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ELECTRICAL CONTROL RELAY WITH REMOVABLE MAGNET ASSEMBLY

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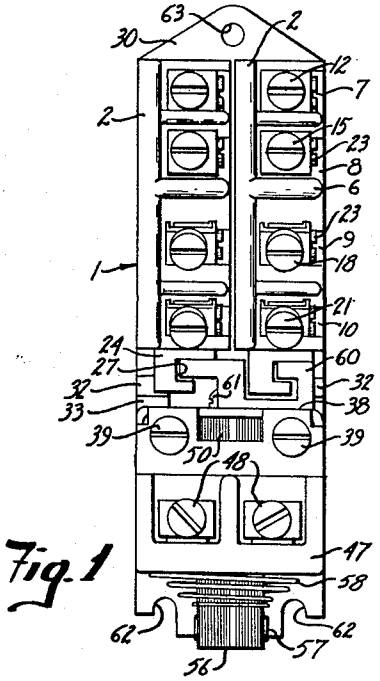


Fig. 1

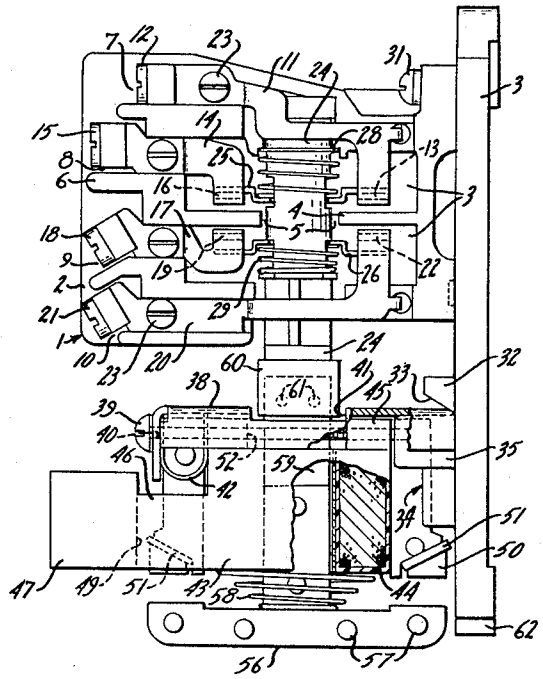


Fig. 2

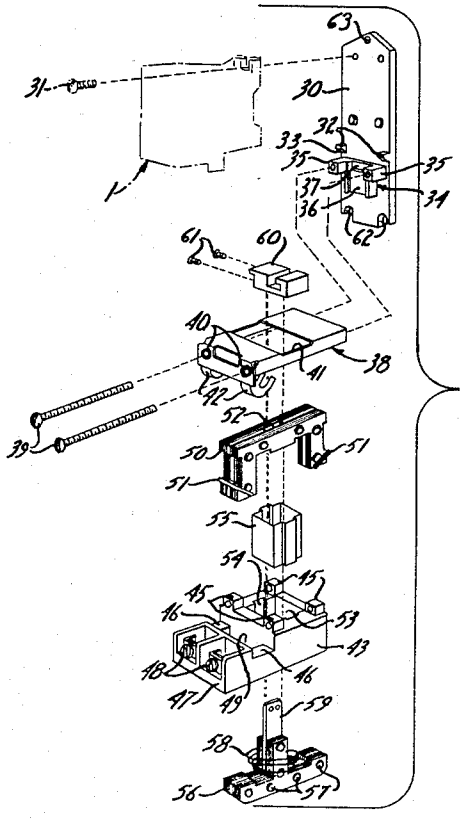


Fig. 3

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# ELECTRICAL CONTROL RELAY WITH REMOVABLE MAGNET ASSEMBLY

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This invention relates to a magnetically operated circuit controlling device and more particularly to a relay apparatus for service in circuit control applications.

Industrial demand for control relays has been, and is presently, increasing at a rapid rate. This is due primarily to the increase in the use of complex electrically operated and controlled equipment. Such equipment generally requires rather elaborate, space consuming control panels for operations.

While industry seeks control relays which are capable of dependable heavy duty performance over long periods of time, the ever increasing space problem with which industry is confronted leads it to demand extremely compact equipment. In addition to the requirements that control relays be capable of dependable heavy duty service while utilizing a minimum of space, they must also be flexible and permit relatively unskilled replacement of contacts and electromagnet components. Maintenance, repair, and replacement of the relay or its components must be simple.

The control relay of the invention fulfills all of these demands of industry. It is dependable, capable of heavy duty performance over a long time duration, offers simple interchangeability of parts, and provides a substantial space saving over previously available relays.

The control device of the invention offers a significant improvement over those now available in providing for the removal and servicing of the electromagnet assembly wholly from the front thereof. This is accomplished simply by removing a pair of mounting screws which extend perpendicularly from the base plate of the relay to the outer edge of a frame and coil clamp. No vertical clearance is required when an additional relay of the invention is positioned directly beneath the original relay. The electromagnet assembly, once removed, may be disassembled and any of its parts replaced or repaired.

Each pole unit of the relay, which may contain a plurality of contacts, is also removable from the front of the relay. This is accomplished by removing a single mounting screw, which is threaded into the base plate of the relay, and by disconnecting the leads to the pole contacts. Only the pole unit being serviced need be disturbed as no disconnection of the remaining pole units or contacts is required.

When a number of such devices are to be assembled on a circuit control panel, they may be lined up side by side with no clearance being required between individual relays. Rows of relays of the invention may be positioned directly above and directly below the initial row of relays.

Various other objects and advantages of the invention will become more fully apparent from the following description and drawings illustrating presently preferred embodiments thereof and wherein:

FIGURE 1 is a front elevation of the electromagnetically operated relay of the invention;

FIG. 2 is a side elevation of the relay of the invention; and

FIG. 3 is an exploded view of the relay of the invention, particularly illustrating the mode of assembly and attachment of the electromagnetic operator of the relay.

The contact unit of the relay device of the invention, generally designated **1** in FIGURES 1, 2 and 3, is similar



in most material respects to the electric switching device disclosed in the patent of Oswald M. Bundy 3,045,092 entitled "Electric Switch."

The contact unit **1**, as shown in FIGURES 1 and 2, includes a molded one-piece melamine housing **2**. One side of the housing is open and the other side is closed. A pair of adjoining chambers **3**, seen in FIG. 2, are formed in housing **2** and open outwardly therefrom. These chambers are separated by a midwall **4** which has an opening **5** permitting communication between the chambers **3**.

The contact unit **1** has an irregular front wall **6** which is characterized by four vertically spaced horizontal channels **7**, **8**, **9** and **10**. Channels **7** and **8** communicate with the uppermost of chambers **3**, and channels **9** and **10** communicate with the lower chamber **3**.

A conducting strap **11** is positioned in channel **7**. A portion of the strap **11** extends outwardly from the housing and is equipped with a terminal element **12**. The other end of strap **11** protrudes into the uppermost chamber **3** and provides a stationary contact **13**. Similarly, a smaller strap **14** is fitted into channel **8**, and a terminal element **15** projects outwardly therefrom and a stationary contact **16** extends inwardly into the uppermost of chambers **3**.

A conducting strap **17** is positioned in channel **9** and has a terminal end **18** extending outwardly from the housing **2** and a contact **19** projecting into the lower of chambers **3**. An additional strap **20** is fitted into channel **10** and has a terminal end **21** and a contact **22** corresponding in function to those of strap **17**.

Each of the individual straps **11**, **14**, **17** and **20** is secured to housing **2** by screws **23**.

A contact carrier **24** of a one-piece molding, preferably nylon, and having a generally cylindrical shape, is positioned in housing **2**. Carrier **24** extends through guide openings provided in the top and bottom of housing **2** and opening **5** in midwall **4**. The carrier thereby communicates with both the upper and lower chambers **3** in housing **2**. A pair of bridging contacts **25** and **26** are connected to carrier **24** in a manner such that contact **25** rests in the uppermost chamber **3** and contact **26** rests in the lower chamber. As is best viewed in FIGURE 1, the lower portion of carrier **24** is notched at **27**.

A spring **28** is wrapped around carrier **24** in upper chamber **3** and is maintained in position by the top wall of housing **2** and the upper surface of bridging contact **25**. A second spring **29** is wrapped around carrier **24** in lower chamber **3**. Spring **29** is maintained in position by the lower surface of bridging contact **26** and a shoulder formed on carrier **24**.

When contact carrier **24** is in its normal position, bridging contact **25** connects stationary contacts **13** and **16** in an electrical circuit. At the same time, bridging contact **26** is maintained out of contact with stationary contacts **19** and **22** to prevent completion of an electrical circuit therethrough. By moving contact carrier **24** upwardly, the above conditions are reversed. Bridging contact **25** is moved out of contact with stationary contacts **13** and **16** to break the electrical circuit therethrough, and bridging contact **26** is moved into electrical contact with both stationary contacts **19** and **22** to complete an electrical circuit therethrough. With minor modifications in contact position, various combinations of normally closed and normally open contacts may be achieved.

The contact unit **1** is secured to a base **30** by a single screw **31** threaded through the end surface of housing **2** and into base **30**. This is accomplished from directly in front of the unit and requires neither vertical nor horizontal clearance for attachment or removal. Additional relays may be placed directly above or immediately adjacent the unit **1** on base **30**.

The components of the electromagnetic operator element of the device of the invention may be best observed in the exploded view of FIGURE 3. Base 30 is shown to be formed with a pair of spaced guide projections 32 which serve as positioning guides for installation of the electromagnet assembly. Projections 32 extend in a direction generally normal to the plane defined by base 30. The lowermost surfaces 33 of projections 32 are inclined toward the base to deflect the electromagnet assembly into contact with a mounting fixture 34 provided beneath projections 32 on base 30.

Mounting fixture 34 includes a spaced pair of elongated threaded blocks 35 extending from base 30 and at a right angle thereto. Stepped recesses 36 and 37 are formed in the fixture between blocks 35. Recesses 36 and 37 act to establish and maintain the position of a magnetizable core with respect to base 30.

The electromagnet assembly is supported by a frame 38. When installing the frame 38 and electromagnet assembly on the base 30, the frame is directed towards the base from the front thereof and at an angle substantially normal to the plane of the base. Due to the bulk of the unit being installed, mounting fixture 34 becomes obscured before the frame 38 can be attached. Guide projections 32 and the inclined surface 33 thereof act to aid a serviceman in accurately positioning frame 38 with respect to fixture 34 by deflecting the frame and electromagnet assembly into its proper attachment position. Elongated screws 39, which extend through openings 40 in the front portion of frame 38 to blocks 35 in a direction substantially normal ot the plane of the base 30, are then threaded into blocks 35 to secure the frame 38 to base 30. The central portion of frame 38 is formed with an opening 41 through which contact carrier 24 may be actuated. A pair of curved strips of spring steel 42 are connected to the front portion of frame 38 and depend from an area adjacent openings 40.

Spring steel strips 42 serve to engage a surface of a thermoplastic coil case 43 as frame 38 and case 43 are secured to base 30. The thermoplastic coil case 43 is molded around a coil of windings 44, best seen in FIGURE 2. Case 43 is formed with four spaced apertured projections 45 which are aligned in pairs and receive the elongated mounting screws 39. A pair of legs 46, which contain leads from coil 44, extend from case 43 to a terminal block 47. The terminal block is provided with a pair of terminal elements 48 which are connected through legs 46 to the leads of coil 44 and are adapted to be connected in an electrical circuit.

The open area 49 between terminal block 48 and case 43 is designed to contain one leg of a magnetizable core 50 which straddles and is supported by the upper surface of case 43. The position of core 50 relative to case 43 is maintained by the aligned projections 45. Core 50 takes the form of a lamination of stacked magnetizable plates which are riveted together in a C configuration. Each of the legs of core 50 is equipped with shading coils 51. The section of core 50 connecting the two legs thereof is machined to provide an opening 52 in communication with an axially extending generally rectangular passage 53 in coil case 43.

When case 43 and core 50 are secured to the front portion of base 30 by elongated screws 39 and frame 38, a surface of a leg of core 50 conforms to and complements recesses 36 and 37 of mounting fixture 34 to produce continuous contact therewith and a secure fit. The spring steel strips 42 of frame 38 act to impart a slight degree of resiliency to the connection of case 43 and core 50 to the base 30 thereby permitting a cushioned response by the electromagnet assembly to excessive vibration caused by the device itself or other vibratory influences.

Two of the side walls of passage 53 are provided with axially extending guide passages 54. A nylon sleeve 55 or other material having a combination of a low coefficient of friction and good dielectric qualities is inserted into passage 53 in case 43. Sleeve 55 acts to reduce the frictional effects of a T-shaped armature 56 which has the stem portion thereof positioned for reciprocation within passage 53. The armature, as core 50, consists of a lamination of stacked magnetizable plates which are riveted together. The rivets 57 attached along the stem of armature 56 are designed to ride in the guide passages 54 and to control the vertical reciprocation of the armature. A non-magnetic spring 58 is inserted over the stem of armature 56. One end of spring 58 serves to exert a force against the armature 56 and the other end exerts a force against the base of coil case 43. When the electromagnet is energized, the armature 56 overcomes the force of spring 58 and is drawn into contact with the legs of core 50 adjacent shading coils 53. When the magnet is deenergized, spring 58 acts to separate the armature 56 from the core 50 and to maintain the separation until the coil is re-energized.

The stem portion of armature 56 is provided with a vertical extension 59. The extension projects through core opening 52, frame opening 41, and is connected to an electrically non-conducting flanged member 60 by screws 61. Flanged member 60 is designed to establish a floating linkage between armature 56 and contact carrier 24. The floating linkage eliminates a rigid connection between armature 56 and carrier 24 and the vibration problems attendant therewith. Due to the configuration of flanged member 60 and notch 27 of contact carrier 24, armature 56 and carrier 24 can be operatively linked and maintained by installing or removing the electromagnet assembly and frame 38 from the front of the base in a direction substantially perpendicular to the plane of base 30.

The lower edge of base 30, as may be observed in FIGURES 1 and 3, is formed with a pair of spaced notches 62 which are designed to receive a pair of bolts (not shown) when the base is connected to a control panel. An opening 63 is provided at a point adjacent the peaked upper edge of base 30, and serves to receive a fastening bolt (not shown) for connecting the base to a panel. The base of the device may therefore be secured to a control panel or other structure from the front thereof and in a direction generally normal to the plane of base 30. No additional vertical or horizontal space is required in mounting the devices of the invention immediately above, below or at the side of an initially installed relay. The device is wholly removable from the front, and one such device can be withdrawn from a tight grouping of devices without disturbing the others.

In operation, when coil 44 of the electromagnet is energized, armature 56 is magnetized, overcomes the bias of spring 58 and is drawn into contact with core 50. The vertical movement of armature 56 is transmitted through extension 59 and flanged member 60 to contact carrier 24. The contact carrier moves bridging contact 25 out of contact with stationary contacts 13 and 16 to break the electrical circuit therethrough, and bridging contact 26 is moved into electrical contact with both stationary contacts 19 and 22 to complete an electrical circuit therethrough. When the coil is de-energized, the process is reversed.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. A circuit controlling apparatus comprising a base, the base being adapted for mounting upon a control panel; a contact unit attached to the base, the contact unit having co-operable stationary contacts and a movable contact and having means for connecting the contacts in an electrical circuit, the contact unit being positioned on the base to permit the mounting of additional contact units adjacent thereto; a contact operating member positioned to engage the movable contact and to move the contact to its operative and inoperative positions; an elec-

tromagnet assembly including a core, a coil and an armature disposed adjacent the contact operating member, the coil being encased in a non-conducting plastic material and acting to support the core, the armature being separably connected to the contact operating member and acting in response to the condition of the coil to move the contact operating member to its operative and inoperative positions; a frame simultaneously connecting the core, coil and armature to the base and having means thereon engageable with the electromagnet assembly, when positioned in assembled relation, to secure the electromagnet assembly between the frame and the base; and a plurality of elongated screws threaded through the frame and serving to removably secure the frame, and simultaneously therewith, the electromagnet assembly, to the base, the frame and the electromagnet assembly being removable in a direction normal to the plane of the base to permit the disposition of additional circuit controlling apparatus of the invention immediately adjacent to the electromagnet assembly.

2. An electromagnetically operable circuit controlling device comprising a base, means on the base for positioning and securing an electromagnet frame thereto; an electromagnet frame positioned on and secured to the base by a plurality of elongate bolts threaded through the frame and into the base in a direction substantially normal to the plane of the base; an electromagnet assembly including: a magnetizable core; a coil of windings encased in a non-conducting material and having an opening therein, the encased coil serving as a support for the magnetizable core, the encased coil having a plurality of spaced apertures formed in the non-conducting material thereof and receiving the elongate bolts to thereby secure the encased coil and core to the base and the electromagnet frame; a magnetizable armature having a portion thereof projecting through the opening of the encased coil, the magnetizable core, and the electromagnet frame and disposed for reciprocating motion therethrough; a contact unit attached to the base, the unit having co-operable stationary contacts and a movable contact and having means for connecting the contacts in an electrical circuit; and a contact operating member positioned to engage the movable contact and to move the contact to its operative



and inoperative position, the contact operating member being linked to the portion of the magnetizable aperture projecting through the electromagnet frame in a linkage separable by unobstructed movement in a plane substantially normal to the plane of the base whereby the entire electromagnet assembly and frame may be simultaneously removed from the base in a direction substantially normal to the plane thereof when the elongate bolts and electromagnet frame are disconnected therefrom thereby permitting the placement of additional electromagnetically operable circuit controlling devices immediately adjacent thereto.

3. The device of claim 2 wherein the base is provided with an electromagnet frame guide projection extending in a direction generally normal to the plane of the base and having a surface thereof inclined relative to the electromagnet frame positioning and securing means to establish a co-operative relationship between the guide projection and the frame positioning and securing means in accurately positioning the electromagnet frame with respect to the base.

4. The device of claim 2 wherein the electromagnet frame includes resilient biasing means engageable with the encased coil when the coil is supported by the elongate bolts to urge the coil and the core supported thereby into resilient contact with the base.

5. The device of claim 2 wherein the opening in the encased coil is provided with a sleeve having a low coefficient of friction to protect the coil from the reciprocal movement therethrough of a portion of the magnetizable armature.

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