June 1, 1965 E. F. PIERCE 3,187,133

SNAP ACTION, PUSH BUTTON ELECTRIC SWITCH

Filed March 7, 1963

Fig. 1.

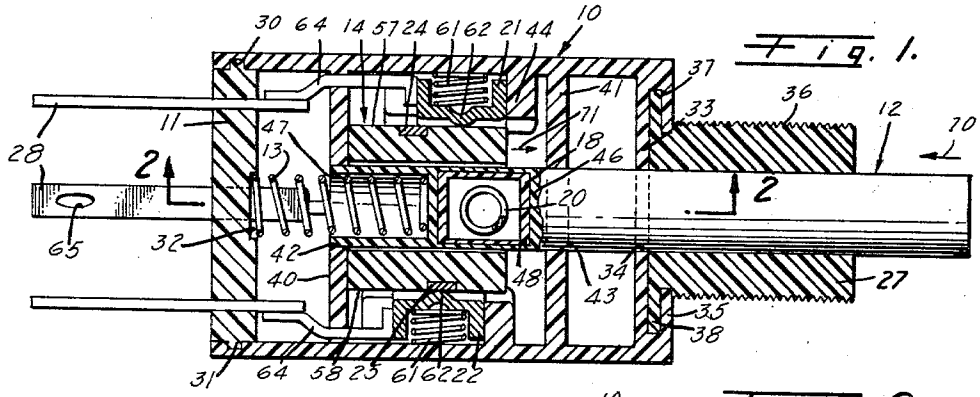


Fig. 2.

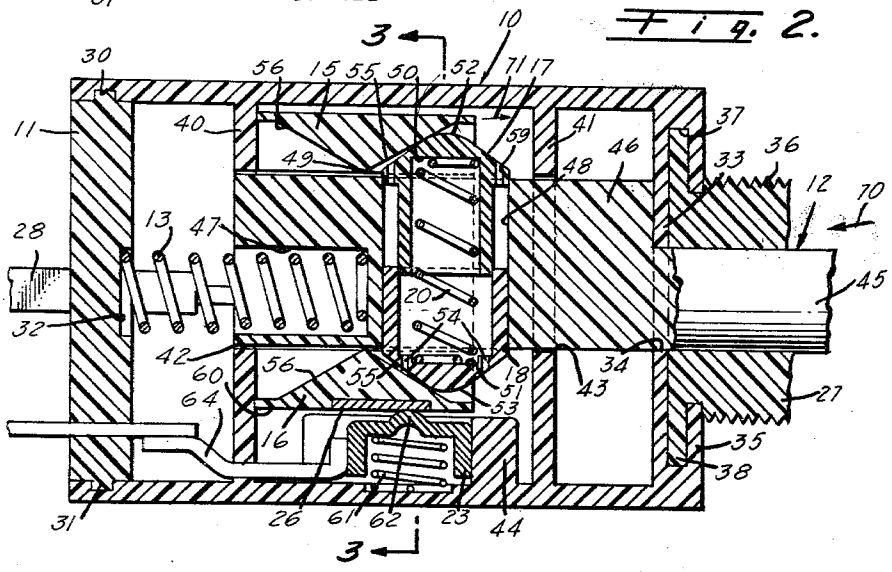


Fig. 3.

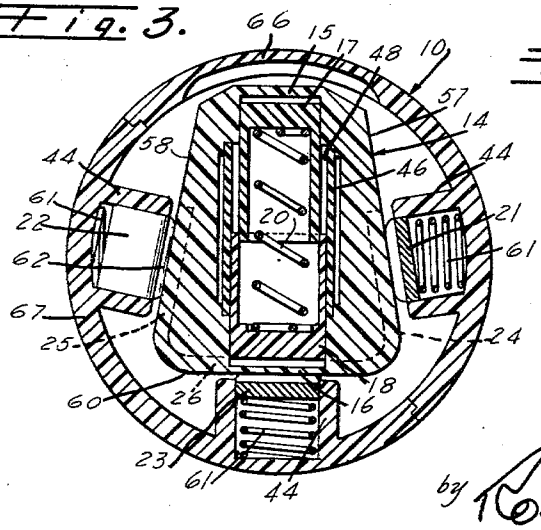
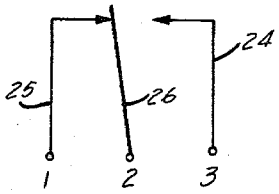


Fig. 4.



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SNAP ACTION, PUSH BUTTON ELECTRIC SWITCH

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This invention relates generally to electromechanical devices and particularly relates to a push button switch having a snap action to provide sudden opening or closing movements of the switch.

In a conventional push button switch, opening or closing of the contacts of the switch takes place at a speed depending upon the operator of the push button. Accordingly, when the contacts are slowly closed, there usually occurs arcing between the contacts before they are actually in contact with each other. The danger of arcing is particularly great when the switch is operated at relatively high voltages. Thus, a push button switch which has a snap action is desirable to minimize arcing. In addition, in a snap action switch, the switches are opened and closed always at the same rate. Thus, arcing and noise are both minimized.

The switch of the present invention is of the sliding contact type. In any sliding contact switch, the contact pressure is of great importance. If the contact pressure is too low the switch contacts may bounce thus causing both arcing and noise or erratic signals. The arcing in due time will corrode the contacts and thus reduce the life of the switch. On the other hand, if the contact pressure is made too high, metal particles are worn off the contacts which are subsequently deposited on the insulating portion of the switch which causes what is known as tracking. Accordingly, a circuit path is provided between the contacts even when they are in their open position.

It is accordingly an object of the present invention to provide a snap action, push button switch which minimizes arcing and which has no tracking problem.

Another object of the present invention is to provide a push button switch where the speed with which the contacts are opened and closed is independent of the operator and remains the same regardless of how fast or slow the push button is depressed or released.

A further object of the present invention is to provide a push button switch of the snap action type which is provided with an insulating lubricant thereby to minimize tracking and which has a long useful life.

Still another object of the present invention is to provide a push button switch of the type referred to which will operate at relatively high voltages and which will carry a relatively large wattage without danger of arcing.

Still a further object of the present invention is to provide a snap action, push button switch which can be readily designed to provide break-before-make operation as well as make-before-break operation.

A snap action, push button switch in accordance with the present invention comprises a push button which is adapted to be depressed from a normal to an actuated position. First spring means are provided for urging the push button into its normal position. There are further provided cam means movable from a normal to an actuated position and back again. The cam means has two inclined surfaces projecting toward and disposed adjacent the push button. A cam follower is slidably disposed in the push button and second spring means urge the cam follower against the inclined surfaces of the cam means.

As a result, when the push button is depressed, the cam follower will ride over one of the inclined surfaces of the cam means thereby to force the cam means to move suddenly in a direction opposite the direction of movement of the push button. When the push button is released again the cam means will return just as suddenly to its original position because its cam follower will again ride over the inclined surfaces of the cam means.

A movable carrier is secured to the cam means and moves therewith. Two brushes are fixedly disposed about the carrier and are in contact with the carrier. A contact member has portions so disposed as to be engageable with both of the brushes in one position of the carrier and as to be disengaged from at least one of the brushes in the other position of the carrier.

Finally, an insulating lubricant is provided on the brushes and the contact member. The insulating lubricant preferably has a high dielectric constant and serves the purpose to embed particles worn off the brushes and the contact member so that they are insulated from each other. This in turn will prevent tracking because the embedded particles from the brushes and the contact member cannot be plated out on the insulating surface of the carrier.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view of a snap action, push button switch embodying the present invention;

FIG. 2 is a longitudinal sectional view taken substantially on line 2—2 of FIG. 1;

FIG. 3 is a cross sectional view of the push button of the invention taken substantially on line 3—3 of FIG. 2; and

FIG. 4 is a circuit diagram of the single-pole, double-throw switch provided by the structure of FIGS. 1 through 3.

Referring now particularly to FIGS. 1 through 3, there is illustrated a snap action, push button switch embodying the present invention. The switch of FIGS. 1 through 3 includes essentially a main housing 10 having a circular cross section as clearly shown in FIG. 3, an end plate 11, a push button 12, extending opposite from the end plate 11 and a return spring 13 disposed between the end plate 11 and the push button. The snap action, push button switch further includes a contact carrier 14 movably disposed in the housing 10 and preferably being formed integral with two cams 15 and 16, two telescoping cam follower members 17 and 18 which are outwardly urged by a spring 20, three spring-biased brushes 21, 22 and 23 and a corresponding set of three contacts 24, 25 and 26. Finally, the switch includes a threaded sleeve 27 and three terminal lugs 28 extending through the end plate 11.

The housing 10 near one of its ends is provided with an annular recess 30 into which extends a similar cylindrical projection 31 of the end plate 11. As a result the end plate 11 closes or seals one end of the housing 10. The end plate 11 which is of generally disc shape is provided with a central cylindrical recess 32 for receiving the return spring 13. The other end of the housing 10 is provided with a disc 33 having a central aperture 34 through which the push button 12 extends and is adapted to slide. The housing 10 is further provided with an outer disc 35 for receiving the sleeve 27 provided with outer threads 36. An annular recess 37 is formed between the two discs 33 and 35 of the housing into which projects a disc 38 of the sleeve 27. The threaded sleeve 27 serves the purpose of securing the push button switch of the invention to a panel which may be fastened to the sleeve 27 by a pair of lock nuts, not shown.

The housing 10 is further provided with two stop walls 40 and 41. Each of the walls 40 and 41 is of generally disc shape and has a central opening 42 and 43 respective-

ly to permit the push button **12** to pass therethrough. The purpose of the two stop walls **40** and **41** is to limit movement of the cam carrier **14** in both directions. Finally, the housing **10** is provided with three spaced receptacles **44** for receiving the three brushes **21, 22** and **23**. Thus, the three brushes are fixedly disposed on the housing **10** with respect to the movable carrier **14**.

The push button **12** has an outer cylindrical portion **45** and an inner portion **46** of elongated or rectangular cross section as clearly shown in FIG. 2. The cylindrical portion **45** of the push button slides through the threaded sleeve **27** and the housing wall **33**. The inner end of the push button **12** has a cylindrical recess **47** for receiving the return spring **13** which urges the push button into its normal position. The enlarged portion **46** of the push button **12** also has a rectangular opening **48** extending therethrough. The two cam followers **17** and **18** are slidably disposed in the rectangular opening **48** which forms a bearing surface for the outer cam follower **18**.

The two cam followers **17** and **18** are hollow and of substantially rectangular cross section as clearly shown in FIG. 1. The spring **20** is disposed inside the two telescoping cam followers **17** and **18** and bears against their respective flat bottom surfaces **50** and **51**. The outer surfaces **52** and **53** of the two telescoping cam followers **17** and **18** are outwardly curved as shown in FIG. 2 but straight at right angles as illustrated in FIG. 3. These surfaces **52** and **53** bear respectively against the surfaces of the two cams **15** and **16**. Each of the two cam followers **17** and **18** is provided with a plurality of apertures **54** to permit air to enter and leave the closed spaces formed between the two cam followers. As pointed out before, the cam follower **18** slides along the bearing surfaces **48** formed in the enlarged portion **46** of the push button **12**. The inner cam follower **17** slides within the outer cam follower **18** and has an enlarged end portion **49** which also contacts the bearing surfaces **48** of the push button.

The two cam followers **17** and **18** cooperate with the two cams **15** and **16** respectively which are preferably made integral with the movable carrier **14**. Thus, the cam **15** has two inclined cam surfaces **55** and **56** which are preferably plane surfaces and which project toward the enlarged portion **46** of the push button **12**. The two cams **15** and **16** are disposed in a plane which intersects the push button and hence they are oppositely arranged with their cam surfaces **55** and **56** facing each other. These flat cam surfaces **55** and **56** of the two cams **15** and **16** in cooperation with the two cam followers **17, 18** cause the snap action of the switch as will be more fully explained hereinafter.

The cam or contact carrier **14** as shown particularly in FIG. 3 forms substantially a triangular prism having three flat surfaces **57, 58** and **60**. The three brushes **21, 22** and **23** are each disposed in contact with one of the respective flat surfaces **57, 58** and **60** of the carrier **14**. The three surfaces **57, 58** and **60** of the carrier **14** are preferably so arranged that the pressures exerted by the three brushes **21** to **23** are at least partially balanced. As pointed out before, the two cams **15, 16** and the carrier **14** are preferably made integral.

A continuous contact member forming the contact portions **24, 25** and **26**, is disposed in the carrier **14** in such a manner that its outer surface is flush with the surfaces **57, 58** and **60** of the armature. The three contact portions **24, 25** and **26** cooperate respectively with the three brushes **21, 22** and **23** in order to open or close electric circuits. Thus, the arrangement preferably is such that one of the contact portions such as **25** is in contact with its associated brush **22** in the normal or nonactuated position of the switch. At the same time the contact portion **24** is out of contact with its brush **21**. Preferably, the contact portion **26** is so disposed and of such a length that it remains in contact with its brush **23** in both the normal and the actuated position of the switch.

The three brushes **21** through **23** are disposed in the three receptacles **44** of the housing **10**. The three brushes are symmetrically disposed about the carrier **14** as clearly shown in FIG. 3 and either contact their cooperating contact portions or are out of contact therewith depending upon the position of the switch. Each of the brushes is urged by a spring **61** which is preferably a coil spring against the respective surfaces **57, 58** and **60** of the carrier. Each of the brushes **21** to **23** preferably consists of a piece of sheet metal which generally is of U-shape as clearly shown in FIGS. 1 and 2 and has a central substantially rectangular projection **62** which is in contact either with the contact portions **24** through **26** or with the carrier surfaces **57, 58** and **60** as the case may be. The two outer end portions of each of the U-shaped brushes may be bent inwardly so that the brush does not have sharp corners.

Each of the three brushes **21, 22** and **23** is electrically connected with one of the terminal lugs **28**. To this end, there may be provided a conductor **64** which may be connected to each brush such as **21** by welding or soldering or the like and which has its other end similarly connected to one of the terminal lugs **28**. The terminal lugs may be provided with an opening **65** for connecting thereto a wire or conductor by welding, soldering or the like. The conductor **64** extends through suitable openings in the receptacles **44** as clearly shown in FIGS. 1 and 2. The connections between the conductors **64** and the respective brushes are such that each brush is permitted to move slightly under the influence of its bias spring **61**.

As clearly shown in FIG. 3, the main housing **3** may consist of two portions **66** and **67**. This will facilitate assembly of the switch and makes it possible to insert both the end cap **11** and the threaded sleeve **27** in the main housing **10**.

Before explaining the operation of the switch of the invention, the materials of which the respective parts of the switch are preferably made will now be explained.

The main housing **10** may be made from a suitable insulating material which may be a plastic material such for example as a polycarbonate. A polycarbonate is a polymer derived from biphenol A or **4, 4'** dihydroxy diphenyl propane. This compound has the chemical formula $C_6H_4—OH—C—CH_3—CH_3—C_6H_4—OH$. Such a polycarbonate is sold in the trade under the name of Lexan by General Electric Company. This plastic material may readily be molded and can be cheaply made in mass production. It is also characterized by great impact strength.

The two housing portions **66** and **67** may be joined together by a suitable cement, by heat sealing or in any other expedient manner. Lexan permits to join the two housing portions by applying a solvent to the surfaces to be joined. The two housing portions may then be put together and are joined when the solvent dries.

Preferably, the push button **12**, the two cam followers **17** and **18**, the carrier **14** as well as the two cams **15** and **16** are also made from Lexan. However, it is also possible to make the two cams **15** and **16** from a material sold in the trade under the name of Nylotron GS. Nylotron GS is compounded together with nylon and a suitable lubricant such as graphite and molybdenum disulphate. As a result, Nylotron GS is a plastic material which can be readily molded and which is self-lubricating to reduce wear between the surfaces **55** and **56** of the two cams and the two cam followers.

The end plate **11** is preferably made from a phenolic resin because such a resin will withstand higher temperatures than Lexan. The end plate **11** must withstand the relatively high temperatures generated when a conductor is soldered through the aperture **65** of the terminal lugs **28**.

The various springs such as a return spring **13**, the bias spring **20** for the two cam followers and the three bias springs **61** for the three brushes are preferably made from some spring material such, for example, as

beryllium copper. The conductor 64 may be made of copper while the terminal lugs 28 may be of tin-plated brass. The threaded sleeve 27 may, for example, consist of aluminum which may be anodized to resist corrosion.

The various contact portions 24, 25 and 26 preferably consist of a metal which has a pitted surface and which has a high work function to minimize arcing. Thus, preferably the contacts are made of molybdenum which has both of these qualifications. Where a high work function is not essential, the contact portions 24 and 26 may, for example, be made of copper or brass which is nickel plated, the nickel plating also having pits or depressions in its surface. Alternatively, the various contacts may be plated with or made of tungsten, molybdenum or stainless steel which also provide a pitted surface.

The three brushes 21, 22 and 23, for example, may consist of or may be plated with an alloy known as coin silver which consists of 92% silver and 8% copper. This alloy has a flaking action under wear. However, any other conducting material which has a flaking action may be used for the brushes 21 through 23. Thus, the brushes may consist of an alloy known as nickel silver which includes 81% copper and 18% nickel. Alternatively, the brushes may consist of or may be plated with palladium, rhodium, platinum or gold. These metals have the property that they are resistant to chemical action and hence the contact surfaces tend to remain clean. They also have a flaking action which further helps to maintain a clean contact surface. If the brushes are plated, it is sufficient to plate the outer surface of the rectangular projection 62 of each brush.

Further, in accordance with the present invention the contact portions 24 through 26 and the brushes 21 through 23 are coated or provided with an insulating lubricant. Preferably, the lubricant has a low surface tension or high wetting action so that the lubricant is retained by the pitted surfaces of the contact portions 24 through 26.

By way of example, the insulating lubricating material which is used in accordance with the present invention may include a major proportion of mineral oil of the type used for high voltage transformers. This mineral or transformer oil withstands high temperatures as well as low temperatures and has a high dielectric constant because it is used for transformers carrying up to 300,000 volts. This mineral oil or transformer oil may be emulsified and may have a base of a tallow grease which will not carbonize out under conditions of wear. A mineral detergent may be added to increase the wetting action or to decrease the surface tension.

An insulating lubricant of this type is sold in the trade under No. 871 Switch Lube by Lubrication Company of America. This insulating lubricant includes at least 93% mineral oil and is of relatively high viscosity. Thus, at 100° F., the viscosity may be 2,600 centistokes per second. This mineral oil has a flash point of 550° F. In other words, when the oil is heated to 550° it will flash under the influence of an electric arc. Thus, the lubricant will withstanding arcing up to 550° F. It may be added that the 871 Switch Lube shows substantially no corrosion.

One of the main purposes of the insulating lubricant is to embed or encapsulate worn off metal particles. During operation of the switch, metal particles are worn off the contact portions 24 through 26 and the brushes 21 to 23. These metal particles may plate out, for example, on the insulating surfaces 57, 58 and 60 of the carrier 14 to cause undesirable short circuits. The lubricating material should have a high dielectric constant so that individual encapsulated metal particles are electrically insulated from each other so that they cannot cause short circuits. The contact pressure provided by the springs 61 of the three brushes 21 to 23 should be high enough to break through the lubricating film on the contact surfaces.

This construction further makes it possible to operate the push button switch of the invention with a high contact pressure which may be desirable for certain applications. In that case the wear of the contacts and of the brushes is increased. Without the provision of such an insulating lubricant the operating life of the switch would be drastically reduced.

The operation of the snap action, push button switch will now be explained.

The switch is illustrated in FIGS. 1 to 3 in its normal or unactuated position. It will be noted that the contact portion 25 is in contact with its brush 22. Furthermore, the contact portion 26 is in contact with its brush 23. On the other hand, the contact portion 24 is disconnected from its brush 21. Hence, an electric circuit connected to the terminal lugs connected to brushes 22 and 23 is closed. On the other hand, an electric circuit connected between the terminal lugs of brushes 21 and 23 is open.

Assuming now that the push button 12 is pressed downwardly in the direction of arrow 70. As a result, the two surfaces 52 and 53 of the two cam followers 17 and 18 are pushed by the downward movement of the push button against the cam surfaces 55 of the two cams 15 and 16. Hence, the bias spring 20 of the two cam followers 17 and 18 is gradually compressed thus storing energy. Eventually, the surfaces 52 and 53 of the cam followers pass the edge of the two cams and begin to slide down on the inclined surfaces 56 of the two cams. As a result, the two cams 15 and 16 are forced to move in the direction of arrow 71, that is, against the direction of movement of the push button. In other words, the two cams 15 and 16 and the carrier 14 are forced to move suddenly in the direction of arrow 71. This in turn will cause the contact brush 22 to disengage from its contact 25 while shortly thereafter the contact brush 21 engages the contact portion 24. Brush 23 remains in contact with its contact portion 26.

The switch of FIGS. 1 to 3 is a single-pole, double-throw switch of the type illustrated schematically in FIG. 4. In the normal or unactuated position, the two contact portions 25 and 26 are closed. When the push button 12 is depressed in the manner just described, the two contact portions 24 and 26 are closed thus closing the circuit between terminals 2 and 3 while opening the circuit between terminals 1 and 2. It will be noted that the construction of the switch as illustrated particularly in FIG. 1 is such that contacts 25 and 26 break before contacts 24 and 26 make. However, it will be apparent that by making either one of the contact portions 25 or 24 somewhat longer, it is possible to obtain make-before-break operation.

When the push button 12 is released again after it has previously been depressed, the push button will be moved by its return spring 13 in a direction opposite that of arrow 70. A similar operation takes place as previously described. Thus, the surfaces 52 and 53 of the two cam followers will initially ride over the cam surfaces 56 thereby compressing the spring 20. The spring releases again as soon as the two surfaces 52 and 53 have been moved over the edge of the two cam surfaces whereupon the two cam followers ride on the surfaces 55. As a result, the two cams 15 and 16 and the carrier 14 are forced to move suddenly in a direction opposite that of the arrow 71. As clearly shown in FIG. 2, the two cams 15 and 16 and the carrier 14 move between the stop walls 40 and 41 which thus limit the movement of the carrier.

It may also be noted that the carrier 14 is supported between the three brushes 21, 22 and 23, the construction being such that the contact pressures are nearly balanced. If the carrier 14 could be made to have the shape of a triangular prism with equal sides the pressures exerted by the three brushes and their springs would balance exactly.

Depending on the construction of the two cams 15 and

16 and their inclined surfaces 55 and 56 and on the pressure exerted by spring 20, the carrier may be made to move at a very high speed and very suddenly. This in turn will minimize arcing even with relatively high voltages.

Thus, the snap action, push button switch of the invention has been tested with a voltage of 150 volts and a direct current of 260 milliamperes or 39 watts. With the applied current and voltage, the switch has been tested and has been found to have a useful life of over 1,100,000 cycles. The switch will of course also work at relatively low voltages, for example, at 2 to 4 volts and a current of 100 milliamperes or 0.2 to 0.4 watt. As such low voltages and low wattages, the noise of the switch is extremely low and the switch finds wide application in the electronic or instrumentation fields.

Due to the rapid movement of the switch contacts while they either make or break contact, arcing is minimized and presents no problem. On the other hand, the dielectric grease applied between the contacting surfaces of the contact portions 24 through 26 and of the brushes 21 to 23, substantially eliminates any tracking problems even at high contact pressures.

It may also be noted that the speed of movement from the normal to the actuated position and back again to the normal position of the switch is independent of the operator. In other words, whether the push button is depressed rapidly or slowly, the switch will still operate at its predetermined speed which depends primarily on the construction of the two cams and the force of the bias spring 20.

The switch of the invention may be assembled in the following manner:

At first the three terminal lugs 28 are pushed through suitable apertures in the end plate 11. Thereafter, the three conductors 64 are soldered or welded to their terminal lugs 28 and to their respective brushes 21 to 23. Thereupon, the three brushes 21 through 23 with their bias springs 61 are inserted into their respective receptacles 44 in the main housing portions 66 and 67. Then the two cam followers 17 and 18 are pushed through the aperture 48 in the push button together with their bias spring 20. Subsequently, the two cams 15 and 16 with the carrier 14 are pushed about the enlarged portion 46 of the push button 12 with the cam followers in position. Then the return spring 13 is inserted into the push button 12 and into the cylindrical aperture 32 in the end plate 11. Thereupon, the threaded sleeve 27 is inserted about the push button 12.

Finally, the two housing portions 66 and 67 are assembled about the end plate 11 and the threaded sleeve 27. The two housing portions may then be sealed together in any manner previously explained and the switch is ready for operation.

Instead of providing a single-pole, double-throw switch as illustrated in the drawing it is of course feasible to provide a single-pole, single-throw switch. In other words, all that is needed are two contact brushes and two contact elements to open and close a single electric circuit.

As pointed out before, the contact portion 26 preferably is long enough so that its brush 23 remains in contact therewith in both the normal and the actuated position. Thus, it is not necessary that two brushes simultaneously contact two contact portions to either open or close an electric circuit. If both contacts are not made simultaneously, the danger of arcing is increased in an unpredictable manner.

There has thus been disclosed an improved push button switch of the snap action type. The switch of the invention minimizes arcing and minimizes tracking of the sliding contacts. The switch of the invention is capable of switching relatively high voltages and large wattages substantially without arcing. In addition, the switch has a life expectancy of well over a million cycles. The rapid acceleration of the switch mechanism is entirely independent of the manner in which the push button is actuated whether by hand or by machine. As a result, not only is arcing minimized but the switch has a very low noise which is substantially eliminated at low voltages. The switch of the invention may readily be designed for either make-before-break or break-before-make operation depending on requirements.

The invention and its attendant advantages will be understood from the foregoing description. It will be apparent that various changes may be made in the form, construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing its material advantages, the arrangement hereinbefore described being merely by way of example. I do not wish to be restricted to the specific form shown or uses mentioned except as defined in the accompanying claims, wherein various portions have been separated for clarity or reading and not for emphasis.

I claim:

1. A snap action, push button switch comprising:
(a) a push button adapted to be depressed from a normal to an actuated position;
(b) first spring means urging said push button into its normal position;
(c) cam means having two cam surfaces forming an edge projecting toward and disposed adjacent said push button, said cam means being movable independently of the movement of said push button from a normal to an actuated position and back again;
(b) cam follower slidably disposed in said push button and movable therewith;
(e) second spring means urging said cam follower against the surfaces of said cam means, whereby upon depressing said push button, said cam follower will ride over one of said surfaces to force said cam means to move suddenly in a direction opposite the direction of movement of said push button, and whereby said cam means will return suddenly to its original position upon release of said push button;
(f) a movable carrier secured to said cam means and movable therewith;
(g) two brushes fixedly disposed about said carrier and in contact therewith and;
(h) a contact member having portions disposed in said carrier so as to be engageable with both of said brushes in one position of said carrier and as to be dissengaged from at least one of said brushes in the other position thereof.

2. A snap action, push button switch comprising:
(a) a push button adapted to be depressed from a normal to an actuated position;
(b) first spring means urging said push button into its normal position;
(c) cam means having two inclined surfaces projecting toward and disposed adjacent said push button and movable independently of the movement of said push button from a normal to an actuated position and back again;
(d) a cam follower slidably disposed in said push button and movable therewith;
(e) second spring means urging said cam follower against the inclined surfaces of said cam means, whereby upon depressing said push button, said cam follower will ride over one of said inclined surfaces to force said cam means to move suddenly in a direction opposite the direction of movement of said push button, and whereby said cam means will return suddenly to its original position upon release of said push button;
(f) a movable carrier secured to said cam means and movable therewith;
(g) two conductive brushes fixedly disposed about said carrier and in contact therewith; and
(h) a conductive contact member having portions dis-

posed in said carrier so as to be engageable with both of said brushes in one position of said carrier and as to be disengaged from at least one of said brushes in the other position thereof.

3. A snap action, push button switch comprising:
(a) a push button adapted to be depressed from a normal to an actuated position;
(b) first spring means urging said push button into its normal position;
(c) cam means having two inclined surfaces projecting toward and disposed adjacent said push button and movable from a normal to an actuated position and back again;
(d) a cam follower slidably disposed in said push button;
(e) second spring means urging said cam follower against the inclined surfaces of said cam means, whereby upon depressing said push button, said cam follower will ride over one of said inclined surfaces to force said cam means to move suddenly in a direction opposite the direction of movement of said push button, and whereby said cam means will return suddenly to its original position upon release of said push button;
(f) a movable carrier secured to said cam means and movable therewith;
(g) two brushes fixedly disposed about said carrier and in contact therewith, each of said brushes having a contact surface consisting of a metal having a flaking action; and
(h) a contact member having portions so disposed as to be engageable with both of said brushes in one position of said carrier and as to be disengaged from at least one of said brushes in the other position thereof, said contact member having contact surfaces consisting of a metal having a pitted surface; and
(i) an insulating lubricant provided between said brushes and contact member for embedding and encapsulating metal particles worn off said brushes and said contact member, said lubricant having a low surface tension so as to be retained by the pits in the surface of said contact member.

4. A snap action, push button switch comprising:
(a) a push button adapted to be depressed from a normal to an actuated position;
(b) first spring means urging said push button into its normal position;
(c) cam means having two inclined surfaces projecting toward and disposed adjacent said push button and movable from a normal to an actuated position and back again;
(d) a cam follower slidably disposed in said push button;
(e) second spring means urging said cam follower against the inclined surfaces of said cam means, whereby upon depressing said push button, said cam follower will ride over one of said inclined surfaces to force said cam means to move suddenly in a direction opposite the direction of movement of said push button, and whereby said cam means will return suddenly to its original position upon release of said push button;
(f) a movable carrier secured to said cam means and movable therewith;
(g) two brushes fixedly disposed about said carrier and in contact therewith, each of said brushes having a contact surface consisting of a metal having a flaking action;
(h) a contact member having portions so disposed as to be engageable with said brushes in one position of said carrier and as to be disengaged from at least one of said brushes in the other position thereof, said contact member having a contact surface consisting of a metal having a high work function and a pitted surface; and

(i) an insulating lubricant provided between said brushes and contact member for embedding and encapsulating metal particles worn off said brushes and said contact member, said lubricant having a high wetting action so as to be retained in the pits of said contact member.

5. A snap action, push button switch comprising:
(a) a housing;
(b) a push button movably disposed in said housing and adapted to be depressed from a normal to an actuated position;
(c) a return spring disposed between said housing and said push button for urging said push button into its normal position;
(d) a pair of cam follower members slidably disposed in said push button;
(e) two cam members movably disposed in said housing in a plane intersecting said push button and adjacent thereto, each of said cam members having two inclined surfaces projecting toward said push button;
(f) first spring means urging each of said cam follower members against the inclined surfaces of one of said cam members, whereby said cam members will suddenly move upon depressing said push button in a direction opposite the direction of movement of said push button and will suddenly return to their normal position upon release of said push button;
(g) a carrier integral with said cam members and movable therewith, said carrier having two substantially flat surfaces;
(h) two conductive brushes disposed in said housing and in contact with the surfaces of said carrier;
(i) second spring means for urging each of said brushes against one of the surfaces of said carrier; and
(j) a conductive contact member so disposed in the surfaces of said carrier that both of said brushes contact said contact member when said carrier is in one of its positions and so that only one of said brushes contacts said contact member when said armature is in the other one of said positions.

6. A snap action, push button switch comprising:
(a) a housing;
(b) a push button movably disposed in said housing and adapted to be depressed from a normal to an actuated position;
(c) a return spring disposed between said housing and said push button for urging said push button into its normal position;
(d) a pair of telescoping cam follower members slidably disposed in said push button;
(e) two cam members movably disposed in said housing in a plane intersecting said push button and adjacent thereto, each of said cam members having two inclined surfaces projecting toward said push button;
(f) first spring means urging each of said cam follower members against the inclined surfaces of one of said cam members, whereby said cam members will suddenly move upon depressing said push button in a direction opposite the direction of movement of said push button and will suddenly return to their normal position upon release of said push button;
(g) an insulating carrier integral with said cam members and movable therewith, said carrier having two substantially flat surfaces;
(h) two conductive brushes disposed in said housing and in contact with the surfaces of said carrier;
(i) second spring means for urging each of said brushes against one of the surfaces of said carrier; and
(j) a conductive contact member so disposed in the surfaces of said carrier that both of said brushes contact said contact member when said carrier is in one of its positions and so that only one of said brushes contacts said contact member when said carrier is in the other one of said positions.

7. A snap action, push button switch comprising:
(a) a housing;
(b) a push button movably disposed in said housing and adapted to be depressed from a normal to an actuated position;
(c) a return spring disposed between said housing and said push button for urging said push button into its normal position;
(d) a pair of telescoping cam follower members slidably disposed in said push button;
(e) two cam members movably disposed in said housing in a plane intersecting said push button and adjacent thereto, each of said cam members having two inclined surfaces projecting toward said push button;
(f) first spring means urging each of said cam follower members against the inclined surfaces of one of said cam members, whereby said cam members will suddenly move upon depressing said push button in a direction opposite the direction of movement of said push button and will suddenly return to their normal position upon release of said push button;
(g) an insulating carrier integral with said cam members and movable therewith, said carrier having two substantially flat surfaces;
(h) two brushes disposed in said housing, each being in contact with one of the surfaces of said carrier, each of said brushes consisting of a substantially U-shaped piece of sheet metal, each brush having a substantially rectangular, central, contact-forming projection;
(i) second spring means for urging each of said brushes against its associated surface of said carrier; and
(j) a conductive contact member so disposed in the surfaces of said carrier and flush therewith that both of said contact-forming projections of said brushes contact said contact member when said carrier is in one of its positions and so that only one of said projections of said brushes contacts said contact member when said carrier is in the other one of said positions.

8. A snap action, push button switch comprising:
(a) a housing;
(b) a push button movably disposed in said housing and adapted to be depressed from a normal to an actuated position;
(c) a return spring disposed between said housing and said push button for urging said push button into its normal position;
(d) a pair of telescoping cam follower members slidably disposed in said push button;
(e) two cam members movably disposed in said housing in a plane intersecting said push button and adjacent thereto, each of said cam members having two inclined surfaces projecting toward said push button;
(f) first spring means urging each of said cam follower members against the inclined surfaces of one of said cam members, whereby said cam members will suddenly move upon depressing said push button in a direction opposite the direction of movement of said push button and will suddenly return to their normal position upon release of said push button;
(g) an insulating carrier integral with said cam members and movable therewith, said carrier having two substantially flat surfaces;
(h) two conductive brushes disposed in said housing and each being in contact with one of the surfaces of said carrier;
(i) two terminal lugs extending through said housing, each being electrically connected to one of said brushes;
(j) second spring means for urging each of said brushes against the associated carrier surface; and
(k) a conductive contact member disposed flush in the surfaces of said carrier in such a manner that both of said brushes contact said contact member when said carrier is in one of its positions and so that only one of said bushes contacts said contact member when said carrier is in the other one of said positions.

9. A snap action, push button switch comprising:
(a) a housing of insulating material;
(b) a push button extending through one end of said housing and substantially closing said housing, said push button being slidable in said housing from a normal to an actuated position and back again;
(c) a return spring disposed between said housing and said push button for urging said push button into its normal position;
(d) a carrier of insulating material slidably disposed in said housing and having three substantially flat surfaces, said housing providing three spaced receptacles and having two spaced stop members, said carrier being movable between said two stop members from a normal to an actuated position;
(e) a conductive brush in each of said receptacles, said receptacles being so disposed that each brush is in contact with one of the flat surfaces of said carrier;
(f) first spring means urging each of said brushes against its carrier surface;
(g) said carrier being provided with two cams disposed in a plane intersecting said push button, each of said cams having two inclined surfaces projecting toward said push button;
(h) two telescoping cam followers slidably disposed in said push button and movable therewith;
(i) second spring means for urging said cam followers away from each other and against the inclined surfaces of said two cams, whereby upon depressing said push button said cam followers will ride over the inclined surfaces of said cams to force said carrier to move suddenly in a direction opposite the direction of movement of said push button against one of said stop members and to force said carrier to return suddenly into its normal position upon releasing said push buttons; and
(j) a continuous conductive contact member extending over the flat surfaces of said carrier and substantially flush therewith, said contact member being so disposed that a first and second brush contact said contact member in the normal position of said carrier and that said second and third brush contact said contact member in the actuated position of said carrier.

10. A snap action, push button switch comprising:
(a) a housing of insulating material;
(b) a push button extending through one end of said housing and substantially closing said housing, said push button being slidable in said housing from a normal to an actuated position and back again;
(c) a return spring disposed between said housing and said push button for urging said push button into its normal position;
(d) a carrier of insulating material slidably disposed in said housing and forming substantially a triangular prism having three substantially flat surfaces, said housing providing three spaced receptacles and having two spaced stop members, said carrier being movable between said two stop members from a normal to an actuated position;
(e) a conductive brush in each of said receptacles, said receptacles being so disposed that each brush is in contact with one of the flat surfaces of said carrier;
(f) first spring means urging each of said brushes against its carrier surface;
(g) said carrier being provided with two cams disposed in a plane intersecting said push button, each of said cams having two inclined surfaces projecting toward said push button;
(h) two telescoping cam followers slidably disposed in said push button and movable therewith;
(i) second spring means for urging said cam followers

away from each other and against the inclined surfaces of said two cams, whereby upon depressing said push button said cam followers will ride over the inclined surfaces of said cams to force said carrier to move suddenly in a direction opposite the direction of movement of said push button against one of said stop members and to force said carrier to return suddenly into its normal position upon releasing said push button;

(j) a continuous conductive contact member extending over the flat surfaces of said carrier and substantially flush therewith, said contact member being so disposed that a first and second brush contact said contact member in the normal position of said carrier and that said second and third brush contact said contact member in the actuated position of said carrier;

(k) three terminal lugs extending through said housing; and

(l) conductors connecting each terminal lug to one of said brushes so that electric circuits connected to said terminal lugs can be opened and closed upon actuation of said push button.

11. A snap action, push button switch comprising:

(a) a main housing of insulating material;

(b) an end plate closing one end of said housing;

(c) a push button extending through the opposite end of said housing and substantially closing said housing, said push button being slidable in said housing from a normal to an actuated position and back again;

(d) a return spring disposed between said housing and said push button for urging said push button into its normal position;

(e) a carrier of insulating material slidably disposed in said housing and forming substantially a triangular prism having three substantially flat surfaces, said housing providing three spaced receptacles and having two spaced stop members, said carrier being movable between said two stop members from a normal to an actuated position;

(f) a conductive brush in each of said receptacles, said receptacles being so disposed that each brush is in contact with one of the flat surfaces of said carrier;

(g) first spring means urging each of said brushes against its carrier surface;

(h) said carrier being provided with two cams disposed in a plane intersecting said push button, each of said cams having two inclined surfaces projecting toward said push button;

(i) two telescoping cam followers slidably disposed in said push button and movable therewith;

(j) second spring means for urging said cam followers away from each other and against the inclined surfaces of said two cams, whereby upon depressing said push button said cam followers will ride over the inclined surfaces of said cams to force said carrier to move suddenly in a direction opposite the direction of movement of said push button against one of said stop members and to force said carrier to return suddenly into its normal position upon releasing said push button;

(k) a continuous conductive contact member extending over the flat surfaces of said carrier and substantially flush therewith, said contact member being so disposed that a first and second brush contact said contact member in the normal position of said carrier and that said second and third brush contact said contact member in the actuated position of said carrier;

(l) three terminal lugs extending through said end plate; and

(m) conductors connecting each terminal lug to one of said brushes so that electric circuits connected to said terminal lugs can be opened and closed upon actuation of said push button.

12. A snap action, push button switch comprising:

(a) a main housing of insulating material;

(b) an end plate closing one end of said housing;

(c) a push button extending through the opposite end of said housing and substantially closing said housing, said push button being slidable in said housing from a normal to an actuated position and back again;

(d) a return spring disposed between said housing and said push button for urging said push button into its normal position;

(e) a carrier of insulating material slidably disposed in said housing and forming substantially a triangular prism having three substantially flat surfaces, said housing providing three spaced receptacles and having two spaced stop members, said carrier being movable between said two stop members from a normal to an actuated position;

(f) a conductive brush in each of said receptacles, said receptacles being so disposed that each brush is in contact with one of the flat surfaces of said carrier;

(g) first spring means urging each of said brushes against its carrier surface;

(h) said carrier being provided with two cams disposed in a plane intersecting said push button, each of said cams having two inclined substantially flat plane surfaces projecting toward said push button;

(i) two telescoping cam followers slidably disposed in said push button and movable therewith;

(j) second spring means for urging said cam followers away from each other and against the inclined surfaces of said two cams, whereby upon depressing said push button said cam followers will ride over the inclined surfaces of said cams to force said carrier to move suddenly in a direction opposite the direction of movement of said push button against one of said stop members and to force said carrier to return suddenly into its normal position upon releasing said push button;

(k) a continuous conductive contact member extending over the flat surfaces of said carrier and substantially flush therewith, said contact member being so disposed that a first and a second brush contact said contact member in the normal position of said carrier and that said second and third brush contact said contact member in the actuated position of said carrier;

(l) three terminal lugs extending through said end plate;

(m) conductors connecting each terminal lug to one of said brushes so that electric circuits connected to said terminal lugs can be opened and closed upon actuation of said push button; and

(n) an insulating lubricant having a high dielectric constant provided between said brushes and contact member for encapsulating and insulating from each other particles worn off said brush and said contact member.

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