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SAFETY LOWERING DEVICE

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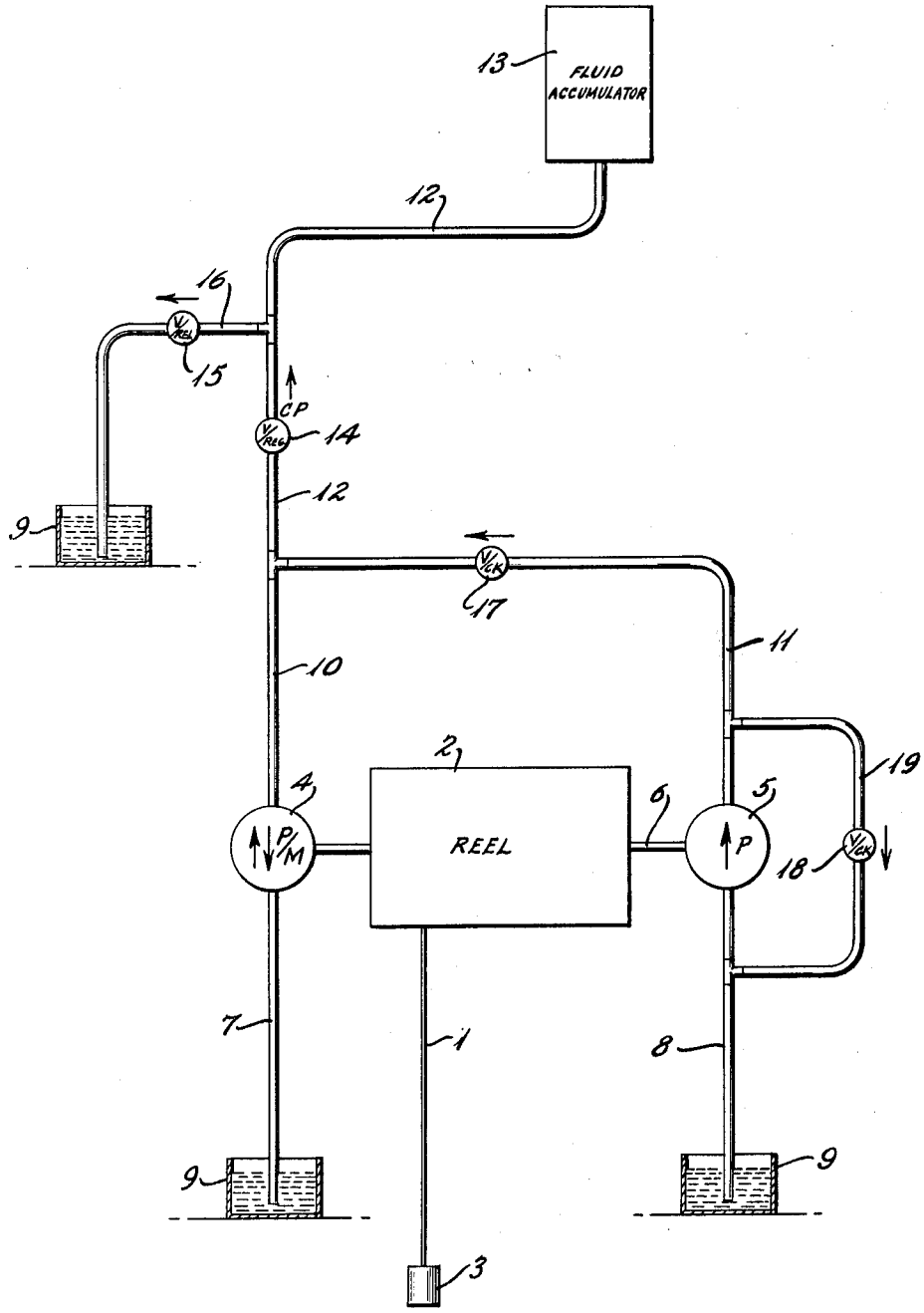

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SAFETY LOWERING DEVICE

Edgar C. Bech, Gretna, and Gerald J. Gardelle, Marreso, La., assignors to Safety Line Corporation, Gretna, La., a corporation of Louisiana

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This invention relates to safety lowering devices which may be affixed at some elevated position, for instance an upper store of a building, and be provided with a suitable means by which a person or other relatively heavy body may be lowered at a safe rate of speed.

More specifically, the present invention relates to a safety lowering device which is adapted to maintain constant the speed of descent of a body supported by a cable associated with the device, and to automatically rewind the cable when the body is released therefrom.

The lowering device of this invention may be employed to safely lower any of a wide range of bodies at a desired constant speed of descent. The device has utility as a fire escape for lowering persons safely to the ground from the upper stories of buildings in case of fire or other disaster. The device may also be employed to lower machinery, shipping containers, or the like from or onto a railroad platform, dock or other transportation facility where it is desired to safely control the descent of an object.

It is an object of the present invention to provide a self-contained hydraulically operated lowering device adapted to lower at a constant predetermined speed bodies of widely varying weights.

A further object of the present invention is to provide a hydraulically controlled safety lowering device having means to store some or all of the energy expended by a descending body and to employ such energy to rewind a body lowering cable onto a reel automatically, as soon as the body is released from the cable.

Additional objects of this invention will become apparent from the description which follows, taken in connection with the accompanying drawing which is a schematic diagram showing the hydraulic system and accompanying components of the safety lowering device.

A safety lowering device constructed in accordance with the present invention may be housed in any suitable casing, which may be either removably or permanently affixed to an elevated support.

Specifically, the device includes a descent cable **1** which may be wound up on a reel **2**. The cable **1** is adapted to be unwound from the reel by the weight of a person or other heavy body **3** which is removably attached by any suitable means to the free end of the cable, the speed of descent of the body **3** being maintained relatively constant by means hereinafter discussed. When body **3** is released from the end of cable **1**, the above referred to means also acts to automatically rewind the cable **1** on reel **2** in preparation for the next body to be lowered.

The means for controlling the operation of the reel **2** is illustrated diagrammatically in the drawing, and includes a pump-motor **4** and pump **5** which are keyed, respectively, to the ends of the reel supporting shaft **6**. The pump-motor **4** and pump **5** may be of any desired construction.

When a body is affixed to the free end of the cable **1** and released, reel **2** and thus pump-motor **4** and pump **5** are caused to rotate thereby drawing hydraulic fluid through conduits **7** and **8** from a source of hydraulic fluid **9** and forcing such fluid under pressure through conduits **10**, **11**, and **12** to a hydraulic fluid accumulator **13**. From the standpoint of compactness of the lowering device, it is desirable that the accumulator be of the spring piston or gas loaded variety. However, in a permanent installation the accumulator may merely be elevated with respect to the other components of the lowering device.

A pressure compensated flow control valve **14** is placed in conduit **12** between the pump-motor **4** and pump **5** and the accumulator **13**. The function of valve **14** is to prevent hydraulic fluid pumped to the accumulator from flowing at greater than a predetermined desired rate regardless of the pressure exerted on the fluid by the pump-motor **4** and pump **5**. Thus, for a given maximum fluid flow rate through the valve **14**, the maximum rotational speed of the reel **2** and thus the speed of descent of body **3** is determined. Accordingly, in the case where it is desirable to maintain constant the speed of descent of bodies within a specific range of weights, the valve **14** would be constructed or adjustably set so as to permit a predetermined rate of fluid flow to the accumulator **13** which is a characteristic of the lightest body to be lowered.

While many pressure compensated flow control valves now commercially available can be employed in the practice of this invention, we prefer to use a Waterman Model 320.

A pressure relief valve **15**, which is disposed in conduit **16** is adapated to selectively connect conduit **12** with the source of hydraulic fluid **9** to permit recycling of the fluid pumped by pump-motor **4** and pump **5** whenever the accumulator **13** becomes filled with fluid.

The provision of relief valve **15** is a particularly desirable feature of the present invention. It will be appreciated that in the absence of valve **15**, both the source **9** and the accumulator **13** would have to be of such size as to store that volume of fluid necessary to control the complete unwinding of cable. However, only a relatively small portion of the total volume of fluid necessary to control unwinding of the cable is required to affect rewinding thereof after the relatively heavy body is released. Thus, by the provision of valve **15** to permit the pumped fluid to be recycled after the accumulator has been filled, the accumulator **13** need only be large enough to store that amount of fluid required to effect rewinding of the cable, and the source **9** need only be large enough to store that amount of fluid contained within the various conduits and components of the device.

Referring again to the drawing, it will be seen that a check valve **17** is provided in conduit **11**, and a check valve **18** is provided in conduit **19**. Conduit **19** is connected across the pump **5** to conduits **8** and **11**. During unwinding of the cable **1**, the pressure of hydraulic fluid pumped by pump **5** acts to maintain check valve **17** open and check valve **18** closed, thereby permitting pumped fluid to either pass to the accumulator **13** or be returned to source **9** via the pressure release valve **15**, as discussed above. During rewinding of the cable **1**, check valve **17** is closed and check valve **18** is permitted to open, thereby allowing pump **5** to idle. It will be seen that by the utilization of both the pump-motor **4** and pump **5**, during unwinding of cable **1**, a relatively large volume of fluid may be pumped per unit time through the device to retard the descent of body **3**. Further, by passing fluid returning to the source **9** from the accumulator **13** only through the pump-motor **4**, rather than both the pump-motor **4** and pump **5**, a greater cable length may be rewound on the reel for any given volume of fluid stored in the accumulator.

In operation the valve **14** is set to permit only a predetermined rate of pumped fluid flow, which is a characteristic of the speed at which a body of a predetermined weight is to be lowered. The body is then attached to the free end of cable **1** and released to effect unwinding of the cable. Unwinding of the cable from the reel **2**

causes the latter to revolve, thereby driving the pump-motor 4 and pump 5 to force fluid from the source 9, through the valve 14 to the accumulator 13. After the accumulator has become filled to capacity the relief valve 15 is forced open to permit recycling of the pumped fluid until the lowered body is removed from the cable or the complete cable is unwound from the reel.

When the lowered body is removed from the cable, the pressure exerted on the pumped fluid by pump-motor 4 and pump 5 ceases, thereby permitting pressure release valve 15 and check valve 17 to close, and check valve 18 to open. Thereafter, fluid stored in accumulator 13 flows back through valve 14 and pump-motor 4 to the source 9. Rotation of the pump-motor 4 causes rotation of the reel 2 to effect rewinding of the cable.

In the case where the accumulator 13 has not been completely filled prior to the removal of the body 3 from the cable, the rewinding operation is the same as that discussed above, except that the valve 15 had been closed during a previous winding operation.

A second embodiment of the present safety lowering device would include the removal of pump 5 thereby permitting pump-motor 4 alone to control both the winding and unwinding of the reel. A further embodiment would employ a single pump to control unwinding of the cable and a single motor to control rewinding of the cable. These embodiments are, however, not preferred, since the former results in a reduction in volumetric efficiency of the unit, and in the latter the size and weight of the required pump would necessarily be larger with little or no change in size and weight of the motor.

Various changes and modifications may be made in the present safety lowering device without departing from the scope and spirit of this invention. This invention is therefore only to be limited by the scope of the following claims.

What is claimed is:

1. A safety lowering device having in combination: a reel adapted to be installed in an elevated position; a cable having one end thereof affixed to said reel and adapted to be wound up thereon, said cable being adapted to be unwound from said reel by the weight of a body removably affixed to the free end thereof; and hydraulic means adapted to control operation of said reel, whereby the speed of descent of said body affixed to said cable is maintained constant and whereby said cable is automatically rewound on said reel when said body is released from said cable.

2. A safety lowering device having in combination: a reel adapted to be installed in an elevated position; a cable having one end thereof affixed to said reel and adapted to be wound up thereon, said cable being adapted to be unwound from said reel by the weight of a body removably affixed to the free end thereof; and means adapted to control operation of said reel, whereby the speed of descent of said body affixed to said cable is maintained constant and whereby said cable is automatically rewound on said reel when said body is released from said cable, said means including a source of hydraulic fluid, a pump-motor keyed for rotation with said reel, a hydraulic fluid accumulator, and a valve disposed in fluid connection between said pump-motor and said accumulator, said valve being adapted to maintain constant the rate at which hydraulic fluid is pumped by said pump-motor from said source to said accumulator as said cable is unwound by said body from said reel, whereafter upon release of said body from said cable hydraulic fluid stored in said accumulator flows to said source through said pump-motor to effect rewinding of said cable on said reel.

3. The safety lowering device of claim 2, wherein a pressure release valve is disposed in fluid connection between said accumulator and said source, said pressure release valve permitting hydraulic fluid pumped to said accumulator by said pump-motor to be returned to said source after said accumulator has become filled to capacity.

4. A safety lowering device having in combination: a reel adapted to be installed in an elevated position; a cable having one end thereof affixed to said reel and adapted to be wound up thereon, said cable being adapted to be unwound from said reel by the weight of a body affixed to the free end thereof; a source of hydraulic fluid; a pump-motor keyed to one end of said reel for rotation therewith; a pump keyed to the other end of said reel for rotation therewith; a hydraulic fluid accumulator; hydraulic circuit means connecting said source to said pump-motor and said pump and hydraulic circuit means connecting said pump-motor and said pump to said accumulator; valve means disposed in said last mentioned circuit means for maintaining constant the rate at which hydraulic fluid is pumped by said pump-motor and said pump from said source to said accumulator as said cable is unwound from said reel, whereafter upon release of said body from said cable, hydraulic fluid stored in said accumulator flows to said source through said circuit means to effect rewinding of said cable on said reel.

5. The safety lowering device of claim 4, wherein check valve means are provided to prevent hydraulic fluid flowing from said accumulator to said source during rewinding of said cable from passing through said pump.

6. The safety lowering device of claim 5, wherein a pressure release valve is disposed in fluid connection between said accumulator and said source, said pressure release valve permitting hydraulic fluid pumped to said accumulator to be returned to said source after said accumulator has become filled to capacity.

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SAMUEL F. COLEMAN, *Primary Examiner.*