This invention relates to limit switches and, in particular, to an improved switch construction adapted for use with an actuator operating at relatively high speed and thereby subjecting the switch to successive impact blows of considerable force.

Limit switches are extensively used for the automatic control of reciprocating members and various forms of such switches have been devised, usually including a rock shaft and one or two actuating levers therefor. In one of these forms, the moving parts of the switch oscillate between extreme positions on engagement of one of the angularly disposed levers by a trip or striker mounted on the reciprocating member, the limits of travel of the switch parts being fixed by mechanical stops. If the reciprocating member is operated at high speed, the trip or strikers and stops are subject to severe abuse and breakage frequently occurs. This involves substantial loss in the case of large costly machines, because of the time necessarily consumed in making a replacement. Breakage may also result from rebound of the levers after striking the stops to an intermediate position in which normal engagement by the trip or strikers is precluded.

I have invented a novel switch construction which effectually overcomes the disadvantage explained above and obviates breakage of the parts and the delay and loss incident to their replacement. In a preferred embodiment, I provide a pendulum or counterweight pivotally adjacent the switch levers and adapted to be engaged thereby after predetermined angular movement thereof. The resulting tilting of the pendulum gradually absorbs the energy imparted to the lever by the impact of the trip or striker thereon. After finally arresting the moving parts of the switch, the pendulum restores them to the proper position for the next operation. Specifically, I utilize as a pendulum a bar pivoted on the rock shaft of the switch and provide the switch-actuating levers with means engaging the bar when tilted through a predetermined angle in opposite directions successively.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating the preferred embodiment. In the drawings,

Figure 1 is a side elevation of my improved limit switch;

Figure 2 is an end elevation thereof; and

Figures 3 and 4 are diagrams illustrating the operation of the switch.

Referring in detail to the drawings, a limit switch, indicated generally at 0, comprises a housing 11 of any suitable type enclosing electric contacts (not shown) similar to those used in known limit switches of the track type. These usually include fixed contacts and movable contacts cooperating therewith, the movable contacts being mounted on a rock shaft, such as that indicated at 12, journaled in the housing. Operating levers 13 and 14 secured to the rock shaft are adapted to be engaged successively by a trip or striker 15 (see Figures 3 and 4) on reciprocation thereof. The trip or striker is mounted on the traveling member to be controlled, whatever its nature, indicated diagrammatically at 16. The levers 13 and 14 may conveniently be formed of one piece of plate shaped to provide ears disposed at an angle to each other. The structure so far described is known and forms no part of my invention.

The improvement in the construction of a limit switch which I have invented relates to means for arresting the moving parts gradually after one of the levers 13 and 14 has been struck by the trip or striker as it moves past the switch. For this purpose I provide a pendulum 17 pivoted adjacent the levers and, most conveniently, on the end of the shaft 12. I also provide projections or tongues on the inner ends of the levers, as indicated at 18 and 19, to engage and tilt the pendulum after the levers have turned through the angle necessary for operating the switch. The shaft, of course, turns freely in the pivot hole in the pendulum and the latter is swung bodily from its position of rest only after the completion of an operating movement of the switch from one of the two normal positions of the levers to the other.

The pendulum may be of any desired form but that shown is simply a length of bar of suitable size and weight. I preferably attach a lug 20 to the face of the bar adjacent the levers, as by welding, in such position that it will be engaged by the projections 18 and 19.

The operation of the switch may best be explained by reference to the diagrams of Figures 3 and 4. Figure 3 shows the relation of the parts when the trip or striker is approaching the switch from the left, as indicated by the arrow. The trip or striker is in a relatively high speed, it will deliver a heavy impact blow to the lever tending to carry it beyond the position in which the switch contacts have been fully actuated.

As the moving parts pass such position, the pro-
section or tongue 19 engages the lug 20 and tilts the pendulum 17 clockwise from its normal vertical position, as shown in dotted lines in Figure 3. The work thus done in raising the center of gravity of the pendulum absorbs the kinetic energy of the switch movement and gradually arrests it after which the pendulum returns to normal position, thereby restoring the lever 13 to position for engagement by the tripper or its reverse movement, as shown in solid lines in Figure 4. The reverse operation of the switch has a similar effect in the opposite direction, i.e., to tilt the pendulum counterclockwise, as shown in dotted lines in Figure 4.

It will be evident that the pendulum serves as a yielding stop or a progressively effective check or damper for excessive movements of the switch-operating levers. The spaced projections 18 and 19 provide a lost-motion connection between the levers and the pendulum. The fixed switch contacts, of course, must be designed to permit the movable ones to travel beyond the fully opened or closed position to an extent depending on the force applied to the operating levers by the tripper. That is to say, the engagement of the contacts should not limit the movement of the movable contacts on a circuit-closing operation and the travel of the movable contact on a circuit-opening movement should likewise be free and unobstructed. Since the pendulum on displacement gradually absorbs the impact delivered to the levers by the tripper, there is less likelihood of resultant damage to or breakage of the parts than in switches having fixed stops which arrest the switch movement suddenly and positively. There is no rebound of the levers, furthermore, which might leave them in an intermediate position such that normal reverse operation would not be effected on the next traverse of the tripper. Damage which would otherwise be certain to occur is thus avoided. The pendulum requires no maintenance beyond occasional lubrication to insure that the rock shaft is free to turn without tilting it. The extremely simple form of pendulum shown, furthermore, does not materially increase the overall cost of the switch. My switch is also characterized by improved operation and longer life compared to known switches.

Although I have illustrated and described only a preferred embodiment of the invention, it will be understood that changes in the details or arrangement thereof may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a limit switch, a housing, a rock shaft journaled therein, and a sector plate secured on said shaft having angularly disposed levers upstanding therefrom, said plate being tiltable between two extreme positions, the combination therewith of a pendulum pivoted on said shaft and a pair of projections extending downwardly from said plate adapted alternately to engage said pendulum and tilt it from its normal position on tilting of said plate from one extreme position to the other.

2. In a limit switch including a rotateably mounted contact-actuating rock shaft and a pair of levers secured thereto disposed at an angle to each other and adapted to be engaged successively by a reciprocating striker member and tilted thereby from one extreme position to another, the combination therewith of a pendulum pivoted on said shaft, and means rigid with said levers adapted to tilt said pendulum from its normal position when either of said levers approaches one of said extreme positions.

LAWRENCE B. PETRAK.

REFERENCES CITED

The following references are of record in the file of this patent:

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,303,443</td>
<td>Duffing et al.</td>
<td>Dec. 1, 1942</td>
</tr>
<tr>
<td>2,424,385</td>
<td>Cook</td>
<td>July 22, 1947</td>
</tr>
</tbody>
</table>