ELECTROMAGNETIC CONTACTOR WITH SAFETY LATCH DEVICE

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ABSTRACT

Electric control apparatus of the electromagnetic type in which movable contacts are movable between contacting and non-contacting positions relative to stationary contacts by electromagnetic means for opening and closing a circuit; latch means for holding the movable contact in the non-contacting position when there is an open circuit through the electromagnetic means; and switch means for opening and closing the circuit through the electromagnetic means which switch is actuated by the latch means to open the circuit when the latch means is in the latched position and to close the circuit when the latch is in the unlatched position, the foregoing latch means being controlled by a first operator. The apparatus also includes an additional latch means under the control of a second operator for independent purposes.

8 Claims, 5 Drawing Figures
ELECTROMAGNETIC CONTACTOR WITH SAFETY LATCH DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an electric control device such as a contactor or relay and a latch device for releasably latching the control device in a non-operating position.

2. Description of the Prior Art

Industrial equipment which is operated electrically such as by a motor is usually regulated by a control device. Such devices may be a contactor or relay having parts movable between two positions for opening and closing a circuit through the motor. Although, the control device is subject to manually operated switches, it is desirable to provide additional means for preventing the closing of the circuit for any reason, such as inadvertence, under certain defined conditions. That is particularly true where safety of operating personnel is involved.

Associated with the foregoing is the problem of providing additional safety under certain circumstances. For example, a control device may include one latch for preventing the closing of a circuit by an operator of a control switch as well as a second latch independently controlled by another person, such as an electrician, who is required to perform some of the maintenance duty on the apparatus. During that duty an open contact or safe condition is necessary and is assured by the provision of an additional safety latch that is under exclusive control of the electrician.

Therefore, safety latches of the foregoing type have been unavailable for which reason the safety of personnel involved with industrial apparatus has been compromised.

U. S. Pat. No. 3,364,450 issued to John P. Connor on Jan. 16, 1968 and entitled "Electrical Control Apparatus Having An Electromagnetic Control Device And An Electromagnetic Latch Device With Manually Operating Means For Both," discloses an electric control device in combination with a latch for releasably latching the control device in a "closed circuit" condition which is desirable for certain applications, but which condition is not suitable for the object of this invention.

SUMMARY OF THE INVENTION

In accordance with this invention it has been found that the foregoing problems may be overcome by providing an electric control apparatus having a control device and latch means therefor which device includes a stationary contact, a movable contact carrier which is movable between contacting and non-contacting positions relative to the stationary contact, means for biasing the contact carrier toward the non-contacting position, and electromagnetic means for moving the contact carrier into engagement with the stationary contact; the latch means including a latch member movable between unlatched and latched positions, wherein the latched position is located in the path of travel of the movable contact carrier relative to the contacting and non-contacting positions, the latch member being movable to the latched position when the contact carrier is disposed in the non-contacting position; and switch means for opening and closing the circuit through the electromagnetic means which switch means is responsive to open the circuit when the latch member is in the latched position and to close the circuit when the latch member is in the unlatched position. The apparatus also includes in combination with or independently of the latch means a second latch means for holding the contact in the non-contacting position independently of the first latch means.

The advantage of the device of this invention is the maintenance of a safe condition for operating personnel whereby the contacts may be maintained in an open circuit condition by separate and independent means which in combination can provide substantially fail-safe protection.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a contactor having two latch devices attached to different sides thereof;
FIG. 2 is a elevational view taken on the line II—II of FIG. 1;
FIG. 3 is a vertical sectional view taken on the line III—III of FIG. 1 and showing the latch member in the latched position;
FIG. 4 is a sectional view of the latch device taken on the line IV—IV of FIG. 1 and showing the latch member in an unlatched position; and
FIG. 5 is a circuit showing a pair of switches within the limit switch of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 an electric control apparatus is generally indicated at 10 and includes a control device or contactor 12, a latch device 14, and a latch device 16, all of which devices are mounted on a mounting plate 18. The control device 12 is a contactor of the type that is more specifically described in U. S. Pat. No. 3,296,567, for which reason only a brief description of the control device or contactor is provided herein.

As shown in FIG. 3 the contactor 12 comprises a dielectric housing structure 20, a support base 22, a stationary contact structure 24, a movable contact carrier 26, and electromagnetic means 28. The stationary contact structure 24 includes a pair of spaced contacts 30 and 32 which are mounted on mounting brackets 34 and 36 which, in turn, are attached to conductors 38 and 40, respectively. The brackets 34 and 36 are secured to the conductors 38 and 40 by suitable means such as screws 42. The conductors 38 and 40 are attached to housing portions 44 and 46, respectively, by suitable means such as screws 48. As shown in FIGS. 1 and 3 the conductors 38 and 40 extend through the housing 20 in opposite directions thereof.

The movable contact carrier structure 26 comprises a pair of movable contacts 50 and 52, a carrier 54, and a carrier base 56. The contacts 50 and 52 are movable by the carrier 54 into and out of engagement with the stationary contacts 30 and 32, respectively. The contacts 50 and 52 are located at opposite ends of a metallic bridge member 58. The carrier 54 is composed of a dielectric material and is disposed substantially centrally of the housing 20 and in an opening 60 between the spaced brackets 34 and 36 and contacts 30 and 32. The upper end portion of the carrier 54 includes a slot 62 through which the bridge member 58 extends and in which the bridge member is mounted for limited movement by a sheet metal damping spring 64. The carrier base 56, being composed of a dielectric material is a substantially rectangular member having peripheral
edge surfaces 66 which are spaced inwardly with respect to inner surfaces of the housing 20 and are proximate to similar spaced openings 68 in the lower portion of the housing at pairs of opposite sides thereof. The carrier base 56 also includes an undersurface 70 adjacent to the peripheral edge surfaces 66 and extending around the four sides of the base.

The electromagnetic means 28 includes a generally U-shaped stationary magnetic member 72 supported on the base 22, a conducting coil 74 which is encapsulated in an insulating shell 76, and an inverted generally U-shaped magnetic armature 78. The armature 78 is secured within the carrier base 56 and is movable toward the magnetic member 72 to the broken line position 80 when the coil 74 is energized. When the armature 78 moves to the position 80, the movable contact carrier 26 is moved downwardly against biasing springs (not shown) to bring the contacts 50 and 52 into engagement with the stationary contacts 30 and 32, respectively. Conversely, when the coil 74 is deenergized, the movable contact carrier 26 returns to the upper position as shown in FIG. 3 by action of the biasing spring, thereby opening the circuit through the several contacts.

As shown more particularly in FIGS. 1 and 2, the contactor 12 is a three-pole contactor as indicated by a set of three conductors 38 and a set of three conductors 40 on opposite sides thereof. However, it is understood that other types of contactors may be used so long as they include a movable contact carrier structure such as the structure 26 having the carrier base 56.

The latch 14 comprises a dielectric housing structure 80 (FIG. 4) and an electromagnet 82 supported generally within the housing structure. The electromagnet 82 comprises a generally E-shaped laminated magnetic core 84, a generally E-shaped laminated magnetic armature 86 supported opposite the core, and an energizing coil 88. The core 84 is supported on a latch mounting plate 90 by a pair of screws 92 that secure the opposite legs of a mounting bracket 94 to the plate which bracket passes over a bight portion of the core. A pair of screws 96 secure the insulating housing structure 80 on the mounting plate 90. The coil 88 is supported on an insulating spool 96 that is positioned over the center leg of the E-shaped core 84. The armature 86 is connected to an insulating support member 98 by means of a support pin 100 that passes through an opening in the member 98 and through a suitable opening in the armature 86 and that rests on ledge portions of the support member 98 at opposite ends thereof. The support member 98 is a generally U-shaped member, and the opposite legs are formed with ledges 102 (of which one is shown in FIG. 3) that are engaged by metal retainers 104 to limit upward movement of the armature 86 and support member 98. The retainers 104 are connected to the housing structure 80 by the screws 96. A pair of compression springs 106 (FIGS. 1 and 3) are supported between a suitable ledge on the housing 80 and the insulating support member 98 to bias the insulating member and the armature 86 upwardly to a retracted position.

The mounting plate 90 of the latch 14 is mounted on the support base 22 where it is retained in place by suitable means such as a screw 108 on a mounting bracket 110 on the plate 18. A latch member 112, being a generally C-shaped member having spaced legs 114 (FIG. 3) and 116 (FIG. 4), and intermediate portion 118, is pivotally mounted by similar screws 120 on similar upward support portions 122 of the plate 90. Each leg 114 and 116 includes an upper projection as indicated at 124 and 126, respectively. A coil spring 128 is disposed between the plate 90 and the intermediate portion 118 to bias the latch member 112 in the clockwise (FIG. 1) direction about the screws 120 so that the projections 124 are disposed directly below the undersurface 70 of the carrier base 56 and thereby prevent the carrier 54 from moving downwardly in order to enable engagement between the pairs of contacts 30, 50, and 32, and 52.

It is pointed out that although the contactor 12 and latch device 14 are shown in the drawings as being mounted on a horizontal mounting plate 18, the plate may be disposed vertically. In fact, some users prefer to mount the contactor 12 and the latch device 14 on a wall, in which event the latch member 112 rotates clockwise by gravity to the latched position of FIG. 3 and the spring 128 may serve merely as an assist member, or may be eliminated.

In addition to the foregoing, the latch member 112 has two actuating arms 130 (FIG. 3) and 132 (FIG. 4) which straddle the housing structure 80 and are positioned for engagement by the lower ends 134 (only one of which is shown in FIG. 3) of the opposite legs of the generally U-shaped insulating member 98 when the latch 14 is electromagnetically operated. Thus, when the latch 14 is actuated, the latch member 112 is rotated counterclockwise to the position shown in FIG. 4, whereby the projections 124 and 126 are moved out of the path of travel of the carrier base 56 in order to enable downward movement of the carrier upon actuation of the electromagnetic means 28. The upper position of the carrier base 56 is shown in FIG. 3 and the lower position is shown in FIG. 4.

In addition, the latch member 112 may be provided with a locking arm 136 which is secured to and extends from the leg 114 and along one side of the latch housing 80 as shown in FIG. 3. The arm 136 includes a down-turned portion 138 at the end opposite the latch member 112 which portion is provided with a hole 140. An upright bracket 142 is secured to a mounting plate 90 and extends upwardly therefrom and is provided with a hole which is aligned with the hole 140 of the arm when the arm is in the position shown in FIG. 3; namely, when the latch member 112 is in the locking position for preventing closing of the circuits through the contacts 30, 32, 50, and 52. In that position of the arm 138 a shackle of a padlock may be inserted through the aligned holes for retaining the latch member 112 in the latched position by a qualified person such as an electrician.

As shown in FIGS. 1 and 4 a limit switch 144 is provided to operate in cooperation with the latch member 112. The switch 144 has a primary purpose of opening the circuit through the coil 74 as an additional safety measure when the latch member 112 is in the latching position as shown in FIG. 3. Conversely, when the latch member is in the unlatched or retracted position as shown in FIG. 4, the switch 144 is merely an additional switch in the circuit for closing the circuit through the coil 74. A switch actuating arm 146 is mounted on a shaft 148. The left end of the arm 146 has a roller 150 pivotally mounted thereon for contact with a projection 152 at the upper end of the intermediate portion 118 of the latched member 112. Inasmuch as the shaft
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148 is spring biased in the counterclockwise direction as viewed in FIG. 1, the roller 150 is in continuous contact with the projection 152. Thus, when the latch member 112 is in the latching position as shown in FIG. 3, the limit switch is in the condition shown in FIG. 1 in which a pair of contacts 154 and 156 are open due to their mechanical connection with the shaft 148 as indicated by the broken line 158. At the same time another pair of contacts 160 and 162 are closed. As shown more particularly in the circuit diagram of FIG. 5, the contacts 154 and 156 lead to the coil 74 and thus serve as an additional electrical interlock for preventing closing of the contacts 30, 32, 50, and 52. At the same time the contacts 160 and 162 are closed and thereby actuate a signal device 164, such as a light for indicating that the contactor 12 and latch 14 are in the conditions shown in FIG. 3.

Conversely, when latch member 112 is in the unlatched or retracted position as shown in FIG. 4 due to actuation of the electromagnet 82 that overcomes the force of the spring 128, the switch actuating arm 146 is in a clockwise position as compared with the position shown in FIG. 1, whereby the contacts 154 and 156 are closed and the contacts 160 and 162 are open. Accordingly, the contactor 12 is in the unlatched condition and ready for closing of the contacts upon actuation of the coil 74 by an operator. More particularly as shown in FIG. 4 the projection 126 of the latch member 112 is out of the path of travel of the carrier base 56.

The latch 16 is an additional safety device which may be attached to a side of the contactor other than the side on which the latch 14 is attached as shown in FIGS. 1 and 2. The latch 16 is a mechanical device for use by another person such as an electrician or a maintenance man who is required to perform some duty when the contactor is in the open position as shown in FIG. 3. Employment of the latch 16 prevents inadvertent actuation of the contactor by actuation of the latch 14 to move the latch member 112 to the retracted or unlatched position by a person who may be unaware of a second person working on the line.

The latch 16 comprises a mounting bracket 166 and a slide member 168. The mounting bracket 166 includes a pair of upright supports 170 and 172 for the slide member as well as bases 174 and 176, respectively. The base 174 includes an upturned flange 178 which is attached to the support base 22 of the contactor 12 in a suitable manner such as by screws 180. The base 176 is secured to the base 74 in a suitable manner such as by spot welding.

As shown more particularly in FIG. 1 a slide 168 is a U-shaped member including spaced legs 182 and 184 and the slide is maintained in the retracted or unlatched position (FIGS. 1 and 2) by a pair of coil springs 186. The legs 182 and 184 extend through and are slidably disposed in space pairs of aligned apertures in the upright supports 170 and 172. Similar retaining pins 188 are provided at the left end of each leg to prevent the slide 168 from being completely retracted from the mounting bracket 166.

In operation, the latch 16 is used when the contactor 12 is in the open circuit condition by advancing the slide 168 to the latching position as shown in broken line in FIG. 2, whereby the legs 182 and 184 are disposed under the carrier base 56 of the contactor 12. To prevent the springs 186 from retracted the slide 168 from the latched position to the unlatched position one or both of the legs 182 and 184 are provided with a hole 190, which hole is in the broken-line position 190a when the slide is in the advanced or latched position between the support members 170 and 172 as shown in FIG. 2. In that position the shackle of a padlock may be inserted in the opening 190 to prevent retraction of the slide from the latch position by anyone other than an individual having a key to remove the padlock.

Accordingly, the device of the present invention provides safety devices for maintaining a safe condition for one or more operating personnel who are required to perform various duties on the equipment associated with the contactor 12, and thereby prevent premature operation of the contactor or motor associated therewith.

What is claimed is:

1. An electric control apparatus comprising a control device and latch means therefor, the control device comprising a stationary contact structure, a movable contact carrier structure movable between contacting and non-contacting positions relative to the stationary contact structure, first biasing means for holding the contact carrier structure in one of the positions, first electromagnetic means for actuating the contact carrier structure to the other of the positions, the latch means comprising a movable latch member movable between unlatched and latched positions, the latch position being located in the path of travel of the movable contact carrier structure relative to the contacting and non-contacting positions, the latch member being movable to the latched position when the contact carrier structure is disposed in the non-contacting position, second biasing means holding the latch member in the latched position, and second electromagnetic means actuating the latch member in the unlatched position.

2. The apparatus of claim 1 in which the first biasing means holds the contact carrier structure in the non-contacting position relative to the stationary contact structure.

3. The apparatus of claim 1 in which the latch member in the latched position is positioned to block movement of the contact carrier structure from the non-contacting position.

4. The apparatus of claim 1 in which the latch member comprises a lever pivotally mounted for movement between the two positions.

5. The apparatus of claim 1 wherein the latch means also comprises first switch means for opening and closing a circuit through the first electromagnetic means, the switch means being responsive to open the circuit when the movable latch member is in the latched position and to close the circuit when the movable latch member is in the unlatched position.

6. The apparatus of claim 5 in which the latch member comprises a first lever pivotally mounted for movement between the latched and unlatched positions, the lever being biased in the latched position, and the switch means comprising a switch lever associated with the first lever for opening and closing the circuit.

7. An electric control apparatus comprising a control device and latch means therefor, the control device comprising a stationary contact structure, a movable contact carrier structure movable between contacting and non-contacting positions relative to the stationary contact structure, first biasing means for holding the contact carrier structure in one of the positions, first
electromagnetic means for actuating the contact carrier structure to the other of the positions, the latch means comprising a movable latch member manually movable between unlatched and latched positions, the latched position being located in the path of travel of the movable contact carrier structure relative to the contacting and non-contacting positions, the latch member being movable to the latched position when the contact carrier structure is disposed in the non-contacting position, and the latch member comprising means for receiving a padlock to prevent retraction of the latch member from the latched position.

8. An electric control apparatus comprising a control device and latch means therefor, the control device comprising a stationary contact structure, a movable contact carrier structure moveable between contacting and non-contacting positions relative to the stationary contact structure, first biasing means for holding the contact carrier structure in one of the positions, first electromagnetic means for actuating the contact carrier structure to the other of the positions, the latch means comprising first and second latch members between unlatched and latched positions, the latched position being located in the path of travel of the movable contact carrier structure relative to the contacting and non-contacting positions, the first latch member comprising second biasing means for holding the first latch member in the latched position when the contact carrier structure is disposed in the non-contacting position, the first latch means also comprising second electromagnetic means for moving the first latch member to the unlatched position, the second latch member comprising third biasing means for holding the second latch member in the unlatched position, and the second latch member comprising means for retaining the second latch member in the latched position.