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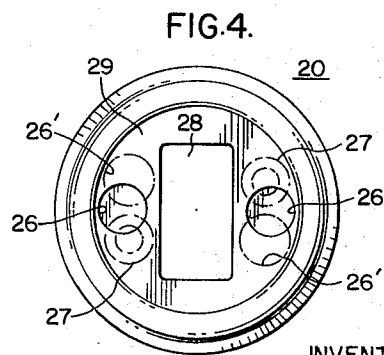
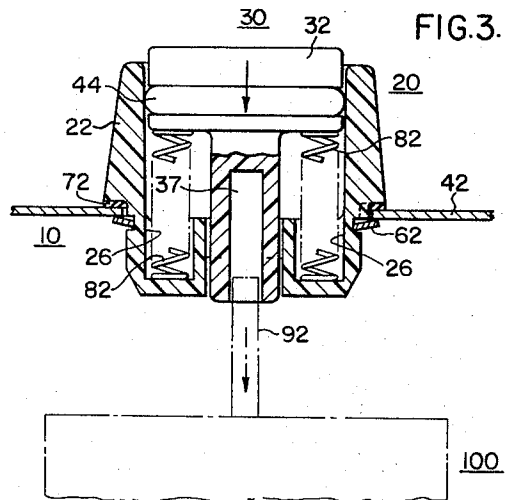
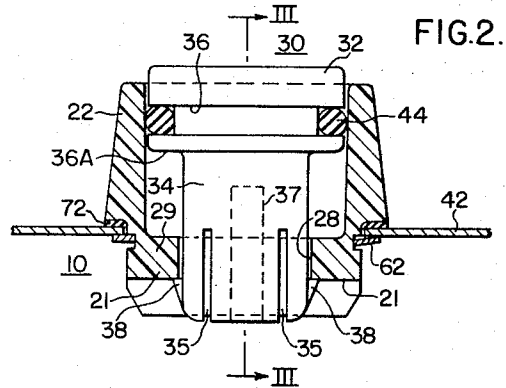
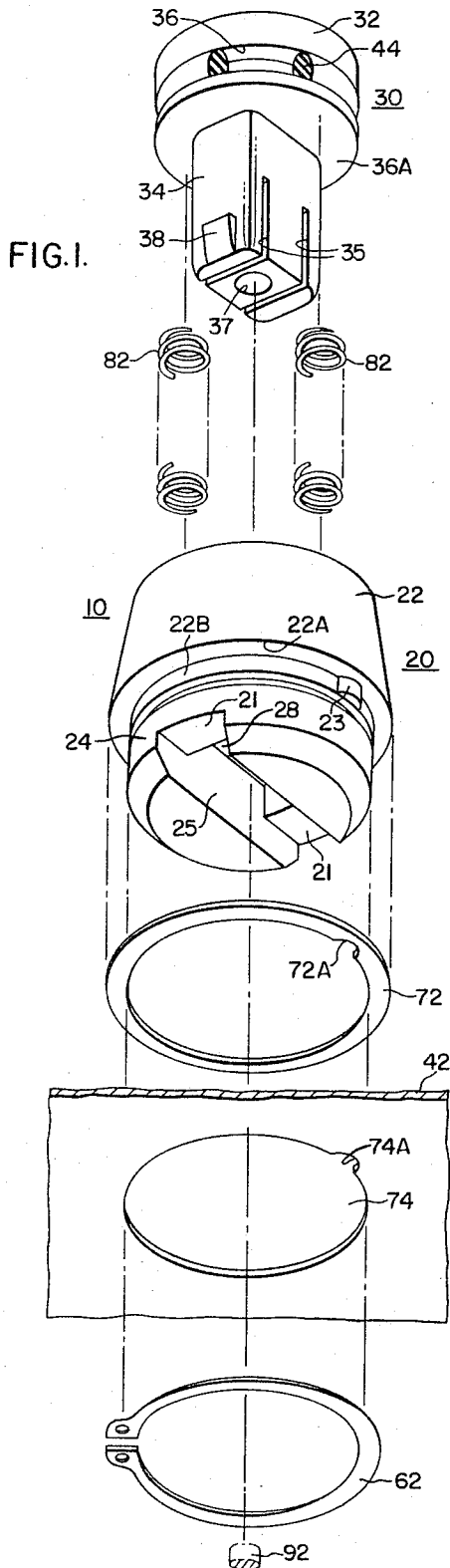
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PUSHBUTTON ACTUATOR

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2 Sheets-Sheet 1



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3,367,206

PUSHBUTTON ACTUATOR

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ABSTRACT OF THE DISCLOSURE

More particularly, a plunger is slidably disposed in a supporting sleeve and includes a resilient portion of reduced cross-section which moves through an opening in a transverse web in the sleeve. The latter portion of the plunger includes projecting tabs which retain the plunger in assembled relation with the sleeve. Additional openings may be provided in the web of the sleeve or in the plunger to act as spring seats for the resetting springs disposed between the web and the plunger.

This invention relates to pushbutton structures and more particularly to pushbutton actuators adapted for mounting on a supporting panel.

Pushbutton operators or actuators are commonly employed to actuate associated electrical devices, such as switches, or to reset devices, such as thermostatic devices of the type which are included with motor starters. For applications where the pushbutton operator is to be mounted on a supporting panel, it has been found that pushbutton structures of the type described which have been employed in the past have several disadvantages. For example, certain types of known pushbutton structures do not readily lend themselves to mounting on an associated supporting panel. Other types of known pushbutton operators do not readily lend themselves to an oil-tight or fluid-tight construction or have the disadvantage that the pushbutton structure reduces the electrical insulating clearances between the supporting panel and associated electrical apparatus which is disposed adjacent to the supporting panel. It is, therefore, desirable to provide an improved pushbutton structure which overcomes the above disadvantages and also offers several additional advantages.

It is an object of this invention to provide a new and improved pushbutton actuator.

Another object of this invention is to provide an improved pushbutton operator which more readily lends itself to mounting on a supporting panel.

A more specific object of this invention is to provide an improved means for maintaining a pushbutton actuator and an associated supporting means in assembled relationship.

Other objects of the invention will, in part, be obvious and will, in part, appear hereinafter.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is an exploded view, in perspective, of a pushbutton operator assembly embodying the principal features of the invention;

FIG. 2 is a view, partly in section and partly in elevation, of the structure shown in FIG. 1 when assembled on a supporting panel;

FIG. 3 is a view, in section, of the structure shown in FIG. 2 taken along the line III—III with the associated electrical apparatus indicated in phantom;

FIG. 4 is a top plan view of a supporting sleeve which performs part of the structure shown in FIGS. 1 through 3;

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FIG. 5 is an exploded view, in perspective, of an alternate construction of a pushbutton actuator embodying the principal features of the invention.

FIG. 6 is an elevational view, partly in section and partly cut away of the structure shown in FIG. 5 when assembled on a supporting panel;

FIG. 7 is an elevational view, in section, of the structure shown in FIG. 6 taken along the line VII—VII; and

FIG. 8 is a diagrammatic view of a control system utilizing two of the pushbutton actuators shown in FIGS. 1 through 4.

Referring now to the drawings and to FIGS. 1 and 2 in particular, there is illustrated a pushbutton operator or actuator assembly 10 which is particularly adapted for mounting on a supporting panel or housing wall 42 of an associated electrical apparatus, such as a motor starter. The supporting panel 42 may be formed from a suitable material such as sheet steel and in a typical application may comprise part of the door of an enclosure of the associated apparatus, such as the apparatus 100 indicated in phantom in FIG. 3, which is adjacent to and spaced from the supporting panel 42. The pushbutton operator 10 may be operatively connected to the associated apparatus 100 by an actuating member 92, as indicated in phantom in FIG. 3.

In general, the pushbutton operator 10 comprises a supporting sleeve or generally tubular member 20 and a plunger member or pushbutton member 30 which is slidably disposed in the supporting sleeve 20, as best shown in FIGS. 2 and 3. As illustrated in FIG. 1, the supporting panel 42 includes a generally circular opening 74 through which a portion of the supporting sleeve 20 passes during the assembly of the pushbutton operator 10 on the supporting panel 42.

More specifically, the supporting sleeve 20 is preferably formed from an electrically insulating material which is also resilient and which has suitable mechanical wearing properties. One suitable material which has been found to be particularly satisfactory is a thermoplastic material such as an acrylonitrile butadiene styrene resin. The supporting sleeve 20 includes a first portion 22 which has a larger outer periphery than the opening 74 in the associated supporting panel 42 and a second portion 24 which has an outer periphery smaller than the opening 74 and which passes through the opening 74 when the supporting sleeve 20 is assembled with the supporting panel 42, as shown in FIGS. 2 and 3. As shown in FIG. 1, a shoulder portion 22A is formed on the outer periphery of the supporting sleeve 20 where the first portion 22 joins or meets the second portion 24. When the supporting sleeve 20 is assembled with the supporting panel 42 as shown in FIG. 2, the shoulder portion 22A may bear directly against one side of the supporting panel 42 around the opening 74 or gasket member 72 may be interposed between the shoulder portion 22A and the supporting panel 42 to substantially prevent the entrance of oil or other fluids. In order to retain the supporting sleeve 20 in assembled relationship with the supporting panel 42, a self-locking, bowed, retaining, snap ring 62 may be assembled over the second portion 24 of the supporting sleeve 20 and pressed against the other side of the supporting panel 42 opposite the shoulder portion 22A until the retaining ring 62 snaps into a groove 22B provided on the outer surface of the second portion 24 of the supporting sleeve 20. In order to properly position the supporting sleeve 20 with respect to the opening 74 provided in the supporting panel 42, a projecting portion 23 may be provided inside the groove 22B on the outer periphery of the second portion 24 of the supporting sleeve 20. The projecting portion 23 projects into a corresponding guiding recess 74A which is dis-

posed at a predetermined point around the periphery of the opening 74, as best shown in FIG. 1.

The supporting sleeve 20 is provided with a transversely extending web portion 29 having a generally rectangular opening 28 therein, as best shown in FIGS. 2 and 4. As illustrated, the supporting sleeve 20 also includes a transversely extending recess 25 across the bottom of the second portion 24 of the supporting sleeve 20 to thereby form a pair of shoulder portions 21 at the opposite sides of the opening 28, as best shown in FIG. 1. As will be explained in detail hereinafter, the web portion 29 of the supporting sleeve 20 assists in guiding the axial movement of the plunger member 30 within the supporting sleeve 20 and also prevents rotation of the plunger member 30 in place during the operation of the pushbutton operator 10.

As mentioned previously, the plunger member 30 is slidably disposed in the supporting sleeve 20 and is preferably formed from an electrically insulating material which is resilient and which has suitable mechanical wearing properties, such as the material previously mentioned in connection with the supporting sleeve 20. The plunger member 30 comprises an upper portion which is generally circular in configuration and which substantially fills the opening inside the first portion 22 of the supporting sleeve 20 and a second portion which is generally rectangular in configuration and which substantially fills the generally rectangular opening 28 in the web portion 29 of the supporting sleeve 20. Where desired, a recess 36 may be provided around the outer periphery of the upper portion 36 of the plunger member 30 in which an O-ring gasket may be disposed to substantially prevent the entrance of oil or other fluids into the space or clearance provided between the outer periphery of the upper portion 36 of the plunger member 30 and the inner surface of the first portion 22 of the supporting sleeve 20. The O-ring gasket 44 is preferably formed from a suitable resilient, electrically insulating material where provided.

It is to be noted that the cross-section of the upper portion 36 of the plunger member 30 is larger than the size of the opening 28 through the web portion 29 of the supporting sleeve 20 and also greater than the cross-section of the substantially rectangular lower portion 34 of the plunger member 30 to define a shoulder portion 36 where the upper portion 36 meets the lower portion 34 of the plunger member 32, as best shown in FIGS. 2 and 3. In the normal operating position of the plunger member 30 as shown in FIGS. 2 and 3, the shoulder portion 36 is axially spaced from the upper surface of the web portion 29.

In order to releasably retain the plunger member 30 in assembled relationship with the supporting sleeve 20, the projecting tab portions 38 are provided on the opposite sides of the lower portion 34 of the plunger member 30 to engage the shoulder portion 21 provided at the bottom of the web portion 29 of the supporting sleeve 20 when the plunger member 30 is assembled with the supporting sleeve 20. In order to permit assembly of the plunger member 30 with the supporting sleeve 20, one or more axially extending slots 35 are provided in the lower portion 34 of the plunger member 30, as best shown in FIG. 2, to permit the outer portions or prongs of the lower portion 34 of the plunger member 30 to deflect during the assembly of the plunger member 30 with the supporting sleeve 20 and to permit the lower portion 34 of the plunger member 30 to pass through the opening 28 until the outer portions of the lower portion 34 of the plunger member 30 spring to the position shown in FIG. 2 with the projecting portions 38 engaging the bottom of the web portion 29. As mentioned previously, the plunger member 30 is preferably formed from a resilient material to permit the deflection of the projecting portion 38 during the manual assembly of the plunger member 30 with the supporting sleeve 20 or the removal of the plunger member 30 from the supporting sleeve 20.

In order to receive one end of an actuating member, such as the actuating member 92 of an associated apparatus, such as the apparatus 100 indicated in phantom in FIG. 3, the lower portion 34 of the plunger member 30 may be provided with a vertically extending opening 37 into which one end of the actuating member 92 may project when the pushbutton operator 10 is assembled on the associated supporting panel 42. During the operation of the pushbutton operator 10, the plunger member 30 which is slidably disposed within the supporting sleeve 20 may be manually actuated or pushed in a downward direction, as viewed in FIGS. 2 and 3, to also actuate or push the actuating member 92 in a downward direction. Where the actuating member 92 is normally reset by a spring means included in the apparatus 100, the plunger member 30 will also be reset by the upward resetting movement of the actuating member 92 to the normal position shown in FIGS. 2 and 3. Where required, a resetting spring means may be included with the pushbutton operator assembly 10, as best shown in FIGS. 1 and 3. In this instance, the supporting sleeve 20 may be provided with a pair of vertically extending openings 26 which act as spring seats for a pair of associated resetting springs 82, as best shown in FIGS. 3 and 4. The compression springs 82 operate to bias the upper portion 32 of the plunger member 30 away from the web portion 29 of the supporting sleeve 20 after the plunger member 30 has been manually actuated in a downward direction to thereby reset the plunger member to its normal position shown in FIGS. 2 and 3.

In certain applications, the opening 37 in the plunger 30 may be internally threaded or employed to receive a fastening means, such as a bolt or screw, for securing an extension member to the lower end of the plunger 30 where required.

Where it is desired to support an associated apparatus, such as a switch, on the supporting sleeve 20 of the pushbutton operator assembly 10, the openings 26 may be shifted by a predetermined angle from the positions shown in full in FIG. 4 to the positions indicated in phantom at 26' in FIG. 4 and a pair of additional openings 27 may be provided in the supporting sleeve 20 to receive suitable fastening means such as bolts or screws. In the latter arrangement, the openings 27 may be internally threaded to engage the associated fastening means.

It is to be noted that, in the absence of the resetting springs 82 in a particular application, the upper surface of the web portion 29 of the supporting sleeve 20 may act as a stop means during the movement of the plunger member 30 into the supporting sleeve 20 when the shoulder portion 36A of the plunger member 30 engages the upper surface of the web portion 29.

Referring now to FIGS. 5 to 7, there is illustrated an alternate pushbutton operator assembly 100 which in general is similar to the pushbutton operator assembly 10 previously described except that the supporting sleeve 120 of the pushbutton operator assembly 100 is also retained in assembled relationship with the associated supporting panel 42 by projecting tab portions 125, similarly to the projecting tab portion 38 of the plunger member 30 of the pushbutton operator assembly 10.

More specifically, the pushbutton operator assembly 100 includes a supporting sleeve or generally tubular member 120 and a plunger member 130 which is slidably disposed in the supporting sleeve 120 similarly to the pushbutton operator assembly 10. The supporting sleeve 120 includes an upper portion 122 which is generally circular in configuration and which has a larger outer periphery than the opening 74 in the associated supporting panel 42 and a second portion 124 which has a smaller outer periphery than the first portion 122 of the supporting sleeve 120. The supporting sleeve 120 is preferably formed from an electrically insulating material which is resilient and which has suitable mechanical wearing properties, such as the material previously disclosed in

connection with the supporting sleeve 20 of the pushbutton operator assembly 10.

In order to releasably retain the supporting sleeve 120 in assembled relationship with the associated supporting panel 42, the second or lower portion 124 of the supporting sleeve 120 includes a plurality of projecting tab portions 125 which project outwardly beyond the periphery of the opening 74 in the supporting panel 42 when the supporting sleeve 120 is assembled with the supporting panel 42 to engage one side of the supporting panel 42. It is to be noted that when the supporting sleeve 120 is assembled with the supporting panel 42, the supporting panel 42 is disposed between a shoulder portion 122A which results where the upper portion 122 of the supporting sleeve 120 meets the lower portion 124 and the projecting tab portions 125 which are axially spaced from the shoulder portion 122A by a predetermined distance which is substantially equal to the thickness of the supporting panel 42. In order to permit the projecting tab portions 125 to deflect during the assembly of the supporting sleeve 120, with the supporting panel 42, a slot 127 may be provided adjacent to each of the projecting tab portions, as best shown in FIG. 5, to permit the projecting tab portions 125 to deflect inwardly away from the edge of the opening 74 provided in the supporting panel 42.

Similarly to the supporting sleeve 20, the supporting sleeve 120 includes a transversely extending web portion 129 having a generally rectangular opening 128 provided therein which similarly assists in guiding the reciprocating movement of the plunger member 130 within the supporting sleeve 120 and which also prevents rotation of the plunger member 130 in place. As illustrated, the transversely extending web portion 129 includes a pair of upwardly extending projecting portions 122B and 122C on the opposite sides of the opening 128 which may be employed as spring seats where resetting springs are included as part of the pushbutton operator assembly 100.

Similarly to the plunger member 30, the plunger member 130 of the pushbutton operator assembly 100 includes a generally circular upper portion 132 and a generally rectangular lower portion 134. The lower portion 134 includes a pair of projecting tab portions 138 at the lower end thereof and may include one or more vertically extending slots 135 to permit the deflection of the projecting tab portions 138 during the assembly or removal of the plunger member 130 into or out of the supporting sleeve 120. The lower portion 134 may also include a vertically extending opening 137 which is adapted to receive one end of an actuating member of an associated apparatus similarly to the opening 37 provided in the plunger member 30 of the pushbutton operator assembly 10 previously described. Where required for resetting springs such as a resetting spring 182 shown in FIGS. 5 and 7, the upper portion 132 of the plunger member 130 may include one or more vertically extending openings 126 which are adapted to receive one of the associated resetting springs 182 and function as spring seats. As shown in FIG. 7, one end of each of the resetting springs 182 is positioned on one of the spring seat portions 122A or 122B and the other end of the resetting spring is disposed inside one of the openings 126 provided in this instance in the upper portion 132 of the plunger member 130. It is to be noted that the projecting tab portions 138 provided on the plunger member 130 engage the bottom surface of the web portion 129 adjacent to the opening 128 provided in the web portion 129.

The operation of the pushbutton operator assembly 100 is similar to that of the pushbutton operator assembly 10 previously described. The plunger member 130 may be manually actuated in a downward direction to actuate an associated apparatus which is operatively connected to the pushbutton operator assembly 100 in similar fashion to the pushbutton operator assembly 10 previously described. As previously mentioned in connection with the

pushbutton operator assembly 10, the resilience of the material from which the plunger member 130 is formed permits the deflection of the lower portions of the plunger member 130 during the assembly or removal of the plunger member 130 with respect to the associated supporting sleeve 120.

Referring now to FIG. 8, there is illustrated diagrammatically a typical application in which two of the pushbutton operator assemblies 10 may be employed. As illustrated, an electric motor 250 is arranged to be energized from a three-phase source of alternating current electric power, as indicated by the terminals S1, S2 and S3, through the separable contacts 212, 214 and 216, respectively, of a contactor 210. In order to electrically connect the motor 250 to the terminals S1, S2 and S3, the operating coil or solenoid 222 of the contactor 210 is energized by actuating a normally open "ON" pushbutton 242 to the closed position to thereby form a series circuit which extends from the terminal S1, through the normally closed contacts 226 and 236 of the overload relays 220 and 230, respectively, through the operating coil 222 of the contactor 210, through the "OFF" pushbutton 244 which is normally closed and the momentarily closed "ON" pushbutton 242 to the terminal S2. The contacts 212, 214 and 216 of the contactor 210 will then be actuated to the closed position to thereby energize the motor 250 along with a contact 218 which will close and form a holding circuit around the "ON" pushbutton 242 which is normally a momentary pushbutton. In order to protect the motor 250 from certain overload conditions, the heater elements 224 and 234 of the overload relays 220 and 230, respectively, are electrically connected in series with the contacts 212 and 216, respectively, of the contactor 210 between the motor 250 and the source terminals S1 and S3, respectively. When certain overload conditions result in the motor 250, the bimetallic elements B1 and B2 of the overload relays 220 or 230, respectively, are actuated by the associated heater elements 224 and 234, respectively, to cause the normally closed contacts 226 or 236, respectively, to open and deenergize the operating coil 222 of the contactor 210 to open the contacts 212, 214 and 216 and to thereby electrically disconnect the motor 250 from the source terminals S1, S2 and S3.

In order to reset the bimetallic elements B1 or B2 of the overload relays 220 or 230 respectively, a pushbutton operator assembly 10 may be provided adjacent to each bimetallic element to reset the bimetallic elements B1 or B2 after the bimetallic elements have cooled following the electrical deenergization of the motor 250 by the contactor 210, as just explained. The motor 250 may also be deenergized in a conventional manner by the "OFF" pushbutton 244 which may be actuated to an open position manually to deenergize the operating coil of the contactor 210 in a typical motor control system.

It is to be noted that the pushbutton switches 242 and 244 may include a pushbutton actuator, such as the pushbutton actuators 10 and 100 previously disclosed. In the latter construction, the pushbutton operators 10 or 100 would actuate conventional separable contacts of any suitable type.

It is to be understood that a pushbutton operator assembly, as disclosed, may be employed to reset electrical apparatus as just described in a typical application or may be employed to actuate an associated electrical apparatus, such as a switch, which is operatively connected to the pushbutton operator assembly.

The apparatus embodying the teachings of this invention has several advantages. For example, a pushbutton operator assembly as disclosed may be assembled in a simpler manner and in certain applications without the use of special tools. In addition, the pushbutton operator assembly, as disclosed, which is formed preferably of electrical insulating material provides increased electrical insulating clearances between the supporting panel on which the pushbutton operator assembly is disposed and the

associated apparatus which is normally disposed adjacent to and spaced from the supporting panel. Finally, a pushbutton operator assembly as disclosed readily lends itself to an oil-tight or fluid-tight construction.

Since numerous changes may be made in the above described apparatus and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all the matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. A pushbutton actuator comprising a supporting sleeve having a transverse web with a central opening therein which extends axially therethrough, a plunger member slidably disposed in the sleeve, said plunger member including a first portion which has a cross-section larger than said opening and which is disposed on one side of the web and a second portion which has a cross-section smaller than said opening and which extends through said opening, the second portion of the plunger member including one or more projecting tabs which engage the other side of the web to releasably retain the plunger member in assembled relationship with the sleeve, the web of said sleeve including one or more additional openings laterally spaced from said central opening and extending axially only partially therethrough, and spring means disposed between the first portion of the plunger member and the web to extend into each of the additional openings and to bias the plunger member away from the web.

2. A pushbutton actuator adapted for mounting on a supporting wall comprising a supporting sleeve having a transverse web with a central opening extending axially therethrough, a pushbutton member which is slidably disposed in the sleeve, said sleeve having a first portion which has a periphery larger than the opening and a second portion which has a periphery smaller than the opening to define a shoulder at the line of junction between said first and second portions which is adapted to bear against one side of the supporting wall, the second portion of the sleeve including one or more projecting portions on the outer periphery spaced from the shoulder and adapted to engage the other side of the supporting wall and to releasably retain the sleeve on the wall, said pushbutton member including a first portion having a cross-section larger than the opening through the web disposed on one side of the web and a second slotted portion having a cross-section smaller than the opening and extending through the opening of the web, the slotted portion of the pushbutton including one or more projecting portions adapted to engage the other side of the web and to releasably retain the pushbutton member in assembled relation with the sleeve, the web of said sleeve including one or more additional openings laterally spaced from said control opening and extending axially only partially therethrough, and spring means disposed inside the sleeve between the web and the first portion of the pushbutton member to extend into each of the additional openings and to bias the pushbutton member away from the web.

3. A pushbutton operator comprising a supporting sleeve having a transverse web with a substantially rectangular opening therein, a plunger member slidably disposed in the sleeve, said plunger member including a first portion which has a cross-section larger than that of the opening in the web and which is disposed on one side of the web and a second slotted portion which has a substantially rectangular cross-section smaller than that of the opening in the web and which substantially fills the opening, the second portion of the plunger member being formed of a resilient material and extending through the opening in the web, one or more projecting tabs integrally formed with the second portion of the plunger member to engage the other side of the web and to releasably retain the plunger member in the sleeve, and spring means disposed inside the sleeve between the web and the first portion of the plunger member to bias the first portion of the plunger member away from the web, the second portion of the plunger member including an axially extending opening only at the end away from the first portion which is adapted to receive an actuating member of an associated apparatus.

4. A pushbutton operator comprising a supporting sleeve having a transverse web with a substantially rectangular opening therein, and a plunger member slidably disposed in the sleeve, said plunger member including a first portion which has a cross-section larger than that of the opening in the web and which is disposed on one side of the web and a second slotted portion which has a substantially rectangular cross-section smaller than that of the opening in the web and which substantially fills the opening, the second portion of the plunger member being formed of a resilient material and extending through the opening in the web, and one or more projecting tabs integrally formed with the second portion of the plunger member to engage the other side of the web and to releasably retain the plunger member in the sleeve, the first portion of the plunger member including one or more openings extending axially from adjacent the second portion of the plunger member through part of the first portion and spring means disposed between the web and the first portion of the plunger member to extend into each of the latter openings and to bias the first portion of the plunger member away from the web.

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