Nov. 19, 1929. L. C. FRANK 1,736,438

TIME DELAY LOW VOLTAGE RELEASE

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Fig. 2.

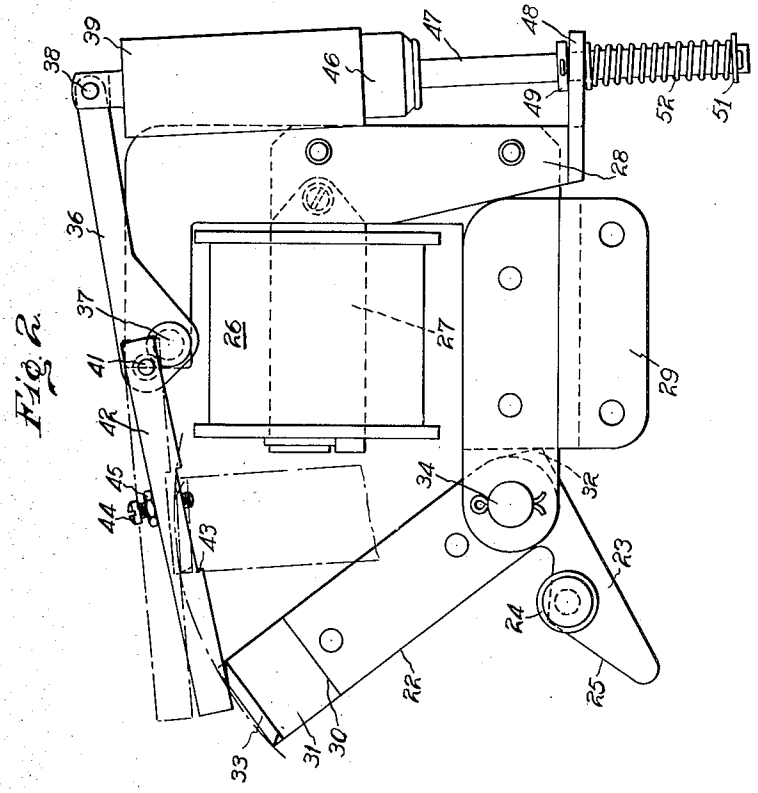
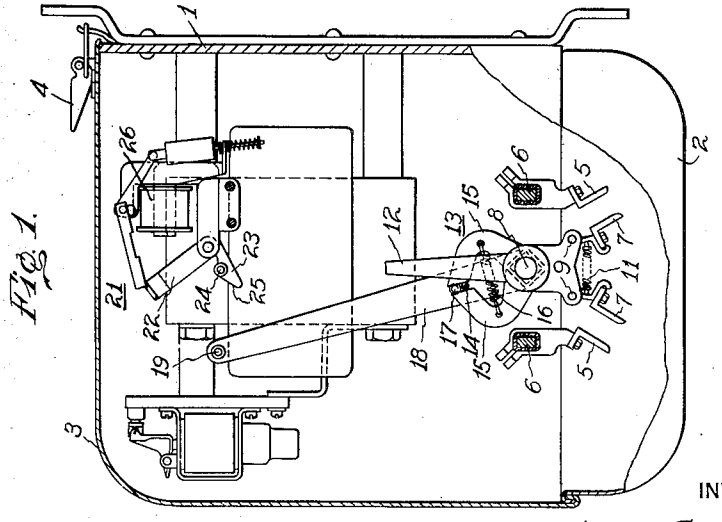


Fig. 1.



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Fig. 4.

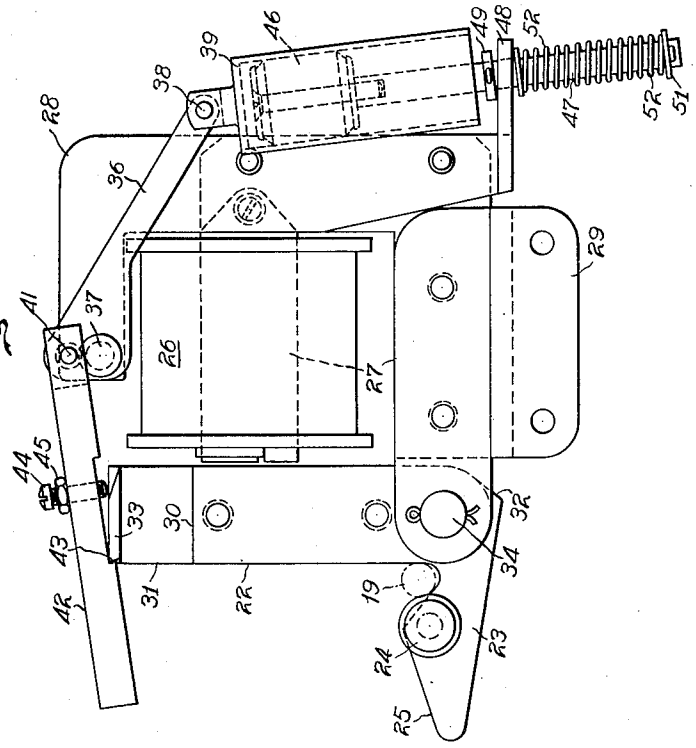
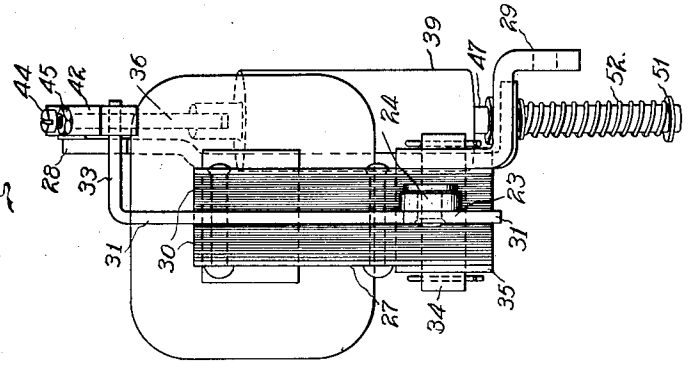


Fig. 3.



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UNITED STATES PATENT OFFICE

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TIME-DELAY LOW-VOLTAGE RELEASE

Application filed November 2, 1927. Serial No. 230,471.

My invention relates to motor-control apparatus and more particularly to time-delay, low-voltage-release devices for control systems.

My invention has application in connection with controlling mechanisms, such as auto starters, the movable switch members of which are adapted to be held in closed position until released, whereupon the switch members, being centrally biased, return to the central position.

It is customary to provide an auto starter of the type mentioned with a low-voltage-release device which normally holds the switch in its closed or running position and which releases the switch member, permitting the switch to open in case the voltage of the supply circuit is interrupted or falls below a given value. It is desirable to do this in order to prevent full voltage from being thrown on the motor after it has come to rest, as would happen, upon normal voltage being again applied to the circuit, after a voltage failure of sufficient duration to permit the motor to stop.

It often happens, however, that the voltage of the supply circuit, feeding power to the motor, is interrupted or lowered for short intervals of time and quickly returned to its normal value before the motor has had time to slow down appreciably. It is desirable, in such cases, that the motor should remain connected to the power circuit, thus avoiding the necessity of again starting the motor, and also avoiding the delay and possible injury to material which may, in certain industrial-motor applications, be occasioned by stopping the machines operated by the motor.

An object of my invention is to provide means for holding the switch members in a desired position against the action of biasing means and to release this holding means after predetermined power-circuit conditions have existed for a desired time interval.

A further object of my invention is to provide means of the above-indicated character that is adapted to be manually and promptly released, irrespective of power-circuit conditions.

My invention will be better understood by reference to the accompanying drawings, in which:

Figure 1 is a view, partly in elevation and partly in section, showing the application of my time-delay release mechanism to an auto starter,

Fig. 2 is a side elevational view of my time-delay release device in its open or released position,

Figs. 3 and 4 are, respectively, front and side elevational views of my time-delay device in its closed or holding position.

Referring to the drawing and more particularly to Fig. 1 thereof, the control mechanism comprises a casing having a stationary part 1 that is adapted to be secured to any suitable support, a part 2 that is adapted for enclosing the switching mechanism and which may constitute an oil tank, and a cover 3. The cover 3 of the casing may be loosely hinged to the portion 2 by means of mutually engaging hook portions and may be secured in position by a latching mechanism 4 that is located at the top of the casing.

The switching mechanism comprises two groups of stationary contact members 5 that are mounted upon, and insulated from, supporting bars 6. A corresponding number of oppositely disposed movable contact members 7, adapted to engage the stationary contact members 5, are mounted upon, and insulated from, a rock shaft 8. The contact members 7 are pivotally supported by pins 9, and the contact members 7 of each pair are yieldingly retained in predetermined relative positions by means of springs 11.

The switching mechanism is operated by a hand lever 12 that is located outside the casing and is connected to the rock shaft 8. The rock shaft 8 is normally retained in its central or illustrated position by a centering device 13 which comprises a stationary pin 14 attached to the casing, two oppositely disposed curved arms 15 that are pivotally supported by the rock shaft 10 and disposed to bear against the pin 14 when the rock shaft 8 is in its central position. A spring member 16 resists the separation of the arms 15 and a pin 17, that is mounted upon an arm 18 which is connected to rotate with the rock

shaft 8, effects the separation of the arms as the rock shaft is moved from its central position to close either group of switch contact members.

The lever 12 and the arm 18, each being secured to the shaft 8 bear a fixed relation to each other and move with the shaft. Upon the upper end of the arm 18 is provided a laterally projecting pin 19 which coacts with the holding mechanism 21 to retain the arm 18 and its connected switch members in their motor running position. The holding mechanism 21 comprises a pivotally mounted armature member 22 that is provided, at its lower end, with a hook 23 extending substantially at right angles thereto. The hook 23 is provided with a roller 24 and an inclined face 25 to coact with the pin 19 to thereby hold the arm 18 and the switch mechanism in given positions. An electromagnet 26 retains the armature member 22 in a vertical position when the pin 19 has been actuated into engagement therewith, or into the notch formed between the roller 24 and the armature. The switch mechanism and the lever 12 are retained in their respective running positions by the electromagnet 26, except upon reduction of voltage to a predetermined low value or failure of voltage of the supply circuit which de-energizes the electromagnet 26, unless the switch is manually returned to its open position by actuating the lever 12.

Referring more particularly to Figs. 2, 3 and 4 of the drawing, the electromagnet 26 comprises a U-shaped laminated core member 27, the upper portion of which extends through the magnet coil. Bracket members 28 and 29 are attached respectively, to the right-hand and lower portions of the core member by any suitable means such as rivets. The armature member 22 comprises a plurality of laminations 30 and a latch member 31 extending therethrough and riveted thereto. The lower end of the latch member 31 is shaped to form the hook 23, above described, and also is provided with a projection shaped to form a stop 32 for limiting the movement of the member, when released. The upper portion of the member 31 is bent over, as at 33, forming a latch. The armature 22 is pivotally mounted adjacent to the core of the electromagnet 26 upon the pivot 34 which extends through the armature member and through a portion of the bracket 29 and a bracket 35 mounted on opposite sides of the lower leg of the U-shaped core 27.

Upon the upper portion of the bracket 28, a dash pot lever 36 is pivotally mounted at 37. One end of the lever 36 is provided with a pivot 38 for connecting it to a dash pot 39. At the other end of the lever 36 and above the pivot 37, a pivot 41 is provided which connects the dash-pot lever 36 to a latch lever 42. The latch lever 42 is provided with a notch 43 for engaging the latch 33 to thereby retain the armature member 22 in its vertical position after the electromagnet has been de-energized. A set screw and nuts 44 and 45 are provided in the latch lever 42 the set screw being attached to engage the latch when the latch member 33 and latch lever 42 are moved toward the left, as will be explained hereinafter.

The dash-pot 39 is provided with a plunger 46 attached to a plunger rod 47 which extends through an opening in an extension 48 of the bracket 28. Collars 49 and 51 are provided and are mounted upon the plunger rod 47 to limit the movement thereof. A spring member 52 is provided between the collar 51 and the bracket portion 48 which normally biases the plunger to its lower, or illustrated, position.

The operation of the mechanism is as follows: When it is desired to start the motor, the hand lever 12 will first be moved toward the left, thus closing the group of contact members 5 and 7 that are below and to the right of the rock shaft 8 to supply a low or starting voltage to the motor in a well known manner. After the motor has increased its speed sufficiently, the hand lever 12 will be thrown toward the right, thus separating the group of contact members below and to the right of the rock shaft 8 and causing the group of switch contact members 5 and 7 that are below and to the left of the rock shaft 8 to become engaged. The arm 18 is moved by the lever 12 and carries the pin 19 across the roller 24, causing the armature 22 to be actuated to its vertical or closed position, as shown in Fig. 4. The electromagnet 26 now holds the armature 22 in the vertical position, thus retaining the hook 23 and the roller 24 in their raised positions. The pin 19 and the arm 18 will, therefore, be retained in their extreme right positions, holding the switch mechanism in the motor-running position.

Should the line voltage for any reason fail, thus deenergizing the electromagnet 26, its pull upon the armature 22 will be released and the centering mechanism 13 will tend to rotate the rock shaft 8 in a counter-clockwise direction and separate the switch contact members 5 and 7. The arm 18 and the pin 19 will, therefore, be biased toward the left and will bias the armature 22 and the latch 33 toward the left, but the latch 33 is held, for a predetermined time, against any substantial motion by the latch lever 42. The bias of the latch 33 will move the latch lever 42 toward the left, the pivot 41 moving about the fixed pivot 37 as a center and raising the lever 36 and dash-pot 39. The dash-pot 39 is retarded by the plunger 46 which normally remains in its illustrated or lower position during the operation of the releasing mechanism. As the latch lever 42 and the latch 43 move toward the left, the lower end of the set screw 44 engages the latch 33, causing the latch to

be disengaged from the notch 43 after a predetermined movement of the mechanism. Upon release of the latch member, the armature 22 is rapidly biased to the position illustrated in Figs. 1 and 2, and the switch mechanism is actuated to its central position. The set screw 44 may be adjusted to determine the amount of movement and thereby the time required to effect disengagement of the latch 33 by the lever 42 after the electromagnet has been deenergized.

Assuming now that the energization of the electro-magnet 26 is suddenly decreased, due to some condition, such, for example, as the momentary failure of voltage, then, as set forth hereinbefore, the latch member 42 and the latch 43 are actuated toward the left, as viewed in Figure 4. The movement of the armature 22 and the latching member 42, under the influence of the biasing means, will be greatly impeded by the dash pot 39, and if the electro-magnet 26 is reenergized before the armature 22 has moved any considerable distance counter-clockwise and before it has become disengaged from the latch member 42, then the electro-magnet, in cooperation with the latching means. will actuate the armature 22 clockwise to the position illustrated in Figure 4.

Thus, a time-delay device of this type may be used for controlling a motor circuit, since it will function to maintain the motor-circuit connections established during a momentary failure of voltage but will function to interrupt the circuit connections if the failure of voltage lasts for a predetermined period.

In the open position of the armature, the stop 32 engages the lower end of the laminated core member, thus limiting its travel. It will be noted that the left-hand portion of the latch lever 42, having the notch 43, is actuated in an upwardly direction upon movement of the latch 33 because of engagement of the set screw 44 with the latch member.

During the actuation of the holding device to effect a time-delay, low-voltage release of the switch contact members, the spring member 52 and the dash-pot plunger 46 remain in their illustrated positions. The upward pull of the dash-pot 39 is not sufficient to compress the spring 52 when the device is operated by the switch centering or biasing means. When, however, it is desired to manually interrupt the motor circuit, the hand lever 12 is operated toward the left, the force being sufficient to give a sudden pull upon the armature 22, thus causing the spring 52 to be compressed, permitting the dash-pot 39 and plunger 46 to move rapidly upward, and promptly release, the latch.

Since modifications of my invention may be made within the spirit thereof, I do not desire to be limited otherwise than by the scope of the appended claims.

I claim as my invention:

1. In combination, an electromagnet, an armature actuated thereby, means for biasing said armature in opposition to the attraction of said electromagnet, and means for retarding the actuation of said armature by said biasing means for a time interval after the deenergization of said electromagnet and for permitting the immediate manual operation of said armature.

2. In combination, an electromagnet, an armature actuated thereby to close the magnetic circuit thereof, latching means for engaging said armature, means for biasing said armature in opposition to the action of said latching means, means for releasing said latching means at a time interval after the application of said biasing means thereto, said means permitting the immediate release of said latching means upon the application of a greater biasing force.

3. In combination, an electromagnet, an armature adapted to be attracted thereby, means for biasing said armature in opposition to the attraction of said electromagnet, latching means cooperative with the electromagnet for preventing the actuation of said armature by said biasing means, and means for releasing said latching means at a desired time interval after the application of said biasing means to said latch.

4. In combination, an electromagnet, an armature adapted to be attracted thereby, means for biasing said armature in opposition to the attraction of said electromagnet, latching means for preventing the actuation of said armature by said biasing means, and means for releasing said latching means at a desired time interval after the application of said biasing means to said latch, said latching means being adapted to release promptly upon the application of sufficient force to said armature.

5. In combination, an electromagnet, an armature attracted thereby, means for biasing said armature in opposition to the attraction of said electromagnet, a latch member for engaging said armature and opposing the action of said biasing means, one end of said latch member being pivotally mounted for a limited movement, said movement effecting the release of said latch, and means for retarding the movement of said latch.

6. In combination, an electromagnet, a movable armature adapted to be attracted thereby, a latch for engaging said armature and checking its motion away from said electromagnet, said latch being mounted for movement in a path varying from the path of movement of said armature to release said armature after a predetermined movement thereof, and means for retarding the movement of said latch.

7. In combination, an electromagnet, a movable armature adapted to be attracted

thereby, a latch member for engaging said armature and checking its movement away from said electromagnet, said latch member being mounted for movement in a path varying from the path of movement of said armature to release said armature after a predetermined movement thereof, and means for retarding the movement of said latch member, said retarding means comprising a dash-pot and plunger which are relatively movable to permit a slow release of said latch and jointly movable to permit a rapid release of said latch.

8. In combination, an electromagnet, a movable armature adapted to be attracted thereby, a latch lever for engaging said armature to check its movement away from said electromagnet, said latch being mounted for movement in a path varying from the path of movement of said armature to release said armature after a predetermined movement thereof, and means for retarding the movement of said latch lever, said retarding means comprising a dash-pot and plunger connected to said latch lever to permit a slow release of said latch and resilient means associated therewith to permit a rapid release of said latch.

9. In a time-delay control device, in combination, an actuating member, means for biasing the actuating member to a predetermined position, and latching means for engaging the actuating member, said biasing means being capable of moving the actuating member toward said predetermined position when engaged by the latching means, said latching means being resilient to permit a quick manual operation of the actuating member.

10. In a time-delay control device, in combination, an actuating member, means for biasing the actuating member to a predetermined position, latching means for engaging the actuating member, said biasing means being capable of moving the actuating member toward said predetermined position when engaged by the latching means, said latching means being resilient to permit a quick manual operation of the actuating member, and an electro-magnet cooperative with the latching means to retain the actuating member in a predetermined position to which it may be actuated in opposition to said biasing means.

11. In a time-delay control device, in combination, an actuating member, means for biasing the actuating member to a predetermined position, latching means for engaging the actuating member, said biasing means being capable of moving the actuating member toward said predetermined position when engaged by the latching means, and an electromagnet cooperative with the latching means to effect the movement of the actuating member in a predetermined direction.

12. In a time-delay control device, in combination, an actuating member, means for biasing the actuating member to a predetermined position, latching means for engaging the actuating member, said biasing means being capable of moving the actuating member toward said predetermined position when engaged by the latching means, said latching means being resilient to permit a quick manual operation of the actuating member, and an electro-magnet cooperative with the latching means to operate the actuating member in opposition to said biasing means when the electro-magnet is energized during the engagement of the actuating member and latching means.

13. In a time-delay control device, in combination, an actuating member, means for biasing the actuating member to a predetermined inactive position, latching means for engaging the actuating member and electromagnetic means disposed to cooperate with the latching means to retain the actuating member in a predetermined active position in opposition to the biasing means, said biasing means being capable of operating the actuating member to its inactive position upon a predetermined decrease in the energization of said electro-magnet.

14. In a time-delay control device, in combination, an actuating member, means for biasing the actuating member to a predetermined inactive position, latching means for engaging the actuating member and electromagnetic means disposed to cooperate with the latching means to retain the actuating member in a predetermined active position in opposition to the biasing means, said biasing means being capable of operating the actuating member to its inactive position upon a predetermined decrease in the energization of said electro-magnet, said latching means being disposed to impede the movement of the actuating member when moved from an active to an inactive position by the biasing means.

15. In a time-delay control device, in combination, an actuating member, means for biasing the actuating member to a neutral position, latching means for engaging the actuating member, said biasing means being capable of moving the actuating member toward the neutral position when engaged by the latch, and means carried by the latching means cooperative to effect the release of the actuating member as it is moved toward the neutral position.

In testimony whereof, I have hereunto subscribed my name this 26th day of October, 1927.

LEO C. FRANK.