Sept. 19, 1944. A. L. RICHE ET AL 2,358,658

SNAP SWITCH PLUNGER CONSTRUCTION

Filed June 26, 1942

Fig. 1

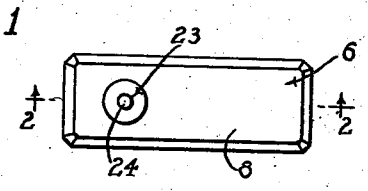


Fig. 3

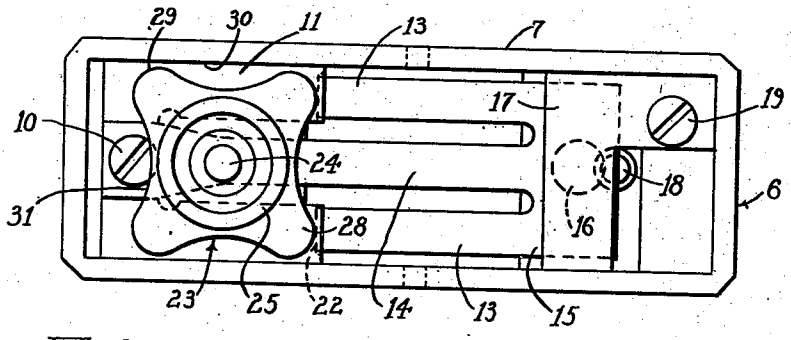


Fig. 2

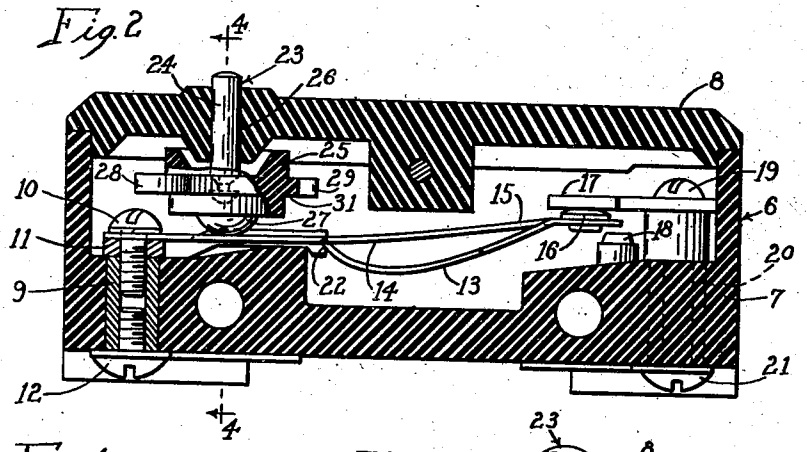


Fig. 4

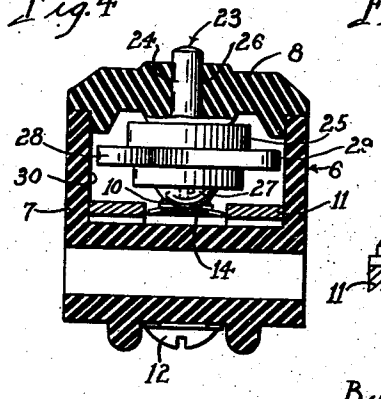
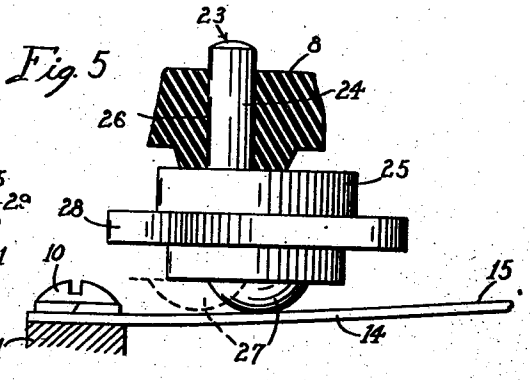


Fig. 5



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Patented Sept. 19, 1944 2,358,658

UNITED STATES PATENT OFFICE

2,358,658

SNAP SWITCH PLUNGER CONSTRUCTION

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Application June 26, 1942, Serial No. 448,598

9 Claims. (Cl. 200—67)

This invention relates to electric snap switches of the small, compact, precision type shown in McGall Patent 1,960,020, issued May 22, 1934, and is more particularly concerned with an improved operating plunger construction. In referring to the switch of our invention as a "precision switch," it must be understood that we mean one which operates in response to very slight movement of the operating plunger and one which is intended to operate consistently at the same position of its plunger. One commercial construction of the switch, for example, has the switch mechanism in a molded housing of insulating material, occupying less than one and one-half (1½) cubic inches of space, and operating in response to a plunger movement of the order of one ten thousandth (0.0001) inch between "on" and "off" with only a few ounces of operating force, although controlling directly loads of the order of a thousand watts on alternating current.

Because the switch is a precision device, and because it operates in response to such slight motion and pressure, extreme care and accuracy are required in manufacture, and the operation of the switch can be impaired very materially by slight changes or misadjustments of its mechanism. Even slight misadjustments or mislocations of its parts will cause the switch to exhibit operating characteristics far inferior to those of a properly constructed switch. The switch must be manufactured to close tolerances and protected against any injury which might result in a disarrangement of its operating mechanism.

While the McGall switch operates satisfactorily for many purposes and has certain desirable characteristics, it has other characteristics which leave it unsuited to other applications and it presents a number of manufacturing difficulties. For example, switches made in quantity production have exhibited widely different operating characteristics, and have even changed their characteristics in use. Consequently, they could not be made easily interchangeable for replacement purposes, and the switch could not conveniently be fitted into the design of other apparatus, the characteristics of which had to be matched to the characteristics of the switch. These shortcomings have seriously restricted the commercial use and value of the McGall switch, and their correction has required experiment and development looking to structural improvements.

Due to the fact that the switch with which our invention is concerned is small and compact and must operate with a high degree of precision, its construction and arrangement of parts presents a number of difficulties not encountered in larger switch structures. The operating plunger, as will be pointed out later, has presented a difficulty of this sort, one which would not have been noticed, let alone appreciated, in a large switch. The small space available in the compact switches with which our invention deals and the fact that the switch is intended to operate with only a few ounces of operating force applied naturally imposes a considerable restriction on the practical solutions to the problems presented.

It is desirable in the large quantity production of these precision switches to adjust each switch individually at the time its assembling is completed. Frequently the adjustments include the bending of certain parts to make the switch conform to a standard so far as operating characteristics are concerned. For example, it has been the practice to bend the stationary contacts after assembly of the switch to obtain the desired functioning.

In switches of the precision type mentioned, it has been difficult to maintain the desired accuracy in operation due to the fact that the slightest change in the relationship of the operating plunger to the snap action spring while in service was sufficient to make a very appreciable change in the operating characteristics of the switch, and the switch manufacturer could not, therefore, with any definite assurance recommend a switch as being adaptable for a specific purpose requiring certain specific operating characteristics. It has been the practice, as illustrated for example in Riche Patent 2,181,068, to provide the operating plunger in the form of a highly polished stainless steel pin molded into a head of insulation material for contact with the snap action spring, thereby insuring freedom from electrical leakage to the plunger itself. In the molding operation, the pin in one plunger was apt to assume a slightly different relationship to the molded head from the pin in another plunger, and the slightest eccentricity of the molded head we found caused the difficulty mentioned—a change in the operating characteristics of the switch upon rotation of the plunger.

It is, therefore, the principal object of our invention to provide an operating plunger the molded head of which has a star-shaped skirt portion of such dimensions that the plunger cannot turn out of a set position within the housing, although it is substantially free to move

otherwise and operates with substantially the same freedom as in the old unimproved construction. The skirt is given a star shape so that the plunger has line contact at relatively widely spaced points inside the housing and there is, therefore, no danger of any binding action and frictional resistance to movement is reduced to a minimum, the relieved sides of the head furthermore affording extra space within the housing for other operating elements.

The invention will be better understood as reference is made in the following description to the accompanying drawing, in which—

Figure 1 is a top view of a switch made in accordance with our invention, this view showing the actual size;

Fig. 2 is a longitudinal section on an enlarged scale taken on the line 2—2 of Fig. 1;

Fig. 3 is a top view with the cover removed so as to show the plunger and its relationship in the housing to the snap action spring;

Fig. 4 is a cross-section on the line 4—4 of Fig. 2 to further illustrate the relationship of the operating plunger to the other parts of the switch, and

Fig. 5 is a more or less diagrammatic view, partly in section and partly in side elevation, to illustrate by exaggeration in the eccentricity of the head of the plunger with respect to the pin the inaccuracy that is apt to be introduced and the resultant change in the operating characteristics of the switch, where the plunger is not safeguarded against rotation.

The same reference numerals are applied to corresponding parts throughout the views.

The switch comprises a housing 6 of insulation material consisting of a base 7 and a cover 8 for enclosing the switch mechanism. 9 is a metal insert in the base carrying a screw 10, and 11 is an anchor held by the screw. The insert 9 provides an electrical connection between the anchor 11 and an external terminal screw 12. The anchor 11 supports a pair of compression spring members 13 and a tension spring member 14 of the snap mechanism of the switch. The two side compression members 13 and the central tension member 14 of the snap mechanism are stamped integrally from a single sheet of thin spring material, so that the several spring members together constitute a three-pronged piece 15. This piece carries a movable contact 16 which, when the switch operates, moves with snap action between the stationary contact 17 and the insulating abutment 18 on the base. The contact 17 has a screw 19 mounting the same on another metal insert 20 in the base 7 which provides an electrical connection between the contact 17 and an external terminal screw 21.

The compression members 13 are pivotally supported in notches 22 in the ends of the legs of the U-shaped anchor 11. The tension member 14 is supported in cantilever fashion under the head of the screw 10 at the base of the U of the anchor 11 and passes near the pivotal axis of the two compression members 13 in the notches 22. If pressure is applied to the tension member 14 to deflect its tension center line across the pivotal axis of the two compression members 13, the spring members 13 and 14 will coact to snap the movable contact 16 from its one extreme position to the other. When the tension member 14 is forced down, the movable contact 16 is snapped out of engagement with the stationary contact 17, the snap action member 15 coming into engagement with the abutment 18, but when the pressure is released, the contact 16 snaps back to its normal position in engagement with the stationary contact 17. As has already been pointed out, the switch will operate in response to a movement of the order of one ten thousandth (0.0001) inch and accordingly the actual distance through which the tension member need be deflected to operate the switch is exceedingly small. It should be understood, therefore, that Fig. 2 is intended only to show the general relationship of the parts mentioned.

The operating plunger with which our invention is especially concerned is designated by the reference numeral 23 and includes a highly polished stainless steel pin 24 onto which is molded a head 25 of insulation material. The pin 24 is reciprocable in a hole 26 in the cover 8 to depress the head 25 and deflect the tension member 14 downwardly to operate the switch. The pressure is applied to the tension member 14 by a central spherical projection 27 on the bottom of the head 25 at a point between the point of support of the tension member under the head of the screw 10 and the point of support of the compression springs 13 in the notches 22. The head 25 overhangs the two legs of the anchor 11 so that the anchor serves as a stop to limit the downward movement of the plunger, the movement being limited to a little more than that necessary to deflect the tension member 14 to the point at which it moves with snap action to the opposite extreme position. The head 25 is of generally cylindrical form but has a star-shaped skirt portion 28 formed thereon intermediate the ends thereof in a plane substantially normal to the axis of the pin 24 of such dimensions that the light sliding contact of the rounded points 29 with the smooth inner side walls 30 of the housing will prevent rotation of the plunger with no perceptible increase in the resistance to the movement of the plunger. Bearing in mind the fact that switches of this kind must be operable with only a few ounces of force applied and are supposed to be so accurate in their operation that they can be used reliably for gauging, it can be seen how important it is that any means provided to prevent rotation of the operating plunger 23 must not add perceptibly to the resistance to movement. The reason it is so important to prevent rotation of the operating plunger is illustrated in Fig. 5, by showing the head 25 in exaggerated eccentricity with respect to the pin 24 and indicating in full and dotted lines the extent to which rotation of the plunger through one hundred eighty degrees (180°) affects the position of the projection 27 measured longitudinally of the tension member 14. Assuming any eccentricity of the head 25 of whatever degree with respect to the pin 24, it is clear that the projection 27 in one extreme position, shown in full lines, will cause the switch to operate with much more movement of the plunger than in the opposite extreme position, indicated in dotted lines. Needless to say, the force required to operate the switch also changes with any alteration in the position of the projection 27 lengthwise with respect to the tension member 14, the plunger 23 having greater mechanical advantage when the projection 27 is in the full line position than when it is in the opposite extreme position indicated in dotted lines. It is impossible to mold the heads 25 on the pins 24 accurately enough to insure the same point of contact of the pro-

jection 27 on the tension member 14 throughout three hundred sixty degrees (360°) rotation of the plungers. Such inaccuracy as is bound to occur is practically reduced to zero by limiting the rotary movement of the head 25 to the few degrees herein indicated, and, therefore, when the switch is assembled and the usual adjustments are made at that time, there is no danger thereafter of any change in the operating characteristics of the switch. Relieving the sides of the skirt portion 28 between the points 29, as indicated at 31, has a two-fold advantage, one being that it makes for reduced friction drag by avoiding any likelihood of surface to surface contact between the skirt and the walls of the housing, there being only line contact at widely spaced points, and it avoids any likelihood of the skirt coming in contact with other operating elements of the switch, the head of the screw 10, for example, being assured of ample clearance with respect to the skirt 28 by virtue of the relief between the points 29 on that side of the head 25, as clearly indicated in Figs. 2 and 3.

It is believed the foregoing description conveys a good understanding of the objects and advantages of our invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

We claim:

1. As an article of manufacture, an operating plunger for close accuracy operative engagement with the snap action element of an electric snap switch of the character described, and to have close accuracy, non-rotary, reciprocatory operation but with a free fit between the substantially parallel side walls of the housing of said switch, said plunger comprising a metallic pin for reciprocation of the plunger and a head of non-metallic insulating material mounted on one end thereof in substantially concentric relation thereto, having a central projection on the side thereof opposite said pin for operative engagement with the snap action element of the switch, said head having a generally rectangular, radially projecting skirt portion in a plane substantially normal to the axis of the pin adapted to have free but accurate non-rotary slidable guiding engagement on its opposed edge portions with the side walls of the housing, the skirt portion being cut away between the corners thereof, substantially as and for the purpose described.

2. As an article of manufacture, an operating plunger for close accuracy operative engagement with the snap action element of an electric snap switch of the character described, and to have close accuracy, non-rotary, reciprocatory operation but with a free fit between the substantially parallel side walls of the housing of said switch, said plunger comprising a metallic pin for reciprocation of the plunger having mounted on one end thereof a head of non-metallic insulating material of substantially cylindrical form in substantially concentric relation with the pin having a central projection on the side thereof opposite said pin for operative engagement against the snap action element of the switch for operation thereof upon longitudinal movement of the pin, the head having rigid therewith and projecting radially therefrom a star-shaped skirt portion in a plane substantially normal to the axis of the pin, said skirt portion being of such width dimensions in relation to the inside width dimensions of the housing that the plunger can reciprocate freely within the housing while held against turning by sliding contact of the points of the skirt at the edge thereof with the walls of the housing.

3. An article of manufacture as set forth in claim 2, wherein the points of the star-shaped skirt portion are of thin cross-section, of substantially semi-circular form and are struck on arcs of small radius.

4. For use in a spring snap mechanism of the class described, comprising a housing, a bowed, thin, elongated snap action leaf spring, and a support therefor in the housing, said housing having a guide and having side walls presenting smooth inner surfaces substantially parallel to one another on opposite sides of said spring, an operating plunger comprising a pin reciprocable in the guide, and a head mounted on the inner end of said pin having a downward projection on the bottom thereof adapted to engage the leaf spring at a point intermediate the ends thereof for deflection of the spring under pressure applied to said pin, said head having lateral projections which by sliding engagement with the aforesaid smooth inner surfaces prevent rotation of the plunger relative to said spring.

5. For use in a spring snap mechanism of the class described, comprising a housing, a bowed, thin, elongated snap action leaf spring, and a support therefor in the housing, said housing having a guide and having side walls presenting smooth inner surfaces substantially parallel to one another on opposite sides of said spring, an operating plunger comprising a metal pin reciprocable in the guide, and a head of non-metallic insulating material mounted on the inner end of said pin having a downward projection on the bottom thereof adapted to engage the leaf spring at a point intermediate the ends thereof for deflection of the spring under pressure applied to said pin, said head having a readily projecting star-shaped skirt portion provided thereon in a plane substantially normal to the axis of the pin, the points of which by sliding engagement with the aforesaid smooth inner surfaces prevent rotation of the plunger.

6. For use in a spring snap mechanism of the class described, comprising a housing having a guide therein, a bowed, thin, elongated snap action leaf spring, and a support therefor in the housing, an operating plunger comprising a pin reciprocable in the guide provided therefor, and a head mounted on the inner end of said pin having a downward projection on the bottom thereof adapted to engage the leaf spring at a point intermediate the ends thereof for deflection of the spring under pressure applied to said pin, said operating plunger having means acting between the side walls of said housing and the peripheral portion of the head in radially spaced relation to the pin to hold the plunger against turning while permitting free reciprocation thereof.

7. For use in a spring snap mechanism of the class described, comprising a housing having a guide therein, a bowed, thin, elongated snap action leaf spring, and a support therefor in the housing, an operating plunger comprising a pin reciprocable in the guide provided therefor, and a head mounted on the inner end of said pin adapted to engage the leaf spring at a point intermediate the ends thereof for deflection of the spring under pressure applied to said pin, said operating plunger having means to hold the plunger against turning while permitting free reciprocation thereof.

8. For use in a spring snap mechanism of the class described, comprising a housing having a

guide therein, a bowed, thin, elongated snap action leaf spring, and a support therefor in the housing, an operating plunger comprising a pin reciprocable in the guide provided therefor, and a head mounted on the inner end of said pin adapted to engage the leaf spring at a point intermediate the ends thereof for deflection of the spring under pressure applied to said pin, said operating plunger having means limiting within close limits the rotation of said head with respect to said housing while permitting free reciprocation thereof.

9. The combination in a switch of the precision type having a snap action leaf spring and a housing therefor of an operating plunger comprising a metallic pin mounted in the housing for reciprocation therein and a head of insulating material mounted on one end thereof within the housing in substantially concentric relation thereto, said head having a central projection on the side thereof opposite said pin for engagement against said spring to operate the same by pressure thereagainst upon axial movement of the plunger, said head also having a thin radially projecting skirt portion of generally rectangular shape in a plane substantially normal to the axis of the pin having a width slightly less than the distance between the side walls of the housing for free but accurate non-rotary, slidable guiding engagement on its edges against the side walls to prevent rotation of the plunger and consequent change of the point of engagement of the projection with the spring.

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