

April 9, 1968

K. K. STONG

3,377,519

MAGNETICALLY LATCHED SWITCH

Filed Dec. 26, 1963

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Fig. 1

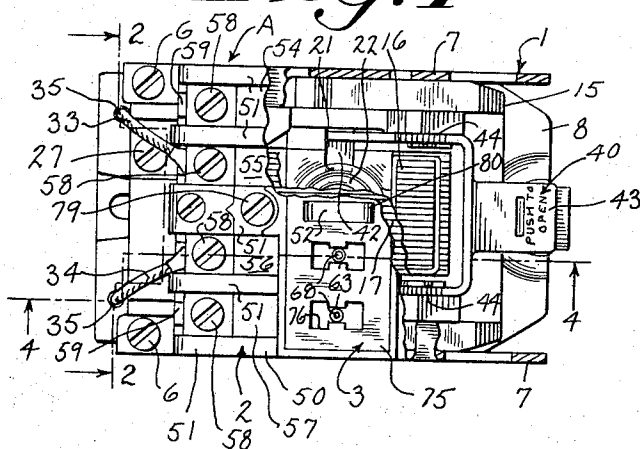


Fig. 2

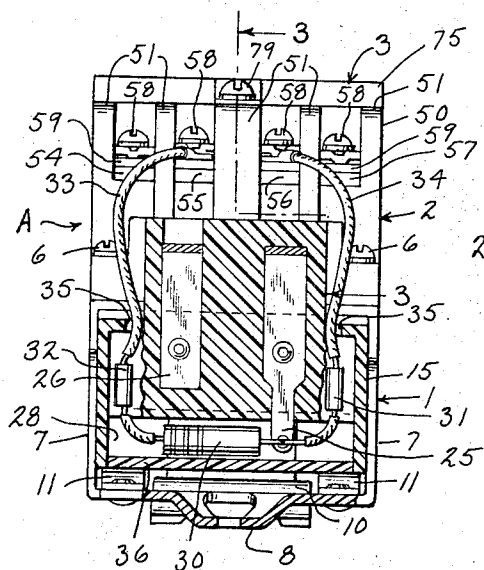
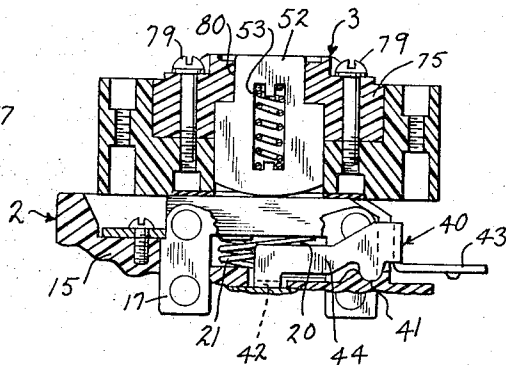


Fig. 3



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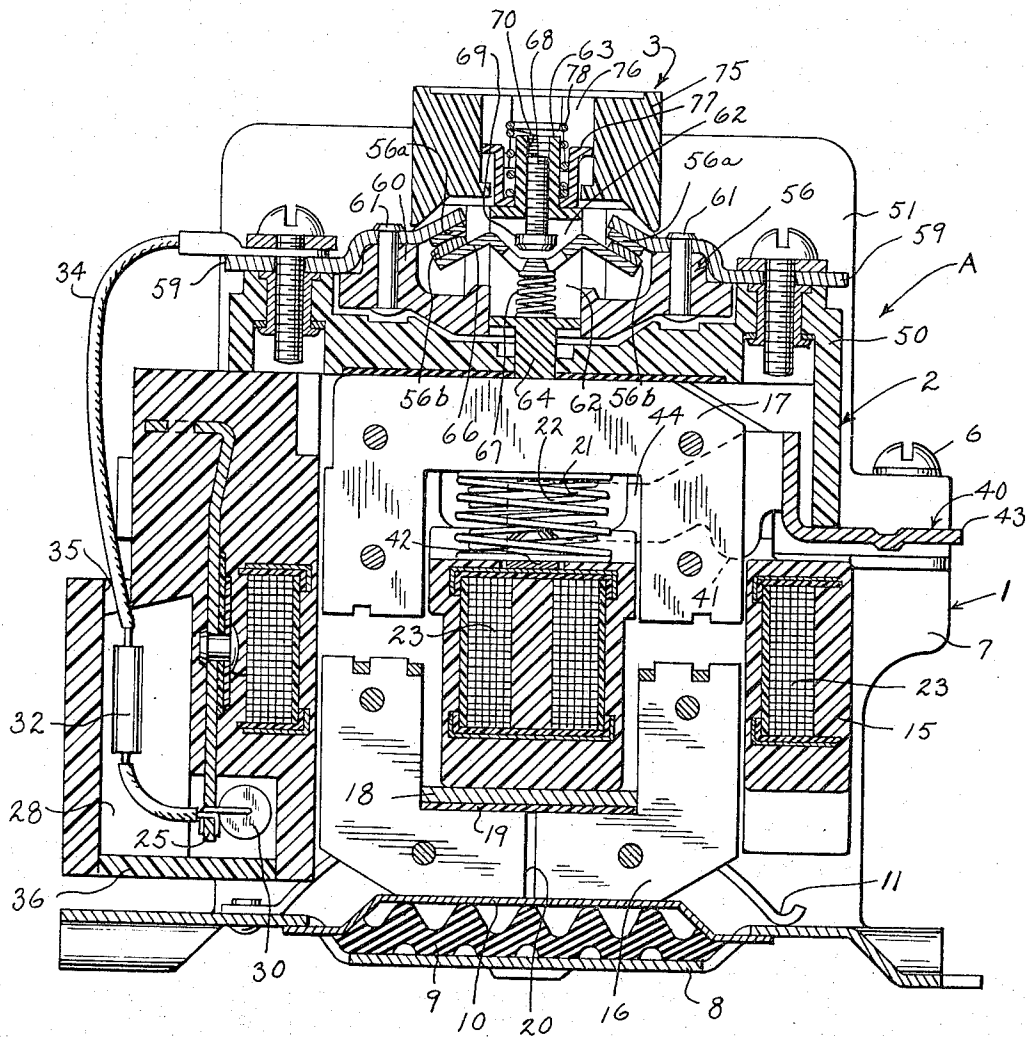
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Fig. 4



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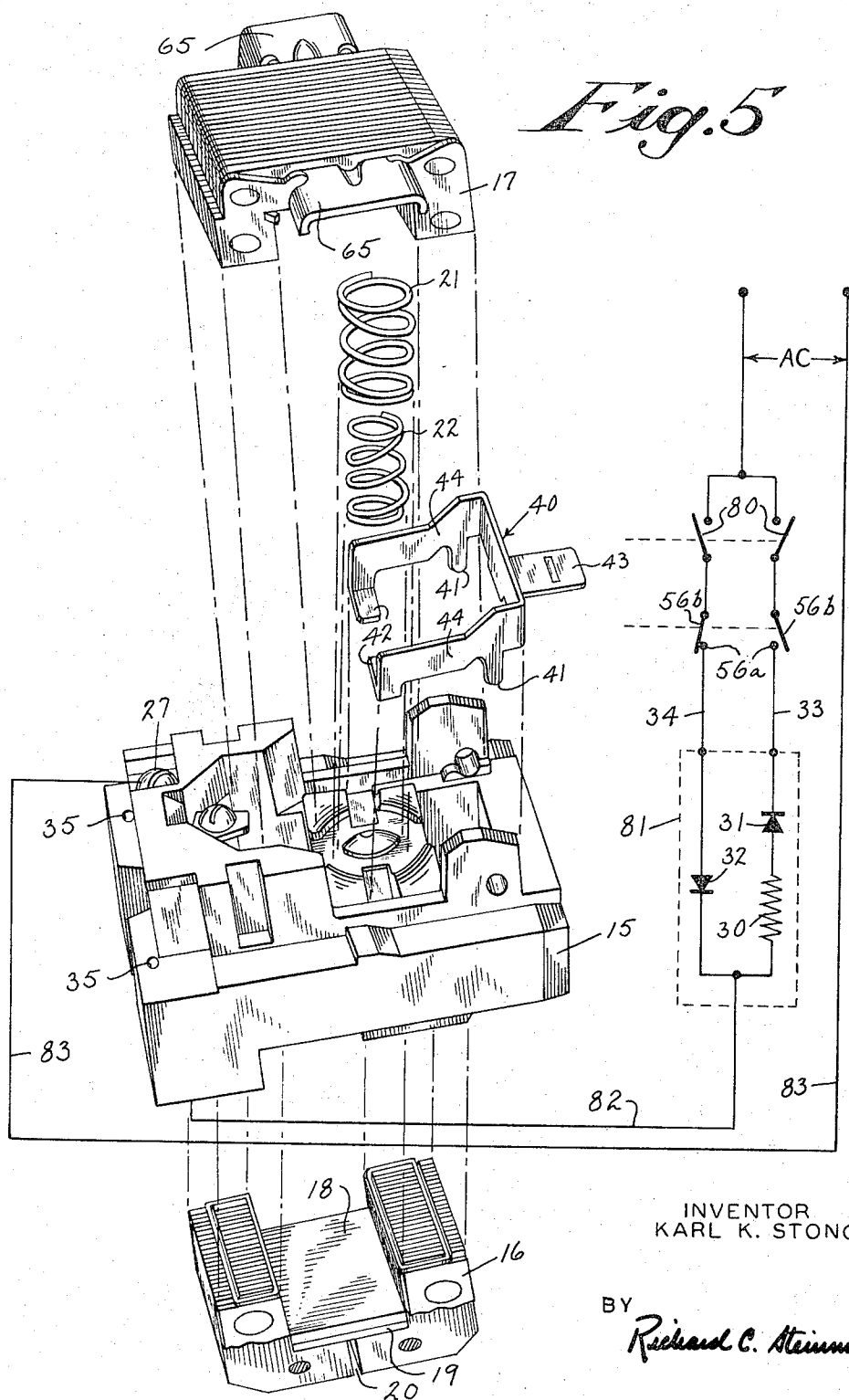
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Fig. 6

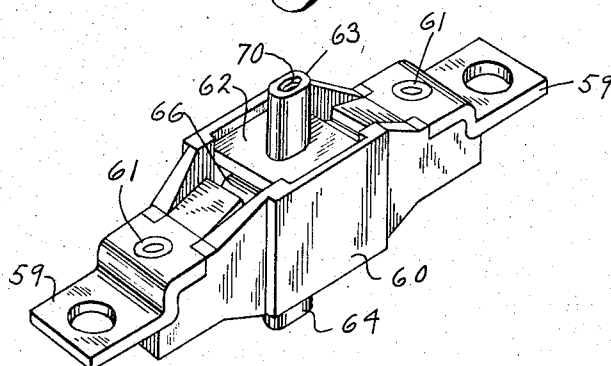


Fig. 7

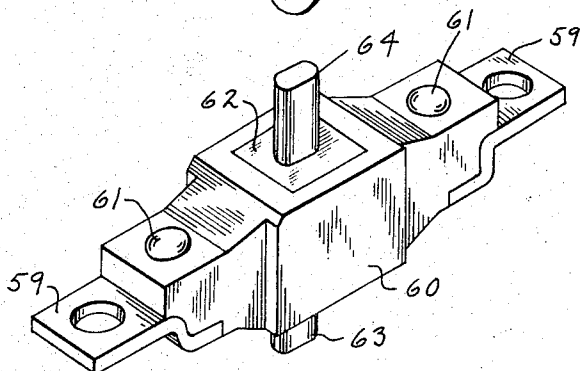
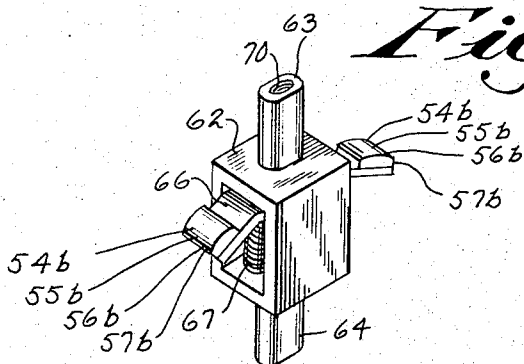


Fig. 8



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3,377,519

MAGNETICALLY LATCHED SWITCH

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Filed Dec. 26, 1963, Ser. No. 333,324

13 Claims. (Cl. 317-157)

This invention is related to a magnetic switch and more particularly to a magnetic latch comprising a permanent magnet in combination with magnetic core structure, e.g. an armature and yoke, plus a switch operating coil. By locating the permanent magnet in either the armature or yoke, a path of relatively low reluctance between the poles of said permanent magnet results so as to provide desired pick-up and drop-out conditions.

Previous to this invention, latching for magnetic switches has been employed through purely mechanical structure, e.g. a spring bias; but the resulting switch size is considerably larger than the unlatched unit and often the resulting latch is unreliable. Permanent magnets have also been used for latching purposes in magnetic switches, but the latching flux of these permanent magnets has been limited to the remanence of the pick-up flux induced by the operating coil. Moreover, these switches must be opened by passing a reverse polarity current through the operating coil which consequently demagnetizes the permanent magnet.

The disadvantages of this last mentioned permanent magnet latch are obvious. For example, manual operation of the switch is not possible since the magnet is demagnetized in the drop-out position. Moreover, the current required to provide sufficient remanence is of such a magnitude that the induced magnetomotive force of the operating coil causes the switch to close with a damaging impact. While it is possible to design around some of this impact problem, the resulting product has a very limited range of operating coil signal strengths and a minimum remanence level. Both of these limitations are significant; but the latter is especially important since the minimum remanence level can easily lead to incomplete switch closing with its consequential chatter.

The present invention overcomes the many disadvantages of previous magnetic switch latches by using a unique combination of a permanent magnet with magnetic core structure, e.g. an armature and yoke, plus the coil of an electromagnetic switch although the operating flux may be provided through means other than direct or indirect induction by a coil. Through this combination the permanent magnet is not deenergized during the period when the operating coil is subject to the drop-out signal nor is a large operating coil current necessary during pick-up. Should an A.C. rather than a D.C. signal be supplied to the operating coil, a simple yet effective circuit is included herein so as to supply a rectified A.C. signal regardless of the desired polarity. In addition, this circuit incorporates a unique adjustable contact assembly to insure proper latching. Of equal importance is the overall latch combination of this invention which is adaptable to commercially available switches, e.g. relays, by merely substituting a minimum of parts while maintaining the original switch size.

Accordingly, it is an object of this invention to provide a magnetically latched magnetic switch which may be manually latched and unlatched.

It is another object of this invention to provide a magnetically latched magnetic switch which is of substantially the same size as an unlatched magnetic switch.

It is another object of the present invention to provide a magnetically latched magnetic switch which produces a minimum pick-up impact.

It is another object of this invention to provide a magnetically latched magnetic switch which will operate reliably within a substantial range of operating signal strengths while at the same time producing a minimum pick-up impact.

It is another object of the present invention to provide a magnetically latched magnetic switch utilizing a permanent latching magnet.

It is another object of this invention to provide a magnetically latched magnetic switch utilizing a permanent latching magnet which is not subject to demagnetization during normal use of the magnetic switch.

It is a still further object of this invention to provide a magnetic latch which is adaptable to most, if not all, magnetic switches with the substitution and addition of a minimum of parts.

It is a still further object of this invention to provide a lever for mechanically operating a magnetically latched magnetic switch.

It is a still further object of this invention to provide a simple, yet compact circuit for controlling a magnetically latched magnetic switch utilizing a permanent latching magnet.

Other objects of this invention are and will become apparent from the description and appended claims.

In the drawings:

FIG. 1 is a top, fragmentary view of an electromagnetic switch incorporating the invention.

FIG. 2 is a front, cross-sectional view of the electromagnetic switch in FIG. 1 taken along line 2-2 of FIG. 1.

FIG. 3 is a partial, cross-sectional, side view of the electromagnetic switch of FIG. 1 taken along line 3-3 of FIG. 2.

FIG. 4 is a cross-sectional, side view of the electromagnetic switch in FIG. 1 taken along line 4-4 of FIG. 1.

FIG. 5 is an exploded view based upon the molded coil block of the invention and showing the relative location of the armature, yoke, compression springs and lever. The figure also shows schematically a circuit used to control the magnetic latch.

FIG. 6 is a perspective view of the contact assembly used in the electromagnetic switch of FIG. 1.

FIG. 7 is a perspective view showing the reverse side of the contact assembly in FIG. 6.

FIG. 8 is a subassembly of the contact assembly in FIGS. 6 and 7 showing the spanner guide, with its spanner and the movable contacts as well as stems extending from the spanner guide.

Attention is called to the fact that the above-described drawings are included for illustrative purposes only, as it is not intended that the invention be so limited. Moreover, the following description is limited in scope for the purposes of understanding and clarity with the appended claims, alone, setting forth the scope of the present invention.

A particular electromagnetic switch A in combination with the magnetic latch of this invention is shown in FIGS. 1-5; but as is mentioned above, the present invention is not limited to such a switch. It should be noted that this illustrated electromagnetic switch is the subject matter of a co-pending application Ser. No. 333,596, filed Dec. 26, 1963, now United States Patent 3,251,964, from which details of the switch structure can be obtained. Accordingly, the illustrated switch will be described only to the degree necessary for complete understanding of the present invention.

As is best shown in FIG. 4, the switch A basically comprises a base section 1 and a contact housing 2, although a plurality of contact housing units may be stacked one

on top of the other as is shown in the copending application S.N. 333,596. A cover unit 3 is located transversely to and above the contact housing 2 as is shown in FIGS. 1 and 3.

The base section 1 and contact housing 2 are joined together by means of screws 6 which are to be found at the four outer corners of the rectangularly shaped switch A. In itself, the base section 1 comprises parallel side walls 7 and a bottom wall 8 to which a resilient cushion 9 with its metal plate cover 10 is attached as well as a pair of curved springs 11.

As is apparent from the drawings, the resilient pad 9 with its cover plate 10, along with curved springs 11 and the particular shape of base section 1, function to receive and tightly engage a molded coil block 15 with its particular shape associated U-shaped yoke 16 and U-shaped armature 17. This relationship is best shown in FIG. 4, while the shape of coil block 15 and its combination with U-shaped yoke 16 and U-shaped armature 17 is best shown in FIG. 5. When inserted into the base section 1, the outer portion of the U-shaped yoke 16 slides onto and abuts the plate 10 while a permanent magnet 18, which is adjacent the inner section of yoke 16, abuts the lower portion of the coil block 15. Interposed between the permanent magnet 18 and yoke 16 is a non-magnetic plate 19, which substantially restricts the magnetic flux of permanent magnet 18 and any flux in the yoke 16 to their respective structure. The function of this last mentioned combination along with gap 20 will be described later.

The armature 17 abuts the lower portion of contact housing 2 on its outer face and compression springs 21 and 22 on its inner face when the switch A is in the open or drop-out position, as shown in FIG. 4. Energization of the coils 23, which coils are connected in series, results in an induced magnetomotive force which moves the armature 17 from the position shown in FIG. 4 to a position in which yoke 16 and armature 17 abut. The coils 23 are themselves molded in a resin which takes the shape necessary, e.g. coil block 15, to accommodate the yoke 16 and armature 17 and yet allow the insertion into and a tight fit with the base section 1. To permit connection between outside current sources and the coils 23, coil terminals 25 and 26 are molded into the coil block 15 with FIG. 2 illustrating the difference between the structure of the terminals 25 and 26, i.e. terminal 25 permits connection at a level different from that permitted by terminal 26 which alone utilizes a screw connection 27 (see FIG. 1).

A cavity in the coil block 15 at 28 permits inclusion of electronic components which are a part of a latch circuit, viz. resistor 30 and diodes 31 and 32. As is shown in FIGS. 2 and 4, diode 31 and resistor 30 are connected in series with coil terminal 25 while diode 32 is connected to the terminal 25. Each of the diodes 31 and 32 is connected to lead wires 33 and 34, respectively, which in turn exit the cavity 28 through holes 35 in coil block 15. When the components 30, 31 and 32 have been connected in cavity 28, the access end of cavity 28 is closed as shown at 36. The role of the components 30, 31 and 32 along with the circuit of which they are a part will be more fully explained in a later part of this description.

One remaining feature associated with the coil block 15 is lever 40 which is used for mechanically opening the switch A. As will be seen in FIG. 3, the lever 40 is pivoted at 41 on coil block 15 while abutting coils 21 and 22 by means of tabs 42. Thus, when the operator exerts force on extended portion 43, the lever 40 pivots at 41 and the movement is transferred through parallel arms 44 to tabs 42.

The contact housing 2 is made up of a molded block 50 comprising a plurality of ribs 51 and a captive plunger 52 with return spring 53. Spring 53 is biased at its lower end against contact housing 2 (not shown) so as to return plunger 52 after downward movement and conse-

quential downward movement of the armature 17. Thus, it is possible to mechanically close the switch A by means of plunger 52 which results in latching due to permanent magnet 18.

In the switch A shown in the drawing, five ribs 51 are shown (see FIGS. 1 and 2) which permit the use of four contact modules, viz. 54, 55, 56 and 57. Each of these contact modules is connected to the contact housing 2 by means of screws 58 which also provide the means for connecting the necessary lead wires to the module, e.g. lead wires 33 and 34, which form part of the magnetic latch contact circuit, are connected to modules 55 and 56, respectively. Modules 54 and 57 are therefore available for connection with a desired outside circuit. The modules 54-57 comprise a molded housing 60 riveted at 61 to connector elements 59. The internal ends of connector elements 59 are attached to stationary contacts, which for purposes of understanding will be identified by reference numerals related to the particular module of which they are a part, i.e. since the contact module shown at FIG. 4 is designated by reference numeral 56, the stationary contacts will be designated as 56a. Accordingly, the movable contacts of each module are designated by reference numerals consistent with their module designation so that those moving contacts found in FIG. 4 are designated by reference numerals 56b.

Each of the modules 54-57 includes a spanner guide 62, which is best illustrated in FIG. 8. Extending from either end of spanner guide 62 are vertical stems 63 and 64 with the lower stem 64 abutting the armature 17 as in the case of modules 55 and 56 (see FIG. 4) or the side wings 65 of armature 17 as in the case of modules 54 and 57 (see FIG. 5). Within spanner guide 62, spanner 66 is located between compression spring 67 and an extension of stem 63 which abuts the spanner in modules 54, 55 and 57 (not shown). The module 56, shown in FIG. 4, modifies the extended stem of modules 54, 55 and 57 by using an adjustable screw 68 which is threaded into stem 63 and includes a head 69. It is contemplated that the positions of spring 67 and adjustable screw 68 with respect to spanner 66 may be reversed. As is evident from FIG. 4, it is possible to preset the instant, with respect to armature motion, at which head 69 will abut the spanner 66 and thereby separate the contacts 56a and 56b (or the instant at which the contacts 56a and 56b will close assuming an initial contact-open position) simply by adjusting the distance between head 69 and spanner 66. The importance of this adjustable screw 68 in module 56 in the magnetic latch circuit will be described later. It should be noted, however, that adjustment of screw 68 can be had through access opening 70 at the top of stem 63 (see FIGS. 4 and 6 and 8).

The versatility of the module structure 54-57, i.e. including module 56 with its adjustable feature, is worthy of note since normally-closed contacts, e.g. module 56 of FIG. 4, easily become normally-open contacts by a simple inversion of the module. This feature, along with the ease of installation, is due at least in part to the connector elements 59 with their external end which are symmetrical with respect to the molded housing 60 and which accommodate a single screw 58 to not only connect lead wires with the modules but also connect the module with the contact housing 2. It should be noted further that the module 54-57 may be used with operators other than armature 17, e.g. a cammed surface.

The cover unit 3 comprises a molded block 75 with a plurality of apertures 76 so as to accommodate the stem 63 of each module 54, 55, 56 and 57. As is best seen in FIG. 4, each aperture 76 includes a U-shaped button 77 which is biased against the spanner guide 62 by spring 78. Thus, as is illustrated by the arrangement of FIG. 4, any motion of armature 17 is transmitted via the spanner guide 62 to spanner 66 as the latter is pushed by the head 69 against spring 67 (i.e. during contact opening) or is pushed by a compression spring 67 as abutting

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head 69 is moved by guide means 62 (i.e. during contact closing). It is the bias of spring 78 which locates the spanner guide means 62 with respect to armature means 17 thereby permitting the opening and closing of the contacts in modules 54-57. As is mentioned above, the modules 54-57 can be inverted and thereby change a normally-closed module to normally-open or vice versa; but since module operation remains basically the same with inversion, further explanation is not considered necessary. Before leaving the description of cover unit 3, attention is directed to FIGS. 1 and 3 which show screws 79 used to attach the contact housing 2 to cover unit 3 along with aperture 80 which accommodates plunger 52.

Because the pick-up and drop-out of armature 17 requires reduced magnetic fields of reverse polarity, a circuit such as that shown in FIG. 5 may be used to provide the necessary rectified alternating current, although obviously, a direct current source for coils 23 with well known polarity switching means may also be used. The schematic circuit diagram of FIG. 5 is used here to help explain the circuitry involved; and it should be noted that each of the elements shown in the circuit diagram (with the exception of double-throw operating switch 80) have been previously described and are specifically illustrated in the drawings. Accordingly, the same reference numerals are used in this schematic drawing as have been used previously. More specifically, the electronic components shown inside the dotted line box 81 are those which are located in coil block 15 and are best shown in FIG. 2. The lead wire 34 connecting diode 32 and normally-closed module 56 (see FIGS. 1 and 4) is shown in FIG. 5 as lead 34 connecting diode 32 with fixed contact 56. Likewise, lead 33 which connects diode 31 with normally open module 55 (see FIG. 1) is shown in FIG. 5 as lead 33 connecting diode 31 and fixed contact 55a. The conductor 82 in FIG. 5 connecting the block 81 with the coil block 15 at terminal 25 (not shown in FIG. 5) represents the connection leads between resistor 30 and coil terminal 25 plus the lead between diode 32 and coil terminal 25 (see FIG. 2). Finally, wire 83 which is connected to coil terminal 26 by means of screw 27 represents the connection between the A.C. source and the coils 23 which the user would employ when installing a switch. It should be noted that double-throw operating switch 80 can be any standard switch or switches used to close a circuit in the manner shown.

Turning to the operation of the combination shown in the drawings: When the switch A is in the position shown in FIG. 2, i.e. the armature 17 and yoke 16 are in an open or drop-out position, the double-throw operating switch 80 is moved so as to close the circuit through normally-closed contacts 56a and 56b which means a rectified A.C. signal will be transmitted to the coils 23 from diode 32. The energized coils 23 induce a magnetic field which supplies the magnetomotive force necessary to draw armature 17 toward yoke 16. It is important to note here that the polarity of the magnetic field induced in the yoke 16 and armature 17 is the same as the polarity of the permanent magnet 18. Thus, as the distance between the yoke 16 and armature 17 becomes less with closing, the reluctance across the gap therebetween approaches and becomes less than that of the gap 20 which has acted as the keeper for permanent magnet 18 during dropout conditions. At this point, the flux path of permanent magnet 18 will be diverted from yoke 16 and gap 20 to the armature 17 and thereby provide the magnetomotive force necessary to retain the yoke 16 and armature 17 in an abutting or pick-up position.

Because of the relationship between armature 17, stem 64 and attached spanner guide 62, the head 69 of adjustable screw 68 abuts spanner 66 after initial travel of armature 17 and consequently opens contacts 56a and 56b. This delayed contact opening takes place before yoke 16 and armature 17 have met but are close enough so that the final switch A closing is accomplished by the

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inertia of the armature 17, by magnetomotive force of the permanent magnet 18, and by any residual magnetomotive force from the field induced by coils 23. Thus, the impact of armature 17 upon yoke 16 is minimized.

As the switch closes with the abutment of armature 17 and yoke 16, the contacts 56a and 56b, which are in a normally-open contact module 55, are closed so as to prime the coil control circuit for a drop-out signal. When this drop-out signal is desired, double-throw operating switch 80 is closed to complete the circuit from the coils 23 through resistor 30, diode 31 and already closed contacts 56a and 56b. As has been mentioned above, it is necessary that the polarity of this drop-out signal be the reverse of the pick-up signal, which is accomplished here through diode 31. The induced magnetic field and magnetomotive force resulting from this reverse polarity signal partially cancels the magnetic field and magnetomotive force of the permanent magnet 18 which has held the switch closed; and consequently, the armature 17 and yoke 16 separate.

Because gap 20, located in yoke 16, is in a parallel relationship with the permanent magnet 18, the reverse polarity flux induced by the drop-out signal is shunted around the permanent magnet 18 as a result of the relative low reluctance of gap 20, thus minimizing any demagnetization of permanent magnet 18. Therefore, when the switch A is in its open or drop-out position, i.e. that position shown in FIG. 4, permanent magnet 18 remains magnetized, with the shunt path in yoke 16 and including gap 20 acting as the keeper.

Attention should be called to the fact that more efficient and positive operation results from the use of conductor plates, e.g. copper, adjacent to the coils 23. These plates act as current carrying paths for currents induced by coils 23 during the latching and unlatching operations; since without these conductor plates, higher voltages are necessary to provide latching and to prevent against chatter or incomplete closing between yoke 16 and armature 17. Obviously, this reduced voltage requirement increases the possible ranges of operating voltages. Finally, shading coils may or may not be used in accordance with the voltage range desired.

It is apparent, then, that applicant has provided a permanent magnetic latch for a magnetic switch which is compact and yet minimizes operational damage. Moreover, the simplicity of the latch makes it easily adaptable to known magnetic switches; while the unique combination permits mechanical operation of magnetic switches utilizing a magnetic latch to be a reality.

I claim:

1. In combination with a magnetic switch comprising magnetic core means including a magnetically actuated armature means

(a) a permanent magnet latch means used to maintain said switch in a closed position,

(b) a plurality of electric conductor means connected between a coil means of said switch and a current source,

(c) said coil means comprising

(1) a molded coil block means encapsulating said coil means and housing said core means,

(2) a hollow cavity formed in said block means,

(3) a plurality of coil terminal means molded into said block means and connected to said coil means,

(4) a first coil terminal means extending into said cavity,

(d) a normally-closed switch means in said magnetic switch and in a first of said conductor means comprising,

(1) a housing means with internal, spaced apart, fixed contact means,

(2) connector means with internal ends carrying said fixed contact means and external ends which are symmetrical with respect to said

- housing means and include a single connection means, respectively, to permit lead connection as well as attachment of said housing to said magnetic switch,
- (3) spanner guide means intermediate said fixed contacts which guide means carry a spanner means comprising movable contact means for engagement with said fixed contact means,
- (4) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to permit adjustment of engagement and disengagement between said fixed and movable contact means,
- (5) said normally-closed switch means capable of becoming a normally-open switch means when inverted,
- (e) the combination of said coil block means and said magnetic core means being removably inserted into said magnetic switch,
- (f) stem means attached to said spanner guide means and responsive to motion of said armature means which at least causes said normally-closed switch to open with the closing of said magnetic switch,
- (g) spring means adjacent said stem means for biasing said guide means against said armature means,
- (h) a normally-open switch means in a second of said conduit means which normally-open switch closes upon the closing of said magnetic switch,
- (i) control means in said conductor means to reverse the polarity of said current source comprising
- (1) rectifier means in said first and second conductor means and located in said hollow cavity of said coil block means,
- (2) said first and second conductor means connected to said first coil means terminal,
- (j) operating switch means in said first and second conductor means to initiate opening and closing of said magnetic switch,
- (k) a third conductor means connected to a second coil means terminal,
- (l) lever means pivoted on said coil block means for mechanically moving said armature means and thereby opening said magnetic switch comprising
- (1) spring means with a first end against which the armature must close and a second end abutting said coil block means,
- (2) one end of said lever means inserted between said coil block means and said second end of said spring means.
2. In combination with a magnetic switch comprising magnetic core means including a magnetically actuated armature means
- (a) a permanent magnet latch means used to maintain said switch in a closed position comprising,
- (1) a permanent magnet means adjacent the magnetic core means so as to provide parallel flux paths,
- (2) a gap in said parallel flux path of said core,
- (b) a plurality of electric conductor means connected between a coil means of said switch and a current source,
- (c) said coil means comprising
- (1) a molded coil block means encapsulating said coil means and housing said core means,
- (2) a hollow cavity formed in said block means,
- (3) a plurality of coil terminal means molded into said block means and connected to said coil means,
- (4) a first coil terminal means extending into said cavity,
- (d) a normally-closed switch means in said magnetic switch and in the first of said conductor means comprising,
- (1) a housing means with internal, spaced apart, fixed contact means,

- (2) spanner guide means intermediate said fixed contacts which guide means carry a spanner means comprising movable contact means for engagement with said fixed contact means,
- (3) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to permit adjustment of engagement and disengagement between said fixed and movable contact means,
- (e) the combination of said coil block means and said magnetic core means being removably inserted into said magnetic switch,
- (f) stem means attached to said spanner guide means and responsive to motion of said armature means which at least causes said normally-closed switch to open with the closing of said magnetic switch,
- (g) a normally-open switch means in a second of said conduit means which normally-open switch closes upon the closing of said magnetic switch,
- (h) control means in said conductor means to reverse the polarity of said current source comprising
- (1) rectifier means in said first and second conductor means and located in said hollow cavity of said coil block means,
- (2) said first and second conductor means connected to a first coil means terminal,
- (i) operating switch means in said first and second conductor means to initiate opening and closing of said magnet switch,
- (j) a third conductor means connected to a second coil means terminal,
- (k) lever means pivoted on said coil block means for mechanically opening said magnetic switch.
3. In combination with a magnetic switch comprising magnetic core means including a magnetically actuated armature means,
- (a) a permanent magnet latch means used to maintain said switch in a closed position comprising,
- (1) a permanent magnet means adjacent the magnetic core means so as to provide parallel flux paths,
- (b) a plurality of electric conductor means connected between a coil means of said switch and a current source,
- (c) said coil means comprising,
- (1) a molded coil block means encapsulating said coil means and housing said core means,
- (2) a hollow cavity formed in said block means,
- (3) a plurality of coil terminal means molded into said block means and connected to said coil means,
- (4) a first coil terminal means extending into said cavity,
- (d) a normally-closed switch means in said magnetic switch and in the first of said conductor means comprising,
- (1) a housing means with internal, spaced apart, fixed contact means,
- (2) spanner guide means intermediate said fixed contacts which guide means carry a spanner means comprising movable contact means for engagement with said fixed contact means,
- (3) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to permit adjustment of engagement and disengagement between said fixed and movable contact means,
- (e) the combination of said coil block means and said magnetic core means being removably inserted into said magnetic switch,
- (f) stem means attached to said spanner guide means and responsive to motion of said armature means which at least causes said normally-closed switch to open the closing of said magnetic switch,

- (g) a normally-open switch means in a second of said conduit means which normally-open switch closes upon the closing of said magnetic switch,
- (h) control means in said conductor means to reverse the polarity of said current source comprising,
 - (1) rectifier means in said first and second conductor means and located in said hollow cavity of said coil block means,
 - (2) said first and second conductor means connected to a first coil means terminal,
- (i) operating switch means in said first and second conductor means to initiate opening and closing of said magnet switch,
- (j) a third conductor means connected to a second coil means terminal,
- (k) lever means pivoted on said coil block means for mechanically opening said magnetic switch.
- 4. In combination with a magnetic switch,
 - (a) a permanent magnet latch means used to maintain said switch in a closed position,
 - (b) a plurality of electric conductor means connected between magnetic flux source means of said switch and a current source,
 - (c) a normally-closed switch means in a first of said conductor means comprising,
 - (1) a housing means with internal, spaced apart, fixed contact means,
 - (2) spanner guide means intermediate said fixed contacts which guide means carry a spanner means comprising movable contact means for engagement with said fixed contact means,
 - (3) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to permit adjustment of engagement and disengagement between said fixed and movable contact means,
 - (d) intermediate means transferring motion from said magnetic switch to said normally-closed switch means which motion at least causes the latter switch means to open with the closing of said former switch means,
 - (e) a normally-open switch means in a second of said conductor means which normally-open switch closes upon the closing of said magnetic switch,
 - (f) control means in said conductor means to reverse the polarity of said current source comprising,
 - (1) rectifier means in said first and second conductor means,
 - (2) said first and second conduit means connected to a common terminal of said magnetic flux source means,
 - (g) operating switch means in said first and second conductor means to initiate opening and closing of said magnet switch,
 - (h) a third conductor means connected to a second terminal of said magnetic flux source means.- 5. The combination of claim 4 in which an electrical resistance means is in said second conductor means.
- 6. In combination with a magnetic switch comprising magnetic core means including a magnetically actuated armature means,
 - (a) a permanent magnet latch means used to maintain said switch in a closed position comprising,
 - (1) a permanent magnet means adjacent the magnetic core means so as to provide parallel flux paths,
 - (2) a gap in said parallel flux path of said magnetic core,
 - (b) a plurality of electric conductor means connected between magnetic flux source means of said switch and a current source,
 - (c) a normally-closed switch means in a first of said conductor means comprising,
 - (1) a housing means with internal, spaced apart, fixed contact means,

- (2) spanner guide means intermediate said fixed contacts which guide means carry a spanner means comprising movable contact means for engagement with said fixed contact means,
- (3) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to permit adjustment of engagement and disengagement between said fixed and movable contact means,
- (d) intermediate means transferring motion from said magnetic switch to said normally-closed switch means which motion at least causes the latter switch means to open with the closing of said former switch means,
- (e) a normally-open switch means in a second of said conductor means which normally-open switch closes upon the closing of said magnetic switch,
- (f) control means in said conductor means to reverse the polarity of said current source and
- (g) operating switch means in said conductor means to initiate opening and closing of said magnet switch.
- 7. In combination with a magnetic switch comprising magnetic core means including a magnetically actuated armature means,
 - (a) a permanent magnet latch means used to maintain said switch in a closed position comprising,
 - (1) a permanent magnet means adjacent the magnetic core means so as to provide parallel flux paths,
 - (b) a plurality of electric conductor means connected between magnetic flux source means of said switch and a current source,
 - (c) a normally-closed switch means in a first of said conductor means comprising,
 - (1) a housing means with internal, spaced apart, fixed contact means,
 - (2) spanner guide means intermediate said fixed contacts which guide means carry a spanner means comprising movable contact means for engagement with said fixed contact means,
 - (3) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to permit adjustment of engagement and disengagement between said fixed and movable contact means,
 - (d) intermediate means transferring motion from said magnetic switch to said normally-closed switch means which motion at least causes the latter switch means to open with the closing of said former switch means,
 - (e) a normally-open switch means in a second of said conductor means which normally-open switch closes upon the closing of said magnetic switch,
 - (f) control means in said conductor means to reverse the polarity of said current source and
 - (g) operating switch means in said conductor means to initiate opening and closing of said magnet switch.- 8. In combination with a magnetic switch,
 - (a) a permanent magnet latch means used to maintain said switch in a closed position,
 - (b) a plurality of electric conductor means connected between magnetic flux source means of said switch and a current source,
 - (c) a normally-closed switch means in a first of said conductor means comprising,
 - (1) a housing means with internal, spaced apart, fixed contact means,
 - (2) spanner guide means intermediate said fixed contacts which guide means carry a spanner means comprising movable contact means for engagement with said fixed contact means,
 - (3) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to permit adjustment

- of engagement and disengagement between said fixed and movable contact means,
- (d) intermediate means transferring motion from said magnetic switch to said normally-closed switch means which motion at least causes the latter switch means to open with the closing of said former switch means, 5
- (e) a normally-open switch means in a second of said conductor means which normally-open switch closes upon the closing of said magnetic switch, 10
- (f) control means in said conductor means to reverse the polarity of said current source and 15
- (g) operating switch means in said conductor means to initiate opening and closing of said magnet switch.
9. A molded coil block means comprising, 15
- (a) an electrical coil means encapsulated therein,
- (b) a hollow cavity formed in said block means,
- (c) coil terminal means molded in said block means and connected to said coil means with the end of at least one terminal means extending into said 20 cavity,
- (d) electronic component means located in said cavity and connected to said one terminal means extending therein and
- (e) means to permit external connection of said electronic component means. 25
10. In combination with yoke means and armature means of an electromagnetic switch, a molded coil block means comprising, 30
- (a) an electrical coil means encapsulated therein and surrounding said armature means,
- (b) a hollow cavity formed in said block means,
- (c) coil terminal means molded in said block means and connected to said coil means with the end of at least one terminal means extending into said cavity, 35
- (d) electronic component means located in said cavity and connected to said one terminal means extending therein, and
- (e) means to permit external connection of said component means. 40
11. Means for completing and interrupting an electrical circuit comprising, 45
- (a) housing means with internal, spaced apart, fixed contact means,
- (b) spanner guide means intermediate said fixed contacts which guide means carry a spanner means with movable contact means for engagement with said fixed contact means, 50
- (c) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to predetermine any engagement and disengagement between said fixed and movable contact means, 55
- (d) said fixed and movable contact means being normally closed when the housing means is in a first position and normally open when said housing means is inverted from said first position.
12. Means for completing and interrupting an electrical circuit comprising, 60

- (a) housing means with internal, spaced apart, fixed contact means,
- (b) connector means with internal ends carrying said fixed contact means and external ends which are symmetrical with respect to said housing means and include a single connection means, respectively, to permit lead connection as well as attachment of said housing to an adjacent structure,
- (c) spanner guide means intermediate said fixed contact which guide means carry a spanner means with movable contact means for engagement with said fixed contact means,
- (d) stem means attached to said spanner guide means for transferring motion of an adjacent operator to said spanner guide means,
- (e) spring means adjacent said stem means for biasing said guide means against said operator,
- (f) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to predetermine any engagement and disengagement between said fixed and movable contact means,
- (g) said fixed and movable contact means being normally closed when the housing means is in a first position and normally open when said housing means is inverted from said first position.
13. Means for completing and interrupting an electrical circuit comprising,
- (a) housing means with internal, spaced apart, fixed contact means,
- (b) spanner guide means intermediate said fixed contact which guide means carry a spanner means with movable contact means for engagement with said fixed contact means,
- (c) stem means attached to said spanner guide means for transferring motion of an adjacent operator to said spanner guide means,
- (d) spring means adjacent said stem means for biasing said guide means against said operator,
- (e) said spanner means being located within said spanner guide means by a resilient means and an adjustable means so as to predetermine any engagement and disengagement between said fixed and movable contact means,
- (f) said adjustable means comprising an adjustable screw housed in a tapped bore of said stem means,
- (g) said fixed and movable contact means being normally closed when the housing means is in a first position and normally open when said housing means is inverted from said first position.

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