Nov. 7, 1967 C. E. LINKOUS 3,351,790

RESETTABLE OVERLOAD SWITCH DEVICE FOR USE IN AN ELECTRICAL INDUCTIVE APPARATUS

Original Filed Jan. 2, 1964 4 Sheets-Sheet 1

Fig. 1

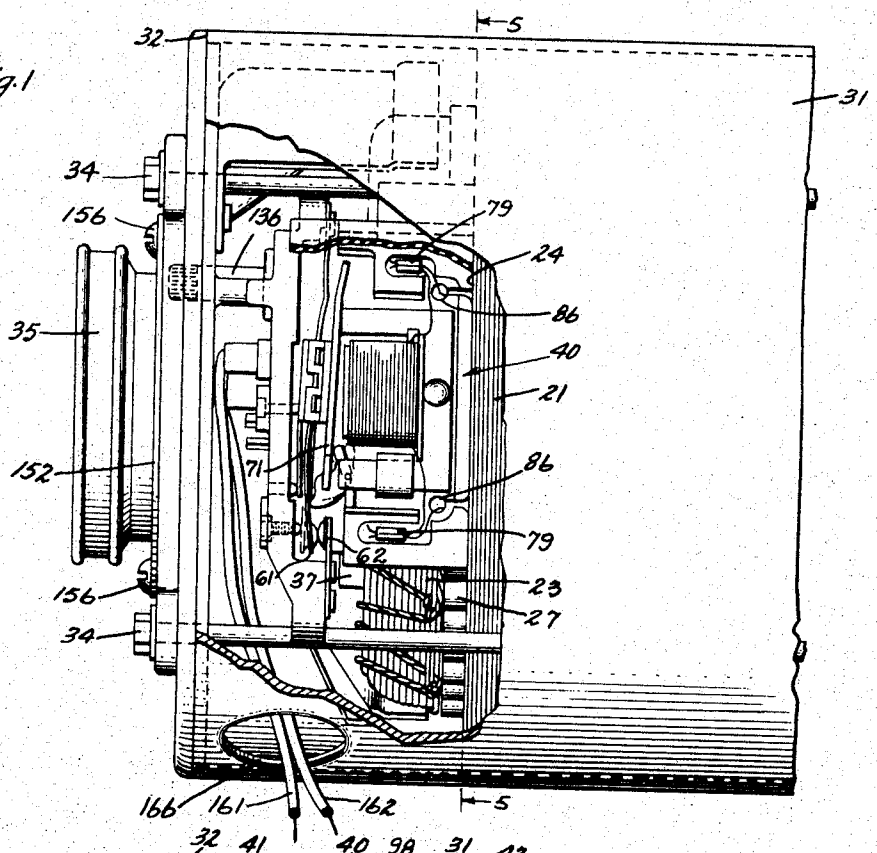
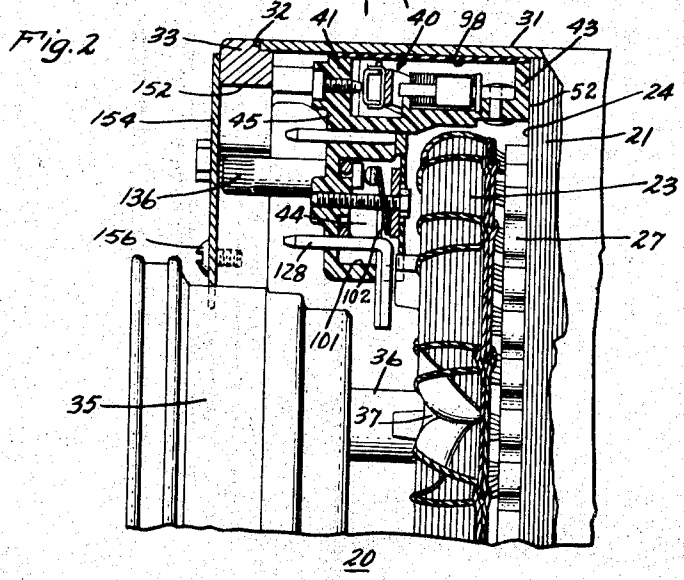


Fig. 2



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RESETTABLE OVERLOAD SWITCH DEVICE FOR USE IN AN ELECTRICAL INDUCTIVE APPARATUS

Original Filed Jan. 2, 1964 4 Sheets-Sheet 2

Fig. 3

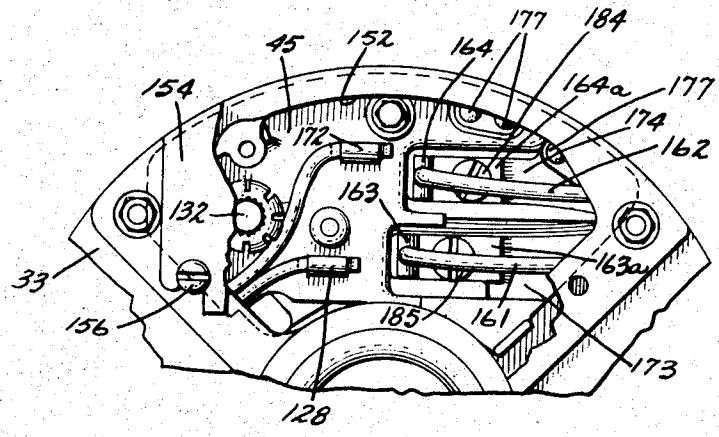
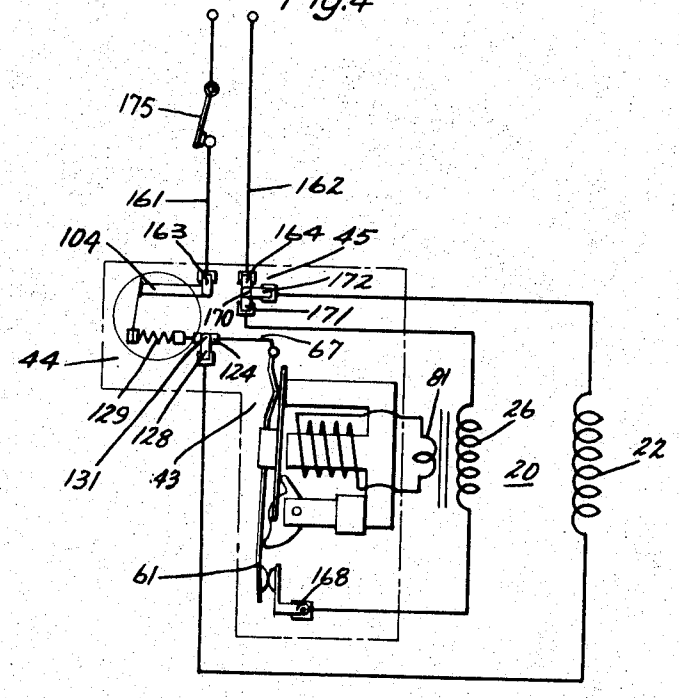


Fig. 4



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RESETTABLE OVERLOAD SWITCH DEVICE FOR USE IN AN ELECTRICAL INDUCTIVE APPARATUS

Original Filed Jan. 2, 1964 4 Sheets-Sheet 3

Fig. 5

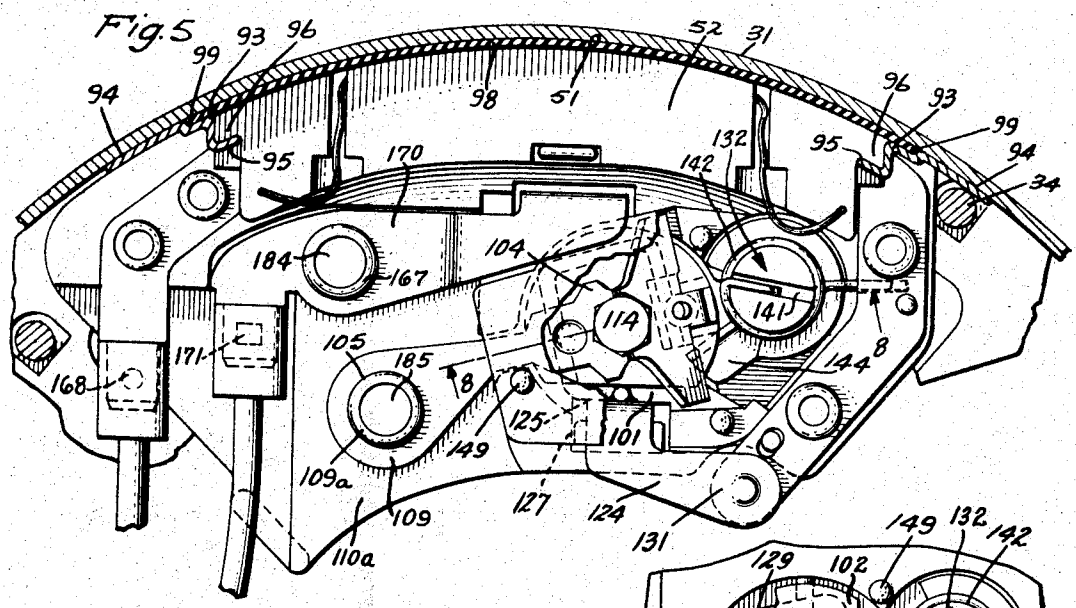


Fig. 7

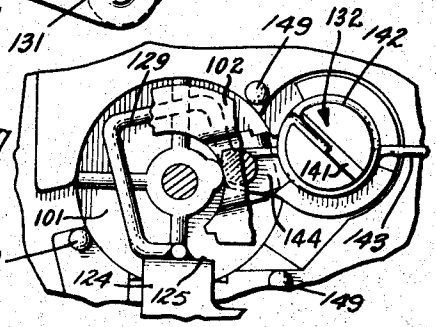
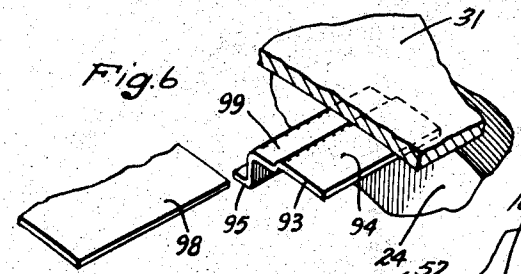
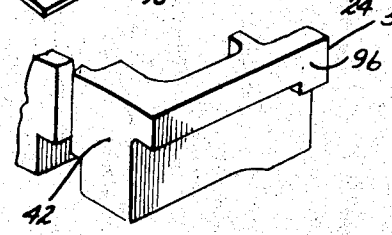


Fig. 6





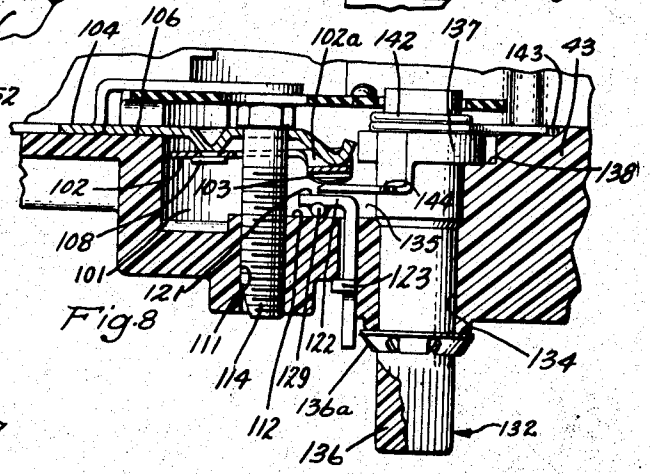
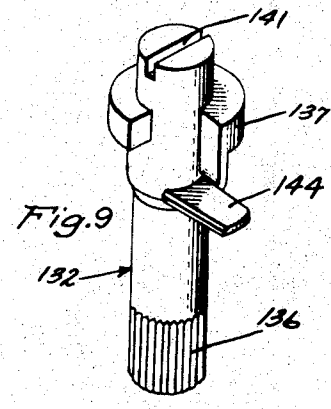


Fig. 8

Fig. 9



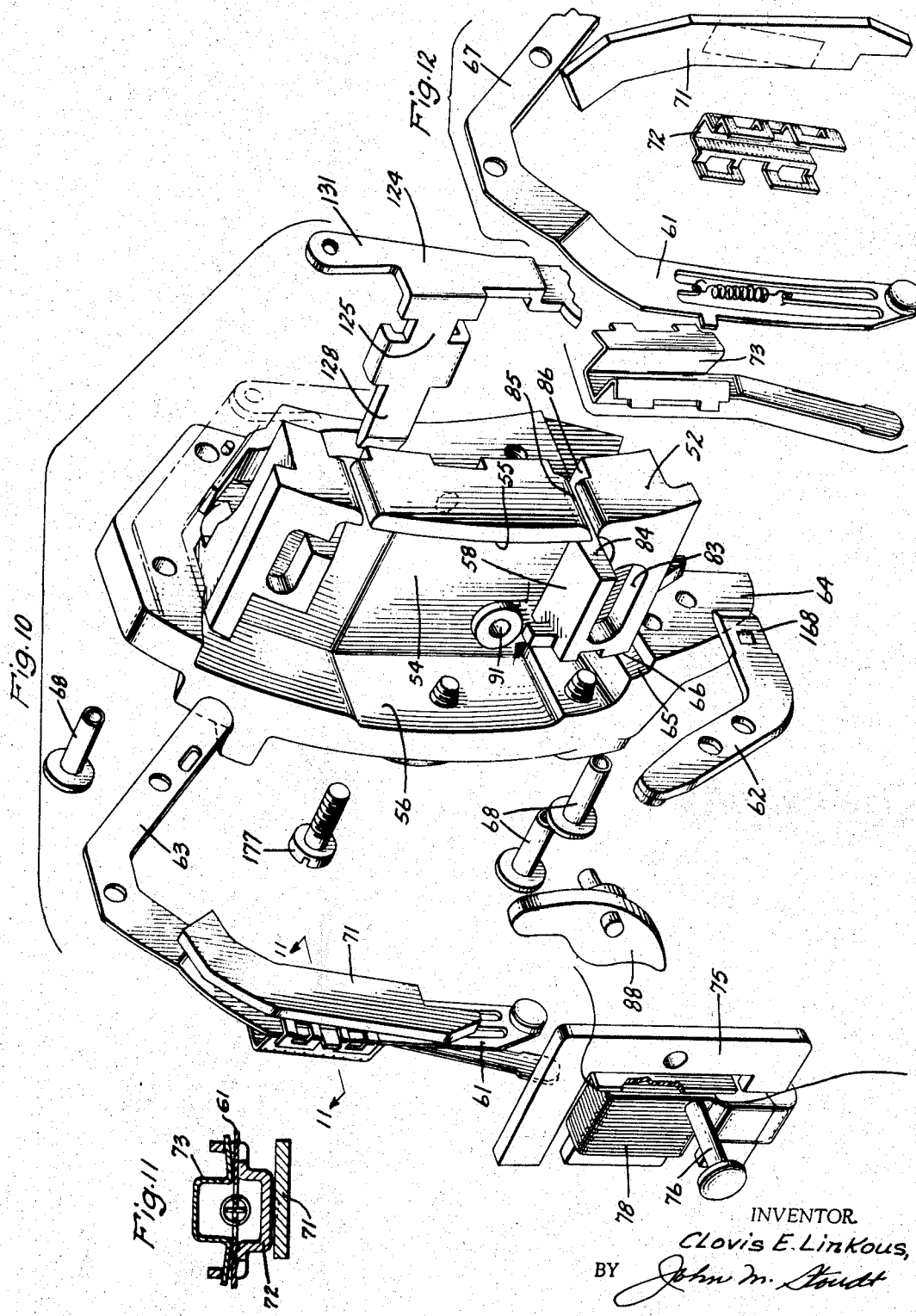
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RESETTABLE OVERLOAD SWITCH DEVICE FOR USE IN AN ELECTRICAL INDUCTIVE APPARATUS

Original Filed Jan. 2, 1964 4 Sheets-Sheet 4



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United States Patent Office 3,351,790
Patented Nov. 7, 1967

3,351,790

RESETTABLE OVERLOAD SWITCH DEVICE FOR USE IN AN ELECTRICAL INDUCTIVE APPARATUS

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Original application Jan. 2, 1964, Ser. No. 335,243, now Patent No. 3,311,764, dated Mar. 28, 1967. Divided and this application Nov. 21, 1966, Ser. No. 595,870
5 Claims. (Cl. 310—68)

ABSTRACT OF THE DISCLOSURE

This invention relates to resettable overload switch devices and more particularly to an improved manually resettable thermal overload switch device of the type suitable for use in the control of a winding circuit of electrical inductive apparatus, such as dynamoelectric machines. The device, when used in connection with dynamoelectric machines, may be conveniently mounted within the machine frame as part of a winding control unit which is accessible from the frame exterior to permit, among other things, resetting of the device when such is desired.

The present application is a division of patent application S.N. 335,243, filed Jan. 2, 1964, now Patent 3,311,764 issued Mar. 28, 1967.

It is a primary object of the present invention to provide an improved resettable overload device for use in electrical inductive apparatus, and it is a more specific object to provide such device of the type adaptable for use in the winding circuit of dynamoelectric machines.

It is another object of the present invention to provide an improved yet low cost thermal overload device which permits a reduction in the number of connections and parts normally required and results in a low cost unit.

It is a further object of the present invention to provide a low cost manually resettable device for use in a winding circuit which is readily assembled together, is efficient in preventing energization of the winding circuit when conditions so dictate, and is capable of being easily reset when desired.

In carrying out the present invention in one form, I provide an improved manually resettable thermal overload device for use in an electrical inductive apparatus, such as for example in the winding circuit of a dynamoelectric machine. The device includes a pair of contacts mounted within an overload chamber of a support, the contacts being connected in the winding circuit of the machine and being responsive to a preselected adverse temperature condition within the machine frame. In the illustrated embodiment, these contacts are in a normally closed position so that a closed electrical path is furnished through the contacts under normal operating conditions within the frame. When the preselected condition is reached, the contacts are caused to become separated to an open position.

A spring loaded, single piece, electrical insulator is turnably mounted by the support, adjacent the contacts to prevent their premature reclosing and to provide a means for manually resetting the contacts to the closed position when such is desired, as for instance when the preselected condition becomes abated. The insulator includes a stepped post having a radial enlargement seated on a shoulder of a cavity in communication with the overload chamber for proper support and a wedge originally biased into engagement with the contacts when in their closed position. A spring attached between the support and one end of the post furnishes the bias. If desired, a

cover plate may be employed over the above components to prevent entry of dust or their foreign material.

When the contacts are opened, the spring turns the post in a direction such that the wedge enters between the contacts and engages a support wall which together with the spring, maintains it in that position. The post has the end remote from the end with the spring terminating in a handle section which projects beyond the support, away from the overload chamber, in a location accessible to the exterior of the machine frame. Once the conditions within the frame return to normal, the contacts and wedge may be returned to their original positions by merely turning the handle section of the insulator.

This arrangement is not only inexpensive to produce and easily installed but also furnishes a highly effective overload device with relatively few number of components which are capable of being efficiently reset whenever conditions justify. These and other advantages will become more apparent from the following discussion.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. My invention, itself, however, both as to its organization and method of operation, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing.

In the drawing:

FIG. 1 is a fragmentary plan elevational view, partly broken away, showing one end of a dynamoelectric machine incorporating the preferred embodiment of the present invention;

FIG. 2 is a fragmentary side elevational view, partially broken away and in section of the same dynamoelectric machine end illustrated in FIG. 1 to show further details of the winding control unit seen in FIG. 1;

FIG. 3 is a fragmentary end view, partly broken away, of the machine end of FIG. 1 to reveal details of the terminal section of the control unit;

FIG. 4 is a schematic representation of the winding control circuit for the dynamoelectric machine of FIG. 1;

FIG. 5 is a partial and enlarged view taken along line 5—5 in FIG. 1 to show further details of the control unit and its mounting within the motor frame;

FIG. 6 is an enlarged fragmentary view in perspective of the manner in which one side of the control unit is mounted to the machine frame;

FIG. 7 is a fragmentary view, partially broken away, showing the thermal overload switch and manual reset components of FIG. 6, with the switch contacts being held in open circuit by the reset element to reveal the preferred form of the manually resettable overload device;

FIG. 8 is a view taken along line 8—8 in FIG. 6 to show further details of the overload switch and manual reset components of the device;

FIG. 9 is a view in perspective of the manual reset element seen in FIG. 8;

FIG. 10 is an enlarged partially exploded view in perspective of the control support and one type of relay switch which may be satisfactorily employed in the control support of the present invention;

FIG. 11 is a view of the relay armature assembly taken along line 11—11 in FIG. 10; and

FIG. 12 is a view in perspective of the movable armature relay switch assembly shown in FIG. 10.

Turning now to the drawings in more detail and in particular to FIGS. 1, 2, and 4, the preferred embodiment has been shown in connection with a dynamoelectric machine and more specifically a single phase induc-

tion electric motor **20** of the resistance split phase type. The motor includes a laminated stator core **21** of standard construction, formed by a stacked plurality of laminations punched from relatively thin magnetic contour. A distributed main or running winding **22** is arranged in stator winding accommodating slots in the usual way with winding end turns **23** projecting beyond each side face **24** of the core. For reasons of simplicity of illustration and brevity of description, only one side of motor **20** has been shown in FIGS. 1 and 2. An auxiliary or start winding **26** is displaced **90** electrical degrees from the main winding in the slots for the usual reasons. Each winding is wound with a number of turns of insulated wire; e.g., magnet wire, to form winding poles in the well-known manner, the windings being isulated from the core by standard slot lines **27**. Both windings are adapted to be energized during starting conditions, while only the main winding is excited for running operation as will be explained more fully hereinafter.

The stator core is mounted within a cylindrical central shell **31**, fabricated of sheet material like steel, of a motor frame, as by welding the stator to the shell at angularly spaced apart locations. Shell **31** extends axially beyond winding end turns **25**, terminating on each side in an edge **32** which is suitably connected to cast end shield **33** or an end frame. The connection shown in FIGS. 1 and 2 is of the rabbet type, with a number of angularly spaced apart through-bolts **34** securing the parts firmly together. Each end shield incorporates a central hub **35** mounting a bearing for rotatably supporting one end of a shaft **36**, which in turn, carries a conventional rotor (not shown) having a cast squirrel cage type winding formed with end rings partially seen and indicated in FIGS. 1 and 2 by numeral **37**.

The illustrated motor of the exemplification incorporates a single winding control support unit, generally identified by numeral **40**, of the type disclosed and claimed in my co-pending application S.N. 335,243. As shown in FIG. 2, it has a single-piece electrically insulated casing or support **41**, preferably molded of thermoresponsive material such as thermosetting epoxy resin and integral, yet electrically separated, generally formed into the shape of an "L" to provide three interrelated supporting sections, a start winding switch accommodating section **43**, an overload switch mounting section **44** and a terminal supporting section **45**. As will be more clearly developed hereinafter, the interrelationship of these sections to one another as well as to other motor components achieves, among other beneficial results, a reduction in the number of electrical connections required, protection for the switch components, and versatility in use.

The start winding switch accommodating section **43** which is formed by one of the legs of the support, will be considered in connection with FIGS. 2 and 10. This section of generally block-like construction has an outer arcuate surface **51** complementary in configuration to the inner surface of motor shell **31**. The free end **52** of the section is generally flat or planar for abutment against stator end face **24**, intermediate the shell and winding end turns **24**. A chamber or switch accommodating cavity is provided at surface **51**, remote from winding end turns **24**, the chamber being defined by bottom wall **54**, inner and outer walls **55, 56** (as viewed from the motor stator) and side walls **57, 58**. This chamber is especially suitable for supporting the switch relay components of the switch relays disclosed and claimed in my U.S. Patents 3,256,402 and 3,256,403. The switch relay disclosed in Patent 3,256,403 is shown in the drawings by way of example only and a more complete description of the relay details and operation are set forth in that patent.

FIGS. 1, 10, 11, and 12 reveal switch relay details of the exemplification. Briefly described, a pair of switch contact blades **61** and **62** are supported by enlargements **63** and **64** respectively, which are integrally joined to chamber wall **56** by a stepped construction through opening **66** indicated by number **65**. Blade **61** is the movable blade having its blade extension **67** rigidly attached to enlargement **63** by a pair of rivets **68**. In a like manner, the stationary contact blade is riveted to enlargement **64** such that blades **61** and **62** extend toward one another for cooperation. Movable blade **61** has a snap action and bracketed arrangement cooperatively connected to a relay armature **71** by opposed brackets **72** and **73**. This armature is connected above a core **75** mounted with its yoke section disposed adjacent wall **55** by a rivet **76** projecting through the yoke section and into the wall **54** of the chamber. The core accommodates an energizing coil **78** suitably attached by crimped connectors **79** to the terminations of a sensing coil **81** (FIG. 4) carried by the stator in the axis of the start winding. A recess **83** is formed in the section outwardly of walls **57** and **58** with channels **84** communicating between the recess and the chamber for passage of the relay coil wire extremities to the connectors. In addition, wall **55** has slots **85** connecting an opening **86** formed in wall **54** to permit motor winding extremities to permit the assembly of the end sensing coil to the relay coil and to locate the sensing coil wire extremities away from the stator for reasons of protection. Slots **85** allow this assembly while openings **86** provide the protection when the unit is in place. Wall **55** also furnishes the support for an impact mechanism **88**, which has a shaft **89** situated in bearing hole **91**.

Support **41** is mounted in the motor and carried by shell **31** in the manner shown by FIG. 2 with surface **52** abutting against the side face **24** of the stator core, adjacent the inner surface of shell **31**. The illustrated means for achieving this mounting is shown in FIGS. 5 and 6. A pair of spaced apart and opposed, generally Z-shaped, elongated brackets **93** are attached to the inner surface of the shell at one end **94** by welding or the like and extend axially away from the stator. The brackets have recesses next to shell **31** which, along with the inner surface of shell **31**, provide opposed narrow channels **99** for accommodating a curved sheet of electrdical insulation **98** such as fiberboard conforming in contour to the shell. The brackets are bent just below the recesses to furnish opposed flanges at their free ends for fitting beneath complementary shoulders **96** made integral with support section **43** and extending laterally away from that section. The flanges serve to hold support **41** firmly against insulation **98** which is sandwiched between shell **31** and support **41** and covers the start winding switch chamber in section **43** thereby shielding it, both electrically and physically. Support unit **41** is easily installed before the end frame **33** is attached to shell **31** merely by sliding insulator **98** into the bracket channels near the shell and then pushing the support shoulders **96** along the opposed bracket flanges until surface **52** rests against the stator. When end frame **33** is fastened to shell **31**, the unit is held in the brackets, between the stator and the end frame and thus the aixal length of the motor beyond the stator is established by the length of support **41**. It will be seen than in its assembled relation to the motor, the start winding switch is supported away from the winding end turns **23** (FIG. 2) is an enclosed compartment in which the switch contacts are protected from exposure to dirt and foreign matter and the switch is electrically isolated by support **41** and insulator **98**.

Now referring to section **44**, and to FIGS. 2, 5 7, and 8, an overload switch receiving chamber **101** opens toward the winding end turns on the other leg of support **41**. This chamber is constructed, by way of example, to house an overload switch having switch components similar to those disclosed in Patent No. 2,771,528 issued to D. E. Moran on Nov. 20, 1956. A bimetal element **102** is provided having a susbtantially O-shaped configuration (FIG. 8) with an indentation **102***a* mounting a movable contact **103** on its underside. The indentation prestresses the bimetallic element **102** to provide the requisite snap action in response to temperature changes. A

mounting member **104**, formed of relatively thin strip conductive material such as steel, is provided over element **102**, with a portion **105** received in support recessed seat **106** communicating with the chamber. A point **108** of member **104** adjacent the edge of element **102** is secured to an indentation in mounting member as by spot welding.

A terminal portion for movable contact **103** is formed on the extreme end portion **109** of member **104** which extends beyond recess **106** and is riveted to outer surface **110** of support section **44** which faces the motor end turns **23** in the assembled position of unit **40**. Hollow, electrically conductive rivet **109***a* (FIG. 5) attaches portion **109** firmly to surface **110***a*. Mounting member **104** has an opening in the center thereof and a threaded hole **111** (FIG. 8) is furnished through the bottom wall **112** of the chamber, extending to support section **44**. A suitable screw **114** is seated over the opening in member **104**, projects down through it and into thread hole **111** for mounting that end of member **104**.

The stationary contact **121** with which contact **103** cooperates, is mounted on one leg portion of an L-shaped member **122** which projects through an opening formed in the bottom wall **112** of the overload chamber. The other leg portion is locked in place by a number of ears **123** bent over after member **122** has been inserted into the opening. The terminal for the stationary contact, unlike that shown in the aforesaid patent, is a generally Z-shaped conductor strip or link of metal **124** shown in FIG. 5 which has one portion **125** projecting into the chamber and through an opening **127** in the bottom to form an external male terminal post **128** (FIG. 2) upstanding from terminal section **44**. Here, again, suitable ears on the terminal member may be bent over beyond opening **127** after assembly to lock the part in place. The other end **131** of strip **124** is connected to blade extension **67** of the movable contact for the switch relay. Stationary contact **121** is electrically connected to link **124** within the chamber through a suitable serpentine heater **129**, joined at each end by brazing or the like to contact **121** and link portion **125** respectively. This heater is in heat transfer relation with bimetallic element **102**. The thermal overload switch device is responsive to excessive current as well as to excessive ambient temperature and will open with a snap action when a preselected adverse temperature condition has been reached by the motor.

In the preferred embodiment of the overload switch device and by an important feature of the present invention, the device is manually resettable by an improved arrangement. Support **41** mounts a rotatable, spring loaded single piece electrical insulator **132**, shown in FIGS. 5, 7, 8, and 9, which may be made of any suitably hard insulating material such as molded thermo-setting plastic. It includes a cylindrical stepped post accommodated in a complementary hole **134**, extending into a chamber or cavity **135** which opens into the overload chamber in the vicinity of contacts **103**, **121**. The post terminates at one end beyond terminal section **44** in a serrated handle section **136** for manual operation and carries an integral radial enlargement **137** seated on shoulder **138** of cavity **135**. The insulator is held in place by a nut **136***a* engaging the outer surface of section **45**. A transverse slot **141** formed in the extreme end of the insulator remote from section **136** receives one end of a coil spring **142** with the other end being held in grooves **143** near shoulder **138** to provide the requisite compressive support for the arrangement. The spring has several convolutions wrapped around the insulator post under compression for this purpose. A lateral projection or wedge **144** made integral with, but beneath, enlargement **137**, is adapted to be held or biased against contacts **103**, **121**, in their closed position (FIG. 5) by spring **142**.

Upon opening or separation of the contacts, as will occur under adverse temperature operating conditions of the motor, the spring **142** turns insulator **132** from the original biased or extended position shown in FIG. 5 to that of FIGS. 7 and 8 where wedge **144** becomes disposed between the separated contacts to maintain them in the open circuited position. A wall of the chamber stops the wedge and retains it between the contacts. As will be seen from FIG. 4, this disrupts the circuit to the start and main windings to stop the operation of the motor. Once the circumstance causing the adverse temperature condition has been corrected, the switch contacts may be closed merely by manually rotating the insulator to the extended position shown in FIG. 5, outwardly of contacts **103**, **121**, and the contacts will snap closed.

An electrical insulator cover plate **147**, best seen in FIG. 5 is employed to cover the communicating overload and insulator cavities, with an aperture **148** permitting the extreme end of the insulator to pass through the cover. Suitably provided studs **149**, made integral with section **44** and projecting outward from its upper surface, form the means to hold the cover firmly over the cavities. This cover is installed after the overload switch components and insulator **132** have been assembled in place. It therefore prevents dirt or other foreign matter from entering the cavities and holds the respective ends of spring **142** in slot **141** and groove **143**.

In the illustrated embodiment of support unit **40**, certain terminals which control the winding circuit are conventionally located where they are most accessible for easy winding. In addition, the aforedescribed locations of the switch relay and overload switch permits the use of common terminal to make safe connections. More specifically, terminal section **45**, formed on the same depending leg as the overload supporting section **44**, but remote from the interior of the motor, is exposed to the exterior of the machine. A flanged opening **152** furnished in end frame **33** permits access to terminal section **45** as well as to the handle of insulator **132** for resetting the overload device. A suitable removable cover or plate **154** may be utilized to enclose the opening, screws **156** being used to mount the cover over the opening.

Power leads **161**, **162** which enter the motor through conduct opening **166** in end frame **33** (FIG. 3) are seated in recesses **173** and **174** formed in section **45**. The manual power control switch for the motor is indicated by numeral **175** in line **161** as seen in FIG. 4. These line terminals are each provided in the form of an L with the terminals upstanding from the spaced apart recesses to provide an electrical barrier therebetween. Terminal leg **163***a* of terminal **163** is secured to the support by hollow electrically conducting rivet **109***a* which, as previously mentioned, also holds portion **109** of the overload switch mounting member. The other line terminal **164** similarly has its leg **164***a* attached in place by a hollow electrically conducting rivet **167** extending through the support material. Hollow rivets are preferred since screws **184** and **185** may be received in them for making an alternate type connection with line **161**, **162**. A generally Z-shaped terminal strip **170** is held by rivet **167** on the side of support **41**, remote from section **45** such that one of its ends **171**, formed into a male quick-connect terminal, is located next to relay switch terminal **168** for convenience of making the connections to the start winding. The other end of strip **170** enters an opening communicating with section **45** and provides an upstanding male quick-connect terminal **172** disposed near terminal **128**. Consequently, these two terminals can be readily utilized for connecting main winding **22** to the power lines, the manual control for the motor. If reverse rotation of the motor is desired, the necessary change of connections can be made easily by reversing or interchanging the main winding connections at terminals **128**, **172**.

From FIGS. 3 and 4 and the foregoing discussion, it will be appreciated that in support unit **40**, the line lead connections, main winding lead connections, and over-

load switch insulator handle are all easily accessible from end frame opening **152**. In addition, the start winding terminals **168** and **171** have a common and unobstructed location, facilitating their connection with the start winding. Moreover, calibrating screws **177** for adjusting the net force on armature of switch relay may also conveniently extend from terminal section **45**, through the support **41** and into the chamber accommodating the relay in the other leg of support **41**. The heads of these screws can be reached at a location common to the one and main winding terminals without difficulty.

The manner in which the unit mounts the start winding switch and overload switch also permits simple and common interconnections between the components of the start and main winding circuits and allows versatility in use. As to the interconnection benefits for example, short electrical conducting strip or link **124** makes a common connection for a side of the start winding, the overload switch (contact **121**), and the start winding switch (blade **61**).

While in accordance with the patent statutes, I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that numerous changes and modifications may be made therein without departing from the invention and it is therefore aimed in the appended claims to cover all such equivalent variations as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. For use in a single winding control unit of a dynamoelectric machine having a support, the arrangement including an overload switch carried by the support comprising a pair of normally closed contacts, and an insulator post turnably mounted by the support adjacent said contacts, said post including an electrically insulated wedge having an original position outwardly of the contacts, spring means connected to said post biasing said wedge against said contacts in the original position when said contacts are closed, said contacts having means responsive to the operation of the machine to open them, said spring means turning said wedge between the contacts when the contacts are opened, means retaining said wedge between said contacts, and rotatable means for returning said wedge to its original position.

2. A resettable overload device for use in an electrical inductive apparatus comprising a support formed with a chamber; the device comprising a pair of switch contact elements disposed in said chamber having closed and open positions; an insulator post turnably mounted by said support adjacent said contact elements and having a lateral projection rotatable between first and second positions, with one of the positions being located between said contact element at the open position; spring means attached between said insulator post and support for biasing said insulator post toward said second position; said support having means for stopping said projection in said second position; and a section connected to said post for turning said post to return said lateral projection to said first position.

3. The overload device of claim **2** in which said support has a cavity in communication with said chamber and a shoulder receiving a part of said post, and said post has a radial enlargement formed next to said lateral projection seated on said shoulder for support and proper location of said post.

4. The overload device of claim **2** in which one end of said post is formed with a transverse slot for receiving one end of said spring means and the other end of said post terminates in said section which projects beyond said support on the side thereof remote from said chamber to be accessible for turning said post to return the lateral projection to its first position.

5. The overload device of claim **4** in which electrical conducting means is attached to one of said contact elements and projects through said support, said electrical conducting means being accessible on the same side of said support as said section of the post.

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