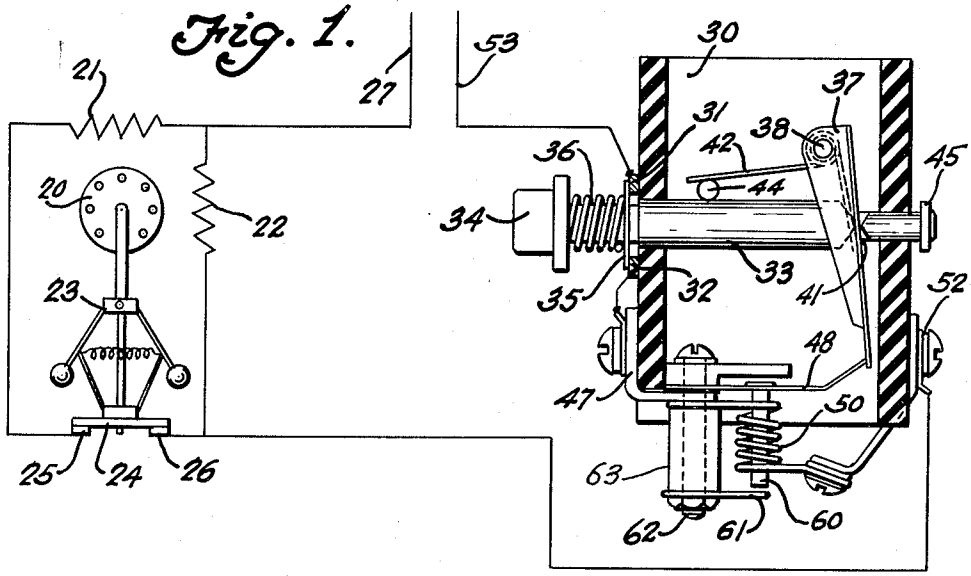
Sept. 28, 1954 H. C. SWAN 2,690,485

MOTOR CONTROL SWITCH

Filed Sept. 18, 1951

Fig. 1.



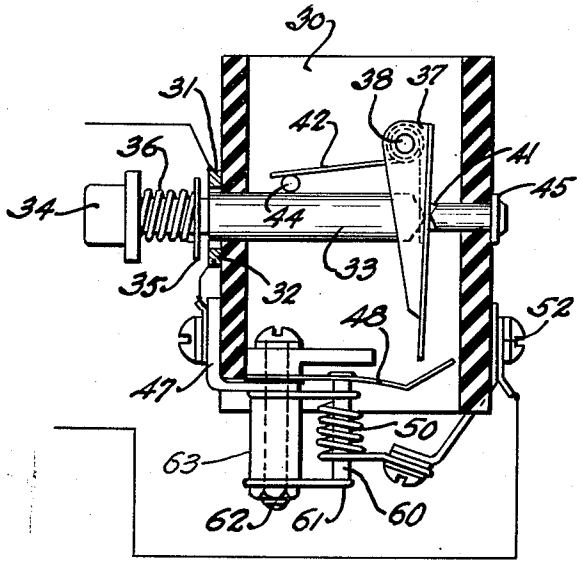


Fig. 2.

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MOTOR CONTROL SWITCH

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3 Claims. (Cl. 200—88)

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This invention relates to an improved protective control device for an electric motor.

It is an object of the present invention to provide a protective control device with means operated electromagnetically and in response to predetermined temperatures ambient thereto for effecting actuation of the device to disconnect the motor from the power source.

Another object of the present invention is to provide electromagnetic means for effecting actuation of the device, said means being operative also to provide heat to raise the ambient temperature predeterminately in response to the current flow therethrough, whereby to effect acceleration of the circuit-breaking operation of the device.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic view showing the protective control device in circuit connection with an electric motor.

Fig. 2 is a view similar to Fig. 1 showing the protective device in circuit-breaking position.

Referring to the drawings, the numeral 20 designates the electric motor which is provided with a starting winding 21 and a running winding 22. A centrifugal switch 23, actuated by the motor, has a movable contact or bridging element 24 which, when the motor is inactive, engages the stationary terminals 25 and 26, and, when the motor operates at a predetermined speed, is moved out of engagement with said terminals. The starting winding 21 and the running winding 22 have one end each connected together and to the one power line 27. The other end of the starting winding 21 is connected to the terminal 25 while the corresponding other end of the running winding 22 is connected to the terminal 26.

The circuit make and break device currently used consists of an insulating housing 30 supporting two stationary terminals 31 and 32. A plunger 33 is slidably supported in the housing 30 and has the operating button 34 secured thereto at one end. This plunger 33 supports a bridging contact 35 movable thereon and urged against a shoulder, provided on the plunger 33, by a spring 36 interposed between the bridging contact 35 and the operating button 34. This bridging contact 35, as shown in Fig. 2, is normally maintained out of engagement with the

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two cooperating stationary terminals 31 and 32 of the device by a spring loaded lever 37 pivoted on the shaft 38 which is supported transversely of the housing 30. This lever 37 has a slotted opening in one wall which fits over a notched portion 41 of the plunger 33, thereby operatively securing the lever to the plunger. Spring 42 has its convolutions surrounding the shaft 38, one arm of the spring abutting the stop pin 44, the other arm of the spring engaging the wall of lever 37 which, as has been mentioned before, has its slotted opening fitting over the notch 41 of the plunger 33 so as to be operatively connected therewith. This spring loaded lever 37 normally, yieldably urges the plunger 33 so that the bridging contact 35 on said plunger is held out of engagement with the stationary terminals 31 and 32 as shown in Fig. 2. However, when manual pressure is exerted upon the button 34 of plunger 33, the bridging contact 35 is moved into engagement with terminals 31 and 32 electrically to connect them. Spring 36 acts as a cushion to absorb excessive pressures upon the button 34 and thus avoids a distortion of the bridging contact 35. A washer 45 secured to the end of plunger 33 opposite the head or button 34, acts as a stop member engageable with the housing to limit the outward movement of said plunger 33 under the effect of the spring loaded lever 37.

The switching device is provided with a conductor plate 47 electrically connected to the stationary terminal 32 and having a resilient bimetallic detent plate 48 clamped between it and a portion of the housing, the terminal plate 47 being insulated from said detent plate in any suitable manner. This detent plate has its free end portion normally lying in the path of movement of the spring loaded lever 37 so that when said lever 37 is moved counterclockwise about its supporting shaft 38, by manual operation of the plunger 33, said detent plate 48 will, when contact 35 bridges and electrically engages terminals 31 and 32, assume a position in front of lever 37 as shown in Fig. 1 to prevent return movement of said lever 37 under the effect of spring 42 as manual pressure is removed from the plunger button 34. Thus, detent plate 48 retains lever 37 and consequently the plunger 33 in the operated position in which the bridging contact 35 electrically engages stationary terminals 31 and 32. This detent plate 48, in order to perform its releasing function under the effect of predetermined temperatures ambient thereto, is preferably made of bimetal comprising two

metal strips bonded together, the strips having different coefficient of expansion to effect bending of the bi-metal strip in one direction upon a rise in temperature thereof and bending in the opposite direction upon a lowering in temperature thereof so that when a predetermined higher temperature ambient to said plate exists, the plate will flex in a direction so as to move out of the line of travel and out of engagement with the lever 37 thereby releasing said lever, and being out of its line of movement as shown in Fig. 2, will permit the unimpeded operation of said lever 37 clockwise under the effect of the spring 42. This release of lever 37 permits it to move the plunger 33 outwardly of the housing and thereby disengage the bridging contact 35 from the stationary terminals 31 and 32, the movement of plunger 33 by the spring loaded lever 37 being limited by the abutment washer 45 engaging the wall of housing 30.

Inasmuch as no current flows through the bi-metallic detent plate 48, it is necessary to provide a heating element adjacent thereto so as to raise the ambient temperature to a predetermined degree in accordance with the current flow through the electric motor. For this purpose, a heater coil or winding 50 is provided, one end thereof being in electrical engagement with the conductor 47, the other end being connected with the terminal plate 52 insulatingly secured to the housing. Terminal plate 52 is electrically connected to the terminal 26 of the centrifugal switch actuated by the motor. Terminal 31 of the control device is electrically connected with the second power line 53.

The control device so far described functions as follows: When the plunger 33 is manually actuated to cause engagement of the bridging contact 35 with the terminals 31 and 32 and is retained in this operated position by the detent plate 48 as shown in Fig. 1, current from the power line 27 will flow through the starting winding 21 to terminal 25 across the centrifugal switch movable contact 24 to terminal 26 thence to the control switch terminal 52 through the heater coil 50 to conductor 47 thence to terminal 32 bridging contact 35, terminal 31 to the other side of the power line designated by the numeral 53. Current also will flow from the power line 27 through the running winding 22 and through the circuit afore-described back to the other power line 53. Circuits completed through the starting and running windings of the motor 20 will effect its operation and as soon as the motor reaches a predetermined running speed, the centrifugal switch 23 will have moved the bridging contact 24 out of engagement with terminals 25 and 26 so as to open and discontinue the circuit through the starting winding, the running winding circuit being maintained for motor operation. When for any reason such as overload, stall or the like, excessive current flows through the motor circuit which also includes heater coil 50, said heater coil will generate a predetermined degree of heat ambient to the bi-metal detent plate 48 causing it to flex in a direction away from its engaged lever 37 whereby said lever will be released permitting spring 42 to return the plunger 33 to its normal circuit-breaking position, in which the bridging contact 35 is disengaged from stationary terminals 31 and 32. This opens the running winding circuit of the motor and causes it to stop.

It has been found by experiment that when an overload exists and excessive current flows through the motor circuit, the time interval for the heater coil 50 to generate sufficient heat for causing the bi-metal detent plate 48 to flex and release lever 37 will sometimes be of sufficient duration as to permit the excessive current flow through the motor to damage the motor. Ordinarily, a period of approximately 45 seconds will be required to cause the standard heater coil 50 to provide sufficient heat for flexing the plate 48 to release lever 32. In some instances it has been found that this 45-second interval, during which excessive current flows through the motor windings, causes damage thereto and therefore it has been desirable to provide means for accelerating the flexing of the detent plate 48.

In the present invention, a means operative to accelerate the flexing of the detent plate 48 is provided, this means utilizing the heater coil 50. To do this, applicant has provided an electromagnet in his switch. This electromagnet comprises a post 60 of magnetic material secured at one end to the flexible bi-metal plate 48, the heater winding 50 surrounding said magnetic post 60 providing the coil of the electromagnet. A pole plate 61 is secured to the housing by a magnetic screw stud 62 surrounded by a spacer collar 63 which is preferably of insulating material and maintains the one end of the heater coil 50 in electrical engagement with the stationary terminal plate 47. The pole plate 61 extends over the magnetic post or core 60 and is spaced therefrom to provide an air gap therebetween. The post 60 and the stud 62 form the two legs of a U shaped magnet structure, the plate 48 forming the yoke between the legs of the structure. The heater coil 50 surrounding the post 60 forms the electromagnet coil of the structure. The pole plate 61 extending across the legs 60 and 62 of the magnet structure is stationary so that the leg 60 moves axially in the coil 50 when the coil is energized, rather than causing movement of the pole plate against the leg 60. From this it may be seen that energization of the heater coil 50 around the magnetic core or post 60 that extends coaxially through said coil, causes said coil to act as a magnet coil, its energization creating a magnetic field consisting of the magnetic core 60, the pole plate 61, the magnetic stud 62 and the plate 48 engaged by said stud and carrying post 60. This magnetic field will, upon energization of the winding 50, cause the post 60 to be moved toward the pole plate 61. This attraction of the post or core 60 by the pole plate 61 adds an additional flexing force to the plate 48 which aids the flexing force caused by heating of the bi-metal plate 48 to flex the bi-metal plate 48 as shown in Fig. 2 and accelerate the release of lever 37. The flexing of plate 48 in response to increased temperatures ambient thereto resulting from heating by the coil 50 in response to excessive current flow therethrough effects one rate of movement of the plate 48 while a faster rate is obtained when aided by the magnetic influence of the coil 50 on the post 60, the movement effected being proportioned by the value of the current flow through the coil 50 which increases the rate of movement as the value of the current flow increases.

From the aforegoing it will be seen that applicant has utilized one element in a well-known circuit breaker to serve a purpose in a dual manner, first, in the known manner of producing heat to create an ambient temperature sufficient for flexing a heat-responsive detent retaining

the switch in circuit-closing position but releasable at predetermined ambient temperatures, and also accelerating such release by causing the heating element to act as one portion of an electromagnet associated with the flexible bimetal plate so that additional flexing force is created by electromagnetic forces, established, as has been said, by the same element which creates the heat for ambient temperature control.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A protective device consisting of a switch operative to close an electric circuit and including an actuating member, a detent plate comprising a heat responsive flexible blade flexed by changes in temperature thereof fixedly anchored at one end and engaged by the switch actuating member when the switch is in circuit closing position, said blade retaining the switch in closed position, said blade predeterminately flexing in response to a predetermined rise in temperature thereof to release the switch actuating member to open said switch, an armature attached to said blade thermally and movable therewith and forming with said blade part of an electro-magnet, and a heating coil in circuit with said switch and encircling said armature to heat the same and provide thereby a magnet coil around said armature effective thereon for movement thereof thereby, said coil in response to a predetermined current flow therethrough simultaneously effecting heating of said armature and thus said blade and establishing a magnetic field including said armature to concurrently effect flexing of the blade thermally and magnetically.

2. A protective device consisting of a switch operative to close an electric circuit, said switch including a spring loaded member yieldably urging the switch into open circuit breaking position, a heat responsive bimetal blade flexed by changes in temperature thereof fixedly anchored at one end and engaged by said member when the switch is in circuit closing position to retain the switch in closed position, said blade predeterminately flexing in response to a predetermined rise in temperature thereof to release said member to open the switch, a first magnetizable

post thermally secured to said blade and movable therewith, a heating coil surrounding said post forming an electromagnet coil and connected in circuit with said switch, a second magnetizable post adjacent said heating coil and including a stationary pole piece in spaced axial position to the free end of said first mentioned post and forming with said first post and said blade a magnetizable circuit means energizable by the heater coil in response to current flow therethrough to flex the blade in response simultaneously to both magnetic and temperature influences.

3. An electric circuit controller consisting of a switch and an actuator for the same operably connected therewith and operable in one position to complete an electric circuit through the switch actuated thereby, a flexible heat responsive bimetallic detent plate flexed by changes in temperature thereof engaged by said actuator for retaining it in circuit closing position, a heater coil fixedly positioned adjacent said bimetallic detent plate to effect heating thereof for flexing of the detent plate to release said actuator, a magnetizable core thermally secured to said detent plate and extending axially through said heater coil, said heater coil providing an electromagnet coil around said core, and a magnetizable pole engaging said detent plate and positioned adjacent said heater coil with a portion thereof extending axially adjacent the free end of said core but spaced therefrom to provide an air gap therebetween; said core, detent plate, and pole forming a magnetizable circuit energized by current flow through the heater coil, said heater coil effecting a magnetic field in the magnetic circuit means concurrently with heating of said detent plate to effect thereby actuation of said detent plate simultaneously in response to heat and magnetic influence.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
963,762	Harris	July 12, 1910
1,437,617	Radley	Dec. 5, 1922
2,160,424	Taylor	May 30, 1939
2,323,784	Baxter	July 6, 1943
2,325,717	Swingle	Aug. 3, 1943