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HOIST SAFETY DEVICE

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2 Sheets-Sheet 1

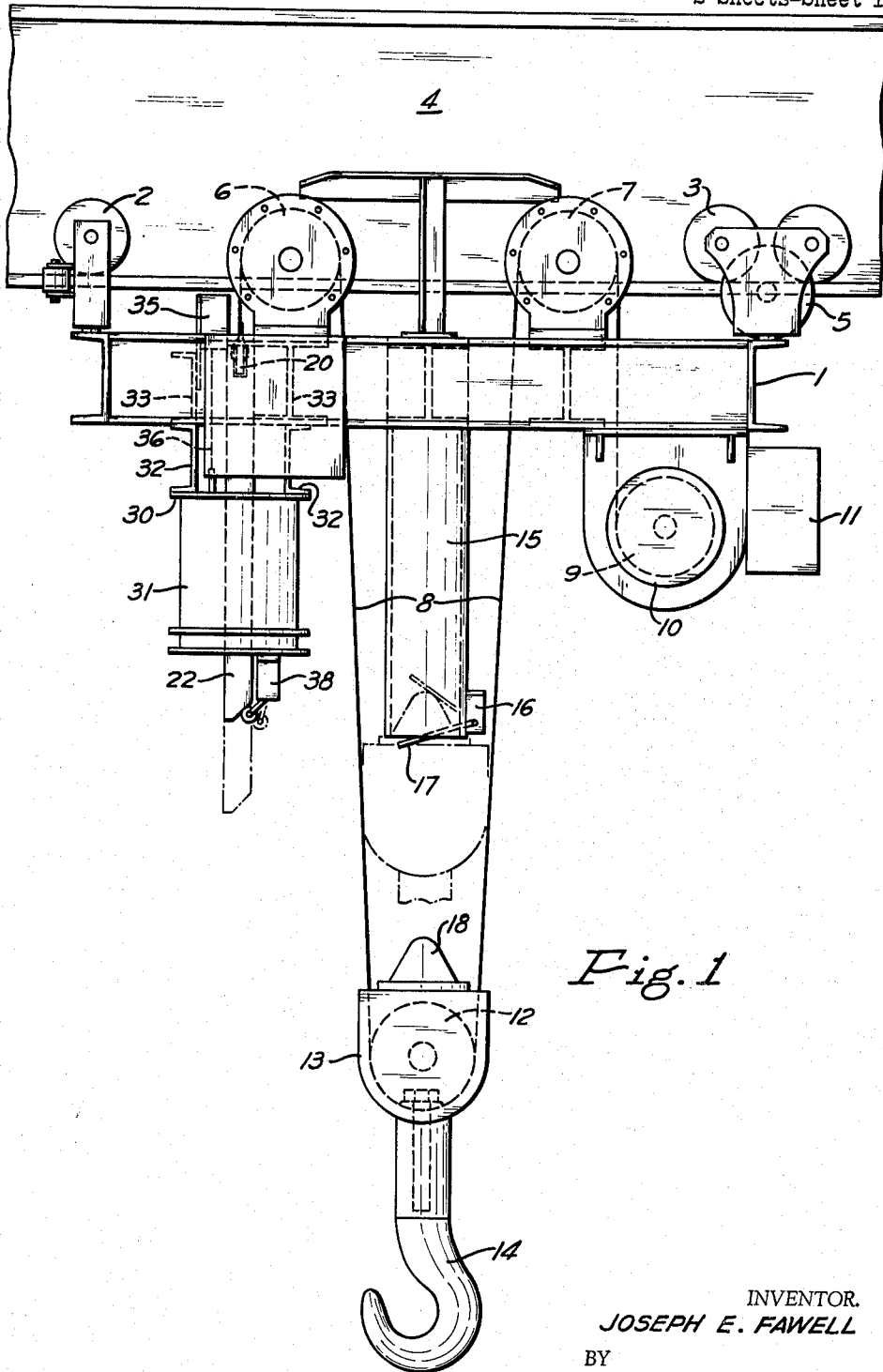


Fig. 1

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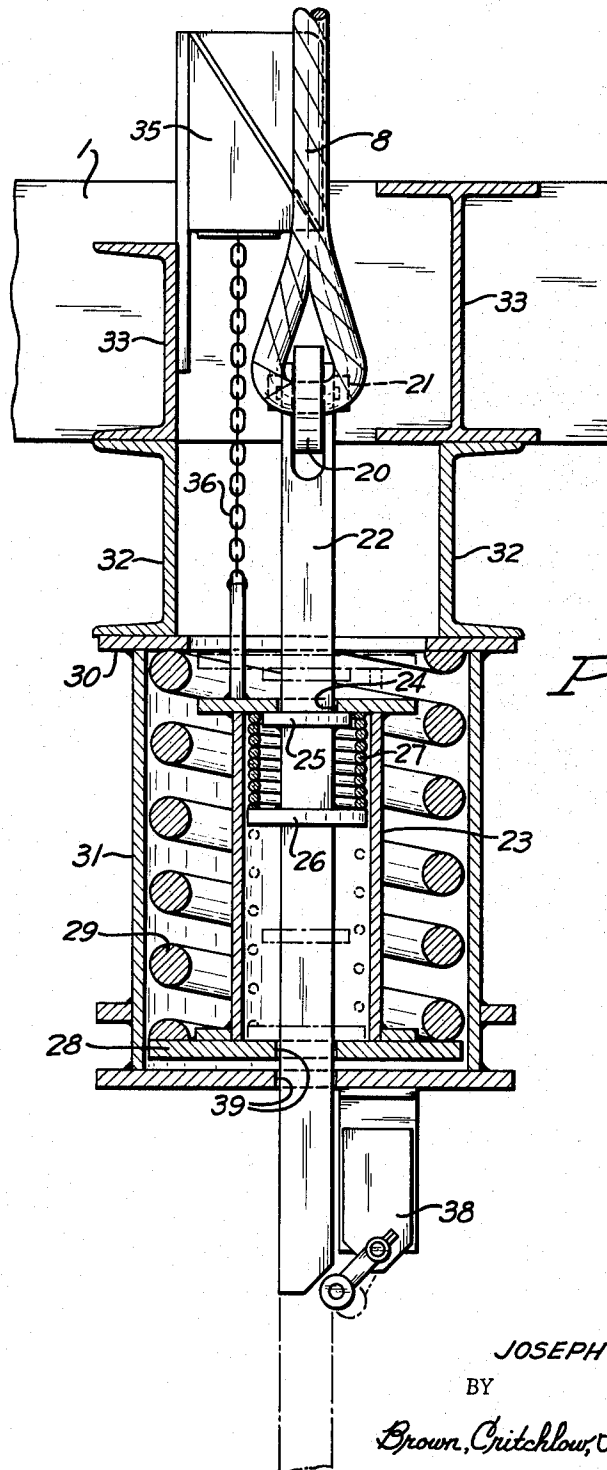


Fig. 2

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HOIST SAFETY DEVICE

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7 Claims. (Cl. 212-86)

This invention relates to hoists, and more particularly to safety devices to prevent accidents in case of improper use.

Hoists or cranes of various kinds will be referred to herein generally as hoists. There are a number of ways in which accidents can occur during their operation. One of the most obvious ways to cause an accident is to overload the equipment so that the cables break and drop the load. On the other hand, even though a proper load is being lifted, if the motor brake fails when the up drive is shut off, the hoisting drum will continue to coast and the load block may hit the drum or the hoist frame, causing the cables to snap. In effect, this too is an overload. In other cases, even though the up drive switch is actuated, the contactors therein may have become fused together so that the hoist continues to operate and raise the load block until it strikes the upper part of the hoist and breaks the cables. Again, an overload effect can be produced, even though the load itself does not exceed the rated capacity of the hoist, by the operator alternating pushing the raise and lower buttons which causes jogging of the load and a build-up in momentum that overloads the cables and breaks them.

In order to increase the distance that the hook can be raised above the floor, mechanics sometimes set up the limit switch in such a way that too little space is left for the normal upward drift of the load block after the up drive is shut off, especially when the brake is worn. In such a case the load block will strike overlying members and snap the cables. A momentary overload, which can be sufficient to break the cables, can take place when the operator allows too much slack in the cables at the beginning of the lift so that the hoisting drum reaches full speed before the slack is taken up. Then, when the cables are yanked taut, the sudden shock on the equipment may cause them to break or even cause other parts of the hoist to fail.

A different type of accident may occur when the operator sets the load down and allows the down drive to continue too long so that excessive slack occurs in the cables. Due to this slack the cables may leave the grooves in the hoisting drum and when the next load is lifted they may become crossed on the drum and cut. Also, when a load is set down and the down drive continues to operate, the cables may wind around the drum in reverse direction. This may release the cables from the hoisting drum. If not, they will be wound in reverse direction on the drum. Then the upper limit switch will no longer work because it is designed for opening the up drive circuit, but the hoist is now raising the load on the down drive circuit.

Some attempts have been made to provide safety devices to avoid at least some of these accidents, but none of them will avoid all of them. Furthermore, the safety devices known heretofore take up head room which limits the distance the load can be lifted from the floor.

It is among the objects of this invention to provide a hoist with a safety device which will prevent the above-mentioned accidents from occurring, which does not reduce head room, which may actually increase head room, which is relatively simple and inexpensive in construction, and which is so reliable that the sizes of many of the hoist members can be reduced without sacrificing safety.

In accordance with this invention my safety device includes a cylinder provided at one end with a central hole

and at the other end with a laterally projecting flange. A bar extends through the hole and is movable axially therein. The bar is provided inside the cylinder with an abutment larger in diameter than the cylinder hole. Also, a collar is rigidly mounted on the bar between the abutment and the flange end of the cylinder. Encircling the bar inside the cylinder is a light coil spring that is compressed between the collar and the end of the cylinder having the hole. A heavy coil spring encircles the cylinder and engages its flange. The opposite end of the heavy spring engages rigid means suitably connected to the hoist frame. The heavy spring is strong enough to maintain the cylinder flange a substantially fixed distance from the opposite end of the heavy coil spring under normal operating conditions of the hoist. The hoisting cable is connected to the outer end of the bar to pull its abutment against the adjacent end of the cylinder when a normal load is applied to the cable and also to pull the cylinder by means of the bar and compress the heavy spring when the cable is overloaded. Whenever the cylinder is moved a predetermined distance by the bar, means movable with it actuates an electric switch to stop the up drive of the hoist. Another electric switch is actuated by the bar to stop the down drive of the hoist whenever the bar collar is moved toward the flange end of the cylinder by the light spring, which occurs when slack starts to develop in the cable.

The preferred embodiment of this invention is illustrated in the accompanying drawings, in which

FIG. 1 is a side view of a hoist incorporating my safety device; and

FIG. 2 is an enlarged vertical section of the safety device.

Referring to FIG. 1 of the drawings, the hoist may be of any suitable construction, the one shown having a rectangular horizontal frame 1 suspended by trolleys 2 and 3 at its opposite ends from a monorail 4. One set of trolleys may be driven by an electric motor 5, which can be controlled in any of the customary ways. Supported by the top of the frame between its center and its opposite ends are vertical sheaves 6 and 7. Preferably, there are two parallel sheaves in each location so that two parallel hoisting cables 8 can be used for greater hoist capacity. These cables are attached at one end to a hoisting drum 9 suspended from one end of the frame and driven by a reversible electric motor 10 operated by a suitable well-known controller 11, by which the drum can be rotated in either direction. The cables are dead ended at their opposite end in a manner that will be described presently.

Between the two sets of sheaves on the hoist frame the cables support a third pair of sheaves 12 forming part of a load block 13 provided with a load pick-up, such as an electromagnet or a crane hook 14. Other types of reeving, such as four-part single or double reeving may be used if desired. With the reeving shown, a short vertical tube 15 has its upper end attached to the bottom of the hoist frame at its center, and a limit switch 16 is attached to one side of the bottom of the tube and has a pivoted operating lever 17 that extends into the tube through a suitable vertical slot. The top of the load block is provided with a cone 18 that can rise up into the lower end of the tube and open the switch in case the block accidentally is raised too high.

It is a feature of this invention that a safety device is provided which will shut off the up drive of the hoist under overload conditions and will stop the down drive if undesirable slack starts to develop in the hoisting cables after the load has been set down. Accordingly, as shown in FIG. 2, the cables are dead ended by connecting them to the opposite ends of an equilizer 20, the center of which is pivotally mounted on a horizontal pin

21 extending through the forked upper end of a vertical rod or bar 22. This bar extends down into a cylinder 23 through a central hole 24 in its upper end. Inside the cylinder the bar is provided with an abutment, such as a small collar 25, which is larger in diameter than the hole 24 but somewhat smaller than the inner diameter of the cylinder. Some distance below this collar the bar is provided with a larger collar 26 or the like, between which and the top of the cylinder a coil spring 27 is compressed. The cylinder has a laterally projecting flange 28 around its lower end, and seated on this flange is a much heavier coil spring 29. The upper end of this spring is engaged by rigid means 30 connected to the hoist frame. Preferably, this rigid means is a ring that forms the top of an outer cylinder 31 enclosing both springs and the inner cylinder. The opening in the ring is large enough to permit the inner cylinder to move upwardly therein. The top of the outer cylinder may be secured to the bottoms of a pair of short channels 32 which are secured to the bottoms of two other members 33 that extend across the frame and are welded to its sides.

The heavy outer spring 29 is strong enough to maintain the inner cylinder flange 28 a substantially fixed distance from the top of the outer cylinder under normal operating conditions of the hoist, but the inner spring 27 is much weaker so that when the hoist starts to lift a load the cables can pull the vertical bar upwardly and thereby cause its lower collar to compress the inner spring until the upper collar 25 engages the top of the inner cylinder. Since under ordinary safe loads the outer spring will not compress appreciably, this is as far as the bar will rise. Temporary moderate overload, such as may be caused by jogging or by picking up the load when the hoisting drum is turning too fast, will merely pull the bar upwardly with only sufficient force to cause the inner cylinder to compress the heavy spring somewhat, which will absorb the shock and prevent damage. However, if the overload persists or is too great, the inner cylinder will be pulled up so far in the outer cylinder as to actuate an electric switch 35 rigidly mounted above it to stop the up drive of the hoist, with which the switch is suitably connected. Various types of switches may be used, such as a Euclid switch or a Youngstown switch. The one shown is a familiar type, in which the contacts are held in one position by a flexible chain 36 or the like extending downwardly and which may be attached to the vertical bar or to the top of the inner cylinder as shown. A spring in the switch will actuate the contacts when the chain is allowed to rise, which will happen when the inner cylinder is pulled upwardly by the vertical bar. The switch may also be provided, as is well known, with means for starting the down drive if for some reason actuation of the switch does not stop the inner cylinder from rising. The switch may even be formed for shutting off all power to the hoist in case the inner cylinder still continues to rise.

A further feature of this invention is that the safety device also will prevent the cables from going so slack that they will slip out of the hoisting drum grooves and become crossed and cut when the next load is lifted. For this purpose, another electric switch 38, preferably mounted on the bottom of the outer cylinder, is electrically connected in the down drive circuit. To open the switch when the cables become slack, the bottoms of the two cylinders may be provided with central openings 39, and bar 22 may be made long enough to extend down through those openings. The lower end of the bar then will operate the switch whenever the bar is moved downwardly in the cylinder by inner spring 27 as slack begins to develop in the cables. When the hoist is reversed to pick up a load and the bar is raised in the cylinders, the bottom switch closes again.

A safety device made in accordance with this invention can easily be mounted on existing hoists, either by suspending it from the bottom of the hoist frame or inverting it and mounting it on top of the frame, or even

laying it on its side. Since the safety device can be mounted in a position where it will not interfere with travel of the load block, head room is not affected, except that by making it possible to reduce the allowance for drift, head room actually can be increased. At most, only half the load on the cable is supported by the large spring in the safety device, and with some reeving much less. This device permits the load that can be imposed on a hoist to be limited to a calculable figure, so that in new hoists incorporating this safety device the size of the structural and mechanical members of the hoist itself can be reduced materially without sacrificing safety. The size of the large coil spring is calculated to absorb shock on the cables by taking work out of them when they are overloaded momentarily.

This invention permits the use of all required safety equipment without dimensional disadvantages. Heretofore, no completely safe hoist has been made, even though various safety devices have been available, because so many safety devices were required for taking care of the various operational and mechanical difficulties that could cause the equipment to fail or the load to drop that a serious problem of physically mounting the safety devices on the hoist has existed. A purchaser therefore was required to specify the protective features he considered most important and to omit the others because of the impossibility of mounting all of the safety equipment on the hoist. My safety device combines in a single, small, compact unit the means for making a hoist safe to use, and it can be readily mounted in a restricted space on the hoist.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A safety device for a hoist having a frame and a hoisting cable with an up drive and a down drive, said device comprising a cylinder provided at one end with a central hole and at the other end with a laterally projecting flange, a bar extending through said hole and movable axially therein, the bar being provided inside the cylinder with an abutment larger in diameter than said hole, a collar rigidly mounted on the bar between said abutment and the flange end of the cylinder, a light coil spring inside the cylinder encircling the bar and compressed between said one end of the cylinder and the collar, a heavy coil spring encircling the cylinder and engaging said flange, rigid means engaging the opposite end of the heavy spring, means for securing said rigid means to the hoist frame, the heavy spring being strong enough to maintain said flange a substantially fixed distance from said rigid means under normal operating conditions of the hoist, means at the outer end of the bar for connecting the hoisting cable therewith to pull said abutment against said one end of the cylinder when a normal load is applied to the cable and also to pull the cylinder by means of the bar and compress the heavy spring when the cable is overloaded, an electric switch, means movable with the cylinder for actuating said switch to stop the up drive of the hoist whenever the cylinder is moved a predetermined distance by means of the bar, and an electric switch actuated by the bar to stop the down drive of the hoist whenever the bar collar is moved toward the flange end of the cylinder by said light spring due to slack starting to develop in said cable.

2. A safety device according to claim 1, in which said bar is vertical and said cable-connecting means is for connecting the bar to the dead end of the cable.

3. A safety device according to claim 1, in which said switch-actuating means is fastened to said one end of said cylinder.

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4. A safety device according to claim 1, in which said rigid means is one end of a cylinder enclosing the heavy spring and the other cylinder.

5. A safety device according to claim 1, in which the flange end of said cylinder is provided with a central opening, and said bar extends through said opening for actuating said last-mentioned switch when slack in the cable starts to develop.

6. In a hoist having a frame, a hoisting cable with an up drive and a down drive, and a load pick-up carried by the cable; a safety device comprising a vertical inner cylinder provided at one end with a central hole and at the other end with a laterally projecting flange, a vertical bar extending through said hole and movable vertically therein, a pair of vertically spaced collars larger in diameter than said hole rigidly mounted on the bar inside the cylinder, a light coil spring inside the cylinder encircling the bar and compressed between said one end of the cylinder and the more remote collar, a heavy coil spring encircling the cylinder and engaging said flange, a vertical outer cylinder encircling the heavy spring and having an annular end wall engaging the end of the spring opposite said flange, means securing the outer cylinder to the hoist frame, the heavy spring being strong enough to maintain said flange a substantially fixed distance from said end wall during normal operating conditions of the hoist, the flange end of the inner cylinder and the adjacent end of the outer cylinder having aligned axial openings, said bar extending through said openings and having an end

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projecting therefrom, means at the opposite end of the bar connecting the hoisting cable therewith to pull the less remote collar vertically against said one end of the inner cylinder when a normal load is applied to the cable and also to pull the inner cylinder by means of the bar and compress the heavy spring when the cable is overloaded, an electric switch carried by the hoist, means connected with the inner cylinder for actuating the switch to stop the up drive of the hoist whenever the inner cylinder is moved vertically in the outer cylinder a predetermined distance by means of the bar, and an electric switch actuated by said projecting end of the bar to stop the down drive whenever the bar collars are moved toward said cylinder openings by said light spring due to slack starting to develop in the cable.

7. In a hoist according to claim 6, said safety device being disposed at one side of said load pick-up, and said cable-connecting means connects the dead end of the cable to said bar.

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