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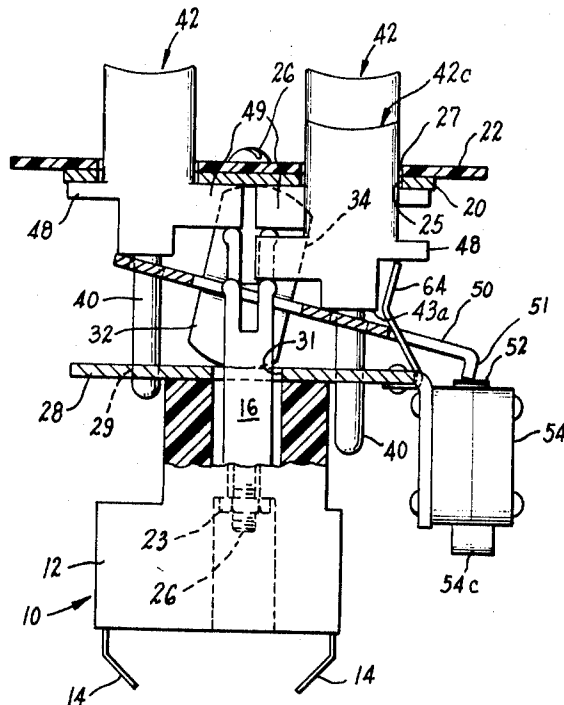
[54] **MULTIPLE PUSHBUTTON SWITCH WITH  
IMPROVED ACTUATING MEANS**  
19 Claims, 5 Drawing Figs.

[52] U.S. Cl..... **200/5 R,  
200/5 E, 200/153 T**

[51] Int. Cl..... **H01h 9/26,  
H01h 3/00**

[50] Field of Search..... **200/5 R, 5  
A, 5 E, 153 T, 159 A, 172 R**

**ABSTRACT:** A broad range of switch operation is provided by an assembly using conventional multiple pushbutton switch for selective electrical connection of a plurality of terminals, a second switch, and a housing providing a pivot assembly and two rows of operating pushbuttons. The operating pushbuttons control the conventional switch directly and the second switch indirectly by means of the pivot assembly which discriminates between the rows of buttons depressed so that the second switch serves to double the range of the basic conventional pushbutton switch.



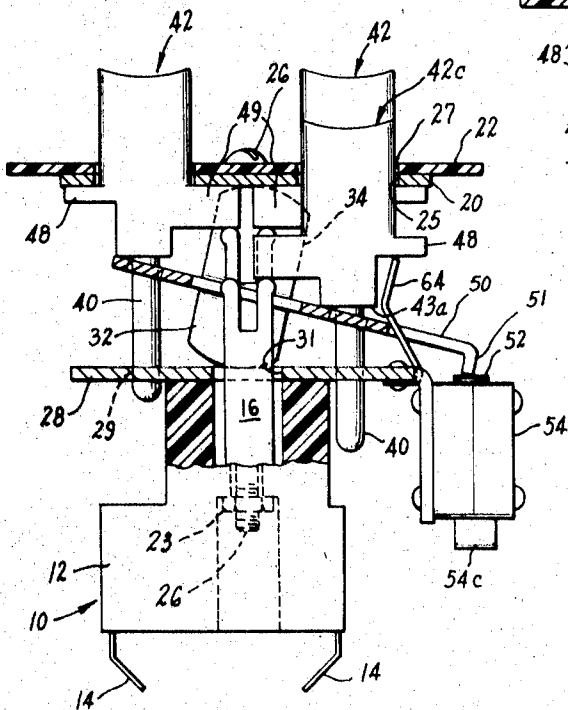
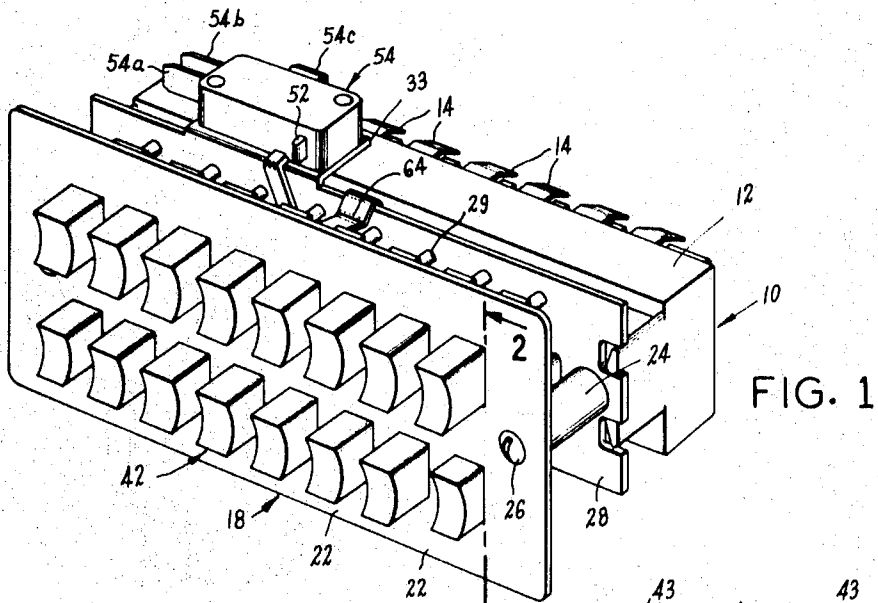


FIG. 2

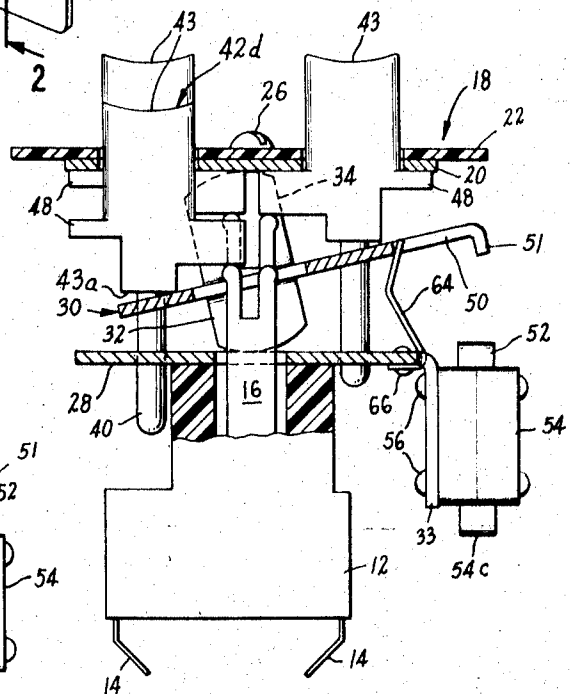


FIG. 3

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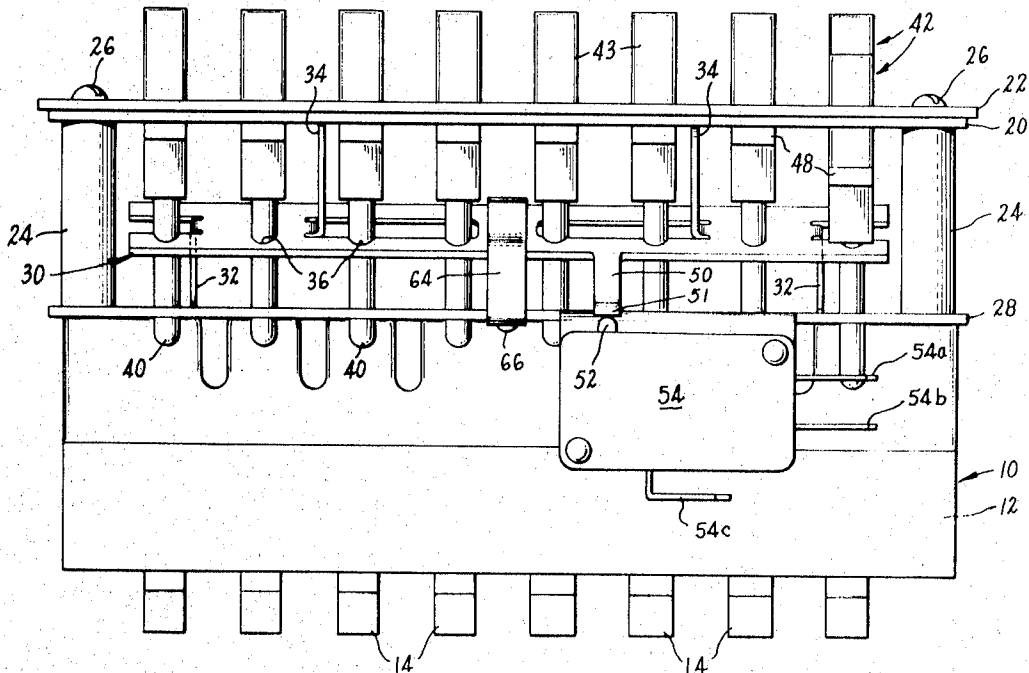


FIG. 4

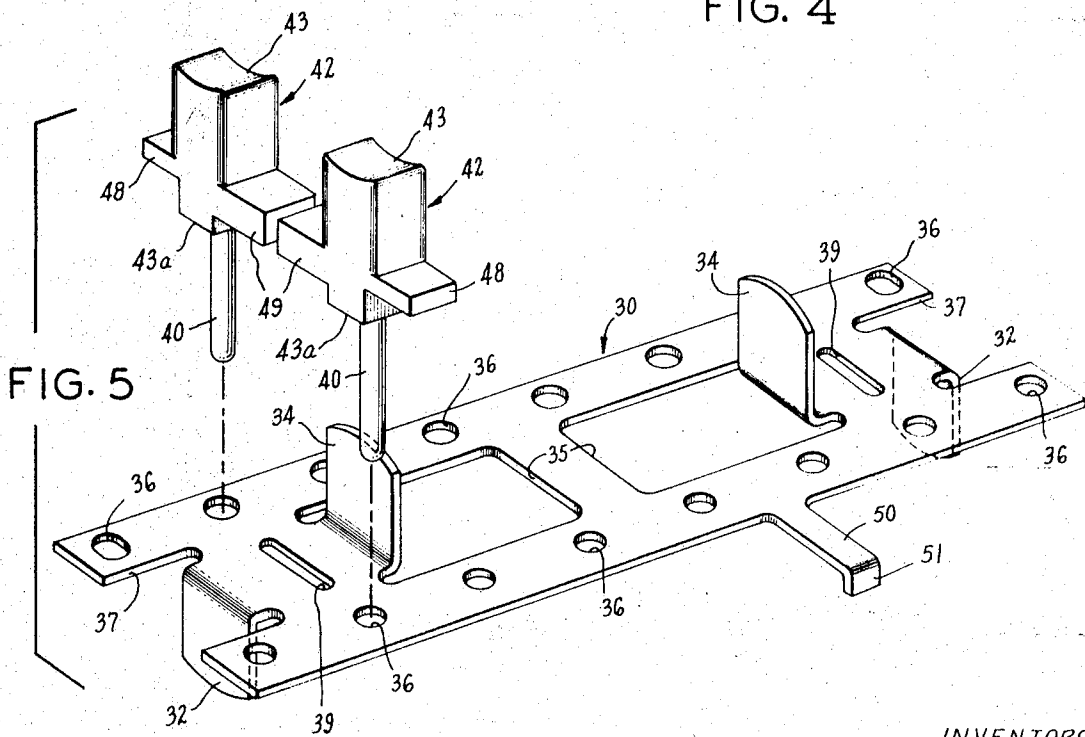


FIG. 5

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## MULTIPLE PUSHBUTTON SWITCH WITH IMPROVED ACTUATING MEANS

### BACKGROUND OF THE INVENTION

Various pushbutton switch assemblies have been proposed such as the multiple pushbutton type switch shown in Kimball, U.S. Pat. No. 3,071,659. This conventional switch has a plurality of push rods or elongated operating buttons arranged in parallel aligned relationship. The operating buttons extend outwardly through appropriate apertures in a top wall of an insulating body. Each operating rod has a curved actuating portion at its lower end to cooperate with various inclined working surfaces formed in sliders. The sliders selectively cooperate with the actuating portions in a well-known manner to provide a switch interlocking and actuating mechanism. The sliders reciprocate longitudinally and actuate moveable contact supporting arms to effect the opening and closing of predetermined contact pairs.

In certain product applications, it is desirable to have many discrete switch combinations to facilitate more complete control, as for example, the motor speed in an appliance mixer or food blenders which typically employs a tapped motor field. Switch assemblies heretofore employed, include that shown in Edwards et al. U.S. Pat. No. 3,420,969, which by means of spring-biased pushbuttons and cooperating spring detents insures that when one pushbutton is depressed, it will stay in position until another button or the "off" button is depressed. This and similar prior art structures do not provide a sufficient number of pushbuttons in the space available and in addition utilize a large number of springs which are difficult to assemble and increase the cost of the material used in the device.

Accordingly, it is an object of the present invention to provide a novel multiple pushbutton switch assembly having a relatively large number of pushbuttons closely spaced together to provide a relatively large number of control positions.

It is also an object to provide such a switch assembly which contains relatively few operating springs and which may be readily assembled.

Another object is to provide such a switch assembly in which the discrete switch combinations possible in an incorporated conventional switch are greatly increased while utilizing minimum space and at relatively low cost with parts which may be easily manufactured and assembled.

### SUMMARY OF THE INVENTION

It has now been found that the foregoing and related objects may be readily attained in a multiple pushbutton switch assembly comprising a housing having a face plate with a multiplicity of apertures therein and a stationary pivot portion disposed below the faceplate. The apertures are arranged in two aligned rows carrying a plurality of pairs of cooperating apertures in the two rows. Each aperture receives a pushbutton for sliding movement perpendicularly to the faceplate between outer and inner positions, thus providing a plurality of aligned pairs of pushbuttons in the two rows of apertures. A first switch means rigidly engaged with the housing has a plurality of terminals and a plurality of operating buttons projecting from its surface towards the faceplate. Each pair of cooperating pushbuttons is aligned and engageable with a particular operating button therebetween so that when a pushbutton is depressed to the inner position, an operating button is also depressed or actuated. The first switch means includes means for connecting predetermined terminals in response to selective operation of the pushbuttons so that actuation of the operating button moves predetermined electrical contacts to connect predetermined terminals.

A second switch means is rigidly seated on the housing and has a plurality of terminals and second means for selectively connecting predetermined terminals so as to allow maximum selectivity. Carried by the housing between said faceplate and said second switch means is a pivot member having depending leg portions pivotably supported on the pivot portion for

pivotal movement thereof about an axis parallel to and extending between the rows of pushbuttons. The pivot member and the pushbuttons have cooperating portions engageable upon depression of the pushbuttons for pivotal movement of the pivot member about the axis between first and second positions. Accordingly the pivot member is pivotable about the pivotal axis between first and second positions in response to depression of pushbuttons in different rows and is engageable upon pivotal movement to one position thereof with the second switch means for operation of the second means to selectively connect predetermined terminals thereof. The depression of a pushbutton in one of the rows produces both depression of an operating button of the first switch means to operate the first means and pivoting of the pivot member to operate the second means of the second switch means. In this manner, connection of various terminals in both of the switch means is produced concurrently to double the range of the first switch means.

In its usual aspect, the leg portions of the pivot member pivotably bear on the outer surface of the pivot portion of the housing. Preferably, the pivot member includes upstanding arm portions which bear against the inner surface of the faceplate to stabilize the pivotal movement thereof, and the legs and arms both have convex outer end surfaces. The housing desirably includes a leaf spring detent engageable with the pivot member and biasing the pivot member to one of the pivoted positions thereof.

In one form, the pushbuttons of the switch assembly are configured to provide stop portions disposed inwardly of the faceplate and of larger dimension than the apertures therein for limiting the outward movement thereof.

The pushbuttons are elongated and have portions of reduced dimension extending through cooperating apertures in the pivot member, the portions of larger dimension abutting against the portion of the pivot member about the apertures to effect pivotal movement thereof, the pushbuttons thus serving to stabilize the pivotal movement of the pivot member.

Preferably the pivot portion extends across the housing below the pivot member and is provided with apertures through which said reduced portions of the pushbuttons extend for guidance thereof.

In its usual aspect, the leg portions of the pivot member pivotably bear on the outer surface of the pivot portion of the housing. Preferably, the pivot member includes upstanding arm portions which bear against the inner surface of the faceplate to stabilize the pivotal movement thereof, and the legs and arms both have convex outer end surfaces. The housing desirably includes a leaf spring detent engageable with the pivot member and biasing the pivot member to one of the pivoted positions thereof.

In one form, the pushbuttons of the switch assembly are configured to provide stop portions disposed inwardly of the faceplate and of larger dimension than the apertures therein for limiting the outward movement thereof. The pushbuttons are elongated and have portions of reduced dimension extending through cooperating apertures in the pivot member, the portions of larger dimension abutting against the portion of the pivot member about the apertures to effect pivotal movement thereof, the pushbuttons thus serving to stabilize the pivotal movement of the pivot member. Preferably the pivot portion extends across the housing below the pivot member and is provided with apertures through which said reduced portions of the pushbuttons extend for guidance thereof.

In its preferred aspect, the pushbuttons are normally gravitationally biased against said pivot member and no spring biasing members are employed for this purpose. First and second means for selectively connecting predetermined terminals each comprise a pushbutton momentary three terminal switch and a slider-type interlocking switch having inclined working surfaces. Normally the pivot member biases one of the rows of the pushbuttons outwardly in either one of the pivoted positions thereof, and the row biased outwardly is other than that of the pushbutton last depressed.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a multiple pushbutton switch assembly embodying the present invention;

FIG. 2 is a view in partial section to an enlarged scale along the line 2-2 of FIG. 1 showing the pivot member in one pivoted portion thereof and the operating button in dotted line in both its extended and its depressed or actuated positions;

FIG. 3 is a similar view showing the relationship of the parts after rotation of the pivot member in the opposite direction by depression of a pushbutton in the other row;

FIG. 4 is an elevational view to an enlarged scale of the switch assembly of FIG. 1; and

FIG. 5 is a perspective view of the pivot member and two pushbuttons in exploded relationship for illustrating the construction thereof in greater detail.

## DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Turning now in detail to the attached drawings, therein illustrated is a multiple pushbutton switch assembly embodying the present invention and having a first switch generally designated by the numeral 10 with a casing 12 and a plurality of electrical terminals 14 depending from one face thereof. The switch 10 has a plurality of narrow width operating rods or buttons 16 projecting from the other face thereof and arranged in a single row in parallel relationship. Each operating button 16 is slidable inwardly and outwardly of the casing 12 and is constructed to operate contacts (not shown) within the casing 12.

The operation and construction of the illustrated switch 10 is disclosed and described fully in Kimball U.S. Pat. No. 3,071,659. The upstanding operating buttons 16 engage inclined working surfaces formed in sliders (not shown) within the switch casing 12 to provide selective connection of internal contacts (not shown) with various of the external terminals 14. As described in the Kimball patent, the sliders reciprocate longitudinally and actuate movable contact supporting arms to effect the opening and closing of predetermined contacts.

The switch 10 is rigidly mounted on the housing generally designated by the numeral 18 and which has a face plate 20 and a decorative escutcheon 22 thereon. Adjacent the ends of the faceplate 20 are tubular posts 24 which space the baseplate 28 therefrom, and the several elements are held together by the machine screws 26 which are engaged in threaded apertures in the casing 12 of the first switch 10 or by a nut 23. The faceplate 20 and escutcheon 22 have two rows of aligned apertures 25, 27 formed therein and arranged in a plurality of cooperating pairs extending along the length thereof, and the base plate 28 is formed with a plurality of generally circular apertures 29 aligned therewith and extending in rows along its longitudinal side margins all for a purpose to be described more fully hereinafter. In addition, the baseplate 28 has apertures 31 in the central portion thereof between the rows of circular apertures 29 and through which the operating buttons 16 of the first switch extend.

Depending from one longitudinal edge portion of the baseplate 28 is a leg portion 33 upon which is mounted by the rivets 56 a second switch generally designated by the numeral 54. Projecting upwardly from the switch 54 is its operating button 52 designed to selectively connect two of the three spade-type terminals 54a, 54b and 54c depending upon whether the button 52 is in its depressed or extended position.

Pivotably mounted within the housing 18 between the faceplate 20 and baseplate 28 is a pivot member generally designated by the numeral 30 and which has depending leg portions 32 and upstanding arm portions 34 bearing respectively on the outer surface of the baseplate 28 and the inner surface of the faceplate 20. Extending from one side margin of the pivot member 30 in the plane of the body portion thereof is an arm portion 50 with a finger portion 51 extending in the direction of the second switch 54 and adapted to bear upon the operating button 52 to effect depression thereof when pivoted in that direction.

As best seen in FIG. 5, the pivot member 30 has a pair of large apertures 35 in the central portion thereof and a pair of notches 37 at the end thereof formed as a part of the operation in which the leg portions 32 and arm portions 34 are stamped from the metal body. In addition, there is a pair of small slots 39 spaced therebetween, and the operating rods 16 of the first switch 10 extend through these several openings. Spaced along both longitudinal edge portions of the pivot member 30 are rows of aligned circular apertures 36 providing a plurality of pairs of apertures aligned with the apertures 29 of the baseplate 28 and the aperture 25 of the faceplate.

Slidably seated in the apertures 36 of the pivot member 30 and apertures 29 of the baseplate 28 are the elongated cylindrical portions 40 of the pushbuttons generally designated by the numeral 42. The pushbuttons 42 have head portions 43 which slidably seat in the apertures 25, 27 in the faceplate 20 and escutcheon 22 respectively and project outwardly thereof for manual operation. As best seen in FIG. 5, the pushbuttons 42 are formed with parallel extending shoulders 48, 49 which abut against the inner surface of the face plate 20 to limit movement outwardly thereof, and the shoulders 49 extend over the operating buttons 16 so as to effect operation thereof when depressed. The apertures 36 in the pivot member 30 are dimensioned and configured to permit pivotal movement thereof about the cylindrical portions 40 of the pushbuttons 42, but it will be appreciated that these cylindrical portions 40 serve to limit unwanted sidewise movement thereof.

The pivot member 30 is held in either pivoted position by a V-shaped leaf spring 64 which bears against the edge thereof and which is mounted on the baseplate 28 by the rivet 66.

Turning now in detail to the operation of the illustrated switch assembly, depression of any pushbutton 42 causes its centrally disposed generally planar shoulder 49 to depress an aligned cooperating operating button 16 of the first switch 10 to move electrical contacts (not shown) within the casing 12 to connect particular predetermined terminals 14. Similarly, depression of the button 42 in the other row providing the other button of an aligned pair will cause depression of the same operating button 16.

Referring particularly to FIG. 2, depression of any one of the right-hand (as viewed) pushbuttons 42, such as the one designated 42c causes the lower extremity 43a of head portion 43 to abut against pivot member 30 thereof and causes movement to the clockwise pivoted position shown wherein finger 51 of the arm portion 50 depresses the button 52 of the second switch 54. This will cause closing of predetermined contacts (not shown) within the switch 54 to introduce a second set of characteristics into the circuit controlled by the predetermined terminals 14 of the first switch 10.

The movement of pivot member 30 is a rocking action about the tips of leg and arm portions 32, 34 bearing respectively on baseplate 28 and the inner surface of faceplate. The rocking action of pivot member is controlled by the cooperating dimensioning and configuration of the pivot member surfaces defining the apertures 36 thereof and of the generally cylindrical portions 40 of the pushbuttons 42 which extend therethrough as well as of the slots 39 and operating buttons 16 which extend therethrough. This control insures proper alignment of the finger 51 with the button 52 for operation of the second switch 54.

Referring now to FIG. 3, depression of any one of the left-hand (as viewed) pushbuttons 42 such as the one designated as 42d which together with 42c forms a cooperating pair, causes the generally planar extremity 43a of head portion 43 of the pushbutton to abut against the pivot member 30 on the opposite side of its pivotal axis to produce rocking movement thereof in a manner similar to that described above. The constraints on the sidewise movement of the pivot member 30 by the cylindrical portions 40 and operating buttons 16 are also similar. The pivot member 30 is biased to either the clockwise or counterclockwise pivoted positions shown respectively in FIG. 2 and FIG. 3 by the V-shaped leaf spring 64 which acts against the side edge of the pivot member 30 as best seen in FIGS. 2 and 3. It will be appreciated that the desired operation

may be achieved without any spring but somewhat more reliable operation may be achieved by the use of a single leaf spring 64 which biases the pivot member 30 to either extreme of pivoted movement. In this connection, the biasing of the pivot member 30 to either clockwise or counterclockwise positions is accomplished more specifically by the overcenter action obtained with the generally V-shaped leaf spring 64 bearing on the side edge of pivot member 30. In the clockwise angular position of pivot member 30 the biasing action drives, and insures positive contact by, the finger 51 of the arm 50 on button 52 which in turn avoids bouncing of the momentary contacts of the second switch means 54.

As described before the depression of any one of a particular pair of pushbuttons such as 42a and 42b causes depression of a particular operating button 16 causing the connection of particular predetermined terminals 14 of the first switch 10. As also described, depending upon the row of the pushbutton 42 selected, a particular predetermined connection of the contacts 54a, 54b and 54c of the second switch 54 occurs. Thus, it will be apparent that pushing a pushbutton 42 can actuate both the first and second switch means to accomplish the object of increasing the number of switching combinations provided by the first switch through the auxiliary circuitry controlled by the second switch, thus effectively doubling the amount of circuit combinations.

In accordance with the particular application of the switch assembly various interconnections of the terminals both within the two switches and externally may be made in accordance with well-known techniques by those skilled in the art to effectively utilize the large number of pushbuttons and associated discrete switch positions utilizing a minimum of space. The types of switches employed may be varied from those shown in the drawings with appropriate modifications of the cooperating members.

Thus, it can be seen that the switch assembly of the present invention is easy and relatively inexpensive to manufacture and assemble from a minimum number of parts. It affords a large number of pushbuttons that are closely spaced together to provide a relatively large number of switch combinations provided by the first switch through the control of the second switch. The structure contains relatively few operating springs and provides the required switching in a minimum space.

In the preferred embodiment, the first switch selectively connects various motor field taps and the second switch switches a diode in or out of the control circuitry to attain the desired motor speed control. Other connections that are possible include using the second switch to selectively connect a single resistor in series with circuitry associated with the first switch which will also connect increments of resistance. Alternatively the second switch may connect one of two windings in the same motor to the first switch means and the first switch can then connect selectively incremental resistance in series with the windings being used.

We claim:

1. A multiple pushbutton switch assembly for operating an electrical device by variation in an electrical control circuit comprising:

- a. a housing having a faceplate with a multiplicity of apertures therein and also having a stationary pivot portion disposed below said faceplate, said apertures being arranged in two aligned rows providing a plurality of aligned pairs of cooperating apertures in the two rows;
- b. a pushbutton slidably received with in each of said faceplate apertures for sliding movement inwardly and outwardly of said faceplate between outer and inner positions; and providing a plurality of aligned pairs of cooperating pushbuttons in the two rows of said apertures;
- c. a first switch means rigidly engaged with said housing and having a plurality of terminals and a plurality of operating buttons projecting from its surface towards said faceplate, one operating button being aligned with a pair of cooperating pushbuttons and engageable by the pushbut-

tons of said pair when a pushbutton is depressed to said inner position thereof for actuation thereof, said first switch means including first means for connecting predetermined terminals in response to selective operation of said pushbuttons,

d. second switch means rigidly seated on said housing and having a plurality of terminals and second means for selectively connecting predetermined terminals,

a pivot member carried by said housing between said faceplate and said second switch means having depending leg portions pivotably supported on said pivot portion for pivotal movement thereof about an axis parallel to and extending between said rows of pushbuttons, said pivot member and pushbuttons having cooperating portions engageable upon depression of said pushbuttons for pivotal movement of said pivot member about said axis between first and second positions, said pivot member being pivotable about said axis between first and second positions in response to depression of pushbuttons in different rows and being engageable upon pivotal movement to one position thereof with said second switch means for operation of said second means to selectively connect predetermined terminals thereof, said depression of a pushbutton in one of said rows producing both depression of an operating button of said first switch means to operate said first means and pivoting of said pivot member to operate said second means of said second switch means thereby producing connection of various terminals in both of said switch means concurrently.

2. The switch assembly of claim 1 wherein said pushbuttons are normally gravitationally biased against said pivot member.

3. The switch assembly of claim 1 wherein said leg portions pivotably bear on the outer surface of said pivot portion.

4. The switch assembly of claim 1 wherein the pivot member includes upstanding arm portions bearing against the inner surface of said faceplate to stabilize the pivotal movement thereof, said leg and arm portions both having convex outer end surfaces.

5. The switch assembly of claim 3 wherein said pushbuttons are configured to provide stop portions inwardly of said faceplate and of larger dimension than the apertures therein for limiting the outward movement thereof.

6. The switch assembly of claim 4 wherein said pushbuttons are elongated and have portions of reduced dimension extending through cooperating apertures in said pivot member, the portions of larger dimension abutting against the portion of said pivot member about said apertures to effect pivotal movement thereof, said pushbuttons thus serving to stabilize the pivotal movement of said pivot member.

7. The switch assembly of claim 5 wherein said pivot portion extends across said housing below said pivot member and is provided with apertures through which said reduced portions of said pushbuttons extend to serve as a guide for said pushbuttons.

8. The switch assembly of claim 7 wherein said first and second switch means comprise respectively a slider-type interlocking switch having inclined working surfaces and a pushbutton momentary three terminal switch.

9. The switch assembly of claim 8 wherein said pivot member biases one of said rows of said pushbuttons outwardly in either one of the pivoted positions thereof.

10. The switch assembly of claim 9 wherein the row of said pushbuttons biased outwardly is the row other than that of the pushbutton last depressed.

11. The switch assembly of claim 10 wherein said housing includes a leaf spring detent engageable with said pivot member and biasing said pivot member to one of said first and second positions thereof.

12. A multiple pushbutton switch assembly for operating an electrical device by variation in an electrical control circuit comprising:

- a. a housing having a faceplate with a multiplicity of apertures therein and also having a stationary pivot portion

disposed below said faceplate, said apertures being arranged in two aligned rows providing a plurality of aligned pairs of cooperating apertures in the two rows;

- b. a pushbutton slidably received with in each of said faceplate apertures for sliding movement inwardly and outwardly of said faceplate between outer and inner positions and providing a plurality of aligned pairs of cooperating pushbuttons in the two rows of said apertures, said pushbuttons being only gravitationally biased to said inner position;
- c. a first switch means rigidly engaged with said housing and having a plurality of terminals and a plurality of operating buttons projecting from its surface towards said faceplate one operating button being aligned with a pair of cooperating pushbuttons and engageable by the pushbuttons of said pair when a pushbutton is depressed to said inner position thereof for actuation thereof, said first switch means further including first means for connecting predetermined terminals in response to selective operation of said pushbuttons;
- d. second switch means rigidly seated on said housing and having a plurality of terminals and second means for selectively connecting predetermined terminals;
- e. a pivot member carried by said housing between said faceplate and said second switch means for pivotal movement thereof about an axis parallel to and extending between said rows of pushbuttons, said pivot member and pushbuttons having cooperating portions engageable upon depression of said pushbuttons for pivotal movement of said pivot member about said axis between first and second positions, said pivot member being pivotable about said axis between first and second positions in response to depression of pushbuttons in different rows and being engageable upon pivotal movement to one position thereof with said second switch means for operation of said second means to selectively connect predetermined terminals thereof, said depression of a pushbutton in one of said rows producing both depression of an

operating button of said first switch means to operate said first means and pivoting of said pivot member to operate said second means of said second switch means thereby producing connection of various terminals in both of said switch means concurrently.

13. The switch assembly of claim 12 wherein said pushbuttons are configured to provide integral stop portions inwardly of said faceplate and of larger dimension than the apertures therein for limiting the outward movement thereof.

14. The switch assembly of claim 13 wherein said pushbuttons are elongated and have portions of reduced dimension extending through cooperating apertures in said pivot member, the larger portion of larger dimension abutting against the portion of said pivot member about said apertures to effect pivotal movement thereof, said pushbuttons thus serving to stabilize the pivotal movement of said pivot member.

15. The switch assembly of claim 14 wherein said pivot portion extends across said housing below said pivot member and is provided with apertures through which said reduced portions of said pushbuttons extend to serve as a guide for said pushbuttons.

16. The switch assembly of claim 15 wherein said first and second means for selectively connecting predetermined terminals comprise a slider type interlocking switch having inclined working surfaces and a pushbutton momentary three terminal switch.

17. The switch assembly of claim 16 wherein said pivot member biases one of said rows of said pushbuttons outwardly in either one of the pivoted positions thereof.

18. The switch assembly of claim 17 wherein the row of said pushbuttons biased outwardly is the row other than that of the pushbutton last depressed.

19. The switch assembly of claim 18 wherein said housing includes a leaf spring detent engageable with said pivot member and biases said pivot member to one of said first and second positions thereof.

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