911,029. Patented Feb. 2, 1909.

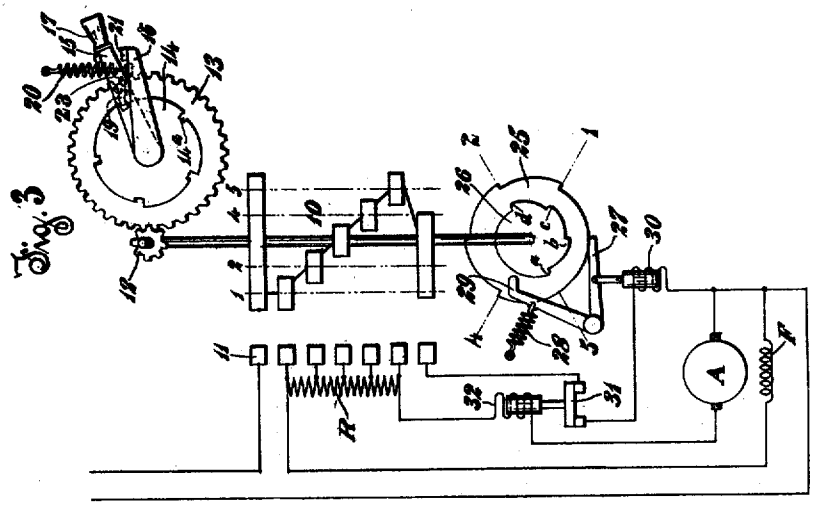


Fig. 3

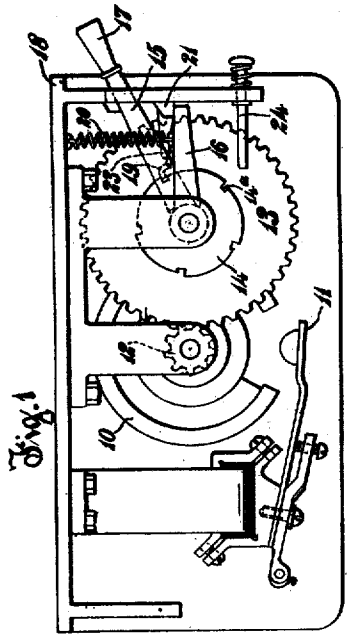


Fig. 1

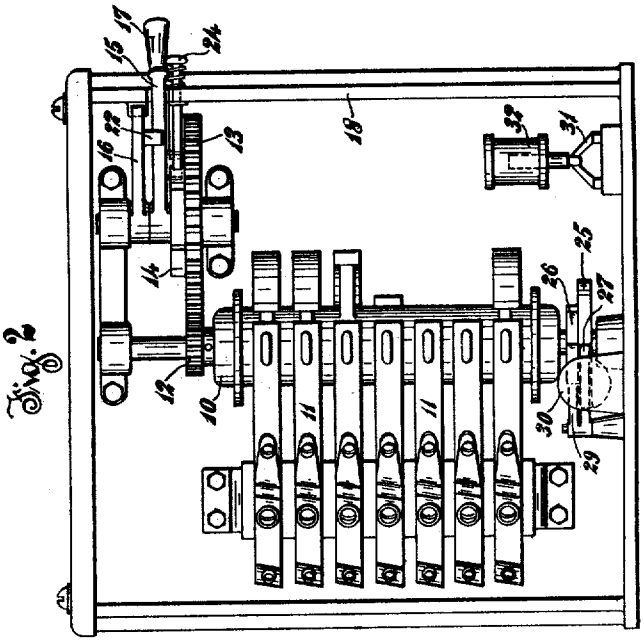


Fig. 2

Witnesses

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HERBERT W. CHENEY, OF NORWOOD, OHIO, ASSIGNOR TO ALLIS-CHALMERS COMPANY, A CORPORATION OF NEW JERSEY, AND THE BULLOCK ELECTRIC MANUFACTURING COMPANY, A CORPORATION OF OHIO, JOINTLY.

CONTROLLER.

No. 911,029. Specification of Letters Patent. Patented Feb. 2, 1909.

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To all whom it may concern:

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

My invention relates to controllers for electric motors.

In the operation of starting controllers for electric motors it is desirable that the controller be left in each starting position until with the controller in such position the motor has gained sufficient counter-electromotive force to reduce its armature current to a predetermined value. If the controller is moved forward too rapidly, there is liability that the large armature current will do damage.

It is the object of my invention to provide a controller which it is impossible to move forward in any manner except that above indicated as desirable.

It is a further object of my invention to make such movement automatic.

With these objects in view I provide a controller in which the controller drum and its operating mechanism are automatically and positively locked against speed-increasing movement at each operative position until with the controller in such position the current in the armature of the controlled motor is below a predetermined value. Preferably there is also provided means whereby the movable part of the controller is biased toward movement in a speed-increasing direction so that after an initial setting by the operator the further movement of the controller in such direction requires no care on his part.

The various novel features of my invention will be apparent from the specification and drawings and will be particularly pointed out in the claims.

Figure 1 shows a plan view of a controller embodying my invention, the controller cover being removed; Fig. 2 is a front elevation of the controller of Fig. 1, the front part of the casing being removed; and Fig. 3 is a diagrammatic view showing the complete connections of the controller and the motor controlled thereby.

The controller drum 10 may be constructed and mounted in any desired manner and is arranged to coöperate with a suitable number of contact fingers 11, also constructed and mounted in any desired manner. On the shaft of the drum 10 is a pinion 12 which meshes with a suitably mounted gear 13. Fixed to rotate with the gear 13 is a notch disk 14, here shown with five notches. The notches of the disk 14 are higher on one side than on the other, so that the disk is somewhat in the nature of a ratchet wheel. Arms 15 and 16 are pivoted concentrically with the gear 13 and disk 14 but are movable relatively thereto and to each other. The arm 15 is movable by a handle 17 which extends outside of the casing 18 within which the remaining controller parts are located. This arm also carries a pawl 19 which is normally spring-pressed toward engagement with the notched disk 14. The arm 16 is biased in a counter-clockwise direction by a spring 20, its movement in this direction being limited by a stop 21. This arm 16 is provided with a projection 22 which extends into the path of the arm 15 so that when the latter arm is moved in a clockwise direction it carries with it the arm 16 against the action of the spring 20. A stop 23 moves the pawl 19 out of engagement with the low side of any notch of the notch-plate 14 with which it may be in engagement when the arm 15 is in its extreme position in a counter-clockwise direction, the off position. When the arm 15 is in its extreme position in a clockwise direction, also an off position, the pawl 19 is movable out of engagement with both sides of any notch of the notch disk 14 by pushing in the normally outwardly spring-pressed plunger 24.

On the shaft of the controller drum are two disks 25 and 26, the former being provided with ratchet teeth and the latter with cam surfaces, *a*, *b*, *c* and *d*, as clearly shown in Fig. 3. One arm 27 of a bell-crank lever is spring-pressed toward engagement with the edge of the disk 25 as by the spring 28, while the other arm 29 of said bell-crank lever is normally just out of engagement with the disk 26 but is arranged to be brought into engagement therewith by a solenoid 30. The arm 27 coöperates with ratchet teeth on the disk 25 to stop the forward movement of

the controller drum at every starting position. The solenoid 30 is controlled by a solenoid switch 31, the solenoid 32 of which is in the circuit of the motor armature A. The circuit of the solenoid is also controlled by the lowest contact segment and finger of the controller so that it is completed only when the controller is in one of the starting positions.

With the parts in the positions shown in the figures the controller is in off position. In order to move the controller through the starting positions to the running position, the arm 15 is moved in a clockwise direction until the pawl 19 engages with the next notch on the disk 14. As the arm 15 is thus moved it engages with the projection 22 on the arm 16 and carries said arm along with it, stretching the spring 20. The pawl 19 having engaged with the notch 14^a say, the arm 15, now in its extreme position in a clockwise direction, is released by the operator. The contracting of the spring 20 moves the arms 16 and 15 and through them the disk 14 and gear 13 in a counter-clockwise direction, and the pinion 12 and controller drum 10 in a clockwise direction. When the drum 10 reaches its first operative position, the arm 27 engages the first tooth of the disk 25 to hold said disk and the drum positively against further rotation in this direction until or unless with the controller in this position the current is below a predetermined value. In the latter case the solenoid 32 in the motor armature circuit, the motor circuits having been completed as the controller drum approached position 1, allows the switch 31 to remain or become closed, as the case may be, to energize the solenoid 30 and move the arm 27 out of the path of the first tooth of the disk 25. Because the cam surface *a* was in the way of the inward movement of the arm 29, the arm 27 could not be moved out of the path of the first tooth of the disk 25 even though the solenoid 30 was momentarily energized as the controller approached position 1. This action is further guarded against by arranging the bottom contact segment of the controller drum as shown so that it does not engage with its cooperating contact finger until after the motor circuits have been completed. When because the motor armature current is below the predetermined value for which the switch 31 is set the arm 27 is moved out of the path of the first tooth of the disk 25, the spring 20 continues its contraction and moves the drum 10 farther in a clockwise direction until stopped by the engagement of the second tooth of the disk 25 with the arm 27. In this second controller position one section of the resistance R is cut out of the motor armature circuit, thus raising the electromotive force impressed on the armature terminals. The controller may be arranged to cut this resistance into the circuit of the field winding F of the motor, as shown, or may be arranged to leave such field circuit without external resistance throughout the controller positions. When the motor armature current has dropped below a predetermined value, or if the cutting out of the first section of the resistance R has not raised such current above such value, the solenoid 30 is energized to move the arm 27 out of the path of the second disk of the tooth 25 to allow the drum 10 to continue its movement under the influence of the spring 20 to the third operative position. This step-by-step movement is continued until the controller reaches the fifth or running position, when the arm 16 engages the stop 21 so that the spring 20 can contract no farther. Thus in each of the starting positions 1, 2, 3 and 4, the speed-increasing movement of the controller drum is stopped until or unless with the controller in such position the current in the motor armature A and the solenoid 32 is below a predetermined value. There is no tooth on the disk 25 for the fifth or the off positions, so that the controller drum can always be moved in a clockwise direction from such positions. Consequently there is no cam surface on the disk 26 just ahead of such positions. In the movement above described there is no possibility that on account of the sluggishness of the locking parts the controller will be moved forward more than one notch at a time. On account of the cam surfaces *a*, *b*, *c* and *d* on the disk 26, the arm 29 is forced outward and the arm 27 inward into proper position to lock the controller drum at each starting position unless the conditions for forward movement from such positions prevail.

If it is desired to stop the movement of the controller at any position, the operator can do this by grasping the handle 17. It is not intended to be possible for the controller to be left indefinitely in any starting position unattended. The controller can be moved backward from any starting or indeed from the running position, if it is so desired, by moving the arm 15 manually in a clockwise direction. With the handle 15 in its extreme clockwise position the pawl 19 may be released from the disk 14, so that if the motor was stopped by a backward movement of the controller from any starting position or the running position, it will not be necessary for the operator to continue to hold the handle 17. From the running position the controller may also be moved to the off position by pushing the handle 17 and arm 15 in a counter-clockwise direction. This is the normal method of reaching the off position. When the arm 15 is thus moved to the off position the stop 23 is engaged by the pawl 19 to move said pawl so that it will clear the low side of the notch

14ª say, thus allowing the arm 15 to be moved in a clockwise direction from its extreme counter-clockwise position without carrying the disk 14 and other parts with it. By this movement the controller may be set for another complete operation. If it is desired that there be no automatic movement of the controller, this can be obtained by simply omitting the arm 16 and spring 20.

Many modifications may be made in the precise arrangement here shown and described without departing from the spirit and scope of my invention, and all such I aim to cover in the following claims.

What I claim as new is:—

1. In combination, an electric motor, a controller therefor comprising two relatively movable members, and means for positively preventing relative speed-increasing movement of said members beyond any position unless with the controller in such position the current in the motor armature is below a predetermined value.

2. In combination, an electric motor, a controller therefor comprising two relatively movable members, and means for positively stopping the relative speed-increasing movement of said members at every operative position unless with the controller in such position the current in the motor armature is below a predetermined value.

3. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for normally positively preventing relative speed-increasing movement of said members beyond any operative position, and means for automatically releasing said preventive means only when with the controller in such position the current in the motor armature is below a predetermined value.

4. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for normally positively stopping the relative speed-increasing movement of said members at every operative position, and means for automatically rendering said stopping means inoperative only when with the controller in such position the current in the motor armature is below a predetermined value.

5. In combination, an electric motor, a controller therefor comprising two relatively movable members, and means controlled by an electromagnetic winding in the motor armature circuit for positively preventing relative speed-increasing movement of said members beyond any position unless with the controller in such position the current in the motor armature is below a predetermined value.

6. In combination, an electric motor, a controller therefor comprising two relatively movable members, and means controlled by an electromagnetic winding in the motor armature circuit for positively stopping the relative speed-increasing movement of said members at every operative position unless with the controller in such position the current in the motor armature is below a predetermined value.

7. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for normally positively preventing relative speed increasing movement of said members beyond any operative position, and electromagnetic means for releasing said preventive means only when with the controller in such position the current in the motor armature is below a predetermined value.

8. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for normally positively stopping the relative speed-increasing movement of said members at every operative position, and electromagnetic means for rendering said stopping means inoperative only when with the controller in such position the current in the motor armature is below a predetermined value.

9. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for normally positively preventing relative speed-increasing movement of said members beyond any operative position, electromagnetic means for releasing said preventive means, and means for rendering said releasing means operative only when with the controller in such operative position the current in the motor armature is below a predetermined value.

10. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for normally positively stopping the relative speed-increasing movement of said members at every operative position, electromagnetic means for rendering said stopping means inoperative, and means for rendering said electromagnetic means operative only when with the controller in such position the current in the motor armature is below a predetermined value.

11. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for normally positively preventing relative speed-increasing movement of said members beyond any operative position, electromagnetically operated means for releasing said preventive means, and a magnet coil in series with the motor armature for rendering said releasing means inoperative whenever with the controller in such position the current in the motor armature is above a predetermined value.

12. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for normally positively stopping the relative speed-increasing movement of said members at every opera-

tive position, electromagnetic means for rendering said stopping means inoperative, and a solenoid in the motor armature circuit for rendering said electromagnetic means inoperative whenever with the controller in such position the current in the motor armature is above a predetermined value.

13. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for biasing said members to relative movement in a direction to increase the speed of said motor, and means for preventing such relative movement of said members beyond any position unless with the controller in such position the current in the motor armature is below a predetermined value.

14. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for biasing said members to relative movement in a direction to increase the speed of said motor, and means for stopping such movement of said members at every operative position unless with the controller in such position the current in the motor armature is below a predetermined value.

15. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for biasing said members to relative movement in a direction to increase the speed of the motor, means for normally preventing such movement of said members beyond any operative position, and means for releasing said preventing means when with the controller in such position the current in the motor armature is below a predetermined value.

16. In combination, an electric motor, a controller therefor comprising two relatively movable members, means for biasing said members to relative movement in a direction to increase the speed of the motor, means for normally stopping such movement of said members at every operative position, and means for rendering said stopping means inoperative when with the controller in such position the current in the motor armature is below a predetermined value.

17. In a controller for electric motors, the combination of fixed and movable members, and means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position.

18. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, and means for automatically stopping such movement of said movable member at a starting position until with said member in such position the motor armature current is below a predetermined value.

19. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, means for normally stopping said movable member at a starting position, and means for rendering said stopping means inoperative when the motor armature current is below a predetermined value.

20. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, means for normally stopping said movable member at each starting position, and electromagnetic means for rendering said stopping means inoperative when with the movable member in such starting position the motor armature current is below a predetermined value.

21. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, means for normally stopping said movable member at a starting position, an electromagnetic device for rendering said stopping means ineffective, and means for energizing said electromagnetic device when the current in the motor armature is below a predetermined value.

22. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, means for normally stopping said movable member at a starting position, an electromagnetic device for rendering said stopping means ineffective, and means for energizing said electromagnetic device only when said movable member is in a starting position and the current in the motor armature is below a predetermined value.

23. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member

the same direction from the running position to the off position, means for normally stopping said movable member at each starting position, an electromagnetic device for rendering said stopping means ineffective, and means for deënergizing said electromagnetic device whenever the motor armature current is above a predetermined value.

24. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, means for normally stopping said movable member at each starting position, an electromagnetic device for rendering said stopping means ineffective, and means for deënergizing said electromagnetic device whenever the motor armature current is above a predetermined value or said movable member is in running position.

25. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, means for normally stopping said movable member at each starting position, an electromagnetic device for rendering said stopping means ineffective, a normally closed switch in the circuit of the electromagnetic device, and a solenoid in the motor armature circuit for opening said switch when the armature current is above a predetermined value.

26. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, means for normally stopping said movable member at each starting position, an electromagnetic device for rendering said stopping means ineffective, a normally closed switch in the circuit of the electromagnetic device, a solenoid in the motor armature circuit for opening said switch when the armature current is above a predetermined value, and means for opening the circuit of said electromagnetic device when the controller is in running position.

27. In a controller for electric motors, the combination of fixed and movable members, means for biasing said movable member from the off position through the starting position or positions to the running position and for manually moving said movable member in the same direction from the running position to the off position, means for normally stopping said movable member at each starting position, an electromagnetic device for rendering said stopping means ineffective, a normally closed switch in the circuit of the electromagnetic device, a solenoid in the motor armature circuit for opening said switch when the armature current is above a predetermined value, and means for opening the circuit of said electromagnetic device when the controller is in either running or off position.

28. In a controller for electric motors, the combination of fixed and movable members, said movable member being movable normally always in one direction from the off position through the starting position or positions and the running position to the off position again, and means for normally positively stopping said movable member at each of the starting positions.

29. In a controller for electric motors, the combination of fixed and movable members, said movable member being movable normally always in one direction from the off position through the starting position or positions and the running position to the off position again, and means for normally stopping said movable member at each of the starting positions until with the controller in such position the motor armature current is below a predetermined value.

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

HERBERT W. CHENEY.

Witnesses:

GEO. B. SCHLEY,

FRED J. KINSEY.