J. J. SINCLAIR.

CONTROLLING DEVICE FOR ELECTRIC MOTORS.

APPLICATION FILED DEC. 7, 1911.

1,037,344.

Patented Sept. 3, 1912.

2 SHEETS—SHEET 1.

Fig. 3,

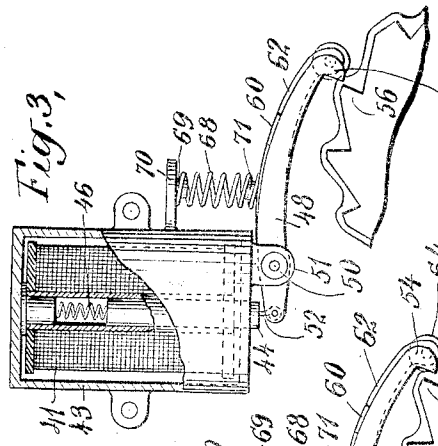


Fig. 4,

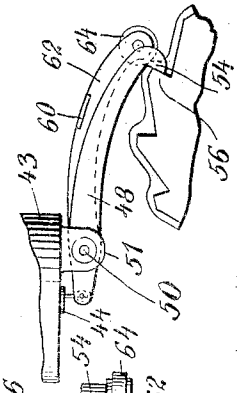


Fig. 2,

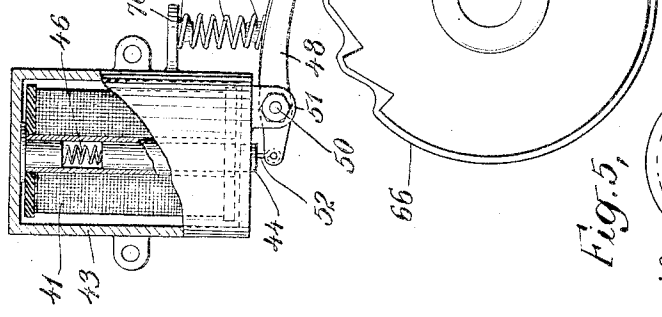


Fig. 5,

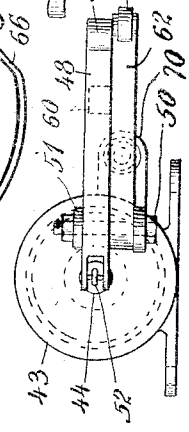
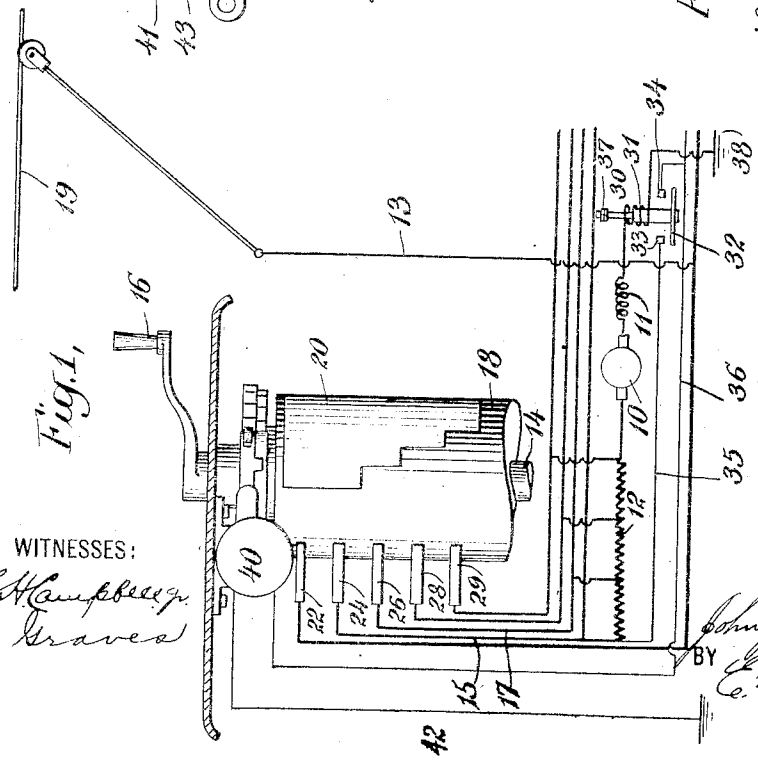


Fig. 1,



WITNESSES:

F. H. Campbell Jr.

F. Graves

INVENTOR

John J. Sinclair

BY E. W. Marshall

ATTORNEY

J. J. SINCLAIR.

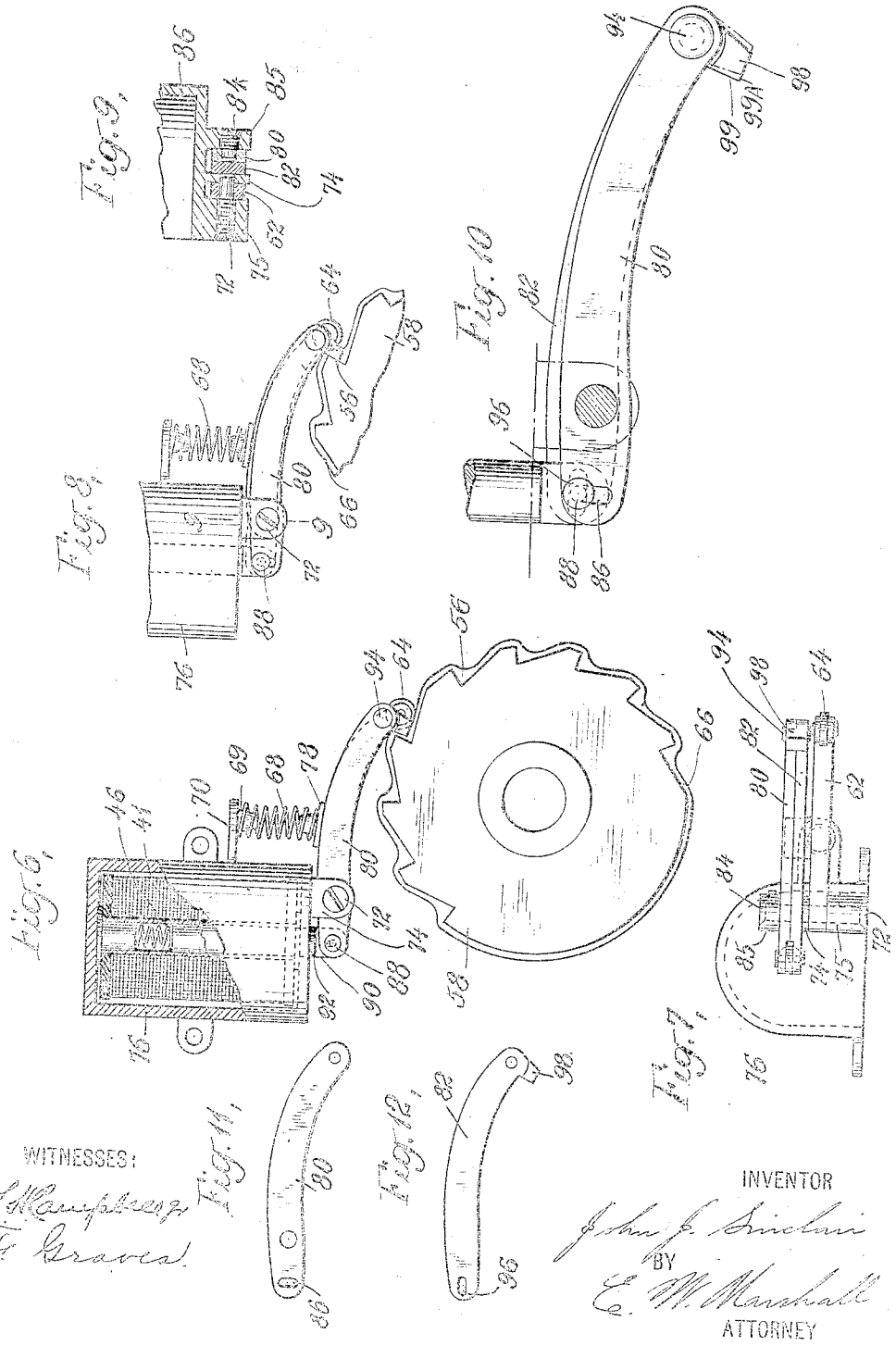
CONTROLLING DEVICE FOR ELECTRIC MOTORS.

APPLICATION FILED DEC. 7, 1911.

1,037,344.

Patented Sept. 3, 1912.

2 SHEETS—SHEET 2.



WITNESSES:

J. Kampbell

F. Graves

INVENTOR

John J. Sinclair

BY

E. M. Marshall

ATTORNEY

UNITED STATES PATENT OFFICE.

JOHN J. SINCLAIR, OF UPPER MONTCLAIR, NEW JERSEY.

CONTROLLING DEVICE FOR ELECTRIC MOTORS.

1,037,344. Specification of Letters Patent. Patented Sept. 3, 1912.

Application filed December 7, 1911. Serial No. 664,480.

To all whom it may concern:

Be it known that I, JOHN J. SINCLAIR, a citizen of the United States of America, and a resident of Upper Montclair, in the county of Essex and State of New Jersey, United States of America, have invented certain new and useful Improvements in Controlling Devices for Electric Motors, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to controlling devices for electric motors and its object is to provide a simple and reliable device to be used in conjunction with hand operated controllers for automatically preventing too rapid or improper manipulation of such mechanisms.

I will describe my invention in the following specification, and point out the novel features thereof in the appended claims.

In the drawings: Figure 1 is a diagram showing certain parts of a trolley car equipment with portions of one of its controllers shown in section, and with my invention shown applied thereto. Fig. 2 is a sectional plan view of one form of the locking mechanism for the controller when it has reached its inward position. Fig. 3 is a similar view, showing the parts in the position which they assume when passing from one step to another. Fig. 4 is a fragmentary plan view, showing the parts in locked position. Fig. 5 is an end elevation of the parts shown in Fig. 2 with the ratchet and cam wheels removed. Fig. 6 is a sectional plan view of a modified form of locking device with the parts in inward position and electromagnet de-energized. Fig. 7 is an end elevation of the same with the ratchet and cam wheels removed. Fig. 8 is a fragmentary plan view showing the position assumed by the parts when in locking position with the electromagnet energized. Fig. 9 is a transverse vertical section taken on the line 9—9 in Fig. 8. Fig. 10 is a fragmentary plan view on an enlarged scale of the locking pawl and latch lever showing how the angle of the tooth engaging face of the locking dog is charged. Figs. 11 and 12 are plan views respectively of a latch lever and a pawl shown removed from the other parts of the mechanism.

Like characters of reference designate corresponding parts in all of the figures.

10 designates an armature of one of the car's electric motors, and 11 its series field winding.

12 is the motor starting resistance.

14 is the shaft of one of the motor controllers at the end of the car and 16 is the handle by means of which it is manipulated. On this shaft is a drum 18 which carries a contact plate 20. This is arranged to be moved first into contact with two stationary contacts 22—24, and then successively onto similar contacts 26—28—29.

30 is a control magnet or solenoid which has a winding 31 connected in series with the motor. Connected with, but insulated from the core of this magnet is a contact plate 32 which is adapted to bridge two stationary contacts 33—34 when the magnet core is raised. A conductor 35 leads from contact 33 to one of the stationary contacts of the controller on the positive side of the motor or control circuit, which is energized at times that the motor or motors are receiving current.

36 is a conductor leading from the contact 34 to one terminal of the winding 41 of a latch controlling magnet 40. The other terminal of the winding 41 is connected with the ground or negative side of control or motor circuit by a wire 42. The latch controlling magnet is preferably in the form of a solenoid inclosed in a shell 43, and provided with a core 44 which is engaged at its upper end by a comparatively weak coiled spring 46. A locking pawl 48 is fulcrumed on a bolt 50 carried by ears 51 depending from the lower end of the shell 43. This pawl is pivotally connected at one end to a member 52 projecting from the lower end of the core 44. The other end of the pawl 48 is formed with a hook 54 adapted to engage the substantially radial faces of teeth 56 on a ratchet wheel 58 on the controller shaft 14. The spring 46 is a light spring which tends to keep the hook 54 out of engagement with the teeth of the ratchet wheel, but the pawl is prevented from moving outwardly beyond a limited distance by a lug 60, which projects laterally from a lever 62 and overlies said pawl. The lever 62 is also fulcrumed on the bolt 50 and is provided at its free end with a cam roller 64, which is held in engagement with a toothed cam 66 by a strong spring 68. The spring 68 is held at one end by a lug 69 on the under side of an ear 70 pro-

jecting laterally from the shell 43, and the other end of the spring is held by a lug 71 on the upper side of the lever 62. The cam 66 is secured to the ratchet wheel 58, and the two move together with the controller shaft 14. The cam 66 controls the movements of the lever 62, and since the spring 46 keeps the pawl 48 in engagement with the lug 60, said pawl and lever travel in unison except when the magnet 40 is energized. In the latter instance the core 44 is drawn up and the hook 54 brought into engagement with the substantially radial face of a tooth 56. The angular relation of the engaging faces of the hook and teeth is such that when they are in engagement the face of the hook makes an angle with the face of the tooth substantially equal to or less than the angle of friction, thus insuring a tight engagement and preventing slipping. When the pawl moves from engaging position it allows a free release. By reference to Fig. 3 it will be seen that the cam wheel 66 moves the lever 62 outward to allow a slight clearance between the hook 54 and the outer corners of the teeth 56. By this construction the hook 54 is always in close proximity to the teeth 56 and only a slight movement of the pawl is required to bring it into locking position. Furthermore, the core 44 is also in the best position for attraction by the solenoid when the hook is in its inward position.

13 is a conductor from the source of electric supply and is shown in Fig. 1 as leading from a trolley wire 19. The conductor 13 is connected with the contact 22. When the operator causes contacts 22 and 24 to be bridged by the plate 20, a circuit is completed through a conductor 15, starting resistance 12, motor armature 10, field 11, and from the winding 31 of the control magnet 30 to the ground at 38. The magnet 30 will thus be energized and if a current of predetermined strength is passing through the motor and the magnet winding 31 the core of the control magnet will be raised and will cause the plate 32 to be brought up against contacts 33 and 34. The controller magnet is adjusted so that it may be set to act on any desired strength of current. One way in which this adjustment may be made is by affixing a desired number of weights 37 to its core. When the contacts 33 and 34 are thus bridged a circuit is established through the magnet 40 and the current causes the core 44 thereof to be drawn into the solenoid, and the hook 54 and the pawl 48 are brought into locking engagement with the substantially radial faces of the opposing tooth on the ratchet wheel 58, so that further movement of the controller shaft in one direction is prevented. The result of this is that when the motor is started the heavy current which passes through it and its starting resistance will cause the control magnet to be actuated and it will cause the lock control magnet 40 and its associated parts to prevent the operator from immediately cutting out any of the starting resistance. But as the motor armature accelerates and cuts down the amount of current flowing through it to a desired amount, the core of the control magnet will drop, the current through the magnet 40 will be broken and the control shaft lock will be released. Now the operator may turn the controller shaft until the plate 20 comes under the contact 26. This contact is connected with the resistance 12 by a conductor 17 and this operation cuts out a portion of the starting resistance. Consequently the motor current increases and if it reaches a certain amount the core of magnet 30 will be raised again and the lock applied to the controller shaft 14 to prevent its further movement until the motor current is again dropped to a desired amount. This same operation may be repeated during the remaining successive steps of controller manipulation.

Only one of the controllers of the car is shown but it will be understood that one control magnet may be utilized to control the locking mechanism at each end of the car. The control magnet may be placed at any convenient part of the car preferably where it cannot be tampered with by the motorman. Its adjustment is easily set and its effect upon the lock controlling magnet is positive and uniform. Moreover, the locking cam and its controlling magnet are so arranged and designed that they may be easily added to existing controllers with but slight alterations so that the invention may be installed on cars already in service with but little expense.

The embodiment illustrated in Figs. 6 to 12 inclusive, comprises an electromagnet substantially the same as that described above, but the locking pawl is of somewhat different construction to provide an improved release and method of changing the angle of the tooth-engaging face of the locking pawl. The cam lever 62 is fulcrumed on a pin 72 held in ears 74—75 on the bottom of the shell 76, said cam lever being provided with a cam roll 64 which engages a toothed cam 66, and is held in engagement therewith by a spring 68, in a manner similar to that explained above. A lug 78 projects laterally from the cam lever 62 and overlies a latch lever 80 and a pawl 82. The latch lever 80 is fulcrumed on a pin 84 held in an ear 85 on the under side of the shell 76. The latch lever 80 is provided at one end with a transversely extending slot 86 through which a pin 88 passes, which projects from both sides of an ear or reduced end 90 formed on the lower end of the core

92 of the magnet. The locking pawl 82 is pivotally connected by a pin 94 to the other end of the latch lever 80. The other end of the locking pawl 82 is provided with a longitudinally extending elongated slot 96 through which the pin 88 also passes. A dog 98 is formed on the outer end of the locking pawl 82, having its face 99 adapted to engage and lock the teeth 56 on the ratchet wheel 58. The operation of this form of the device is as follows: The current is controlled and the magnet is energized in the manner described above. When the controller is in the center of a new circuit-closing position the cam roll 64 is in a position to be lifted out of a depression on the cam wheel 66 by any further movement of the controller as shown in Fig. 8, the spring 46 acting on the core 92 to keep the latch lever 80 in engagement with the lug 78, so that the latch lever, pawl and cam lever travel in unison. When the magnet is sufficiently energized to draw up its core 92 against the pressure of the spring 46, the pin 88 causes the locking pawl to swing about the pin 94 as a fulcrum, thus tilting the dog 98 so that its engaging face 99 is tilted to assume an angle less than the angle of friction, with the teeth of the ratchet wheel, that is, the angle at which the dog and ratchet tooth will engage without slipping. Then the pin 88 engages the upper end of the slot 86 in the latch lever 80, thus forcing the other end of said lever inward and with it the dog 98 on the pawl 82. As the latch lever swings inward it also carries the locking dog into position to engage the substantially radial face of the opposing tooth on the ratchet wheel. The angular relation of the faces on the tooth and dog are such that they are inclined at an angle substantially equal to or less than the angle of friction, that is, at an angle at which slipping of the parts is prevented, and the ratchet wheel is firmly locked against movement in one direction. When the magnet is deënergized, the plunger 92 drops, aided by the spring 46. The pin 88 then forces the left hand end of the locking pawl downward and as it swings about the pin 94, the engaging face of the dog 98 is swung so that it makes an angle greater than the angle of friction, as shown at 99A in dot and dash lines in Fig. 10, to allow a slip and disengagement of the opposing faces of a ratchet tooth and the dog. Then the pin 88 engages the bottom of the slot 86 and tilts the latch lever to hold it in engagement with the lug 78 after which the latch lever, pawl and cam lever, may travel in unison. Thus an operator exerting a uniform pressure on handle 16 sufficient to move the controller drum, will actuate the controller through its successive steps, but the time interval between these steps will be automatically controlled by the current passing through the motor.

While this invention has been shown in conjunction with a certain type of street car controller it is not to be construed as limited to this use. It is well within the scope of this invention to use it in conjunction with any other types of controllers, or in any place where it is desired to automatically prevent the manual operation of a motor controller, by means of the current passing through the motor.

What I claim is:

1. An electric motor, a circuit therefor, a controller for the motor, locking mechanism for said controller, cam controlled means for controlling the normal movement of said locking mechanism, and an electromagnet arranged to move the locking mechanism into locking position.

2. A locking mechanism for a controller comprising a ratchet wheel, a locking dog arranged to engage the teeth of said ratchet wheel to prevent the rotation of the controller in one direction, an electro-magnet for moving said dog into locking position, and cam controlled means for controlling the movements of said dog when released from locking position.

3. A locking mechanism for a controller comprising a ratchet wheel, a locking dog arranged to engage the teeth of said ratchet wheel to prevent the rotation of the controller in one direction, said dog being arranged to change the angularity of its engaging face preparatory to releasing said ratchet.

4. In combination, a controller, a ratchet wheel and a cam wheel on said controller, a locking device arranged to engage the teeth on said ratchet wheel to prevent rotation of the controller in one direction, means controlled by said cam wheel for controlling the movements of said locking device when disengaged from said ratchet wheel and electro-magnetic means for bringing said locking device into engagement with said teeth.

5. In combination, a controller, a ratchet wheel and a cam wheel on said controller, a locking pawl arranged to be brought into engagement with the teeth on said ratchet, means tending normally to keep said pawl out of engagement with said teeth, cam controlled means for controlling the outward movement of said pawl, and electromagnetic means for bringing said pawl into engagement with said teeth.

6. In combination, a controller, a ratchet wheel and a cam wheel on said controller, a latch lever carrying a locking pawl arranged to be brought into engagement with the teeth on said ratchet wheel, means tending normally to keep said pawl out of engagement with said teeth, and cam con-

trolled means for controlling the movement of said pawl while disengaged from said teeth.

7. A locking mechanism for a controller, comprising a ratchet wheel, a latch lever, a locking pawl pivoted on said latch lever and adapted to be brought into engagement with the teeth on said ratchet wheel, means for swinging said pawl independent of said latch lever to change the angularity of the tooth-engaging face of said pawl to allow free release of said controller.

8. A locking mechanism for a controller, comprising a ratchet wheel, a latch lever, a locking pawl pivoted on said latch lever and adapted to be brought into engagement with the teeth on said ratchet wheel, and means for swinging said pawl independent of said latch lever to change the angularity of the tooth-engaging face of said pawl to allow free release of said controller and means for controlling the movements of said latch lever and pawl.

9. A locking mechanism for a controller, comprising a ratchet wheel, an electromagnet, a latch lever having a pin-and-slot connection with the armature of said magnet, a locking pawl arranged to be brought into engagement with the teeth on said ratchet wheel said pawl being pivotally connected to said lever and having a pin-and-slot connection with said armature, and cam controlled means for controlling the movements of said latch lever.

10. A locking mechanism for a controller, comprising a ratchet wheel, a locking dog arranged to engage the teeth of said ratchet wheel to prevent the rotation of the controller in one direction, a latch lever to which said locking pawl is pivoted, and an actuating device, said lever and pawl being connected to said actuating device by a pin-and-slot connection.

In witness whereof, I hereunto set my hand this fifth day of December, 1911.

JOHN J. SINCLAIR.

Witnesses:
W. R. HAMILTON,
J. A. O'BRIEN.