US005131491A

United States Patent [19]

Varner et al.

[11] **Patent Number: 5,131,491**

[45] **Date of Patent: Jul. 21, 1992**

[54] **DESCENT CONTROLLER**

[75] Inventors: **Horace M. Varner; Ernest L. Stech; Richard H. Frost,** all of Littleton, Colo.

[73] Assignee: **Frost Engineering Development Corp.,** Englewood, Colo.

[21] Appl. No.: **652,130**

[22] Filed: **Feb. 7, 1991**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 554,687, Jul. 18, 1990, Pat. No. 5,038,888.

[51] **Int. Cl.**[5] **A62B 1/14;** B65H 59/14

[52] **U.S. Cl.** **182/7;** 188/65.2; 188/65.5

[58] **Field of Search** 182/5-9; 188/65.2-65.5

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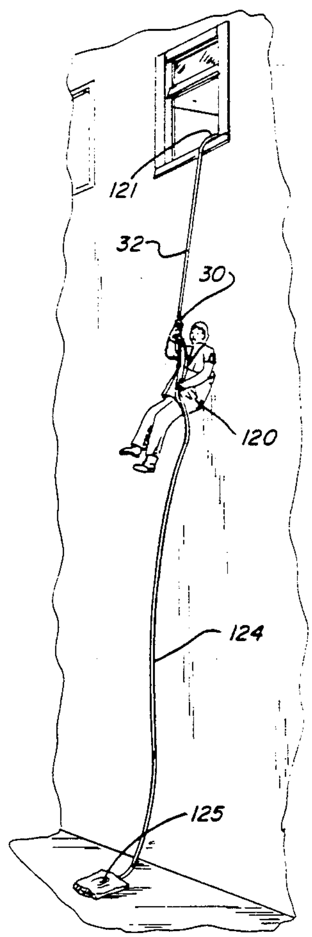
Primary Examiner—Reinaldo P. Machado

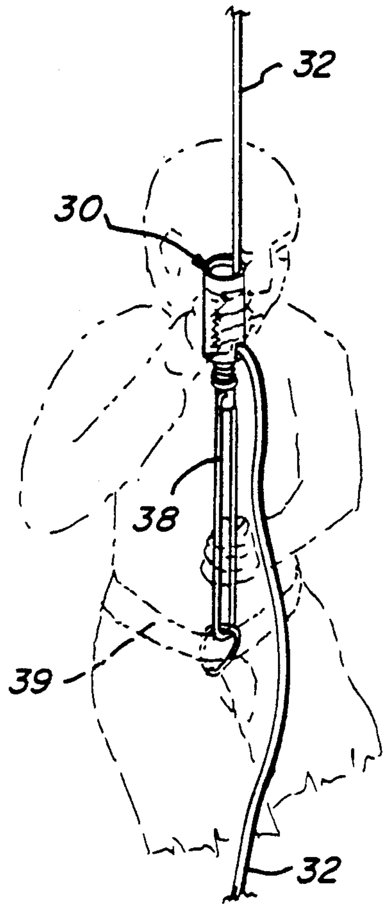
Attorney, Agent, or Firm—Ralph F. Crandell

[57] **ABSTRACT**

A descent controller (**30**) for lowering a load along a rope (**32**). Controller is a friction cylinder or capstan (**31**) of a length adapted to receive a plurality of turns of rope (**32**) between top and bottom end plates (**34, 35**) adjacent the upper and lower ends of said cylinder which overhang the cylinder (**31**) and define radial slots (**40, 41**) sized to loosely receive the rope. An upwardly narrowing tapered slot (**44**) defined diametrically through the capstan (**31**) receives and releasably grips the rope. An annular clamp ring (**48**) is slidably mounted on the cylinder (**31**) and defines a radial aperture (**49**) which loosely receives the rope as it exits from the tapered slot (**44**). A spring (**41**) biases the ring (**48**) upwardly along the said friction cylinder (**31**) for releasably wedging the rope (**32**) in the tapered slot. A gripping cylinder (**55**) is secured to the ring for sliding the ring (**48**) along the friction cylinder (**31**) to release the rope (**32**) from the narrow end (**46**) of the tapered slot (**44**), and defines a housing enclosing the capstan and rope turns.

54 Claims, 14 Drawing Sheets





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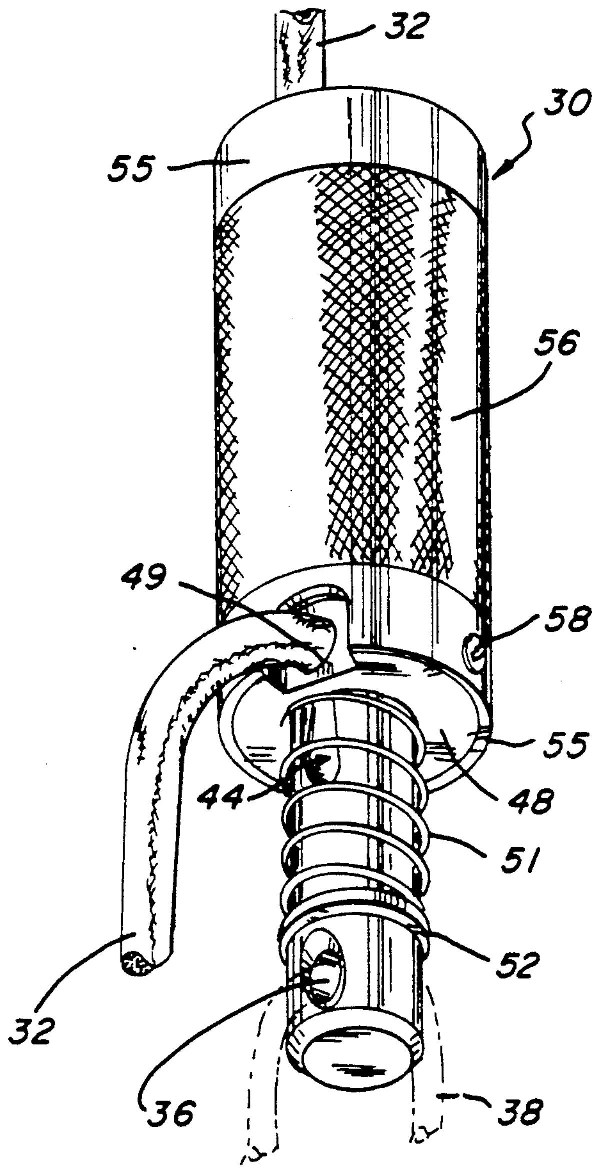

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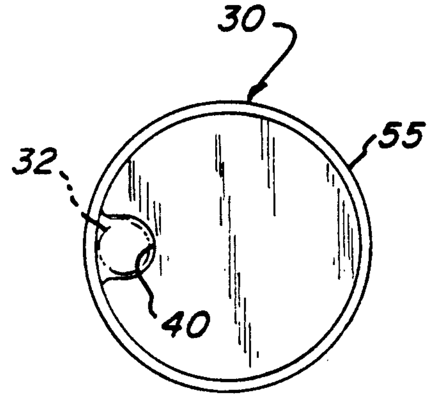

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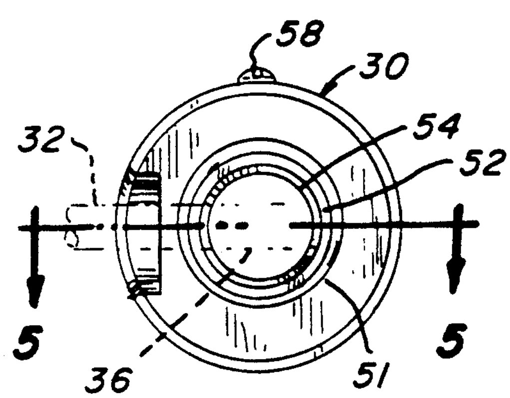

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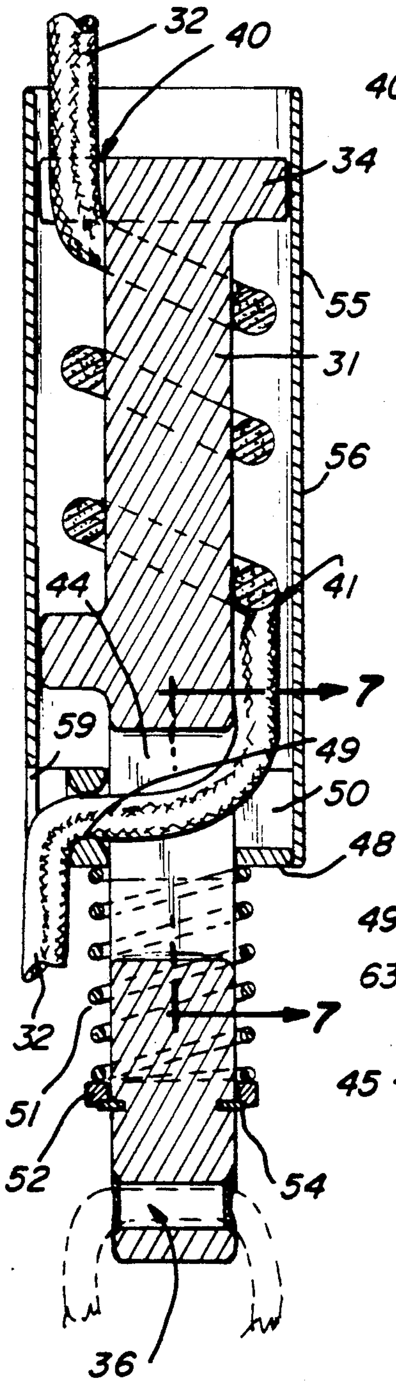

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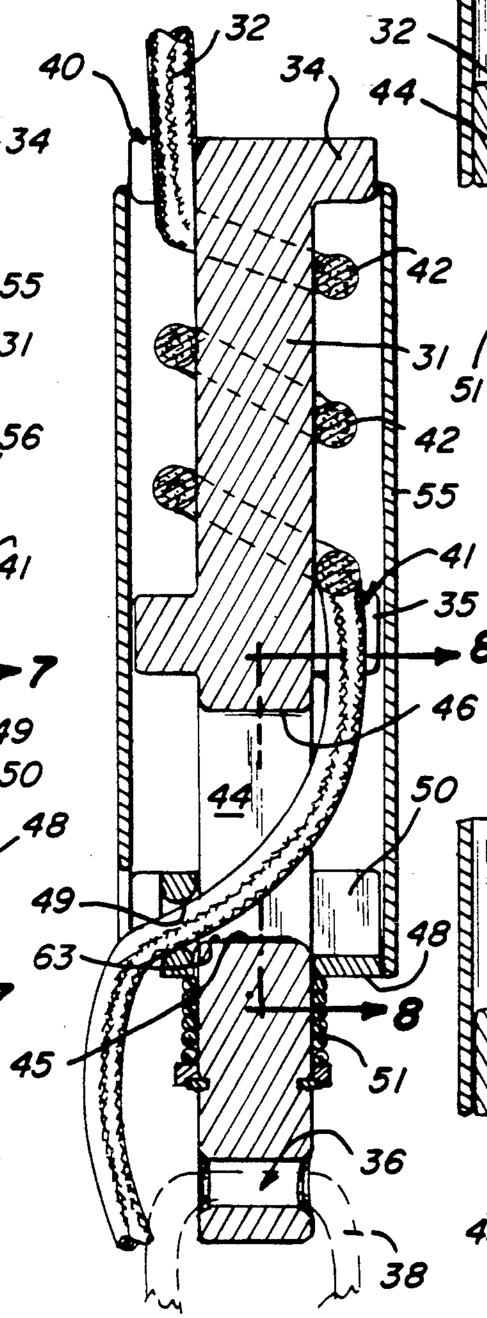

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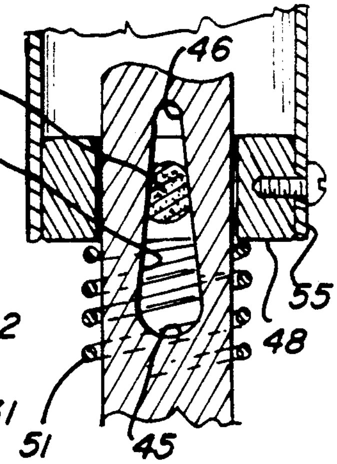

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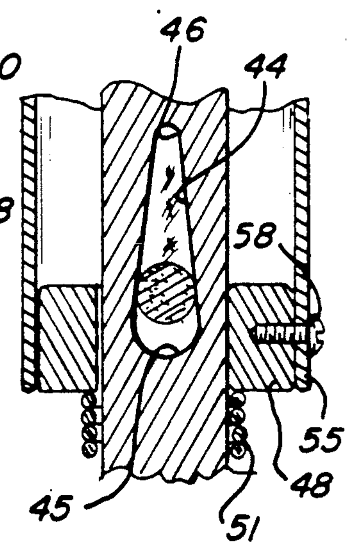

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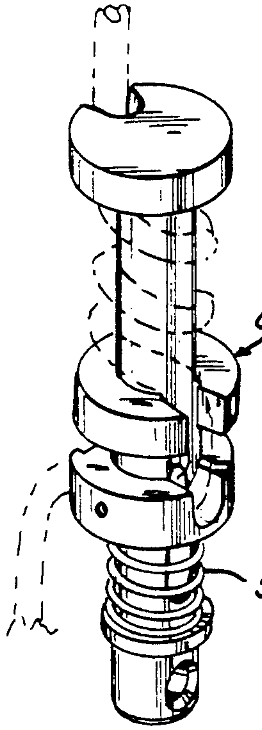

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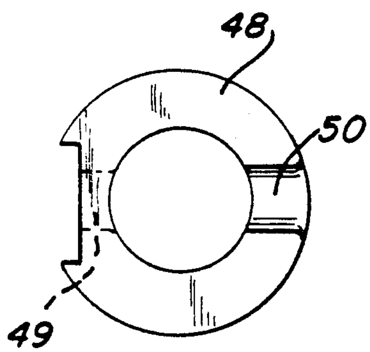

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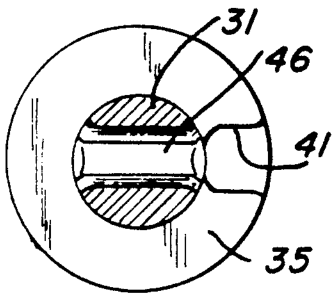

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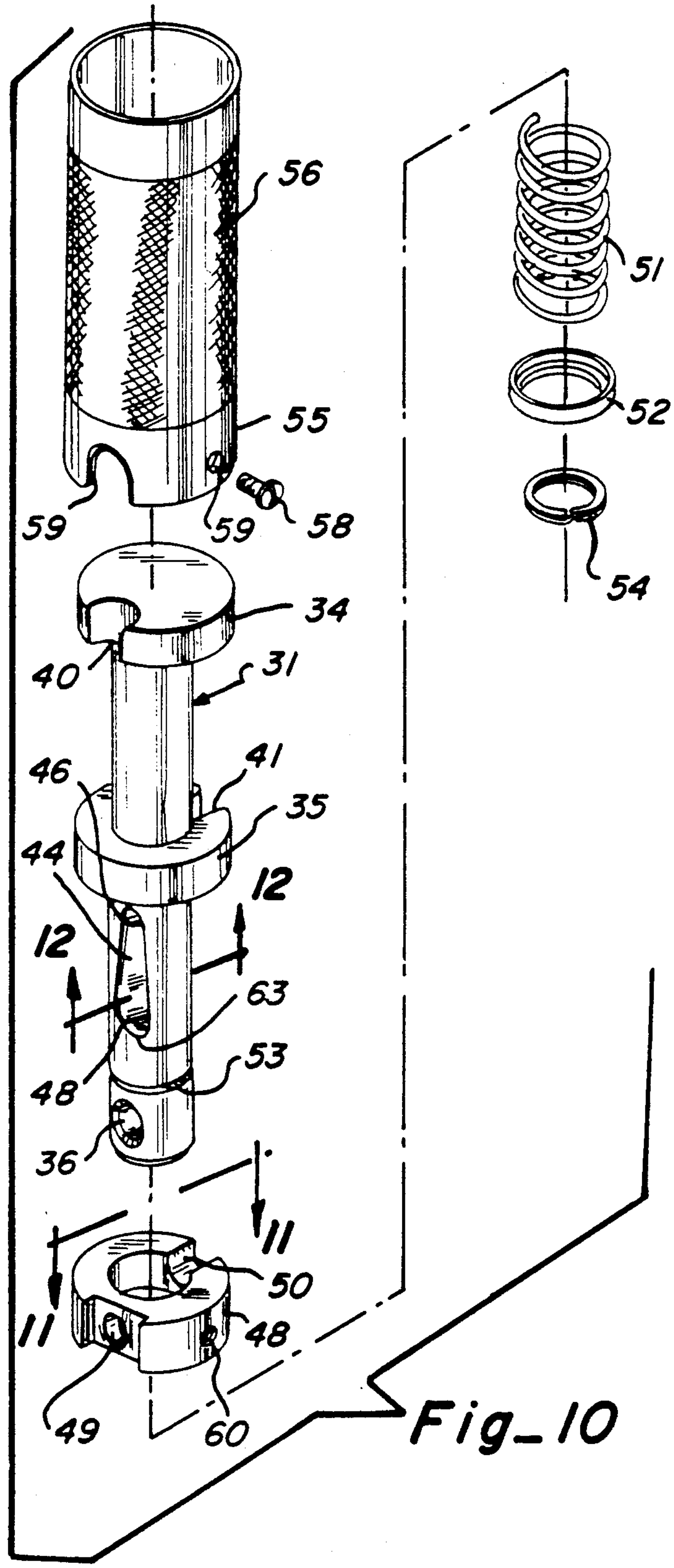

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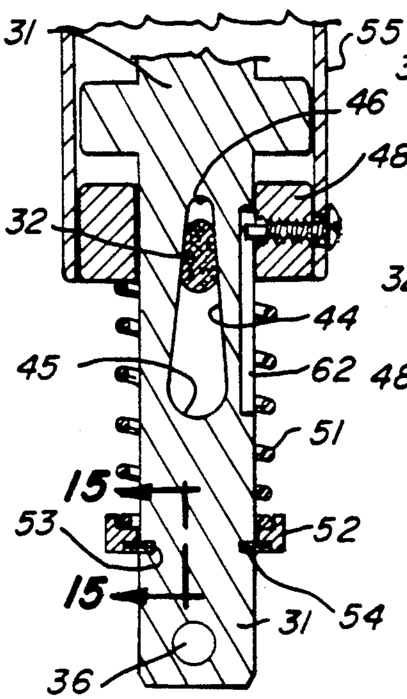

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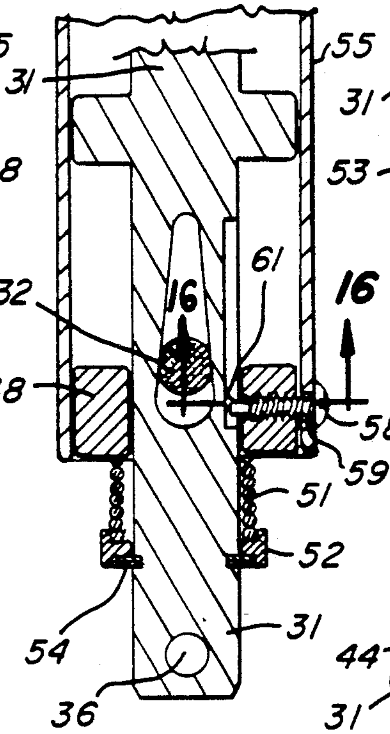

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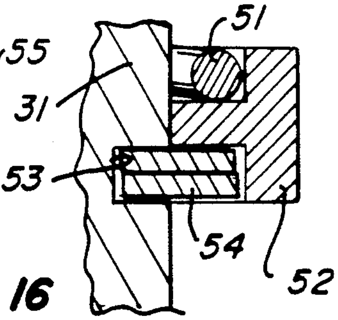

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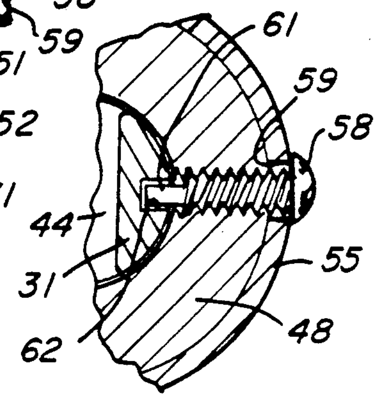

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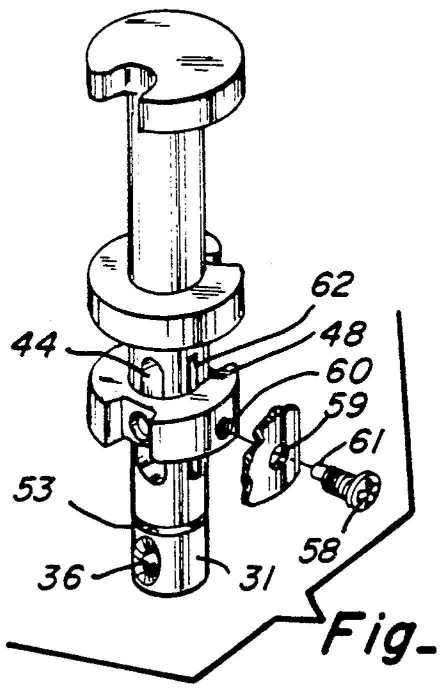

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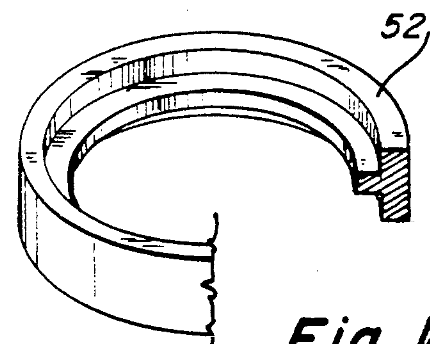

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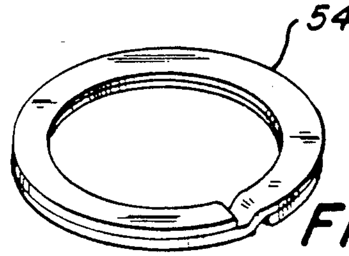

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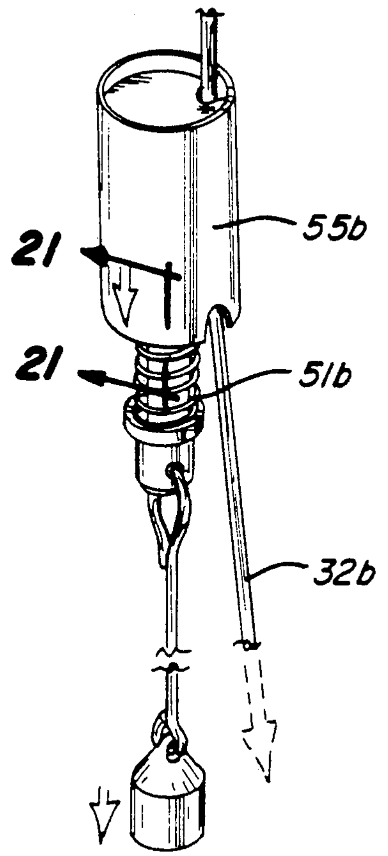

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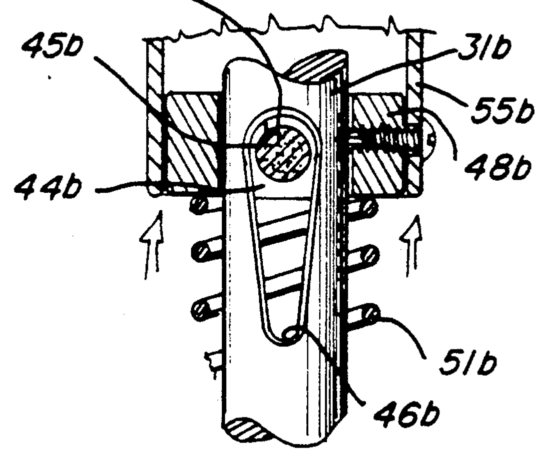

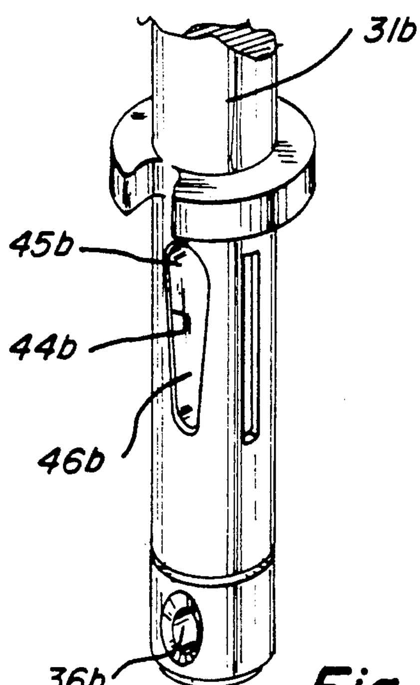

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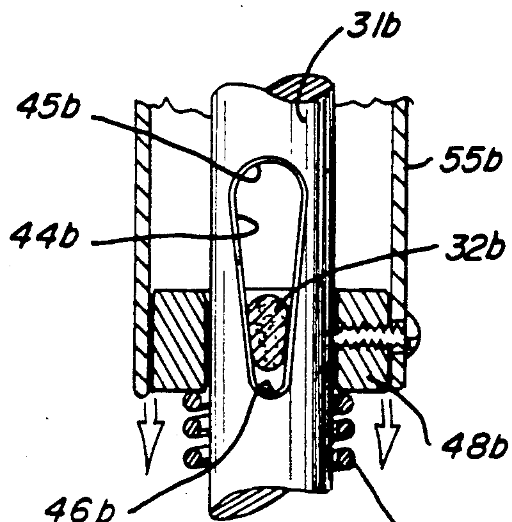

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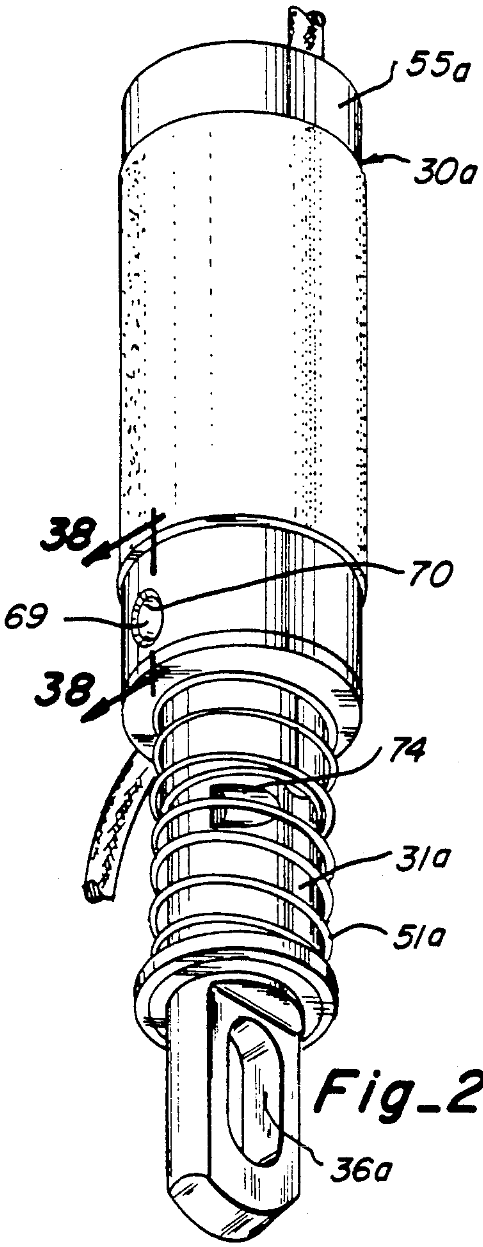

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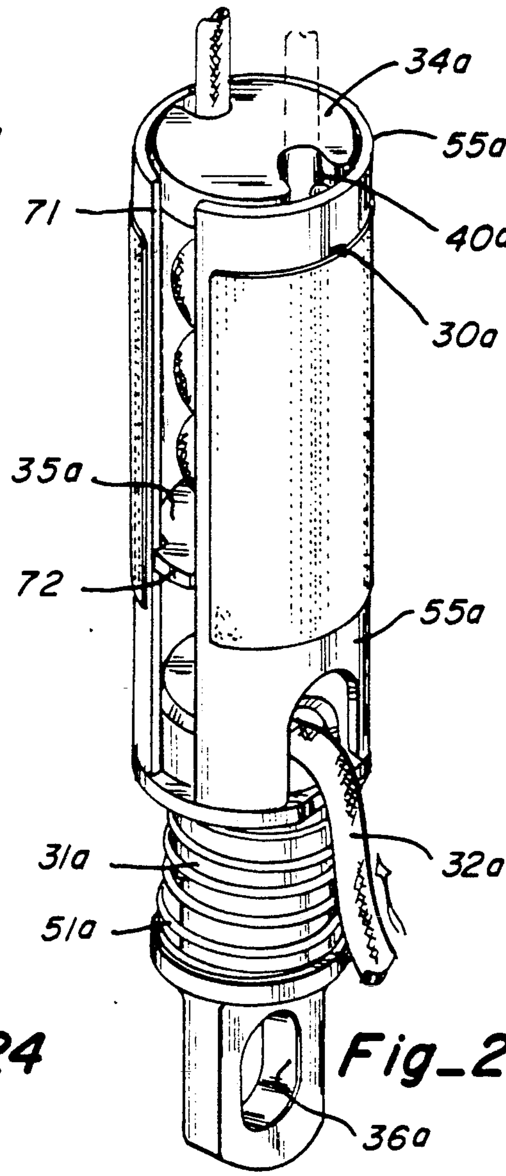

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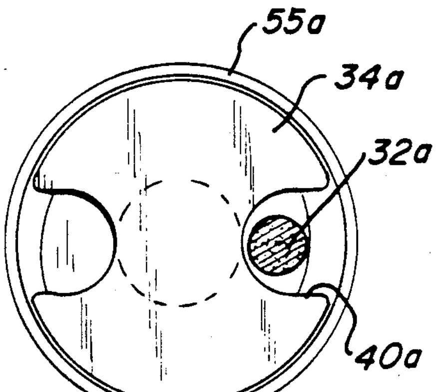

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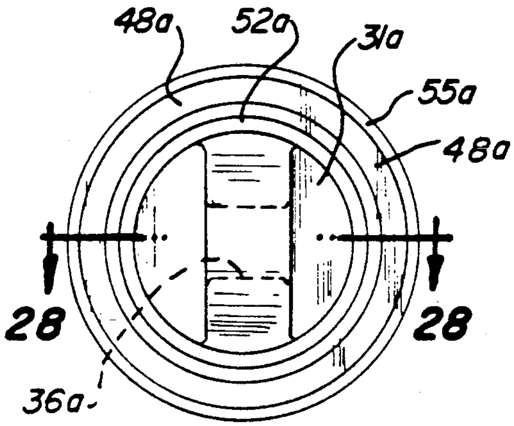

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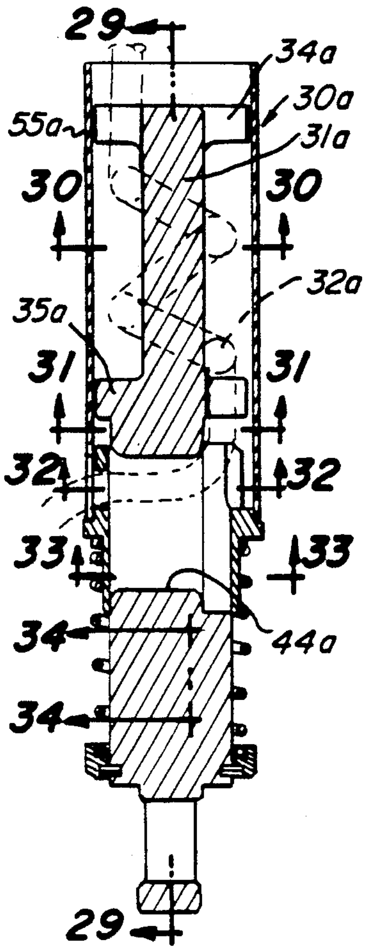

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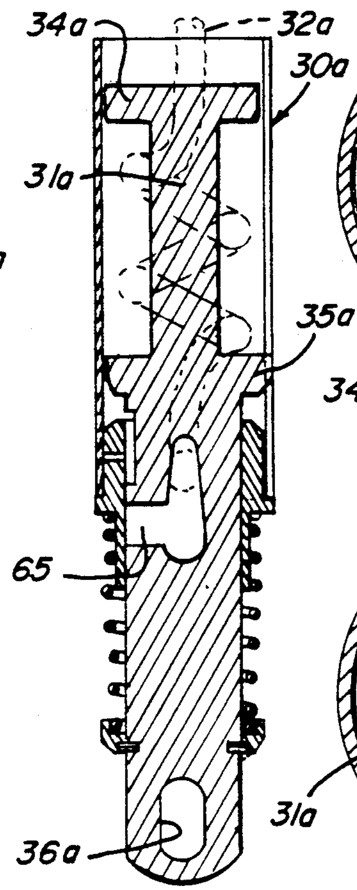

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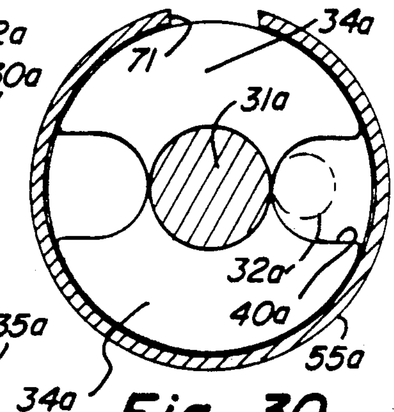

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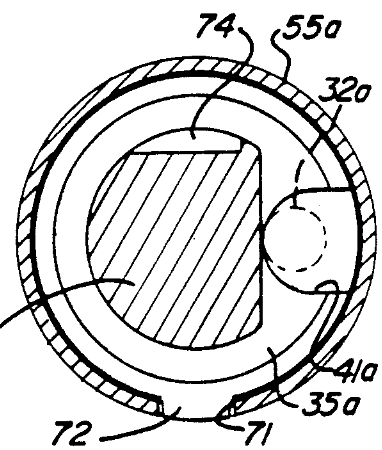

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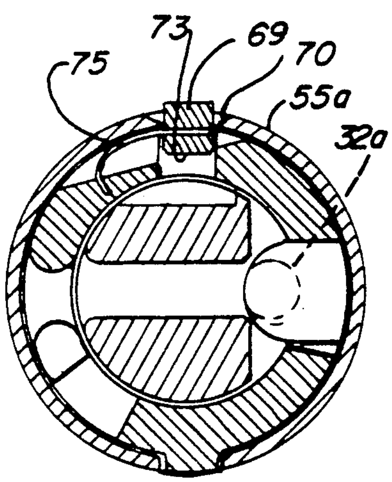

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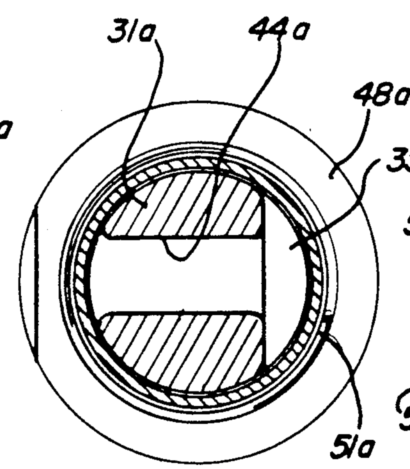

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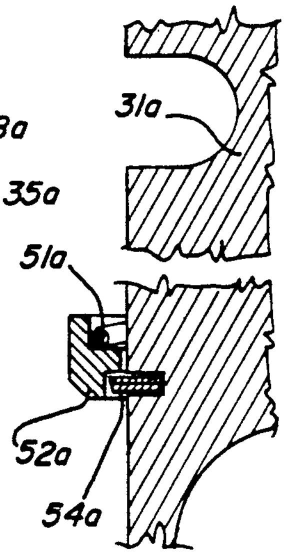

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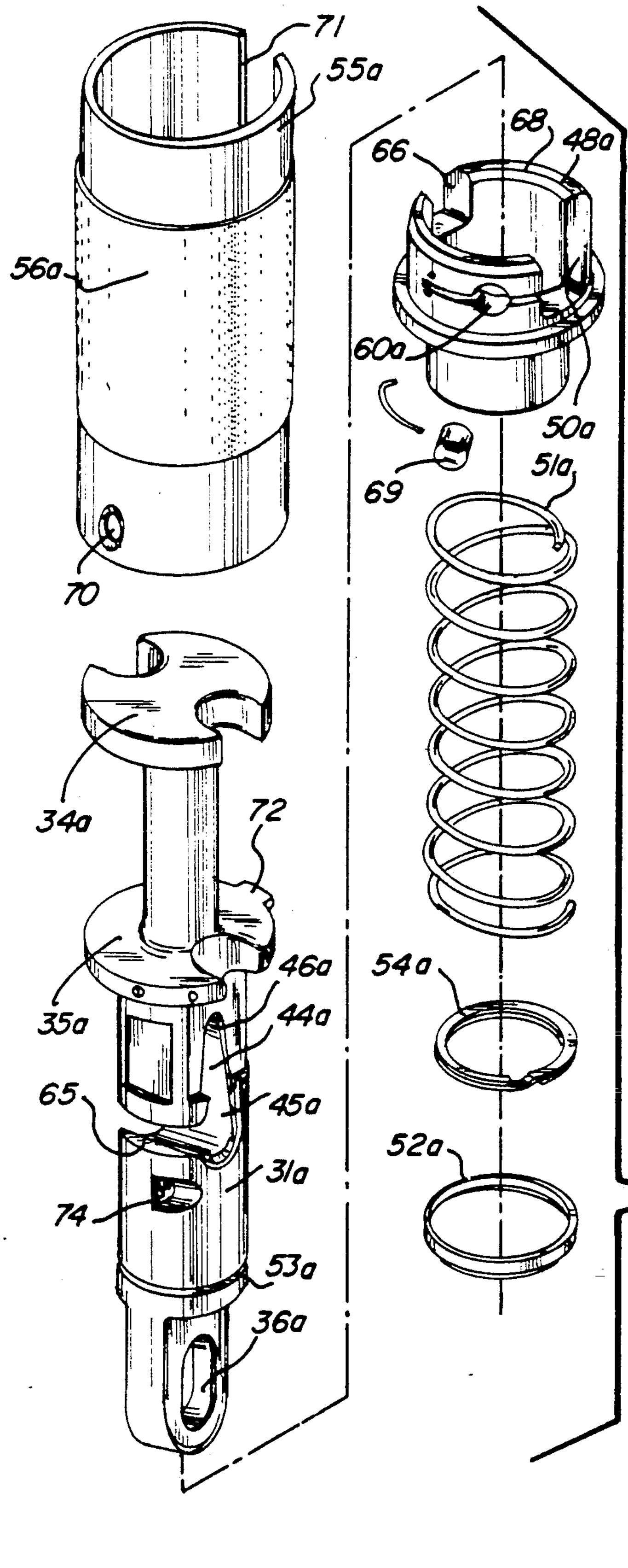

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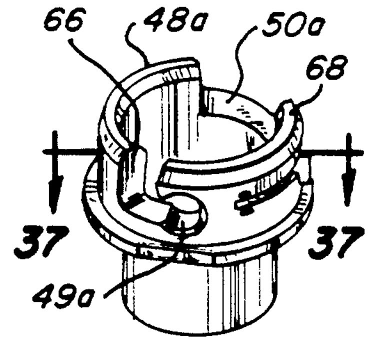

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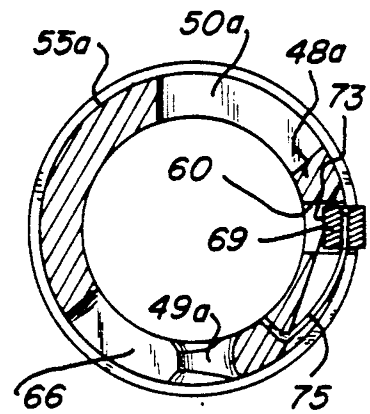

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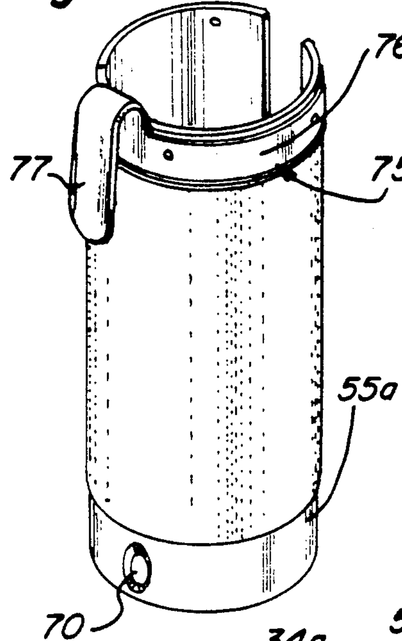

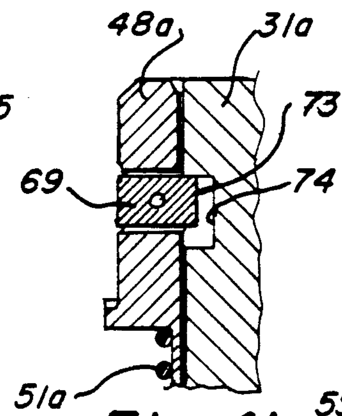

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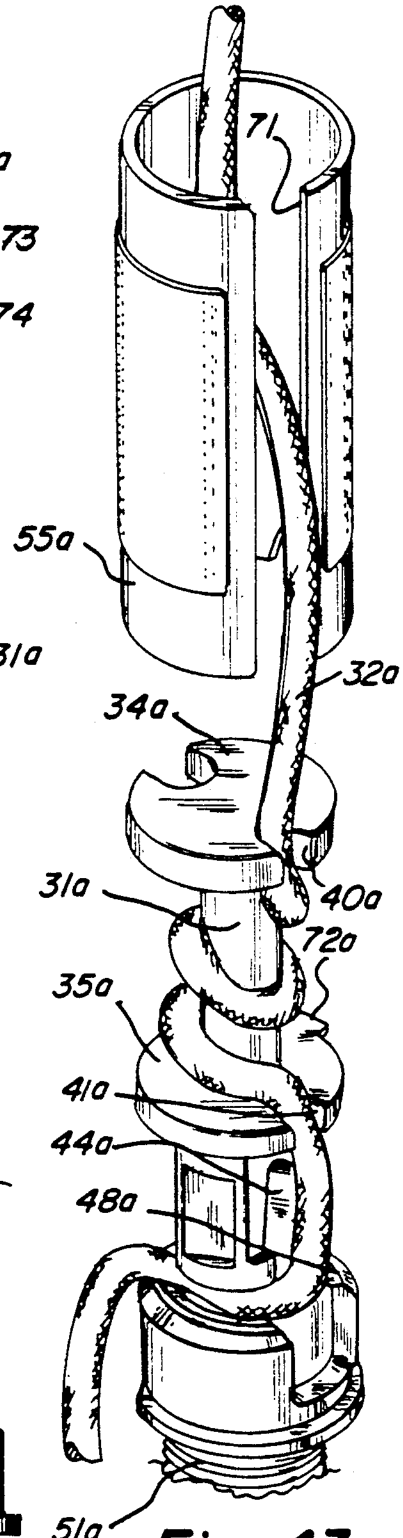

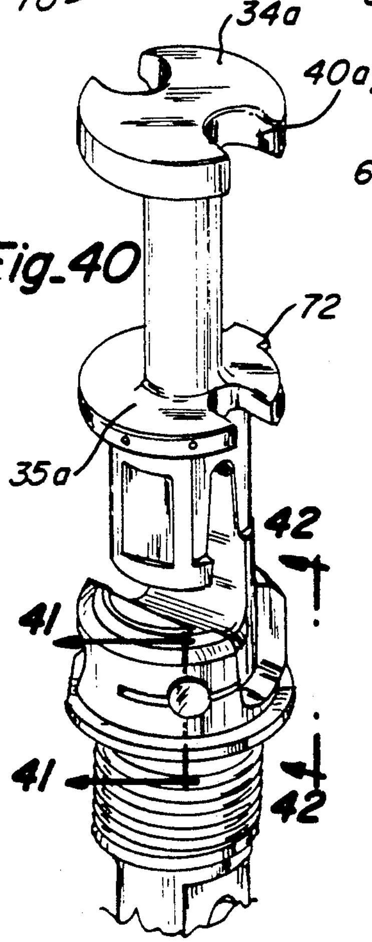

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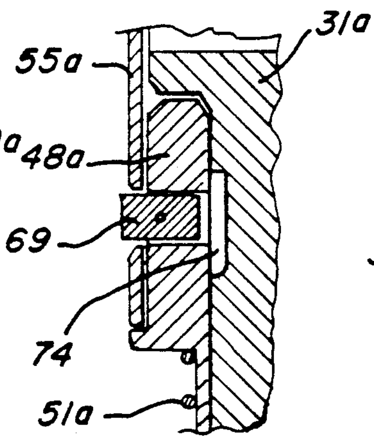

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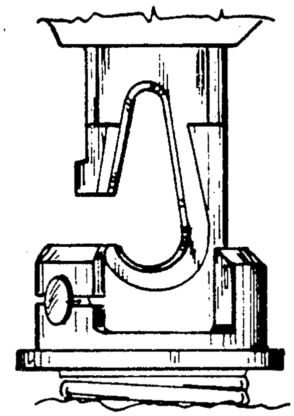

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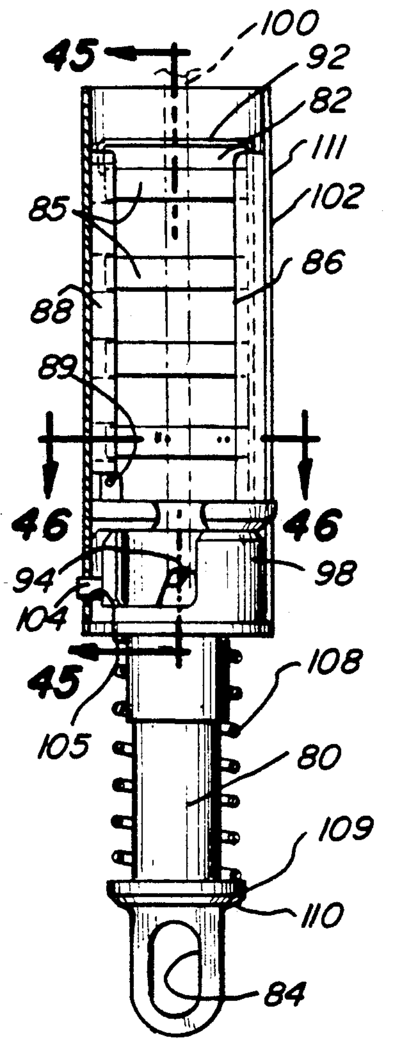

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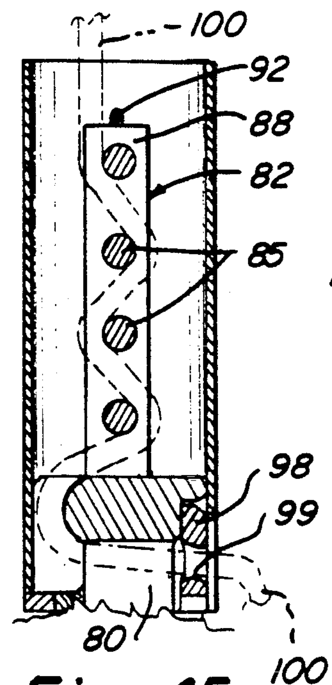

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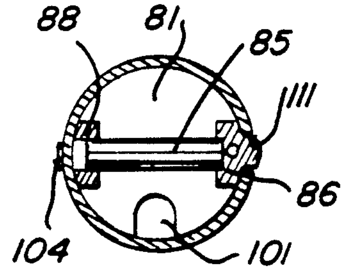

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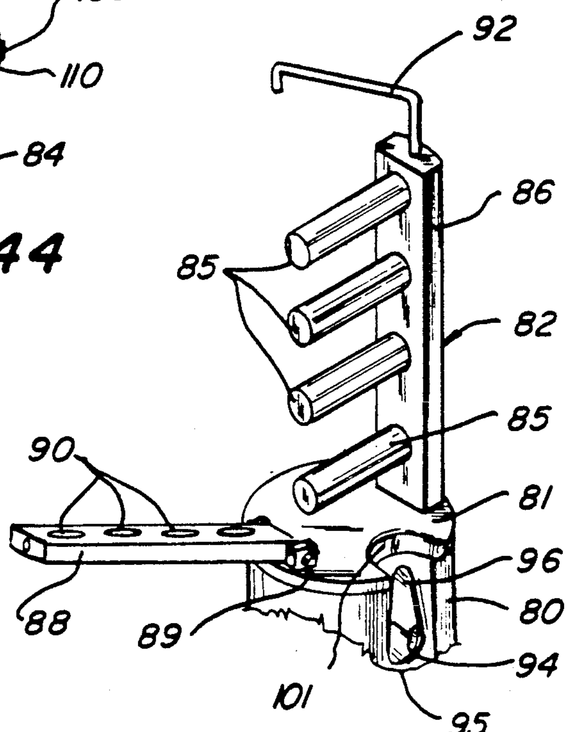

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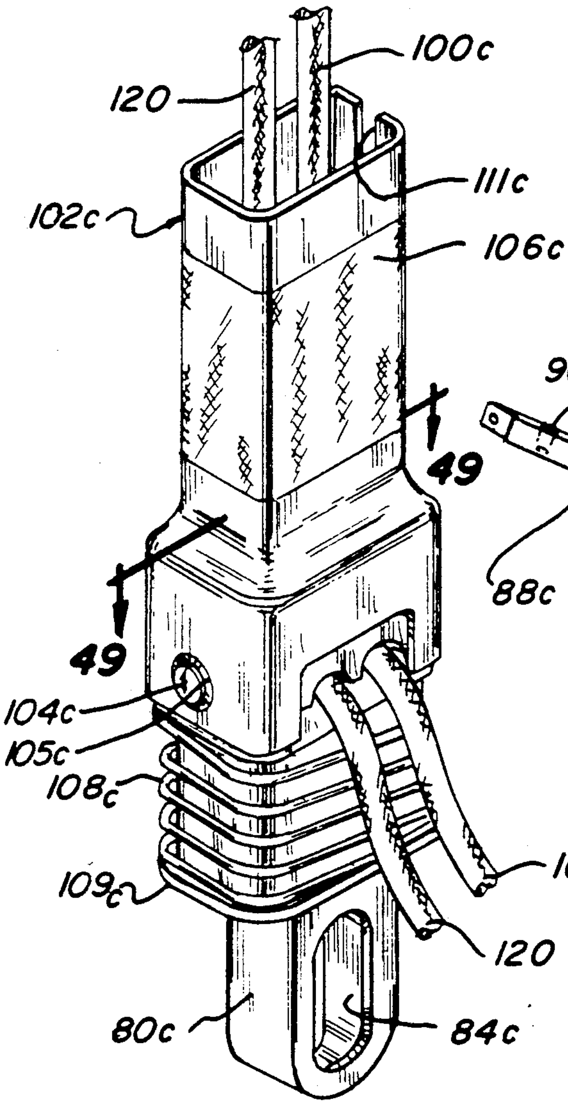

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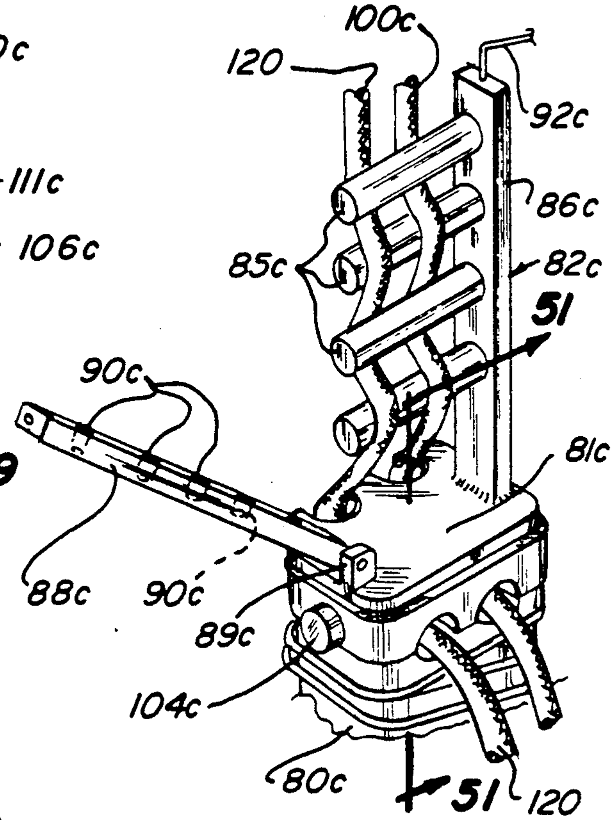

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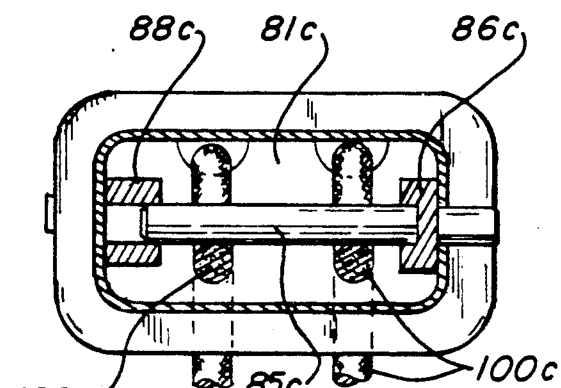

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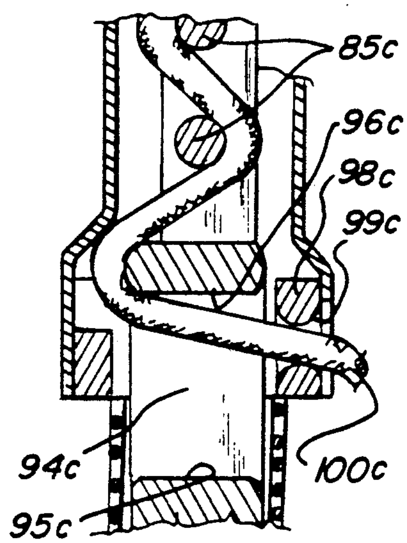

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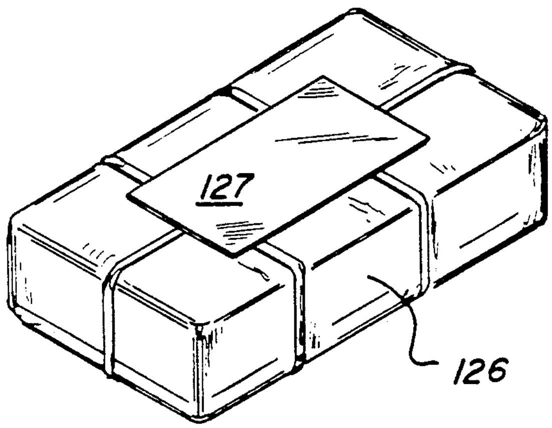

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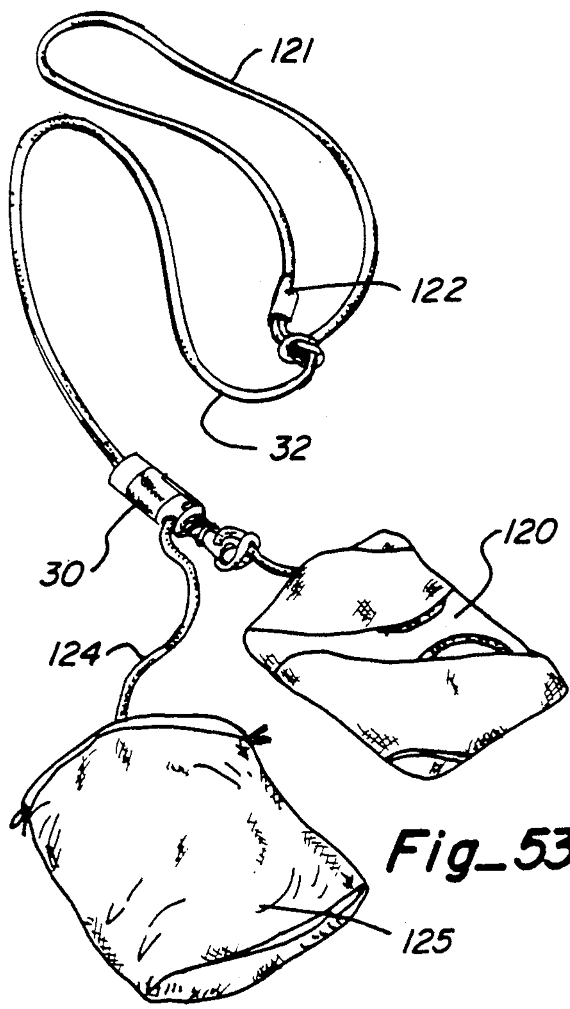

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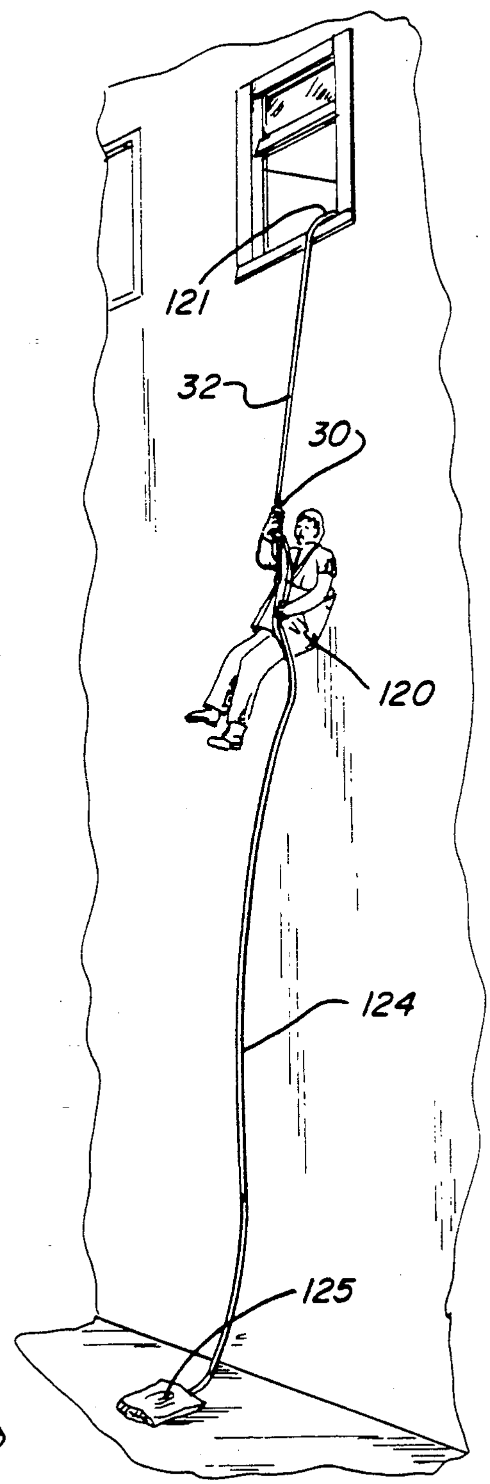

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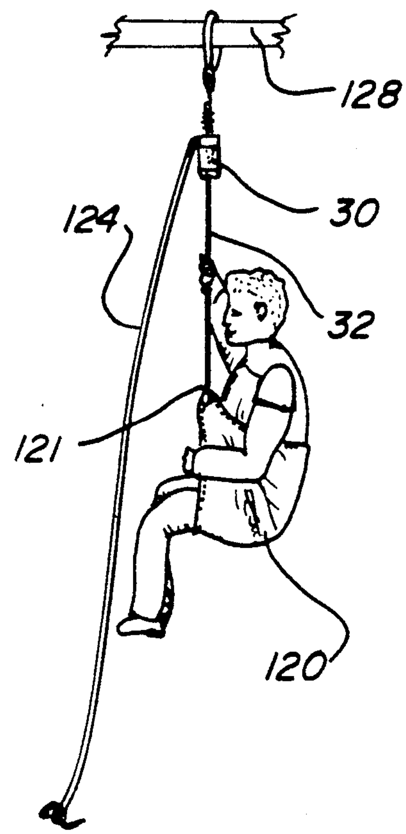

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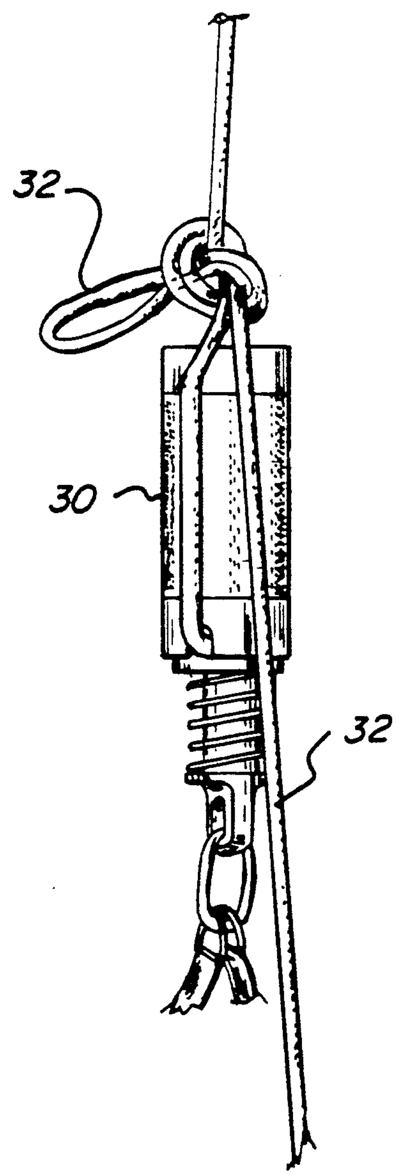

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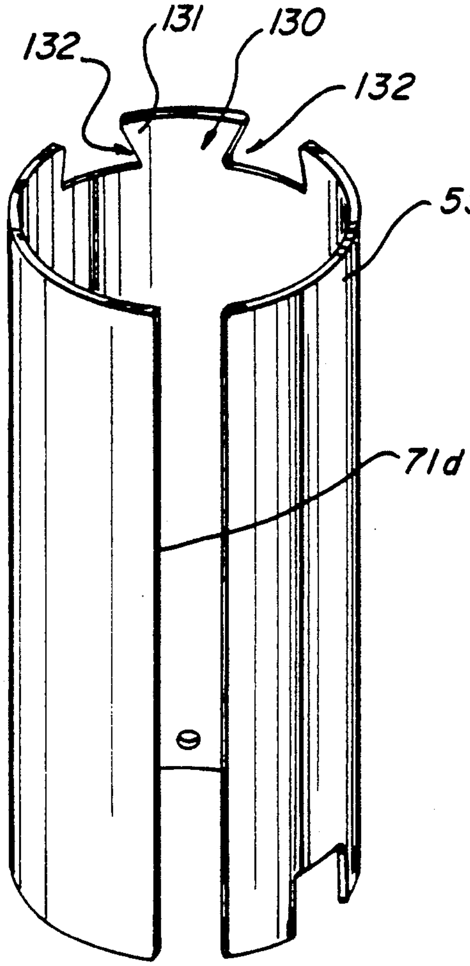

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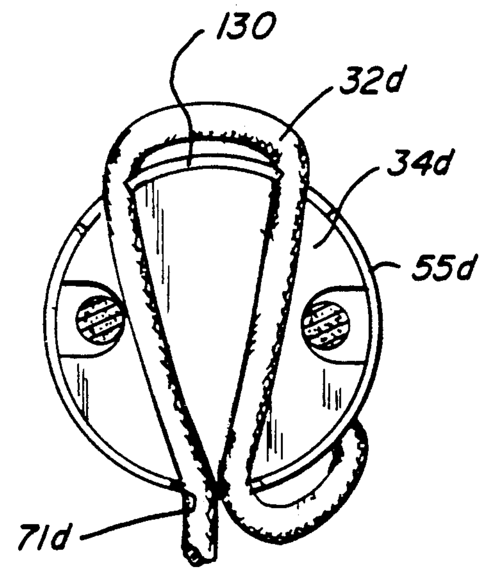

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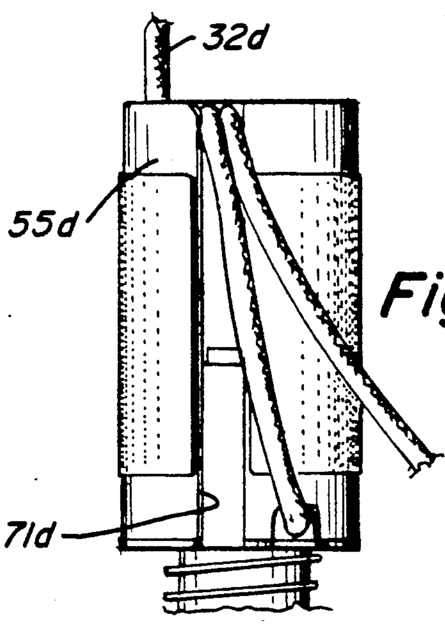

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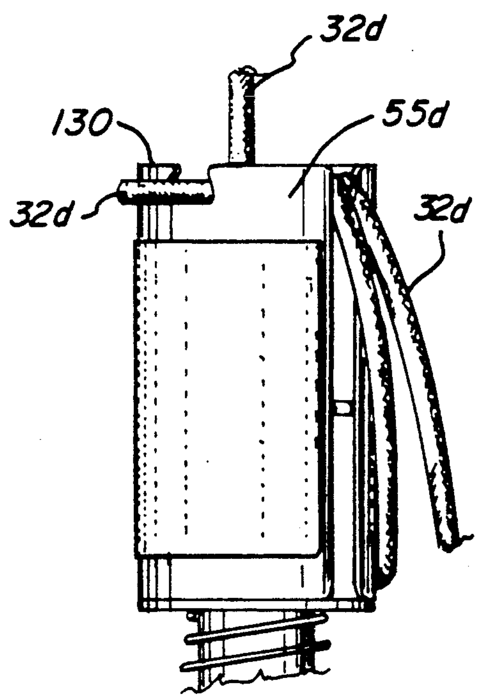

Fig_58

DESCENT CONTROLLER

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of copending application Ser. No. 07/554,687, filed July 18, 1990 for DESCENT CONTROLLER, now U.S. Pat. No. 5,038,888, issued Aug. 13, 1991.

BACKGROUND OF THE INVENTION

1. Field Of The Invention

The present invention relates to a descent controller for use on a rope or cable for lowering a person or load in a controlled descent from a higher elevation to a lower elevation, and more particularly to a rope or cable mounted descent control device having a control member including both a deadman brake and a panic brake.

2. Description Of The Prior Art

Descent control devices have been developed, all with the objective of lowering a load from a higher to a lower elevation. These devices have taken many forms and have utilized a variety of elements capable of providing a mechanical advantage together with a braking mechanism. Safety features, such as deadman and panic control features, are equally important, particularly when the device is used for descent, escape, or rescue purposes.

In more recent years, concerns with occupational safety have led to the development of mechanisms which enable a worker to lower himself from an elevated position such as a scaffold, crane, lift truck or platform in the event of an emergency. The equipment is, in many respects, similar to known fire escape devices, mountain climbing equipment, and military equipment.

A descent control device with a deadman brake, in the form of a vertical cylindrical drum or capstan about which a rope is wound and a tapered slot through the drum for receiving and releasably gripping the rope along which descent is made, together with a releasable locking end plate, is shown in U.S. Pat. No. 4,883,146, issued Nov. 28, 1989, to H. M. Varner and E. L. Stech for "DESCENT CONTROL DEVICE WITH DEADMAN BRAKE." The device shown in the patent to Varner et al. includes end plates on each end of a vertical cylindrical drum or capstan with apertures on each end plate through which a rope is threaded. The rope is wound in two or more turns around the drum. The lower plate is provided with an arcuate tapered slot opening into the rope receiving aperture for engaging and binding the rope in order to provide a brake. The rope is mechanically forced into the aperture by a locking end plate rotatably mounted on the capstan below the lower end plate. The locking plate includes an aperture for loosely receiving the rope. A spring rotatably biases the locking plate to releasably and forcibly urge the rope into the narrowed tapered slot in the lower end plate for locking the rope against movement on the capstan. By rotating the locking plate against the force of the spring the rope can be progressively released from the tapered slot.

Tapered slots are ancient and well known in the art of releasably fastening ropes, lines and cables, such as in the nautical field where tapered slots are widely used for engaging and retaining ropes, lines, hawsers and cables. The use of cylindrical capstans for holding and providing a mechanical advantage for tightening ropes is also old and well known. Likewise, a variety of fire escape devices utilizing a rope wound around a cylinder, are old and well known. See, for example, U.S. Pat. No 4,550,801, issued Nov. 5, 1985, to W. E. Forrest for "PERSONAL HIGH RISE EVACUATION APPARATUS"; U.S. Pat. No. 4,311,218, issued Jan. 9, 1982, to L. Steffen for "BRAKING-DEVICE FOR USE WITH CLIMBING LINES"; U.S. Pat. No. 771,251, issued Oct. 4, 1904, to O. Howe for "FIRE ESCAPE"; U.S. Pat. No. 386,237, issued July 17, 1888, to T. Budd for "FIRE ESCAPE"; U.S. Pat. No. 1,115,603, issued Nov. 3, 1914, to J. Smith for "FIRE ESCAPE"; U.S. Pat. No. 536,866, issued Apr. 2, 1895, to C. FitzGerald for "FIRE ESCAPE"; and U.S. Pat. No. 946,588, issued Jan. 18, 1910, to C. Thuemer for "FIRE ESCAPE."

OBJECTS AND SUMMARY OF THE INVENTION

It is the principal object of the present invention to provide an improved load lowering descent controller of the type embodying a cylindrical body or capstan about which a rope or cable is turned. A related object is to provide a device of the foregoing character which is a fail-safe type descent device. A further related object is to provide such a device capable of retarding descent of the device in the event of a panic actuation of the controller.

Another object of the present invention is to provide a descent controller of the foregoing character which may be actuated for lowering a load such as an unconscious user or equipment.

A further object of the present invention is to provide a descent controller of the foregoing character which incorporates energy absorbing characteristics to provide for shock loading when in the locked position and to provide for a controlled descent after absorption of the shock.

Still another object of the present invention is to provide a descent controller of the foregoing characteristics which may be attached to or removed from a rope at any point along its length.

A further object of the present invention is to provide a descent controller having the foregoing characteristics which enables the user to adjust the mechanical advantage of the device independently of the position of the device on the rope.

In accordance with the foregoing objects, the present invention is embodied in an improved descent controller for lowering a load along a rope from an elevated position to a relatively lower position. The controller comprises a friction cylinder or capstan of a length adapted to receive a plurality of turns of the rope wrapped therearound. The cylinder or capstan has an upper end and a lower end, with top and bottom end plates attached respectively adjacent the upper end and spaced from the lower end of said cylinder. The end plates both have a portion thereof overhanging the cylinder and defining radial slots sized to loosely receive the rope. A portion of the friction cylinder extends below said lower end plate and defines diametrically therethrough an upwardly narrowing tapered slot adapted to receive the rope. The tapered slot defines an enlarged end adapted to freely admit the rope and tapering from said enlarged entry to a relatively constricted end of a width sufficient for gripping the rope. An annular control ring is slidably mounted on said cylinder below the bottom end plate and defines radially therethrough an aperture adapted to loosely receive said rope as it exits from said tapered slot. A spring biases said ring upwardly along said friction cylinder for wedging said rope in the narrow end of said tapered slot. An outer sleeve is secured to the ring for use in sliding said ring along the friction cylinder against the force of the biasing spring to release the rope from the narrow end of the tapered slot. The sleeve defines a housing enclosing the friction cylinder and the rope wrapped therearound. Means are provided on the lower end of the friction cylinder below the tapered slot for engagement with a load support. The descent controller supports a load on the rope and, upon sliding movement of the sleeve, provides for a controlled descent of the supported load along the rope.

The descent controller further includes a gripping sleeve secured to the control ring for use in sliding said control ring along said friction cylinder. The gripping sleeve defines a housing enclosing the friction cylinder and the rope wrapped therearound. It is releasably secured to the control ring, and may also include a longitudinally extending slot therein of a width for receiving said rope. In the latter event, the friction cylinder defines a radial slot opening into the tapered slot and sized to loosely receive said rope, so that the rope may be wound on or removed from the capstan. The control ring also defines an axially extending slot opening into the radial aperture and sized to loosely receive said rope, so that the rope can be released from or inserted into said aperture.

The invention further includes modifications and applications which enhances its utility. One modified form utilizes a rack or ladder capstan arrangement with a plurality of co-planar rollers or cross bars about which the rope is woven or entrained. The controller itself may be secured at an elevated position and actuated at that point to lower a rope-supported load. A second or reserve rope may be used.

The invention also contemplates an emergency descent kit or package which may be held in reserve and used when needed. Such a kit, stored in a bag or package, includes, in addition to the descent controller, a descent rope and harness. The rope includes a loop or hook fastening device at one end adapted to be secured to a fixed object at the elevated position. After fixing the rope to a support, the user drops the case and rope supply to the ground. The user then sits in the harness and using the descent controller, lowers himself to safety.

DESCRIPTION OF THE DRAWINGS

FIG. **1** a perspective view illustrating how a descent controller embodiment the present invention is utilized by a user supported in a harness suspended from the controller for descent along a supporting rope.

FIG. **2** is an enlarged perspective view of the descent controller embodying the present invention mounted on a supporting rope.

FIG. **3** is a top plan view of the descent controller shown in FIG. **2**.

FIG. **4** is a bottom plan view of the descent controller shown in FIG. **2**.

FIG. **5** is a section view taken substantially in the plane of line **5—5** on FIG. **4**.

FIG. **6** is a section view similar to FIG. **5** but showing the descent controller released in rope descending configuration.

FIG. **7** is a section view taken substantially in the plane of line **7—7** on FIG. **5**.

FIG. **8** is a section view taken substantially in the plane of line **8—8** on FIG. **6**.

FIG. **9** is a perspective view of a capstan and rope clamping control ring as shown in FIGS. **2** and **5**, but with the cover removed.

FIG. **10** is an exploded perspective view, somewhat reduced in size, of the descent controller shown in FIG. **2**.

FIG. **11** is an enlarged top plan view of the clamping ring taken substantially in the plane of line **11—11** on FIG. **10**.

FIG. **12** is an enlarged section view taken substantially in the plane of line **12—12** on FIG. **10**.

FIG. **13** is a section view similar to FIG. **7** but showing a modified form of clamping ring and locking screw.

FIG. **14** is a section view similar to FIG. **8** but showing a modified form of clamping ring and locking screw.

FIG. **15** is an enlarged section view taken substantially in the plane of line **15—15** on FIG. **13**.

FIG. **16** is an enlarged section view taken substantially in the plane of line **16—16** on FIG. **14**.

FIG. **17** is a reduced perspective view of the descent controller with portions cut away or removed for clarity and illustrating the modified form of clamping ring and locking screw shown in FIG. **13**.

FIG. **18** is an enlarged perspective view with a portion cut away for clarity of the actuating spring mounting ring utilized on the modification of the descent controller shown in FIG. **13**.

FIG. **19** is an enlarged perspective view of a spiral lock ring.

FIG. **20** is a perspective view of a modified form of descent controller embodying the present invention in which the lowering of the load is controlled by pulling on the free end of the descent rope.

FIG. **21** is an enlarged section view taken substantially in the plane of line **21—21** on FIG. **20**.

FIG. **22** is a section view similar to FIG. **21** but showing the rope in a locked position

FIG. **23** is an enlarged perspective view of a capstan utilized in the modification of the descent controller shown in FIG. **20**.

FIG. **24** is a front perspective view of a modified form of descent controller embodying the present invention adapted for mounting on a rope at a point intermediate the ends thereof.

FIG. **25** is a rear perspective view of the modified form of descent controller shown in FIG. **24**. FIG. **26** is an enlarged top plan view of the descent controller shown in FIG. **24**.

FIG. **27** is an enlarged bottom plan view of the descent controller shown in FIG. **24**.

FIG. **28** is a reduced size section view substantially in the plane of line **28—28** on FIG. **27**.

FIG. **29** is a section view taken substantially in the plane line **29—29** on FIG. **28**.

FIG. **30** is an enlarged section view taken substantially in the plane of line **30—30** on FIG. **28**.

FIG. **31** is an enlarged section view taken substantially in the plane of line **31—31** on FIG. **28**.

FIG. **32** is an enlarged section view taken substantially in the plane of line **32—32** on FIG. **28**.

FIG. 33 is an enlarged section view taken substantially in the plane of line 33—33 on FIG. 28.

FIG. 34 is an enlarged section view taken substantially in the plane of line 34—34 on FIG. 28.

FIG. 35 is an exploded perspective view of the descent controller shown in FIG. 24.

FIG. 36 is a perspective view of the clamping ring and detent of the descent controller shown in FIGS. 24 and 35.

FIG. 37 is an enlarged section view taken substantially in the plane of line 37—37 on FIG. 36.

FIG. 38 is an enlarged section view taken substantially in the plane of line 38—38 on FIG. 24.

FIG. 39 is a perspective view of the outer gripping sleeve of the descent controller shown in FIG. 24 but with a belt hook added thereto.

FIG. 40 is a perspective view of the internal capstan, clamping ring, and spring forming a part of the descent controller shown in FIG. 24.

FIG. 41 is a partial section view taken substantially in the plane of line 41—41 on FIG. 40.

FIG. 42 is a section view taken substantially in the plane of line 42—42 on FIG. 40.

FIG. 43 is an exploded view of a portion of the descent controller shown in FIG. 24 illustrating the controller in association with a portion of rope.

FIG. 44 is an elevation view partly in section of modified form of descent controller utilizing a ladder-type capstan arrangement.

FIG. 45 is a section view taken substantially in the plane of line 45—45 on FIG. 44.

FIG. 46 is a section view taken substantially in the plane of line 46—46 on FIG. 44.

FIG. 47 is a partial perspective view of the descent controller shown in FIG. 44 but with the outer cylindrical cover removed and showing the ladder capstans opened for rope engagement.

FIG. 48 is a perspective view of a modified form of descent controller including ladder-type capstans and double ropes.

FIG. 49 is an enlarged section view taken substantially in the plane of line 49—49 on FIG. 48.

FIG. 50 is a partial perspective view of the descent controller shown in FIG. 48 but with the outer cover removed and the ladder capstans released for rope engagement.

FIG. 51 is an enlarged section view taken substantially in the plane of line 51—51 on FIG. 50.

FIG. 52 is a perspective view of an emergency descent kit utilizing a descent controller embodying the present invention.

FIG. 53 is a perspective view of a portion of the kit shown in FIG. 52 with portions of the kit open for use and illustrating the rope and descent controller arrangement.

FIG. 54 is a perspective view of a descent assembly embodying the present invention in use for descending from an elevated position to ground level.

FIG. 55 is a schematic view illustrating use of the descent controller embodying the present invention for lowering a load separate from the person controlling the device.

FIG. 56 is a perspective view of a modified outer gripping sleeve for the descent controller shown in FIG. 24 having a rope tie-off cleat added thereto.

FIG. 57 is a front elevation view of a descent controller of the type shown in FIG. 24 using a gripping sleeve as shown in FIG. 56.

FIG. 58 is a side elevation view of a descent controller of the type shown in FIG. 24 using a gripping sleeve as shown in FIG. 56.

FIG. 59 is a top plan view of the descent controller shown in FIG. 57.

FIG. 60 illustrates an alternative system for tying the descent rope to prevent inadvertent descent of the controller.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The descent controller 30 embodying the present invention is shown in its basic form in FIGS. 1-19, and comprises by a vertically oriented capstan 31 such as a cylinder shaft or drum about which a length of rope or line 32 is wound. The number of turns of rope is the principal determinate of the capstan ratio or force reduction. The rope 32 is secured at one end at an elevated point (not shown) above the ground, and hangs downwardly to the ground or a lower platform (not shown). The descent controller 30 is mounted on the rope to enable the user or a load to descend slowly and controllably along the rope from the elevated point to the lower point, whether the ground or a platform. The descent controller is characterized as a capstan type, in which the rope is wound in a number of turns around a capstan 31, thereby providing a mechanical advantage enabling the user or load to descend slowly along the rope as the rope hangs from the elevated point. The controller 30 includes means for selecting gripping the rope and preventing descent or releasing the rope to provide for the controlled descent. In one extreme position or deadman position, the controller grips the rope tightly and prevents descent. In the opposite or panic position, the controller temporarily engages and grips the rope to prevent or substantially retard the descent. For example, in the case of a user who believes the descent is too fast and panics by grabbing onto the controller and jamming it downwardly, descent will stop or slow as a result of friction engagement between the controller and the rope. In the normal descent position once the rope is released the rate of descent is determined by the number of turns of rope wrapped around the capstan or friction cylinder as the controller slides down the rope.

A modified and highly useful form of the present invention is shown in FIGS. 24-43. This construction allows the descent controller to be mounted on or removed from the rope at any point between its ends, and similarly allows for adjustment in the number of turns of the rope about the capstan, thereby providing for adjustment of the performance. It must be understood, however, the once the descent has started the number of turns of the rope about the capstan can not be adjusted. It is therefore desirable to adjust the controller before depending upon it to descend from a higher to a lower elevation.

Other modified forms of the invention are shown in the drawings. One modification useful for controlling the descent of a load by pulling or releasing the free end of the rope is shown in FIGS. 20-22. Pulling down on the controller sleeve also retards descent.

A ladder form of capstan is shown in FIGS. 44-51. A safety kit or system is shown in FIGS. 52-54. A rescue use of the descent controller is shown in FIG. 55. A releasable rope securing mechanism is shown in FIGS. 57-59. A rope tie-off method is shown in FIG. 60.

The controller finds substantial but not necessarily exclusive utility as a device for enabling descent from scaffolding, lifts, forklifts, trucks, stock pickers, snorkels, cranes, window washing platforms and the like.

In the basic descent controller as shown in FIGS. **1-19**, the capstan or friction cylinder **31** includes an upper flange **34** adjacent its upper end and a lower flange **35** nearer but spaced from the lower end of the capstan cylinder **31**. Juxtaposed with the lower end of the capstan cylinder **31** is a diametric aperture or bore **36** defined therein for receiving a supporting rope, hook, loop or the like **38** for engaging and supporting a load suspension structure or harness **39**. Each of the top and bottom or upper and lower flanges **34, 35** includes a rope receiving guide notch **40, 41** respectively, defined therein for receiving an inserted portion of the rope **32**. The rope **32** is wound in a number coils or turns **42** about the capstan or friction cylinder **31** between the upper and lower flanges **34, 35**.

For controllably gripping the rope, the lower end of the capstan or cylinder **31**, being the portion extending below the lower flange **35**, is provided with a diametrically extending upwardly tapered slot **44**, of generally teardrop shape. The slot **44** tapers from a lower enlarged end **45** which loosely receives the rope **32** to an upper narrow or gripping end **46** which frictionally grips the rope **32**. A rope **32** passing through the lower open end **45** of the slot **44** moves freely through the slot. However, the rope is tightly gripped and restrained by the upper or narrower end **46** of the slot **44**.

For positively positioning the rope **32** in either the lower enlarged end **45** or upper constricted end **46** of the slot **44**, there is provided an annular sleeve or control ring **48** slidably mounted on the lower or depending end of the friction cylinder or capstan **31** as shown in FIGS. **5** and **6**. The control ring **48** includes a radial aperture **49** defined therein for loosely receiving the rope **32**. The edges of the aperture **49** may be chamfered or rounded to reduce cutting of or damage to the rope. The sliding control ring also includes a recess **50** for receiving the rope allowing the rope to pass freely through the enlarged lower end of the tapered slot **44** with reduced interference from the positioning ring **48** when the ring is in its lower position, as well as for receiving the rope to allow the ring to force or jam the rope into the narrow tapered slot **44** when the ring **48** is in its upper position. The ring is biased towards its upper rope gripping position by a coil spring **51** or other appropriate biasing device. The spring **51** is supported on a T-shaped cross-section shoulder ring **52** secured by a spiral retaining ring **54** engaging in a groove **53** in the lower end of the friction cylinder **31** adjacent the load supporting aperture **36**.

The control ring **48** is adapted to be moved up and down over the capstan cylinder **31**. To this end, a tubular sleeve or housing **55** is secured thereto and extends in surrounding covering relation with the capstan **31**, rope turns, and both the upper and lower flanges **34, 35** on the capstan. The housing **55** is provided with a knurled, grooved or roughened outer surface **56** to enable a user to readily grip the housing surface without slipping, in order to position the control ring **48** in either locking or descent position. The housing is secured to the control ring **48** by one or more screws **58** extending through an aperture **59**. Other appropriate spring biased latches or detents may be utilized in the cylinder sleeve **55** and threadably engaged in a threaded hole **60** in the control ring **48**. Adjacent its lower edge the housing **55** is provided with a longitudinal peripheral notch **59** which corresponds with the rope aperture **49** of the control ring **48** and through which the rope **32** loosely extends.

In order to keep the gripping sleeve **56** and control ring **48** from rotating on the capstan cylinder **31**, which could cause the rope to bind or jam during descent, the housing mounting screw **58** may be provided with an elongated tip **61** which extends through the control ring hole **60** into a longitudinal groove **62** in the external surface of the capstan extension, as shown in FIGS. **13-17**.

The device as described also provides for a panic stop because a hard, pull-down force on the sleeve and control ring will jam the rope between the control ring and the bottom edge **63** of the tapered slot **44** thereby pinching the rope and creating a substantial drag on it. Thus, if a user panics and pulls down hard on the control housing **55** and control ring **48**, the device will stop or retard further descent until the downward force on the control housing and ring is eased. In the event of a deadman fall on the other hand, the control ring will jam the rope in the upper tapered end of the slot to prevent or retard further descent. The device thus provides for a stop or controlled descent under both deadman and panic conditions.

An alternative controller modification, adopted for controlling the descent of a load by an operator at a lower level is shown in FIGS. 20-23. In describing this modification reference characters similar to those utilized above will be employed with the distinguishing suffix "b". This modified form 30*b* of the controller is adapted to be controlled or operated by pulling on or releasing the free end of the rope 32*b*, down which the descent controller 30*b* is sliding. To this end, the tapered slot **44*b*** in the lower end of the capstan cylinder **31*b*** is inverted as compared to the arrangement of the tapered slot **44** as shown in FIG. **10**, so that the wider end **45*b*** of the slot is up as compared to the load supporting aperture **36*b***, and the narrower end **46*b*** is down. In other respects, the construction of the modified unit **30*b*** is identical to the preferred device **30** as shown in FIGS. **1-19**.

In operation, the modified descent controller **30*b*** is controlled by pulling on or releasing the free end of the rope **32*b***. Releasing the tension in the rope **32*b*** allows the control ring **48*b*** under the bias of the spring **51*b***, to position the rope in the wide end **45*b*** of the inverted tapered slot **44*b***, thereby allowing the controller **30*b*** and load L to slide down the rope **32*b***, as shown in FIGS. **20** and **21**. To stop or slow the descent, the operator pulls on the free end of the rope **32*b***, thereby wedging the rope into the narrower end **46*b*** of the tapered slot **44*b*** against the force of the spring **51*b*** and control ring **48*b***.

A similar result can be obtained by pulling down on the housing **55*b*** and control ring **48*b***. The tapered slot **44*b*** through which the rope **32*b*** passes is inverted as compared to the tapered slot **44** in the modification shown in FIGS. **1-19**, with the larger end **45*b*** of the slot upper most and the constricted or narrower end **46*b*** downwardly nearer the load supporting end of the capstan cylinder **31*b***, as shown in FIGS. **20-23**.

A modified preferred form of the present invention is shown in FIGS. **24-43** inclusive. In describing this modification, reference numerals similar to those used in the description of the device shown in FIGS. **1-19** will be employed with the distinguishing suffix "a". The additional function of this modification is to enable the user to mount the descent controller **30***a* on a rope **32***a* at a point intermediate the ends thereof, without utilizing either the upper or the lower end of the rope. This feature is important in situations in which the user desires to shift the position of the descent controller on a rope when the rope ends are not accessible. This may be important, for example when the user is on a moving scaffold or platform which can be stopped at different levels, necessitating continuous changes of the position of the descent controller on a safety rope.

As shown in FIGS. **24–43**, the capstan or cylinder **31***a* of the descent controller **30***a* is constructed essentially as described above, and includes an upper flange **34***a* and lower flange **35***a* nearer but spaced from the lower end of the capstan cylinder **31***a*. The capstan cylinder **31***a* also includes a diametric aperture or bore **36***a* for receiving a load supporting device or harness (not shown. Intermediate the lower flange **35***a* and the load supporting bore **36***a*, there is provided a diametrically extending upwardly tapered slot **44***a*. The slot **44***a* is of generally teardrop shape and tapers from a lower enlarged or crude end **45***a*, which loosely receives the rope **32***a*, to an upper narrow or gripping end **46***a*, in which the rope is tightly gripped. A rope **32***a* passing through the lower open end **45***a* of the slot **44***a* moves freely through the slot. However, the rope is gripped and restrained by engagement in the upper or narrower end **46***a*.

In order to enable the rope to be inserted into or removed from the tapered slot **44***a* without utilizing an end of the rope **32***a*, a radial slot **65** opens through the side wall of the capstan cylinder **31***a* into the tapered slot **44***a*, as shown in FIGS. **29** and **35**. The radial slot **65** enables the rope **32***a* either to be inserted into or removed from the tapered slot **44***a*, so that the rope can be wrapped around the friction cylinder or capstan **31***a* or removed from the capstan. With this construction, the controller device **30***a* can be mounted on the rope **32***a* at any point on the rope intermediate its ends without using either the upper or lower end of the rope or removing the rope from its point of securement.

As described above, for selectively positioning the rope in either the lower enlarged end **45***a* or upper constricted end **46***a* of the slot **44***a*, there is provided an annular sleeve or control ring **48***a* slidably mounted on the lower or depending end of the friction cylinder **31***a* adjacent the tapered slot **44***a*. The annular control ring **48***a* includes a radial aperture **49***a* defined therein for loosely receiving the rope **32***a*. The edges of the aperture **49***a* are chamfered or rounded to prevent cutting or damaging the rope as it passes through the aperture **49***a*. To enable the rope to be inserted or removed from the radial aperture without threading an end of the rope therethrough, while providing for insertion of a section of the rope, an axially directed groove or notch **66** opens from the upper face **68** of the ring into the aperture **49***a*. The sliding control ring **48***a* also includes a recess **50***a* for receiving the rope, allowing the rope to pass freely through the enlarged lower end of the tapered slot **44***a* without interference from the positioning or control ring, when the ring is in its lower position, as well as for receiving the rope to allow the exit aperture **49***a* to force or jam the rope into the narrow tapered slot **44***a* when the ring **48***a* is in its upper position.

As described above, the ring is biased towards its upper position by a coil spring **51***a* or other appropriate biasing device. The spring **51***a* is supported on a shoulder ring **52***a* secured by a spiral retaining ring **54***a* engaged in a peripheral groove **53***a* in the lower end of the friction cylinder **31***a* adjacent the load supporting aperture **36***a*.

The control ring **48***a* is adapted to be moved up and down over the capstan cylinder **31***a* by a tubular sleeve or housing **55***a* secured thereto and extending in surrounding relation with the capstan **31***a*, rope turns thereon, and upper and lower flanges **34***a*, **35***a* respectively. The housing **55***a* is provided with a roughened, knurled or grooved outer surface **56***a* to enable a user to grip the housing surface. The roughened surface may be provided by a sandpaper-like tread sheet of the character commonly used on floors and stairs to prevent slipping.

The housing is removably secured to the control ring **48***a* by a spring biased detent **69** in the form of a pin or button housed in a mating aperture **70** defined in the lower end of the housing sleeve **55***a*. The housing cylinder **55***a* defines an axially extending slot **71** which enables the housing to be slipped over the rope **32***a* at any point along the length of the rope intermediate its ends. By separating the housing from the control ring **48***a* and capstan cylinder **31***a*, the housing may be slipped off of or onto the rope at any point along the length thereof. Likewise, the rope may be removed from or wrapped around the friction cylinder **31***a* at any point along the length of the rope, and the rope can be inserted into or removed from the tapered control slot **44***a* by squeezing it through the access slot **65**. For guiding the housing cylinder **55***a* on the capstan cylinder **31**, the lower flange **35***a* may include a radially extending boss **72** adapted to be inserted into the axial slot **71** on the housing cylinder **55***a*. The housing cover **55***a* thus is retained at its proper rotational position with respect to the flanges, control ring and friction cylinder.

For retaining the control ring **48***a* in a retracted position during the insertion or removal of a section of the rope **32***a*, the detent **69** extends radially through an aperture **60** in the ring **48***a* to a point where its inner end **73** is engagable in a locking slot **74** in the capstan cylinder **31***a* below the radial access slot **65**, to retain the ring in the retracted position. The rope can then be inserted in place in the grooves **50***a*, **66** in the control ring, as shown in FIGS. **40–43**, and thereafter the ring can be released and rotated to position the rope in the control aperture **49***a*. The detent is biased outwardly by a cantilever spring **75** secured in the exterior wall of the control sleeve **48***a* and having an end engaged with the detent **69**, as shown in FIG. **37**. The spring loaded push button detent **69** releasably retains the sleeve housing **55***a* on the control ring **48***a* and further serves to hold the control ring **48***a* in a retracted position during removal or insertion of the rope.

To mount a controller device of the type shown in FIGS. **24** and **25** on a rope hanging from one end at an upper elevation downwardly to a lower elevation the handle or housing **55***a* is removed from the assembly by pushing the detent button and releasing the housing. The control ring is then pulled downwardly against the force of the spring **51***a* with respect to the capstan to position the ring below the tapered slot **44**. At this point, the detent **69** is pushed and engages in the locking slot **74** to lock the control ring **48***a* in its lowered position as shown in FIG. **43**. The control ring, when pulled down, must be turned partially to allow the detent **69** to engage in the locking slot **74** in order to lock the control ring **48***a* against the force of the spring **51***a*.

With the capstan **31***a* exposed, the rope **32***a* is wound around the main capstan body the desired number of turns and is inserted into the receiving slot **40***a* in the upper plate **34***a* and a similar slot **41***a* in the lower plate **35***a*. Below the lower plate **35***a* the rope is inserted into the tapered slot **44***a* by passing the rope through the entrance slot **65**. Simultaneously the rope is placed for reception in the control ring aperture **49***a* by positioning it above the control ring slot **50***a* and the throat **66** into the control ring aperture **49***a*. During this assembly of the rope and control device, the spring **51***a* remains compressed.

After assembling the control device on the rope, the control ring **48***a* is turned and pulled slightly downwardly to release the detent **69**, and is allowed to slide upwardly on the capstan. The housing sleeve **55***a* is then mounted in place by inserting the rope **32***a* through the longitudinal slot **71** and sliding the housing **55***a* downwardly over the capstan **31***a*, entrained rope **32***a* and control ring **48***a*. The detent receiving opening **70** in the housing **55***a* is positioned for receiving the detent button **69** to lock the housing in place. After assembly, both the housing and control ring may then be pulled downwardly to release the rope, or allowed to slide upwardly to position the rope in the narrow end of the tapered slot.

To remove the control device from the rope, the above procedure is reversed by removing the housing **55***a*, and then pulling downwardly on the control ring **48***a* and rotating the ring to release the rope from the tapered throat.

As shown in FIG. **38**, the control ring cannot be slid with respect to the capstan unless the detent button is outwardly positioned with respect to the housing. A recess in the capstan allows the detent button to be pushed only when the ring **48***a* has been rotated to the release position, as shown in FIG. **38**.

A further modification is shown in FIG. **39**. In order to be able to hang or support the sleeve **55***a* during assembly of the rope, a belt hook **75** is provided on the upper end of the sleeve **55***a*. This assembly includes a band **76** surrounding and secured to the exterior surface of the sleeve **55***a* adjacent its upper end, and a hook **77** to go with the band and adapted to be engaged in the user's belt or on any other appropriate support.

A further modification of the present invention utilizing a rack or ladder capstan arrangement is shown in FIGS. **44–51**. A rack or ladder capstan device for a single rope is shown in FIGS. **44–47**, while a similar rack or ladder construction for a two-rope system is shown in FIGS. **48–51**. The rack capstan arrangement provides a functional resistance between a rope **100** and the descent device, allowing a controlled descent of a load secured to the device without the inherent rope twisting experienced with the axial cylindrical capstan devices.

Referring to FIGS. **44–47**, the ladder or rack form of the controller embodies a generally cylindrical body **80** having a flange **81** at one end thereof supporting a rack capstan arrangement **82**. At its other end, the body **80** defines an aperture **84** adapted for securing the device to a load or load-supporting assembly such as a harness (not shown). The capstan assembly **82** comprises a plurality of coplanar vertically arranged generally horizontally spaced apart bars or rods **85** supported at their opposite ends by spaced parallel support panels **86**, **88**, secured in upstanding relation on the end flange **81**. One of the panels **88** is preferably hinged to the support flange **81** by an appropriate hinge structure **89**.

Each of the support panels **86**, **88**, defines an array of apertures **90** for receiving inserted ends of the capstan bars or rods **85**. A latch pin **92** engaged between the side panels **86**, **88** holds the side panels together with the rods **85** securely supported therebetween.

For selectively gripping or releasing the rope **100**, the support post or cylinder body **80** includes, at a point adjacent the support platform or flange **81**, a tapered slot **94** extending diametrically therethrough and having a lower wider end **95** and an upper narrower end **96**. The wider end **95** is of a dimension to freely pass the rope **100** while the narrower end **96** serves to grip a rope wedged therein. For purposes of wedging a rope **100** in the narrower end of the tapered slot **94** or releasing the rope and positioning it in the wider end for movement through the slot, there is provided a control ring **98** slidably mounted on the support body **80** and having a radial aperture **99** extending therethrough for receiving the rope **100** so that the control ring **98** guides the rope into or out of the narrow end **96** of the tapered slot **94** in the same manner as described in detail above.

In use, a rope **100** is woven through the bars **85** of the ladder or rack capstan **82** by passing it alternately in front and back of the bars or rods **85** as shown in FIG. **47**. The rope **100** is then passed through a slot **101** defined in the upper capstan support plate **81** and through the tapered aperture **94** in the capstan support body **80**, and then outwardly through the control aperture **99** in the control ring **98**. By moving the control ring **98** up and down on the capstan support body **80**, the rope **100** may be selectively positioned in gripping engagement with the narrower end **96** of the tapered slot **94** or in the wider end **95** thereof, allowing the device to descend along the rope slowed by the frictional engagement of the rope with the ladder or rack rods **85**. For ease in controlling the movement of the control ring **98** and for surrounding and protecting the ladder and entrained rope, a cylindrical housing sleeve **102** extends in surrounding relationship with the ladder and the control ring **98**. The cylinder **102** is releasably secured to the control ring **98** by a detent **104** on the control ring engagable in a corresponding aperture **105** in the housing. The housing may further be provided with a roughened gripping surface **106** to facilitate use of the cylindrical housing as a handle or grip. The control ring **98** is biased to its rope locking position by a biasing spring **108** acting between the control ring and a support ring **109** securely by a retaining ring **110** on the cylindrical support body **80**. The cylindrical housing **102** may be provided with a longitudinal slot **111** so that the housing may be removed from the rope when the rope is to be positioned in or removed from the ladder or rack. Similarly, appropriate entrance slots may be provided into the tapered slot **95** and the control rings aperture **99** in order to enable the rope to be inserted in or removed from these openings, as described above in connection with the modification shown in FIGS. **24–43**.

A modified form of a ladder or rack descent controller is adapted for use with a second rope in order to provide a safety redundancy, as is shown in FIGS. **50–53**. In describing this modification, reference numerals similar to those utilized in describing the modification shown in FIGS. **46–49** will be employed with the distinguishing suffix "c".

The double rope ladder or rack capstan descent controller, as shown in FIGS. **50–53**, comprises a generally cylindrical body **80***c*, having a flange **81***c* at one end thereof supporting a ladder or rack capstan arrangement **82***c*. At its other end, the body **80***c* defines an aperture **84***c* for securing the device to a load or load supporting assembly, such as a harness (not shown).

The ladder or rack assembly **82***c* comprises a plurality of coplaner vertically arranged generally horizontal-spaced apart bars or rods **85***c* supported at their opposite ends by spaced parallel support panels **86***c*, **88***c*, secured and upstanding relation on the end flange **81***c*. One of the panels **88***c* is preferably hinged to the support flange **81***c* by an appropriate hinged structure **89***c*.

Each of the support panels **86***c*, **88***c*, defines an array of apertures **90***c* for receiving inserted ends of the capstan bars or rods **85***c*. A latch pin **92***c* engaged between the side panels **86***c*, **88***c* holds the side panels together with the rods **85***c* securely supported therebetween.

A pair of ropes **100***c* are woven through the bars or rods **85***c* of the ladder or rack capstan by passing them alternately in front and back of the bars or rods **85***c* as shown in FIG. **52**. A redundant or back-up rope system is thus provided, adding an additional safety factor to the device.

For selectively gripping or releasing the pair of ropes **100***c*, the support body **80***c* includes a pair of side-by-side vertically oriented tapered slots **94***c* each having a lower wider end **95***c* and an upper narrower end **96***c*. The wider end **95***c* is of a dimension to freely pass the rope **100***c* while the narrower end **96***c* serves to grip a rope wedged therein. By selectively positioning the rope either in the wider end or the narrower end of the tapered slots **94***c*, the rope can be selectively released or gripped to control the descent of a supported load. For positively positioning the ropes **100***c* at the desired position in the tapered slots **94***c*, there is provided a control ring **98***c* slidably mounted on the support body **80***c* and having spaced apart radial apertures **99***c* extending therethrough for receiving the ropes **100***c*. By moving the control ring **98***c* upward or downward on the body **80***c* the ropes are guided into or out of the narrower end **96***c* of the tapered slot **94***c* in the same manner as described above.

In use, a pair of ropes **100***c*, **120** are woven through the bars **85***c* of the ladder or rack capstan and then through the tapered apertures **94***c* and the control ring **98***c*, as shown in FIG. **52**. For moving the control ring up and down on the body **80***c* there is provided an external housing sleeve **102***c* which extends in surrounding relationship with the ladder or rack and the control ring **98***c*. The housing or cylinder **102***c* is releasably secured to the control ring **98***c* by an appropriate detent **104***c* on the control ring engagable in a corresponding aperture **105***c* in the housing. The housing is further provided with a roughened gripping surface **106***c*.

The control ring and housing are biased to their upper rope-gripping position by a biasing spring **108***c* supported on the body **80***c* by a support ring assembly **109***c*.

As described above, the housing **102***c* may be provided with a longitudinal slot **111***c* so that the housing may be removed from the ropes **100***c*. Similarly, appropriate access apertures are provided into the tapered slots **94***c* in the controller body **80***c* and into the control apertures **99***c* in the control ring **98***c* to allow application to the ropes intermediate their ends.

The present invention finds particular but not necessarily exclusive utility in safety escape systems, as shown in FIGS. **54-56**. Such an escape system includes a controller **30** such as shown in FIGS. **1-19** in association with a safety rope **32** and a supporting harness **120** such as a harness of the type disclosed and claimed in co-pending application of H. M. Varner, Ser. No. 07/554,540, filed July 18, 1990 for "EGRESS AND EVACUATION HARNES" now U.S. Pat. No. 5,070,692, issued Dec. 10, 1991. At one end, the rope **32** is provided with a loop **121** and securing device **122** to enable the rope to be secured at an elevated position. The free end of **124** of the rope **32** is housed in a container **125**. The rope container **125**, descent device **30**, harness **120**, are packaged in a kit **126** containing appropriate instructions **127**.

In use, such as for a descent from a scaffold or lift truck platform, the kit **126** is opened and the loop end **121** of the rope **32** is secured to a secure fixture at the elevated location, such as a rack. The rope packet **125** is lowered and the user dons the harness **120**, steps off of the platform and utilizes the descent controller **30** to descend to the ground along the free end of the rope **124**.

Alternatively, as shown in FIG. **55**, for lowering an unconscious person, a stretcher or a like load from an elevated position along a rope **32**, a harness **120** can be secured to the loop end **121** of the rope and the descent controller **30** secured to a fixed mounting **128** by attaching the capstan thereto, utilizing the capstan bore **36** to secure the capstan **30** to the support. An operator, at the position of the fixed mounting **128**, can reach the descent device **30** to actuate the controller **30** to control the descent of the load in the harness **120**. The free end **124** of the rope feeds through the controller **30** as the load descends.

A further alternative use of a descent controller embodying the present invention, is for controlling the descent of work stations, such as a bosun's chair, while the rider is working on a vertical surface. The user secures the descent controller to the bosun's chair and descends to the working position. At that point the controller handle or sleeve is released, thereby stopping the descent, and enabling the user to perform a predetermined task at the vertical position at which the unit is located. When the task at that location is finished, the user can descend to a lower position and continue the work. The descent is controlled by actuating the sleeve of the descent controller to provide for a controlled descent. At the work station, it is sometimes desirable to prevent the user support from further descent or slippage along the main descent rope. To this end, the user can tie off the rope and prevent actuation of the descent controller. For additional safety, the user also conventionally employs a safety rope and rope grab (not shown), which is secured at the work station to prevent accidental descent or catch the user and prevent a fall.

In order to enable the descent rope to be tied off to lock the controller temporarily in a set position, a modified form of descent controller is provided with a rope cleat as shown in FIGS. **56-58**. In describing this modification, reference characters similar to those used above will be employed with the distinguishing suffix "d." To provide a rope tie-off cleat as shown in FIG. **56**, the gripping sleeve **55***d* is provided adjacent its upper edge with an integral cleat **130** about which the descent rope **32***d* may be engaged. The frictional engagement between the descent rope **32***d* and the cleat **130** prevents the controller **30***d* from descending further along the descent rope **32***d*. The cleat **130** is integral with the sleeve **55***d* and is formed by an enlarged head portion

131 defining a pair of spaced friction throats 132. By engaging the rope 32*d* in the throats 132, a frictional engagement is provided which prevents the controller from sliding along the rope. The rope may pass through the upper portion of the sleeve slot 71*d*. To release the rope from the cleat, it is only necessary to pull down on the sleeve 55*d*. The rope is engaged by the upper surface of the capstan flange 34*d*, and is pushed off of the cleat 130 thereby allowing the controller to controllably descent along the rope 32*d*.

An alternative rope tie-off is shown in FIG. 59 and simply involves forming the rope 32 into a loop 135 and utilizing the loop, tying a half hitch around the upper portion of the rope above the controller. To descend, it is only necessary to release the half hitch.

The present invention finds utility with a safety or emergency kit utilized for descending from a stacker, forklift or crane, or other piece of industrial equipment in the event of an accident or emergency. The kit is maintained in a compartment in which the user rides, such as the cab of an overhead crane. In the event of an emergency, the rope loop is hooked over a portion of the overhead guard or other stable part of the equipment. The user dons the harness and descends to a lower level, utilizing the controller to control the rate of descent. While the unit may be reusable, such safety kits are preferably adapted for a single use. This insures that the kits are properly packed and complete.

The foregoing descent controller devices provide a controllable means for a person located high above the ground or floor to descend on a rope. Applications include but are not limited to egress from overhead crane cabs, forklift or stockpicker cabs, and the buckets on high-lift utility vehicles. In addition, the device may be used for the evacuation of buildings, bridges, structures, platforms, ships, or aircraft where the descent distance is sufficient to cause injury if the user jumps without a control device. Another application is for the rescue of persons trapped in a building by fire, stranded on a ledge or a mountain, or in similar hazardous situations. Police special weapons teams and armed forces special forces personnel can use the device effectively for controlled descent from buildings, ledges, mountains, and other elevated positions.

While certain illustrative embodiments have been shown in the drawings and described above in considerable detail it should be understood that there is no intention to limit the invention to the specific forms disclosed. On the contrary the intention is to cover all modifications, alternative constructions, equivalents and uses falling within the spirit and scope of the invention as expressed in the appended claims.

We claim:

1. A descent controller for lowering a rope supported load from an elevated position to a relatively lower position, said controller including a friction cylinder of a length adapted to receive a plurality of turns of rope wrapped therearound, said cylinder having a first upper end and a second lower end, a portion of said friction cylinder defining an upwardly narrowing tapered slot diametrically therethrough adapted to receive the rope, said tapered slot defining an enlarged entryway adapted to freely admit the rope and tapering from said entryway to a relatively constricted end of a width sufficient for gripping the rope, a control ring slidably mounted on said cylinder adjacent said tapered slot and defining a radial aperture therethrough adapted to loosely receive said rope as it exits from said tapered slot, a spring biasing said ring in a direction along said friction cylinder for wedging said rope in said tapered slot, said control ring being slidable along said friction cylinder for releasing said rope from the narrow end of said tapered slot, and means on said friction cylinder for engagement with a load support whereby sliding movement of said control ring controls the descent of said supported load along said rope.

2. A descent controller as defined in claim 1 further comprising a gripping sleeve secured to said control ring for use in sliding said control ring along said friction cylinder.

3. A descent controller as defined in claim 2 wherein said gripping sleeve includes a roughened exterior surface.

4. A descent controller as defined in claim 2 wherein said gripping sleeve defines a housing enclosing said friction cylinder and the rope wrapped therearound.

5. A descent controller as defined in claim 2 wherein said gripping sleeve is releasably secured to said control ring, and further includes a longitudinally extending slot therein of a width for receiving said rope.

6. A descent controller as defined in claim 1 wherein said friction cylinder defines a radial slot opening into said tapered slot and sized to loosely receive said rope.

7. A descent controller as defined in claim 6 wherein said control ring defines an axially extending slot opening into said radial aperture and sized to loosely receive said rope whereby said rope can be released from or inserted into said aperture.

8. A descent controller as defined in claim 7 further comprising a gripping sleeve secured to said control ring for use in sliding said control ring along said friction cylinder.

9. A descent controller as defined in claim 8 wherein said gripping sleeve defines a housing enclosing said friction cylinder and the rope wrapped therearound.

10. A descent controller as defined in claim 9 wherein said gripping sleeve is releasably secured to said control ring, and further includes a longitudinally extending slot therein of a width for receiving said rope.

11. A descent controller for lowering a rope supported load from an elevated position to a relatively lower position, said controller including a friction cylinder of a length adapted to receive a plurality of turns of rope wrapped therearound, said cylinder having spaced apart first and second ends, first and second end plates attached respectively adjacent the first end and spaced from the second end of said cylinder, said end plates both having a portion thereof overhanging the cylinder and defining radial slots sized to loosely receive the rope, a portion of said friction cylinder defining means for releasably gripping said rope, means slidably mounted on said cylinder adjacent second end plate for positioning said rope with respect to said gripping means, means secured to said rope positioning means for sliding said rope positioning means along said friction cylinder to release or engage said rope with said gripping means, and means on one end of said friction cylinder for engagement with a support whereby sliding movement of said slidably mounted rope positioning means provides for a controlled descent of said rope supported load.

12. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction brake adapted to receive said rope entrained thereon, a control shaft secured to said friction brake and defining

means for releasably gripping control said rope, means slidably mounted on said control shaft for controllably positioning said rope with respect to said gripping means, and means on said control shaft for engagement with a load support whereby said descent controller supports a load on said rope and upon sliding movement of said sliding means provides for a controlled descent of said supported load along said rope.

13. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction brake adapted to receive said rope entrained thereon, a control shaft secured to said friction brake and defining a tapered slot diametrically therethrough adapted to receive the rope, said tapered slot defining an enlarged entryway adapted to freely admit the rope and tapering from said entryway to a relatively constricted end of a width sufficient for gripping the rope, a control ring slidably mounted on said control shaft and defining a radial aperture therethrough adapted to loosely receive said rope as it exits from said tapered slot, a spring biasing said ring along said shaft in a direction for wedging said rope in said tapered slot, said control ring being slidable along said shaft against the force of said spring for releasing said rope from the narrow end of said tapered slot, and means on said shaft adjacent said tapered slot for engagement with a load support whereby said descent controller supports a load on said rope and upon sliding movement of said control ring provides for a controlled descent of said supported load along said rope.

14. A descent controller as defined in claim **13** further comprising a gripping sleeve secured to said control ring for use in sliding said control ring along said friction cylinder.

15. A descent controller as defined in claim **14** wherein said gripping sleeve defines a housing enclosing said friction brake and the rope entrained thereon.

16. A descent controller as defined in claim **14** wherein said gripping sleeve is releasably secured to said control ring, and further includes a longitudinally extending slot therein of a width for receiving said rope.

17. A descent controller as defined in claim **13** wherein said control shaft defines a radial slot opening into said tapered slot and sized to loosely receive said rope.

18. A descent controller as defined in claim **17** wherein said control ring defines an axially extending slot opening into said radial aperture and sized to loosely receive said rope whereby said rope can be released from or inserted into said aperture.

19. A descent controller as defined in claim **18** further comprising a gripping sleeve secured to said control ring for use in sliding said control ring along said control shaft.

20. A descent controller as defined in claim **19** wherein said gripping sleeve defines a housing enclosing said friction brake and the rope entrained thereon.

21. A descent controller as defined in claim **20** wherein said gripping sleeve is releasably secured to said control ring, and further includes a longitudinally extending slot therein of a width for receiving said rope.

22. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction brake adapted to receive said rope entrained thereon, a control shaft secured to said friction brake and defining diametrically therethrough an upwardly narrowing tapered slot adapted to freely admit the rope and tapering from said enlarged end to a relatively constricted end of a width sufficient for gripping the rope, an annular control ring slidably mounted on said cylinder adjacent said tapered slot and defining radially therethrough an aperture adapted to loosely receive said rope as it exits from said tapered slot, a spring biasing said ring upwardly along said control shaft for wedging said rope in the narrow end of said tapered slot, a sleeve secured to said ring for use in sliding said ring along said friction cylinder against the force of said biasing spring to release said rope from the narrow end of said tapered slot, said sleeve defining a housing enclosing said friction brake and the rope entrained thereon, and means on the lower end of said shaft below said tapered slot for engagement with a load support, whereby said descent controller supports a load on said rope and upon sliding movement of said sleeve provides for a controlled descent of said supported load along said rope.

23. A descent controller for lowering a rope supported load from an elevated position to a relatively lower position, said controller being adapted to be secured at said elevated position and including a friction cylinder of a length adapted to receive a plurality of turns of said rope wrapped therearound, said cylinder having a first end and a second end, first and second end plates attached respectively adjacent the first end and spaced from the second end of said cylinder, said end plates both having a portion thereof overhanging the cylinder and defining radial slots sized to loosely receive the rope, a portion of said friction cylinder extending below said second end plate and defining diametrically therethrough a tapered slot adapted to receive the rope, said tapered slot defining an enlarged end spaced from said second end plate and adapted to freely admit the rope and tapering from said enlarged end to a relatively constricted end adjacent said second end plate and of a width sufficient for gripping the rope, an annular control ring slidably mounted on said cylinder on the opposite side of said second end plate from said first end plate and defining radially therethrough an aperture adapted to loosely receive said rope as it exits from said tapered slot, a spring biasing said ring towards said second end plate along said friction cylinder for wedging said rope in the narrow end of said tapered slot, a sleeve secured to said ring for use in sliding said ring along said friction cylinder against the force of said biasing spring to release said rope from the narrow end of said tapered slot, said sleeve defining a housing enclosing said friction cylinder and the rope wrapped therearound, and means on the second end plate end of said friction cylinder for engagement with a fixed load support at said elevated position, whereby said descent controller supports said rope and upon sliding movement of said sleeve provides for a controlled descent of said rope supported load.

24. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction cylinder of a length adapted to receive a plurality of turns of rope wrapped therearound, said cylinder having an upper end and a lower end, top and bottom end plates attached respectively adjacent the upper end and spaced from the lower end of said cylinder, said end plates both having a portion thereof overhanging the cylinder and defining radial slots sized to loosely receive the rope, a portion of said friction cylinder extending below said lower end plate and defining diametrically therethrough an upwardly narrowing tapered slot adapted to receive the rope, said tapered slot defining an enlarged end adapted to freely admit the rope and tapering from said enlarged end to a relatively constricted end of a width sufficient for gripping the rope, an annual control ring slidably mounted on said cylinder below said bottom end plate and defining a radially therethrough an aperture adapted to loosely receive said rope as it exits from said tapered slot, a spring biasing said ring upwardly along said friction cylinder for wedging said rope in the narrow end of said tapered slot, a sleeve secured to said ring for use in sliding said ring along said friction cylinder against the force of said biasing spring to release said rope from the narrow end of said tapered slot, said sleeve defining a housing enclosing said friction cylinder and the rope wrapped therearound, and means on the lower end of said friction cylinder below said tapered slot for engagement with a load support, whereby said descent controller supports a load on said rope and upon sliding movement of said sleeve provides for a controlled descent of said supported load along said rope.

25. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction cylinder of a length adapted to receive a plurality of turns of rope wrapped therearound, said cylinder having an upper end and a lower end, top and bottom end plates attached respectively adjacent the upper end and spaced from the lower end of said cylinder, said end plates both having a portion thereof overhanging the cylinder and defining radial slots sized to loosely receive the rope, a portion of said friction cylinder extending below said lower end plate and defining an upwardly narrowing tapered slot diametrically therethrough adapted to receive the rope, said tapered slot defining an enlarged entryway adapted to freely admit the rope and tapering from said entryway to a relatively constricted end of a width sufficient for gripping the rope, a control ring slidably mounted on said cylinder below said bottom end plate and defining a radial aperture therethrough adapted to loosely receive said rope as it exits from said tapered slot, a spring biasing said ring upwardly along said friction cylinder for wedging said rope in said tapered slot, said control ring being slidable along said friction cylinder away from said bottom end plate for releasing said rope from the narrow end of said tapered slot, and means on the lower end of said friction cylinder below said tapered slot for engagement with a load support whereby said descent controller supports a load on said rope and upon sliding movement of said control ring provides for a controlled descent of said supported load along said rope.

26. A descent controller as defined in claim 25 further comprising a gripping sleeve secured to said control ring for use in sliding said control ring along said friction cylinder.

27. A descent controller as defined in claim 26 wherein said gripping sleeve includes a roughened exterior surface.

28. A descent controller as defined in claim 26 wherein said gripping sleeve defines a housing enclosing said friction cylinder and the rope wrapped therearound.

29. A descent controller as defined in claim 26 wherein said gripping sleeve is releasably secured to said control ring, and further includes a longitudinally extending slot therein of a width for receiving said rope.

30. A descent controller as defined in claim 25 wherein said friction cylinder defines a radial slot opening into said tapered slot and sized to loosely receive said rope.

31. A descent controller as defined in claim 30 wherein said control ring defines an axially extending slot opening into said radial aperture and sized to loosely receive said rope whereby said rope can be released from or inserted into said aperture.

32. A descent controller as defined in claim 31 further comprising a gripping sleeve secured to said control ring for use in sliding said control ring along said friction cylinder.

33. A descent controller as defined in claim 32 wherein said gripping sleeve defines a housing enclosing said friction cylinder and the rope wrapped therearound.

34. A descent controller as defined in claim 33 wherein said gripping sleeve is releasably secured to said control ring, and further includes a longitudinally extending slot therein of a width for receiving said rope.

35. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction cylinder of a length adapted to receive a plurality of turns of rope wrapped therearound, said cylinder having an upper end and a lower end, top and bottom end plates attached respectively adjacent the upper end and spaced from the lower end of said cylinder, said end plates both having a portion thereof overhanging the cylinder and defining radial slots sized to loosely receive the rope, a portion of said friction cylinder extending below said lower end plate and defining means for releasably gripping said rope, means slidably mounted on said cylinder below said bottom end plate for positioning said rope with respect to said gripping means, means secured to said rope positioning means for sliding said rope positioning means along said friction cylinder to release or engage said rope with said gripping means, and means on the lower end of said friction cylinder for engagement with a load support whereby said descent controller supports a load on said rope and upon sliding movement of said slidably mounted rope positioning means provides for a controlled descent of said supported load along said rope.

36. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction brake adapted to receive said rope entrained therein, a control shaft secured to said friction brake and defining means for releasably gripping control said rope, means slidably mounted on said control shaft for controllably positioning said rope with respect to said gripping means, and means on said control shaft for engagement with a load support whereby said descent controller supports a load on said rope and upon sliding movement of said sliding means provides for a controlled descent of said supported load along said rope.

37. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction brake adapted to receive said rope entrained thereon, a control shaft secured to said friction brake and defining an upwardly narrowing tapered slot diametrically therethrough adapted to receive the rope, said tapered slot defining an enlarged entryway adapted to freely admit the rope and tapering from said entryway to a relatively constricted end of a width sufficient for gripping the

rope, a control ring slidably mounted on said control shaft and defining a radial aperture therethrough adapted to loosely receive said rope as it exits from said tapered slot, a spring biasing said ring upwardly along said shaft for wedging said rope in said tapered slot, said control ring being slidable along said shaft against the force of said spring for releasing said rope from the narrow end of said tapered slot, and means on the lower end of said shaft below said tapered slot for engagement with a load support whereby said descent controller supports a load on said rope and upon sliding movement of said control ring provides for a controlled descent of said supported load along said rope.

38. A descent controller as defined in claim **37** further comprising a gripping sleeve secured to said control ring for use in sliding said control ring along said friction cylinder.

39. A descent controller as defined in claim **38** wherein said gripping sleeve defines a housing enclosing said friction brake and the rope entrained thereon.

40. A descent controller as defined in claim **38** wherein said gripping sleeve is releasably secured to said control ring, and further includes a longitudinally extending slot therein of a width for receiving said rope.

41. A descent controller as defined in claim **37** wherein said control shaft defines a radial slot opening into said tapered slot and sized to loosely receive said rope.

42. A descent controller as defined in claim **41** wherein said control ring defines an axially extending slot opening into said radial aperture and sized to loosely receive said rope whereby said rope can be released from or inserted into said aperture.

43. A descent controller as defined in claim **42** further comprising a gripping sleeve secured to said control ring for use in sliding said control ring along said control shaft.

44. A descent controller as defined in claim **43** wherein said gripping sleeve defines a housing enclosing said friction brake and the rope entrained thereon.

45. A descent controller as defined in claim **44** wherein said gripping sleeve is releasably secured to said control ring, and further includes a longitudinally extending slot therein of a width for receiving said rope.

46. A descent controller for lowering a load along a rope from an elevated position to a relatively lower position, said controller including a friction brake adapted to receive said rope entrained thereon, a control shaft secured to said friction brake and defining diametrically therethrough an upwardly narrowing tapered slot adapted to freely admit the rope and tapering from said enlarged end to a relatively constricted end of a width sufficient for gripping the rope, an annular control ring slidably mounted on said cylinder adjacent said tapered slot and defining radially therethrough an aperture adapted to loosely receive said rope as it exits from said tapered slot, a spring biasing said ring upwardly along said control shaft for wedging said rope in the narrow end of said tapered slot, a sleeve secured to said ring for use in sliding said ring along said friction cylinder against the force of said biasing spring to release said rope from the narrow end of said tapered slot, said sleeve defining a housing enclosing said friction brake and the rope entrained thereon, and means on the lower end of said shaft below said tapered slot for engagement with a load support, whereby said descent controller supports a load on said rope and upon sliding movement of said sleeve provides for a controlled descent of said supported load along said rope.

47. In a detent for releasably securing an outer sleeve in a telescoping arrangement with an inner cylinder, said detent including a detent pin resiliently mounted on said cylinder and an aperture defined in said outer sleeve for releasable engagement with said detent pin, and means brasing said detent pin outwardly of said cylinder, wherein the improvement in said brasing means comprises a stiffly resilient spring engaged with said detent pin and basing said detent pin outwardly of said cylinder into releasable locking engagement with said sleeve aperture, said spring having a general arcual shape, an interval leg on one end of said spring, said cylinder including a peripheral groove adapted to receive said arcuator spring, said groove terminating at one end in a recess adapted to slidably receive said spring let with the opposite free end of said spring extending into said recess, said detent pin having a diametric bore therethrough adapted to receive the free end of said leaf spring, and means for securing said spring in said peripheral groove with said leg in said hole and said free end is engaged with said detent pin in said recess whereby aid detent pin is biased by said spring outwardly of said recess into releasable locking engagement with said sleeve aperture.

48. A detent as defined in claim **47** wherein said spring is a wire spring.

49. A detent as defined in claim **47** wherein said spring is a flat spring.

50. A detent as defined in claim **47** wherein said spring is a leaf spring.

51. A detent as defined in claim **47** wherein said peripheral groove tapers radially inwardly of said cylinder to provide clearance for said spring as said detent pin is pushed.

52. An emergency escape kit comprising, in combination, a safety rope, means on said rope adapted to be secured to a fixed support at an elevated position, a rope pack containing and protecting said rope, a descent controller slidably mounted on said rope, a foldable harness seat secured to said descent controller and adapted to support a user therefrom, and a housing pack for containing and protecting said rope pack, descent controller and harness.

53. A descent controller as defined in claim **1** wherein said gripping sleeve includes a belt hook.

54. A descent controller as defined in claim **1** wherein said gripping sleeve includes an integral rope tie-off cleat.

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