W. W. & G. A. PIERCE.

SAFETY LIMIT SWITCH.

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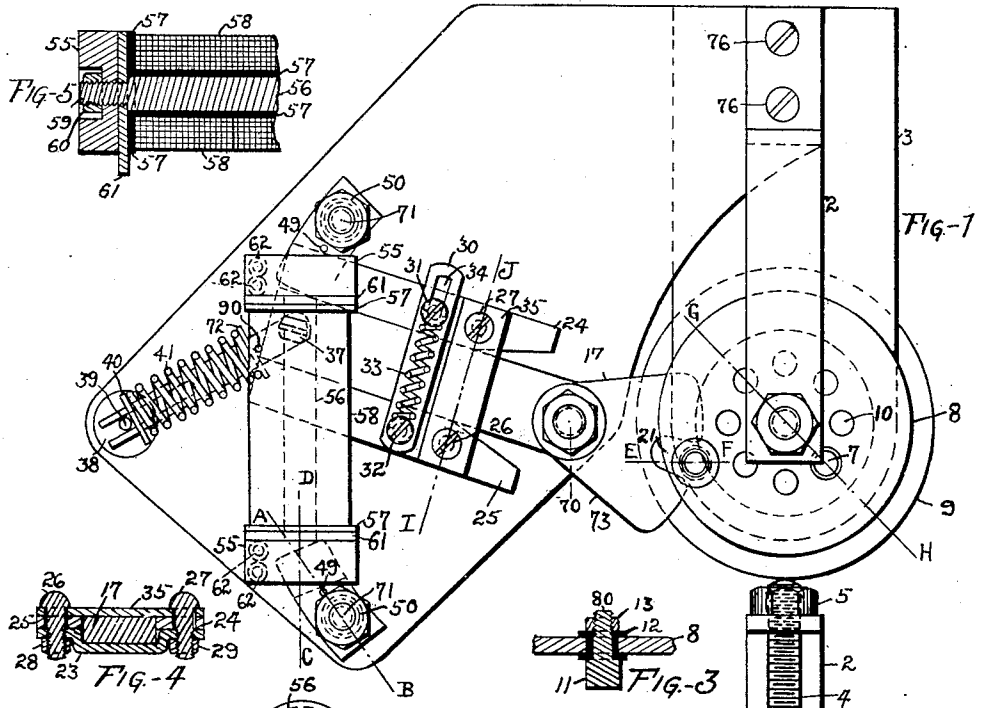

FIG-1

FIG-5

FIG-4

FIG-3

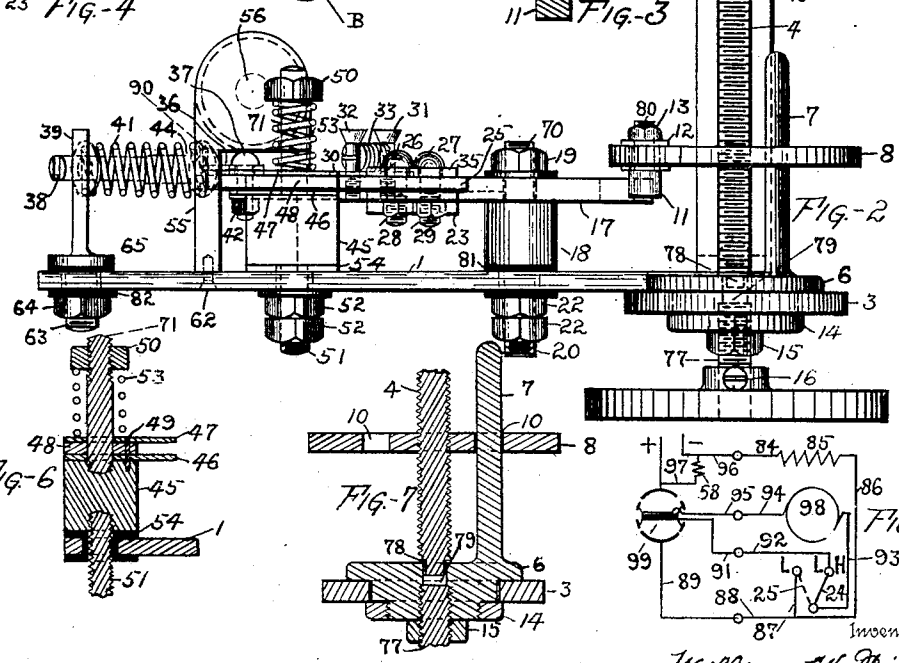

FIG-2

FIG-6

FIG-7

FIG-8

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SAFETY LIMIT-SWITCH.

971,307. Specification of Letters Patent. Patented Sept. 27, 1910.

Application filed February 27, 1909. Serial No. 480,480.

To all whom it may concern:

Be it known that we, WILLIAM W. PIERCE and GEORGE A. PIERCE, citizens of the United States, residing in Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Safety Limit-Switches, of which the following is a specification.

Our invention relates to that class of switches, that are used as protective devices, and our objects are; first; to provide automatic means to prevent a chain block on an electric hoist, or other similar devices, from being moved beyond a predetermined position, thereby preventing said chain block from assuming a jamming position to the supporting structure of said hoist; preventing the breaking of the rope or gearing attached thereto; protecting the motor or motors connected therewith, and to eliminate all possible chance of accidental loss of life due to any of the above causes; second; to provide automatic means whereby after the chain block or other similar device has moved to the predetermined limiting position, the only possible movement by the operator is a reverse movement to that which brought the device in the limiting position; third; to provide automatic means whereby a reverse movement of the chain block restores the switch to normal hoisting and lowering position, and fourth; to provide simple means of adjustment whereby the safety limit switch can be made to operate at various limiting positions.

With these objects in view, our invention consists in certain novel features of construction and arrangement of parts, as will hereinafter be more fully described and pointed out in the claims, reference being had to the accompanying drawings forming part thereof, and in which—

Figure 1 is a plan of the safety limit switch in position for normal hoisting and lowering; Fig. 2 an elevation of the safety limit switch and shows more clearly the arrangement of the switch operating mechanism; Fig. 3 a section on E—F, Fig. 1, and shows the method of insulating the engaging pin of the switch operating mechanism; Fig. 4 a section on I—J, Fig. 1, showing the method of revolubly securing the quick break blades to the saddle embracing the middle blade of the switch operating mechanism and the method of holding these parts in place; Fig. 5 a section on C—D, Fig. 1, through an electric blow-out magnet, showing the method of securing the magnet core and insulating the same from the magnet winding; Fig. 6 a section on A—B, Fig. 1, and shows the method of insulating the switch clips from the securing base, also the method employed for securing good contact surface between the switch blades and the switch clips; Fig. 7 a section on G—H, Fig. 1, and shows the method of actuating the adjustable switch mechanism engaging wheel; and Fig. 8 a diagram of the electrical connections for said switch, motor, controller and blow-out magnet.

In the accompanying drawings, similar numerals of reference designate corresponding parts throughout the several views, and in which,

1 designates a base for supporting the switching mechanism.

2 designates a bracket which is rigidly secured upon the base 1 by the screws 76.

4 designates a screw in threaded engagement with the bracket 2 and locked in place by a nut 5. Said screws 76 also rigidly secures a plate 3 to the base 1. Said plate 3 serves as a bearing for the transmission wheel 6. In threaded engagement with said wheel 6 is a cap 14 which rotatably secures the same to the plate 3.

77 designates a shaft, having secured at one end by threaded engagement the transmission wheel 6, and which is locked in place by the nut 15. The gear wheel 9 is secured to the other end of said shaft by threaded engagement, and is held in place by the set screw 16. Said gear wheel 9 is placed in position on the structure of said hoist to be operative with one of the gears of the operating gear train.

78 designates a shoulder provided on the lower end of the screw 4 and adapted to be inserted in an aperture 79 in the transmission wheel 6. Said transmission wheel revolves on the shoulder 78, motion being transmitted to said gear wheel 9 from the gear train, and this motion retransmitted to the transmission wheel 6 by the shaft 77.

8 designates an adjustable switch mechanism engaging wheel which is adapted to rotatably traverse the rigid screw 4 by means of the wrist pin 7, which extends from the

transmission wheel 6 and is rigidly attached thereto, and which is inserted in the aperture 10 of the said wheel.

11 designates a pin rigidly secured to the said wheel 8, and is insulated therefrom by means of the insulator 12, clearly shown in Fig. 3. Said pin 11 is held in rigid relation with said wheel 8 by means of the nut 13 in threaded engagement with the shoulder 80 of said pin. Said wheel 8 is provided with a plurality of apertures, spaced equidistant on a circumference of a circle, whose radius is equal to the distance from the center of the wrist pin 7 to the center of the transmission wheel 6. The said gear wheel 9 is placed in mesh with the operating gear train, in such a position that a lowering of the chain block will cause the said gear wheel to revolve in such a direction as will move the adjustable switch mechanism engaging wheel 8, away from the switch mechanism. It is obvious that by lowering the chain block a certain distance, the wrist pin 7 will disengage with the aperture 10 in the said wheel 8 and will be free to revolve by hand above the wrist pin 7.

The safety limit switch can be made adjustable to various limiting positions by selecting a suitable aperture 10 in the said wheel 8, depending on the limiting position, and raising the chain block until the wrist pin 7 engages with the selected aperture 10.

18 designates a pedestal bearing, provided with the shoulder 70 which is partly threaded and adapted to engage the nut 19. 20 designates a stud rigidly secured to the said bearing 18 by threaded engagement; said stud and said bearing are insulated from the base 1 by the insulator 81, which is constructed similar to the manner shown in Fig. 3. Said bearing 18 is held in rigid relation to the base 1, by the upper nut 22; the lower nut 22 secures the electrical connection to the stud 20.

17 designates the middle blade of a single pole, double throw, quick break, knife switch, revolubly secured to the shoulder 70 by the nut 19. Said middle blade is provided, at one extremity, with the slot 21, which is adapted to engage with the pin 11, carried by the said wheel 8, upon the chain block reaching its predetermined limiting position. It is obvious that a slightly further movement of said wheel 8, will move the switch blade revolubly to a position as will hereinafter be described, and at the same time disengage the pin 11 and the slot 21. Upon a reverse movement of the wheel 8, caused by a reverse movement of the chain block, the pin 11 again engages with the slot 21 and restores the switch to the position it had heretofore, and upon a further movement of said wheel 8, the said pin disengages with the slot 21.

24 and 25 designates the outer blades of the quick break switch, which are tapered at the inner lower ends in a manner to reduce their width. 35 designates a link connecting the outer blades of said switch and 23 designates a saddle embracing said middle blade 17, more clearly shown in Fig. 4.

26 designates a screw, inserted in an aperture in said link 35 and the outer blade 25 and is secured to said saddle by threaded engagement, and locked in place by the nut 28. 27 designates a similar screw, to that of 26 and is inserted in an aperture in the link 35 and the outer blade 24 and is secured to said saddle 23 by threaded engagement and locked in place by the nut 29.

Since the screws 26 and 27 are inserted in apertures in the outer blades 25 and 24; it is obvious that said blades can revolve through a certain angular movement, respectively, on said screws 26 and 27.

30 designates an additional link connecting the outer blades 24 and 25 and is provided at one end with the slot 34. 32 designates a screw inserted in an aperture in said link 30 and is secured to the outer blade 25 by threaded engagement. 31 designates a similar screw secured to the outer blade 24 by threaded engagement and which is adapted to traverse the slot 34 in the link 30 upon any angular movement of the outer blades 24 and 25.

33 designates a helical spring whose ends are rigidly attached to the screws 31 and 32. Said helical spring assists a helical spring 41, as will hereinafter be described, to quickly open the circuit, between the outer blades 24 and 25 and their respective switch engaging clips, when said blades have revolved through their maximum angular movement by the switch actuating mechanism. Said spring also serves to keep the disengaged switch blade in position against the middle blade 17, thus preventing said blade from making an undesirable electrical connection with its respective switch clip.

45 designates a block, insulated from the base 1 by the insulator 54 and has the stud 51 secured thereto by threaded engagement. Said block is rigidly secured to the base 1 by the upper nut 52, while the lower nut serves to secure the electrical connection to said stud.

71 designates a rod, rigidly secured at one end to the block 45 by threaded engagement. Embracing said rod are the switch clips 46 and 47, separated by the distance piece 48; said clips and said distance piece are prevented from turning on the rod 71 by the pin 49, which is rigidly secured to the block 45. 53 designates a helical spring embracing the said rod 71 and held on the same by the nut 50. It is obvious that various tensions can be exerted by the spring 53, by adjusting said nut with respect to said rod. The lower part of the spring being in con-

tact engagement with said clips, it is obvious that when the same are in engagement with their respective switch blades, that sufficient pressure can be exerted by said spring on said clips to insure good contact surface between said blade and said clips.

65 designates a cylindrical base, which is rigidly attached to the base 1 by means of the nut 64 in threaded engagement with the lower threaded portion 63. The said base 65 is insulated from the base 1, by the insulator 82 in a manner similar to the method shown in Fig. 3.

44 designates a rod, provided with a slot 38 at one end, adapted to engage with the spindle 39; the other end being reduced to a flat which is revolubly secured to the middle blade 17 by the screw 37, in threaded engagement therewith, and locked in place by the nut 42. 90 designates a pin in rigid relation with the flattened end of said rod 44, and intermediate of said pin and said spindle is the helical spring 41, provided at each end with the washers 40 and 72. Said pin 90 confines the movement of the washer 72 toward said flat end of the rod 44. It is obvious that upon the movement of the middle switch blade 17 toward a mid position between said contact clips, that the helical spring 41 will be placed under compression, which will be at its maximum at the mid position. It is also obvious that upon the revolving of the middle switch blade 17, the engaged outer blade will remain in contact with its switch clip, due to the pressure exerted by the helical spring 53 acting thereon. Said outer blade will, however revolve on the screw 31 until the tapered edge of the same engages with the edge of the middle blade 17, and which will occur when the middle blade 17 has moved slightly past the mid position and after the pin 11 has disengaged with the slot 21. It is also obvious that at this position, the spring 33 will be under tension, and upon further movement of the middle blade 17 past the mid position, the pin 11 disengages with the slot 21. It is further obvious that upon the disengaging of the pin 11 with the slot 21, that the helical spring 41 will be free to quickly expand, which will move the middle blade 17, into engagement with the tapered edge of the engaged outer blade and withdraw the engaged outer blade out of engagement with its switch clip. The cooperation of the springs 41 and 33 will quickly break the circuit that heretofore existed and throw into engagement the heretofore disengaged outer blade with its respective switch clip.

58 designates the winding of a magnetic blow out magnet, 56 the core and 61 the pole pieces. Said winding 58 is insulated from the core 56 and the pole pieces 61 by the insulator 57. 55 designates non-magnetic supports for said magnet, having the core 56 secured thereto by threaded engagement and locked in place by the nut 60. Said supports are rigidly secured to the base 1 by the screws 62.

98 designates the operating motor armature, 85 the field winding therefor and 99 designates the controller.

84, 86, 87, 88, 89, 91, 92, 93, 94 and 95 designates connecting leads for the aforesaid parts.

L H designates the normal switch engaging clip, and upon this position normal hoisting and lowering can take place, dependent upon the position of the controller.

L designates the safety position clip and upon this position, a lowering movement only can take place.

The foregoing apparatus is suitably proportioned and mounted upon an appropriate base and operatively connected to a gear in the operating train of gears, all of which will be readily understood by those skilled in the art to which this invention relates. Its mode of operation will be substantially as follows: In mesh with or actuated by one of the gears of the operating gear train, is placed the gear wheel 9. The said gear wheel, being in rigid relation to the transmission wheel 6, revolves the same upon the operation of the gear train. The wrist pin 7 being in rigid relation to the transmission wheel 6 and in engagement with a predetermined aperture 10 in the switch mechanism engaging wheel 8, revolubly traverses the said wheel 8 upon the screw 4 upon the operation of the gear train. The gear wheel 9 and the screw 4 are so proportioned, that the extreme travel of the hoist will bring the pin 11, which revolves with the said wheel 8, in engagement with the slot 21 of the middle blade 17. The switch is shown in position, Fig. 1, for normal hoisting and lowering, and the pin 11 about to engage with slot 21 upon the limiting position having nearly been reached.

By referring to Fig. 8 the controller 99 is shown in the off position. It will be seen that normal hoisting and lowering can be effected as follows:

Normal hoisting.—Positive side of line to controller 99, leads 91, 92, outer blade 24, lead 93, motor armature 98, leads 94, 95, to controller 99, from controller 99, leads 89, 86, motor field 85, lead 84 and back to negative side of line.

Normal lowering.—Positive side of line to controller 99, leads 95, 94, motor armature 98, lead 93, outer blade 24, leads 92, 91, to controller 99, from controller 99 by lead 89, lead 86, motor field 85, lead 84 and back to negative side of line.

Upon the engagement of the pin 11 with the slot 21 of the middle blade 17 upon abnormal hoisting, motion will be transmitted

to the said blade upon further movement of the pin 11. The movement of the said blade causes the outer blade 24 to revolve, until the tapered inner edge is in engagement with the edge of the middle blade 17, the outer blade meanwhile remaining in contact with its engaging switch clip. When the middle blade 17 has moved slightly beyond the mid position of the switch clips, the pin 11 will have passed out of engagement with the slot 21. The helical spring 41 will then quickly move the middle blade 17 until the inner tapered edge of the outer blade 24 is in engagement with the edge of the middle blade 17. The concerted action of the helical springs 41 and 33 will then quickly move the middle blade 17 and the outer blade 24 to pull out of engagement the outer blade 24 and its engaging switch clip. The magnetic blow out winding, being always in circuit with the line, will magnetize the core 56 and the pole pieces 61 and on account of the well known property of magnetism to deflect the arc of an electric circuit, will assist upon the breaking of the circuit between the outer blade 24 and its engaging clip, to quickly break the arc consequent to the breaking of the circuit, and thereby prevent burning of the outer blades 24 and 25 and their engaging clips.

Referring to the wiring diagram of connections Fig. 8, it will be evident that the operator cannot elevate the hoist, and the only possible movement, is a reverse one to that which brought the hoist in the limiting position, namely lowering, as follows, positive line, controller 99, leads 95 and 94, motor armature 98, lead 93, outer blade 25, leads 87 and 86, motor field 85, lead 84 and back to negative side of line.

The foregoing description is applicable where the limit switch is used to prevent abnormal hoisting. It is also obvious that the limit switch can also be used to prevent abnormal lowering.

The foregoing movements accomplish the hereinbefore mentioned first and second objects of our said invention.

Upon the engagement of the outer blade 25 and its engaging clip, the lowering of the hoist will impart a reverse motion to the pin 11, which will again engage with the slot 21 and move the middle blade 17 in a reverse direction, past the mid position of the engaging clips. The pin 11 will then disengage with the slot 21 and the helical springs 41 and 33 will then coact to quickly break the circuit between the outer blade 25 and its engaging clip and throw into engagement the outer blade 24 and its engaging clip; the magnetic blow out, assisting to break the arc upon the breaking of the electric circuit. The foregoing movements accomplish the hereinbefore mentioned third object of our said invention.

By lowering the hoist, until the wrist pin 7, disengages with the aperture 10, the adjustable switch mechanism engaging wheel 6 can be rotated by hand on the screw 4, above the wrist pin 7. By selecting a suitable aperture 10 in the said wheel 6, dependent on the limiting hoisting position and by elevating the hoist and turning the said wheel, the wrist pin 7 can be made to engage with the desired aperture and the switch made to operate at various limiting positions and thereby accomplish the hereinbefore mentioned fourth object of our said invention.

It is obvious that departures can be made from the general features of construction of our said invention, especially, means for actuating the switching mechanism, imparting motion thereto and without departing from the spirit and intent thereof; therefore

What we claim as new and desire to secure by Letters Patent is:—

1. In a limit switch of the character described, the combination with a switching mechanism, of a fixed screw, a member adapted to rotatably traverse the said screw, said member adapted to engage with and actuate said switching mechanism upon a predetermined movement of said member, a transmission means, a crank operatively connected to the transmission means and adapted to engage with said member, all substantially as and for the purpose shown and described.

2. In a limit switch of the character described, the combination with a single pole, double throw, switch, the blade of which is pivoted at one of its extremities and provided with a slot, of a fixed screw, a wheel adapted to rotatably traverse said screw, a pin rigidly attached to said wheel and adapted to engage with the slot of said switch blade, coacting resilient members to actuate said switch upon a predetermined movement of said wheel and to react on the same upon the reverse subsequent movement thereof, a transmission means, a crank operatively connected to the transmission means, a plurality of apertures in said wheel and adapted to engage with the crank wrist of said crank, all substantially as and for the purpose shown and described.

3. In a limit switch of the character described, the combination with a single pole double throw switch provided with a main switch blade and adjacent switch blades, switch clips adapted to engage therewith, a yoke provided on the main blade of said switch at its pivotal end, of a fixed screw, a wheel provided with a plurality of apertures adapted to rotatably traverse the said screw, a pin rigidly attached to said wheel and adapted to engage with said yoke, a helical compression spring attached to one end of said main blade and pivoted at a

point equidistant in relation to said switch clips, a helical spring connecting the said adjacent switch blades together, said springs adapted to actuate said adjacent switch blades upon a predetermined movement of said wheel and to reactuate the same upon the reverse subsequent movement thereof, a transmission means, a crank operatively connected to said transmission means, and a crank wrist on said crank adapted to engage with the said apertures in the said wheel, all substantially as and for the purpose shown and described.

4. In a limit switch of the character described, the combination with a single pole double throw switch provided with a main switch blade and adjacent switch blades; switch clips adapted to engage therewith; a yoke provided on the main blade of said switch at its pivotal end; of a fixed screw, a wheel provided with a plurality of apertures adapted to rotatably traverse the said screw, a pin rigidly attached to the said wheel and adapted to engage with said yoke, a helical compression spring attached to one end of said main blade and pivoted at a point equidistant in relation with the said switch clips, a helical spring connecting the said adjacent switch blades together, said springs adapted to actuate the said adjacent switch blades upon a predetermined movement of said wheel and to reactuate the same upon the reverse subsequent movement thereof, a transmission means, and a means actuated thereby to engage with the apertures in said wheel to actuate the said switch, all substantially as and for the purpose shown and described.

In testimony whereof, we have hereunto signed our respective names to this specification in the presence of two subscribing witnesses.

WILLIAM W. PIERCE.
GEORGE A. PIERCE.

Witnesses:
J. OSCAR GEUTHER,
ALBERT H. THOMAS.