

Nov. 7, 1967

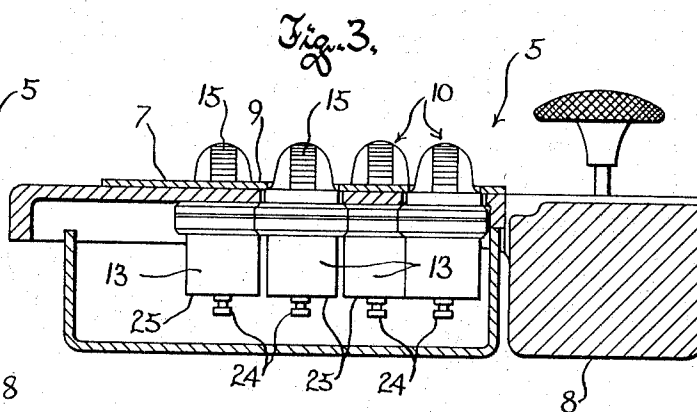
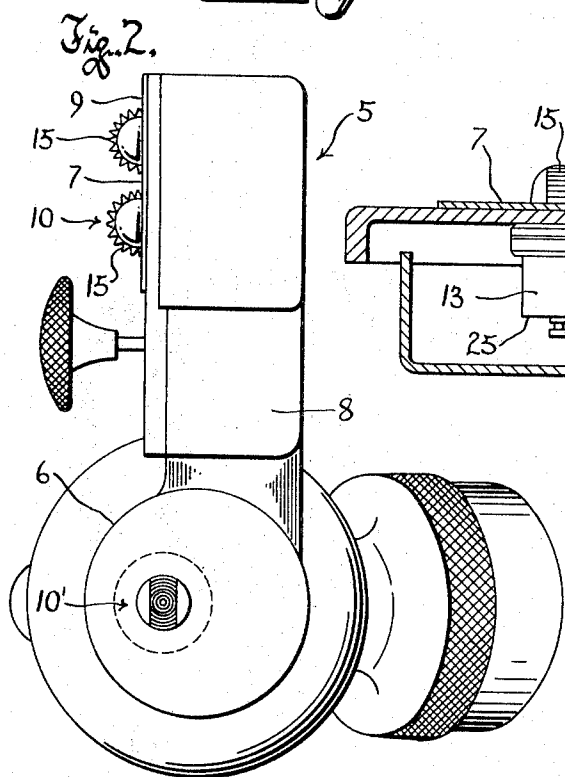
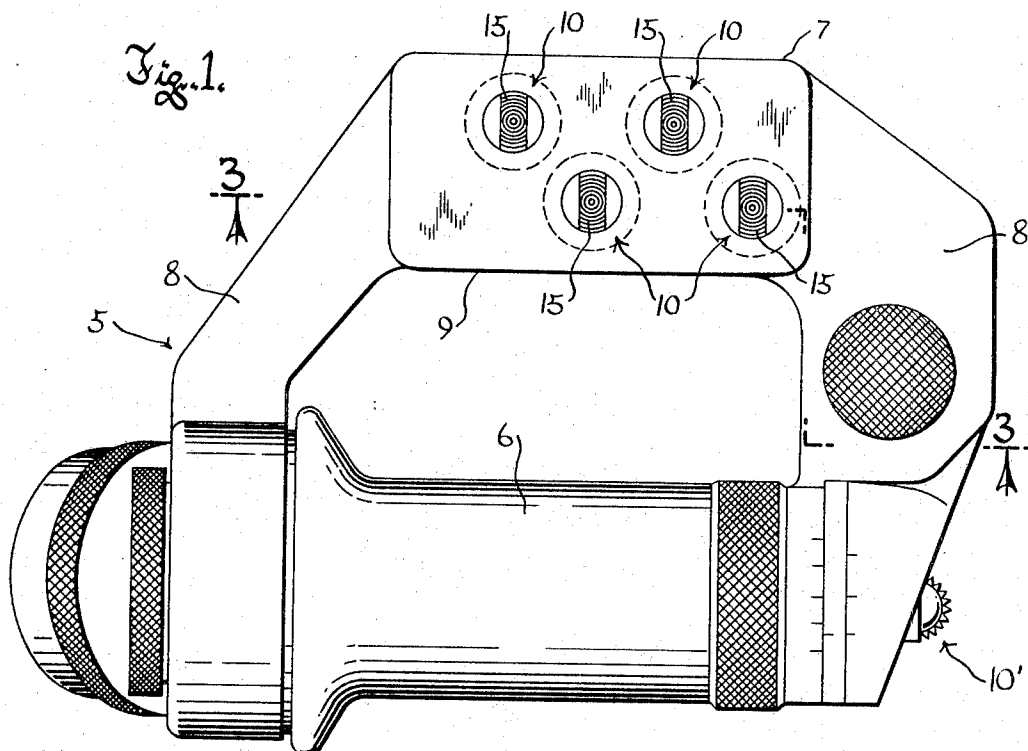
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3,351,729

SWITCH MEANS FOR SELECTIVE CONTROL OF PLURAL CIRCUITS

Filed June 20, 1966

3 Sheets-Sheet 1



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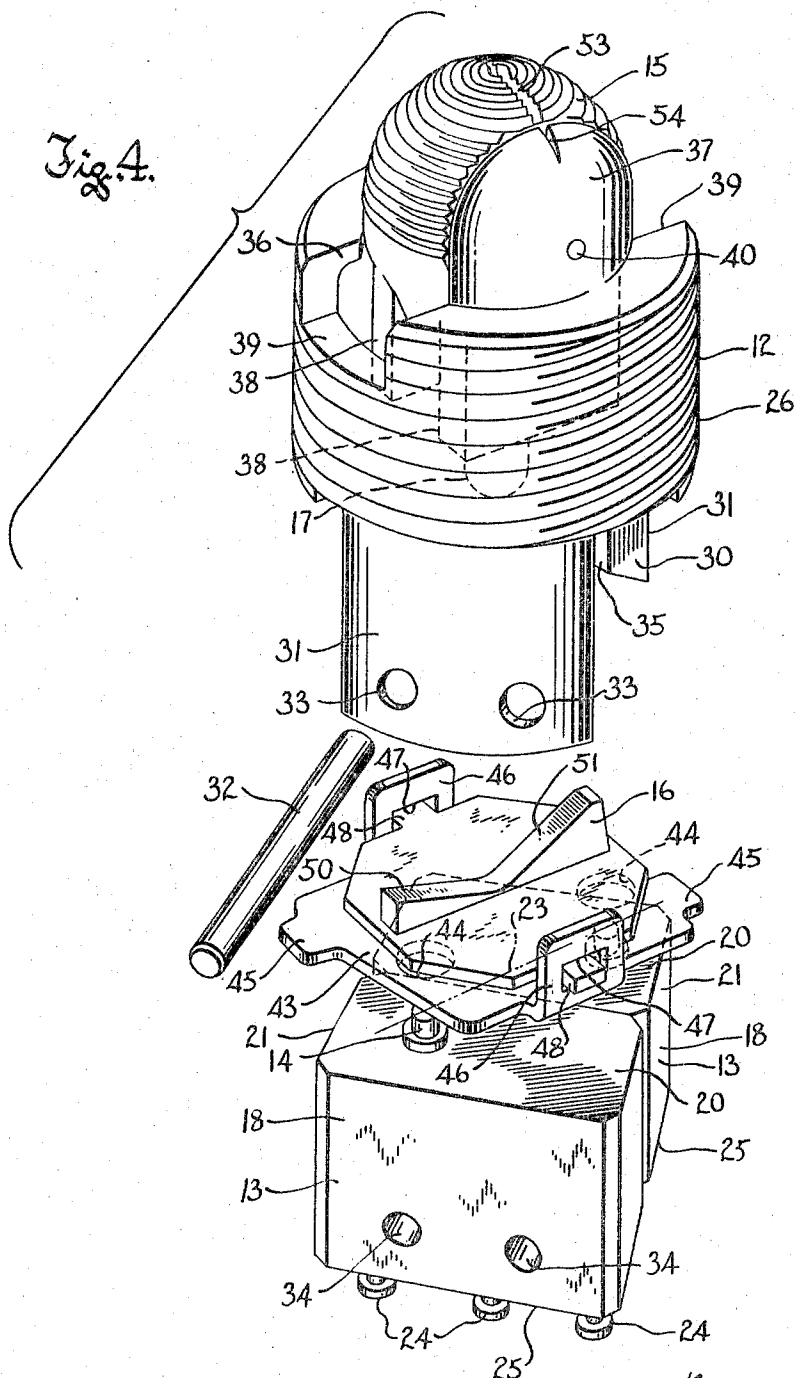
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SWITCH MEANS FOR SELECTIVE CONTROL OF PLURAL CIRCUITS

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3 Sheets-Sheet 2



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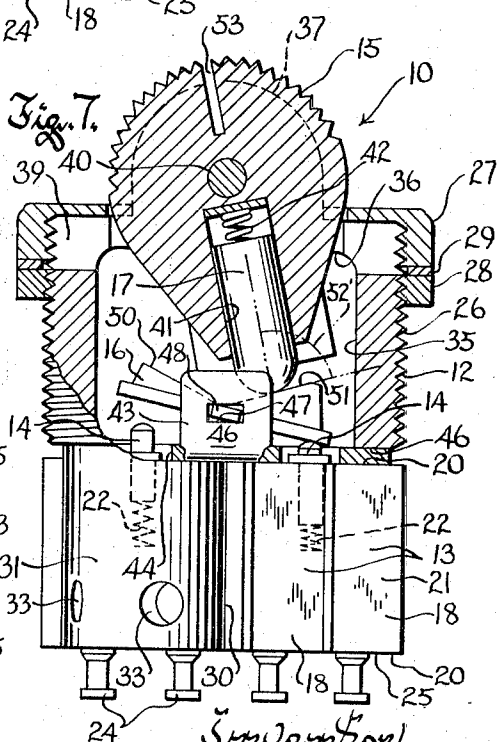
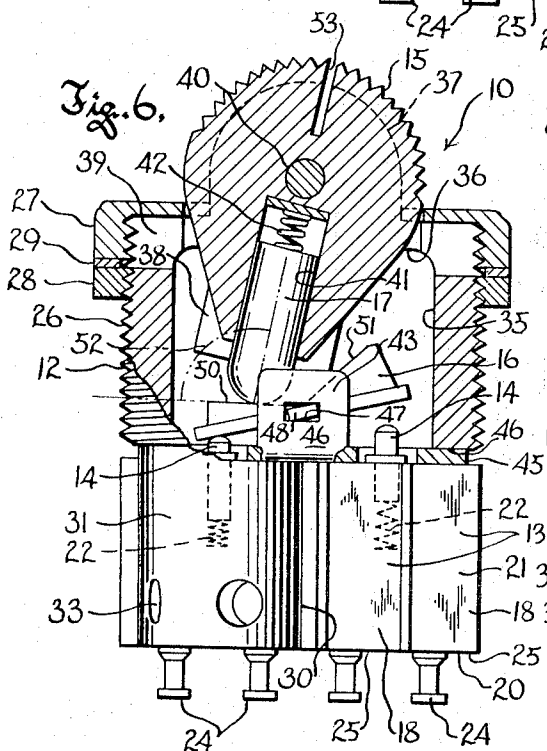
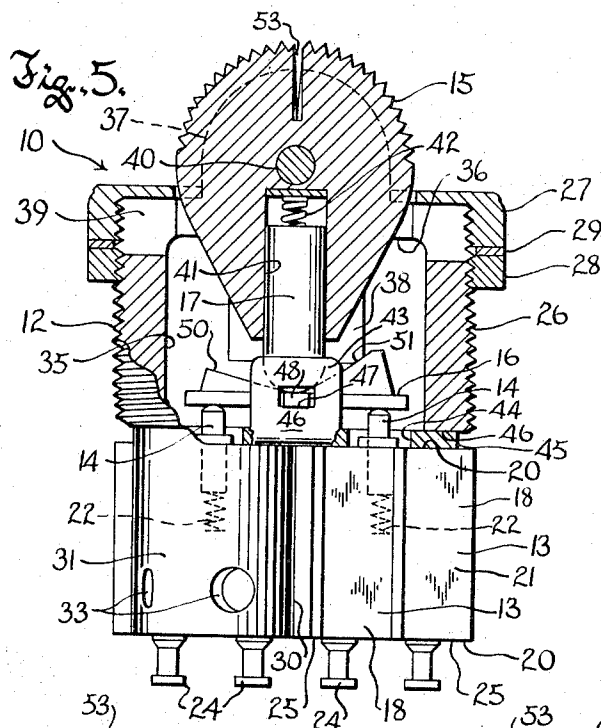
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SWITCH MEANS FOR SELECTIVE CONTROL OF PLURAL CIRCUITS

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3 Sheets-Sheet 3



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SWITCH MEANS FOR SELECTIVE CONTROL OF PLURAL CIRCUITS

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5 Claims. (Cl. 200—172)

ABSTRACT OF THE DISCLOSURE

Selective actuation, by means of a single toggle lever, is provided for a pair of pushbutton microswitches, each having a parallelepiped casing and a pushbutton projecting from a side surface of the casing near one end thereof. The switch casings are fixed side-by-side with their pushbuttons uppermost and remote from one another. A rocking lever which is cam actuated by the toggle lever has its opposite arms over the pushbuttons and tends to be biased to a neutral position by them.

This invention pertains to means for selectively actuating a pair of pushbutton switches, and the invention relates more particularly to a switch assembly comprising a pair of microswitches or the like and an actuating lever that is adapted to be moved in opposite directions from a neutral position in which both switches are in their normal conditions, to operative positions in each of which one of the switches is in its actuated condition.

The general object of this invention is to provide a switch assembly comprising a pair of pushbutton microswitches and a single actuating lever by which they can be selectively actuated, which assembly is adapted for fingertip operation and can be incorporated into a control actuator handle or the like so that an operator can control a plurality of instrumentalities selectively and simultaneously with one hand. Thus, by way of example, one or more switch assemblies of this invention can be incorporated into a throttle control handle for the engine of an aircraft, in an arrangement such that when the palm of an operator's hand is on the throttle handle, he can actuate the switch actuating lever or levers with his fingertips and thereby effect simultaneous and selective management of a plurality of instrumentalities with one hand. Such an arrangement is particularly desirable for helicopters, inasmuch as the helicopter pilot, in maneuvering close to the ground, must at all times keep his left hand on a collective pitch lever which incorporates a rotatable motorcycle type throttle control, and his right hand on a cyclical pitch control lever that resembles the joy stick of a fixed wing aircraft.

As will be apparent from the example just given, it is also a general object of this invention to provide a very simple, dependable and extremely compact assembly comprising a pair of pushbutton microswitches and means comprising a single actuating lever for selectively actuating the microswitches.

It will also be apparent that it is another object of this invention to provide an assembly of the character described, comprising a pair of microswitches, each biased to a normal position, and means for selectively actuating one or the other of the switches so as to prevent simultaneous actuation of both of them.

Another and very important object of this invention is to provide an assembly of the character described, comprising a pair of pushbutton switches and a switch actuating lever which is swingable in opposite directions from a neutral position to a pair of actuating positions in each of

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which it effects depression of the pushbutton of one of the switches, which assembly can be so arranged that the switch actuating lever tends to remain in one of its operative positions and must be manually returned therefrom but is biased away from its other operative position so as to return automatically to neutral when released, or in which the switch actuating lever can require manual return from both of its operative positions, or can have biased return from both of its operative positions.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the herein disclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

FIGURE 1 is a view in elevation of an aircraft throttle control lever incorporating a plurality of switch assemblies embodying the principles of this invention;

FIGURE 2 is a longitudinal sectional view taken on the plane of the line 2—2 in FIGURE 1;

FIGURE 3 is an end view of the throttle control lever shown in FIGURE 1;

FIGURE 4 is a disassembled perspective view of a switch assembly embodying the principles of this invention;

FIGURE 5 is a view of the switch assembly, partly in side elevation and partly in vertical section, with the actuating lever illustrated in its neutral position in which both pushbutton switches are in their normal conditions; and

FIGURES 6 and 7 are views generally similar to FIGURE 5 but illustrating the switch assembly in its respective operative conditions.

Referring now more particularly to the accompanying drawing, the numeral 5 designates generally a manual control unit which can comprise the free end or handle portion of a lever that is adapted to be swung bodily in opposite directions, as for collective pitch control of the rotor blades of a helicopter, and on which there is a generally cylindrical grip member 6 that is rotatable about its axis for throttle actuation in the manner of a motorcycle throttle control. Projecting laterally from the handle portion of the lever is a U-shaped console bracket 7, the legs 8 of which are fixed to the lever at opposite ends of the rotatable grip member 6 and the bight portion 9 of which supports four switch assemblies 10 of this invention.

When the palm of an operator's left hand is on the grip member 6, the four switch assemblies 10 on the console bracket 7 are all accessible to his left fingertips, and they are so arranged in a staggered row as to readily identify themselves by their positions. A fifth and generally similar switch assembly 10' is mounted on the lever proper, substantially on the rotational axis of the grip member 6 and in a position to be engaged by the tip of the operator's left thumb. Thus assuming that the arrangement illustrated in FIGURES 1-3 is incorporated in a helicopter collective pitch control, it not only affords the pilot control of collective pitch by bodily swinging actuation of the lever 5, and of engine speed by rotation of the grip member 6, but also enables him to use the fingers of his left hand to manage as many as ten other instrumentalities under the control of the switch assemblies 10 and 10'.

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Each switch assembly of this invention comprises a generally tubular housing member 12, a pair of pushbutton switches 13 which can be conventional micro-switches and which are fixed in the lower portion of the housing member 12 with their pushbuttons 14 uppermost, a generally upright actuating lever 15 which is medially pivoted in the upper portion of the housing member, and a generally horizontal rocker lever 16 in the medial portion of the housing member which cooperates with a cam follower 17 carried by the actuating lever to effect actuation of one or the other of the pushbutton switches when the actuating lever is swung in one direction or the other from a neutral position in which its axis substantially coincides with that of the housing member.

Each of the pushbutton switches 13 has a casing 18 in the form of a parallelepiped, and its pushbutton 14 projects from one of the longer narrow faces 20 of the casing, near one end face 21 thereof. The mechanism inside the casing, which is actuated by the pushbutton 14 and which also serves to bias the pushbutton outwardly to a normally projected position, is not illustrated because it is well known to those skilled in the art; but the means for effecting such outward bias upon the pushbutton is schematically represented as a coiled compression spring 22.

It will be understood that the switches 13 can be of the normally open type or the normally closed type, and can be single-pole or double-pole, and that the two pushbutton switches comprising the assembly of this invention can both be of one of these types, or can be of different types. As is conventional, suitable terminals 24 project from the long narrow face 25 of the switch casing that is opposite the face 21 from which the pushbutton projects, to provide for connection of suitable conductors to the switch.

The upper portion 26 of the housing member 12 has a somewhat larger outside diameter than its lower portion and is externally threaded to provide for installation of the housing member in a correspondingly threaded hole in the wall of the console bracket 7 or in a wall of a similar member in which the assembly is to be mounted. The housing member can be locked in place in such an installation by means of locking nuts 27 and 28 threaded onto its uppermost portion and having a washer 29 confined between them.

The smaller diameter lower portion of the housing member 12 has opposite slots 30 which open to its bottom and extend through its full height, so that the housing member can be regarded as downwardly bifurcated and its lower portion can be considered as comprising a pair of opposing wall elements 31 which are arcuate in section as viewed from the bottom of the housing member. The two pushbutton switches 13, in contiguous side-by-side relationship, are confined between these wall elements 31 with their opposite end portions projecting a short distance beyond them at opposite sides of the housing member. The switches are secured to the housing member by means of a pair of pins 32, passing through closely fitting axially aligned holes 33 and 34 in the wall elements 31 and in the switch casings 18, respectively.

The switches are of course mounted with the upper surfaces 20 of their casings coplanar, so that the tops of their pushbuttons 14 are normally in a common plane that is normal to the housing member axis and is of course also normal to the axes of the pushbuttons. Further, the switches are arranged with their respective end surfaces 21 that are nearer the pushbuttons remote from one another, so that the axes of the pushbuttons are on a line 23 which extends obliquely across the upper surfaces of the switch casing, thereby providing substantial spacing between the pushbuttons, as is necessary for dependable operation of the apparatus, without sacrificing compactness of the assembly.

Throughout most of its height the tubular housing member 12 has a bore 35 of uniform diameter, so that

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the inner surfaces of the lower wall elements 31 constitute downward continuations of the inner surface of the upper portion of the housing. At the top, however, the housing member has a radially inwardly projecting circumferential flange 36 which cooperates with the actuating lever 15 to substantially close the top of the housing member and which supports upwardly projecting opposite upper wall elements 37 that have flat, parallel inner surfaces and spherically curved outer surfaces.

The actuating lever 15 is swingably confined in the space between these upper wall elements, which space is continuous with opposite slots 39 that extend through and interrupt the flange 36 and extend down into the uppermost portion of the tubular wall of the housing member.

Attention is directed to the fact that the center line of the slots 39 parallels the line 23 connecting the axes of the pushbuttons and therefore extends obliquely across the switch casings.

The actuating lever 15 has flat, parallel side surfaces and a thickness to closely fit the space between the inner surfaces of the upper wall elements. A pin 40 extends transversely through the actuating lever and into the upper wall elements to pivot the actuating lever for swinging motion. In profile the upper portion of the actuating lever is curved on a substantially uniform radius about the pivot axis of the pin 40 so that in all positions of the actuating lever its upper portion cooperates with the flange 36 in substantially closing the top of the housing member. The outer surface of the actuating lever is spherically curved in correspondence with the spherically curved outer surfaces of the upper wall elements but is ridged to facilitate its actuation with a fingertip.

On its lower portion the actuating lever has laterally projecting shoulders 38 that can engage the bore surface of the housing member to define the limits of swinging motion of the actuating lever. In its lower portion the actuating lever also has a downwardly opening well 41, the axis of which is radial to the axis of the pivot pin 40 and in which is carried the cam follower 17 and a coiled expansion spring 42 that biases the cam follower downwardly relative to the actuating lever. The cam follower 17 comprises a pin that closely slidably fits the well 41 in the actuating lever, so that the cam follower is constrained to back and forth swinging motion with the actuating lever but can move generally up and down relative thereto. The spring 42, which is confined in the upper portion of the well 41, reacts between the actuating lever and the cam follower to maintain the cam follower engaged under bias with the rocker lever 16 therebeneath.

The rocker lever 16 is supported for rocking motion upon a carrier 43, which can comprise a substantially square plate that rests upon the top surfaces 20 of the switch casings 18 and in which there are two holes 44 through which the pushbuttons project upwardly. The carrier is confined against displacement both edgewise and upwards by means of edgewise projecting lugs or tangs 45 that project from a pair of opposite side edges of the carrier, near opposite corners thereof, and which engage in closely fitting shallow slots 46 in the upper portion of the housing member, opening downwardly into the slots 30 that bifurcate the lower portion of the housing member. Projecting upwardly from each of the other two opposite side edges of the carrier is an ear 46 in which there is a rectangular hole 47. The two ears 46, which have their holes 47 axially aligned with one another, serve as fulcrum bearings for the rocker lever, and it will be noted that the bottom edges of the holes 47 are substantially on the above mentioned horizontal plane that touches the tops of the two pushbuttons 14 when the pushbuttons are in their normal projected positions.

The rocker lever 16 can comprise a substantially hexagonal plate having tangs or lugs 48 projecting from a pair of opposite edges thereof and received in the holes

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47 in the ears 46 on the carrier. Because the bottoms of the tangs 48 are flat, as are the bottom edges of the holes 47, the rocker lever tends to maintain a horizontal position, with its bottom surface on the plane just mentioned, although it can of course be rocked out of that position in either direction, to effect depression of one or the other of the pushbuttons 14. The axis of the trunnion or fulcrum defined by the tangs 48 in cooperation with the holes 47 is of course at right angles to the line 23 through the axes of the pushbuttons and midway between them, and is parallel to the axis of the pin 40 about which the actuating lever swings.

The top of the rocker lever is formed to provide a pair of cam surfaces 50 and 51 which extend in opposite lateral directions from the cam axis, along the path of swinging motion of the cam follower, and which are in the form of a shallow V, each being upwardly inclined in the direction away from the rocker lever trunnion axis.

When the actuating lever is in its neutral position (illustrated in FIGURE 5), in which the axis of the cam follower 17 coincides with that of the housing member and intersects the rocker lever trunnion axis, the two pushbutton switches are in their normal conditions with their pushbuttons projected.

When the top of the actuating lever is swung to the right, to cause the cam follower to ride along the left cam surface 50 (the condition illustrated in FIGURE 6), the cam follower and said cam surface cooperate to swing the left arm of the rocker lever downwardly, thereby depressing the lefthand pushbutton therebeneath. When the top of the actuating lever is swung to the left, the right-hand pushbutton is actuated in a similar manner, as illustrated in FIGURE 7.

As herein shown, the left cam surface 50 has a more gradual or shallower inclination than the right cam surface 51. As a consequence, when the actuating lever is swung in the direction to depress the left-hand pushbutton (FIGURE 6 condition) the exterior angle 52, between the cam follower axis and the cam surface 50 is greater than 90°, said angle being measured at the side of the cam follower axis that is remote from the rocker lever trunnion axis. Furthermore, the cam follower spring 42 exerts a biasing force which is greater than the force with which the switch mechanism (schematically represented by the spring 22) urges the pushbutton upwardly. Under these circumstances, the mechanism tends to remain in the condition illustrated in FIGURE 6 unless and until it is manually returned therefrom by swinging the actuating lever back to its neutral position. Thus the switch mechanism actuated by the left-hand pushbutton is of the momentary contact type, but in this assembly it functions in the manner of a two-position switch.

The right-hand cam surface 51 is inclined at a relatively high angle to the bottom surface of the rocker lever, such that the exterior angle 52' between said cam surface 51 and the cam follower axis is less than 90° when the mechanism is in the FIGURE 7 condition, and therefore the spring 42 tends to urge the cam follower back down along said cam surface 51 toward the neutral position of the actuating lever. In other words, because of the steep inclination of the cam surface 51, the actuating lever is biased away from the position in which it depresses the right-hand pushbutton and must be manually held in that position for as long as that pushbutton is to be maintained depressed.

The shoulders 38 on the lower portion of the actuating lever prevent the actuating lever from being swung to a position at which the exterior angle 52' too closely approaches 90°.

It will be appreciated that the rocker lever could be made with both of its cam surfaces inclined at a small angle, like the illustrated left cam surface 50, in which event the actuating lever would have to be manually returned from both of its operative positions; or both cam

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surfaces could be steeply inclined, like the illustrated right cam surface 51, in which case there would be automatic return from both operating positions of the actuating lever.

In the case of a mechanism arranged for manual return from one or both of the operative positions of its actuating lever, it is preferred to provide a well defined mark 53 on the top of the actuating lever, adapted to align with a mark 54 on one or both upper wall elements 37 when the actuating lever is in its neutral position, so that the condition of the mechanism can always be readily ascertained. Preferably such marks take the form of well defined grooves or slots which can be detected by touch as well as visually.

The cam surfaces 50 and 51 come together at a shallow but sharply defined obtuse angle at the trunnion axis of the rocker lever, and the bottom of the cam follower is rounded so as to tend to seat itself in the V thus formed by the cam surfaces. This relationship, in cooperation with the noncircular trunnion defined by the tangs 48 and the rectangular holes 47, causes the mechanism of this invention to have a desirable snap action as the actuating lever is moved to its operative positions, inasmuch as the flat undersurfaces on the trunnion tangs 48 resist tilting of the rocking lever until the cam follower has been moved well away from the rocking lever axis; and for the same reason the actuating lever comes back to its neutral position with a detent-like snap action. It will also be noted that when the mechanism is in its neutral position the spring 42 reacts against the several components of the mechanism in such a manner as to prevent any rattling.

From the foregoing description taken together with the accompanying drawings it will be apparent that this invention provides a convenient, dependable, compact and inexpensive mechanism for selectively actuating either of a pair of pushbutton switches, particularly of the micro-switch type, and that the mechanism of this invention can require manual return to its neutral position from both of its operative positions, or can have automatic return from both of its operative positions, or can have manual return from one of its operative positions and biased automatic return from the other.

What is claimed as my invention is:

1. Switch means for selectively controlling a plurality of circuits comprising:

(A) a pair of pushbutton switches, each having a parallelepiped casing and an axially movable pushbutton which projects from a side surface of the casing, near one end thereof, and which is outwardly biased relative to the casing;

(B) housing means mounting the switches with their casings in fixed side-by-side relationship with said surface of each casing uppermost and coplanar with that of the other so that the tops of the pushbuttons are normally in a common plane parallel to that of said surfaces of the casings, and with said end of each casing remote from that of the other so that a line connecting the axes of the pushbuttons extends obliquely across said uppermost surfaces of the casings;

(C) a rocker lever having a pair of oppositely extending arms, one for each pushbutton;

(D) cooperating trunnion means on the housing means and on the rocker lever, between and transverse to the arms of the latter, mounting the rocker lever with its arms over their respective pushbuttons, said trunnion means defining a rocking axis of the rocker lever which is parallel to said plane and transverse to said line, about which the rocking lever can pivot from a neutral position in opposite directions to a pair of operative positions in each of which the rocker lever depresses one of said pushbuttons;

(E) a generally upright actuating lever;

(F) cooperating pivot means on the housing means

and on the actuating lever, medially pivoting the actuating lever for swinging motion about an axis above and substantially parallel to the axis of said trunnion means;

- (G) a cam follower carried by the lower portion of said actuating lever and constrained to swinging motion therewith and to generally up and down motion lengthwise of the actuating lever; 5
- (H) spring means reacting between the actuating lever and the cam follower to bias the latter generally downwardly, toward the rocker lever; and 10
- (I) means on each arm of the rocker lever defining a generally upwardly facing cam surface that is inclined obliquely upwardly from the axis of the trunnion means, each of said cam surfaces being cooperable with the cam follower, upon swinging of the actuating lever in one direction from a neutral straight up position, to rock the rocker lever to one of its said operative positions. 15

2. The switch means of claim 1 further characterized by: 20

said cooperating trunnion means on the housing means and on the rocker lever having opposing flat surfaces which cooperate with the upwardly biased push-buttons in tending to maintain the rocker lever in its neutral position. 25

3. The switch means of claim 1 further characterized by said cooperating trunnion means comprising:

- (A) a plate resting upon said uppermost surfaces of the casings and which is apertured for projection of the pushbuttons therethrough, said plate 30

- (1) having edgewise projecting portions engaged in recesses in the housing means to be confined thereby against edgewise and upward displacement, and

- (2) having upwardly projecting apertured ears at opposite sides thereof; and

- (B) oppositely projecting tangs on the rocker lever received in said ears on the plate.

4. The actuator of claim 1 further characterized by: (A) the upper portion of said housing means being substantially tubular, with its axis upright;

- (B) said housing means having spaced apart downwardly projecting wall portions between which the switch casings are confined in side-by-side relationship; and

- (C) securement means cooperating with said wall portions and with the switch casings to hold the latter in place in the housing means.

5. The actuator of claim 1, further characterized by: (A) a pair of upwardly projecting laterally spaced apart wall members on the top of the housing means having opposing flat and parallel inner surfaces between which the actuating lever is confined; and

- (B) said pivot means comprising a pin extending transversely through the actuating lever and having its end portions engaged in said upwardly projecting wall member.

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