Aug. 18, 1953 H. E. COBB ET AL 2,649,521

MAGNETIC SWITCH

Filed April 13, 1950 3 Sheets-Sheet 1

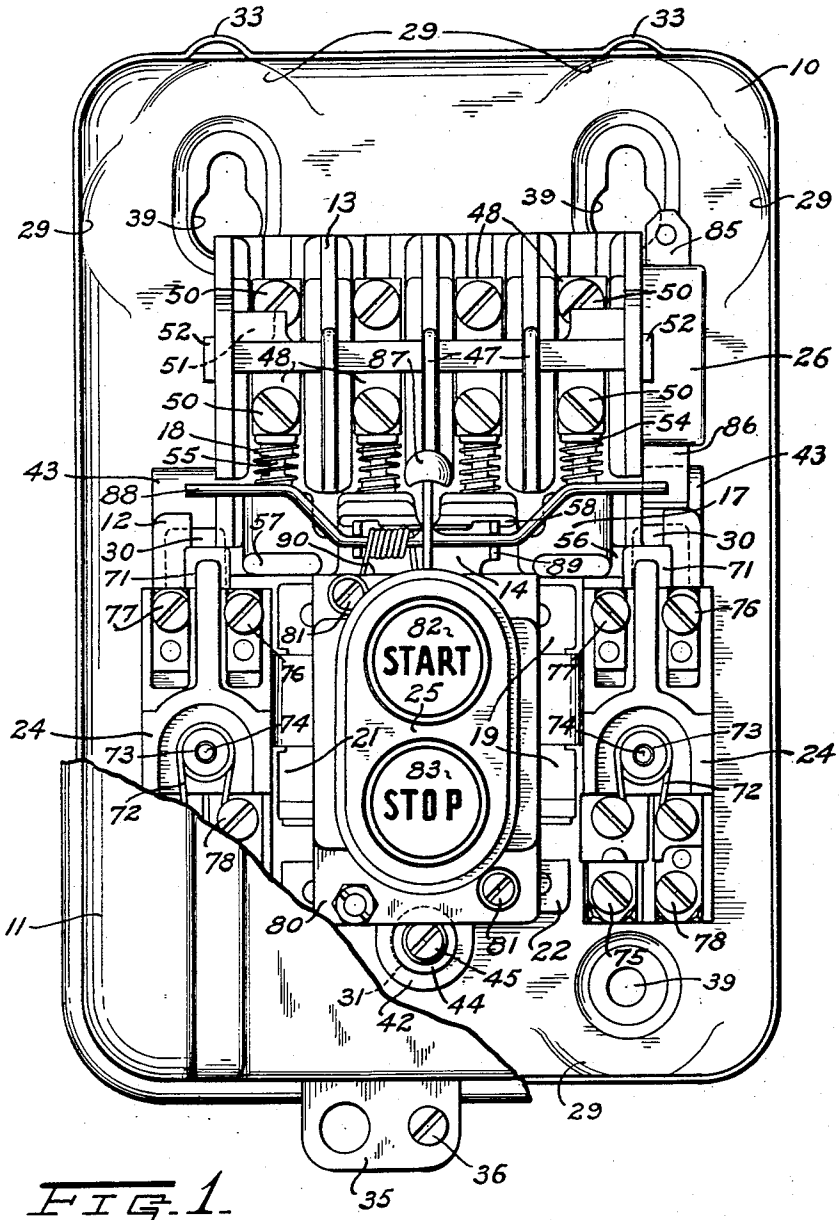


FIG. 1.

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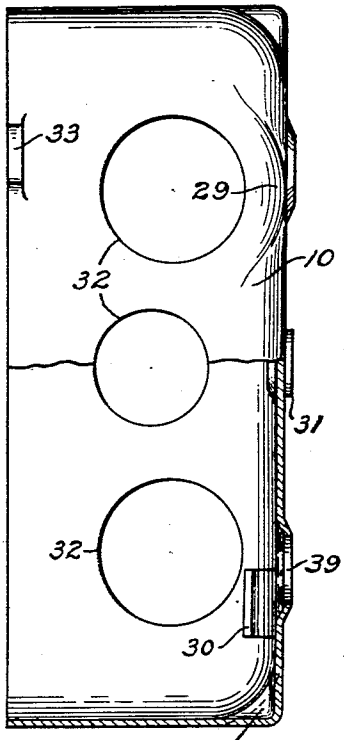


FIG. 4.

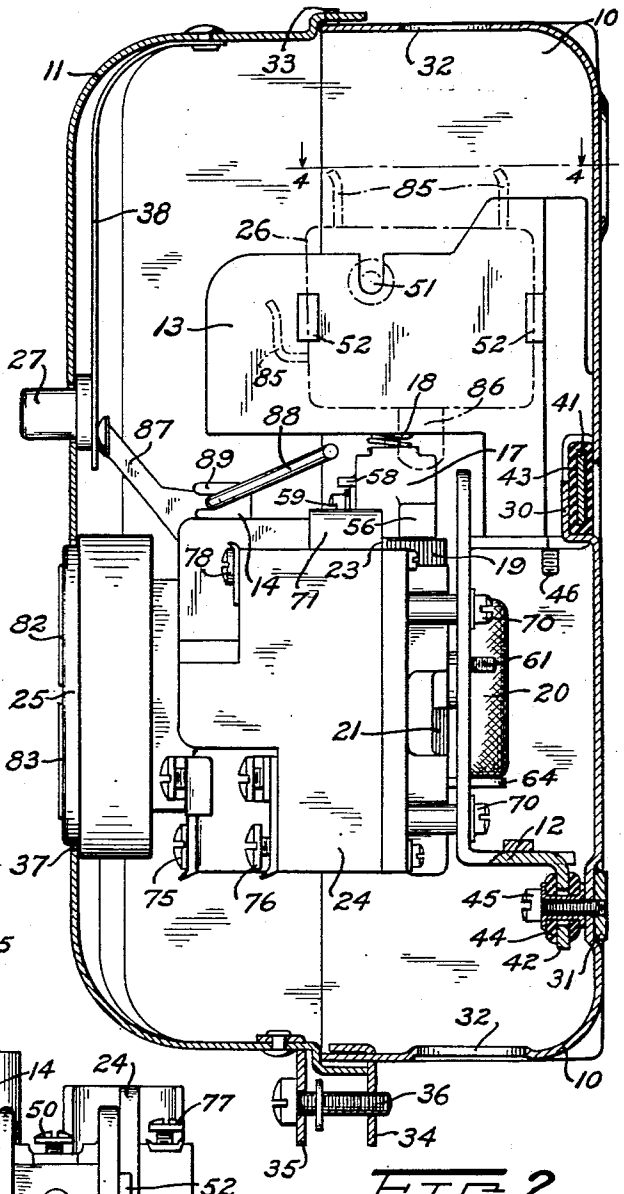
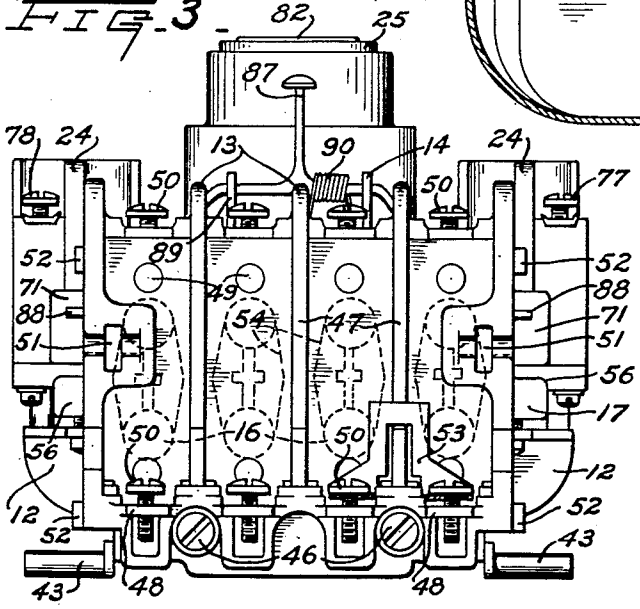


FIG. 2.

FIG. 3.



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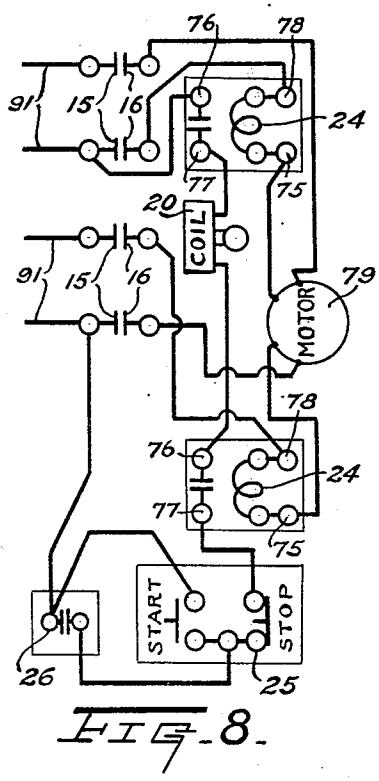


FIG. 8.

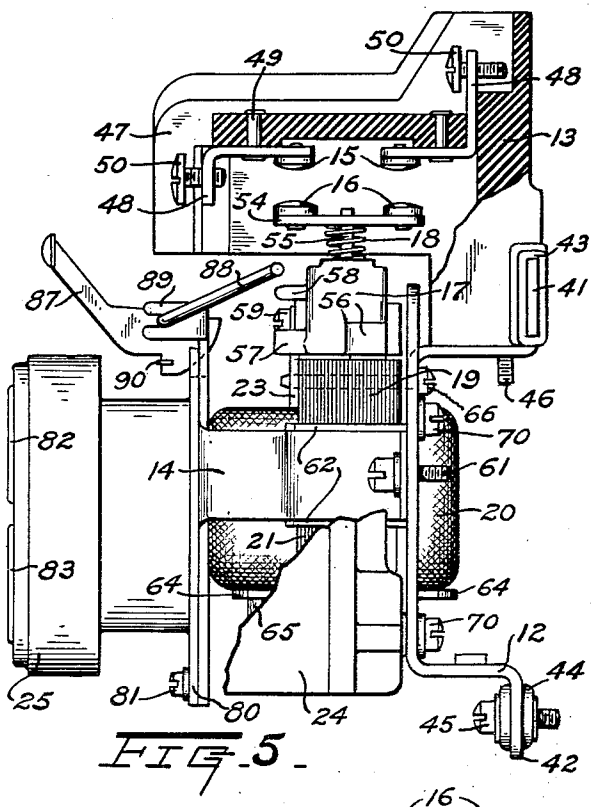


FIG. 5.

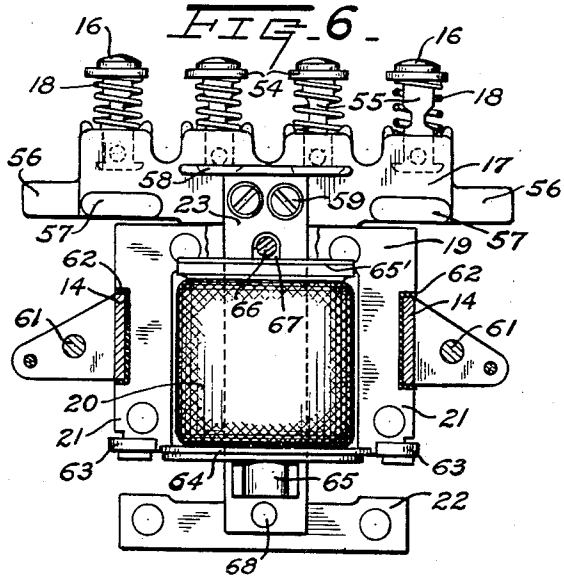


FIG. 6.

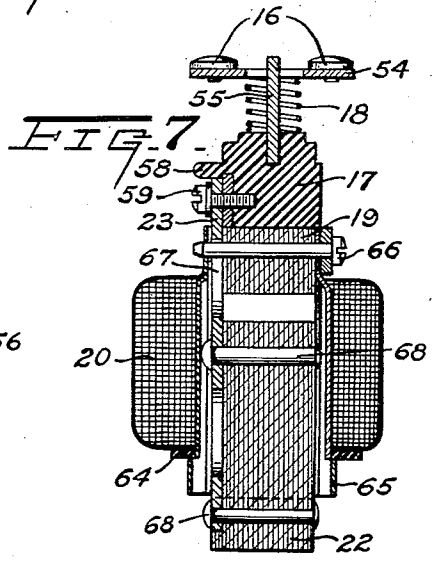


FIG. 7.

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UNITED STATES PATENT OFFICE

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MAGNETIC SWITCH

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Application April 13, 1950, Serial No. 155,651

6 Claims. (Cl. 200—104)

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Our invention relates in general to improvements in electrical equipment for controlling the operation of electrical machines and devices, and relates more specifically to improvements in the construction and operation of electro-magnetically actuated switches.

The principal object of the present invention is to provide a magnetically actuated switch assemblage which is simple in construction, efficient in operation, and flexible in its adaptations.

Many different types of electro-magnetically actuated control switches for motors and other electrical devices, have heretofore been proposed and used commercially with varying degrees of success, but all of these prior so-called starting switches or controllers have been relatively objectionable and not entirely satisfactory for various reasons so that there has long been a need for improvements. Most of the previous magnetic switch mechanisms have been too complicated and unreliable in operation to effectively meet various operating conditions, while many have been exceedingly noisy in operation and insufficiently durable to withstand repeated actuation and moderate abuse. While some of the prior magnetic starters have embodied thermal overload relays for protecting the electrical apparatus associated therewith, these overload devices could not be reset with assurance that the overload had ceased and that no damage would subsequently result from the resetting. Then too, none of the prior switch assemblages of this type made ample provision for varying the number of circuits controlled thereby without great difficulty, and the previous magnetic control units moreover were relatively costly and could not be readily installed, assembled or dismantled, and the various parts thereof were not conveniently accessible for inspection, manipulation or replacement if damaged.

It is therefore an important object of our present invention to provide an improved magnetic starter which obviates all of the above mentioned objectionable features and which meets all of the requirements in a most effective manner.

Another important object of this invention is to provide an improved electrically actuated magnet assemblage for motor controllers or the like, which is durable and compact in construction, exceedingly quiet in operation, and in which the electromotive force is most effectively applied to a simple armature for operating the movable switch contacts.

A further important object of the invention

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is to provide an improved overload relay resetting mechanism for magnetic switches wherein separation of the main switch contacts and de-energization of the magnet are positively effected during resetting of the thermal overload devices or units.

Still another important object of the present invention is to provide an improved magnet mounting for electro-magnetically actuated circuit controls, whereby the field piece and armature of the magnet are constantly maintained in accurate alinement, while transmission of noise and vibration to the supporting frame structure is effectively avoided.

An additional important object of our invention is to provide an improved support for the frame of a magnetic switch assembly, whereby the assemblage is made quickly bodily removable from or insertible within its housing, while transmission of noise and vibration to and from the frame is positively eliminated.

Another important object of this invention is to provide a magnetic switch in which one or more sets of additional contacts may be quickly and conveniently and safely added to provide additional interlocks for special circuits or applications.

A further important object of the invention is to provide improved movable contact carrying bridges and guides for magnetically actuated switches or the like, which will effectively resist wear for prolonged periods of time, while insuring perfect seating of the contacts when closing.

Still another important object of our invention is to provide an improved housing for magnetic switch units, which is sturdy in construction, effectively protects the mechanism against damage from the exterior, and which facilitates inspection of parts and attachment of electrical connections.

Another object of the invention is to provide an electro-magnetically actuated circuit controller which embodies in a single compact unit a main magnetic switch, a starting and stopping switch, additional switchlets, thermal overload relays, and reset mechanism for the overload devices, all conveniently accessible and safely manipulable while also being well insulated against short circuiting.

These and other objects and advantages will be apparent from the following detailed description.

A clear conception of the specific improvements constituting our present invention, and of the construction and operation of a typical magnetic switch embodying the same, may be

had by referring to the drawings accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a front view of one of our improved commercial magnetic switch assemblages with a portion of the housing cover broken away, showing the movable contacts in open position, and having a push button starting and stopping switch and an auxiliary switchlet associated with the main switch unit;

Fig. 2 is an irregular vertical section taken primarily through one side portion of the switch housing, showing the main switch unit in elevation, an auxiliary switch in dot-and-dash lines, and the detachable main frame mounting in section;

Fig. 3 is a top view of the main switch removed from its housing, and showing a push button control applied thereto but no auxiliary switch;

Fig. 4 is a part sectional top view of the rear casing section of the switch housing, the section having been taken along the line 4—4 of Fig. 2;

Fig. 5 is a part sectional side view of the main switch unit, the section having been taken through one of the contact cells or compartments of the terminal board;

Fig. 6 is a front elevation of the improved movable contact and actuating magnet assemblage;

Fig. 7 is an irregular vertical section through the assemblage of Fig. 6, taken centrally through the magnet and through one set of movable contacts; and

Fig. 8 is a typical wiring diagram showing the new switch assembly applied to a two phase four wire motor starting electric circuit.

The gist of the present invention is the provision of an electro-magnetically actuated switch assemblage which embodies a simplified, compact, durable and quiet magnet and cooperating controls whereby various operating conditions may be most effectively met with utmost safety and convenience, and while only one specific embodiment of the switch has been shown and described, it is not our desire or intent to unnecessarily limit the utility of the improved features by virtue of this restricted showing. It is also contemplated that specific descriptive terms used herein be given the broadest interpretation consistent with the disclosure.

Referring to the drawings, the improved magnetic switch assemblage shown therein comprises in general, a housing consisting of a rear suspension casing 10 having a front closure or cover 11; a switch mounting frame 12 detachably secured within the casing 10 and having an upper terminal board 13 and a front bracket 14 attached thereto; stationary contacts 15 fixedly mounted upon the terminal board 13; movable contacts 16 resiliently supported upon a transverse carrier bar 17 by springs 18 and being simultaneously cooperable with the adjacent fixed contacts 15; an electro-magnet mounted upon the frame 12 within the bracket 14 and having a stationary inverted U-shaped field piece 19 provided with an energizing coil 20 confined between its depending side arms 21, and also having an inverted T-shaped armature 22 provided with an upright movable contact actuating plate 23 formed of non-magnetic metal and secured to the extreme front of the armature and rigidly attached to the carrier bar 17; a thermal overload relay 24 fastened to the frame 12 at each side of the electro-magnet field piece 19; a starting and stopping switch 25 attached to the bracket 14 forwardly of the magnet; an auxiliary switch or switchlet 26 mounted on either or both ends of the terminal board 13; and a reset button 27 slidably confined within the housing cover 11 and cooperating with the overload relays 24 to re-establish interrupted circuits and to simultaneously open the movable contacts 16 during resetting operations.

The housing casing 10 and cover 11 are preferably formed of durable sheet metal, and in order to facilitate installation of the switch assemblage and convenient attachment of wires to the various terminals thereof, the rear casing 10 is formed rather shallow and is drawn with local rear pockets 29 near the adjacent terminals but with large corner radii, as shown in Figs. 1, 2 and 4. The rear wall of the casing 10 is also provided with a pair of integral laterally spaced inner hooks 30 and with a lower tapped external washer 31; while the upper and lower casing walls have access openings 32 therein for the current conducting wires. The housing cover 11 is detachably attachable to the casing 10 at the top by means of lugs 33 on the casing coacting with slots in the cover, and the lower end of the casing 10 has a threaded flange 34 to which a flange 35 on the cover 11 may be secured by a screw 36, while the front wall of the cover is provided with an opening 37 through which the push button switch 25 is accessible. The reset button 27 for the thermal overload relays 24, is slidably confined within another opening in the cover 11 by means of a leaf spring 38, see Fig. 2, and the housing may be suspended from a wall by means of screws coacting with openings 39 formed in the rear wall of the casing 10.

The switch mounting frame 12 is formed of heavy sheet metal and is provided at its upper end with integral lateral outwardly extending projections 41 and at its lower end with an integral downwardly extending projection 42. The upper alined projections 41 are covered with rubber sleeves 43 which are snugly downwardly insertible within the hooks 30 of the casing 10, and the lower central projection 42 is provided with a rubber grommet 44 having a metal liner with which a clamping screw 45 is cooperable to fasten the projection 42 to the casing washer 31, as shown in Fig. 2. The soft rubber sleeves 43 and grommet 44 cooperate with the frame projections 41, 42 to provide a three point resilient support for the frame 12 within the housing casing 10, while also insulating the frame from the housing. Upon release of the single screw 45, the entire internal switch mechanism may be lifted free from the hooks 30, thus providing simple but effective means for firmly applying the mounting frame 12 to and for removing it from the casing 10.

The upper terminal board 13 is formed of insulating material and is firmly secured to the upper deck of the frame 12 by means of screws 46, as shown in Figs. 2, 3, and 5. The unitary terminal board 13 is provided with a series of parallel upright partitions 47 secured to a horizontal deck and spaced apart to provide cells or compartments within which the stationary and movable contacts 15, 16 are located; and the stationary contacts 15 are fixedly mounted on angular conductor bars 48 which are rigidly secured to the board 13 by rivets 49, and are provided with ter-

minal screws 50. The opposite end walls of the terminal board have sockets 51 formed therein for effecting attachment of the auxiliary switches or switchlets 26 to the board 13, and the casings of these switches 26 may also be formed to coact with spaced integral lugs 52 projecting outwardly from these end walls. The formation of the terminal board 13 is obviously such that the several sets of cooperating switch contacts 15, 16 are well segregated from each other and thoroughly insulated against short circuiting, and one or more metal contact jumper plates 53 may also be provided as shown in Fig. 3 in order to accommodate special circuits.

The movable contacts 16 are rigidly attached to metal contact bridges 54 which are slidably and tiltably mounted on upright contact guides 55 firmly embedded at their lower ends within the carrier bar 17 formed of insulating material, and the guides 55 are provided at their upper ends with lateral stop projections against which the bridges are urged by the springs 18 which surround the guides. The insulated transverse carrier bar 17 which supports the movable contacts 16 for movement within the contact cells is internally re-enforced and has integral outwardly projecting lugs 56 at its opposite ends, and this bar is also provided on its front face with integral forwardly extending projections 57 and with a shield 58; while the medial front portion of the bar 17 is rigidly secured to the upper extremity of the pusher plate 23 by means of two screws 59 which coact with the internal metallic reenforcement of the bar 17. The movable contacts 16 are thus rockably supported from the magnet armature 22 so as to insure perfect simultaneous engagement between the adjacent contacts 15, 16 whenever the main switch is closed, and the bridges 54 may be readily applied to or removed from their retaining guides 55.

The bracket 14 is firmly attached to the frame 12 by screws 61 and rivets, and the U-shaped field piece 19 of the electro-magnet is formed of laminations and has its opposite depending arms 21 notched for cooperation with the bracket 14 through two resilient rubber pads 62, as shown in Figs. 5 and 6, thus providing a two point mounting. The lower pole of each arm 21 of the field piece 19, is provided with a shading coil 63 and the upper cross-bar of this fixed magnet member is provided with a front slot through which the pusher plate 23 is slidable. The hollow magnet energizing coil 20 is firmly confined between the arms 21 of the field piece 19 by a retainer plate 64 formed of insulation and coacting with an armature guide 65 snugly fitting the coil interior and with a vibration preventing spring 65', and this guide and spring are secured to the upper cross-bar of the field piece 19 by a pin 66 which extends freely through a slot 67 formed in the vertically movable pusher plate 23 so as not to retard the free movement of the armature 22. The T-shaped armature 22 is also formed of laminations, and the pusher bar 23 is firmly secured to the central leg of this armature 22 at its extreme front by rivets 68, but the lower armature cross-bar is provided with laminations extending across and lying in the plane of the plate 23 so as not to reduce the effective area of the pole faces of the magnet.

The thermal overload relays 24 may be of like construction and are preferably of the type shown in copending application Serial No. 117,357 filed September 23, 1949. These relays 24 are attached to the main frame 12 by screws 70, and each relay has a reset slide or plunger 71 extending upwardly therefrom and is also provided with a heating coil 72 and a solder pot 73 and reset spindle 74. The thermal overload relays 24 are also provided with terminals 75, 76, 77, 78, of which the terminals 75 may be connected to a motor 79 or the like, one terminal 76 may be connected to the coil 20 while the other is connected to a fixed contact 15, one terminal 77 may be connected to the switch 25 while the other is also connected to the coils 20, and the terminals 78 may be connected to other contacts of the main switch as illustrated in the diagram of Fig. 8. All of these connections have been omitted from the other figures of the drawings in order to avoid confusion, and other circuits are of course also possible depending upon the specific functioning desired.

The starting and stopping switch 25 need not necessarily be associated directly with the magnetic switch assemblage as shown, but may be located at any convenient station, and while a push button type of switch 25 such as revealed in copending application Serial No. 120,996, filed October 12, 1949 has been specifically illustrated, a rotary control switch of the type forming the subject of the copending application Serial No. 132,945, filed December 14, 1949 may also be utilized. The control switch 25 is mounted upon an insulating plate 80 which is firmly secured to the bracket 14 by screws 81, and is provided with an upper starting button 82 and a lower stopping button 83 for the motor 79. This control switch may be provided with cooperating stationary and movable contacts and applied to the typical electric circuit as shown in the diagram of Fig. 8, or in any other suitable manner.

When it is desirable to provide additional interlocks to the starting switch in the field or at any time and for special applications, one or more auxiliary switches or switchlets 26 may be applied to the lugs 52 of the terminal board 13 and fastened thereto by means of bolts coacting with the sockets 51 at the top of the board. These switchlets 26 are preferably of the type shown in copending application Serial No. 122,667, filed October 21, 1949 now Patent No. 2,562,420, July 31, 1951, each being provided with terminals 85 projecting from its casing, and with a plunger or member 86 depending therefrom and carrying the movable switch contacts. The plungers 86 of the switchlets 26 are disposed and movable in vertical alinement with the outwardly extending lugs 56 formed on the main switch contact carrier bar 17, as shown in Fig. 2, so that when the bar 17 is elevated the switchlets 26 will be closed whereas lowering of the bar 17 will cause these auxiliary switches to open, thus producing operation of the switchlets in unison with the main switch.

The thermal overload reset button 27 which is merely slidably confined within an opening in the cover 11 by the leaf spring 38 as shown in Fig. 2, is cooperable with the overload relay plungers 71 through a swinging arm 87 rigidly attached to a reset yoke 88 pivotally mounted in upstanding integral ears 89 of the bracket 14, and which is constantly urged toward inactive position by a torsion spring 90 surrounding the yoke and having opposite ends engaging the lever arm 87 and bracket 14 respectively, see Figs. 1, 2, 3 and 5. The yoke 88 is swingable downwardly into engagement with the overload relay reset plungers 71 and is simultaneously engageable with the front projections 57 of the movable con-

tact carrier bar 17 to positively open the movable contacts 16 if these contacts are closed at the time resetting of the overload relays 24 is being effected, and especially in case they have welded to the fixed contacts 15. Such resetting may obviously be accomplished by merely pressing the reset button 27, and when this button is released the torsion spring 90 will automatically swing the yoke 88 into inactive position.

When the improved magnetic switch unit has been properly constructed and assembled as hereinabove described, it may be applied to diverse electrical circuits a typical one of which is shown in the diagram of Fig. 8 and depicts a two phase four wire motor control circuit. In this diagram the current is supplied to the system through four lines 91 connected to the main and auxiliary switch contacts, and the thermal overload relays 24 are connected directly to the motor 79 while the starter switch 25 and magnet coil 20 may be applied as shown. In order to start the motor 79 it is only necessary to press the start button 82 of the control switch 25, whereupon the magnet coil 20 will be energized and will cause the field piece 19 of the magnet to attract and lift the armature 22 thus elevating the pusher plate 23 and cross-bar 17 and carrying the movable contacts 16 into engagement with the fixed contacts 15, while simultaneously causing the end lug 56 on the bar 17 to close the switchlet 26. As long as the motor 79 is operating normally the main and auxiliary switches will remain closed.

However, if an abnormal current rise takes place in the system, the thermal overload relays 24 will immediately function to break the circuit, and the relay plungers 71 will rise while the magnet armature 22 and the cross-bar 17 should drop by gravity to lower the movable contacts 16 and to allow the auxiliary switch 26 to open. Under certain conditions, the contacts may be welded together or the magnet coil 20 may not be deenergized sufficiently to cause the switches to open, and under such conditions it is desirable to positively open the main switch and the swichlet 26 before final resetting is accomplished, and our improved reset mechanism takes care of such contingency. When the reset button is pressed the arm 87 will swing the yoke 88 into engagement with the projections 57 of the movable contact carrier bar 17 as the yoke pushes the reset plunger 71 downwardly, thus positively interrupting the switch circuits before final resetting of the relays 24 is effected, and the lowering of the bar 17 simultaneously permits the swichlet 26 to open, thus effectively protecting the entire system.

If it is desired to stop the motor 79 while in normal opration, it is only necessary to press either the reset button 27 or the stop button 83 of the control switch 25, whereupon the electric circuit will be interrupted and the coil 20 of the magnet will be de-energized; and the armature 22 of the magnet will either be forced down or will drop by gravity due to its relatively great weight. This lowering of the armature will obviously quickly open both the main switch movable contacts 16 and the switchlet 26, and normal closing and opening of the switches is not in any manner interfered with by the reset mechanism when the button 27 is released. The invention therefore provides a switch unit which can be readily manually controlled from any desired locality with the aid of either the reset mechanism or a simple control switch 25, and which functions to automatically protect the electrical equipment against damage due to overloading while being quickly and safely resettable.

From the foregoing detailed description of the construction and operation of a typical magnetic switch unit embodying our invention, it should be apparent that we have in fact provided an assemblage which is simple, compact, and durable in construction, and which is highly efficient in operation and flexible in its adaptations. The improved magnet construction is extremely important since it provides a relatively small powerful magnet which can be produced at moderate cost and which operates quietly and without undesirable vibration. The rectangular non-magnetic metal pusher plate 23 and the upright central portion of the armature 22 are freely slidable within the coil 20 and field piece 19, and the plate 23 is also easily attachable to an extreme outer face of the armature 22, while special laminations are applied to the lower armature cross-bar in the plane of the pusher plate 23 to provide maximum pole face area coacting with the field piece arms 21. Since the pusher plate 23 is constructed of very hard material its rectangular formation facilitates production thereof; and the rigid attachment of this pusher to the metal reenforcement within the contact carrier bar 17 with the aid of several screws 59 combined with the vertical guiding effected by the guides 65 insures accurate alinement of the armature and perfect cooperation thereof with the field piece 19 at all times. The two point suspension of the magnet provided by the bracket 14 and pads 62 also prevents misalinement of the magnet armature 22, field piece 19 and coil 20, thus providing for most efficient functioning of the magnetically elevated and gravity lowered armature.

The rubber pads 62 and the sleeves 43 and grommet 44 which are formed of similar material, cooperate to eliminate noise and to prevent vibration from being transmitted to and from the switch mechanism and its supports, and these rubber elements also serve as effective insulators. The hooks 30 and screw 45 besides providing a firm three point mounting for the frame 12, also permit quick attachment of this frame to and removal thereof from the casing 10; and the improved shallow formation of this casing 10 with local pockets 29 facilitates the application of conductors and also materially reduces the cost of manufacturing the casings. The housing cover 11 is also readily attachable to or removable from the casing 10 by merely manipulating a single clamping screw 36, and the reset button 33 is effectively held to the cover by the leaf spring 38 which coacts with the reset arm 87 and spring 90 to hold the yoke 90 in inactive position when the cover 11 is clamped to the casing 10.

The push button control switch 25 is conveniently accessible for operation through the cover opening 37 and is insulated from the bracket 14 by the front plate 80, but this switch 25 need not be associated directly with the magnetic switch unit. The formation of the terminal board 13 with lugs 52 and sockets 51 enables rapid and safe addition or removal of switchlets 26 to meet varying conditions of use or application of the switch unit, and the one-piece construction of the insulated terminal board 13 with its partitions 47 effectively segregates the several sets of fixed and movable contacts 15, 16. This feature combined with the resilient mounting of the movable contacts eliminates arcing and prevents possible short circuiting, since the several sets of contacts

15, 16 are constantly confined within separate and well insulated cells or chambers.

The improved resetting mechanism whereby the contacts 16 are positively opened before resetting of the overload relays 24 is effected is also an important safety feature, and functions to automatically open both the main magnetic switch and the switchlets 26 whenever the reset button 27 is manipulated. All parts of the mechanism are formed for convenient manipulation, and the reset button 27 may also be depressed to force the main contacts 16 open and to open the switch 26 so as to de-energize the motor 79 in emergencies. This feature is important if the control switch 25 is located remote from the magnetic switch and the operator happens to be near the latter; and also in cases where the contacts 15, 16 tend to weld together. The various elements of the improved switch mechanism are all constructed of durable material best adapted to produce long life of the structure, and which may be manufactured at moderate cost and readily assembled, dismantled or inspected; and the improved magnetic switch has proven highly satisfactory and successful in actual use for diverse purposes.

It should be understood that it is not desired to limit this invention to the exact details of construction or to the precise mode of operation of the typical magnetic switch herein shown and described, for various modifications within the scope of the appended claims may occur to persons skilled in the art.

We claim:

1. In a magnetic switch, a housing having a removable front cover, a frame mounted within said housing, an electro-magnet mounted upon said frame and having a reciprocable armature, a terminal board mounted upon said frame and having fixed contacts disposed in the path of movement of said armature but spaced therefrom, a contact carrier bar movable toward said board by said armature, movable contacts mounted upon said carrier bar and cooperating with said fixed contacts, a thermal overload relay carried by said frame on each side of said magnet, a reset button carried by said housing cover, and a yoke centrally pivotally mounted upon said frame and having opposite eccentric end portions and a central lever arm movable by said button to cause the eccentric portions to contact said bar and open said contacts while subsequently resetting said relays.

2. In a magnetic switch, a frame, an electromagnet mounted upon said frame and having a reciprocable armature, a terminal board mounted upon said frame and having fixed contacts disposed in the path of movement of said armature but spaced therefrom, a contact carrier bar movable toward said board by said armature, movable contacts mounted upon said carrier bar and cooperating with said fixed contacts, a thermal overload relay carried by said frame on each side of said magnet, a reset button for said relays, and a yoke pivotally mounted upon said frame and having spaced eccentric portions and a central arm movable by said button to cause said eccentric portions to contact said bar and open said contacts and to subsequently reset said relays.

3. In a magnetic switch, a frame, an electromagnet mounted upon said frame and having a vertically reciprocable armature, fixed contacts supported from said frame above said armature, a contact carrier bar movable toward said fixed contacts by said armature and having thereon movable contacts cooperable with the fixed contacts to close the electric circuit when said electro-magnet is energized, a thermal overload relay carried by said frame on each side of said magnet, a reset button common to both of said relays, and a yoke pivotally mounted upon said frame and having an eccentric portion disposed above each of said relays and also having an arm cooperable with said button to cause said eccentric portions to engage said movable contact carrier bar and separate said fixed and movable contacts before resetting said relays.

4. In a magnetic switch, a frame, an electromagnet mounted upon said frame and having a vertically reciprocable armature, fixed contacts supported from said frame above said armature, a contact carrier bar movable toward said fixed contacts by said armature and having thereon spaced projections and movable contacts cooperable with said fixed contacts to close the electric circuit when said electro-magnet is energized, a thermal overload relay carried by said frame on each side of said magnet and each having a reset plunger, a reset button common to both of said relays, and a yoke pivotally mounted upon said frame and having eccentric portions and an actuating arm cooperable with said button, said eccentric yoke portions being cooperable with said bar projections and with said relay plungers to successively separate said contact and to reset said relays only after such contact separation has been effected.

5. In a magnetic switch, a housing having a cover, a frame mounted within said housing, an electromagnet secured to said frame and having a reciprocable armature, fixed contacts supported from said frame within said housing and above said armature, a carrier bar reciprocable by said armature and having thereon movable contacts cooperable with said fixed contacts and also having a projection, a thermal overload relay carried by said frame, a reset button carried by said housing cover, and a yoke pivotally mounted upon said frame and having an eccentric portion and an actuating arm cooperable with said button, said eccentric portion being engageable with said bar projection to separate said fixed and movable contacts and to subsequently reset said relay only after such contact separation has been effected.

6. In a magnetic switch, a sheet-metal housing having an upright rear wall provided with a pair of laterally separated upwardly open integral hooks and with a single fastener disposed midway between but considerably below said hooks, a sheet-metal frame having outwardly extending integral projections embraced by resilient sleeves insertable downwardly within said hooks and also having a resilient grommet attachable to said fastener to positively maintain said projections within said hooks and to resiliently suspend said frame within said housing, an electro-magnet secured to said frame and having a vertically reciprocable armature, a terminal board mounted upon said frame and having fixed contacts disposed above said armature, a contact carrier bar reciprocable by said armature and having thereon movable contacts cooperable with said fixed contacts, and a thermal overload relay carried by said frame on each side of said armature, said frame and said magnet and said terminal board and said relays being freely vertically removable from said hous-

ing wall upon release of said single lower fastener.

HAROLD E. COBB.
WILLIAM C. FURNAS.

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