

March 16, 1943.

R. B. HUNTER

2,313,995

CRANE LIMIT SWITCH

Filed Sept. 20, 1941

2 Sheets-Sheet 1

Fig. 1

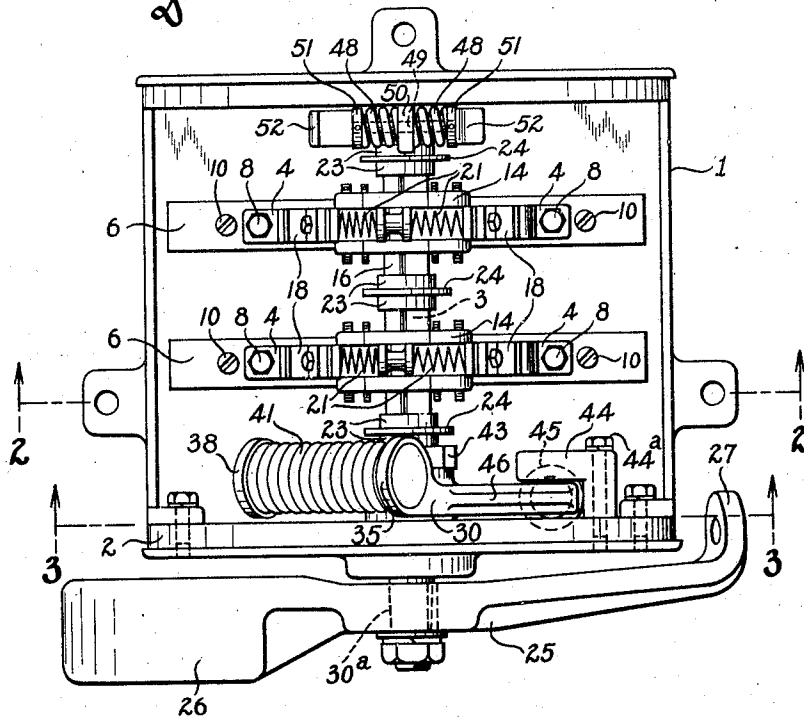
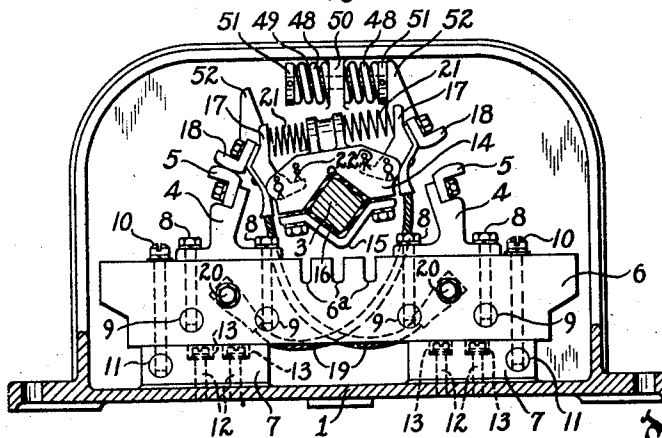


Fig. 2



Inventor
Richard B. Hunter
By Frank H. Hubbard
Attorney

March 16, 1943.

R. B. HUNTER

2,313,995

CRANE LIMIT SWITCH

Filed Sept. 20, 1941

2 Sheets-Sheet 2

Fig. 3

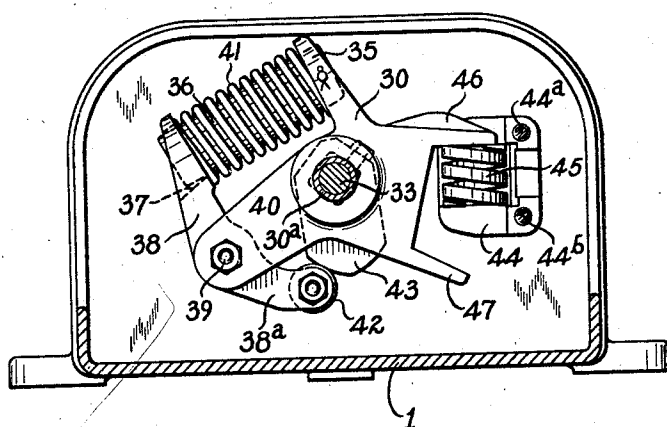


Fig. 4

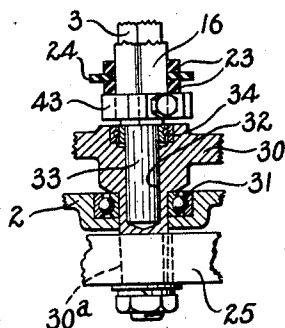


Fig. 5

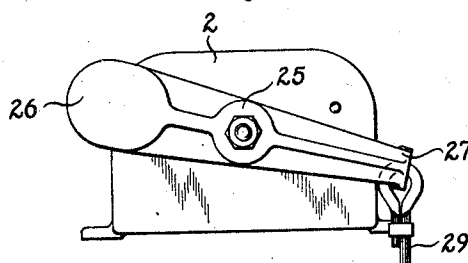
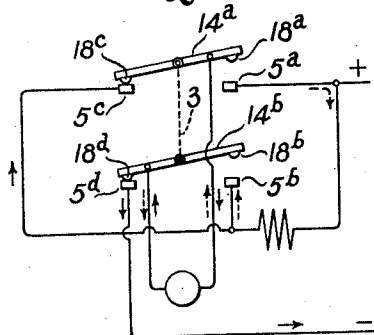
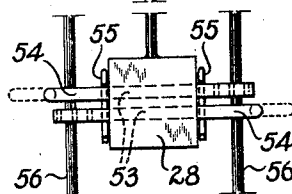


Fig. 6



Inventor
Richard B. Hunter
By Frank H. Hubbard
Attorney

UNITED STATES PATENT OFFICE

2,313,995

CRANE LIMIT SWITCH

Richard B. Hunter, Shorewood, Wis., assignor to
Cutler-Hammer, Inc., Milwaukee, Wis., a cor-
poration of Delaware

Application September 20, 1941, Serial No. 411,664

12 Claims. (Cl. 200—47)

This invention relates to an improvement in crane limit switches.

Crane limit switches are installed on electrically operated cranes and hoists for the purpose of disconnecting the motor from the line and bringing it to a quick stop, if the hook of the hoist should tend to overtravel its safe upper limit. If the hook is permitted to overtravel, the motor puts an excessive strain on the hoisting cables, or the hook and load interfere with parts of the hoist, which may cause the cable to part and release the hook and load, resulting in great damage and endangering life.

The overtravel referred to might be due to various causes, such as failure of the operator to disconnect the motor by the controller at the proper instant, or the controller may become ineffective and fail to disconnect the motor, or some difficulty may develop in the often complicated and exposed wiring of the system.

For the aforementioned reasons it is highly desirable to provide a limit switch which will not fail either electrically or mechanically to disconnect the motor under any circumstances. A great many constructions have been proposed in the past, but none of these has fully met all of the exacting requirements.

A commercial limit switch must be adapted for mounting in various angular positions, depending upon the mechanical arrangement of the hoisting machinery. The construction should therefore be such that the switch is readily rearranged for the various modes of mountings. Furthermore the limit switch is usually mounted in a rather inaccessible location and therefore may receive little attention. In many places, such as foundries and the like, it is exposed to a great deal of dust, which may seriously affect its electrical insulation, while periodic cleaning of the switch to remove the dust cannot be relied upon, and is in any event an undesirable burden.

Most limit switches are equipped with a weight, which biases them to their normal position and which is lifted by the hook or moving sheave for operation. The usual weight is suspended by a rope which may tangle with the hoisting ropes and cause damage.

The object of the present invention is to provide a simple and improved limit switch, which meets the aforementioned exacting requirements and which avoids the disadvantages of prior art switches.

Another object is to provide a simple and improved limit switch snap operating mechanism

which has a long operating life, and which is not likely to get out of order.

Another object is to provide a limit switch which may be mounted in various angular positions, while insuring reliable operation and maintenance of its insulation.

Another object is to provide an improved mounting and arrangement of the current carrying parts of limit switches.

Another object is to provide a maximum of creepage distance between conducting parts of different polarity of the limit switch.

Another object is to provide a limit switch, in which the insulating resistance between live parts of different potentials is not substantially reduced by the accumulation of dust and the like.

Another object is to provide a limit switch which will continue to operate satisfactorily even after the failure of certain operating elements.

Another object is to provide a counterweight for a limit switch with an adjustable means for engagement by the hoisting tackle and the ropes.

Another object is to provide efficient and safe guide means for the counterweight.

Various other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate an embodiment of the invention which will now be described, it being understood that the illustrated embodiment may be modified in various ways without departing from the scope of the appended claims.

In the drawings, Figure 1 is a plan view of a limit switch embodying the invention—the cover member being omitted.

Fig. 2 is a sectional view, on the line 2—2 of Fig. 1.

Fig. 3 is a sectional view, on the line 3—3 of Fig. 1.

Fig. 4 is a view, partly in section through the center line of the operating shaft.

Fig. 5 is an exterior end view of the limit switch, and

Fig. 6 is a diagram of connections, illustrative of an application of the limit switch to control of a direct current motor.

Referring to the drawings, the contact mechanism of the limit switch is enclosed in a frame 1, provided with a removable end cover 2. Pivottally supported by the frame and cover is an operating shaft 3, which throughout the major portions of its length is of square cross section.

The switching mechanism is provided with stationary contact blocks 4, having removable contact tips 5. The stationary contact blocks are

mounted in pairs symmetrical with respect to the operating shaft 3, on insulating blocks 6. These insulating blocks are substantially rectangular in cross section and are arranged with their major axes transverse to the operating shaft 3, and each insulating block is in turn attached to the frame 1 by means of a pair of insulating spacers 7. To further increase the creepage distance between the two contact blocks 4 of each pair along the surface of the blocks 6, a number of transverse notches 6^a (Fig. 2) may be cut into that side of each block 6 to which the contact blocks 4 are attached.

As the limit switch is usually mounted in the horizontal position shown in Figs. 2 and 3, it is desirable to arrange that the creepage distance between live parts of different polarity be as great as possible, and that horizontal surfaces upon which dust might collect, and which would reduce the surface insulation between live parts, be avoided, or be made as long as possible, and to intersperse between such horizontal surfaces (by providing notches or shoulders) vertical surfaces upon which dust cannot accumulate. The arrangement should be such that these conditions obtain with the limit switch mounted in any angular position around the horizontal shaft. The aforementioned requirements are met by the construction and the mounting of the stationary contacts and supports as aforescribed.

Each stationary contact block 4 is fastened to the respective mounting block 6 by means of two bolts 8, which engage special nuts 9 of cylindrical shape, inserted in suitable holes drilled transversely through the mounting block 6, the latter being of substantially rectangular form in cross section, as aforesaid. Each mounting block 6 is in turn mounted upon the pair of spacing blocks 7 by bolts 10 which cooperatively engage cylindrical nuts 11, inserted in suitable holes drilled transversely through the blocks 7, the arrangement of the bolts 10 and the nuts 11 being similar to that of the bolts 8 and the nuts 9. The blocks 7 are fastened to the frame 1 by means of screw bolts 12, the heads of which are countersunk in the blocks 7, as shown in dotted lines at 13, while the threaded ends of the bolts 12 cooperatively engage tapped openings or recesses in the frame 1.

From the foregoing, it will be seen that the creepage surface between each nut 9 which has the same potential as its associated contact block 4 and the bolt 12 which is of the same potential as the frame 1 is exceedingly large, and that a large cross section of the dielectric of the block 6 is in the path between the two parts, and that there is no direct horizontal creepage surface between any live part connected to the block 4 and the frame 1 for any positioning of the limit switch.

Referring now to the movable contacts, the same are mounted in pairs upon brackets 14 attached to and insulated from the shaft 3 adjacent to the respective pairs of stationary contact tips 5. Each bracket 14 is fastened to shaft 3 by means of a clamping piece 15, and is insulated therefrom by an insulating tube 16. Pivotaly mounted to each bracket 14 is a pair of contact supports 17, each carrying a renewable contact tip 18. Attached to each contact support 17 is one end of a flexible connector 19, the other end of which is fastened to a terminal bolt 20 which passes transversely through the insulating block 6. The contact supports 17 with their attached tips 18 are biased toward the stationary contact

tips 5 by means of springs 21, and have their outward movement limited by stop pins 22 carried by said brackets 14.

Mounted upon the insulating tube 16 on both sides of the brackets 14 are pairs of insulating collars 23, between each pair of which is further mounted an insulating disk or plate 24, the purpose of which insulating parts is to increase the creepage surface between adjacent brackets 14, and between the brackets and grounded parts near the ends of the shaft, and particularly to interpose vertical creepage surfaces between the various live parts of different polarity.

The circuit connections of the apparatus thus far described, for a direct current series motor, are illustrated in Fig. 6. In this drawing only the connections essential to explain the operation of the device are shown, whereas the conventional control apparatus for varying the speed and direction of rotation of the motor is not shown, these being of any one of a number of well known types. As shown in Fig. 6, circuit is established from the positive line to one terminal of the series field and a branch extends to stationary contact 5^a. The other terminal of the series field is connected to stationary contact 5^b, and is also connected to stationary contact 5^c, which is symmetrical to contact 5^a with respect to the shaft 3. A fourth stationary contact 5^d is connected to the negative line terminal. One terminal of the armature is connected to one of the brackets 14 which carries the movable contacts 18^a and 18^b, while the other terminal of the motor armature is connected to another bracket 14^b, which carries the movable contacts 18^b and 18^d. The contacts 18^a, 18^b, 18^c and 18^d cooperate with the contacts 5^a, 5^b, 5^c and 5^d, respectively.

In the normal operating position, shown in Fig. 6, the movable and stationary contacts at the left-hand side of the shaft 3 are respectively engaged with each other, and therefore a current flows from the positive line through the motor field, contacts 5^c, 18^c and bracket 14^b through the motor armature and through bracket 14^a and contacts 18^a and 5^a to the negative side of the line. When the limit of travel for the motor is reached, the shaft 3 is rotated in a clockwise direction, as will be explained more in detail hereinafter, whereupon the contacts to the left of the operating shaft in Fig. 6 are opened and the contacts to the right thereof are closed. The current then flows through the series field, contacts 5^b, 18^b and bracket 14^b through the armature in a direction opposite to that in which it flows under normal conditions, thence through bracket 14^a, contacts 18^a and 5^a back to the series field. The full line arrows in Fig. 6 show the direction of current flow under normal conditions, whereas the arrows in dotted lines show the direction of flow for braking. Under braking conditions the motor functions as a simple series wound generator and comes to a standstill in the usual manner.

The mechanism for operating the shaft 3 will now be described, with reference to Figs. 1 and 5. A lever 25 (one end 26 of which is made in the form of a heavy counterweight, whereas the other end is provided with a perforated ear 27, for the attachment of a weight 28, Fig. 5, by means of a cable 29) is keyed at its center (see Figs. 1 and 4) to a shaft extension 30 of a casting 30. The shaft extension 30 is supported for rotary motion by a ball bearing 31 (Fig. 4) in the end cover 2. The weight 28 over-balances the counterweight 26, so that normally the weight 28 biases

the shaft to the position shown in Fig. 5. If, however, the limit of travel is reached, the weight 28 is lifted by a suitable mechanism driven by the motor which is controlled by the limit switch. This permits the weight 28 to rotate the casting 30 in a counterclockwise direction. A part of the casting 30 which is located inside of the frame 1 is provided with a bore 32, aligned with the shaft extension 30^a, into which extends the shouldered cylindrical end portion 33 of the shaft 3. A ball bearing 34, provides for free relative rotary movement between the casting 30 and the shaft 3. The casting 30 is also provided with an arm 35 upon which is mounted a cylindrical guide member 36, one end of which passes through a hole 37 formed in a double ended lever 38, which latter is pivotally supported at 39 on a second arm 40 of the casting 30. A spring 41 surrounds the cylindrical guide 36, its ends respectively abutting the arm 35 and lever 38 so that the spring is always compressed to at least a predetermined degree, thus tending to rotate the lever 38 counterclockwise and to urge a roller 42, mounted on the second arm 38^a of the lever 38, toward the center of the shaft 3. Mounted on a square portion of the shaft 3, adjacent to the bearing 34, and in alignment with the roller 42, is a cam member 43 (Figs. 3 and 4) which is engaged by the roller 42 (see Fig. 3). Secured to the inner face of the end cover 2 on one side of the center of shaft 3, as by means of a pair of bolts 44^a, 44^b, is a casting 44, which is arranged to confine a helical spring 45. The spring 45 is further so arranged, that its ends may be engaged by arms 46 and 47, respectively, of the casting 30, to limit the oscillation thereof and to absorb its impact.

It will be seen that when the casting 30 is rotated counterclockwise (Figs. 3 and 5) by the lifting of the weight 28, the spring 41 is compressed and roller 42 rides down on the left side of the cam 43 (Fig. 3) until it passes its apex, whereupon the cam is caused to rotate with a snap action in a clockwise direction (Fig. 3) to effect engagement of contacts 18^a and 18^b with contacts 5^a and 5^b (Fig. 6). The energy stored up in the counterweight 26 of lever 25 is absorbed by the spring 45, as the arm 46 moves away from the latter (Fig. 3) and the arm 47 makes contact therewith. Thus it will be seen that after the roller 42 has moved to the right beyond the apex of cam 43 the movement of shaft 3 is very rapid, and the normally closed contacts (18^c, 5^c and 18^d, 5^d) of the switch (Fig. 6) are rapidly opened, and the normally open contacts (18^a, 5^a and 18^b, 5^b) are rapidly closed, thereby reducing to a minimum the amount of arcing between these movable and stationary contacts. This snap action is effected regardless of the speed of upward movement of the weight 28, as will be apparent, thus insuring immediate initiation of the braking action subsequent to interruption of the hoisting power.

The momentum of the shaft 3, and of the parts connected thereto and moving therewith, is absorbed by a pair of springs 48 which are mounted on a stud 49, which in turn is supported by a lug 50 on the frame 1. The stud 49 bears at its end two collars 51 (Figs. 1 and 2) which maintain the respective springs 48 under some compression. The shaft 3 has fastened thereto a pair of arms 52 which respectively engage with one or the other of the collars 51, depending upon the position of shaft 3. Thus when the shaft is moved from one extreme position to the other,

one of the arms 52 makes contact with the collar 51, respectively associated therewith, thereby compressing the corresponding spring 48 which thus cushions the impact of the shaft 3.

It should be pointed out that the spring 41 which is subject to relatively great strains, is arranged in such a manner that if it should break at one point intermediate of its length, its pressure is not completely released, as it is compressed in the normal position to a degree greater than the axial dimension of one coil or convolution thereof, thus insuring that there is still force available to operate the shaft. At the same time the cylindrical guide 36 (Fig. 3) prevents the spring 41 from dropping out of position. The spring 45 is enclosed in the cage-like structure of casting 44, so that it is not easily displaced; and springs 48 are confined by the collars 51 attached to stud 49 to prevent them from dropping out of position.

The weight 28 is of generally rectangular shape. It is provided with two pairs of parallel transverse holes 53. A U-shaped fork 54 which is provided with cotter pins 55, selectively insertable in holes in the fork passes through each pair of holes, so that their closed ends may be adjusted to extend various distances from the weight 28. The forks are intended to guide the weight 28 on the ropes 56 of the hoisting tackle, so as to prevent the weight from swinging and/or rotating. By using two guides on opposite sides of the weight any substantial lateral movement or rotation of the weight is avoided, and by making the forks adjustable the weight 28 may be readily adapted for various spacings of the hoist tackles, thus further adapting the limit switch for a great variety of conditions met with in its installation.

To mount the limit switch in any other angular position around the center of the operating shaft it is only necessary to fasten the lever 25 to the shaft extension 30^a in the corresponding relation, two or more keyways being preferably provided in said shaft extension 30^a and in weight lever 25 for this purpose.

Referring again to spring 41, it is to be understood that the wire employed in forming the same is of such diameter and strength, the initial degree of compression thereof when in assembled position is of such magnitude, and the pitch of the coils thereof is of such value, as to insure against telescoping of one section thereof into the other, in the event of breakage of the same when in use. By this means snap operation of the shaft 3 by the action of roller 42 upon cam member 43 will be insured in the event of a single break in such spring, the cylindrical guide 36 acting to insure maintenance of all coils of the spring in a coaxial relationship under such a condition.

I claim:

1. A crane limit switch for mounting with its operating shaft horizontal and for mounting in different positions about the axis of its operating shaft comprising, an enclosing casing, an operating shaft oscillatably supported by said casing, a plurality of movable contacts mounted on said shaft, a plurality of pairs of stationary contacts, the stationary contacts of each pair being arranged for selective engagement by one of said movable contacts, an elongated insulating supporting block for each pair of stationary contacts, said block being substantially a rectangular prism with its major axis arranged at a right angle to the axis of said shaft, means to support said stationary contacts on said insulating

block and said block on said casing and arranged to interpose a maximum of vertical insulating surface distance between any two of said stationary contacts and between any one of said stationary contacts and said casing with the switch mounted in any of said positions, and a snap action mechanism for oscillating said shaft between a normal and a braking position, and including a counterweight for biasing said shaft to its normal position, said counterweight being operable to permit rotation of said shaft to its braking position and including adjustable means for engagement with the operating ropes of a crane.

2. A crane limit switch for mounting with its operating shaft horizontal and for mounting in different positions about the axis of its operating shaft comprising, an enclosing casing, an operating shaft oscillatably supported by said casing, a plurality of movable contacts mounted on said shaft, a plurality of pairs of stationary contacts, the stationary contacts of each pair being arranged for selective engagement by one of said movable contacts, an elongated insulating supporting block for each pair of stationary contacts, said block being substantially a rectangular prism with its major axis arranged at a right angle to the axis of said shaft, means to support said stationary contacts on said insulating block, an insulating spacer interposed between each end of said block and said casing, means to attach said insulating block to said spacers, means to attach said spacers to said casing, said supporting means, said spacers and said attaching means being arranged to interpose a maximum of vertical insulating surface distance between any two of said stationary contacts, and between any one of said stationary contacts and said casing with the switch mounted in any of said positions, and a snap action mechanism for oscillating said shaft between a normal and a braking position, and including a counterweight for biasing said shaft to its normal position, said counterweight being operable to permit rotation of said shaft to its braking position and including adjustable means for engagement with the operating ropes of a crane.

3. A crane limit switch for mounting with its operating shaft horizontal and for mounting in different positions about the axis of its operating shaft comprising, an enclosing casing, an operating shaft oscillatably supported by said casing, a plurality of movable contacts mounted on said shaft, a plurality of pairs of stationary contacts, the stationary contacts of each pair being arranged for selective engagement by one of said movable contacts, an elongated insulating supporting block for each pair of stationary contacts, each of said supports being substantially a rectangular prism with its major axis arranged at a right angle to the axis of said shaft, means to support said stationary contacts on said insulating blocks and said blocks on said casing and arranged to interpose a maximum of vertical insulating surface distance between any two of said stationary contacts and between any one of said stationary contacts and said casing with the switch mounted in any of said positions, a snap acting mechanism for oscillating said shaft between a normal and a braking position, buffer means on said casing and said shaft and arranged to stop said shaft in either of its extreme positions and to absorb the impact due to the action of said snap acting mechanism, and including a counterweight for biasing said shaft to its normal position, said counterweight being

operable to effect a bias of said shaft to its braking position and including adjustable means for engagement with the operating ropes of a crane.

4. A crane limit switch comprising, in combination with an oscillatable shaft, an operating lever oscillatably mounted concentric with said shaft and biased to a given position, a counterweight connected with said lever and normally exerting a force thereon opposing its normal bias and biasing it to another position, a cam on said shaft having a center apex, a double-ended supporting lever pivotally connected with said operating lever eccentric of its center of rotation, a roller on one arm of said supporting lever adapted to engage said cam to bias said shaft to either of its extreme positions of oscillation, an abutment on said operating lever, and a compression spring interposed between said abutment and the other arm of said supporting lever and arranged to urge said roller into contact with said cam.

5. A crane limit switch comprising, in combination with an oscillatable shaft, an operating lever oscillatably mounted concentric with said shaft and biased to a given position, a weight associated with said lever and normally exerting a force thereon opposing its normal bias and biasing it to another position, a cam on said shaft having a center apex, a double-ended supporting lever pivotally connected with said operating lever eccentric of its center of rotation, a roller on one arm of said supporting lever adapted to engage said cam to bias said shaft to either of its extreme positions of oscillation, an abutment on said operating lever, a coiled compression spring interposed between said abutment and the other arm of said supporting lever and arranged to urge said roller into contact with said cam, and a guide member inside of said spring, said guide member being carried by said abutment and slidable through an orifice in said other arm of said supporting lever.

6. A crane limit switch comprising, in combination with an oscillatable shaft, an operating lever oscillatably mounted concentric with said shaft and biased to a given position, a weight associated with said lever and normally exerting a force thereon opposing its normal bias and biasing it to another position, a cam on said shaft having a central apex, a double-ended supporting lever pivotally connected with said operating lever eccentric of its center of rotation, a roller on one arm of said supporting lever adapted to engage said cam to bias said shaft to either of its extreme positions of oscillation, an abutment on said operating lever, a coiled compression spring interposed between said abutment and a second abutment on the other arm of said supporting lever and arranged to urge said roller into contact with said cam, a guide member inside of said spring and movable longitudinally with respect thereto, said guide member being carried by one of said abutments and slidable through an orifice provided in the other of the same, a buffer compression spring having its ends normally confined between stationary abutments, and a pair of spaced abutments on said operating lever adapted to selectively engage the ends of said buffer spring to yieldably stop said lever in its respective opposite extreme positions and to absorb the impact of the latter.

7. A limit switch for controlling the operation of a crane, comprising a snap action mechanism including a weight for biasing said mecha-

nism to a given position and adapted to be moved in response to movement of an element of said crane to remove said bias, and a pair of guide members each having a loop at one end and extending an adjustable distance from opposing vertical sides of said weight, and each adapted for the free passage of a hoist cable through the respective loop.

8. A limit switch for controlling the operation of a crane, comprising a snap action mechanism including a weight for biasing said mechanism to a given position, and adapted to be moved in response to movement of an element of said crane to remove said bias, and a pair of guide forks each having its closed end extending an adjustable distance from one of the opposite vertical sides of said weight and each of said closed ends being adapted for the free passage of a hoist cable therethrough.

9. A crane limit switch for mounting with its operating shaft horizontal and for mounting in different positions about the axis of its operating shaft comprising, a metal enclosing casing, an operating shaft oscillatably supported by said casing, a plurality of pairs of movable contacts mounted on said shaft in insulated relationship thereto, the movable contacts of each pair being electrically connected with each other, a corresponding number of pairs of stationary contacts, one stationary contact of each pair being arranged for engagement simultaneously by the movable contacts respectively associated therewith, a relatively long insulating supporting block for each pair of stationary contacts, said block having the plane of its major axis perpendicular to a vertical plane through the axis of said shaft, means to attach each pair of stationary contacts to their respective block on opposite sides of said shaft, and each block being formed to provide a plurality of shoulders at the respective ends thereof and between the contacts carried thereby, to thereby insure at least a predetermined minimum length of vertical insulating surface between said stationary contacts and between the same and said casing with the switch mounted in any of said positions.

10. A crane limit switch comprising, in combination with an oscillatable shaft, an operating lever oscillatably mounted concentric with said shaft and biased to a given position, a weight associated with said lever and normally exerting a force thereon opposing its normal bias and biasing it to another position, a cam on said shaft having a center apex, a double-ended supporting lever pivotally connected with said operating lever eccentric of its center of rotation, a roller on one arm of said supporting lever adapted to engage said cam to bias said shaft to either of its extreme positions of oscillation, an abutment on said operating lever, a coiled compression spring interposed between said abutment and the other arm of said supporting lever and arranged to urge said roller into contact with said cam, a guide member inside of said spring, said guide member being carried by said abutment and slidable through an orifice in said other arm of said supporting lever, said spring being composed of wire of such diameter and strength as to insure against telescoping of the coiled sections in the event of breakage of the spring at any point

when in use, the aforementioned guide member cooperating, and the initial degree of compression of said spring when assembled being sufficiently great to afford the proper bias of said shaft to either of said extreme positions thereof in the event of such breakage.

11. A crane limit switch comprising, in combination with an oscillatable shaft, an operating lever oscillatably mounted concentric with said shaft and biased to a given position, a weight associated with said lever and normally exerting a force thereon opposing its normal bias and biasing it to another position, a cam on said shaft having a center apex, a double-ended supporting lever pivotally connected with said operating lever eccentric of its center of rotation, a roller on one arm of said supporting lever adapted to engage said cam to bias said shaft to either of its extreme positions of oscillation, an abutment on said operating lever, a coiled compression spring interposed between said abutment and the other arm of said supporting lever and arranged to urge said roller into contact with said cam, a guide member inside of said spring, said guide member being carried by said abutment and slidable through an orifice in said other arm of said supporting lever, said spring being formed of wire of such diameter and strength and the initial degree of compression thereof when in assembled position being of such magnitude, and the pitch of the coils thereof being of such value, as to insure against telescoping of one section thereof into the other in the event of breakage of the same at any point when in use.

12. A crane limit switch for mounting with its operating shaft horizontal and for mounting in different positions about the axis of its operating shaft comprising, a metal casing completely enclosing the contact elements of said switch, an operating shaft oscillatably supported by said casing, a plurality of pairs of movable contacts mounted on said shaft in insulated relationship thereto, the movable contacts of each pair being electrically connected with each other, a corresponding number of pairs of stationary contacts, one stationary contact of each pair being arranged for engagement simultaneously by the movable contacts respectively associated therewith, a relatively long insulating supporting block for each pair of stationary contacts, each block having the plane of its major axis perpendicular to a vertical plane through the axis of said shaft, means to attach each pair of stationary contacts to their respective block on opposite sides of said shaft, an insulating supporting spacer interposed between each end of said block and said casing, means to attach said insulating block to said spacers, means to attach said spacers to said casing, each block being formed to provide a plurality of shoulders at the respective ends thereof and between the contacts carried thereby, and said blocks and said spacers acting to insure at least a predetermined length of vertical insulating surface between said stationary contacts and between the same and said casing with the switch mounted in any of said positions.

RICHARD B. HUNTER.