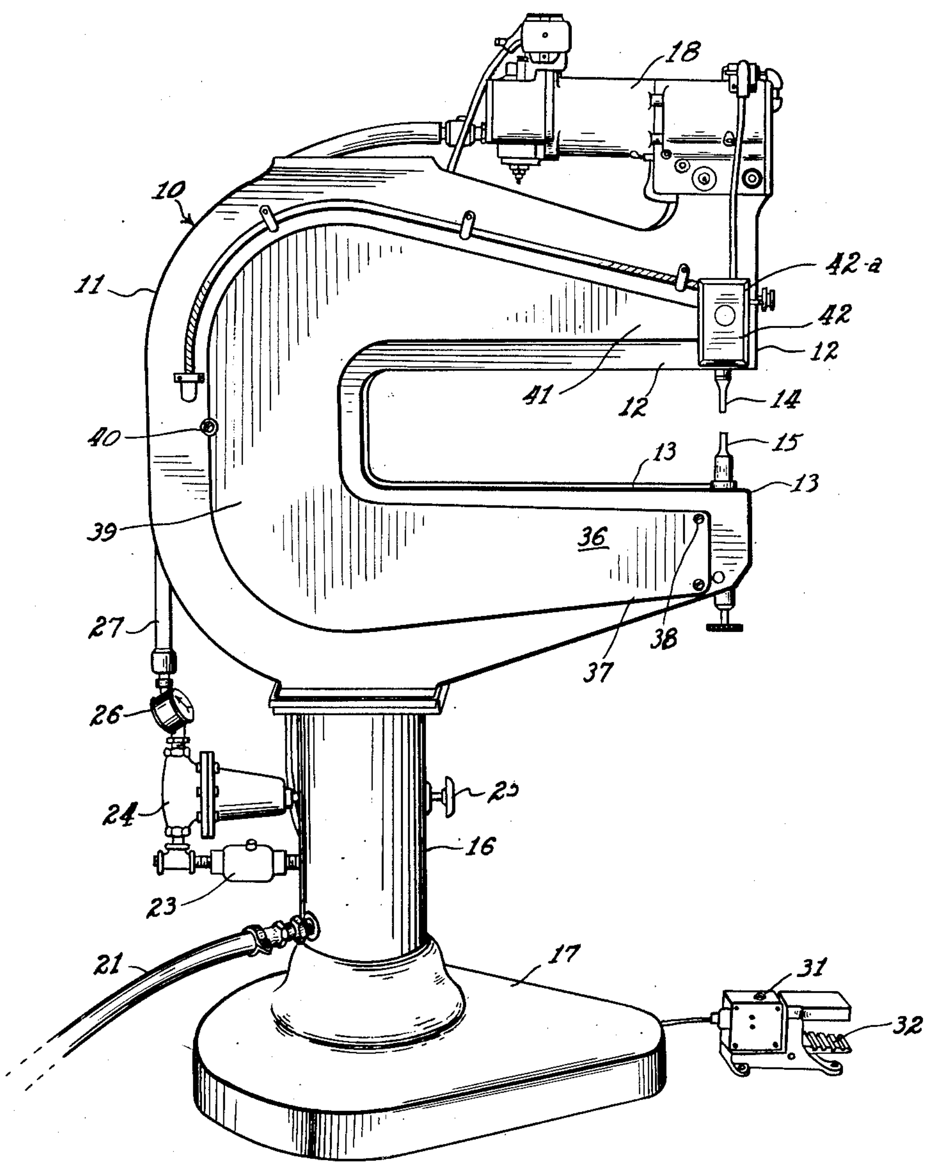
COMPRESSION RIVETER SWITCH

Original Filed Dec. 13, 1943 2 Sheets-Sheet 1

Fig. 1



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Nov. 10, 1953 H. R. FISCHER ET AL 2,658,966

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Fig. 2

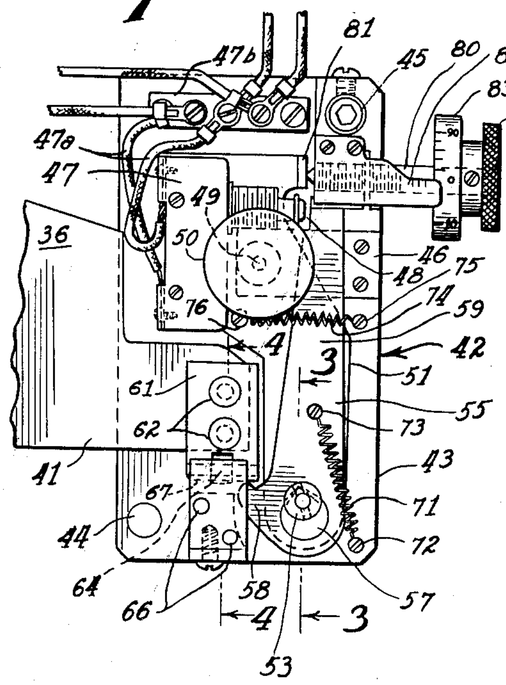


Fig. 5

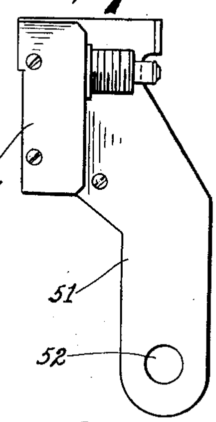


Fig. 4

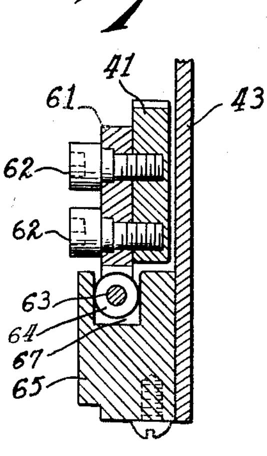
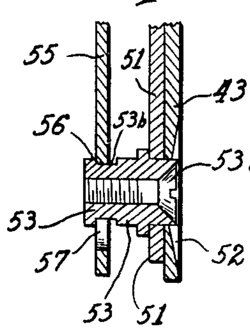


Fig. 3



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COMPRESSION RIVETER SWITCH

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8 Claims. (Cl. 200—52)

1

This invention relates to electric switches, and particularly to a switch for use as a deflection trip switch with machines in which the deflection of a part of the machine, during operation, is utilized to operate the switch to control an external circuit, and is a division of our application, Serial No. 514,068, filed December 13, 1943 (now abandoned), relating to compressing riveting machines.

One object of this invention is to provide a sensitive control switch suitable for use with a massive riveting machine of the open jaw type, in which a relative deflection of one jaw with respect to the other jaw, during operation, is utilized to operate the switch when the deflection reaches a predetermined value for which the switch may be accurately adjusted.

Another object of the invention is to provide a control switch of the foregoing type in which a sensitive switch of the micro-switch type is employed and in which the operating member of the switch is disposed to be controlled by a deflection measuring member on the machine, to operate the switch when the deflection member indicates a relative displacement of the jaws of the machine amounting to a predetermined distance for which the switch is, or has been adjusted.

Another object of the invention is to provide a switch of the foregoing character, in which all parts of the switch are formed of relatively rugged members, and yet the construction of the switch is such as to permit of very sensitive operation and a micrometer adjustment for adjustably setting the switch to operate at a predetermined deflection of a jaw of the machine.

The construction of the switch in accordance with the present invention and its mode of application and operation are illustrated in the accompanying drawings, in which:

Fig. 1 is a side elevational view of a massive machine of the open jaw riveting type, employing a deflection plate to obtain a measure of the relative deflection of one jaw of the machine when under pressure during operation;

Fig. 2 is a front elevational view of the switch, with a portion of the deflection plate shown in normal operating position relative to the switch;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2 to illustrate the disposition of a fulcrum ferrule for the operating arm of the switch;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 2, to illustrate the guide restraint for the free end of the deflection plate in its movement to operate the one end of the actuating arm of the switch; and

2

Fig. 5 is an elevational front view of the adjustable switch plate that carries the micro-switch.

As generally illustrated in Fig. 1, a fluid actuated riveting machine **10** consists of a massive yoke structure **11** and terminating at the front of the machine in two opposed vertically spaced jaws **12** and **13** for respectively supporting two cooperating rivet-shaping tools **14** and **15**. The yoke **11** is supported rigidly on a column **16** that in turn is supported and affixed to a substantial stable piece **17**. The two jaws **12** and **13** extend forward from the main body of the yoke. The yoke structure is made of material having great strength, toughness and elasticity, such as boiler plate steel, in order to permit the development of a riveting pressure of many tons. Consequently, the jaws **12** and **13** may be spread apart slightly, during such pressure operation, without straining the yoke beyond the elastic limit or development of fatigue of the middle. For the purpose of the present application, it is sufficient to note briefly that the tool **15** in the lower jaw is adjustably positioned and fixed in the lower jaw **13** to provide one adjustment in the spacing between the jaws of the machine to provide for shaping of rivets of different lengths. The upper tool **14** in the upper jaw **12** is carried by a plunger that need not be shown for the purpose of the present invention but that is controlled by pressure generating device **18** supported at the upper end of the top jaw **12**. During operation the plunger is brought down to force the tool **14** towards the bottom tool or dolly **15** in order to compress any rivet that may be disposed between the two tools **14** and **15**.

The operating fluid for the pressure device **18** is supplied from a suitable source of pressure supply through a conduit **21** at the bottom of column **16** and thence through suitable air line oiler **23** and a pressure regulator **24** controlled by its regulating handle **25** and thence past a pressure gauge **26**, through a conduit **27** to the cylinder of the pressure generating unit **18**.

The operation of the machine is arranged to be controlled by a foot switch **31** provided with an operating pedal **32**. The operation of the foot switch **31** completes a circuit to the electrical control apparatus which initiates operation of the equipment including the pressure generating device **18**, to move its plunger downward and force the tool **14** down towards the dolly or anvil **15**, in order to operate on a rivet disposed between those two tools **14** and **15**.

When the two tools **14** and **15** engage a rivet and impress a compression force on the rivet, the reaction pressure against the two jaws 12 and 13 tends to separate them slightly. That separating movement is measured, and is utilized to control the operation of the machine in a normal sequence of operations. The nature of the control operations in that sequence is not necessary to an understanding of the present invention, and the present reference thereto is made merely to indicate that the separation of the jaws is measured to control the operation of the switch of the present invention.

In order to measure the separation for deflection of the two jaws 12 and 13, during operation, a deflection plate 36, of substantially U-shape, is mounted on and supported by the main yoke 11 of the machine, in such manner as to be slightly spaced on the main yoke 11 and free of any reaction force from the two separating jaws 12 and 13. The lower arm 37 of the deflection plate 36 is secured at its end to the jaw 13 by screws 38 through suitable blocks, not shown, that will serve to space the deflection plate 36 somewhat from the surface of the main yoke 11. The back body portion 39 of the deflection plate 36 is held from bending or swinging away from the main yoke 11 by a screw 40 which holds that part of the deflection plate at a fixed distance from the adjacent face of the main yoke 11. The upper arm 41 of the deflection plate extends into the switch box 42 which contains the switch of the present invention. The manner in which the free end of the arm 41 of the deflection plate operates the switch is more fully shown in Fig. 2.

The deflection plate remains unaltered and free from stresses and strains arising in the yoke 11 upon the machine during riveting operation, despite the fact that the jaws 12 and 13 are measurably separated or opened apart when the pressure is applied to a rivet to produce the head upon the same. As the deflection plate thus remains free and unchanged, the movement of the upper jaw 12 of the yoke away from the lower jaw 13 produces relative movement between the upper jaw 12 and the adjacent upper arm of the deflection plate.

It is merely necessary to note at this time that the deflection trip switch is mounted and supported as a unit on the upper jaw 12 of the yoke 11. When the upper jaw 12 is deflected upwardly, during operation, its upward movement relative to the adjacent upper arm 41 of the deflection plate 36 is utilized to operate the switch.

The various movements that are to be measured in this machine are relatively small. A high degree of accuracy is therefore required in the mechanism that responds to those movements in order to actuate the switch. At the same time the switch itself should be susceptible of accurate positioning and adjustment. Notwithstanding these requirements of sensitivity and accuracy, the service to which the switch will be subjected in operation on a machine of the character described, requires that the switch must, above all, be extremely rugged. Moreover, since the machine must be readily adaptable to operation on rivets of various sizes and dimensions, the switch should be quickly adjustable to adapt the machine for operation on rivets of such various dimensions, while, at the same time, retaining its high degree of accuracy throughout the wide range of adjustment necessary for the range of operation of the machine. In order to establish and maintain these desirable characteristics in the switch, it has been designed so that its

cooperating parts will operate with a minimum of friction.

Referring now to Fig. 2, it will be seen that the switch 42 comprises a base plate 43 that supports the switch mechanism, and, in turn, serve as a unit member to be secured to the upper jaw 12 of the yoke by suitable screws through openings in the base plate 43, such as shown at 44 and 45.

For simplicity, the switch contact unit used in this switch assembly consists of a micro-switch 47 provided with the customary operating plunger or pin 48, extending through a protective ferrule into the micro-switch housing. To provide for quick, easy and accurate adjustment of the position of the switch and the end face of its operating pin 48, the micro-switch housing is supported on an adjustable switch plate mounted as a pivoted arm 51.

At the side of the base plate 43 is fixed a locking plate 46 which serves as a lateral support for the adjustable switch plate in its movement as a pivoted arm. The locking plate 46 carries a locking screw 49 having a wide inner knob 50 by which the screw may be tightened or loosened manually to lock or to release the pivoted switch plate 51 in position. The locking plate 46 consists of a rectangular strip slightly spaced from the base plate 43 to provide a space within which a complementary flat portion of the switch plate 51 may move within its plane to engage both the back surface of the locking plate 46 and the front surface of the base plate 43 with some slight frictional surface contact. The locking screw 49 is threadedly supported on the locking plate 46, and when tightened, serves to lock the adjustable switch plate in position against movement so long as the locking screw is in such tight condition.

The micro-switch 47 is supported at the upper end of the switch plate 51 and its interior contact members are connected by suitable conductors 47*a* to a terminal block 47*b*, supported at the top of the base 43, to which connections may be suitably made to external circuits that are to be controlled by the micro-switch contacts.

The switch plate 51 is provided with a hole 52 at its lower end to permit the switch plate to be readily fitted over the pivot 53 that is anchored on and supported on the base plate 43. The pivot 53 is anchored to the base plate 43 by a screw 53*a* and serves both as a retainer and as pivot for the switch plate 51. The pivot 53 is also formed to have knife-edge 53-*b* that serves as pivot to support a deflection switch trip lever 55 in a V-shaped pivot seat 56 to engage the upper part of the peripheral edge of an opening 57 located at the lower end of the trip lever 55 (Fig. 2). A trip lever 55 has a short actuating arm or force arm 58 at one side of the lower end of the trip lever and relatively close to the pivot mounting, and above the pivot the trip lever has a relatively long upright arm 59 which is spaced but a slight distance from the face of the switch plunger 48. Due to the difference in the lengths of the two lever arms 58 and 59, it is obvious that a slight movement of the short arm 58 will produce a much greater corresponding movement or swing of the long arm 59 of the trip lever 55.

In view of the small movements that occur in the members that are to control the operation of the switch, in this case the relative movement between the upper jaw 12 and the upper arm 41 of the deflection plate, it is extremely important that the entire deflection movement of said upper arm 41 be available, rather than merely a component of that movement to actuate the switch trip lever 55. For that purpose the movement of the deflection plate upper arm 41 is confined to a planar path, without permitting any sidewise components of motion. The deflection plate 41 is provided with a lever actuating block 61 that is secured to the deflection plate arm 41 by two screws 62. The block 61 is provided with a pivot pin 63 along its lower end to support a roller 64 which cooperates with a guide block 65 to hold the actuating block 61 in the same general plane throughout its movement. The guide block 65 is secured to the base plate 43 by screws 66, and is provided with a seat 67 for receiving and guiding the roller 64 to space the actuating block 61 from the sides of the slot and facilitate the movement of the block therein.

As the block 61 moves relatively downward against the short arm 58 of the switch trip lever 55, the downward movement of arm 58 is multiplied, by the ratio of the length of the long arm 59 of lever 55 to the length of the short arm 58, from the fulcrum point of the lever 55 on pivot 53, and that multiplied movement of arm 59 provides an enlarged range of adjustment for positioning the front face of the end of the switch plunger 48 relative to the engaging face at the end of the long arm 59 of the trip lever 55. The trip lever 55 is kept with its short arm 58 continuously in engagement with the undersurface of the actuating block 61, by a biasing spring 71 having one end anchored at screw 72 on the switch base plate 43 and the other end anchored at screw 73 on the arm 59 of trip lever 55. Thus, the trip lever is immediately responsive to even the slightest movement of the deflection plate arm 41 and its supported actuating block 61 relative to the switch base plate 43 that is rigidly mounted on the upper yoke jaw 12. When the relative movement reaches the preset value for which the switch is adjusted, the trip lever 55 moves its arm 59 to engage and actuate the switch plunger 48 to operate the micro-switch 47.

The operating point of micro-switch 47 is controlled by positioning the switch plate 55 on the pivot 53. The switch plate is biased toward the trip lever arm 59 by a biasing spring 74 having one end anchored at screw 75 on the base frame 43, and the other end attached to the switch plate 55 by a screw 76. That bias spring 74 is effective only while the locking screw 49 is released to permit the switch plate to be adjustably positioned. During that time the bias spring serves to bias the plate to the point of a micrometer adjusting screw 80 to ensure contact of the micrometer against a stop lug 81 on the switch plate, with consequent significance to the micrometer setting.

The micrometer setting to determine the position of the micro-switch, when used with a riveting machine of the kind indicated, depends upon the size of the rivet being set. During that operation, the yoke is expanded to a degree corresponding to the pressure applied to the rivet. The jaws of the yoke separate in direct ratio to that pressure, but the deflection plate does not share in that expanding movement of the yoke. Instead, when the predetermined pressure is reached, and the jaws are correspondingly separated, the upper arm 41 of the deflection plate, acting through the actuating block 61 depresses the short arm 58 of the switch trip lever 55 and swings the longer upper arm 59 into active contact with the switch plunger 48 and causes operation of that switch to control an external circuit. In the case illustrated, that circuit then controls the termination of the riveting operation, but that particular operation is not directly pertinent to this invention of the switch itself. Inasmuch as a riveting machine of the type shown herein may operate on rivets that vary in size and in the nature of the material of the rivet, the machine is provided with an adjustable means that is accessible to the operator from the front of the machine to effect proper adjustment when desired of the switch by adjusting the position of the switch plate 55.

The adjusting means for the switch includes the micro-meter adjusting screw 80, that is provided with an operating knob 82 and a calibrated dial 83, movable with the screw 80 and cooperative with the stationary calibrated dial 84 to provide an accurate reading of the adjusted spacing of the micro-switch from the trip lever.

As shown in Fig. 1 the operating knob 50 of the locking screw 49 is accessible from the front of the switch cover plate 42-*a* being disposed to project through the switch cover plate. When it is desired to adjust the switch in order to permit the machine to operate on a different size or type of rivet, the locking screw 49 is loosened by partial unscrewing of that screw by means of the knob 50 in order to release the switch plate 51 for movement by its biasing spring 74 toward the micrometer adjusting screw 80 and adjusting movement of the micrometer screw against the stop lug 81 of the switch plate in opposition to the biasing force of the biasing spring 74. During such adjustment of the switch plate 51, the gap or spacing between the switch plunger 48 and the facing edge of the upper end of the upper arm 59 of the trip lever can be varied to increase or decrease the spacing between that plunger and the trip lever. For a small rivet, the micrometer screw is adjusted to reduce the gap between the trip lever and the switch plunger. Usually, the adjustment of the machine is tested by setting one or more rivets of the desired size until the switch adjustment is correct for the desired setting of the rivets. When that adjustment is achieved by the micrometer screw, the locking screw 49 is then moved to clamping position by its knob 50 to clamp the switch plate 51 in position against movement by its biasing spring 74, in response to any casual or undesired external force. When a heavier rivet is to be operated on, the locking screw 49 is again loosened and the micrometer screw 80 is adjusted to increase the gap between the switch plunger 48 and the adjacent edge of trip lever arm 59, until the machine by test will set the larger size rivet exactly as desired.

By means of such a switch structure, the setting obtained by adjustment of the micrometer screw 80 will be very accurate. Consequently, once the calibrating screw 80 has been adjusted to the correct position for a given size rivet and definite type of work, an operator may restore the machine to any such previously ascertained correct setting for that same type of work without retesting or loss of time, where the machine has been readjusted for different rivets and other work pieces requiring different adjustments of the machine in the interim. The calibrated scale 84 may thus be provided with markings to serve as calibrations for that particular switch in relation to that particular machine on which it is mounted for a specific size of rivet and of specific material.

The switch described herein thus serves not only as a circuit controlling device for terminating a rivet setting operation, but will serve also as an accurate calibrating means for quickly calibrating the machine by actual test on a rivet that is to be worked, and thereby provides an accurately calibrated setting which may be utilized for quickly adjusting the machine to a similar position for any work to be done which is a repetition of work that has been previously performed on the same machine.

While various changes may be made in the detail construction, it shall be understood that such changes may be made within the spirit and scope of the invention as set forth in the appended claims:

We claim:

1. A switch for use with the machine of the character having two cooperating jaws and a deflection plate for measuring the separation of the two jaws during operation relative to their normal separation when not in operation, said switch comprising a supporting frame, a micro-switch having an operating pin, a trip lever for the switch having a long arm to engage the switch operating pin and having a short arm to be engaged and actuated by a free end of the deflection plate, a fulcrum secured to the frame and serving to support the trip lever for the switch, means confining the free end of the deflection plate to a planar path against the short arm of the trip lever, means for biasing the switch toward the end of the long arm of the lever, a vernier adjustment screw supported on the frame to adjustably position the switch relative to the operating surface of the long arm of the lever, and means for locking the micro-switch in selected adjusted position.

2. A switch, as in claim 1, in which the fulcrum for the trip lever consists of a pivot anchored on the frame and having a definite outer dimension or diameter, and the trip lever is provided with an opening at its pivotal region that is sufficiently large to permit the lever to be directly slipped over the front end face of the pivot in position, the pivot having an undercut region directly behind the front end surface and of sufficient width to accommodate the thickness of the trip lever and to provide a seat and a shoulder to hold the lever on the pivot during operation.

3. A switch, as in claim 1, in which the fulcrum for the trip lever is shaped as a relatively sharp inverted V-shaped edge to limit frictional surface area.

4. A switch comprising a base, a micro-switch assembly including an operating pin, a support plate for the micro-switch assembly, said plate being pivoted at one end with the switch supported on the free end of the plate and the operating pin facing in the plane of movement of the plate, a fulcrumed trip lever having a load arm disposed to engage and press the operating pin to actuate the micro-switch and a force arm disposed to receive an external pressure force, a single element on the base to serve as a pivot for the switch support plate and as a fulcrum for the trip lever so the switch support plate and the trip lever will function as the two arms of a tong, and means to bias the work arm of the trip lever away from the switch operating pin and towards a stop serving to define the initial terminal position of the trip lever work arm.

5. A control switch, for use with a riveting machine of the character including two cooperating jaws and a deflection plate for measuring the separation of the jaws due to operating stresses developed therein, said switch comprising a micro-switch assembly including cooperating contact members and terminals for connections thereto, an actuating element for the contact members, and control means for operating the switch when the free end of the deflection plate moves a predetermined distance relative to the associated jaw of the machine, said control means comprising a trip lever having a short force arm and a long switch operating arm, a fulcrum for supporting and pivoting the lever, a pressure block subject to the movement of one end of the deflection plate and operable as an actuator to engage the short arm of the fulcrumed trip lever, a restraining guide for the actuator block to keep the actuator block in a predetermined straight line path of movement against the end of the short arm of the trip lever, a frame to support the switch assembly and the controls therefor, a pivoted plate to support the switch assembly in position with the actuating element therefor disposed parallel to the path of movement of the end of the long arm of the trip lever, a biasing spring to bias the switch plate toward the end of the long arm of the trip lever, and a vernier adjustment screw supported on the frame and operative to adjustably position the switch plate against the bias of said spring.

6. A control switch of the character described comprising a base plate, a switch carrying plate having a switch mounted thereon, a trip lever for the switch, a single element serving as a pivot for the switch plate and for the trip lever, means biasing the switch and its plate toward the trip lever, means biasing the trip lever away from the switch, means for calibrating the separation between the switch and the trip lever, and means for locking the switch plate in adjusted position.

7. A switch, as in claim 6, including a housing and cover plate to enclose the switch, with the calibrating and locking means extending out through the housing and the cover plate to permit readjustment of the switch from time to time without removing the cover plate.

8. A switch, as in claim 6, including an actuating member for the trip lever, said biasing means for the trip lever serving to maintain the trip lever in continous engagement with the actuating member, and means for maintaining the actuating member in co-planar alignment with the trip lever to assure transfer of the full movement of the actuating member to the trip lever.

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