United States Patent [19]

Belew

[11] **4,018,423**

[45] **Apr. 19, 1977**

[54] EMERGENCY DESCENT DEVICE

[75] Inventor: **Robert R. Belew,** Huntsville, Ala.

[73] Assignee: **The United States of America as represented by the Administrator of the National Aeronautics and Space Administration,** Washington, D.C.

[22] Filed: **Oct. 16, 1975**

[21] Appl. No.: **623,188**

[52] **U.S. Cl.** **254/158;** 188/291

[51] **Int. Cl.²** **A62B 1/12;** B66D 5/04

[58] **Field of Search** 254/158, 160; 182/74, 182/75; 188/295, 305, 293, 290–291, 307

[56] **References Cited**

UNITED STATES PATENTS

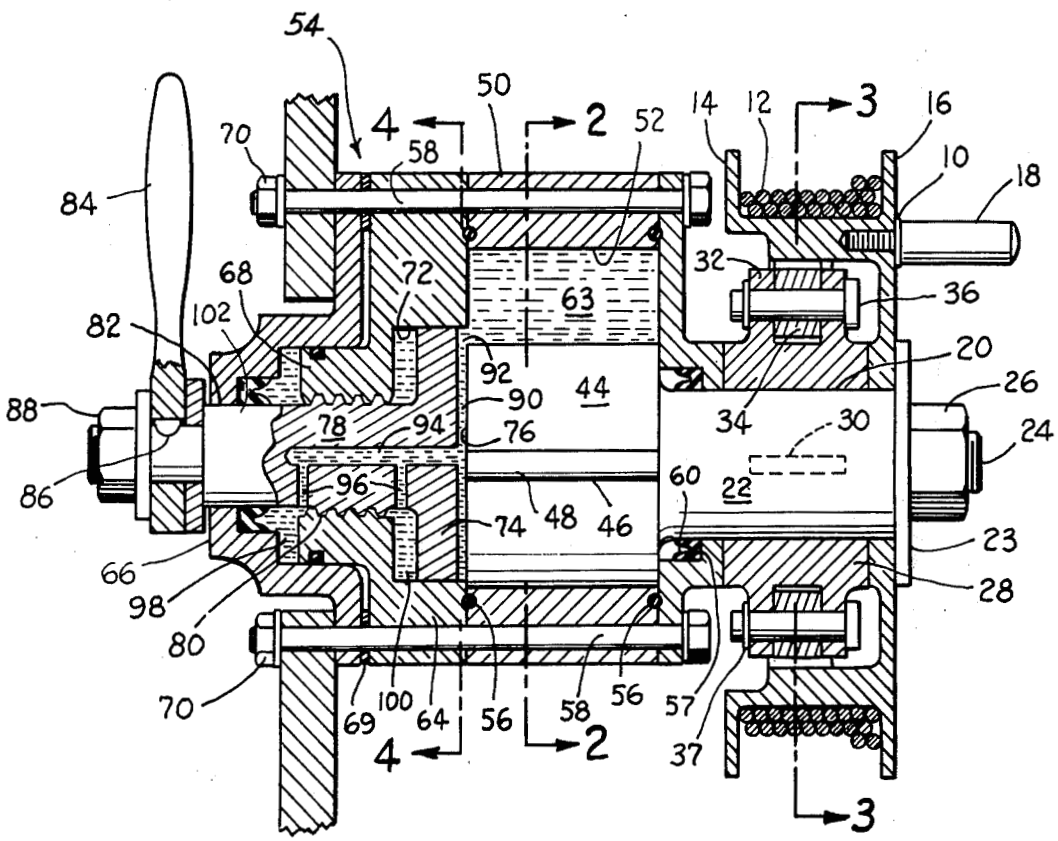
628,736	7/1899	Young	254/160
1,888,912	11/1932	Doose	254/160
3,595,528	7/1971	Virkki	254/160
3,946,989	12/1974	Tsuda	254/160 X

Primary Examiner—Robert B. Reeves
Assistant Examiner—Fred A. Silverberg
Attorney, Agent, or Firm—L. D. Wofford, Jr.; John R. Manning

[57] **ABSTRACT**

A descent device is provided for emergency descent from tall structures and for lowering objects from high elevations such as a hovering helicopter. The device includes a rotating spool having a cable wound thereon for descent and a rotation-retarding vane member which rotates in a fluid cylinder. An adjustable bypass is provided for the fluid as the vane member rotates therein so that the speed of descent can be adjustably controlled.

7 Claims, 9 Drawing Figures



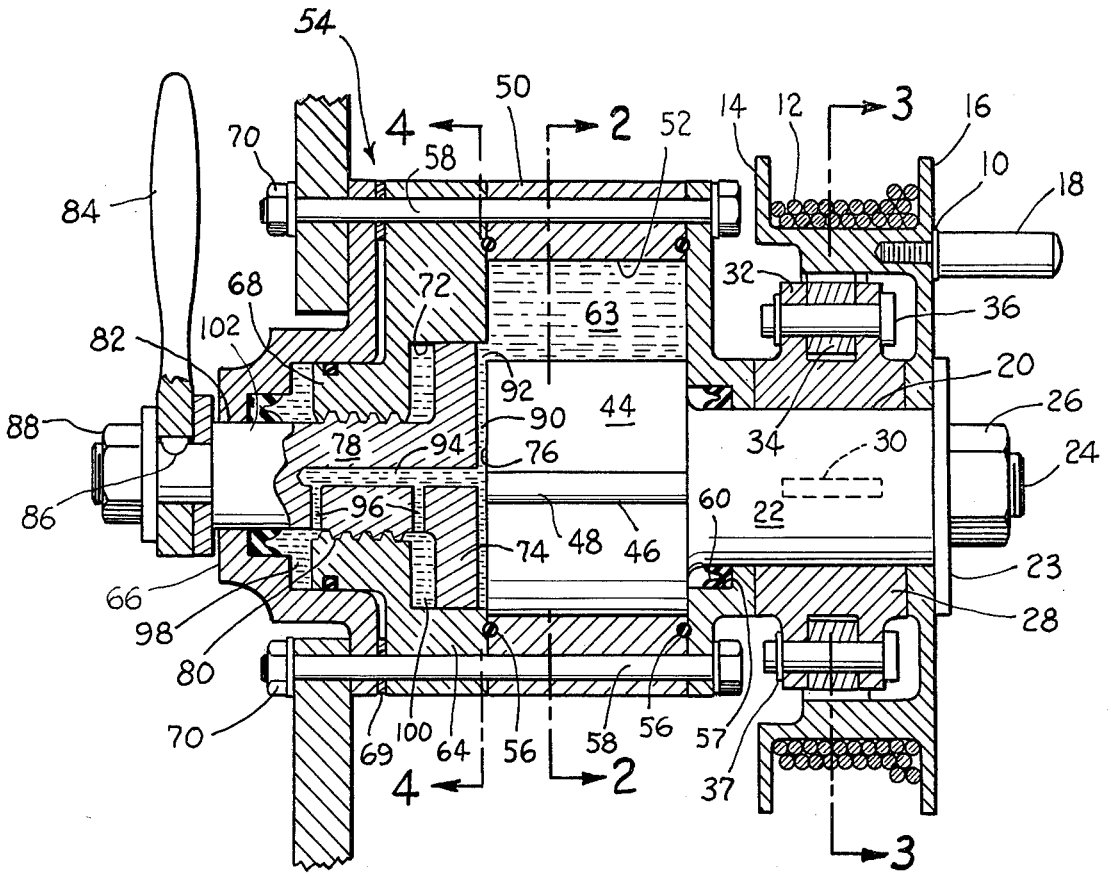


Fig. 1.

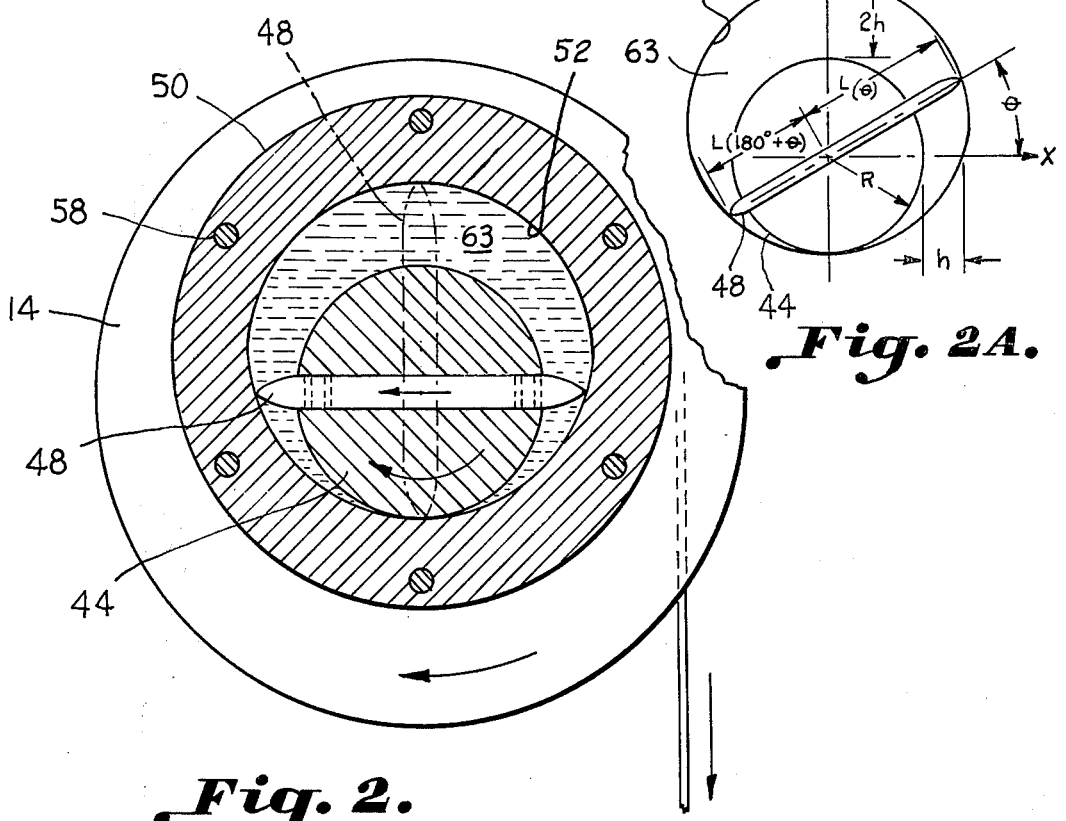
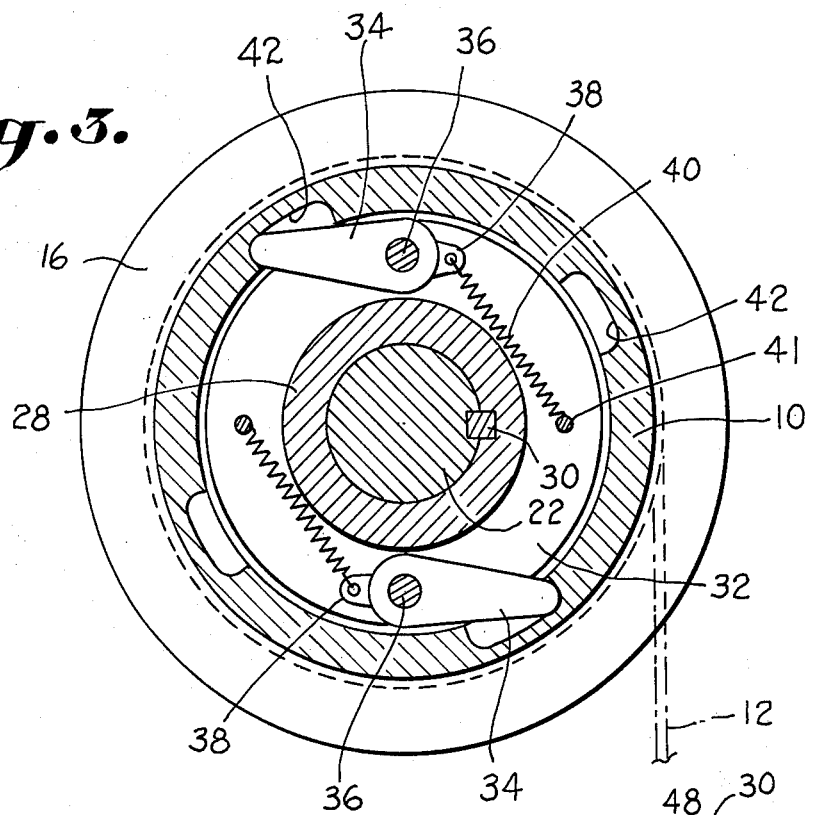


Fig. 2A.

Fig. 2.

Fig. 3.



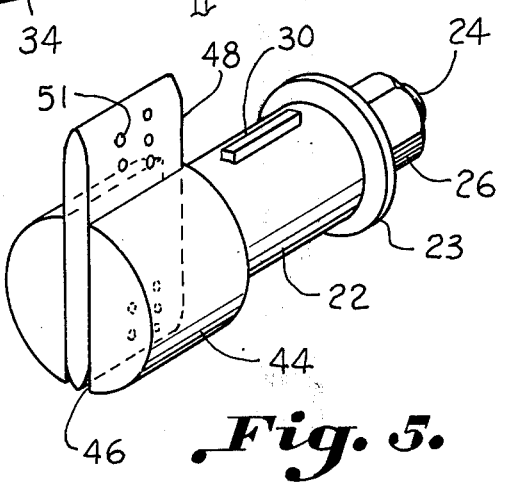


Fig. 5.

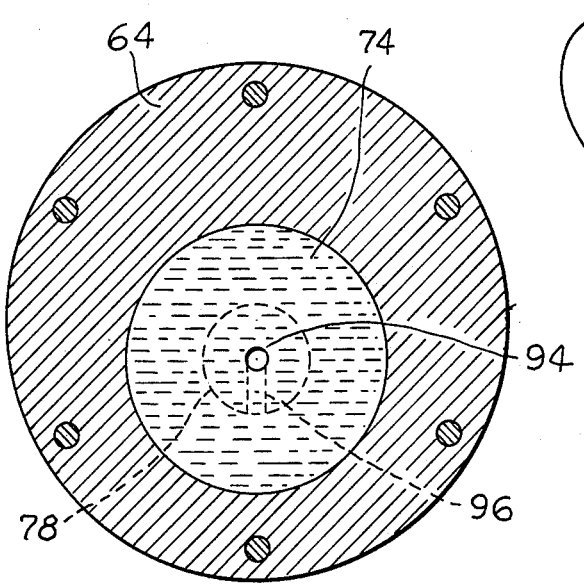


Fig. 4.

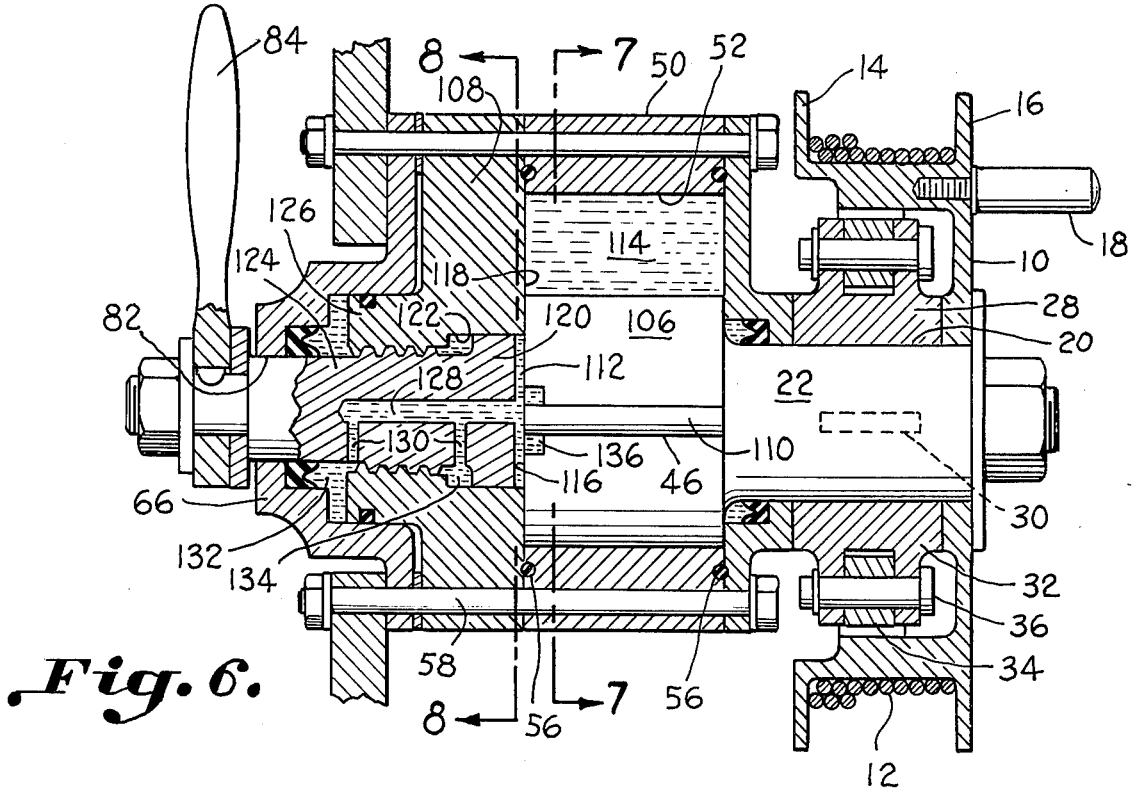


Fig. 6.

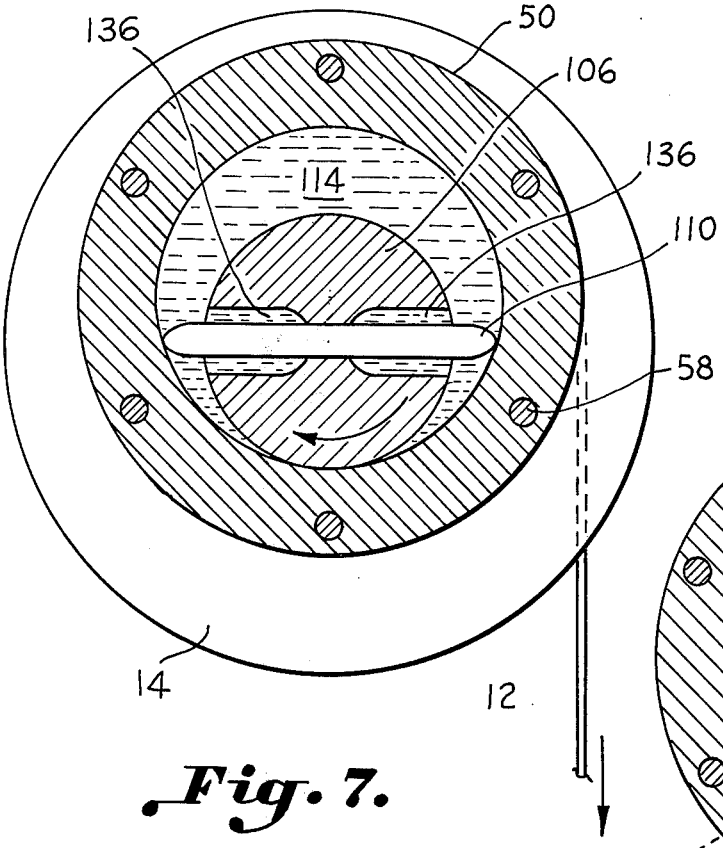


Fig. 7.

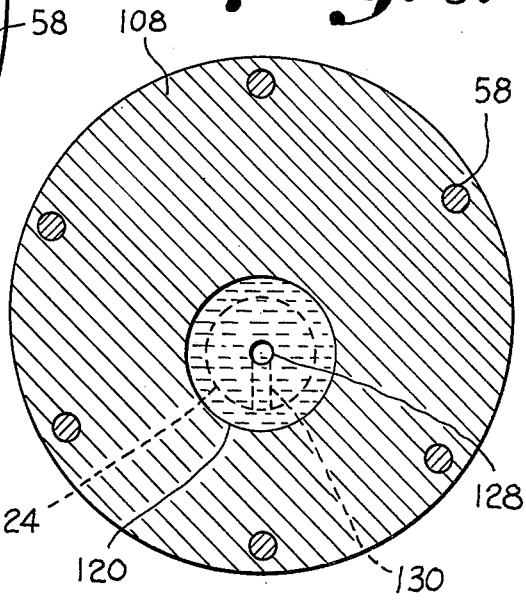


Fig. 8.

EMERGENCY DESCENT DEVICE

ORIGIN OF THE INVENTION

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

This invention relates to emergency descent devices of the type shown in U.S. Pat. No. 530,863 and 516,117 wherein a spool having a cable member wound thereon is retarded in its rotation as the cable member descends by a rotating vane member in a fluid cylinder. More particularly, the invention relates to improvement in such devices and to providing an adjustable bypass for the fluid around the vane member so that the speed of descent can be controlled. The improved device has much broader application than those devices heretofore known for lowering equipment from elevated places such as lowering equipment from a hovering helicopter wherein it is necessary to control the speed at which the equipment is lowered. The improved invention also has application to heavier loads.

SUMMARY OF THE INVENTION

A descent device for emergency descents and for lowering equipment from tall structures and the like is provided comprising a cylindrical housing having an interior space containing a fluid, and a rotor shaft carried for rotation in the housing having a reduced end portion of reduced diameter extending through an opening in one end of the housing. A spool member is carried by the reduced end portion of the rotor shaft so as to rotate the rotor shaft when rotated in a first direction while being rotatable relative to the rotor shaft when rotated in a second opposite direction. A cable member is wound about the spool member having one end connected thereto. A diametrical slot is formed in the rotor shaft carried within the interior space of said cylindrical housing, and a vane member is slideably carried in the diametrical slot extending across said interior space of said housing.

A channel means is provided for transferring the fluid from one side of the vane member to the other as the vane member is rotated in the interior space by the rotor shaft to retard the rotation thereof.

An end cap member encloses the cylindrical housing on an end opposite the end through which the reduced portion of said rotor shaft extends and means carried by the end cap provide an adjustable bypass channel around the vane member for the fluid contained in the interior space of the housing as the vane member rotates so as to adjust the retarding force.

Thus, the fluid and the rotating vane member produce a retarding force on the rotation of the spool member in the first direction due to the unwinding of the cable member from the spool member and the adjustable bypass means may be adjusted so as to control the speed of descent of said cable.

Accordingly, it is an important object of the present invention to provide a descent device for emergency descents and for lowering equipment from elevated places which permits a safe descent at a controlled speed.

Another important object of the present invention is to provide a descent device for emergency descents and for lowering equipment whereby the speed at which the descent occurs can be varied.

Another important object of the present invention is to provide a descent device which can be used to lower heavy equipment from a hovering helicopter and the like and in which the speed of descent can be adjustably controlled.

These and other objects and advantages of the present invention will become apparent upon reference to the following specification, attendant claims and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side cut-away elevational view illustrating a descent device constructed in accordance with the present invention,

FIG. **2** is a sectional view taken along line **2—2** of FIG. **1**,

FIG. **2***a* is a schematic diagram illustrating the geometry of the interior surface of fluid containing cylindrical housing constructed in accordance with the present invention,

FIG. **3** is a sectional view taken along line **3—3** of FIG. **1**,

FIG. **4** is a sectional view taken along line **4—4** of FIG. **1**,

FIG. **5** is a perspective view illustrating a rotor shaft and vane member utilized in the descent device constructed in accordance with the present invention,

FIG. **6** is a side cut-away elevational view of an alternate embodiment of a descent device constructed in accordance with the present invention,

FIG. **7** is a sectional view taken along line **7—7** of FIG. **6**, and

FIG. **8** is a sectional view taken along line **8—8** of FIG. **6**.

DESCRIPTION OF A PREFERRED EMBODIMENT

The descent apparatus is provided for producing a controlled descent of a person from a tall structure, such as a building, as he grabs onto an emergency cable and the cable unwinds from a spool, or for controlling the descent of equipment from elevated places such as a hovering helicopter. Referring now to FIG. **1** in detail, the device includes a spool **10** upon which any suitable type of cable **12** is coiled. The spool **10** has outer walls **14** and **16** for retaining the cable therein. Extending outwardly from the outer wall **16** is a rotatable handle **18** which enables the spool to be manually rotated to coil or wind the cable **12** thereon. The wall **16** of the spool **10** has an opening **20** extending therethrough through which a cylindrical, reduced diameter portion **22** of a rotor extends. On the outer end of the reduced diameter portion **22** of the rotor is a circular flange **23** and a threaded end portion **24** which is threaded for receiving a nut **26** for securing the spool **10** to the portion **22** of the rotor. It is to be understood that the spool **10** is adapted to be rotated freely relative to the rotor **22** when the spool is rotated to wind the cable **12** thereon.

A concentric latching mechanism is also provided on the reduced diameter portion **22** of the rotor and includes a cylindrical latching ring member **28** which is keyed by a key **30** to the rotor **22**. The latching ring **28** has a radially, outwardly extending flange **32** upon which pawls **34** are pivotally mounted by pins **36** se-

cured by spring clips **37**. The inner end of each pawl **34** has an outwardly extending portion **38** into which one end of a spring **40** is attached. The other end of the spring **40** is attached to pin **41** projecting from the radially extending flange **32** of the latch. The purpose of the spring **20** is to pivot the reduced opposite end of the pawl **34** outwardly so that such will engage in a recess **42** provided in the inner walls of the spool **10**.

The inner end of the rotor **22** has an enlarged diameter portion **44** provided with a diametrical extending slot **46** therein. Extending through this slot **46** is a sliding vane member **48** which has its outer ends engaging the inner wall of a substantially cylindrical housing **50**. The vane **48** has a plurality of holes **51** formed adjacent each end thereof. An inner chamber **52** of the housing **50** has an inner surface closely approximating that of a right cylindrical surface defined by the following equations (see FIG. **2***a*):

$$L(\theta) = R + h\,(1 + \mathrm{Sin}\,\theta), \text{ and}$$

$$L(180° + \theta) = R + h\,[1 + \mathrm{Sin}(180° + \theta)]$$

A cap assembly, designated generally at **54**, is bolted to the housing **50**. O-rings **56** are provided at the opposite ends of the housing providing a seal coupling between the housing and the cap assembly **54** at one end and an end plate **57** at the other end. The bolts **58** extend through the cap **54** and the housing **50**. Seals **60** are also provided between the rotor **22** and the end plate **57** so that a fluid **63** is retained in the housing. This fluid could be any suitable fluid and in one particular embodiment it may be silicone. The perforations or holes **51** provide channel means permitting transfer of the fluid **63** from one side of the vane member **48** to the other. Thus, the vane-rotor assembly revolves in the confined fluid medium **63** and developes torque as a function of rotational velocity providing a slowed and controlled descent rate.

The housing **50** is mounted to the structure upon which it is desired to locate the emergency descent device by any suitable bracket means so as to prevent the housing from rotating as the cable is unwound therefrom.

In operation, when an emergency descent is desired say, from a space launching platform or the like, the person would merely grab hold of the downwardly extending cable **12**. The cable could be provided with any suitable seat or harness to be attached for safety reasons. As the person begins to descent, the cable unwinds from the spool **10** rotating the spool in a first direction. When the spool begins rotating, the pawls **34** engage within the recessed slots **42** provided in the inner wall of the spool which causes the latch ring **28** to also rotate. Since the latch ring is keyed at **30** to the rotor **22**, such, in turn, rotates the entire rotor in the first direction. The rate of rotation of the rotor is the same as the rotation of the spool; however, it is to be understood that gearing could be provided therebetween so as to vary the rotation of the rotor relative to the rotation of the spool. As the rotor is rotated, the vane **48** is also rotated compressing the fluid **63** within the housing **50**. The vane **48** slides within the slot **46** maintaining the opposite ends thereof always in contact with the interior wall **52** of the housing. As the rotor is rotated, the fluid flows through holes **51** provided in the vane producing a retarding or restraining force to the rotor. The diameter, number and arrangement of holes extending through the vane would control the restraining force. Therefore, the speed of descent of the person on the cable can be suitably controlled.

When the spool member **10** is rotated by handle **18** in a second direction to rewind the cable **12**, the pawls **34** do not engage in recesses **42** and therefore the spool rotates relative to the rotor portion **22**. In this manner the retarding force of vane **48** need not be encountered during rewind.

The cap assembly **54** includes a cylinder head member **64** and an end cap member **66**. The cylinder head member **64** encloses the interior space **52** of the cylinder housing **50** at the end of the housing opposite the end through which the reduced end portion **22** of the rotor extends. The cylinder head is then, in turn, carried by the end cap member **66** which is fitted over an upwardly extending flange member **68** of the cylinder head **64** and is spaced therefrom by a pair of spacing rings **69**. The entire assembly is secured together by the bolt members **58** having a conventional nut member **70** fastened over the threaded ends thereof. The cylinder head member **64** has a concentric cylinder bore **72** formed therein in which a piston **74** is slideably moves toward and away from an end surface face **76** of the enlarged rotor portion **44**.

A threaded piston stem **78** is integral with the piston **74** and is threadably received within internal threads formed in a central opening **80** of the upper flange **68**. The threaded stem extends to the exterior of the descent device through an aligned opening **82** formed in the end cap member **66**. A lever member **84** is keyed at **86** to the extended end of the threaded stem **78** exterior of the end cap and is fastened thereto by a nut member **88** received over a threaded end of the stem. As the lever **84** is rotated the threaded stem moves the piston **74** toward and away from the end surface face **76** of the rotor to vary the size of the clearance space **90** therebetween. If the piston **74** is moved toward the end face surface **76** of the rotor reducing the clearance space **90** to zero then the only path that the fluid **63** has from one side of the vane **48** to the other is through the perforations **51** formed therein. However, when the piston **74** is moved away from the end face surface **76**, an additional channel is provided through a space **92**, between the edge surface of the cylinder bore **72** and the edge of rotor surface **76**, and the bypass or clearance channel **90** to the other side of the vane member **48**. As the clearance space **90** is increased more fluid can flow from one side of the vane member **48** to the other, thus, less retarding force is provided against the rotation of the rotor vane allowing a faster rate of descent. The maximum retarding force is provided when the clearance space **90** is zero, thus providing the slowest rate of descent of the unwinding cable member **12**.

The piston **74** and threaded stem **78** integral therewith have an axial bore **94** formed therein with a plurality of radial bores **96** extending outwardly therefrom communicating with fluid spaces **98** and **100**. As the piston **74** moves backwards and forwards in the cylindrical bore **72** of the cylinder head **64**, the fluid is displaced between the fluid spaces **98** and **100** and the fluid clearance space **90**. Suitable sealing means is utilized at **102** for sealing the threaded stem **78** at the opening **82**.

Referring now to FIG. **6**, an alternate embodiment of a descent device is illustrated comprising essentially the same components as illustrated in FIG. **1** except that the enlarged portion **106** of the rotor **22** is modified

along with the configuration of the cylinder head member **108.** In addition, the vane member **110** is similar to the vane member **48** of FIG. **1** except that the perforations **51** are omitted adjacent the ends thereof. A clearance space **112** is provided which does not communicate with the fluid space **114** as it does in FIG. **1.** The end surface **116** of the rotor portion **106** abuts the end surface **118** of the cylinder head **108.** A piston **120** slides in a cylindrical bore **122** formed in the cylinder head **108** for providing a variable clearance between the piston and the end surface **116** of the rotor and providing a variable fluid space at **112.** A threaded stem member **124** is threadably received in an upper flange **126** of the cylinder head and extends through the aligned opening **82** formed in the end cap member **66,** which is identically shown in FIG. **1.** An axial bore **128** has a pair of radial bores **130** extending outwardly therefrom communicating with fluid spaces **132** and **134.**

A channel means is provided for transferring the fluid from one side of the rotating vane **110** to the other side by a pair of cutout portions **136** formed in the end surface face **116** of the rotor **106** and extending a short distance axially along the vane member **106** as best shown in FIGS. **6** and **7.** In operation, the fluid moves from one side of the vane member **110** as it rotates through the channel means **136** through the clearance space **112** to the other side of the vane member **110.** By increasing the clearance space **112** more fluid can be transferred from one side of the vane member **110** to the other reducing retardation of the rotation of the vane member **110** thus producing a faster descent rate. As the piston **120** moves away from the rotor surface **116,** fluid is displaced from the spaces **132** and **134** into the clearance space **112** by way of radial bores **130** and axial bore **128.** As the clearance space **112** is decreased, the speed of descent of the cable member **12** would also decrease as it is unwound from the rotating spool **10.**

Thus, it can be seen that a highly effective descent device can be provided for emergency descents and for lowering equipment and objects from elevated places wherein a controlled speed of descent can be provided and in which the speed of descent can be easily varied. The device can be controlled to provide a slow rate of descent of a person descending from an elevated place during an emergency situation in a safe manner.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. A descent device for emergency descents and for lowering equipment from tall structures and the like comprising;

a cylindrical housing having an interior space containing a fluid;

a rotor shaft carried for rotation in said interior space having an end portion of reduced diameter extending through an opening in one end of said housing;

a spool member carried by said reduced end portion of said rotor shaft so as to rotate said rotor shaft when rotated in a first direction while being rotatable relative to said rotor shaft when rotated in a second, opposite direction;

a cable member wound about said spool member having one end connected thereto;

a diametrical slot formed in said rotor shaft carried for rotation in said interior space of said cylindrical housing;

a vane member slideably carried in said diametrical slot extending across said interior space of said housing;

channel means for transferring said fluid from one side of said vane member to the other as said vane member is rotated in said interior space by said rotor shaft to retard the rotation thereof; and

an end cap member enclosing said cylindrical housing on an end opposite said end through which said reduced portion of said rotor shaft extends, means carried by said end cap providing an adjustable bypass channel around said vane member for said fluid contained in said interior of said housing so as to adjust said retarding force thereagainst;

whereby said fluid and said rotating vane member produce a retarding force on the rotation of said spool member in said first direction due to the unwinding of said cable member from said spool member and said adjustable bypass means may be adjusted so as to control the speed of descent of said cable.

2. The device as set forth in claim **1** further comprising a latch ring member carried by said reduced end portion of said rotor shaft for rotation therewith; and

means connecting said latch ring member to said spool member as said cable member is unwound therefrom to rotate said rotor shaft in said first direction while permitting said spool member to be rotated relative to said rotor shaft when said spool member is rotated in said second direction to rewind said cable member thereon.

3. The device as set forth in claim **1** wherein said end cap member carries a cylinder head having a cylindrical bore formed therein opposing the end surface of said rotor shaft carried within said cylindrical housing interior; and

a movable piston carried within said cylindrical bore being movable away from and toward said rotor shaft end surface to vary the clearance therebetween providing an adjustable bypass for fluid around said vane member.

4. The device as set forth in claim **3** wherein said piston includes a threaded piston stem received through a threaded opening in said cylinder head in one end opposite said cylindrical bore;

said piston stem further extending through an aligned opening in said end cap member; and

a lever member connected to said piston stem extending on the exterior of said end cap whereby rotation of said lever varies the clearance between said piston and the end of said rotor shaft.

5. The device as set forth in claim **3** wherein said piston includes an axial internal bore having a plurality of radial bores extending outwardly therefrom providing channels for the displacement of said fluid as said piston moves in said cylindrical bore.

6. The device as set forth in claim **1** wherein said channel means includes a plurality of perforations formed in said vane member adjacent the ends thereof permitting said fluid to flow therethrough to retard the rotation of said rotor shaft and said spool member connected thereto during unwinding of said cable member.

7. The device as set forth in claim **1** wherein said channel means includes a cut-out portion in an end surface of said rotor shaft opposing said piston member so as to permit said fluid to move from one side of said vane member to the opposite side of said vane member by way of said channel means and said channel bypass.

* * * * *