No. 758,722. PATENTED MAY 3, 1904.

V. J. VAN HORN.

CONTROLLER REGULATOR.

APPLICATION FILED SEPT. 10, 1900.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

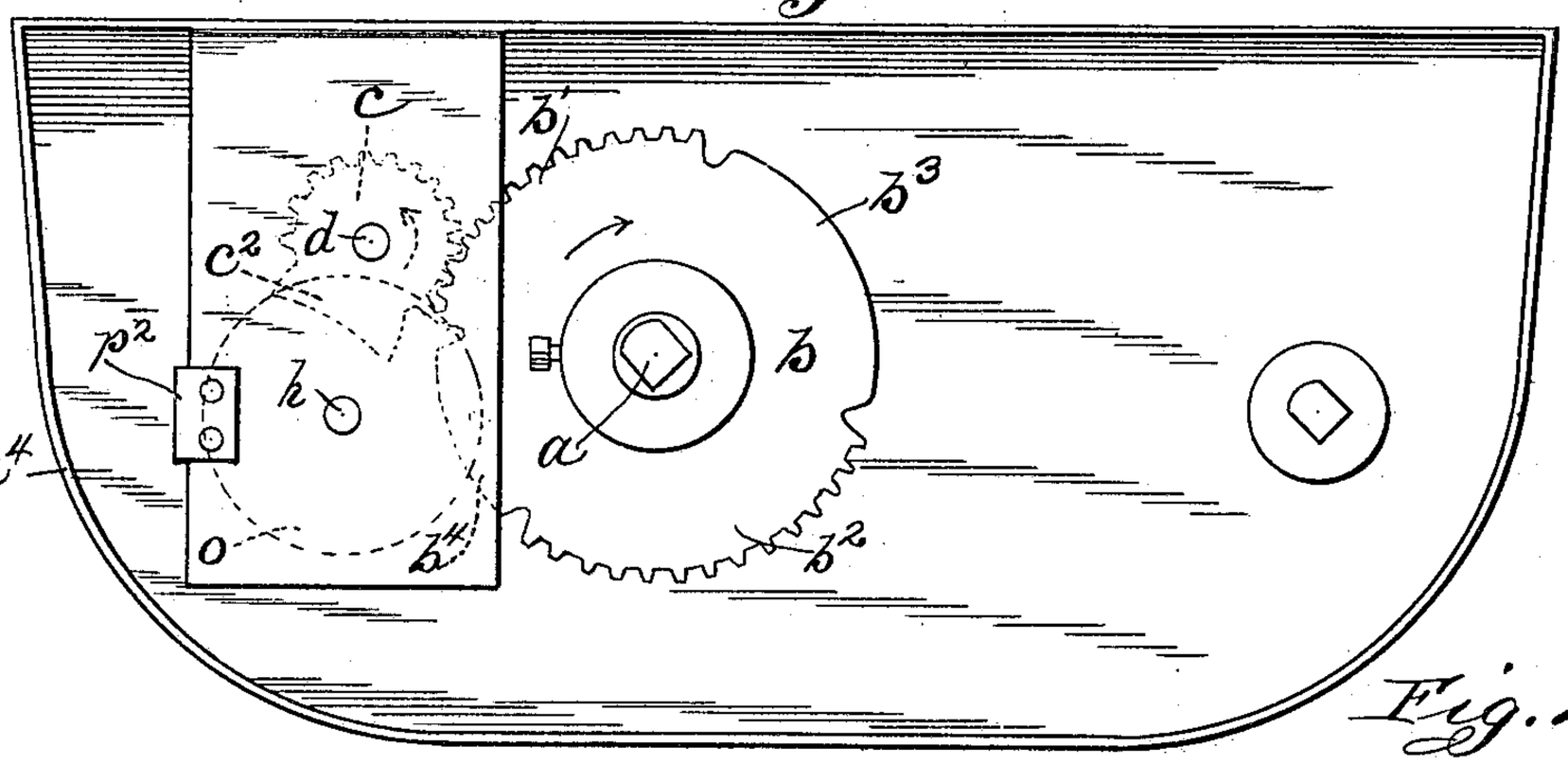


Fig. 2.

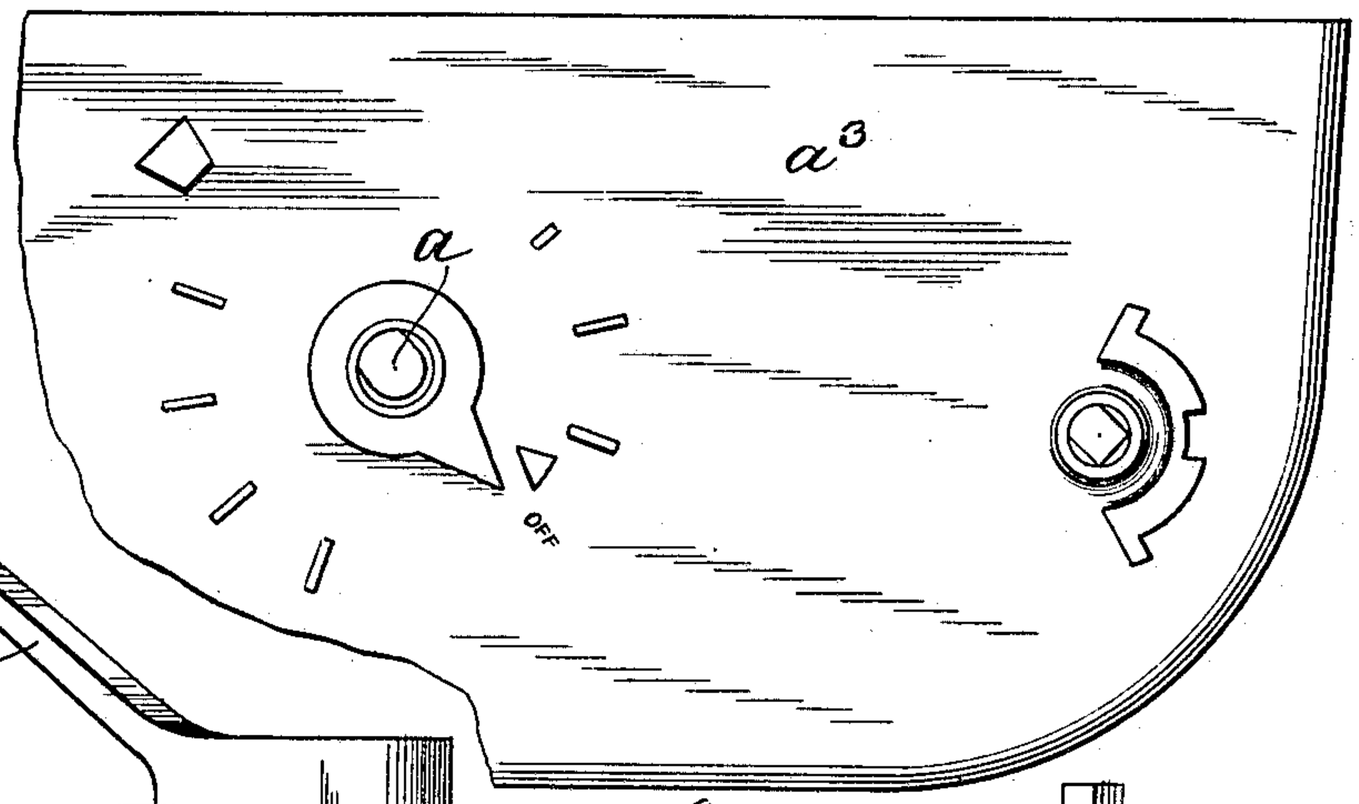


Fig. 3.

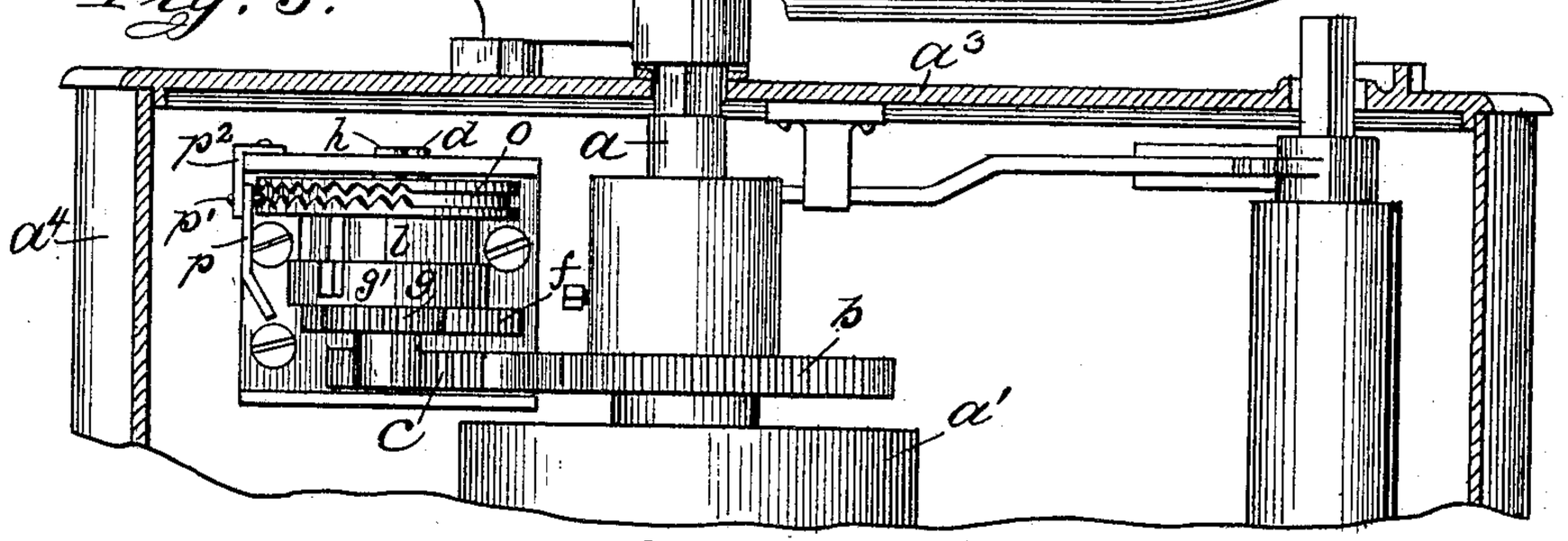


Fig. 5.

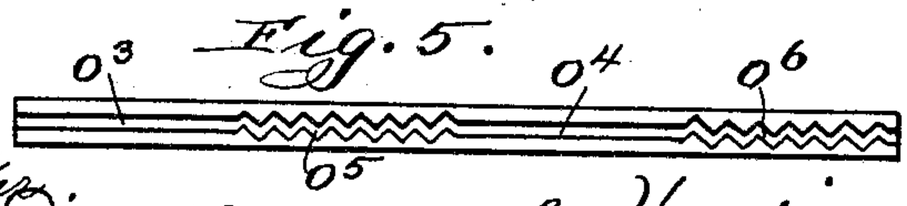
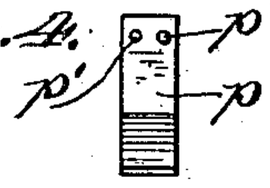


Fig. 4.



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CONTROLLER REGULATOR.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 6.

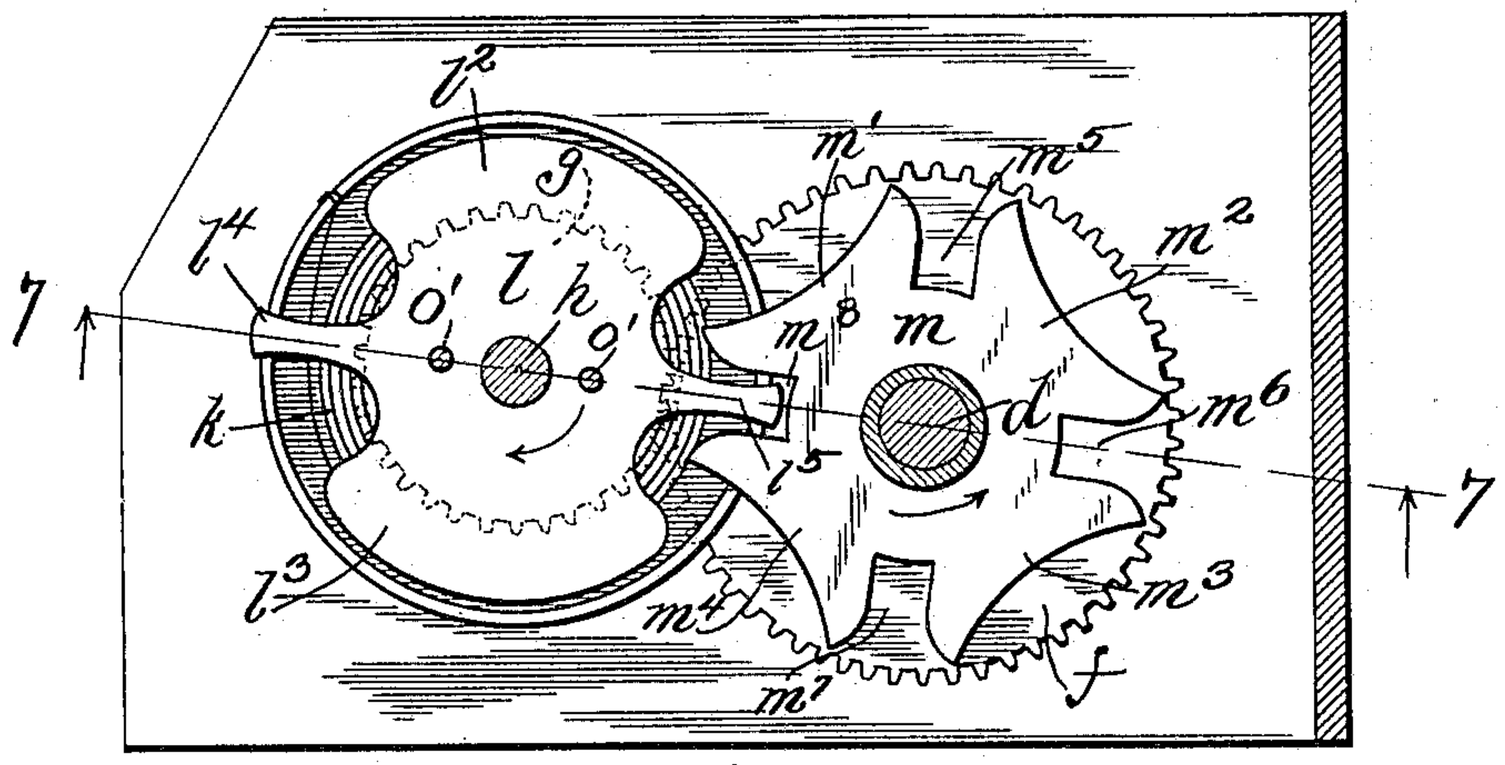


Fig. 7.

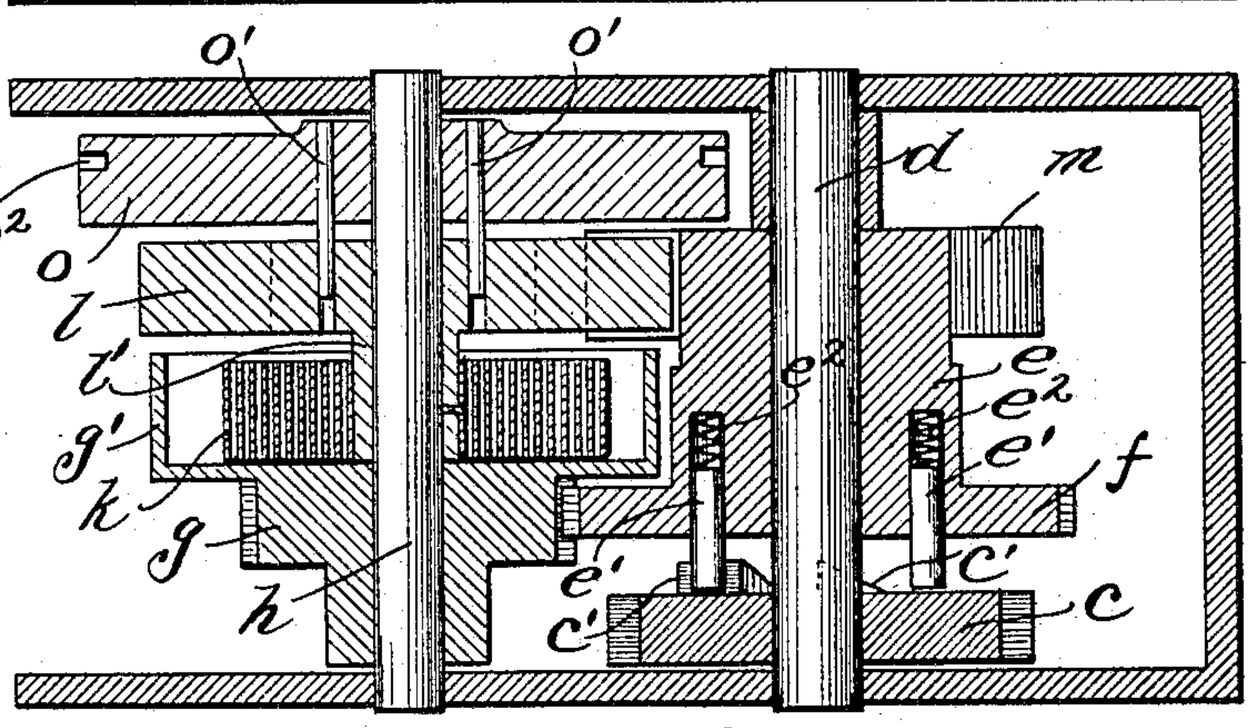


Fig. 9.

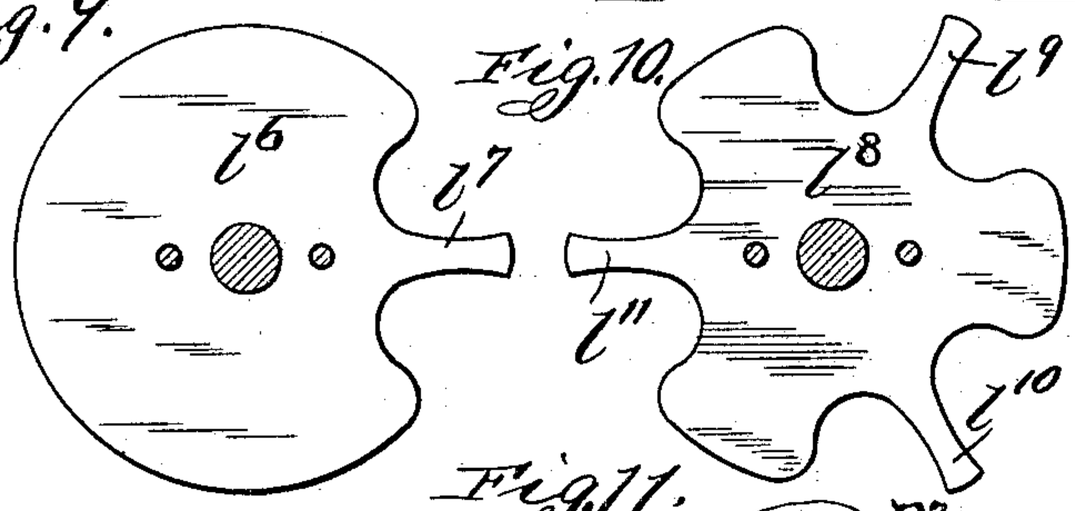


Fig. 10.

Fig. 8.

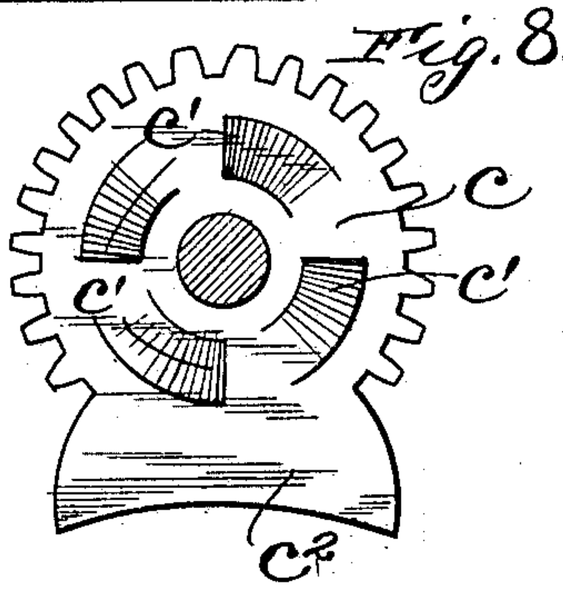
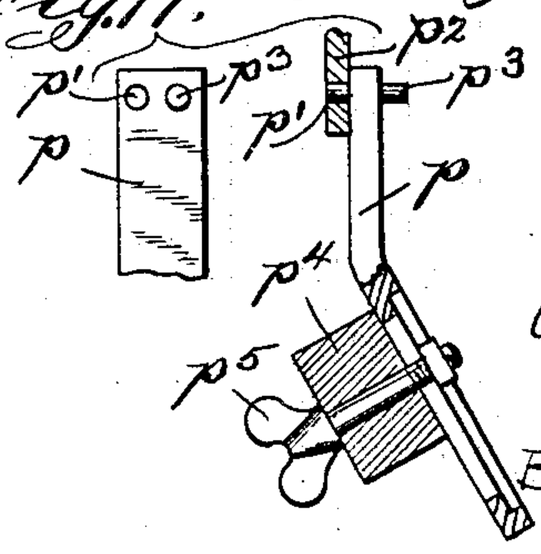


Fig. 11.



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No. 758,722. Patented May 3, 1904.

UNITED STATES PATENT OFFICE.

VANDIVER J. VAN HORN, OF KEOKUK, IOWA, ASSIGNOR TO THE GARTON DANIELS COMPANY, OF KEOKUK, IOWA, A CORPORATION OF IOWA.

CONTROLLER-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 758,722, dated May 3, 1904.

Application filed September 10, 1900. Serial No. 29,509. (No model.)

To all whom it may concern:

Be it known that I, VANDIVER J. VAN HORN, a citizen of the United States, residing at Keokuk, in the county of Lee and State of Iowa, have invented a certain new and useful Improvement in Controller-Regulators, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a regulator for street-railway and other controllers.

My invention is particularly applicable to street-railway controllers; and it is the primary object of my invention to provide a regulator or governing device which will enforce a gradual operation of the controlling mechanism.

In the operation of electric motors, particularly electric motors employed for driving street-railway cars, a controller is provided adapted to be operated by a handle which is manipulated by the motorneer, the movement of the handle in one direction serving to energize the driving motor or motors and to start the car in motion, while the movement of the handle in the opposite direction serves to decrease the speed and eventually to bring the car to a standstill. It is desirable in practice that the controller should be operated at a gradual speed in starting the car, as otherwise an unduly-large current will traverse the electrical apparatus, causing a waste of energy and frequently resulting in damage to the electrical apparatus. A careful operator will in starting the car move the controller step by step, pausing for an interval at the end of each step to permit the motor and other apparatus to accommodate themselves to the new circuit conditions, the controller being thus moved step by step, with brief pauses between the different steps, thereby producing a gradual and safe starting of the driving mechanism. A careless operator will frequently move the controller too rapidly, thereby wasting energy and lowering the efficiency of the apparatus, and, moreover, subjecting the electrical apparatus to severe strains, which may result in injury thereto.

It is the object of the present invention to provide a regulator which will enforce a gradual movement of the controller in starting, while permitting a rapid movement thereof in stopping.

While I have illustrated my invention in connection with the controller of a street-railway car and while my invention has been particularly designed for this purpose, it will be understood that the regulator of my invention is equally applicable to the control of electric motors generally and, in fact, to the control of any mechanism where it is desired to enforce a gradual movement of the operating element of the mechanism.

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 is a plan view of the regulator of my invention, showing the top plate of the controller-casing removed. Fig. 2 is a partial view of the top plate or cover of the casing of the usual street-railway controller. Fig. 3 is a view in elevation showing the apparatus of my invention applied to a street-railway controller of well-known form. Fig. 4 is a detached view of the pendulum provided on the regulator. Fig. 5 is a view of the periphery of the governing-wheel developed into a plane, showing the sinuous channel formed therein. Fig. 6 is a plan view of the regulating mechanism of my invention. Fig. 7 is a sectional view on line 7 7, Fig. 6. Fig. 8 is a detached view of the ratchet-wheel employed therein. Figs. 9 and 10 are modified forms of the escapement-wheel employed in the mechanism of my invention. Fig. 11 illustrates a modified form of the pendulum.

Like letters refer to like parts in the several figures.

Upon the shaft a, which carries the controller-roller a', is mounted the usual operating-handle a^2, the upper end of the shaft a extending through an opening provided in the cover a^3 of the controller-casing a^4. Secured to the shaft a so as to rotate therewith is a gear-wheel b, which, as shown more clearly in Fig. 1, is provided with teeth around a portion only of the periphery, which wheel I term an "intermittent" gear-wheel. The

gear-wheel b is provided with a series of teeth b', extending around a portion of the periphery, and a series of teeth b^2, extending around a portion of the periphery, while between these two series of teeth are the toothless portions b^3 b^4, the peripheries of which are of arc shape.

Meshing with the gear-wheel b is a pinion or wheel c, which I term the "ratchet-wheel," and this wheel is provided around the periphery with teeth adapted to mesh with the teeth b' b^2, and this wheel is also provided with one large tooth c^2, the exterior of which is concave and arc-shaped and conformed to the curvature of the toothless parts b^3 b^4 of gear-wheel b. When the gear-wheel b is rotated, the gear-wheel c will also be rotated so long as the teeth b' or the teeth b^2 mesh with the small teeth of the wheel c. When, however, the large concave tooth c^2 is moved into engagement with the toothless portions b^3 b^4 of gear-wheel b, said toothless portions slide past the tooth c^2, and during such sliding movement lock the wheel c against rotation. The gear-wheel b is thus free to move, while the ratchet-wheel c is held in a non-rotatable position until the teeth on the wheel b engage the side of the large tooth c^2 to thereby rotate wheel c and bring the small teeth thereon into engagement with the teeth upon the wheel b, when the further rotation of the wheel c results. The teeth upon the wheels b and c are so disposed that as the gear-wheel b rotates the large tooth c^2 is brought into contact with the toothless portions b^3 b^4 of the wheel b at the proper times.

The wheel c is journaled to rotate about a stem d and carries upon its upper face a plurality of inclined projections c' c', in the present instance four, which projections present an inclined face and a perpendicular wall adapted to coact with the pins e' e', mounted in openings provided in the hub e, springs e^2 e^2 being provided for yieldingly pressing said pins e' e' toward the wheel c. As the wheel c rotates in one direction—that is, in the direction to start the motor—the pins e' e' are engaged by the perpendicular walls of the projections c, whereby the hub e is caused to rotate with the wheel c. When the controller is moved in the opposite direction—that is, to throw the motor out of action—the inclined faces of the projections c engage and force upward the pins e' e', thereby permitting the wheel c to rotate without imparting movement to the hub e, the pins and projections thus constituting a ratchet, which permits the movement of the wheel c in one direction without imparting movement to the hub e.

Upon the hub e and preferably integral therewith a gear-wheel f is provided, said gear-wheel being adapted to mesh with a gear-wheel g, mounted to rotate about the stem h. The gear-wheel g carries a casing g', which incloses a spiral spring k. Journaled to rotate upon the stem h is an escapement-wheel l, carrying a sleeve l', between which and the casing g' said spring k is adapted to rest, the outer end of said spring being attached to the wall of said casing, as shown more clearly in Fig. 6, while the inner end of said spring is attached to said sleeve l'.

Mounted upon the hub e is a locking-wheel m, having four teeth m' m^2 m^3 m^4, separated by recesses m^5 m^6 m^7 m^8. The exteriors of said teeth are concave and conform in curvature to the peripheries of lobes l^2 l^3 of the escapement-wheel l. The escapement-wheel is provided with two teeth l^4 l^5, situated in diametral positions and adapted to extend into the channels m^5 m^6, &c., in the wheel m.

Mounted upon the stem h is a governing-wheel o, which is adapted to rotate with the escapement-wheel l and which is locked thereto by means of the pins o' o', which are secured to the wheel o and extend into holes provided in the wheel l. The periphery of the governing-wheel o is provided with a channel o^2, which extends parallel to the faces of the wheel except at diametrically opposite positions where the channel partakes of sinuous or zigzag form. Thus the portions o^3 o^4 are straight, while the portions o^5 and o^6 are zigzag or sinuous. A pendulum p is pivoted at p' to a bracket p^2 and carries a pin p^3, adapted to extend into the channel in the periphery of the governing-wheel o. As the governor-wheel rotates the pendulum remains at rest so long as the pin p^3 engages the parts o^3 o^4 of the channel and is vibrated when the pin engages the parts o^5 o^6.

Due to the fact that there is a greater reduction between the gear-wheels f and g than between the wheels m and l, the gear-wheel g is caused to rotate at a faster speed than the wheel l. Accordingly when the hub e is rotated the spring k will be placed under tension, due to the more rapid movement of the gear-wheel g relatively to the wheel l, and a tendency is thus imparted to the wheel to rotate, say, in clockwise direction, as shown by the arrow on the wheel l in Fig. 6. As soon as the wheel m has been rotated sufficiently to permit the tooth l^5 to escape from the recess m^8 the spring k causes the wheel l to continue in rotation, thereby bringing the lobe l^2 into engagement with the concave periphery of the tooth m'. The lobe l^2 is thus free to move relatively to the wheel m, while the wheel m, due to the concave formation of the tooth m, is locked against further movement until the tooth l^4 passes into the recess m^5, when the further rotation of the escapement-wheel l, due to the spring, is checked. The escapement-wheel is then caused to rotate with the wheel m. The portions o^3 and o^4 of the channel in wheel o are so disposed that the pin p^3 will engage therewith during the time the escapement-wheel l receives motion from the wheel m. When the escapement-

wheel *l* is freed from the wheel *m* and rotates, due to the spring *k*, the pin p^3 engages the sinuous portions o^5 o^6 of the channel, and, due to the fact that the pendulum *p* must be oscillated as the pin travels in the sinuous channel, the movement of the escapement-wheel *l* is somewhat checked and slowed in speed. The extent to which the pendulum will lower the speed of the escapement-wheel during these periods will depend, among other things, upon the weight of the pendulum *p*, and I have shown in Fig. 11 a modified form of the pendulum in which an adjustable weight p^4 is provided, which may be adjusted along the pendulum *p* by means of the set-screw p^5, whereby the inertia of the pendulum may be varied as desired to thereby vary the retarding effect of the pendulum.

As illustrated in Fig. 6, the wheel *m* carries four teeth, while the escapement-wheel *l* carries two. If it be desired to lock the operating-lever for a longer period, the wheel *l* may be replaced by a wheel l^6, which has a single tooth l^7, Fig. 9, or if it be desired to decrease the period during which the operating-lever is locked at the end of each step in its movement the escapement-wheel *l* may be replaced by a wheel l^8, Fig. 10, having three teeth l^9 l^{10} l^{11}, placed at equal distances apart. The time limit of the governor may thus be regulated either by varying the number of teeth upon the escapement-wheel or by varying the inertia of the pendulum. Another way in which the time limit may be varied would be by adjusting the tension of the spring *k* or by having a number of springs *k* of different tension, any one of which may be placed in the casing *g'*, as desired. I preferably, however, regulate the time limit by the employment of an escapement-wheel having the desired number of teeth in preference to the other methods mentioned, since this change when made prevents the motorneer from tampering with the mechanism while the car is in service, the change of the escapement-wheels being made by a party at the power house or station whose duty it may be to attend to such matters.

The operation of the controller is as follows: When the motorneer desires to start the car, he retates the handle a^2, thereby rotating the gear-wheel *b* in the direction shown by the arrow and imparting rotation to gear-wheel *c*, which in turn rotates the hub *e*. The gear-wheel *f* rotates the gear-wheel *g* at a greater speed than the wheel *m* rotates the escapement-wheel *l*. The spring *k* is thus placed under tension, and when the wheel *m* has been rotated sufficiently to release the tooth of the escapement-wheel *l* in engagement therewith the tension of the spring *k* asserts itself, thereby rotating the escapement-wheel *l* independently of the wheel *m* and locking the wheel *m* against rotation so long as the lobe of the escapement-wheel remains in engagement with the concave tooth on the wheel *m*. During this independent movement of the escapement-wheel *l* the pin p^3 of the pendulum *p* is in engagement with one of the sinuous portions of the channel in the governing-wheel *o*, and the movement of the escapement-wheel and the governing-wheel is thereby retarded to the desired extent. During this period of independent movement of the escapement-wheel the wheel *m* is, as before stated, locked against rotation, and through the agency of the pins *d' d'* and the projections *d' d'* the gear-wheel *c* is locked to the hub *e* and through the agency of the gear-wheel *b*, meshing with wheel *c*, the handle a^2 is locked against movement. When the escapement-wheel has completed its independent movement and a tooth thereof again brought into engagement with the wheel *m*, the handle is again freed for further movement and the handle may be moved through a further step until the escapement-wheel is again released, when the handle will again be locked against further movement. There are certain arcs through which it is desired in starting the car that the handle a^2 should move freely without retarding effect, and for this purpose the toothless parts b^3 b^4 are provided upon the gear-wheel *b*, which, as before explained, permit the rotation of the gear-wheel *b*, and consequently the handle a^2, while holding the remainder of the train of gears against rotation. When it is desired to decrease the speed of the vehicle or to bring the same to rest, the handle is moved in contra-clockwise direction and the ratchet between the wheel *c* and the hub *e* permits the backward movement of the handle without imparting motion to the train of gears.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a controller, of a governing device, means actuated by the movement of the controller for intermittently setting said governing device in action, and a lock controlled by said governing device for temporarily locking said controller for a limited period during the action of the governing device, substantially as described.

2. The combination with a controller, of means actuated by the movement of said controller for intermittently storing energy in a suitable device and releasing same, a governing device adapted to be operated by the energy thus stored, and a lock controlled by said governing device for temporarily locking said controller for a limited period during the action of said governing device, substantially as described.

3. The combination with a controller, of means actuated by the movement thereof for intermittently storing energy in a suitable device and releasing the same and locking mechanism adapted to be actuated by the energy thus stored for periodically locking the con-

troller against movement, substantially as described.

4. The combination with a controller, of means actuated by the movement thereof, for storing energy in a suitable device and releasing the same, and locking mechanism actuated by the energy thus stored for temporarily locking said controller against movement for a limited period, substantially as described.

5. The combination with a controller, of means operated by the movement thereof for storing energy in a suitable device and then releasing the same, a lock for locking the controller during said release, and a governing device for limiting the speed of release whereby the controller is temporarily locked against movement, substantially as described.

6. The combination with a controller, of a governing device for periodically checking the movement of the controller for limited periods of time, and means interposed between the operating-handle and the governing device for permitting the free movement of the handle through a prearranged distance without actuating the governing device, substantially as described.

7. The combination with a controller, of a governing device for periodically checking the movement of the controller for limited periods of time, and intermittent gearing interposed between the operating-handle of the controller and the governing device permitting limited movement of the handle without actuating the governing device, substantially as described.

8. The combination with a controller, of a governing device for periodically checking the movement of the controller for limited periods, of intermeshing gears interposed between the operating-handle of the controller and said governing device, said gears having portions on the peripheries thereof toothless whereby the operating-handle is free to move for a prearranged distance without actuating the governing device, substantially as described.

9. The combination with a controller, of a governing device for periodically checking the movement of the controller for definite periods, intermeshing gears interposed between the operating-handle and the governing device, the driving-gear having a toothless portion with convex periphery, and the driven gear having a toothless portion with concave periphery adapted to coact therewith whereby the handle is free to move through a prearranged distance while the governing device is locked against movement, substantially as described.

10. The combination with a controller, of means actuated by the movement thereof for storing energy in a suitable device, an escapement-wheel receiving motion from the energy thus stored and a lock for locking the controller during the movement of said escapement-wheel, substantially as described.

11. The combination with a controller, of a spring or equivalent means adapted to have energy stored therein by the movement of the controller, a locking-wheel receiving motion from the controller, an escapement-wheel receiving motion from the locking-wheel throughout a portion of its travel and partaking of independent rotation due to the energy stored in said spring through another portion of its travel, said escapement-wheel being adapted to lock said locking-wheel and thereby the controller against movement during the independent travel of the escapement-wheel, substantially as described.

12. The combination with a controller, of an escapement-wheel and a suitable source of energy for rotating the same, means actuated by the movement of the controller for setting said escapement-wheel in motion and a lock controlled by said escapement-wheel for locking said controller against movement, substantially as described.

13. The combination with a controller-handle, of a part geared thereto, and adapted to be moved thereby through a definite distance and then released, and a lock for holding said handle against further movement during the return stroke of said part, substantially as described.

14. The combination with a controller-handle, of a part adapted to be moved through a definite distance and then released, intermittent mechanism between said handle and said part for intermittently moving said part as the handle is rotated, and a lock for holding the handle against further movement during the return stroke of said part, substantially as described.

15. The combination with a handle, of a moving part and a spring or similar means associated therewith, said part being adapted to be moved through a definite distance by means of said handle, and then released, and a locking device for holding said handle against further movement during the return stroke of said moving part, substantially as described.

16. The combination with a controller, of a governing device therefor, means actuated by the controller in its movement for starting said device into action, a stop device controlled by said governing device for temporarily stopping said controller in its movement for a limited period, and means for intermittently retarding said governing device, substantially as described.

17. The combination with a controller, of stops movable with said controller, means adapted to engage said stops and lock said controller against movement, and cams movable with said stops to place said means in position to lock said controller against movement during a limited period, whereby only an intermit-

tent movement of said controller may be effected when its operating means is moved in one direction.

18. The combination with a controller, of stops movable with said controller, means adapted to engage said stops and lock said controller against movement, cams movable with said stops to place said means in position to lock said controller against movement during a limited period, and means for regulating the period during which said means may engage said stops in the operation of the controller, whereby only an intermittent movement of said controller may be effected when its operating means is moved in one direction.

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

VANDIVER J. VAN HORN.

Witnesses:

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CORA M. SLOANAKER.