July 2, 1968 S. L. FRANK 3,391,257

MAINTAINED-POSITION INTERLOCKING MECHANISM FOR INTERLOCKING A PAIR OF PUSHBUTTON SWITCHES

Filed Feb. 14, 1967 2 Sheets-Sheet 1

FIG. 1

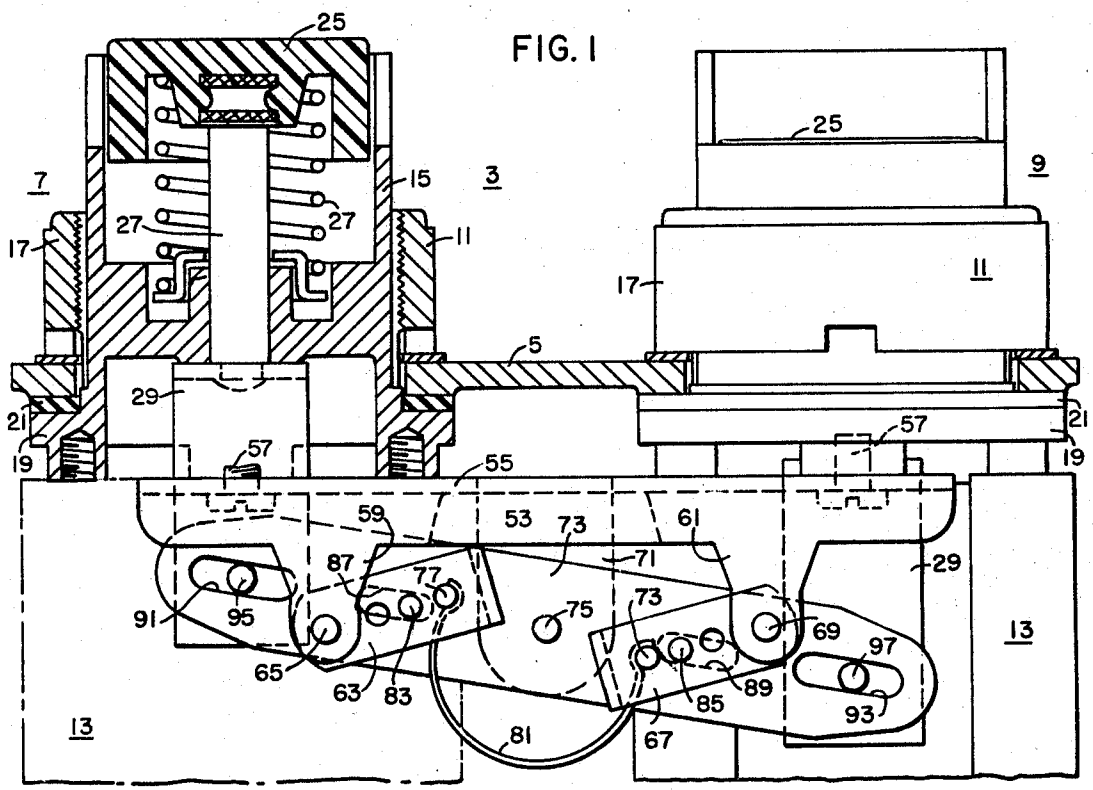
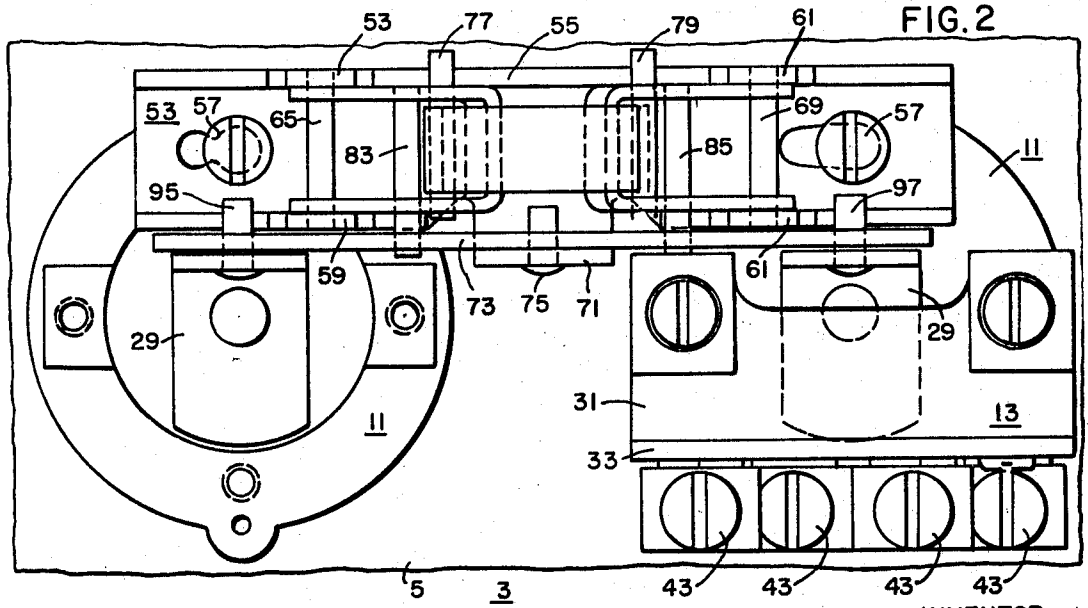


FIG. 2



WITNESSES

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FIG. 3

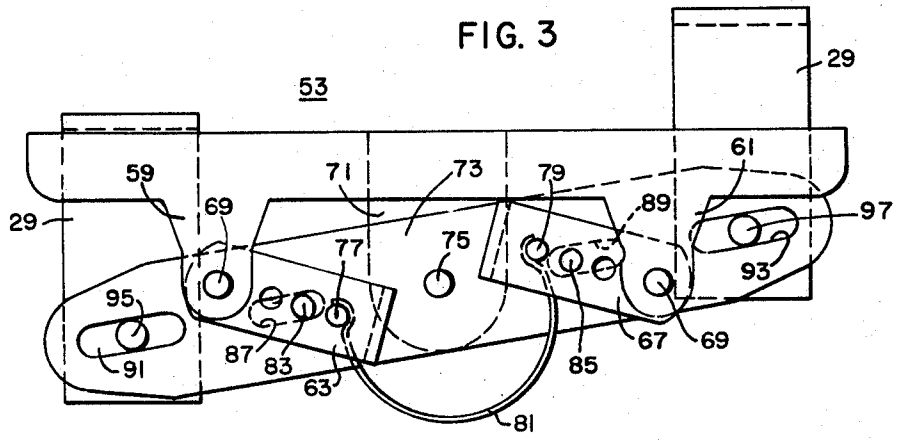
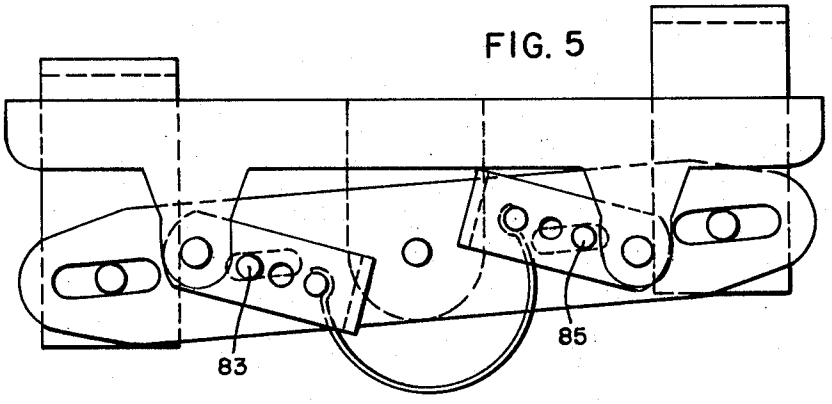


FIG. 5



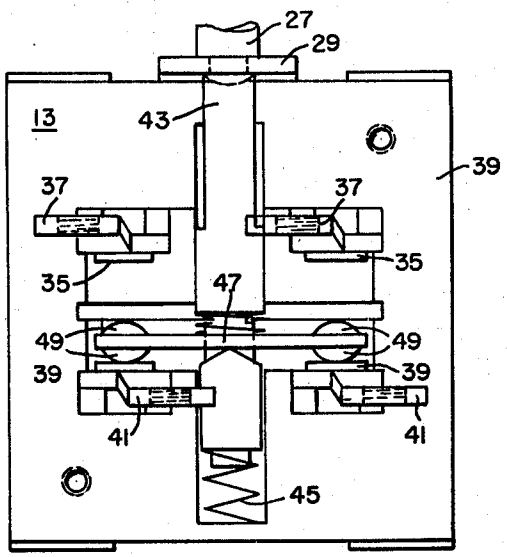


FIG. 4

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3,391,257

MAINTAINED-POSITION INTERLOCKING MECHANISM FOR INTERLOCKING A PAIR OF PUSHBUTTON SWITCHES

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10 Claims. (Cl. 200—5)

ABSTRACT OF THE DISCLOSURE

A maintained-position interlocking mechanism for interlocking a pair of pushbutton switches for operation between two maintained positions.

An improved interlocking mechanism comprises a support and an elongated connecting arm pivotally mounted on the support intermediate the ends thereof with means for connecting operating structures of two pushbutton switches to the connecting arm at opposite sides of the pivot. A pair of link members are pivotally mounted on the support on opposite sides of the pivot of the connecting arm. The link members are connected to the connecting arm at opposite sides of the pivot of the connecting arm by lost-motion connecting means. An over-center spring connects the link members. When one of the pushbutton operators is depressed the interlocking mechanism is operated over center to raise the pushbutton operator. The over-center spring maintains the connecting arm, and therefore the pushbutton operators, in position until the other pushbutton operator is depressed. The link of the lever arm of each link member between the pivotal support thereof and the position where the link member is connected to the connecting arm can be adjusted so that the interlocking mechanism can be used with push buttons having different dimensions of operator travel.

An object of this invention is to provide an improved maintained-position interlocking mechanism for interlocking a pair of pushbutton switches for seesaw type operation between two maintained positions.

Another object of this invention is to provide an improved maintained-position interlocking mechanism that is adapted so that the mechanism can be adjusted to be used with pushbuttons having different dimensions of operator travel.

Another object of this invention is to provide an improved maintained-position over-center spring interlocking mechanism for interlocking a pair of pushbutton switches.

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

FIGURE 1 is a side view partly in elevation and partly in section, with parts broken away and with one contact block shown in phantom, of an electric control device constructed in accordance with principles of this invention;

FIG. 2 is a bottom view, with parts broken away and with one contact block removed, of the control device shown in FIG. 1;

FIG. 3 is a side elevational view of the interlocking mechanism of FIG. 1, which mechanism is shown in the other operating position;

FIG. 4 is a side view of one of the contact blocks of FIG. 1 taken from the side opposite that seen in FIG. 1 with the side cover of the contact block removed for the purpose of clarity; and

FIG. 5 is a view similar to FIG. 3 of the interlocking mechanism of FIG. 3 adjusted to operate with pushbuttons having a different dimension of operator travel.

Referring to the drawings, there is shown in FIGS. 1 and 2 an electric control device 3 comprising a metallic supporting panel member 5 having two pushbutton switches 7 and 9 mounted thereon. The pushbutton switches 7 and 9 are of identical construction, and each comprises an operating structure 11 and a contact block 13. Each of the pushbutton switches comprises a support 15 that extends outward through an opening in the panel 5, and a clamp ring 17 that is threaded on the support 15 to draw the support upward such that a flange 19 on the support 15 is drawn against a gasket 21 which is drawn against the underside of the panel 5 to support the pushbutton switch on the panel 5. Each of the pushbutton switches comprises a pushbutton operator 25 biased to the upper position by means of a spring 27. Each of the operators 25 comprises a shaft portion 27 that extends through an opening in the support 15 and a generally L-shaped plate member 29 that is fixedly secured to the lower end of the shaft 27.

As can be seen in FIG. 4, each of the contact blocks 13 comprises an insulating housing block 31 having a cavity therein. An insulating cover 33 (FIG. 2) is removed in the FIG. 4 showing. A first pair of stationary contacts 35 are secured to conductors 37 that extend out through openings in the cover 33 and a second pair of stationary contacts 39 are secured to conductors 41 that also extend out through openings in the cover 33. The conductors 37 and 41 are provided with openings therein for receiving connecting screws 43 (FIG. 2) that are used at the installation to connect conducting wires to the contact block 13. An insulating contact carrier 43 is supported in the cavity for recitilinear up-and-down movement and biased to the upper position seen in FIG. 4 against the lower surface of the plate member 29 by means of a spring 45. An elongated bridging conductor 47, that is carried by the carrier 43, is provided with four contacts 49 that are positioned at the ends of the conductor 47 on opposite sides of the conductor as seen in FIG. 4. Vertical movement of the carrier 43 moves the movable contacts 49 of the bridging conductor 47 into and out of engagement with the pairs of stationary contacts 35 and 39 in a well-known manner.

An over-center spring maintained-position interlocking mechanism 53 (FIGS. 1–3) is supported on the pushbutton switches 7, 9 to interlock the switches for maintained position seesaw type operation. The interlocking mechanism 53 comprises a generally U-shaped rigid metallic support 55 that is secured to the supports 19 of the two pushbutton switches by means of a pair of screws 57. The support 55 comprises a first pair of depending leg portions 59 and a second pair of depending leg portions 61. A generally U-shaped link member 63 is pivotally mounted on the leg portions 59 by means of a pin 65. Another link member 67 is pivotally secured to the depending leg portions 61 by means of a pin 69. The support 55 also comprises an integral depending support part 71. An elongated connecting arm 73 is pivotally supported midway between the ends thereof on the depending part 71 by means of a pin 75. As can be understood with reference to FIGS. 1 and 3, each of the U-shaped link members 63 and 67 is provided with three pairs of aligned openings (in addition to the openings which receive the supporting pins) that extend through the opposite legs thereof. A pair of spring-support pins 77 and 79 are secured to the link members 63, 67 respectively in the inside openings of the link members 63, 67. An over-center leaf spring 81 is connected at the opposite ends thereof to the pins 77, 79 in a compressed bowed condition to connect the link members 63, 67. A pair of pin mem-

bers 83 and 85 are secured to the link members 63, 67 respectively in the center openings of the three pairs of aligned openings of the link members 63, 67. The elongated connecting arm 73 is provided with a pair of opposite slots 87 and 89 on opposite sides of the pivots 75, and the pins 83, 85 extend out through the legs of the link members 63, 67 (FIG. 2) into the slots 87, 89 respectively to provide a lost-motion slot-and-pin type operative connection between the links 63, 67 and the elongated connecting arm 73. The elongated connecting arm 73 is formed with a pair of slots 91 and 93 therein in proximity to the ends thereof, and a pair of pins 95 and 97, that are secured to the depending leg parts of the members 29 that are connected to the opposite switches 7, 9, extend into these slots 91, 93 to provide lost-motion slot-and-pin type connections between the members 29 and the connecting arm 73.

As can be seen in FIG. 1, the operator 25 of the switch 9 is in the depressed position wherein the bridging contact member 47 bridges the lower stationary contacts 39 (FIG. 4) of the associated contact block, and the operator 25 of the switch 7 (FIG. 1) is in the upper position wherein the associated bridging contact member 47 bridges the upper contacts 35 (FIG. 4) of the associated contact block 13. The pushbutton operators 25 of the switches 7, 9 are maintained in the position seen in FIG. 1 by means of the over-center spring maintained-position interlocking mechanism 53. As can be seen in FIG. 1, the spring 81 biases the link member 67 in a counterclockwise direction about the pivot 69 and the spring 81 biases the link member 63 in a counterclockwise direction about the pivot 65. This force is transmitted through the slot-and-pin connections 85, 89 and 83, 87 to bias the connecting arm 73 in a clockwise direction about the pivot 75. This force is transmitted through the connecting arm 73 by virtue of the slot-and-pin connections 93, 97 and 91, 95 to bias the member 29 of the switch 9 to the lower position seen in FIG. 1 and to bias the member 29 of the switch 7 to the upper position seen in FIG. 1. The limits of movement of the switches 7, 9 and the mechanism 53 are determined by engagement of the members 29 and 25 of the switches with the associated support parts 15.

When it is desired to operate the control device 3, the pushbutton operator 25 of the switch 7 is manually depressed to the lower position thereof to move the associated bridging contact member into engagement with the associated lower stationary contacts and to operate through the connecting arm 73 to effect movement of the bridging contact member of the switch 9 to the upper position into engagement with the upper stationary contacts of the switch 9. During this movement, the pin 95 of the switch 7 moves in the slot 91 to rotate the connecting arm 73 in a counterclockwise direction about the pivot 75. During this movement, the links 63, 67 are operated by means of the slot-and-pin connections 87, 83 and 85, 89 respectively such that the links are moved in clockwise directions about their pivots 65, 69 respectively. During this movement, the pin 97 of the member 29 of the switch 9 is moved upward to move the pushbutton operator 25 of the switch 9 upward to the upper position. As the connecting arm 73 is pivoted from the position seen in FIG. 1 to the position seen in FIG. 3, the connecting arm 73 moves to a horizontal position and the link members 63, 67 move to horizontal positions during which movement the spring 81 is compressed as the spring support pins 77, 79 move closer to each other. When an imaginary line drawn through the centers of the pins 65, 83, 77, 75, 79, 85, 69 is horizontal, the parts are on dead center, and additional movement will move the parts over center whereupon the spring 81 will operate with a snap action to move the link members 63, 67 clockwise about their respective pivots 65, 69 to the position seen in FIG. 3. During this movement, the links 63, 67 operate through the slot-in-pin connections 87, 83 and 89, 95 respectively to move the connecting arm 73 to the position seen in FIG. 3, which movement of the connecting arm 73 operates through the slot-and-pin connections 91, 95 and 93, 97 respectively to move the members 29 to the position seen in FIG. 3. Movement of the parts is limited in the mainner that was described with reference to FIG. 1. The spring member 81 operates to bias the parts of the position seen in FIG. 3 to thereby provide that the pushbutton switches will be maintained in position until a subsequent manual operation which operation would be effected by depressing the pushbutton operator 25 of the switch 9. It can be understood that the spring 81 serves to provide a positive action during each operation of the control device 3 and to maintain the control device 3 in position after each manual operation until a subsequent manual operation. As can be understood with reference to FIGS. 1 and 3, the mechanism 53 ties the pushbutton switches 7, 9 together for seesaw type maintained-position operation in the manner hereinbefore described.

The maintained-position interlocking mechanism 53 described with reference to FIGS. 1–4 is constructed to provide effective over-center operation to the over-center operating positions seen in FIGS. 1 and 3 under the control of the two pushbutton switches 7 and 9 that are constructed with a certain dimension (for example 3/8 inch) of travel of the pushbutton operators 25 (FIG. 1) and contact carriers 43 (FIG. 4). The interlocking mechanism 53 can be adjusted to provide over-center maintained-position interlocking between two pushbutton switches having a lesser dimension (for example 3/16 of an inch) of travel of the operators 25 and contact carriers 43. The adjusted interlocking mechanism is shown in FIG. 5. For the purpose of clarity, only two reference characters are utilized in FIG. 5 to highlight the adjusted condition of the interlocking mechanism. The interlocking mechanism of FIG. 5 is exactly like that of FIGS. 1–3 except that the pins 83 and 85 that connect the link members 63 and 67 respectively to the connecting arm 73 have been moved from the center holes in which they appear in FIG. 3 to the holes that are positioned between the pivots of the link members and the center holes. The lengths of the lever arms of the link members 63 and 67 have therefore been reduced from the lengths shown in FIG. 3, wherein the length extends from the pivots 65, 69 to the pins 83, 85 respectively that are positioned in the center holes of the three holes shown in each of the links in FIG. 3, to the lesser lengths seen in FIG. 5 wherein the lengths extend from the pivots 65, 69 to the pins 83, 85 respectively that are positioned in the openings that are closest to the pivots of the link members 63, 67. Thus, the over-center spring member will be operated between the two maintained over-center operating positions under the control of pushbutton operators that have a lesser dimension of operator travel than that described with reference to FIGS. 1–3. The interlocking mechanism FIG. 5 will interlock a pair of pushbutton switches in the same manner as that described with reference to FIGS. 1–4. Interlocking mechanisms constructed in accordance with this invention have been successfully tested on pushbutton switches having a dimension operator travel of 3/8 of an inch (constructed in accordance with the embodiment of FIGS. 1–3) and also with pushbutton switches having a dimension of operator travel of 3/16 of an inch (constructed in accordance with the embodiment of FIG. 5). It can be understood that an interlocking mechanism could be constructed with a plurality of openings therein for a plurality of different adjusted over-center maintained-positions and that the mechanism could be utilized with different pushbutton switches having a plurality of different dimensions of operator travel by merely changing the position of the pin that is mounted on the link members and that extends into slots in the connecting arm to operatively connect the link members with the connecting arm.

Having described the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the structural details and arrangement of parts without departing from some of the essential features of the invention.

I claim as my invention:

1. A maintained-position mechanism for interlocking a pair of pushbutton switches, said mechanism comprising support means, an elongated connecting arm pivotally mounted intermediate the ends thereof on said support means, a pair of link members, means pivotally mounting said link members on said support means on opposite sides of the pivot of said connecting arm, means connecting said connecting arm with said link members, over-center spring means connecting said link members, said connecting arm being reciprocally pivotal between two positions, upon each operation of said connecting arm between said two positions said connecting arm driving said link members to operate said over-center spring means over-center, and said over-center spring means in each of the two over-center positions operating to maintain said connecting arm in position until a subsequent operation of said connecting arm.

2. A maintained-position mechanism according to **1**, and means for connecting said connecting arm to a pair of pushbutton operators on opposite sides of the pivot of said connecting arm.

3. A maintained-position mechanism according to claim **2**, and said means connecting said connecting arm with said link members comprising a separate slot-and-pin type connection between each of said link members and said connecting arm.

4. A maintained-position mechanism according to claim **2**, and said over-center spring means comprising a flat leaf spring connected in a bowed position between said link members.

5. A maintained-position mechanism according to claim **4**, and said means connecting said connecting arm with said link members comprising a separate slot-and-pin type connection between each of said link members and said connecting arm.

6. A maintained-position mechanism according to claim **3**, and each of said separate slot-and-pin type connections between each of said link members and said connecting arm being adjustable to vary the length of the lever arm of each link member between the pivot of the link member and the associated slot-and-pin type connection.

7. A maintained-position mechanism according to claim **1**, said support comprising a generally U-shaped support member comprising a first pair of spaced leg supports and a second pair of spaced leg supports, each of said link members comprising a generally U-shaped member, a first of said link members being pivotally supported between said first pair of spaced leg supports and the second of said link members being pivotally supported between said second pair of spaced leg supports, said link members extending from the pivots thereof toward each other, each of said link members comprising a spring supporting pin supported between the associated legs in proximity to the free end of the link member, said over-center spring means being connected between said spring supporting pins, each of said link members comprising a connecting pin positioned between the pivot thereof and the associated spring supporting pin, said elongated connecting arm having a pair of slots therein on opposite sides of the pivot thereof, and said connecting pins of said link members being positioned in said slots to provide a separate lost-motion slot-and-pin type connection between each of said link members and said connecting arm.

8. A maintained-position mechanism according to claim **7**, and means for repositioning the connecting pin on each of said link members to vary the lever arm of each link member which lever arm extends from the pivot of the link member to the slot-and-pin connection of the link member with the connecting arm.

9. A maintained-position mechanism according to claim **7**, and said over-center spring means comprising a leaf spring supported between said link members on said spring supporting pins in a bowed condition.

10. A maintained-position mechanism according to claim **9**, and said connecting arm having a pair of slots therein at opposite ends thereof for receiving a pair of pin members of a pair of push-button operators to thereby provide for over-center maintained-position seesaw type operation of said pushbutton operators.

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