July 29, 1958 F. C. IGLEHART 2,845,504

SNAP ACTING ELECTRICAL SWITCH

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Fig.1.

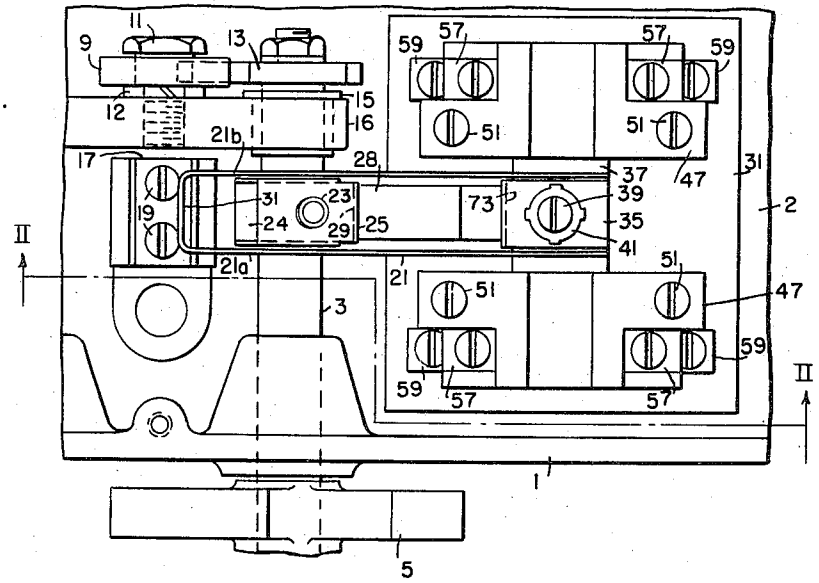


Fig.2.

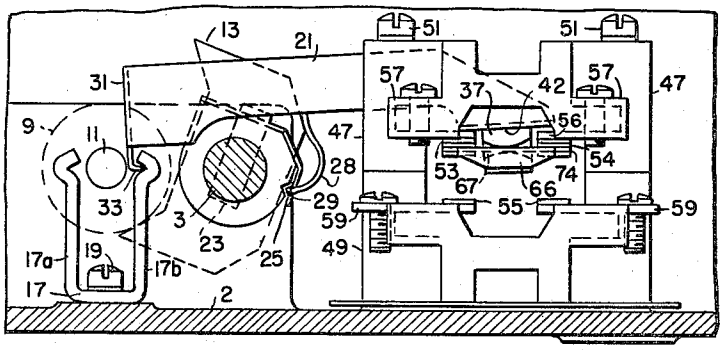
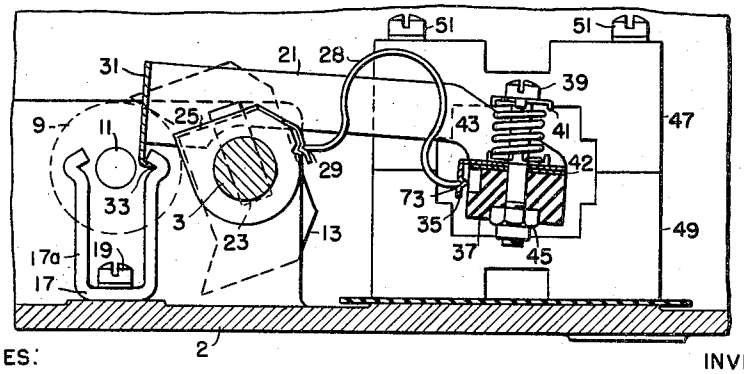


Fig.3.



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SNAP ACTING ELECTRICAL SWITCH

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2 Claims. (Cl. 200—67)

This invention relates generally to electric toggle switches and more particularly to snap action toggle switches of the type utilized to control the length of stroke of reciprocating machine tools such as planers, roll grinders, transfer tables and the like.

Reciprocating machine tools of the type referred to above generally are driven by an electric motor, the speed during the cut stroke usually being considerably less than the speed on the return stroke. The length of the stroke is controlled by cam-actuated electric switches which control apparatus for reversing the direction of rotation of the motor. In order to obtain maximum productivity from the machine tool, it is necessary that the reciprocating member be operated at very high speeds which in turn makes it requisite for the limit switch to be very fast acting in operation in order to minimize the amount of overtravel at the end of a stroke. The cams of the limit switches are generally tripped by dogs or stops set adjacent the limits of travel of the reciprocating member.

The switch and its associated cam actuator must be positive acting, rugged, and virtually fail-proof. In the event of switch failure, the reciprocating member will not be reversed at the end of the stroke and almost inevitably servere damage to the machine will ensue. Obviously, if tool production is to be kept high and the possibility of damage to the machine tool is to be obviated, the switches must undergo an extremely high number of operations without appreciable wear or need for maintenance.

As mentioned above, the switch assemblies are actuated by dogs on the machine and, as may be readily inferred, the switch and associated cams are subjected to severe impacts from the dogs due to the requisite high speeds of operation. Such severe impacts result in high shock loads and extremely rapid acceleration of the component parts of the switch. The component parts must have very little inertia and yet be quite strong in order to have long life under the described operating conditions. These requirements are mutually conflicting and in the past it has been the usual practice to sacrifice either one or the other.

In addition to the requirements set forth above, it is absolutely essential that the switch not be teased into a neutral or dead-center position. Otherwise, the control equipment for reversing motor operation will not be actuated and the reciprocating member of the machine tool will not be stopped at the end of the stroke, and inevitably the machine tool will be severely damaged. This means that the switch must be absolutely positive acting; that is, it must snap from one position to the other without possibility of being stopped once movement of the switch parts has been initiated. Additionally, friction within the switch must be minimized so that initiation of the snap action always will be started at a given position of the actuating member of the switch assembly.

One object of this invention is to provide a snap acting switch wherein the possibilities of the switch being left in a dead-center position or being stopped before a snap

action can be consummated are absolutely minimized.

Another object is to provide a snap acting electric switch wherein the component parts are very strong and long-lived under adverse operating conditions, yet have very low inertia.

Still another object is to provide a snap acting electric switch adapted for easy maintenance and manufacture.

Still another object is to provide a snap acting electric switch capable of an extremely great number of operations without appreciable wear or necessity for replacement of component parts.

Other objects and features of my invention will become apparent from a study of the following detailed description thereof when taken in connection with the accompanying drawings, wherein:

Figure 1 is a top plan view of an electric switch and associated actuating mechanism employing the principles of my invention;

Fig. 2 is a sectional view taken along the section II—II of the embodiment of my invention shown in Fig. 1; and

Fig. 3 is a view similar to Fig. 2 wherein certain of the component parts are removed to more perspicuously illustrate the construction of certain of the other component parts of the switch.

The view of the switch assembly shown in Fig. 1 illustrates only a portion of a complete switch assembly wherein two switches, one a mirror image of the other, are combined in a single housing. The switch assembly shown, however, is sufficient to adequately illustrate my invention. As shown, an operating shaft **3** extends through switch housing **1** and has an operating lever or other suitable device **5** fastened to the shaft externally of the housing by means of a roll pin or a similar device. The function of the operating lever **3** is to receive the impact of the dog attached to the machine tool as described above. The other end of the operating shaft may extend through the other end of the shaft housing or be securely fastened to the base of the housing by means of a bracket **16** in the usual manner. The operating shaft may be journalled to the bracket through a sleeve bearing **15**, as shown.

In order to limit rotational movement of the actuating shaft within predetermined angular limits, a generally C-shaped member **13** is secured to the end of the operating shaft **3** opposite that to which operating lever **5** is secured. Facing the jaws of the C-shaped member is a generally circular stop member **9** which is secured to bracket **16** by means of a threaded bolt **11** and washer **12**. The stop member **9** preferably is free to rotate on bolt **11** to distribute wear; additionally, if the stop member is free to wobble to some extent, it will absorb considerable mechanical energy from C-shaped member **13** and minimize the tendency of C-shaped member **13** to bounce upon striking stop member **9**. Angular movement of operating shaft **3** is stopped when the interior of the jaws of the C-shaped member **13** strike the stop member **9**.

A generally U-shaped member **17** having crimped ends so as to form knife edge bearings thereat is secured to the base plate **2** of switch housing **1** by means of a small screw **19**. The switch arm **21** is of the general configuration illustrated and comprises a pair of laterally spaced frame members **21***a*, **21***b* to which is affixed at one end a generally L-shaped knife edge bearing member **33**, the knife edge being at the tip of the bottom section of the L so as to fit into the crimped section of U-shaped member **17**. The switch arm frame members are connected together by L-shaped member **31** at one end and by a crossover section **42** at the other end. The generally L-shaped member **35** and a contact support **37** formed of insulating material are secured to opposite sides of crossover member **42** by nut **45**, bolt **39** and a spring

around the body of said bolt held between the bolt head and the L-shaped bracket member 35 by means of a pair of spring seats 41. The L-shaped bracket member 35 is crimped or notched to form a knife edge bearing seat 73.

A bowed leaf spring 28 having knife edge bearings at the ends thereof pivots in knife edge bearing seat 73 and a knife edge bearing seat 29 formed in a bearing seat member 25 which fits over an actuator block 24 secured to operating shaft 3. (For certain applications bearing seat member 25 may be omitted, the bearing seat being the detent shown in actuator block 24.) The actuator block 24 and the bearing seat member 25 are secured to the switch operating shaft 3 by means of a roll pin 23. As shown, the bearing seat members 29 and 73 generally face each other to accommodate the knife edge bearings of bowed spring member 28 so that bowed spring member 28 biases the contact end of contact arm 21 away from actuating shaft 3 and additionally biases the knife edge of member 31 into knife edge bearing seat 33 of stationary bearing seat member 17.

As has been mentioned, the contact support or contact bar 37 is of insulating material and is secured to the bottom side of crossover member 42 by means of a spring loaded bolt 39. The contact bar is provided with a recess (not shown) in its upper face which straddles the side frame members 21*a*, 21*b* of the switch arm assembly. The bottom face of the recess is sufficiently convex to engage and set against the adjacent face of the cross-over member 42. With this arrangement the contact bar 66 may tilt about its bearing point against the member 42 to provide positive contact alignment and setting. The contact bar 37 is provided with longitudinally disposed slots 67 which open through each of its extremities. These slots occupy positions in planes substantially paralleling the axis of the shaft 3 and the slot faces are of convex configuration. The slots are adapted to receive respective flat conductive members 74 which are of electrically conducting material, such as beryllium copper, and which have respective pairs of contacts 53 and 54 mounted at the extremities thereof. These assemblies form bridging contacts which cooperate with respective pairs of lower stationary contacts 55.

The stationary contacts are mounted in suitable electrically insulated contact bases 49 through which external connections to the switch may be made. For example, as seen in Fig. 2, the contacts 55 are connected to terminal straps 59. Similar pairs of upper stationary contacts may also be provided along with cooperating terminal straps 57 in insulating electrical contact supports 47 which are positioned above block 49 and secured thereto by means of suitable bolts 51.

For a more detailed description of the terminal block assembly and the contact end of the switch arm 21, reference is made to the application Serial No. 462,236, of Ralph B. Immel and Martin Wibell, titled "Electric Switch," filed October 14, 1954, and assigned to the assignee of my present invention.

The angle through which the knife-edge bearing seat 73 may move relative to bearing seat 33 is determined by the distance between electrical contacts 54 and 55. This angle should be smaller than the angle through which bearing seat 29 may move relative to the axis of rotation of operating shaft 3 and preferably should be included within this angle.

In operation, let it first be assumed that the contact arm 21 is in the position shown in Fig. 2, that is, in engagement with the upper electrical contacts 56. With counterclockwise rotation of the actuating shaft 3, the contact arm will not move until the knife edge bearing seat 29 is in line with bearing seats 33 and 73. Movement of the bearing seat 29 an infinitesimal distance past the line between bearing seats 33 and 73 will produce a vector force downwardly such as to move the contact end of contact arm 21 downwardly. Once this motion has started, the downwardly biasing vector force will progressively increase in magnitude and, in effect, the contact arm will snap from the upper contacts 56 to the lower contacts 55. Clockwise rotation of actuating shaft 3 will produce a similar snap action from the lower contacts 55 to the upper contacts 56 as soon as the kinfe edge bearing seat 29 moves past the overcenter position thereof.

As is evident from an inspection of the drawings, the entire assembly is quite easy to assemble and disassemble. All of the removable parts are quite accessible from above, particularly those parts which are apt to fail in operation. All of the moving members are extremely light and yet are adapted to be made for considerable strength; for example, by flanging the ends of side frame members 21*a* and 21*b*, the rigidity and strength thereof can be considerably enhanced. The need for maintenance, however, is quite small inasmuch as the members are very strong and are not easily damaged even by the severe operating conditions imposed by the reciprocating machine tools as described above.

Additionally, since all moving parts with the exception of the operating shaft 3 move on knife edge bearings, the forces opposing movement of the moving parts are only infinitesimal so that it is virtually impossible to tease the unit into a dead-center position. The angular rotation of the operating shaft through a given angle will in every instance produce a snap action of the switch.

Although but one embodiment of my invention has been illustrated and described, it will be appreciated by those skilled in the art that various changes may be made in the embodiments illustrated and described both as to their details and as to the organization of parts without departing from the spirit and scope of the invention. Accordingly, it is intended that the foregoing disclosure and the showings made in the drawings shall be considered only as illustrative of the principles of this invention and not be interpreted in a limiting sense.

I claim as my invention:

1. A snap acting switch comprising a base; an operating shaft having bearing surfaces, bearing support members for said shaft affixed to said base, an operating lever affixed to said shaft; a generally C-shaped member affixed to said shaft at a central point on said generally C-shaped member; and annular removable stop member for said C-shaped member positioned to engage opposed points on the inner surface of said C-shaped member so as to limit rotation of said shaft between first and second angular positions, said annular stop member being loosely mounted on a shaft affixed to said base so as to be free to rotate and wobble on said shaft upon being stricken by said C-shaped member; an actuator block on said shaft notched on the outer surface thereof to form a first knife edge bearing seat to receive a knife-edge bearing, a knife edge bearing seat member affixed to said base having a second knife edge bearing seat thereon, a switch arm having at one end thereof, an insulating member for supporting contact members, fixed contact members positioned to be interconnected by said switch arm contact members, a first knife edge bearing at the opposite end thereof at which said arm is adapted to pivot, and a third knife-edge bearing seat at said one end; a bowed leaf spring having second and third knife edge bearings adapted for insertion into said first and third bearing seats to bias said first knife edge bearing into said second knife edge bearing seat; said contact members being adapted to move between first and second positions, said spring being adapted to bias said contact member to said first position upon clockwise rotation of said shaft to said first angular position and to bias said contact member to said second position upon counterclockwise rotation of said shaft to said second angular positions, the transition between said first and second positions being with a snap action.

2. A snap action switch comprising: a base plate; a rotatable shaft rotatable about a central axis thereof and se-

cured to said plate by bearing support members; a knife edge bearing seat member secured to said base plate on one side of said shaft; the bearing seat of said member being adapted to receive a first knife edge bearing on a side thereof facing away from said shaft; a contact arm having a knife edge bearing at one end thereof hooking around the top of said member away from said base plate to engage said knife edge bearing, said arm extending over said shaft and having an insulating member supporting contact members attached to the end thereof opposite said knife edge bearing; fixed contact members for engaging said contact members on said arm for interconnecting selected fixed contact members and restricting rotation of said arm through a given angle with said bearing seat as a center of rotation; a second knife edge bearing seat on said arm at the end thereof opposite said knife edge bearing; a third knife edge bearing on said shaft generally facing said second knife edge bearing; a U-shaped spring having knife edge bearings at the ends thereof engaging said second and third bearing seats to bias said first knife edge bearing into its seat; an annular removable washer in a plane generally normal to the axis of said shaft, loosely fitted on a supporting shaft affixed to said base plate, the central opening of said washer being slightly larger in diameter than said supporting shaft so that said washer is free to wobble as well as to rotate on said supporting

shaft; a C-shaped member affixed to said rotatable shaft so that opposed inner points thereon will strike said washer to limit rotation of said rotatable shaft to first and second angular positions thereof, said washer being adapted to absorb energy from said C-shaped member to minimize bouncing of said C-shaped member upon striking said washer; said angular movement of said rotatable shaft being sufficiently great that said spring will bias said contact arm from one position to the other and vice-versa with substantial snap-action when said shaft is rotated in one direction or the other.

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