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Kankkunen

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[54] **DEVICE FOR LOWERING PERSONS AND LOADS**

[76] Inventor: **Kauko Valdemar Kankkunen,** Leppisaarentie 6 F, 00830 Helsinki 83, Finland

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[51] **Int. Cl.**[2] **A62B 1/08**

[58] **Field of Search** 254/160, 158, 157, 159; 188/297, 311, 314, 318, 312, 295

[56] **References Cited**

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Primary Examiner—Robert J. Spar
Assistant Examiner—Kenneth Noland
Attorney, Agent, or Firm—Waters, Schwartz & Nissen

[57] **ABSTRACT**

The present invention concerns a device for lowering persons and loads. The braking mechanism of the device comprises two interconnected cylinders, one of which is filled with a liquid and the other with a gas. Lowering is performed by unwinding a cable or rope from a drum. Rotation of the drum causes, by means of a gear system, the piston of the cylinder filled with a liquid to move thereby pressing liquid into the second cylinder and moving the piston of this cylinder against the mounting counter pressure of the gas cushion therein. When this counter pressure equals the force exerted on the piston of the first cylinder by the cable load the unwinding stops.

By providing the device with an additional bearing and means for selectively coupling the cable drum to said gear system, the device may be used as a safety device when working at high heights.

6 Claims, 7 Drawing Figures

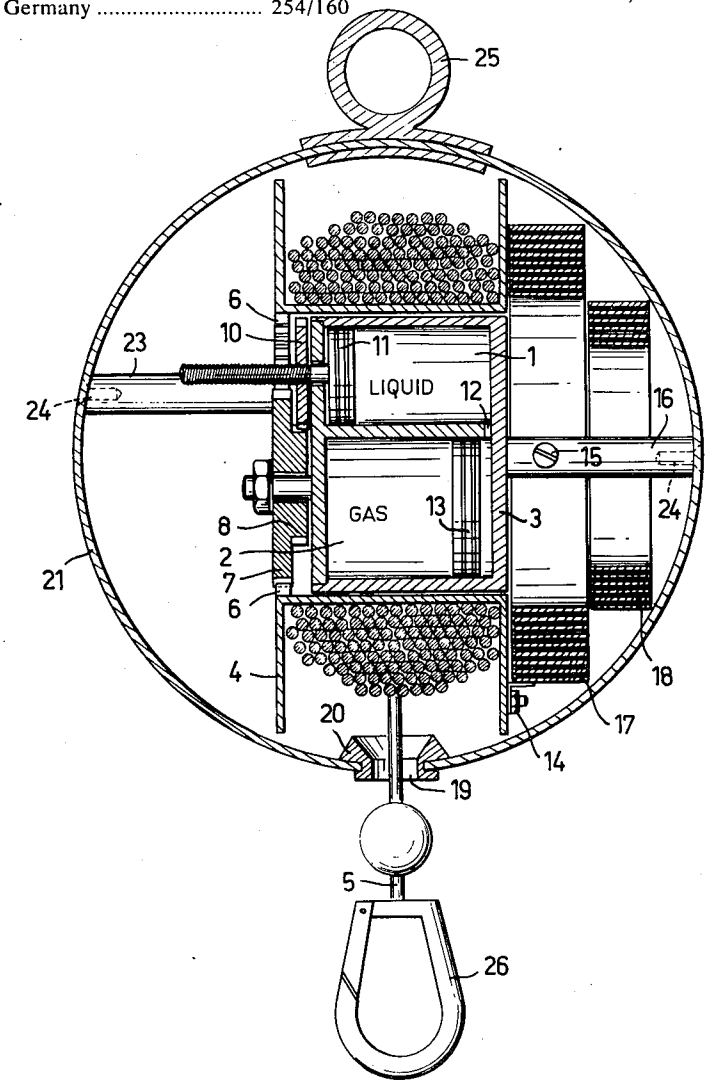
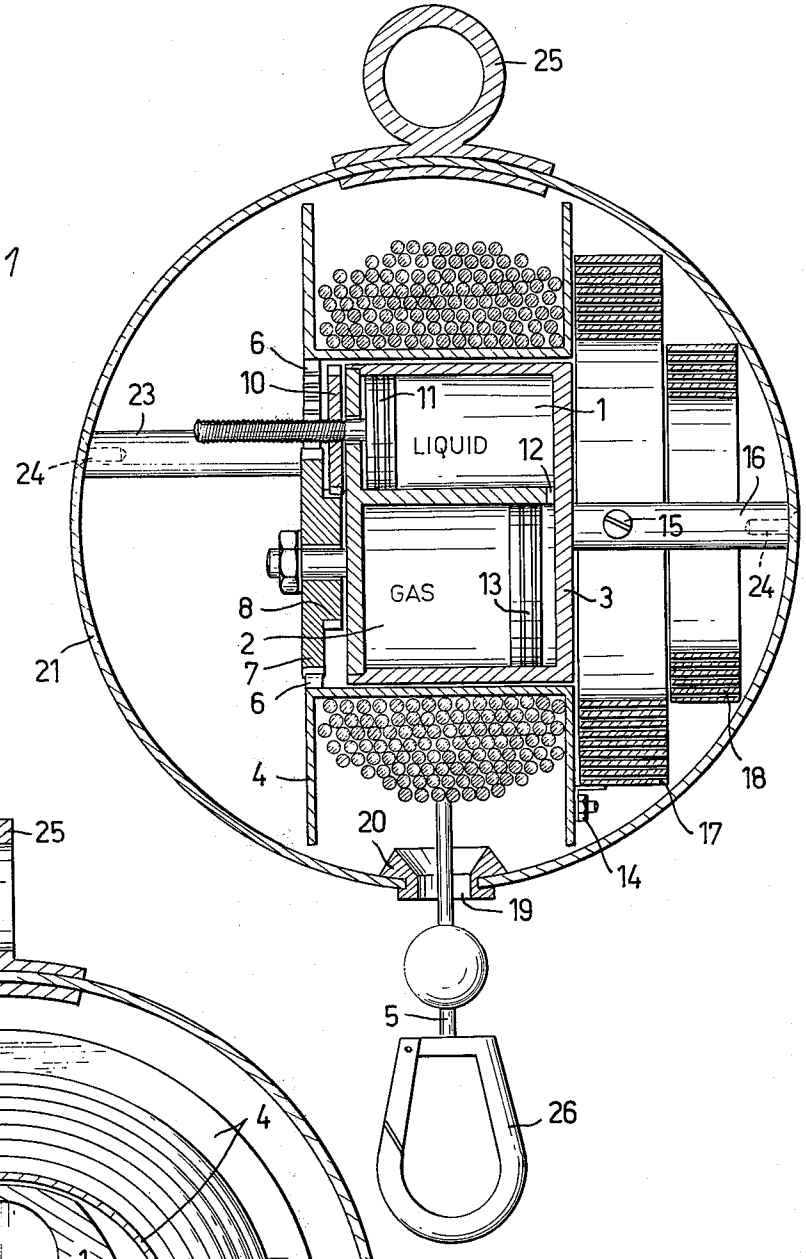


FIG. 1


25
6
10
11
1
23
LIQUID
12
16
24
15
GAS
13
3
24
8
2
7
6
21
4
18
20
17
14
19
5
26

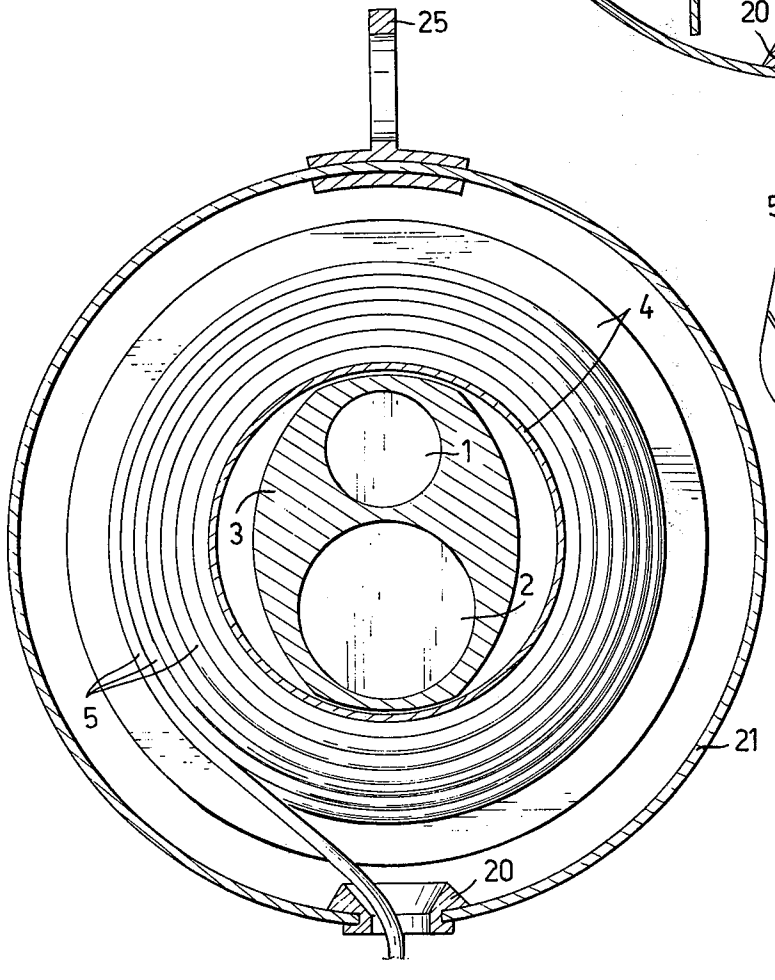
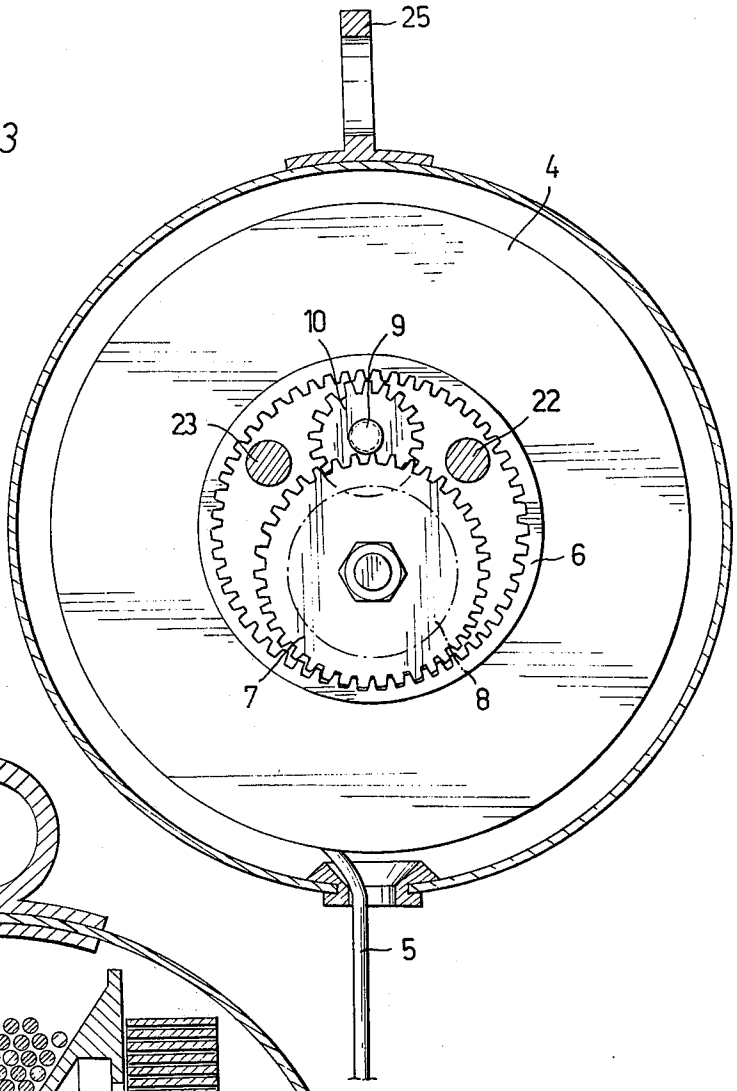

25
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1
3
2
5
21
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FIG. 2

FIG. 3


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23
6
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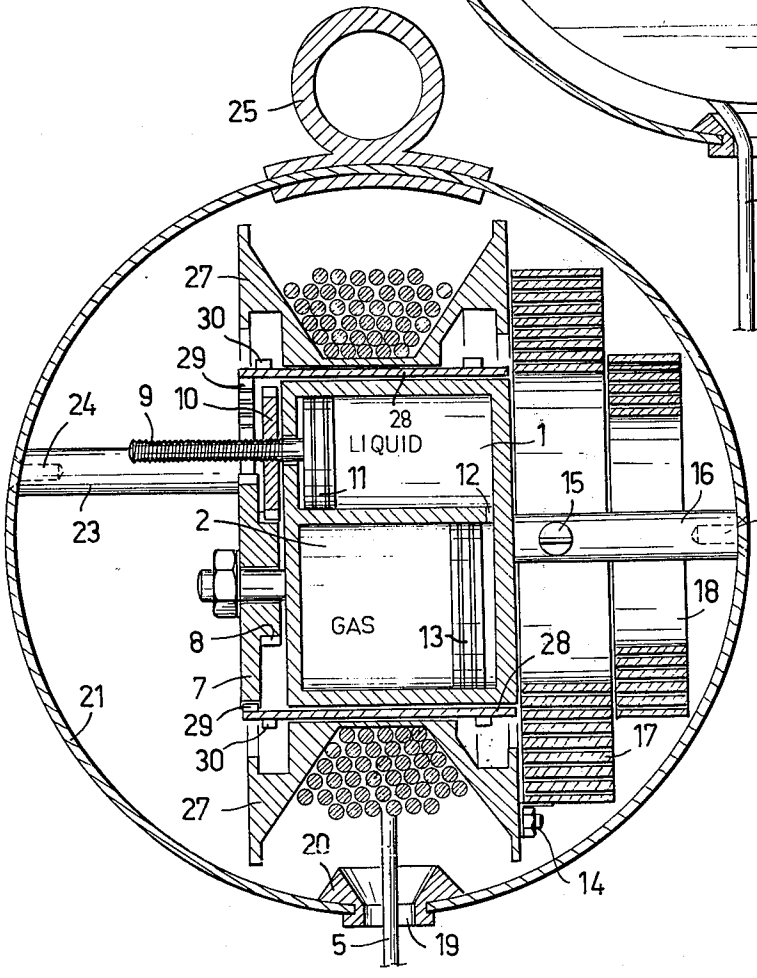

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LIQUID
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GAS
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FIG. 4

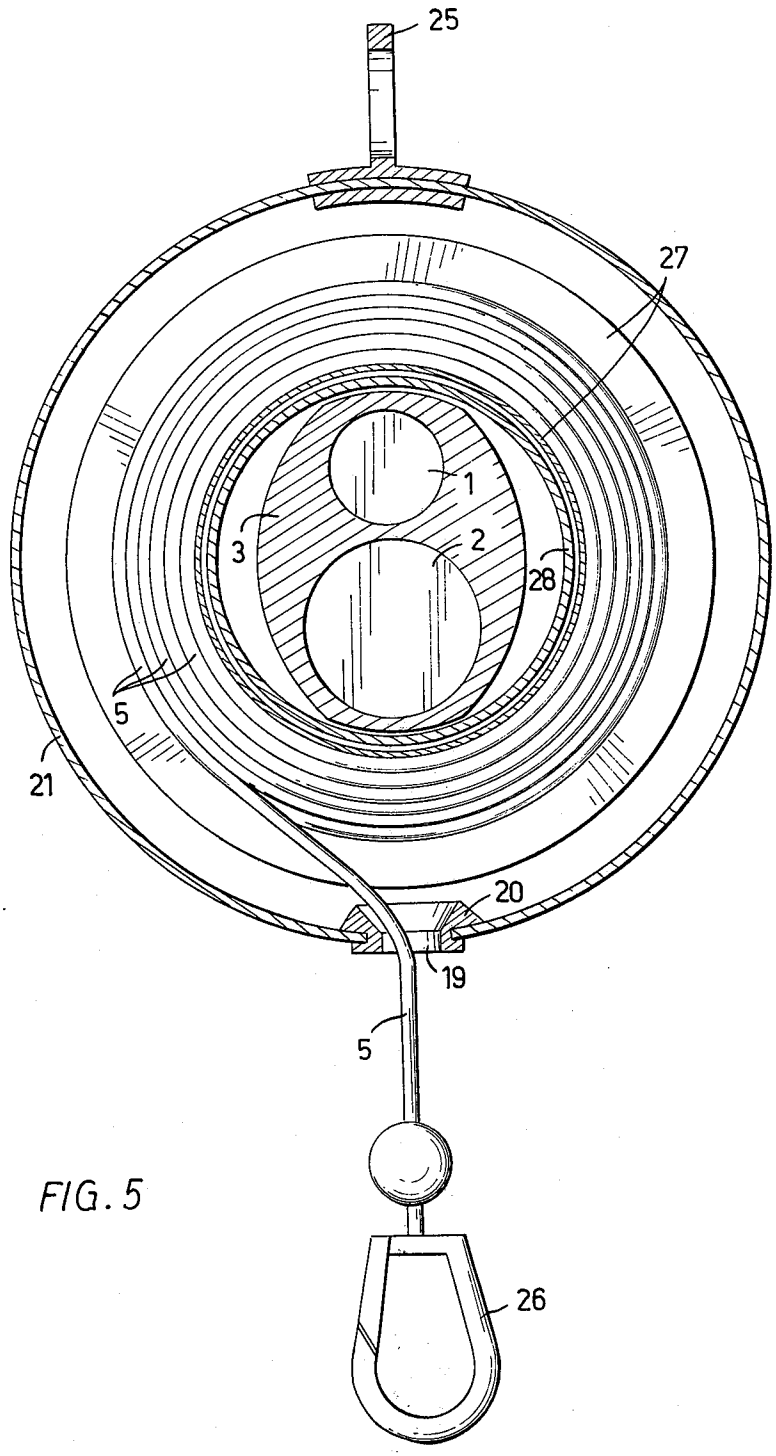
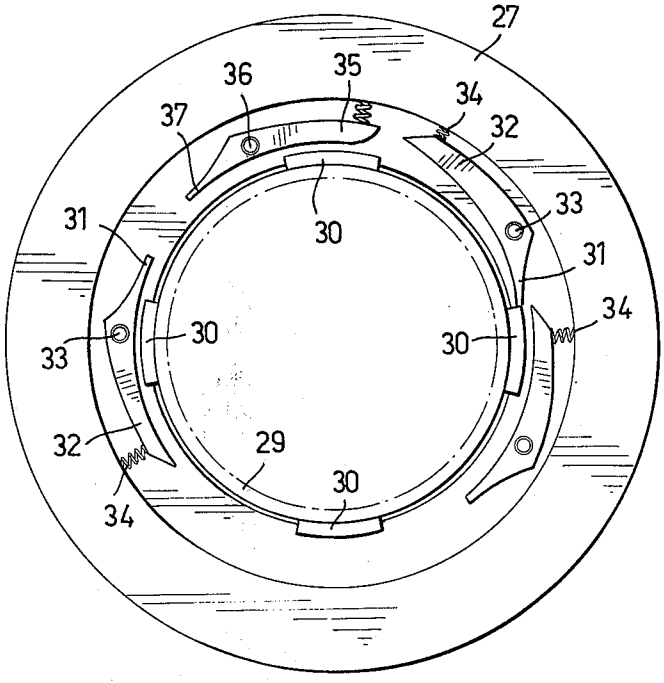


FIG. 5

FIG. 6


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36
35
37
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32
29
34
30

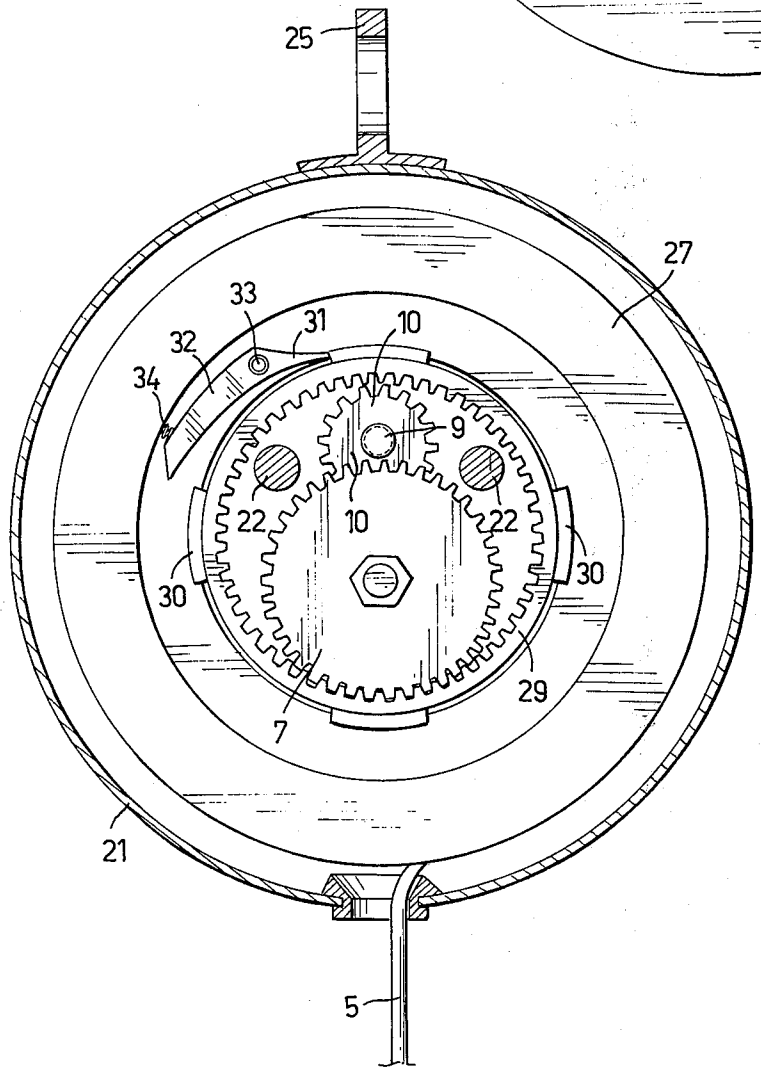

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FIG. 7

DEVICE FOR LOWERING PERSONS AND LOADS

BACKGROUND OF THE INVENTION

The present invention is related to safety devices for lowering persons and loads, in particular from high heights. Known devices for this purpose usually comprise a drum wheel from which a safety cable or rope, appropriately fastened to the person or load, is unrolled. The unrolling of the cable is braked by hydraulical means.

A device of this kind is described in U.S. Pat. No. **3,595,528.** In said device the cable cylinder is arranged to move a piston by means of a thread on the piston rod and a corresponding thread on the piston cooperating with a brake cylinder. The safety device according to said patent is further characterized in that it comprises one cylinder which is closed and filled with a liquid and that the flow of the liquid takes place from one side of the piston to the other side when the safety device is in operation.

This device has, however, several serious drawbacks. Since the operating main principle involves flow of liquid from one side of the piston to the other side through the tolerance in the thread and through a nozzle in the piston, it is not possible to determine a precise lowering speed for the device and neither possible to make this speed remain constant, due to wear occurring in the thread.

Secondly in a liquid subject to a high pressure, the temperature rises and causes a change in the viscosity of the liquid, due to which the braking effect of the liquid is reduced and the lowering speed increased, because there is no counter-effect in the device. When the piston reaches the cylinder end, it suddenly stops thus causing a dangerous situation.

Moreover, in order to produce continuous operation, the device is provided with a twin-reel and with cables reeled in opposite directions, which cables alternatingly hang free and tend to get entangled with each other and with outside objects.

The lowering device can also be used as a safety device when working e.g. on high buildings. In such cases the device is affected with an additional drawback in that the rope is always unwinding against a resistance. Thus, under normal or safe conditions, when, for example, a person works at a distance from the point of fastening of the safety device at a building, he must struggle against the force exerted on the cable by the braking means and the rewinding means of the device.

The basic object of the present invention is to overcome the difficulties and drawbacks of the hitherto known devices.

Another object of the present invention is the efficient use of the movement of the piston for lengthening the braking distance and for relieving the pressures occurring in the cylinder.

Another object is to selectively eliminate the resistance at unwinding the rope drum during normal working situations at high heights, by disconnecting the coupling from the rope drum and the brake cylinders.

An additional object is to enable a selective coupling between the drum and the brake cylinder in emergency situations when high-power braking is required.

Another object is to permit fast lowering, for example, through flames coming out of windows, yet stopping without a jerk at the end.

The above objects have been achieved by means of the device according to the present invention. A basic feature of the device is the arrangement of two cooperating braking cylinders, one of which is filled with a liquid and the other with a gas, e.g. air. The cylinders are interconnected by means of a nozzle and both cylinders have movable pistons. Pulling of the cable end results in rotation of the cable drum and this rotary movement is transferred by means of a gear system to forward movement of the piston of the first cylinder. Liquid is pressed into the second cylinder and causes the piston of the second cylinder to move thereby building up a counter gas pressure. Eventually this counter pressure stops the unwinding of the cable from the drum.

The device according to the invention permits increased height of lowering, without increasing the size of the device. A triple capacity is achieved as a result of the tightness of the cylinder and the fine feeding of the piston. By means of the gear system, a pressure reduction is achieved in the cylinders, whereby the load on the cylinder is further reduced. Due to the air cushion, the work of the return spring is facilitated, because, when the air cushion is discharged, the pressure pushes the piston to the staring position. The other features and advantages of the invention concerned come out from the following detailed description in connection with the accompanying drawing.

FIG. **1** is a cross section view of the lowering device,

FIG. **2** is a longitudinal section of the same device,

FIG. **3** shows the gear system of the device,

FIGS. **4** and **5** show the safety device in sections corresponding to FIGS. **1** and **2,** respectively.

FIG. **6** shows the coupling of the cable wheel to the braking mechanism.

FIG. **7** shows the gear system of the safety device.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the drawings the safe reference numerals have been used for identical parts of the lowering device and of the safety device. The braking mechanism of the device comprises a first cylinder **1** and a second cylinder **2** preferably forming a stationary unit **3.** The cylinders **1** and **2** operate as one unit, **1** as a container of liquid and **2** as one of gas, e.g. air. The essential operating components of the device comprise a rotating cable wheel or drum **4,** which is arranged so as to rotate around the cylinder group **3** in one direction to unwind the rope **5** and the opposite direction in order to wind the cable back thereon. Pulling of the cable causes a rotating movement of the toothed rim **6** at the inner edge of the drum **4,** the rim transmits the movement to the gear **7,** the lower part **8** of which transmits the movement of rotation to another gear **10** surrounding the piston rod **9.** The piston rod **9** and, correspondingly, the gear **10** are provided with a fine thread of **1/1** mm, whereby the rotating movement of the gear **10** forces the piston **11** to move forwards into the cylinder. When the piston **11** is pressed forwards, it forces the liquid in the cylinder **1** to escape through a nozzle **12,** into the cylinder **2,** said nozzle including a valve or the like permitting the liquid to flow back. The liquid flow into the cylinder **2** accordingly causes movement of the piston **13** towards the other end of this cylinder. This causes a counter-pressure from the air being compressed. When the air pressure in the cylinder **2** equals the liquid pressure caused by the object to be lowered, the unwinding of the rope **5** stops. After removal of the

load, the return spring 17, which is fixed to the rope drum 4 stationarily by means of a bolt 14 and to the shaft 16 by means of a bolt 15 and which is tensioned in connection with the pulling of the cable, starts winding and reeling the cable in the opposite direction. The cable winding is aided by the discharging air cushion, which presses the piston 13, and, by means of the liquid, the piston 1 as well, to the initial position. In case of high heights an auxiliary spring 18 is used if required. When the rope wheel rotates in the opposite direction, the gear system 6, 7, 8 and 10 pulls the piston 11 to its initial position.

The discharge opening 19 for the cable is provided with a hardened bushing 20. The device is secured in a spherical case 21 by means of support shafts 16, 22 and 23 fastened by means of machine screws 24.

FIGS. 4–7 show another embodiment of the device according to the present invention. This embodiment is adapted for use as a safety device when working at high heights on buildings or the like. The safety device is similar to the afore described lowering device in most respects. It differs, however, from said lowering device in that the cable drum 27 is not directly connected to the gear system driving the piston 11 of said first cylinder 1. Between said cable drum 27 and the cylinder unit 3 is arranged an additional bearing 28 carrying a toothed rim 29 similar to the rim 6 of the lowering device and capable of driving the piston 11 via the gear system 7, 8, 10, 9.

The device is also provided with means for selectively coupling the cable drum 27 into driving engagement with the additional bearing 28. These means comprise blocks 30 mounted on the additional bearing 28 and hooks 31, 32 and 35, 37 selectively catching at least one of said blocks 30. Each one of said block hooks is pivotably mounted around a pin 33; 36 in such a way that the parts of the hook on different sides of said pin, in the direction of the drum circumference, are of different weights, the lighter part 31; 37 of the hook forming the block catching part.

This coupling arrangement is best shown in FIG. 6; in FIG. 7 only one block hook is shown. When the cable 5 is pulled out, the cable drum 27 rotates clockwise. Due to the centrifugal force, the heavier part 32; 35 of the hook tends to swing out and the lighter part 31; 37 correspondingly, tends to move inwards into engagement with a block 30. In FIG. 6, hooks 31, 32 are arranged to catch a block 30 when the drum 27 rotates clockwise, i.e. cable 5 is pulled out. At least one hook, in FIG. 6 the hook 35, 37 is, however, arranged the other way catching a block 30 when the rewinding means 17, 18 rotate the drum 27 anticlockwise, in order to return the pistons of the cylinders to their initial positions as the cable is rolled back on the drum 27. The end of the heavier part 35 of this hook is rounded to avoid unwanted engagement with a block 30.

In order to make it possible to slowly pull out the cable 5 without coupling the cable drum 27 to the braking mechanism, the heavier part 32; 35 is supported by a spring 34 the force of which works against said outward movement. The spring 34 also prevents the heavier part 32 of the hook from engaging a block 30 when the cable 5 is slowly rewinded on the drum 27 under normal conditions involving no emergency.

When the pulling speed of the cable increases, for example, as a result of stumbling, the thicker part 32 of the block hook moves outwards in spite of spring 34, and at the same time the other end 31 of the block hook is pressed down and catches the support 30 thus stopping the free rotation of the reel 27 and connecting the braking mechanism, thus starting the braking. If the stumbling results in falling down, the safety device lowers the load slowly. After removal of the load, the block hook, 35, 37 correspondingly catches a block 30 when the returning mechanism starts working in the opposite direction reeling the free cable back onto the drum, at the same time restoring the pistons in the cylinder to the initial positions.

Operation

The devices in accordance with the present invention are intended for use by people that work at high heights, for example at construction work or on electricity poles, running the risk of falling down after possible electric shock. Also, the lowering device saves people or objects from high burning houses.

The device is fastened by means of a ring 25 at a stationary support above the worker. The other fastening is accomplished by means of a hook 26 at the worker's security belt or equivalent.

In normal operation of the safety device, which takes place within the worker's duties at a building site or equivalent, he can move freely, for only a low tension is produced by the springs 17 and 18 that rewind the cable 5. At this time there is no coupling between the drum and the braking device. However, should the worker slip or otherwise lose the position of his feet so that the drum 27 moves at a sufficient speed, the result is that the block hooks are moved by the centrifugal force against the springs 34 so that the part 31 moves inwards and catches a block 30; in this way the rotation of the drum of the cylinder can be made to take place around the stationary body. Since the rotation of the drum of the cylinder produces the operation of the braking mechanism, it guarantees the above safe lowering.

The lowering speed of a lowering device of a stationary installation or the lowering speed of a lowering device otherwise in advance adjusted for a certain height can thus be adjusted to be considerably faster than the speed of a device by means of which lowering is accomplished from any height whatsoever. Therefore a liquid should be used besides air, in order to guarantee a sufficiently low lowering speed under all conditions. The lowering device permits fast rushes, for example at a fire through flames coming from windows of lower storeys, because it is possible to adjust in advance the soft landing required by the height of storeys, due to the air cushion.

What I claim is:

1. A device for lowering persons and loads, comprising a case having an opening for a cable or rope and having means for fastening the device to a stationary support;

a cable drum rotatably mounted within said case;

a cable wound on said drum and unwindable therefrom and having means for fastening the free end of the cable to the person or load to be lowered;

means for rewinding the cable on said drum after the cable has been pulled off said drum;

a first cylinder filled with a liquid and having a movable piston with a rod protruding from the cylinder and provided with a thread;

a second cylinder filled with a gas and having a movable piston;

nozzle means connecting said first cylinder with said second cylinder,

means transferring rotary movement of said drum into movement of the piston within said first cylinder;

an additional bearing driving said rotary movement transferring means; and

means for selectively coupling said cable drum into driving engagement with said additional bearing.

2. A device according to claim **1**, wherein said transferring means comprise a toothed rim on said additional bearing and gear means connecting said toothed rim to said piston of said first cylinder.

3. A device according to claim **1**, wherein said means for selectively coupling the cable drum into driving engagement with said additional bearing comprise

blocks mounted on said additional bearing, and

catch means mounted on the cable drum and selectively engaging at least one of said blocks.

4. A device according to claim **3**, wherein said catch means comprise a plurality of hooks arranged asymmetrically around the cable drum, each one of said hooks being pivotably mounted around a pin in such a way that the parts of the hook on different sides of said pin, in the direction of the drum circumference, are of different weights.

5. A device according to claim **4**, wherein the heavier part of said hooks is supported by spring means.

6. A device according to claim **4**, wherein the lighter part of each hook constitutes the block catching part and wherein at least one of said hooks is arranged to catch a block during rewinding of the cable on the drum, the end of the heavier part of said at least one hook being rounded.

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