Feb. 15, 1966 J. J. GRIBBLE ETAL 3,235,686

MAGNETIC SWITCH WITH READILY REMOVABLE ELECTROMAGNETIC CONTACT UNIT

Filed June 29, 1961 5 Sheets-Sheet 1

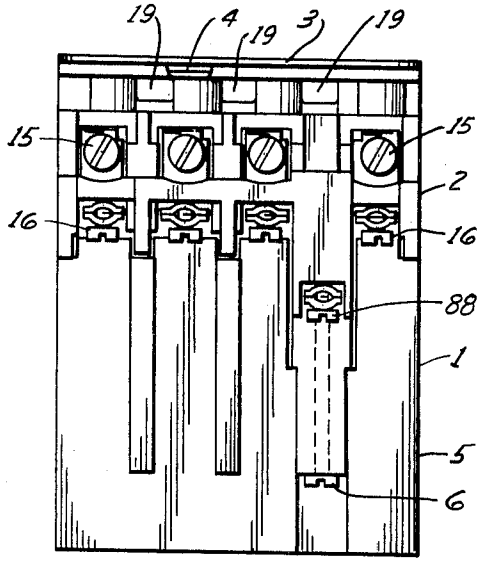


Fig. 1.

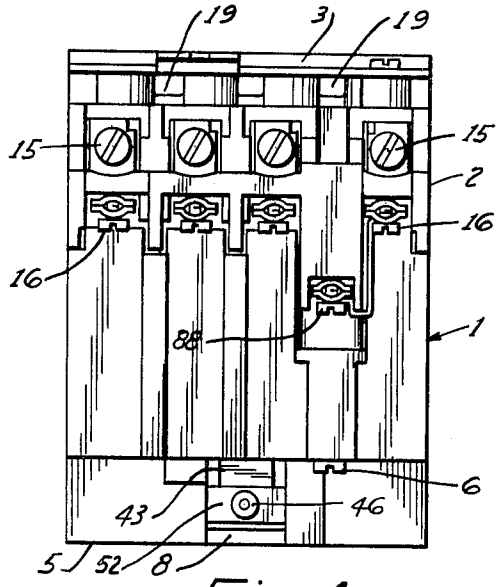


Fig. 4.

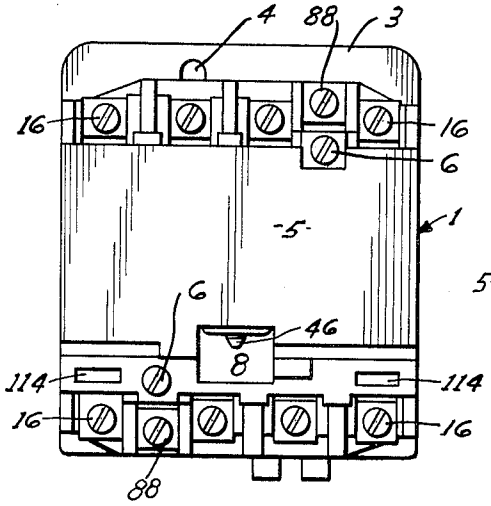


Fig. 2.

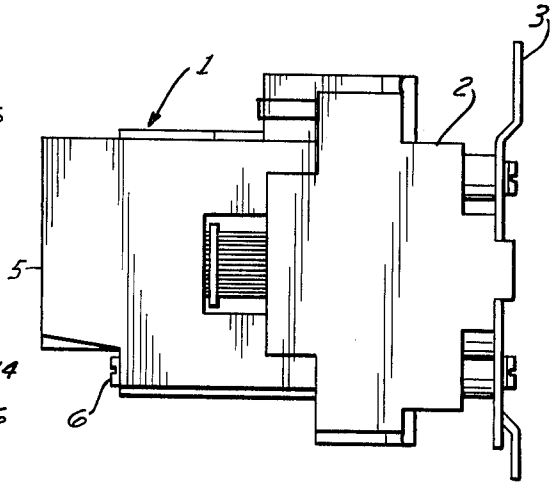


Fig. 3.

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5 Sheets-Sheet 2

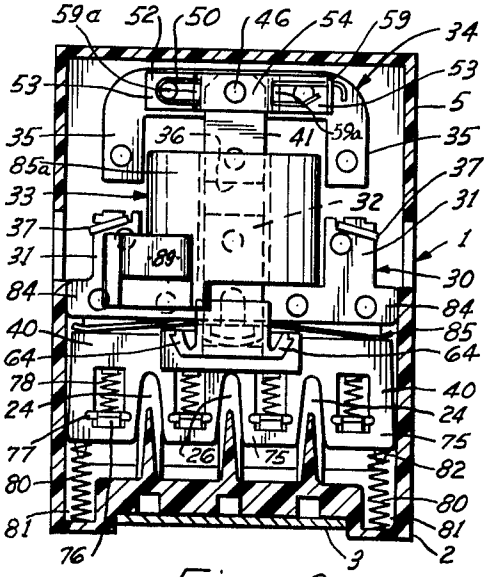


Fig. 9.

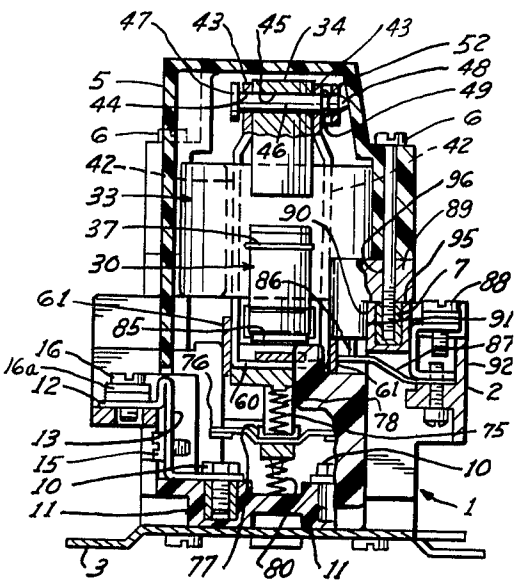


Fig. 10.

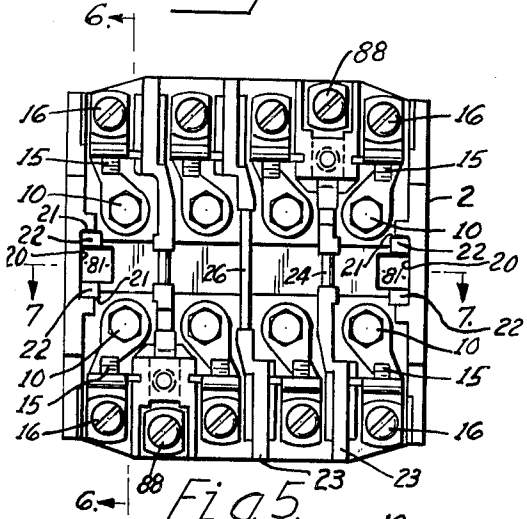


Fig. 5.

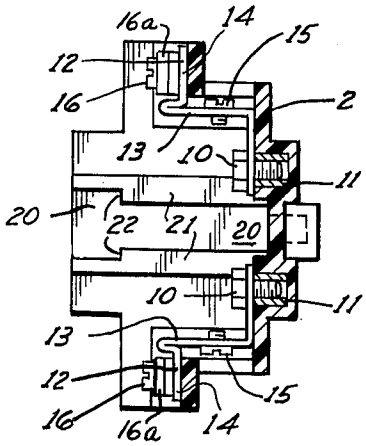


Fig. 6.

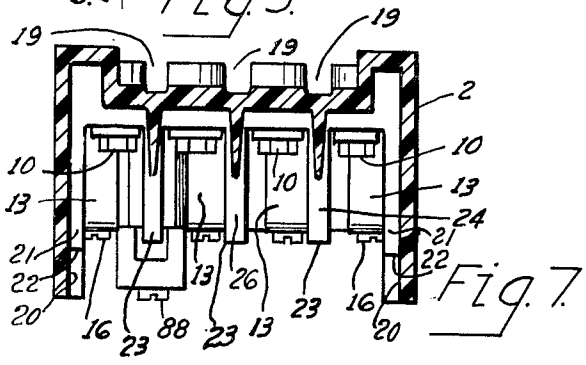


Fig. 7.

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MAGNETIC SWITCH WITH READILY REMOVABLE ELECTROMAGNETIC CONTACT UNIT

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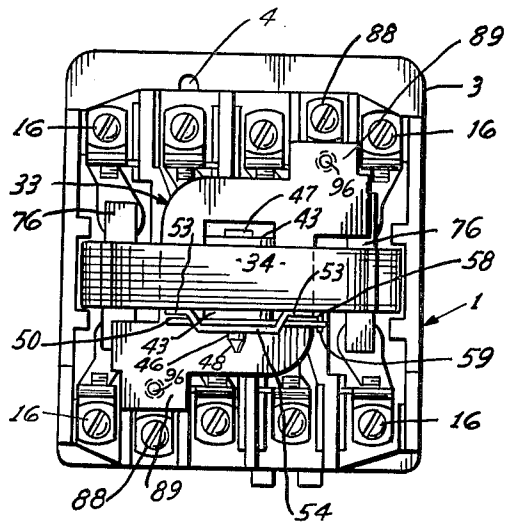


Fig. 8.

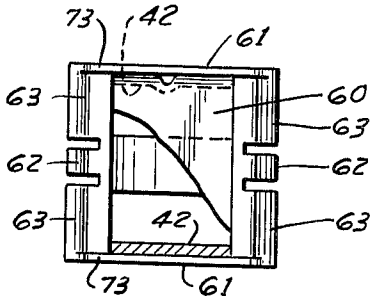


Fig. 11.

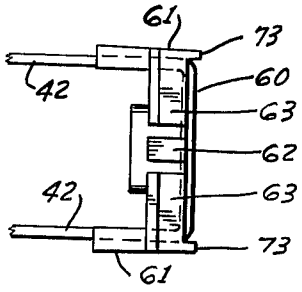


Fig. 12.

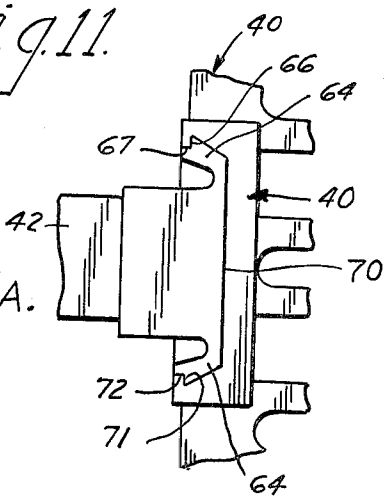


Fig. 11A.

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MAGNETIC SWITCH WITH READILY REMOVABLE ELECTROMAGNETIC CONTACT UNIT

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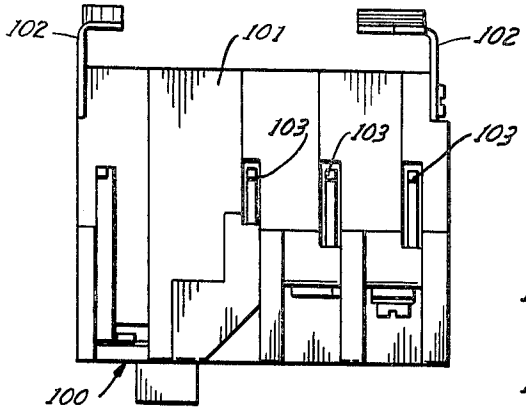


Fig. 13.

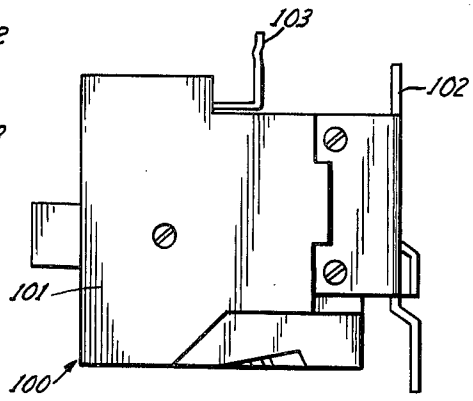


Fig. 14.

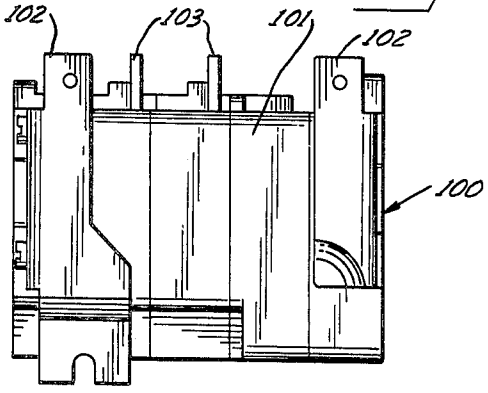


Fig. 15.

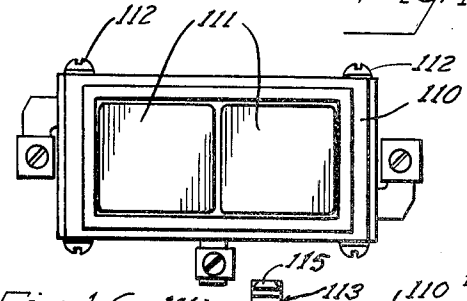


Fig. 16.

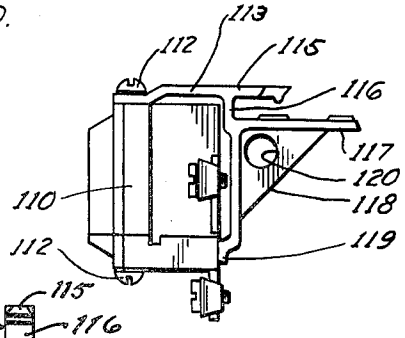


Fig. 17.

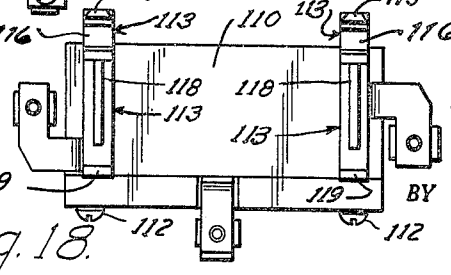


Fig. 18.

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MAGNETIC SWITCH WITH READILY REMOVABLE ELECTROMAGNETIC CONTACT UNIT

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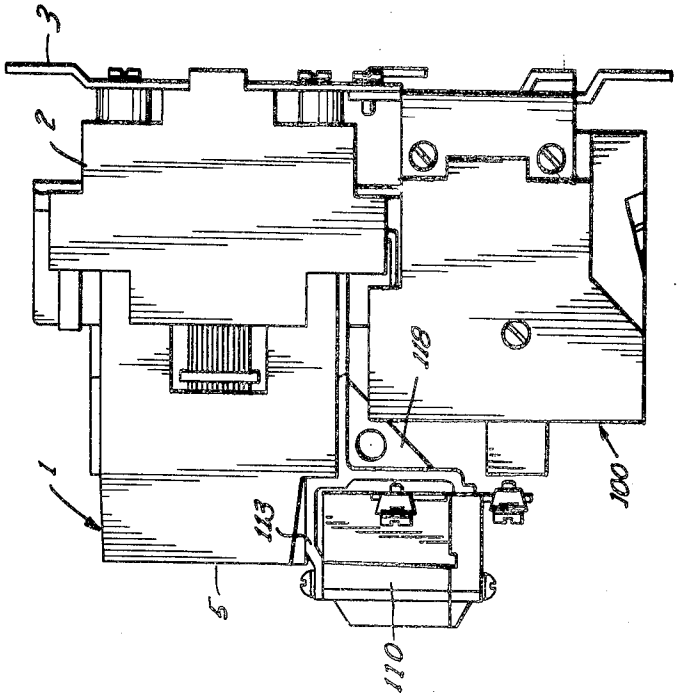


Fig 20.

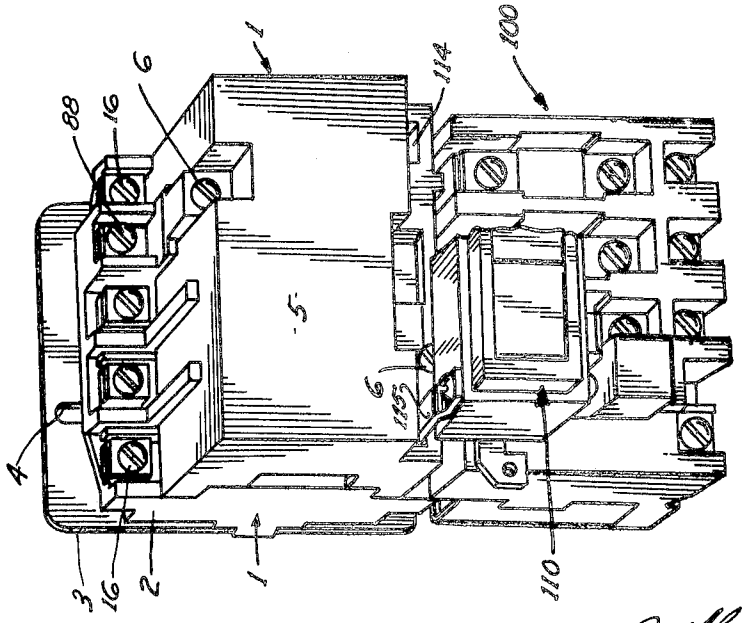


Fig 19.

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Robert H. Howard,
ATTORNEY.

United States Patent Office 3,235,686 Patented Feb. 15, 1966

3,235,686

MAGNETIC SWITCH WITH READILY REMOVABLE ELECTROMAGNETIC CONTACT UNIT

Joseph J. Gribble and Kenneth Marien, Milwaukee, Wis., assignors to Square D Company, Park Ridge, Ill., a corporation of Michigan

Filed June 29, 1961, Ser. No. 120,725
5 Claims. (Cl. 200—104)

This invention relates to a contact structure, and particularly to a magnetically operated switch, and to the combination thereof with an overload relay and push button assemblage which fits readily in conventional enclosures.

Electromagnetic switches, as well known in the art, generally include a plurality of sets of stationary contacts and electromagnetically operated movable contacts for cooperation therewith. Various line and load terminals are provided for connecting the switch to power and control circuits and other equipment. One of the disadvantages of the prior electromagnetic switches of this general character is the difficulty of servicing them. In general, the contacts, terminals, and electromagnetic assemblage, are so arranged that a large number of wires must be disconnected and reconnected in order to remove the switch from its installed position, and to remove and service or replace various individual elements thereof.

In accordance with the present invention, the switch comprises essentially a base having a cavity therein which is open at the top of the base, a magnetic movable contact assembly, and a cover. All of the stationary contacts are mounted in the base so as to be readily accessible for servicing merely by removing the cover and then the magnetic assembly as a unit. The terminals for the stationary contacts, together with the connectors thereon, also are mounted in the base and are accessible for connecting lines thereto while the remainder of the switch is undisturbed, even the cover remaining in place. Furthermore, the electromagnetic assemblage is one which can be readily removed as a unit simply by removing the cover to expose the assemblage and then lifting the assemblage as a unit from the base. The connections of the coil are made simply by restoring the assemblage to its position on the base.

The movable contacts and their carrier are part of the removable assemblage and hence are removed therewith.

The assemblage can be installed readily merely by placing it in the base with certain of its portions in engagement with suitable guideways and the like formed in the base which guide it to proper position, placing the cover thereover, and then pressing the cover to closing position and securing it in position by a pair of screws which hold the cover in place and thereby also the assemblage.

The carrier can be easily detached from the assemblage and the movable contacts can be removed from the carrier either while it is connected to, or disconnected from, the assemblage.

Further, the assemblage is so arranged that the armature may be removed from the remainder of the assemblage very readily, and the movable contact carrier and its supporting and operating parts can be detached from each other and removed for replacement or repair.

A number of parts of the magnetic assemblage are so held in assembled relation and supported resiliently when in operating position as to absorb shocks. Proper alignment of the magnet armature and stationary pole piece are assured. The cover is arranged for detachable snap fastening engagement with a start-stop push button switch or hand auto-button switch.

The electromagnetic switch is particularly adaptable for connection with a specific type of overload relay, such as described in application Serial No. 116,091, filed June 9, 1961, now Pat. No 3,179,757 and entitled "Switch Mechanism," which relay has a plurality of parallel external prong terminals. The switch has load terminals complementary to the prongs and adapted for receiving the prong terminals, respectively, concurrently, simply by moving the electromagnetic relay relatively toward the electromagnetic switch while in proper alignment therewith.

Various other objects and advantages will become apparent from the following description wherein reference is made to the drawings, in which:

FIG. 1 is a top plan view of an electromagnetic switch embodying the principles of the present invention;

FIG. 2 is a front elevation of the switch illustrated in FIG. 1;

FIG. 3 is a right end elevation of the switch illustrated in FIGS. 1 and 2;

FIG. 4 is a bottom plan view of the switch illustrated in FIGS. 1 through 3;

FIG. 5 is a front elevation of the switch illustrated in FIG. 1, but with the cover, the base plate, and the electromagnetic assembly removed;

FIG. 6 is a vertical cross sectional view taken on the line 6—6 in FIG. 5;

FIG. 7 is a longitudinal horizontal sectional view taken on the line 7—7 in FIG. 5;

FIG. 8 is a view similar to FIG. 5 but with only the cover removed;

FIG. 9 is a plan view, partly in section, of the bottom of the structure illustrated in FIG. 7, but with the device turned so that the base is disposed horizontally for convenience in projection between FIGS. 9 and 10;

FIG. 10 is a left end view, partly in section, of the structure as positioned in FIG. 9, part of the cover and casing being shown in section for clearness in illustration;

FIG. 11 is a fragmentary rear elevation of the supporting means of the movable contact carrier, the carrier being omitted for clearness in illustration;

FIG. 11A is a fragmentary front elevation of the supporting means shown in FIG. 11, with the carrier connected thereto;

FIG. 12 is a right end elevation of the structure illustrated in FIG. 11;

FIGS. 13, 14 and 15 are a top plan view, side elevation, respectively, of an overload relay structure combined with the present electromagnetic switch;

FIGS. 16, 17 and 18 are a top plan view, right end elevation, and rear elevation, respectively, of a push button assemblage arranged to be combined with the electromagnetic switch of the present invention;

FIG. 19 is a perspective view of the combined switch and relay viewed generally from the front; and

FIG. 20 is a side elevation of the electromagnetic switch, relay, and push button assemblage connected in operating position with respect to each other.

Referring first to FIGS. 1 through 4, the electromagnetic switch, indicated generally at 1, comprises a hollow base 2 having a cavity therein which is open at the top of the base. The base is mounted on a metal base plate 3 which has an aperture 4 which can receive a suitable screw or bolt for securing the switch in a suitable box or enclosure or on a panel.

The base 2 is preferably composed of insulating material such as set synthetic resin, hard rubber, or the like. The base is provided with stationary contacts and terminals therefor, later to be described. An electromagnetic assemblage and switch means are carried by the base and enclosed by a suitable cover 5 of insulating material.

The cover 5 is secured in place on the base by two bolts 6 which engage suitable threaded fittings 7 embedded in the base 2. The cover 5 is provided with a window 8 through which a portion of the coil and the armature of the electromagnetic assemblage and its supporting parts are observable for determining the rating of the coil when the coil is provided with suitably located indicia for determining whether or not the armature is in proper operative position, and also to permit access to the assemblage for manual operation thereof.

Referring next to FIGS. 5, 6, and 7 the base 2 is shown with the cover, base plate and electromagnetic assemblage removed. As there shown, a plurality of stationary contacts 10 are provided in the base, these contacts being arranged in two rows which are parallel to each other. Each contact 10 is screw fitted into a conventional metal threaded insert 11 (FIG. 6) embedded in the base 2.

Each stationary contact 10 is connected to a terminal member 12 which has a horizontal portion 13 and a vertically extending portion 14 tapped to receive screws 15 and 16, respectively. Each screw cooperates with a suitable clamping element 16*a* such as disclosed in copending application Serial No. 116,091, filed June 9, 1961, and entitled "Switch Mechanism," for clamping the end portion of a wire to the associated one of the portions 13 and 14.

The horizontal portions 13 are exposed exteriorly of the base 2 both at the bottom and the top, facing downwardly and upwardly, respectively, so that wires can be connected thereto readily from the exterior of the base by the screws 15 while the cover 5 is in place. The vertical portions 14 are exposed exteriorly of the base 2 both at the upper and lower margins of the base so that wires can be connected thereto readily by the screws 16 when the cover 5 is in place.

With this arrangement, it can readily be seen the connections can be made to the stationary contacts without removing the cover 5 and without disturbing any of the wiring and parts of the switch.

Suitable vertical channels 19 (FIG. 7) are provided in the rear face of the base 2 so that wiring can be disposed between the rear face and the base plate 3.

In order to receive and support the electromagnetic assemblage, the side walls of the base are provided with respective suitable integral guideways 20 which extend from the open front of the base rearwardly and which are formed by the associated side wall of the base and adjacent faces of integral guide bars 21 on the associated side wall The bars 21 stop part way inwardly from the open front and the forward ends of which provide forwardly facing stop shoulders 22. Between its sides, the base 2 has intermediate walls 23 which are in parallel spaced face to face relation to the side walls and to each other and terminate a distance inwardly from the open front. The intermediate walls 23, except for the middle one, have forwardly open guideways 24 therein. Except for the intermediate wall 23, the middle one of the walls 23 has a forwardly open guideway 26 which is wider than the guideways 24.

These guideways 24 and 26 terminate short of the back wall of the base 2 so that the rearward portions of the walls 23 shield the contacts 10 in each row from each other.

The electromagnetic assembly shown best in FIGS. 8, 9, and 10 is in the form of a separate assemblage which can be installed and removed from the base 2 as a unit. It comprises generally a pole piece 30 which, in horizontal projection, is of E-shaped configuration (FIG. 9), having outer legs 31 and an intermediate leg 32. A coil 33 is provided and is arranged horizontally with the central leg 32 accommodated within the central passage of the coil. An armature 34 is arranged to cooperate with the pole piece 30 and is provided with outer legs 35 and a central leg 36 complementary to and aligned endwise of the coil with the legs 31 and 32, respectively, of the pole piece 30. The faces of all of these legs are ground to a smooth and precise finish. The legs 31 are shaded with suitable shading coils 37.

The armature 34 is connected to a movable contact carrier 40 so as to move the carrier 40 forwardly and rearwardly upon like movement of the armature 34.

For assembling both the armature 34 and the carrier 40 with the coil 33 and guiding them during operation, suitable guide means 41 are provided. The guide means 41 comprise a pair of parallel arms 42 which extend through the axial passage of the coil and fit therein with sufficient clearance so that both the armature 34 and the movable carrier 40 are constrained thereby to move in proper relation with each other and in alignment with the coil 33 and stationary pole piece 30.

As mentioned, it is desirable that both the armature and the movable contact carrier 40 be readily removable from the electromagnetic assemblage. Therefore, the arms 42 are provided with forward end portions 43 (FIG. 8) which are spaced apart less than the thickness of the armature 24, and can receive the armature therebetween by springing them slightly apart by pressing the armature edgewise therebetween, and which grip the armature 34 under resilient clamping pressure. The forward end portions 43 have suitable apertures 44 and the armature 34 has a passage 45 at its midportion. The apertures 44 and passage 45 are aligned with each other when the armature 34 is in proper position. A suitable pin 46 extends through the aligned apertures 44 and passage 45 for securing the armature rockably on the forward ends of the arms 42. The pin 46 has a head 47 at one end, a tapered cam surface 48 at the other end, and an angular groove 49 adjacent the cam and arranged that when the head 47 is seated against the outer face of one arm 42 the groove 49 is disposed outwardly just beyond the outer face of the other arm 42. A U-shaped snap fastening spring 50 is carried on the armature 34 with its legs arranged so as to be spread by the tapered cam surface 48 and to snap into a seated position in the groove 49 for retaining the pin 46 in place. In order that the spring 50 be retained in position and not lost while the parts are disassembled, a suitable holder 52 is secured to one face of the armature. This holder includes two wall portions 53 juxtaposed against and secured to the armature 34 and an intermediate wall portion 54 spaced outwardly beyond the outer face of the arm 42 at the adjacent side of the armature 34. Passages 59*a* are provided at the ends of the wall portion 54 so that both legs of the spring 50 can be passed therebeneath and overlie the arm portion. One end of the spring 50 is received in a suitable notch 58 in a lug 59 at one end of the holder 52 so as to prevent accidental displacement of the spring 50.

The arms 42 are preferably in the form of a yoke having a base portion 60. In order to support the carrier 40 on the arms 42, a suitable nylon fitting is mounted on the arms for sliding therealong. In the form illustrated in FIGS. 11, 11A, and 12, the fitting comprises two side members 61 adapted to engage the outer faces of the arms 42, respectively, and an intermediate bridge portion 62 and snap fastening end portions 63 joining the members 61. Each end portion 63 has an outer marginal portion in the form of a pair of rearwardly extending tongues 64. Due to the shape and resilience of the material, the tongues 64 of one member 61 may be pressed toward those of the other and, when released, restore themselves to their normal spaced position. Each of the arms has at its upper end snap fastening shoulders 66 and 67 for a snap fastening engagement with the movable contact carrier 40.

The movable contact carrier 40 preferably also is nylon and unitary in construction. At its midportion it is provided with a rearwardly open channel portion 70, (FIG. 11A), the margins of which, at the open side of the channel portion, are provided with shoulders 71 and 72 which are arranged to be placed in snap fastening engagement

with shoulders **66** and **67**, respectively. Due to resiliency of the tongues **64**, the carrier **40** can be installed in place by merely snapping the tongues **64** into position between the sides of the channel **70** so that the shoulders **66** and **67** engage the shoulders **71** and **72**, respectively. The side members **61** have forwardly extending marginal flanges **73** which engage the upper and lower wall surfaces of the carrier **40** adjacent the ends of the channel **70** and prevent displacement of the carrier **40** endwise of the channel **70**.

The carrier **40** has a number of depending integral frames **75** in each of which is a movable contact member **76**. Each contact member **76** rests against the inner face of the outer wall of its frame **75** and is held thereagainst by a follower **77** which is pressed theretoward by a suitable spring **78**.

As mentioned, the end walls of the base **2** are provided wtih guideways **20** and **21** and the outer intermediate walls **23** are provided with guideways **24**. These receive the carrier **40**, engaging its upper and lower faces and guiding the carrier along a proper path to dispose its movable contact members in proper position so that the movable contacts are in proper contacting relation with the stationary contacts in the base. Further guiding of the carrier **40** is provided by the guideway **26**, on the central intermediate wall **23**, which engages the members **61** of the nylon fitting.

Suitable coil springs **80** are provided and are received at one end in recesses **81** in the base **2** and at the other end are received on bosses **82** formed on the rear face of the carrier **40**, and yieldably urge the carrier **40** to its forward or contact breaking position.

The guides **20** in the base are provided for guiding the pole piece **30** into place. For this purpose, the pole piece **30** has end portions, indicated at **84**, which slidably fit in the guides **20** with operating clearance so that the pole piece can move forwardly and rearwardly therein. A leaf spring **85** is mounted on the rear of the pole piece **30** and is convex forwardly. Its outer ends engage the shoulders **21** and thereby yieldably urge the pole piece forwardly and yieldably support it so that it can shift slightly and accommodate the faces of its poles properly to the precisely formed pole faces of the armature **34**.

The coil **33** is of the type in which a winding is embedded in a molded body **85***a* of insulating material, such as hard rubber. The coil is provided with two contact tabs **86** which provide its terminals. Mounted in the base **2** are spring contacts **87**, respective to the tabs **86**, and adapted to engage them under yielding pressure so as to connect the coil to terminals **88** on the base **2** when the coil is pressed into seated position.

In order to hold the coil and the pole piece **30** in place, the molded body of the coil body **85***a* is provided with two integral diagonally opposite lugs **89** each having guide surfaces **90** which engage respective cooperating guide surfaces **91** on a pair of lugs **92** integral with the base **2**. The lugs **92** on the base support the terminals **88** which are connected to the spring contacts **87**, respectively.

When the rear faces of the lugs **89** seat on the forward ends, indicated at **95**, of the lugs **92** of the base, the lugs and guide surfaces **90** and **91** hold the coil body **85** in position and, at the same time, the coil body bears against the pole piece **30** and holds it in position against the resistance of the leaf spring **85**.

Each of the lugs **89** is provided with an aperture **96** through which the cover screws **6** extend so that their inner ends can be placed in threaded engagement with threaded fittings **7** which are molded into the lugs **92** of the base. When the cover is drawn into place by the screws **6**, it engages the forward faces of the lugs **89** of the coil body **85***a* and forces them rearwardly against the forward ends **95** of the lugs **92** on the base so that the coil body **85***a* is clamped tightly to the base by the screws **6** and the cover **5**. This operation also secures the pole piece **30** in position.

As mentioned it is desirable to use the structure at times in combination with a relay **100**. Such a relay is illustrated generally in FIGS. 13 through 15, and FIGS. 19 and 20. The relay there shown is fully set forth and described in United States Patent No. 3,179,757, issued April 20, 1965, to Karl A. Brandenberg, entitled "Multi-Circuit Trip Free Overload Switch." Insofar as concerns the present invention, it includes a housing **101** having a base plate **102**, the upper end of which can be connected to the base plate **3** of the switch, as by a pair of screws. The relay **100** is provided with a plurality of parallel rigid contact prongs **103** which extend outwardly of the casing **101** and are positioned so that, by moving the relay **100** into proper position for connecting it to the base plate **3** of the electromagnetic switch, the prongs **103** will be received in the position for clamping to the terminals **12** of the electromagnetic contact, as illustrated in FIGS. 6 and 10, by the clamp operating screws **16**.

Likewise, it is desirable to support a push button assemblage on the electromagnetic switch. In such a case, a push button assemblage such as illustrated in FIGS. 16 through 18 and FIGS. 19 and 20 may be provided. This assemblage comprises a two part casing **110** in which suitable push button switches **111** are mounted, the wires therefrom being lead to the electromagnetic switch. Suitable screws **112** are provided for holding the parts of the casing **110** together. Also they secure snap fastening element **113** on the casing for fastening the casing to the electromagnetic switch.

For this purpose, the cover of the electromagnetic switch is provided with sockets **114** which face forwardly and are arranged to receive suitable prongs **115** on the elements **113**. Each of the elements **113** is in the form of a bracket having its prong **115** arranged to overlie the top of a casing **110** and, at its forward end, is secured in place by the associated screw **112**. Each prong **115** extends rearwardly from the casing **110**. At the rear of the casing **110**, each element **113** is provided with a downwardly extending portion **116** which terminates at its lower end in a horizontal arm **117**. The arms **117** extend rearwardly into position to press firmly against the under face of the cover **5** of the electromagnetic switch when the prongs **115** are in the sockets **114**.

Suitable reinforcing webs **118** are provided for reinforcing the elements **113**. On the lower ends of the webs are abutments **119** which engage the rear face of the casing **110** so as to stabilize the assembly.

Thus, in order to mount the push buttons on the electromagnetic switch, all that is necessary is to align the prongs **115** with the respective sockets **114** and press the push button casing toward the switch, thus snap fastening it detachably in place. The webs **118** are provided with holes **120** through which wiring may be passed so that the elements support the wires neatly.

Having thus described our invention, we claim:

1. A magnetically operated switch comprising a base, sets of stationary contacts on the base, terminals on the base connected to the stationary contacts, an electromagnetic coil, an armature, a pole piece in flux conducting relation to the coil and cooperable with the armature for moving the armature upon energization of the coil, a first means connecting the armature and pole piece to the coil for movement of the pole piece and armature relative to the coil axially of the coil and for movement relatively toward and away from each other, means for detachably securing the coil in fixed operating position on the base, interengageable abutment means carried by the pole piece and on the base, respectively, and interengageable with each other consequent upon securing the coil in said position for securing the pole piece in operating position relative to the coil, movable contact carrier means connected to the armature for movement therewith, movable contacts carried on the carrier means, said interengageable abutment means comprising first abutment means on the base toward and away from which

the pole piece has limited movement when the coil is installed in said fixed position, second abutment means on the pole piece facing the first abutment means, and a leaf spring operatively interposed between the first and second abutment means and yieldingly urging the pole piece toward the coil.

2. A magnetically operated switch according to claim 1 wherein the armature and pole piece each has three pole portions arranged in a row, the central pole portion of each is disposed in the coil, said portions of the armature have pole faces aligned with corresponding portions of the pole piece, said faces are precision ground, a cover is provided for the coil, armature, pole piece and carrier, the means which detachably secure the coil are clamping portions on the cover and base, portions on the coil are received in clamped relation between the clamping portions, and screws extend through the cover and said portions on the coil and secure the cover and base together with the portions in clamping relation.

3. A magnetically operated switch comprising a base of insulating material having therein a cavity which is open at one face of the base, sets of stationary contacts carried by the base at the bottom of the cavity, line and load connector terminals carried on the base and connected to the stationary contacts, a magnetically operable contact unit including a coil member, a pole member in flux conducting relation to the coil member, an armature movable toward and away from the pole member, movable contacts and carrier means carried by the armature and supporting the movable contacts for movement by the armature to contact closing position, resilient means in the cavity and operably engaging the carrier means for returning the carrier means to contact breaking position, complementary shoulders on the base and coil member, respectively, detachably supporting the coil member on the base with the pole member and movable contacts disposed in the cavity, said unit being removable from said shoulders and out of the cavity as a unit, coil terminals on the base, means for connecting the coil member to the terminals, a cover for the cavity and having shoulders cooperable with the shoulders on the coil member for holding the coil member with said complementary shoulders in engagement when the cover is in closing position with respect to the cavity, mechanical means detachably connecting the cover to the base when the cover is in said closing position and engaging the coil member when the cover is so connected and thereby cooperating with the shoulder for holding the coil member, and thereby the unit in operating position and all of said connector terminals being operable to permit removal of said unit from the base while said connector terminals and stationary contacts remain undisturbed.

4. The switch according to claim 3 wherein first guide means are provided on the base for engaging said coil member and guiding it into final installed position, second guide means are provided on the base in the cavity and are accessible to the carrier means through the open side of the cavity and are operable for engaging the carrier means and guiding the carrier means in a lineal path toward and away from the stationary contacts when the unit is installed in the base and third guiding means are provided in the base on the cavity and are accessible to the pole member through the open side of the cavity for engaging the pole member and guiding it into final installed position.

5. An apparatus according to claim 3 wherein the means for connecting the coil member to the terminals are exposed terminals on the coil member positioned to make contact with the coil terminals of the base by movement of the coil member into operating position.

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