

[54] **ELECTRIC HOIST OVERLOAD PROTECTION DEVICE**

3,233,746 2/1966 Fawell200/85 R
3,095,979 7/1963 Silberger212/39 DB

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FOREIGN PATENTS OR APPLICATIONS

814,642 6/1959 Great Britain212/39 DB

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[58] Field of Search.....200/85 R; 212/39 DB,
212/39 MS; 254/173 R, 174 R

[56] **References Cited**

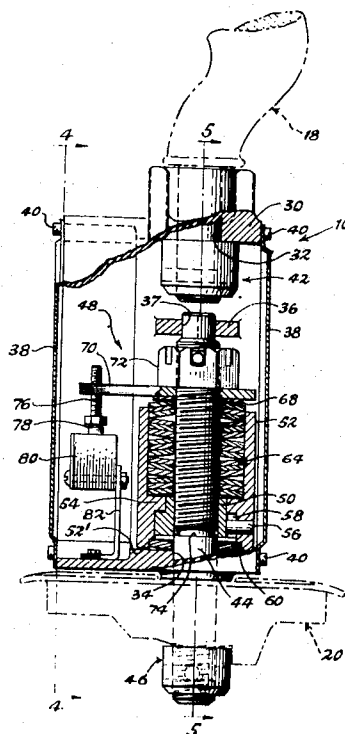
UNITED STATES PATENTS

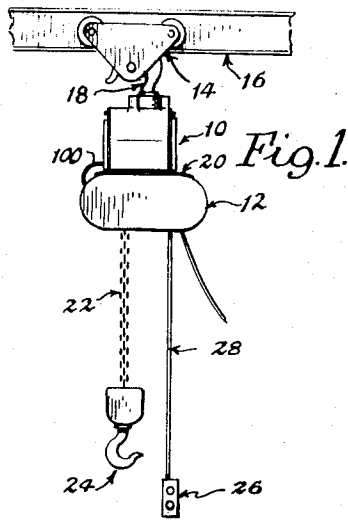
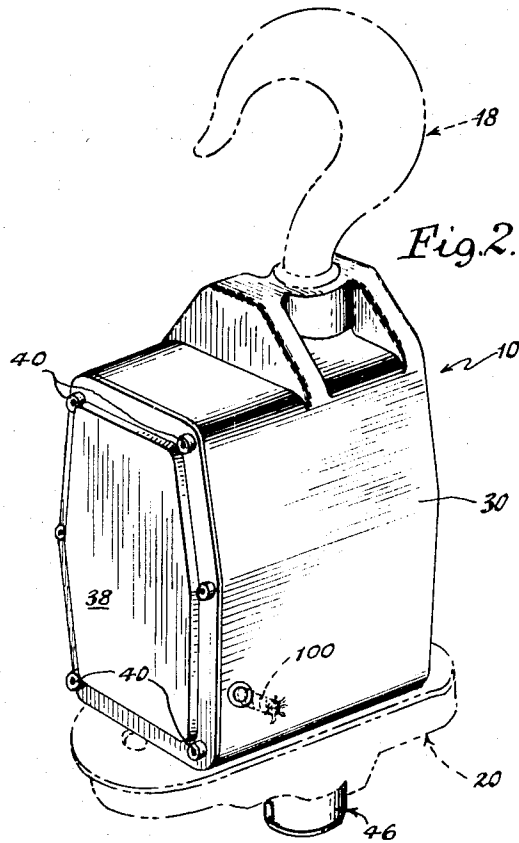
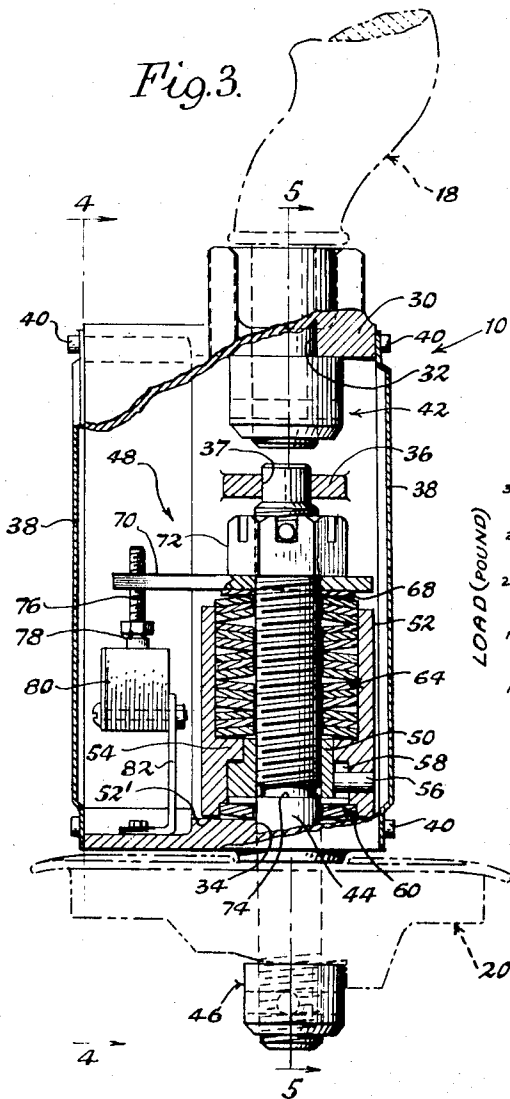
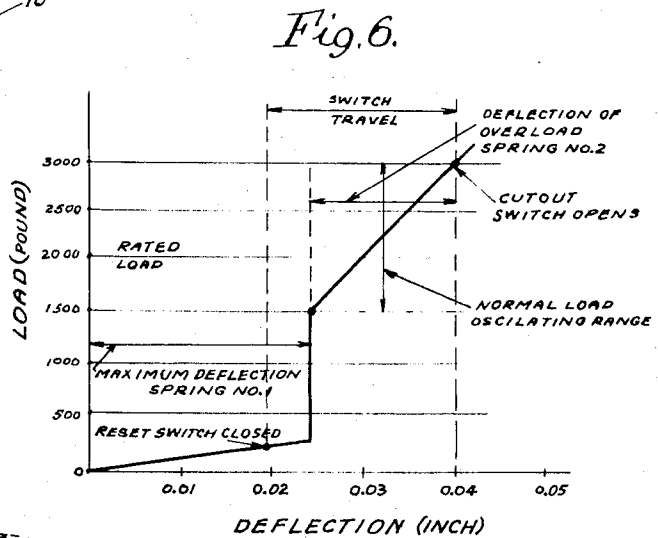
2,636,953 4/1953 Hunt.....200/85 R

[57] **ABSTRACT**

A hoist overload prevention device featuring a pair of spring devices deformable under relatively low and relatively high loading conditions, and a snap action switch arranged to be "reset" and "cut out" during such low and high loading conditions, respectively, whereby an electric circuit for controlling lifting operation of the hoist is "cut out" upon the occurrence of an overload condition and subsequently "reset" only after substantially all loading is removed from the hoist.

12 Claims, 6 Drawing Figures





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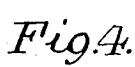
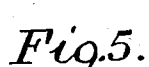
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SHEET 2 OF 2



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ELECTRIC HOIST OVERLOAD PROTECTION DEVICE

BACKGROUND OF THE INVENTION

Various types of devices are presently used for stopping the motor of an electric hoist when there is an overload applied to the hoist lift chain or cable. Typically, such devices include a self resetting electrical switch, that is, one which opens as the magnitude of the load rises above a predetermined setting and subsequently closes when the magnitude of the load is reduced. However, devices of this type are normally sensitive not only to the actual load being lifted, but also to load oscillations resulting from impact and/or acceleration forces. Since the forces of impact and acceleration are only momentary, these prior overload prevention devices suffer from the drawback that their switches cut off and immediately restore power to the hoist operating motor, thereby resulting in a jerky or spasmodic start and stop action of the hoist.

Conventionally, the electric control system of the hoist includes means to bypass the switch, thereby to permit lowering of an overload sufficiently to permit it to be removed from the hoist.

SUMMARY OF THE INVENTION

The present invention relates to an improved device for preventing overloading of electrically operated hoists and more particularly a device not subject to cyclic operating conditions, due to momentary impact and acceleration forces.

The overload prevention device of the present invention features a construction wherein a pair of members are coupled for relative movement within a first range, corresponding to relatively low hoist loading conditions and a final range corresponding to relatively high hoist loadings including an overload condition; and a snap action switch associated with the members such that it cuts out and resets the hoist lifting control circuit within the final and initial ranges of member movement, respectively. Thus, after the occurrence of an overload condition due to the weight of the load being lifted or to oscillation of a load for which the hoist is rated, substantially all of the load producing the overload condition must be removed from the hoist in order to permit resetting of the switch.

DRAWINGS

The nature and mode of the present invention will now be more fully described in the following detailed description taken with the accompanying drawings wherein:

FIG. 1 is an elevational view illustrating the overload prevention device of the present invention in association with electrically operated hoist and suspension structure therefor;

FIG. 2 is a perspective view of the overload device of the present invention;

FIG. 3 is an elevational view of the device of FIG. 2, but with parts broken away for purposes of clarity;

FIG. 4 is a sectional view taken generally along line 4-4 in FIG. 3;

FIG. 5 is a sectional view taken generally along line 5-5 in FIG. 3; and

FIG. 6 is a load-deflection curve illustrating the mode of operation of the device of the present invention.

DETAILED DESCRIPTION

As by way of specific example, reference is now made to FIG. 1, wherein the present overload prevention device is designated as 10 and shown as being employed to suspend a conventional electrically operated hoist 12 from a trolley 14 for movement along an overhead rail 16. Device 10 may be connected to trolley 14 by any suitable means, such as a conventional swivel hook 18 and to hoist 12 by suitable means, such as a conventional suspension adaptor 20 removably bolt connected to the hoist. Typically, hoist 12 includes housing enclosed electric motor, motor control circuit and reel (not shown); a lift cable or chain 22, which is trained about the reel and has a hook 24 carried adjacent its lower end; and a push button control 26, which is suspended on the end of a cable 28. Normally, control 26 is provided with two control buttons whose operation serves alternately to raise or lower hook 24. The manner in which device 10 is connected to hoist 12 and/or to a hoist support forms no part of the present invention.

Now referring particularly to FIGS. 2-5, it will be seen that device 10 includes a casing member or load yoke 30, which is preferably in the form of an open ended aluminum casting formed with top and bottom wall through bore openings 32 and 34, and with a transversely extending guide flange 36 having a through bore opening 37 arranged in substantial vertical alignment with bore openings 32 and 34. The open ends of casing 30 are closed or sealed by cover or closure plates 38 attached to the casing by suitable fastener devices 40. As best seen in FIGS. 3 and 5, bore opening 32 is dimensioned to rotatably receive the lower or shank end portion of hook 18, which is retained in position by a pinned-retainer device 42.

Also as best seen in FIGS. 3 and 5, bore openings 34 and 37 are dimensioned to slideably receive an upper end portion of a load stud member 44. Load stud 44 is threaded adjacent its lower end to receive a suspension adaptor supporting load stud nut 46 and adjacent its upper end to receive a coupling assembly 48 by which the load stud is coupled or supported for movement relative to casing 30.

Assembly 48 generally includes a pre-load nut 50, which is threaded downwardly on the upper end of load stud 44; a sleeve-like spring holder 52, which is formed with an inner, stepped annular rib 54 disposed concentrically of load stud 44 and keyed to nut 50 for relative axial reciprocating movement by a pin 56 received within axially extending nut slot recess 58; a first spring device 60, which is disposed concentrically of load stud 44 in axial engagement with a downwardly facing annular shoulder 62 of holder rib 54 and the lower wall of casing 30; a second spring device 64, which is disposed concentrically of load stud 44 in axial engagement with an upwardly facing annular shoulder 66 of holder rib 54 and a spacer washer 68; a trip plate 70, which is apertured to receive load stud 44 and arranged to bear on spacer washer 68; and a pinned-retained trip plate nut 72, which is threaded onto load stud 44 and arranged to bear on trip plate 70. As will be apparent, nut

50 is accurately positioned on load stud 44 by providing the load stud with an annular slot 74; spring device 60 is employed to initially maintain the lower end portion 52' of spring holder 52 out of engagement with the bottom wall of casing 30 when hoist 12 is in an unloaded condition; and spring device 64 serves to maintain holder rib 54 seated in engagement with nut 50 until the spring holder is arrested from further downward movement by engagement of end portion 52' with the casing bottom wall.

Spring devices 60 and 64 are preferably comprised of Belleville washers, which have inner and outer dimensions permitting deformation or collapse thereof without binding with load stud 44 and the inner surface of spring holder 52. It will be understood that the number and spring characteristics of the Belleville washers will depend upon the load rating of the hoist with which device 10 is to be employed. However, in all cases, spring device 60 will be designed to deform under relatively low hoist loadings, whereas spring device 64 will be designed to deform under only relatively high hoist loadings including an overload condition against which the hoist is to be protected. As will become apparent, pre-loading of spring device 64 in order to adjustably vary the value of the "overload" to which the hoist may be subjected before deenergization of its electrical control circuit may be readily effected by adjustments of trip plate nut 72 relative to pre-load nut 50.

As by way of example, reference is made to FIG. 6, wherein the preferred load-deflection curve of the spring devices 60 and 64 is illustrated for the case of a hoist, which has a rated load of 2,000 pounds but may safely accommodate a 50 percent overload of about 3,000 pounds. Such overload condition may result from merely the weight of a load to be lifted or be occasioned by oscillations of a normal load subject to unacceptably large impact or acceleration forces.

Upon viewing FIGS. 3, 5 and 6, it will be understood that upon initial application of a load to the hoist, the first spring device readily deforms to permit downward movement of assembly 48 and load stud 44 relative to casing 30 through an initial range of travel limited by abutment of spring holder lower end portion 52' with the lower wall of casing 30 and terminating at a relatively low loading of between about 200 and 300 pounds. By employing holder lower end portion 52' to limit the initial range of movement, the extent of such movement may be accurately controlled and spring device 60 need not be subject to complete deformation, which might otherwise lead to failure thereof after repeated operations. Further movement of load stud 44 will not take place during intermediate hoist loadings for which spring device 64 is designed or preloaded to resist without deformation, such as for example further loadings of up to between 1,500 and 1,600 pounds. Thereafter, load stud 44 is again permitted to move downwardly relative to the previously arrested spring holder 52 and casing 30 through a final range of movement until the whole of spring device 64 is collapsed or trip plate 70 moves into abutting engagement with the upper edge of the spring holder; the construction being such that a predetermined overload is encountered before the maximum possible deflection of spring device 64. Preferably, spring device 64 is designed or pre-

loaded to deform within the normal or acceptable load oscillating range of the hoist under rated load conditions.

Now referring particularly to FIGS. 3 and 4, it will be seen that trip plate 70 threadably receives a trip or operator in the form of a headed bolt 76 arranged to depress an actuator 78 of a snap action switch 80, as load stud 44 moves downward relative to casing 30. Suitable means, such as an L-shaped bracket 82 may be employed to fixedly position switch 80 relative to the casing.

Switch 80 is best shown in FIG. 4 as including a spring 84, which tends to hold actuator button 78 in its illustrated raised position; and a tension spring 86, which urges a pair of contact blades 88 towards one another, such that when the actuator button is in its raised position, contact buttons 90 engage with a pair of lower contacts 92. When button 78 is depressed by operator 76 against the force of spring 84, the pivot of contact blades 88, which comprises grooves 94, is lowered past a dead centered position relative to spring 86 and portions of the contact blades to which such spring is anchored. As soon as the pivot passes this dead center position, the contact blades are snapped upwardly by spring 86 to cause contact buttons 90 to engage with a pair of upper contacts 96. When button 78 is released, spring 84 returns the button and the pivot to their uppermost positions, during which time the pivot again passes through a dead center and spring 86 is permitted to snap buttons 90 downwardly into engagement with lower contacts 92. A more detailed description of switch 80 may be had by reference to U.S. Pat. No. 2,840,657.

In the present invention, lower contacts 92 are connected into the load lifting control circuit of the hoist via a cable connection 100 and upper contacts 96 are preferably left unconnected. However, if desired, upper contacts 96 may be connected into the circuit of a suitable audible or visual warning device, not shown, in order to give a clear warning of a hoist overload condition.

Thus, when the circuit established across lower contacts 92 via buttons 90, contact blades 88 and the lower end of actuator buttons 78 is broken upon disengagement of buttons 90 from lower contacts 92, the load lifting control circuit of the hoist motor is interrupted and cannot again be established until buttons 90 are returned to their original position.

It is critical to the understanding of the present invention to note that the dead center positions of the pivot point referred above are not located at the same point along the path of actuator button deflection or travel. Rather, in commercially available models of switch 80, there is a difference of about 0.02 inches of actuator button travel between switch "cutout" at which buttons 90 disengage from lower contacts 92 and switch "reset" at which buttons 90 re-engage with the lower contacts. This switch characteristic is used to advantage in the present invention by adjusting trip 76 and/or trip plate nut 72 such that switch "cutout" occurs only during the final range of load stud travel permitted by spring device 64 and that "reset" occurs only during the initial range of load stud travel permitted by spring device 60. As indicated above, trip plate nut 72 may be adjusted, as desired, to variably preload spring

device 64 and thus vary the valve of the overload at which switch "cutout" occurs.

Thus, when an overload occurs for any reason, substantially all of the load producing the overload condition must be removed from the hoist prior to its again being used in its load lifting capacity. Moreover, since "reset" occurs at a loading substantially below the lower limit of the normal load oscillating range, jerky or spasmodic stop and start action of the hoist under normal operating conditions is effectively prevented.

While the present overload prevention device has been described as a separate unit serving to suspend a hoist from a suitable support, it will be readily apparent that the functional elements of the device may be otherwise arranged, such as for instance within the casing of the hoist. Moreover, it is anticipated that with slight changes in construction, the switch may be mounted for movement with the load stud and the adjustable trip may be attached to the relatively stationary casing.

We claim:

1. A device for use in preventing overloading of a load lift device of the type having an electric circuit for controlling load lifting operations, which comprises in combination:

a pair of members;

means for coupling said members for relative movement initially within a first range of movement when said lift device is subject to relatively low loadings and then within a second range of movement when said lift device is subject to relatively high loadings including an overload to be prevented, said coupling means tending to constrain said members from relative movement for loadings intermediate about said relatively low and relatively high loadings; and

switch means for controlling said circuit, said switch means having a movable actuator and characterized as having circuit cutout and circuit reset conditions occurring at different points along the path of actuator travel, said switch means being associated with said members whereby to produce travel of said actuator upon relative movement of said members and to place said switch means in said cutout condition upon occurrence of said overload during relative movement of said members within said second range of movement and in said reset condition upon reduction of lift device loading permitting relative movement of said members in said first range of movement.

2. A device according to claim 1, wherein said coupling means includes a first spring means deformable to permit initial relative movement of said members within said first range of movement, and a second spring means deformable to permit subsequent relative movement of said members within said second range of movement, said second spring means tending to constrain said members from relative movement for loadings intermediate about said relatively low and relatively high loadings.

3. A device according to claim 2, wherein said coupling means includes means for adjusting said second spring means whereby to adjust the value of said overload at which said cutout condition occurs.

4. A device for use in preventing overloading of a load lift device of the type having an electric circuit for controlling load lifting operations, said lift device being characterized as having a rated load while being capable of lifting without failure loads up to an overload which is greater than said rated load and of experiencing without failure impact/acceleration forces produced rated load oscillations within a range bounded by an upper loading corresponding to said overload and a lower loading less than said rated load, which comprises in combination:

a pair of members;

means for coupling said members for relative movement initially within a first range of movement when said lift device is subject to relatively low loadings below about said lower loading and then within a second range of movement when said lift device is subject to relatively high loadings intermediate about said lower loading and said overload;

a switch for controlling said electric circuit, said switch having a movable actuator and being characterized as having circuit cutout and circuit reset conditions occurring at different points along the path of actuator travel; and an operator for controlling movement of said switch actuator, said switch and said operator being fixed relative one to each of said members whereby to produce travel of said actuator by engagement with said operator upon relative movement of said members and to place said switch in said cutout condition upon occurrence of said overload during relative movement of said members within said second range of movement and in said reset condition upon reduction of lift device loading permitting relative movement of said members in said first range of movement.

5. A device according to claim 4, wherein said coupling means tends to prevent relative movement between said members for lift device loadings intermediate about said loading at which said reset condition occurs and said lower loading.

6. A device according to claim 5, wherein said coupling means includes first spring means resiliently accommodating for relative movement of said members within said first range of movement, second spring means resiliently accommodating for relative movement of said members within said second range of movement, and means to adjust said second spring means whereby to adjust the value of said overload at which said cutout condition occurs.

7. A device for use in suspending a hoist from a support and for preventing overloading of said hoist, said hoist having an electrical circuit for controlling load lifting operations, said device comprising in combination:

a first member connectable to said support;

a second member connectable to said hoist, said first member having a bottom wall apertured to receive said second member for vertical reciprocating movement relative thereto; and

an assembly for coupling said members for relative movement during load lifting operations and for controlling said electrical circuit, said assembly including preload means fixed to said second

member, a sleeve member disposed above said bottom wall and about said second member, a first compression spring means and engaged by said sleeve member and said bottom wall and tending to bias said sleeve member upwardly away from engagement with said bottom wall, other means fixed for movement with said second member at a point vertically above said preload means, a second spring means and engaged between said sleeve member and said other means and tending to bias said sleeve member into engagement with said preload means, a switch having a movable actuator and being characterized as having circuit cutout and circuit reset conditions occurring at different points along the path of actuator travel, and an operator, said first spring means being deformable under relatively low hoist loadings thereby to permit initial downward movement of said second member relative to said first member within a first range of movement limited by engagement of said sleeve member with said bottom wall, and said second spring means being deformable only under relatively high hoist loadings including an overload thereby to permit further downward movement of said second member relative to said first member within a second range of movement, said switch and said operator being fixed relative one to each of said first and second members whereby upon relative movement of said members said operator effects movement of said actuator along said path of travel to place said switch means in said cutout condition upon occurrence of said overload during said second range of movement and in said reset condition during said first range of movement.

8. A device according to claim 7, wherein said other means is adjustable relative to said preload means whereby to adjustably preload said second spring means to adjust the value of said preload at which said cutout condition will occur.

9. A device according to claim 7, wherein each of said spring means are Belleville springs.

10. A device for use in preventing overloading of a load lift device of the type having a circuit for controlling load lifting operations, which comprises in combination:

- a pair of relatively movable members;
- a first spring device deformable under relatively low lift device loadings for permitting relative movement of said members within a first range of movement;
- a second spring device deformable under relatively high lift device loadings including an overload to be prevented for permitting further relative movement of said members within a second range of movement;
- a switch fixed to one of said members for controlling said circuit, said switch having an actuator movable relative thereto and said one member, said switch being characterized as having circuit cutout and circuit reset conditions occurring at different points spaced along the path of actuator travel; and
- an operator fixed to another of said members for controlling movement of said actuator, said operator moving said actuator along its path of travel upon relative movement of said members whereby to place said switch in said circuit cutout condition upon occurrence of said overload during movement of said members within said second range of movement and to place said switch in said reset condition upon reduction of lift device loading permitting relative movement of said members within said first range of movement.

11. A device according to claim 10, wherein means are provided to adjustably preload said second spring device, whereby to vary the lift device loading at which relative movement of said members within said second range of movement is initiated.

12. A device according to claim 11, wherein means are provided to fix said operator to said other member for adjustable movement in a direction aligned with said path of actuator travel.

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