SAFETY SYSTEM FOR HYDRAULIC ELEVATORS

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Abstract
Emergency braking system for hydraulic elevators responsive to abnormal operating conditions including loss of pressure in the jack cylinder through rupture of the cylinder or of fluid conduit means and overspeed of the elevator cab in the downward direction. The system includes selectively operable braking means controlled by a pressure responsive actuating means, normally exposed to the fluid pressure in the cylinder with a pilot valve operated by speed responsive means when downward movement exceeds a predetermined value.

6 Claims, 4 Drawing Figures
SAFETY SYSTEM FOR HYDRAULIC ELEVATORS

The invention relates to a safety system for hydraulic elevator installations, and, more particularly, to novel and improved selectively operable braking means responsive to fluid pressure conditions in the system and to the downward speed of movement of the elevator cab.

In practice, hydraulic elevator systems have traditionally not used safety devices since they normally are not subject to emergency failure situations in the same degree as the usually higher rise traction elevators. However, from time to time work has been done on developing safety devices and systems that could be used in hydraulic elevator installations. For example, in the patent's earlier U.S. Pat. No. 2,785,660, a safety valve is provided to stop the elevator descent upon pressure failure in the line between the jack and the lowering valve.

In other earlier patents, there have been suggestions of auxiliary valve means for controlling application of motor fluid to the brake device independently of the main control valve apparatus. Normally ineffective gripping jaw devices adapted to grip the plunger have been suggested, wherein the jaws are kept apart by a wedge that is removed by a mechanical trip linkage either manually or automatically actuated to enable the jaws to grip the plunger under emergency conditions.

In many hydraulic elevator installations, the jack cylinder is buried in the ground and is consequently subject to corrosive attack resulting in a sudden loss of fluid pressure in the cylinder, thereby permitting the elevator cab to descend out of control and at a hazardous speed. As a matter of practical safety, it is important that a device be provided which functions independently of the usual control and power apparatus which can seize and hold the plunger firmly enough to bring the elevator to a stop in a safe distance without excessive decelerating force, even when hydraulic pressure is completely lost.

In accordance with the invention, there is provided a novel and improved safety system for hydraulic elevator installations which normally include a source of hydraulic fluid, an hydraulic pump, control equipment comprising flow control valves, and a fluid pressure responsive jack having a vertically movable plunger reciprocating in and out of a cylinder under the influence of fluid pressure conditions within the cylinder. The safety system includes a selectively operable braking means adapted in a first condition to engage the plunger to stop movement thereof during the existence of abnormal operating condition, and to permit free movement of the plunger when in a second condition. Pressure responsive actuating means maintain the braking means in the second condition during normal operation of the elevator installation and enable the braking means to assume the first condition in response to a drop in pressure below a predetermined value.

The pressure responsive actuating means and the cylinder are interconnected by fluid conduit means so that the pressure responsive means is exposed to the fluid pressure existing in the cylinder. Pilot valve means are positioned in the fluid conduit intermediate the cylinder and the pressure responsive means. The pilot valve means is operated by a speed responsive means when downward movement of the elevator cab and plunger exceeds a predetermined value to relieve pressure on the pressure responsive actuating means so that the braking means assumes its first condition.

For a more complete understanding of the invention, reference may be had to the following detailed description taken in conjunction with the accompanying figures of the drawing, in which:

FIG. 1 is a schematic representation of a conventional hydraulic elevator installation incorporating an exemplary embodiment of a safety system, in accordance with the invention;

FIG. 2 is a partially broken-away cross-sectional view, taken along the lines 2—2 in FIG. 1 and looking in the direction of the arrows, of the braking means and pressure responsive actuating means of the safety system;
As shown in greater detail in FIG. 3, the pilot valve means 40 comprises a spring-biased double acting valve which normally maintains tubing 29 and 30 in direct fluid communication. When the pilot valve means 40 is operated under abnormal speed conditions by the speed responsive means 41, a valve stem 45 moves under the influence of an operating spring 46 to close off the passageway between the tubing 29 and 30, and communicates the tubing 29 and the cylinder 26 with a relief chamber 48 that is exposed to the atmosphere through a vent pipe 49. The valve stem 45 is mechanically held in the position shown in FIG. 3 by a bistable pivoted cammed operating arm 50, which can be manually reset by the repairman either directly or by pulling on a reset rope 51 after it is tripped by the action of the speed responsive means 41.

The governor of the speed responsive means 41 has a plurality of spring biased centrifugal weights which swing radially outward from their normal rotational path, acting against the spring restraint, when the governor rotates above an adjustable preselected tripping speed. Under abnormal speed conditions, one of the radially extending centrifugal weights 60 will engage the cammed operating arm 50 of the pilot valve means 40 causing the arm 50 to rotate in the direction of the arrow (FIG. 3) releasing the spring biased valve stem 45. Thus the pilot valve means 40 is tripped and remains in its operated condition until manually reset.

If the pilot valve means 40 was not maintained in its tripped position, a failure might cause alternate setting and releasing of the safety system as the elevator cab speed exceeds the governor setting and is brought below that setting, which would be a hazardous operation in itself.

In traction elevator systems, a switch is sometimes connected in series in the safety circuit that is opened by the setting of the safety. A similar switch 65 is mounted on the support of the braking means operator 22 (FIG. 2) which is normally held closed by engagement with the mechanical linkage of the operator 22 when the braking means 15 is in its second condition, but opens when the braking means 15 is set by the brake spring 24 retracting the piston 28 into the cylinder 26 upon a drop in fluid pressure. When the switch 65 is open, it opens the electrical circuit (not shown) for the pump and other control circuits in the power unit 14, so that the hydraulic pump will not operate in response to normal call registration and the lowering valve will not open. In order to reset the safety system when it has been tripped by overspeed alone, the repairman may temporarily jump the switch 65 until the pump has operated enough to restore pressure and release the braking means 15.

Thus there is provided, in accordance with the invention, a novel and improved safety system for hydraulic elevator installations whereby braking means are automatically operated by loss of pressure in the system or by abnormal overspeed conditions of the elevator.

It will be understood by those skilled in the elevator art that the above described embodiment is meant to be merely exemplary and that it is susceptible of modification and variation without departing from the spirit and scope of the invention. Therefore, the invention is not deemed to be limited except as defined in the appended claims.

1 claim:

1. A safety system for an hydraulic elevator installation including a source of hydraulic fluid and a fluid pressure responsive vertically movable plunger and cylinder, comprising selectively operable braking means adapted in a first condition to engage the plunger to stop movement thereof and in a second condition to permit free movement of the plunger, pressure responsive actuating means for maintaining said braking means in said second condition during normal operation of the elevator installation and responsive to a drop in pressure below a predetermined value for enabling said braking means to assume said first condition, fluid conduit means interconnecting said pressure responsive actuating means and the cylinder to expose said pressure responsive actuating means to the fluid pressure existing in the cylinder during normal operating conditions, selectively operable pilot valve means positioned in said fluid conduit means intermediate said pressure responsive actuating means and the cylinder for relieving, when operated, the pressure in said pressure responsive actuating means so that said braking means assumes said first condition during abnormal operating conditions, and speed responsive means for operating said pilot valve means when downward movement of the plunger exceeds a predetermined value.

2. A safety system as claimed in claim 1, wherein said pilot valve means under normal operating conditions of the elevator installation provides a passageway for fluid coupling of said pressure responsive actuating means to the interior of the cylinder through said fluid conduit means, and when operated connects said pressure responsive actuating means to a location of substantially reduced pressure to thereby relieve the pressure in said actuating means.

3. A safety system as claimed in claim 2, wherein said pilot valve means when operated closes said passageway leading to the cylinder so that said pressure responsive actuating means is no longer responsive to fluid pressure conditions existing in the cylinder.

4. A safety system as claimed in claim 2, wherein said pilot means includes a bistable valve positioning means for holding said pilot valve in its operated position, whereby when the pilot valve has been once operated, it must be manually restored to its non-operated condition to enable said braking means to be restored to said second condition.

5. A safety system as claimed in claim 1, wherein said fluid conduit means includes a fluid restriction means located closely adjacent the cylinder to assure sufficient drop in fluid pressure at said pressure responsive actuating means upon rupture of said fluid conduit means to enable said braking means to assume said first condition.

6. A safety system as claimed in claim 1, wherein the elevator installation includes an elevator cab mounted on the plunger for controlled vertical movement, said braking means comprises a spring biased friction clamp adapted when released to fixedly engage the plunger, said braking means being fixedly mounted relative to the cylinder so as to positively control when said friction clamp is released relative movement of the plunger and cylinder, and said speed responsive means includes centrifugal governor means mechanically driven in response to movement of said elevator cab and having radially extensible members adapted to mechanically operate said pilot valve means when downward movement of said elevator cab exceeds a predetermined speed.