

Nov. 24, 1964

W. A. DE SMIDT
CONTROL STATION COMPRISING IN COMBINATION A RECEPTACLE
WITH REMOVABLY PLUGGED-IN SWITCH UNIT
Filed April 12, 1962

3,158,703

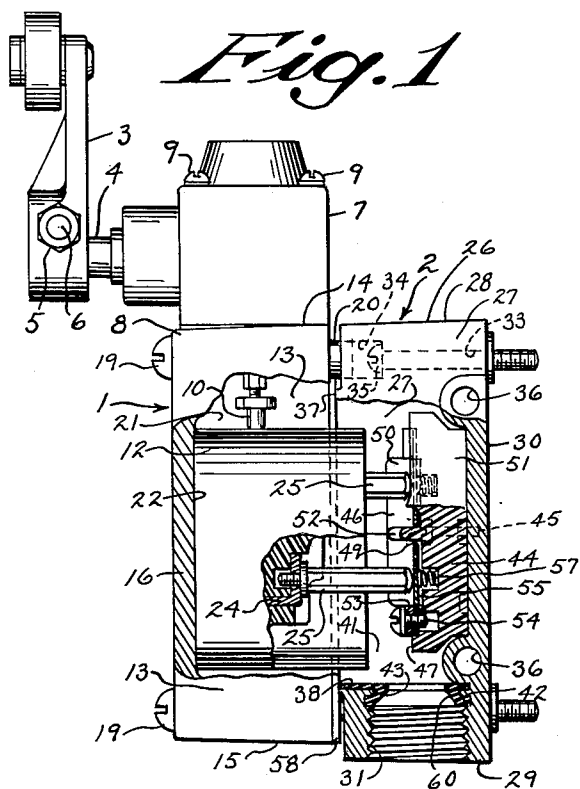


Fig. 1

Fig. 2

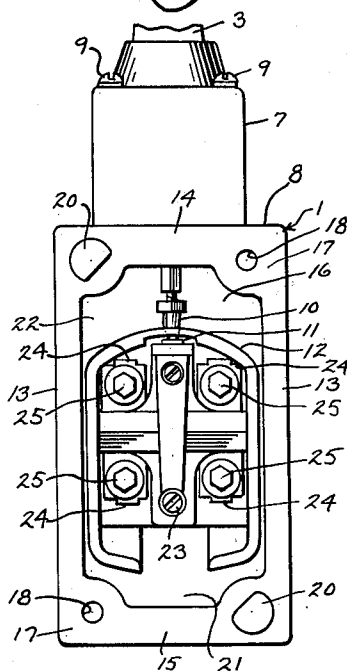
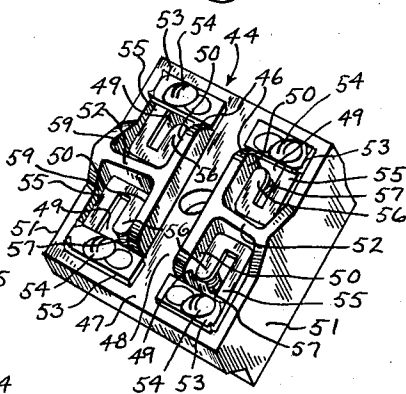
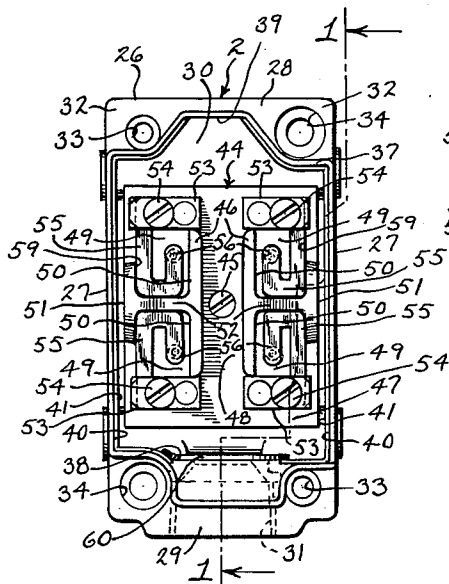


Fig. 3

Fig. 4



INVENTOR
WOODROW A. DE SMIDT

BY

Arthur H. Seidel

ATTORNEY

1

3,158,703

CONTROL STATION COMPRISING IN COMBINATION A RECEPTACLE WITH REMOVABLY PLUGGED-IN SWITCH UNIT

Woodrow A. De Smidt, Whitefish Bay, Wis., assignor to Allen-Bradley Company, Milwaukee, Wis., a corporation of Wisconsin

Filed Apr. 12, 1962, Ser. No. 187,076

3 Claims. (Cl. 200—51)

This invention relates to a mechanically actuated switch comprising a receptacle and a control switch, the latter being adapted for plugging into the receptacle, and the receptacle being adapted for a permanent mounting to receive conductors of a circuit and thereby function as a junction box. The receptacle also houses resilient connectors with exposed contact faces that are engaged by jumper posts of the control switch when the switch is assembled with the receptacle.

Mechanically operated control switches commonly require cleaning, repair, or replacement after a large number of operations. Such control switches may be limit switches, which are frequently the very heart of an automatic industrial operation of one sort or another, and, when so employed, the switches may be operated thousands of times per day. Consequently, there may be a rather frequent requirement for routine maintenance of the switches, but when the switches are out of operation, the whole system which they control must be shut down.

In the past, such switches have been connected directly into the pilot control circuits which they regulate. Thus, when the switch required repair or other maintenance, a skilled repairman would perform the necessary work on the switch either while it was connected into the circuit, or elsewhere, after disabling the control circuit by removing the switch. Both of those alternatives were time consuming, and they frequently required that a highly skilled electrician be employed to perform these functions in places where it was cramped and awkward, not to say undesirable, to work. The result, economically speaking, was an increase in maintenance expense occasioning a decrease in production.

Accordingly, it is an object of this invention to provide a pilot control station wherein the switching unit may be repaired while causing only a minimum circuit outage time.

It is another object of the present invention to provide a pilot control station such that the switch may be repaired under the ideal circumstances of properly equipped workbench regardless of the operating location of the switch, while occasioning a minimum circuit outage time.

It is another object of the present invention to provide a pilot control station wherein the switching unit may be readily and quickly removed or installed by a comparatively low skilled worker.

It is another object of the present invention to provide a pilot control station wherein the switching unit is physically separated from a control circuit conductor, while maintaining an efficient electrical contact therewith.

It is another object of the present invention to provide a pilot control station wherein the switch, which may be removably plugged into a receptacle, has protruding jumper posts electrically joined with its contacts to engage terminal connectors in the receptacle in an electrically conductive connection.

The foregoing and other objects and advantages will appear from the description to follow. In the description, reference is made to the accompanying drawing which forms a part hereof and in which there is shown by way of illustration a specific embodiment in which this in-

2

vention may be practiced. This embodiment will be described in sufficient detail to enable those skilled in the art to practice this invention, but it is to be understood that other embodiments of the invention may be used and that structural changes may be made in the embodiments described without departing from the scope of the invention. Consequently, the following detailed description is not to be taken in a limiting sense; instead, the scope of the present invention is best defined by the appended claims.

In the drawing:

FIG. 1 is a side view of a preferred embodiment of the present invention in elevation, with portions cut away to disclose the internal structural features of this embodiment,

FIG. 2 is a rear view in elevation of the switch unit which appears in FIG. 1,

FIG. 3 is a front view of the terminal assembly as it appears in FIG. 1,

FIG. 4 is a view in perspective of the terminal block shown in FIGS. 1 and 3.

The preferred embodiment of the present invention as shown in the drawing and to be described here illustrates an application of the invention with a limit switch of the variety frequently used on machine tools for controlling the length of travel of bed plates and the like. FIG. 1 shows a complete pilot control station, which is made up of a control switch unit 1 and a receptacle 2. Although the control switch unit 1 and the receptacle 2 cooperate to carry out the present invention, it is convenient for descriptive purposes to treat them separately in the beginning. Accordingly, the control switch unit 1 will initiate the description.

The control switch unit 1 is a form of snap action limit switch having a roller lever 3 to receive the switch actuating stimulus. The roller lever 3 is secured to a rotatable shaft 4 by means of a locking nut 5 on a clamp pin 6, and the rotatable shaft 4 is journaled in an actuator housing 7 to drive any one of a number of well known types of snapover mechanisms that might be contained therein. The actuator housing 7 is fastened onto an upper end wall 14 of a switch unit enclosure 8 by means of screws 9, so that a pin 10 may extend downward into the switch unit enclosure 8 to abut and impel a plunger 11 slidably mounted in a switch housing 12, thus actuating switch contacts contained therein but not shown in the drawing. The components of the switch unit thus far described are largely old, commercially available items which, taken alone, are mainly environmental of the presently described embodiment of this invention.

The switch unit enclosure 8 is a box-like member molded of aluminum or other appropriate material, opening to the rear, and having side walls 13, end walls 14 and 15 and a front wall 16. The upper end wall 14 is adapted to permit the pin 10 from the actuator housing 7 to pass therethrough. At each corner where the side walls 13 join the end walls 14 and 15, respectively, the walls are thickened to provide solid corner portions 17 of substantial cross section. Viewing the switch unit enclosure 8 from the rear, as in FIG. 2, the diagonally opposed, top right and bottom left, corner portions 17 have holes 18 bored through from front to back without communicating with the inner cavity 21 defined by walls 14, 15 and 16, to receive mounting screws 19. The other diagonally opposed corner portions 17 have mounting studs 20 of semi-round cross section protruding rearwardly therefrom. The inside surface 22 is adapted to receive and support the switch housing 12, which is mounted thereon within the cavity 21 by a screw 23.

It is to be noted in this embodiment that screwed into the terminals 24 to form electrical connections through the terminals 24 with the switch contacts are jumper

3

posts 25. The jumper posts 25 are rigid bars of conductive material extending straight out from the rear of the switch housing 12 which extends rearward out of the switch unit enclosure 8. The jumper posts 25 serve to insert the switch contact terminals 24 and thus the switch, into the circuit to be controlled, as will become manifest from the following description of the receptacle 2.

The external aspect so to speak of the receptacle 2 is a mounting box 26. The mounting box 26 is a rectangular box-like object of molded aluminum or other suitable material opening to the front and having side walls 27, an upper end wall 28, a lower end wall 29, and a rear wall 30, of shape and dimension corresponding to the walls 13, 14, 15 and 16 of the switch unit enclosure 8. The lower end wall 29 of the mounting box 26 is considerably thicker than the other walls and has a threaded opening 31 through it to receive wires of a circuit to be controlled by the pilot control station. The upper end wall 28 is thickened at the corners 32 where it joins the side walls 27.

Viewing the mounting box 26 from the front, as in FIG. 3, it will be seen that threaded holes 33 are bored through the diagonally opposed, upper left and lower right corners 32, from front to back, corresponding to the holes 18 in the diagonally opposed corners 17 of the switch unit enclosure 8. The holes 33 are adapted to receive control switch unit mounting screws 19 entering from the front, and bolts entering from the rear (not shown) to secure the mounting box 26 to a supporting surface. At the other diagonally opposed corners 32 of the mounting box 26, holes 34 extend through from front to back, and the holes 34 are sufficiently countersunk to receive the mounting studs 20 over the heads of bolts 35 securing the mounting base to a supporting structure, as shown in FIG. 1. Additional means for receiving supporting devices are provided in two holes 36 bored transversely through the rear wall 30 from side to side near the upper and lower ends of the mounting box 26.

A continuous sealing ridge 37 extends outwardly from the front of the mounting box 26 by forming an extension of the side walls 26 from the inside surface 38 of the lower end wall 29 to the inside surface of the upper end wall 28, following the inside surface 38 of the upper end wall 28, passing around the inside of the holes 33 and 34 in the lower end wall 29 and extending between those holes across the middle of the lower end wall 29. A thin sheet of dielectric material 41 lines the inside surfaces 40 of the side walls 27 and end portions of the inside surfaces 38 and 39 of the lower and upper end walls 29 and 28, respectively. Thus, the electrical energy introduced into the receptacle 2 is effectively isolated from the mounting box 26, should a bare wire inadvertently come into contact with the inside surfaces 38, 39 and 40 of the walls 29, 28 and 27, respectively. In addition, a rectangular groove 42 is formed in the inner end of the wall of the threaded opening 31 in the lower end 29 of mounting box 26. The upper limit of the groove 42 is defined by a ridge 43 flush with the inside surface 38 of the lower end wall 29 and having a diameter somewhat less than that of the opening 31. A bushing 60 made of rubber or a similarly elastic dielectric and shaped to fit snugly around the ridge 43 and in the groove 42 with a broad upper flange covering an area of the inside surface 29 of the lower end wall 38, forms an effective insulation against contact of bare wires with the mounting box 26 and a moisture, oil or gas seal between such wires or their conduit and the opening 31.

A terminal block 44 is mounted within the mounting box 26 against the rear wall 30 thereof, where it is held by a screw 45. The terminal block 44, see FIG. 4, is a relatively flat, rectangular shaped molded object of a suitable dielectric material.

A pair of longitudinally extending ridges 46 rise from the face 47 of the terminal block 44 to define a dielectric channel 48 across its center for confining and isolating

4

circuit wires passing from the opening 31 to the upper end of the terminal block 44. Four sharply defined rectangular depressions 49 are formed in the face 47 of terminal block 44 between the outside surfaces 50 of the ridges 46 and walls 59 formed by sides 51 of the terminal block 44. The two depressions 49 thus formed on each side of the channel 48 in the face 47 of the terminal block 44 are separated by short transverse barriers 52 extending outwardly from the centers of the outside surfaces 50 of the longitudinal ridges 46 across the depressions 49 to the opposite walls 59.

Four terminal strips 53 are secured to the face 47 of the terminal block 44, one extending laterally outward from each end of the two longitudinally extending ridges 46. The terminal strips 53 are short flat bars of conductive material, and each has a binding screw 54 screw-mounted in it to receive and secure wires to the terminal strip 53.

A J-shaped, leaf-spring connector strip 55 extends longitudinally from the outer end of each terminal strip 53 toward the centrally positioned transverse barriers 52 projecting over the depressions 49 formed in the face 47 of the terminal block 44. The hooks of the J-shaped connector strips turn inwardly toward the longitudinal ridges 46, and then turn back toward their terminal strips 53, each leaving a free end suspended over the depression 49 beneath it and presenting a forward facing contact area 56. The J-shape of the connector strips 55 permits the use of connector strips 55 sufficiently long to allow maximum flexing without unduly straining the connector strips 55 or exceeding their elastic limits. Beneath the free end contact area 56 of each connector strip 55 is a coil spring 57 bearing outwardly against the underside of the contact area 56 and against the floor of the depression 49, to add greater resiliency to the contact areas 56.

To install the pilot control station described above, the receptacle 2, including the mounting box 26 containing the terminal block 44, is secured to a supporting surface or structure by bolts or similar means through some or all of the holes 33, 34 and 36 formed in the mounting box 26 for that purpose. Wires from a circuit to be controlled by the pilot station are introduced through the threaded opening 31, and where four wires are used, two are fastened around the binding screws 54 in the lower two terminal strips 53, and the other two wires are conducted through the channel 47 to the binding posts 54 in the upper two terminal strips 53. A gasket 58 is placed on the edges of the walls 13, 14, 15 and 16 of the switch unit enclosure 8 around its rearward facing opening. The switch unit enclosure 8 is placed over the forward opening mounting box 26 so that the mounting studs 20 fit into the countersunk holes 34 in the mounting box 26. When the control switch unit 1 and the receptacle 2 are so positioned, the ends of the jumper posts 25 bear forcibly against the spring biased contact areas 56 of the connector strips 55 in the terminal block 44. Thus, a switch may be placed quickly and easily into a circuit it is to control. Then the control switch unit mounting screws 19 are introduced through holes 18 in the switch unit enclosure 8 into the threaded holes 33 in the mounting box 26 and drawn up tightly, forcing the sealing ridge 37 into the gasket 58 to form a waterproof seal therewith.

The switch unit enclosure 8, with its mounting screws 19, mounting studs 20, the jumper posts 26, and the mounting box 26 and the contact areas 56 are so symmetrically positioned that the control switch unit 1 and the receptacle 2 may be assembled as shown in FIG. 1, or reversed so that the wire opening 31 in the mounting box 26 and the actuator housing 7 face in the same direction. Thus, the appellation of top and bottom, lower and upper used throughout the description are entirely arbitrary, and chosen for convenience to relate to the configuration shown in the drawing.

Thus, the receptacle 2 is a permanent fixture once it is installed and need never be removed. If it is desired

5

to render the particular circuit inoperative, a cover plate may be substituted for the control switch unit 2 on the receptacle 1. The control switch unit 1 may be repaired in a maintenance shop, while interrupting the operation of the circuit is controls only for the few seconds required to remove the malfunctioning control switch unit 1 and replace it with a properly functioning one. Finally, the pilot control station of the present invention is as durable and can be made as water, oil or gas proof as the single unit pilot control stations of the prior art.

I claim:

1. A plug-in limit switch comprising the combination of:

- a junction box receptacle having an open front side and a lead-in opening for introducing circuit wires therein;
- a terminal block of insulating material mounted in said receptacle with a central channel extending across the face thereof, said channel being in alignment with said lead-in opening to receive circuit wires;
- a set of resilient connectors mounted upon said terminal block and being disposed on opposite sides of said channel, each connector having one end anchored with respect to the terminal block for electrical junction with a circuit wire and extending from the anchored end in a form coiled upon itself to terminate in a movable end facing the open front of the junction box receptacle, which end is deflectable in a direction toward and away from said open front;
- a bias spring means disposed between the back of each resilient connector and said terminal block to urge the movable end of the connector toward the open front of the box receptacle;
- a limit switch unit mountable upon said junction box receptacle including a switch mechanism, terminals for such mechanism, and an open back facing the open front of said junction box receptacle when mounted thereon;
- and a set of conductive jumper posts electrically secured to said switch mechanism terminals which protrude out of the open back of said switch unit and engage the movable ends of said resilient connectors upon mounting the switch unit upon the junction box receptacle.

2. In a junction box receptacle for a plug-in limit switch the combination comprising:

- a forward opening mounting box having a rear wall, two side walls, and two end walls, having means in said walls to permit fastening of said mounting box to a supporting structure, having sealing surfaces

6

about its opening and means permitting a limit switch unit to be tightly fastened over its opening, one of said end walls having an opening therethrough to receive control circuit wires;

- a terminal block fastened inside said mounting box against the rear wall of said mounting box, said terminal block being fashioned from a dielectric material, and having a wire channel formed by parallel ridges projecting across its face in alignment with said opening for receiving control circuit wires, and recessed portions formed beside said wire channel;

terminal strips with binding screws for electrically and mechanically engaging control circuit wires secured to the face of said terminal block at at least one end of said wire channel;

- a J-shaped contact leaf of resilient material fastened to each strip by one end with its remaining portion suspended over said recessed portions in the face of said terminal block;

and an expansion coil spring behind the suspended end of each J-shaped contact leaf and bearing forwardly against said suspended end and bearing rearwardly against the rear wall of the adjacent recessed portion formed in the face of said terminal block.

3. A plug-in limit switch comprising the combination of a junction box receptacle as claimed in claim 2;

and a limit switch unit having a rearwardly opening enclosure adapted to be mounted over sealing surfaces about said forward opening mounting box of said junction box receptacle;

a limit switch mechanism mounted in said enclosure with rearward facing terminals;

and jumper posts electrically and mechanically secured to said terminals and extending rearwardly in a position to forcibly abut said suspended ends of said J-shaped contact leaves in said junction box receptacle, forming an electrical junction therewith to thereby electrically connect said terminal strips in said junction box receptacle with attached circuit wires to said switch.

References Cited in the file of this patent

UNITED STATES PATENTS

1,578,999	Kaschub	Mar. 30, 1926
1,663,544	Burgesser	Mar. 27, 1928
2,433,917	McCartney	Jan. 6, 1948
2,751,569	Anderson et al.	June 19, 1956
2,766,434	Gear	Oct. 9, 1956