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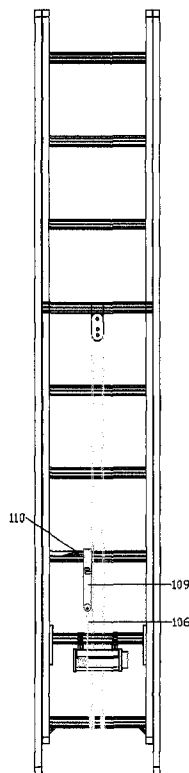
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(57) Abrégé/Abstract:

Ladder Safety System with Retractable Tie-Down Abstract A safety tie down system for ladders that provides a method to prevent the base of the ladder from sliding during use is disclosed. The system comprises a tether located at or near the base of the ladder that can be unwound from a lockable reel and tied to a fixed object or alternatively connected to an adze. Once the tether is anchored and the reel is locked, the base of the ladder cannot slide.

Ladder Safety System with Retractable Tie-Down

Abstract

A safety tie down system for ladders that provides a method to prevent the base of the ladder from sliding during use is disclosed. The system comprises a tether located at or near the base of the ladder that can be unwound from a lockable reel and tied to a fixed object or alternatively connected to an adze. Once the tether is anchored and the reel is locked, the base of the ladder cannot slide.

LADDER SAFETY SYSTEM with RETRACTABLE TIE-DOWN

TECHNICAL FIELD

This disclosure relates to a ladder safety system with retractable tie-down and methods for dispensing and retracting the safety tether of the ladder safety system with retractable tie-down.

BACKGROUND

When placed against a house, wall of a commercial building, pole or any other vertical supporting surface, a straight or extension ground ladder depends solely on friction and gravity to prevent the ladder's base from sliding away from the wall. Ladders are used in utility, commercial and consumer sectors as well as in specialized fields, such as firefighting. In many cases, unloaded and loaded ladders have slid out at their bases causing injuries to users, bystanders, or rescuers [such as firefighters] and victims, respectively.

During a fire ground operation, ladders are used to gain access to heights for many reasons. Performing work from a ladder such as window breaching, roof ventilation, hand line operation and observation all require the ladder to be occupied by the firefighter(s) at an angle of approximately 75 degrees. Depending on the length of the ladder and the height of the operation, this can place extensive weight at the base of the ladder. If not properly "butted", "heeled" or otherwise secured by means of a rope or webbing at the base, this could result in the ladder slipping away from the building causing the occupants to fall. Many times, motion from work on the ladder will overcome the friction between the ladder's butt and the ground resulting in slippage away from the vertical support.

Often times a firefighter will be tasked with solely holding the ladder in place whereby he/she places their feet against the butts (butting) to prevent slippage or the firefighter stands under the ladder, grasps it at chest height and leans back adding additional friction support at the base (heeling). These methods require that the number of personnel on the fire ground be sufficient to allow for this technique. In many cases, the firefighter tasked with supporting the ladder will also be required to perform other duties around the base of the ladder (e.g. hand up tools, retrieve items from engine, etc.) and becomes preoccupied with these other tasks. This results in the ladder being intermittently supported during the work activity on the ladder

thus placing the occupants of the ladder at risk of falling.

Often ladders are utilized by Rapid Intervention Teams (RITs) as part of a tactic whereby multiple second and third story windows are “laddered” to allow rapid means of egress for firefighters and patients in need during a hostile event. These ladders are placed at an angle of approximately 60 degrees, resulting in decreased friction at the base of the ladder and increased likelihood of slippage if the ladder becomes loaded. These ladders are often left unattended and are required to be tied off at the base using rope or webbing. The process of securing the ladder is time consuming, and if there is a need to re-position the ladder, it must be unsecured and re-secured multiple times increasing the time required to ladder the building. Furthermore, if in the event one of these ladders are used as an emergency exit, it will be subject to immense loading whereby the base tie-off performed by the firefighter is the primary means of preventing slippage during ladder operations.

Establishing an anchor point in a multitude of situations can be challenging. Often the same ladder could be set up on concrete, grass or even ice depending on tactical need. Therefore, a versatile anchoring system must be employed.

Prior ladder safety systems are designed for consumer use and do not address the needs specific to the fire ground or a commercial setting. The features of the invention overcome the shortcomings for use in such environments and in commercial and consumer sectors.

Structural Integrity / Load Capacity - All components of the invention are rated equal to or greater than that of the ladder of which it is mounted. It observes all safety factors in ladder design and can safely withstand a rescue load for emergency egress. It achieves this while maintaining the guidelines of ladder accessory design set out in the applicable standards.

Portability – The invention is available as a ladder accessory however once installed on the ladder, remains in place for the life of the ladder. This allows the ladder accessory to be carried to and from the vehicle as part of the ladder. When installed it allows for a ladder to be stored on the fire apparatus as it normally would be. Users are not required to change the layout of the truck or make space for additional components.

Prior ladder systems use separate components. They are stowed and carried separately from the ladder and are assembled in place prior to ladder use. Storage space would need to be added to the fire apparatus to accommodate for these devices.

Rapid Deployment – The invention deploys rapidly and without need for additional tools or accessories. The supporting tether is rapidly deployed from the reel allowing basal support of the ladder to be achieved quickly. It can be performed by one person once the ladder has been extended into place.

Prior ladder systems require the time-consuming process of assembly before the ladder can be raised. It would be difficult to support the ladder in a vertical manor while installation is in process and would most likely require two people.

Adjustability – If a ladder that is placed and secured requires relocating, the ladder accessory permits relocation to be done safely and rapidly. If a change in angle is required, unlocking, and sliding the base of the ladder to its new desired location, followed by re-locking, is all that is required. If a completely new position is required, the user may remove the anchor, un-lock the reel and allow the tether to recoil back into the reel. This allows the user to safely maneuver the ladder in a rapid manor, without creating a tripping hazard.

Most prior ladder systems require either partial disassembly or folding which make the ladder inefficient to reposition, or requires full disassembly, which takes considerable time.

Anchoring – The anchoring component of the invention allows for an unlimited number of anchoring possibilities, however, any other suitable anchor could also be used such as pre-placed or improvised tie-off points, a tree, a vehicle or any structure deemed secure by a competent operator.

Versatility – The invention fits all makes and models of fire ground ladders by applying the appropriate rung adapter to the system on initial installation. After the device is in place, there is no need to remove, adjust or adapt the device. It is effective no matter the height or width of the ladder and performs well at any level of extension. The invention could also be manufactured to incorporate adapters for commercial and consumer grade products in the future. Prior systems have been limited to the height or style of ladder design.

Maintenance – The invention requires that only annual maintenance be done on schedule with the ladder maintenance and can be maintained and tested by the same technicians who perform ladder maintenance at each fire department.

In summary the invention improves ladder stabilization techniques and usage in at least the following ways:

- 1) Decreases time required to secure base of ladder to an anchor point.

- 2) Ladder repositioning can be done quickly and safely.
- 3) Provides greater basal support than prior systems and firefighters “butting” or “heeling” the ladder.
- 4) Replaces need for a firefighter to physically support and supervise a ladder during use.
- 5) Is permanently mounted to ladder rung so no additional tools are required.
- 6) Is low profile to allow ladder to function normally and be “bedded” on the truck with other ladders for ease of storage.
- 7) Is stowed in a position that prevents use of the ladder without the use of the invention.
- 8) Contains indication that ladder is safe or unsafe to use or leave unattended.
- 9) Is constructed of material that will outlast the ladder itself and is easily maintained.
- 10) Meets and exceeds structural requirements of the ladder.

Technical Problems the invention solves:

- 1) Base of ladder slips at 75 degrees during work if not tied off; firefighter may be required to stabilize ladder thereby decreasing available fire ground personnel.
- 2) Base of ladder slips during use of RIT ladders set at 60 degrees or while left unattended. These ladders are required to be tied off which is time consuming and difficult to reposition.
- 3) Creating an improvised anchor point takes time and requires the use of one or more hand tools thereby reducing the number of hand tools for use on the fire ground.
- 4) Eliminates the need to carry additional anchoring tools and materials while carrying ladders and other tools for use during fire.

SUMMARY

Three embodiments of the ladder safety system with retractable tie-down are described in the following detailed description.

The first embodiment of the disclosure provides a ladder safety system with retractable tie-down comprising a reel assembly including a housing having an upper section and a lower section, a first end plate and an opposing second end plate. The housing spans between the end plates and contains a shaft, a bearing at each shaft end, a reel, a retracting mechanism, and a tether attached at one end to the reel and at the second end to an anchor. A locking handle is provided for locking the reel in position. An anchor member is comprised of an arched blade (adze) at a right angle to a shaft and opposite a striking surface, a bedding hook and two tether attachment points. Mounting brackets extend from the upper housing section, pivot on an axle and are adapted to fit multiple sized and shaped ladder rungs. The two mounting brackets with pivot link the ladder safety system with retractable tie-down to the ladder rung.

A second embodiment of the disclosure provides a ladder safety system with retractable tie-down comprising a reel assembly including a housing having an upper section and end plate. The upper housing spans over the reel and contains a shaft and mount for the rung adapter. The reel contains bearings, rotates upon the shaft of the upper housing and is driven by a retracting mechanism and a tether. A locking handle is provided for operating the locking mechanism within the end plate for locking the reel in position. An anchor member is comprised of an arched blade (adze) at a right angle to a shaft and opposite a striking surface, a bedding hook and two tether attachment points. A mounting bracket extends from the upper housing section, pivot on an axle and is adapted to fit multiple sized and shaped ladder rungs. The mounting bracket with pivot links the ladder safety system with retractable tie-down to the ladder rung.

A third embodiment of the disclosure provides a ladder safety system with retractable tie-down comprising a reel assembly integrated within the rung of the ladder with a first end plate and an opposing second end plate. The rung spans between the end plates and contains a reel with bearings at each end rotating on a shaft. The first end plate contains a locking mechanism, is operated by an external locking handle and the second end plate contains a retracting mechanism. A locking handle is provided for locking the reel in position. A tether is wound upon the reel and is attached at one end to the reel and at the second end to an anchor. An opening in the rung allows the tether to extend and retract from within the rung. An anchor member is comprised of an arched blade (adze) at a right angle to a shaft and opposite a striking surface, a bedding hook and two tether attachment points.

BRIEF DESCRIPTION OF THE DRAWINGS

Three embodiments will now be described in detail by way of example, with reference to the accompanying drawings in which:

Figure 1: Shows a ladder safety system with retractable tie-down used at a 75° angle for working from

Figure 2: Shows a ladder safety system with retractable tie-down used at a 60° angle for rapid egress above grade.

Figure 3: Shows a ladder safety system with retractable tie-down in its stowed position.

Figure 4: Shows a ladder safety system with retractable tie-down close-up when in use.

Figure 5: Shows a first embodiment of the ladder safety system with retractable tie-down frontal view in a stowed position with its anchor pictured as stowed.

Figure 6: Shows a close-up front view of the first embodiment of the ladder safety system with retractable tie-down in stowed position.

Figure 7: Shows a close-up rear view of the first embodiment of the ladder safety system with retractable tie-down in stowed position.

Figure 8: Shows a front elevation of the first embodiment of the ladder safety system with retractable tie-down.

Figure 9: Shows cross-section views A thru C of the first embodiment of the ladder safety system with retractable tie-down.

Figure 10: Shows cross-section views D and E (unlocked position) and cross-section view F of the first embodiment of the ladder safety system with retractable tie-down.

Figure 11: Shows cross-section view E of the first embodiment of the ladder safety system with retractable tie-down (locked position).

Figure 12: Shows a front and side view of the anchor.

Figure 13: Shows a cross-section of the tether.

Figure 14: Shows the tether cable.

Figure 15: Shows a flow chart detailing the method of use of the ladder safety system with retractable tie-down.

Figure 16: Shows a variation to the locking mechanism of the first embodiment of the ladder safety system with retractable tie-down cross-section views D, E, and F.

Figure 17: Shows a second embodiment of the ladder safety system with retractable tie-down mounted on a ladder.

Figure 18: Shows a close-up front view of the second embodiment of ladder safety system with retractable tie-down.

Figure 19: Shows cross-section views G thru I of the second embodiment of the ladder safety system with retractable tie-down.

Figure 20: Shows a front view of the third embodiment of the ladder safety system with retractable tie-down.

Figure 21: Shows a close-up view of the third embodiment of the ladder safety system with retractable tie-down as well as cross-section J.

Figure 22: Shows cross-section views K thru N of the third embodiment of ladder safety system with retractable tie-down.

DETAILED DESCRIPTION

The description, which follows, and the embodiments described therein, is provided by way of illustration of an example, or examples of particular embodiments of principles and aspects of the present invention. These examples are provided for the purposes of explanation, and not of limitation, of those principles and of the invention. In the description that follows, like parts are marked throughout the specification and the drawings with the same respective reference numerals.

The first embodiment of the ladder safety system with retractable tie-down includes the following elements:

- a) A shaft 100;
- b) A reel 101; the reel comprising one rotatable member, wherein the reel is rotatable around the shaft;
- c) A first end plate 103; configured to accommodate the recessed bearing of the shaft and encompassing the width of a retracting spring;
- d) A second end plate 104 opposite to first plate 103; configured to accommodate the recessed bearing and recoil safety brake and locking mechanism;
- e) A locking handle 105; a rotational locking handle for locking the reel in position, preventing rotation in either direction during use.
- f) A tether 106; the tether attached to the reel and to the anchor at the other end;
- g) A retracting mechanism 107; the retracting mechanism is operatively coupled to the reel and attached to the shaft at one end of the retracting mechanism; and
- h) A housing 102 upper and 108 lower; the housing spanning between the end plates containing at least a portion of the shaft and bearing, the reel, the retracting mechanism, and the tether.
- i) An anchor 109; inclusive of an "adze" 110 (arched blade at right angle to the handle), a bar, a hook and multiple tether attachment points.
- j) Mounting brackets 111; adapted to fit multiple sized and shaped rungs.
- k) Mount pivots 112; component that connects the mounting brackets and the ladder safety system with retractable tie-down to the ladder rung. The pivot is used to aid in bedding of ladder, storage and to reduce torque on rung during use. The pivot may also utilize slide or arching motion to attain clearance.

Referring first to Figures 5 to 12, the retracting element is mounted to one of the lower rungs of an extension ladder or straight ladder using the rung adapters 111 made specifically to the shape and size of the rung, depending on the ladder design. These rung adapters are made of strong, corrosion resistant material such as stainless steel and designed in such a way that they split 113 to allow easy installation. They are held in place by a fastener such as a recessed bolt in a blind threaded hole 114 and is designed so that the reel may rotate out of the way of the ladder user when climbing. A non-slip finish such as knurling or ribbing 115 is incorporated into the adapter design to ensure traction equal to that of the ladder rung to which it is mounted. The mounting bracket incorporates a pivot 112 to facilitate a

rotational movement of the reel and housing. The pivot allows the reel assembly to move inward while in the bedded position (Figure 5) facilitating clearance to the lowering fly section of the ladder from above. Once the ladder is extended for use and leaned against the vertical supporting structure, the reel assembly swings forward under gravity and pull of the tether reducing the torque which will be applied to the rung. Torque is reduced by pivoting the reel and shortening the distance from the center of the rung to where the force is applied. The pivot is constructed of a strong corrosion resistant material such as stainless steel similar to the rung adapter and utilizes a corrosion resistant fastener 116 (e.g. bolt, rivet, etc.) to attach to the upper housing of the reel assembly. It mates with an identically machined "mount" protruding from the upper housing body to facilitate mounting the reel assembly. A wear device such as a grommet or washer made of a material such as plastic or brass 117 is placed between the mating surfaces to facilitate movement and prevent wearing of stainless materials.

The use of the ladder rung adapter allows the accessory to be field installed using simple instructions and installation specifications for the bolts or fasteners. It requires limited knowledge of ladders however would be best performed by a competent individual or maintenance department and scheduled to be inspected on interval with inspection of the ladder.

The reel assembly contains the reel 101, the upper housing 102, the lower housing 108, spring assembly and end cap 103, the brake/ lock mechanisms and end cap 104 and the locking handle 105.

With reference to Figures 8 and 10, sections B thru E, the reel 101 is constructed of corrosion resistant material and is shaped in such a way to allow re-winding of the tether to be done smoothly and easily.

It is cylindrical in shape and rotates around the axis of an integrated shaft 100 along its longitudinal axis. The ends of the integrated shafts; are made to fit within the bearing 118 housed in the spring assembly end cap and the brake/lock assembly end cap. The reel rotates with little friction due to the use of the bearings.

The reel is driven in a rotational manner by the retracting mechanism or integrated spring 107 around its longitudinal axis to facilitate the re-winding of the un-wound tether used to secure the ladder in place. The retracting mechanism, whether integrated into the body of the reel or installed as a separate component is constructed of corrosion resistant materials and sealed from the elements. The retracting mechanism is anchored at one end to the reel

itself 119 and at the other to the end cap 120 to allow tension to be created during unwinding of the reel. This places tension on the tether when it is extended from the device.

The reel is locked and braked using the components incorporated into the brake/lock end plate 104 and is recessed into the end of the reel 101. Once the tether is extended and anchor point is established and tested, the ladder is locked in place by the locking mechanism (Unlocked 121/Locked 122). This system utilizes a cogged or toothed system.

The reel's braking mechanism 123 incorporated into the system is designed to prevent injury to the user and damage to the device. It achieves this by using a centrifugal brake to prevent a rapid retraction of the reel if the anchor is removed and the reel is unlocked when not under control of the user (e.g. during packing-up of the ladder). A braking system such as the one shown in this particular embodiment acts when the retraction speed exceeds a safe level engage the teeth of the brake with the cogs incorporated in the end cap, thus stopping the reels inward motion. The pictured brake is one embodiment however many centrifugal braking systems could be utilized to achieve the desired effect.

With reference to Figures 8 and 9, the upper housing 102 and lower housing 108 are constructed of a corrosion resistant material (e.g. stainless steel or synthetic material) and provide structural support for the end plates and reel.

The upper housing 102 incorporates mounts 124 protruding from the top which are constructed to mate with the rung adapter pivot points. The rear face of the upper housing incorporates a recessed area 125 for identification or logo purposes. On both the upper and lower housing, at the ends of the housings there is a protrusion of material 126 designed to interlock with the mating recession 127 in the end plate to aid in preventing movement of the two combined components. The end plates are held in place by machined bolts 128 extending through holes in the end plate 129 and securing into threaded holes in the upper and lower housings 130. The lower housing incorporates a rounded forward edge 131 to prevent wear to tether when in use and while stowed as in Figure 5.

The end plate incorporating the spring mechanism 103 (Figure 9 section A) is constructed of a corrosion resistant material and protects the mechanism from the elements. There is a protrusion 132 allowing the bearing to mount flush to the inside. A recession along the perimeter 127, mates with the protrusion in the upper and lower housings to ensure alignment. Through-holes 129 allow for mounting.

The end plate incorporating the lock/brake components 104 is constructed of a corrosion

resistant material and protects the mechanism from the elements. The pictured locking mechanism 121 is the preferred embodiment utilizing an S-cam and cogged and tooth system however the general premise of the locking mechanism is to secure the reel from rotating in the forward direction. This could be done using palls and a rotating cog mounted to the reel, a braking surface or a pin to secure the reel. There is a protrusion 132 allowing the bearing to mount flush to the inside. A recession along the perimeter 127, mates with the protrusion in the upper and lower housings 126 to ensure alignment. Through-holes 129 allow for mounting.

The locking handle 105 is constructed of a strong, corrosion resistant material constructed for added grip such as incorporated finger grooves 134 or knurling. It rotates the shaft 135 that extends through the locking end plate causing the s-cam to engage the locking mechanism 121.

Referring now to Figure 12, the anchor 109 is constructed of a corrosion resistant metal such as stainless steel designed to withstand a prying force to the adze 110, a pulling force to the tether attachment points 137 and bedding hook 138 as well as striking force to the flat surface 139 directly opposite the adze. Anchor slot 140 incorporated into the shaft of the anchor is designed to allow the cable to be passed through the anchor, wrapped around an anchor point and secured back to itself creating a cinch around an object. The attachment point 137, allows for a fastener to pass through the base of the anchor securing the eyelet from the tether to the anchor. The anchor can be stored in the bedded position (see Figures 2 and 5) using the bedding hook 138 to place tension on the cable, rotate the reel assembly back in-line (see Figure 3) with the ladder and facilitate clearance for the fly section of the ladder. This allows for safe storage of the anchor and allows ladders to be stacked easily (common practice) when mounted on a fire apparatus or service vehicle. Furthermore it prevents the user from using the ladder without deploying the safety device and eliminates the need for carrying a separate anchor to the site where the ladder is placed.

Referring now to Figures 13 and 14, the tether 106 is constructed of a corrosion resistant, flexible material 142 capable of handling the loads applied to it (e.g. cable, webbing, belting, or rope). It may employ a coating 141 to achieve this. The preferred embodiment is a cable such as a stainless 7x19 coated aircraft cable. Other materials such as Kevlar based cables may be used in other embodiments. The tether incorporates an attachment point at one

end such as a ball 143 and a second attachment such as an eyelet 144 at the other. The tether may also incorporate a reflective band wrapped within the coating or is colored in such a way to prevent tripping and injury.

Referring now to Figure 15, another aspect of this disclosure describes a method for automatically or manually retracting the tether. The method includes performing the following steps: providing a tether for extension and retraction; applying a retraction force to the tether manually or with a retracting mechanism, applying a braking force to the reel if the retracting speed exceeds a safe rate and the ability to lock the reel in place during use.

A variation to the locking mechanism is shown in Figure 16. This embodiment incorporates two palls 145 and springs 146 using rotational unlocking motion. This design leaves the reel normally locked position by the spring below the locking handle 147. The user must apply a rotational force and maintain that force in order for the reel to re-wind the tether.

The second embodiment of the ladder safety system with retractable tie-down includes the following elements:

- a) A shaft 100;
- b) A reel 101; the reel comprising one rotatable member and accommodates bearings, wherein the reel is rotatable around the shaft;
- c) An end plate 103; including the shaft and encompassing the width of the retracting spring and locking assembly;
- d) A locking handle 105; a rotational locking handle for locking the reel in position, preventing rotation in either direction during use.
- e) A tether 106; the tether attached to the reel and to the anchor at the other end;
- f) A retracting mechanism 107; the retracting mechanism is operatively coupled to the reel and attached to the shaft at one end of the retracting mechanism; and
- g) An upper housing 102; the housing spanning between the end plate and

configured to protect the tether when wound upon the reel.

- h) An anchor 109; inclusive of an “adze” 110 (arched blade at right angle to the handle), a bar, a hook and multiple tether attachment points.
- i) A mounting bracket 111; adapted to fit multiple sized and shaped rungs.
- j) A mount pivot 112; component that connects the mounting brackets and the basal tie-off system to the ladder rung. Pivot is used to aid in bedding of ladder, storage and to reduce torque on rung during use. Pivot may also utilize slide or arching motion to attain clearance.

Referring first to Figures 17 to 19, the retracting element is mounted to one of the lower rungs of an extension ladder or straight ladder using the rung adapters 111 made specifically to the shape and size of the rung, depending on ladder design. The rung adapter is made of a strong, corrosion resistant material such as stainless steel and designed in such a way that it splits 113 to allow easy installation. They are held in place by a fastener such as a recessed bolt in a blind threaded hole 114 and is designed so that the reel may rotate out of the way of the ladder user when climbing. A non-slip finish such as knurling or ribbing 115 is incorporated into the adapter design to ensure traction equal to that of the ladder rung to which it is mounted. The mounting bracket incorporates a pivot 112 to facilitate a rotational movement of the reel and housing. The pivot is constructed of a strong corrosion resistant material such as stainless steel similar to the rung adapter and utilizes a corrosion resistant fastener 116 (e.g. bolt, rivet) to attach to the upper housing of the reel assembly. It mates with an identically machined “mount” protruding from the upper housing body to facilitate mounting the reel assembly. A wear device such as a grommet or washer made of a material such as plastic or brass 117 is placed between the mating surfaces to facilitate movement and prevent wearing of stainless materials.

The use of the ladder rung adapter allows the accessory to be field installed using simple instructions and installation specifications for the bolts or fasteners. It requires limited knowledge of ladders however would be best performed by a competent individual or maintenance department and scheduled to be inspected on interval with inspection of the ladder.

With reference to Figure 19, sections G thru I, the reel assembly contains the reel 101, the

upper housing 102, spring assembly 107, the brake/ lock mechanisms 123, end cap 103 and the locking handle 105.

The reel 101 is constructed of corrosion resistant material and is shaped in such a way to allow re-winding of the tether to be done smoothly and easily.

It is cylindrical in shape and rotates around the axis of the shaft 100 along its longitudinal axis. The reel accommodates bearings 118 and rotates with little friction due to the use of the bearings.

The reel is driven in a rotational manner by the retracting mechanism or integrated spring 107 around its longitudinal axis to facilitate the re-winding of the un- wound tether used to secure the ladder in place. The retracting mechanism, whether integrated into the body of the reel or installed as a separate component is constructed of corrosion resistant materials and sealed from the elements. The retracting mechanism is anchored at one end to the reel itself 119 and at the other to the end cap 120 to allow tension to be created during unwinding of the reel. This places tension on the tether when it is extended from the device.

The reel is locked and braked using the components incorporated into the brake/lock end plate 103 and is recessed into the end of the reel 101. Once the tether is extended and anchor point is established and tested, the ladder is locked in place by the locking mechanism 123. This system utilizes a cogged or tooth system.

The reel's braking mechanism 123 incorporated into the system is designed to prevent injury from ladder slippage to the user and damage to the ladder.

With reference to Figure 17, the upper housing 102 is constructed of a corrosion resistant material (e.g. stainless steel or synthetic) is shaped in such a way to protect the tether from damage and provide structural support for the end plate and reel.

With reference to Figures 17 thru 19 and sections G thru I, the upper housing 102 incorporates a mount 124 protruding from the top which is constructed to mate with the rung adapter pivot point. The rear face of the upper housing incorporates a recessed area 125 for identification or logo purposes. On upper housing the end of the housing is a protrusion of material 126 designed to interlock with the mating recession 127 in the end plate to aid in preventing movement of the two combined components. The end plates are held in place by fasteners 128 such as bolts extending through holes in the end plate and securing into threaded holes in the upper housing 130.

The locking handle 105 is constructed of a strong, corrosion resistant material constructed

for added grip such as incorporated finger grooves 134 or knurling. It rotates on a shaft 135 and extends through the locking end plate engage/disengage the locking mechanism 121 and 123.

The third embodiment of the ladder safety system with retractable tie-down includes the following elements:

- a) A shaft 100;
- b) A reel 101; the reel comprising one rotatable member, wherein the reel is rotatable around the shaft;
- c) A first end plate 103; configured to accommodate the recessed bearing of the shaft and encompassing the width of a retracting spring;
- d) A second end plate 104 opposite to first plate 103; configured to accommodate the *recessed bearing and locking mechanism*;
- e) A locking handle 105; a rotational locking handle for locking the reel in position, preventing rotation in either direction during use.
- f) A tether 106; the tether attached to the reel and to the anchor at the other end;
- g) A retracting mechanism 107; the retracting mechanism is operatively coupled to the reel and attached to the shaft at one end of the retracting mechanism; and
- h) A housing 102 upper and 108 lower incorporated into the ladder rung itself; the housing spanning between the end plates containing at least a portion of the shaft and bearing, the reel, the retracting mechanism, and the tether.
- i) An anchor 109; inclusive of an “adze” 110 (arched blade at right angle to the handle), a bar, a hook and multiple tether attachment points.

Referring first to Figure 20, the retracting element is integrated into one of the lower rungs of an extension ladder or straight ladder. The overall dimensions of the rung and integrated mechanism will vary depending on the size, rating and purpose for the ladder. A non-slip finish such as knurling or ribbing 115 is incorporated equal to that of the other rungs on the

ladder. The upper housing 102 and lower housing 108 are constructed of a strong, corrosion resistant material such as stainless steel and is design to carry the load of the user like any other rung of the ladder.

Referring now to Figures 21 and 22 and sections J thru N, the reel assembly integrated into the rung contains the reel 101, the upper housing 102, the lower housing 108, spring assembly and end cap 103, the brake/lock mechanisms and end cap 104 and the locking handle 105.

With reference to section J, the reel 101 is constructed of a corrosion resistant material, is cylindrical in shape rotating around an integrated shaft 100 along its longitudinal axis and is shaped in such a way to allow re-winding of the tether to be done smoothly and easily.

One end of the integrated shaft 100 is attached to the end cap 104 and the other slid into a hole with a wear material or bushing 148 in the opposite end cap 103. This allows installation during ladder assembly. The reel 101 incorporates two bearings 118 to ensure the reel rotates with little friction due to the use of the bearings.

The reel is driven in a rotational manner by the retracting mechanism or integrated spring 107 around its longitudinal axis to facilitate the re-winding of the un-wound tether used to secure the ladder in place. The retracting mechanism, whether integrated into the body of the reel or installed as a separate component is constructed of corrosion resistant materials and sealed from the elements. The retracting mechanism is anchored at one end to the reel itself 119 and at the other to the end cap 120 to allow tension to be created during unwinding of the reel. This places tension on the tether when it is extended from the device.

With reference to Figures 21 and 22 Sections J thru N, the reel is locked and braked using the components incorporated into the brake/lock end plate 104 and is recessed into the end of the reel 101. Once the tether is extended and anchor point is established and tested, the ladder is locked in place by the locking mechanism 121 and 123.

The end plates 103 and 104 contain an impression along the perimeter 127, mates with the protrusion in the upper 102 and lower 108 housings to ensure alignment. Through-holes 129 allow for mounting.

The locking handle 105 is constructed of a strong, corrosion resistant material constructed for added grip such as incorporated finger grooves 134 or knurling. It rotates on a shaft 135 and extends through the locking end plate engage / disengage the locking mechanism 121 and 123.

While the principles of the invention have been shown and described in connection with specific embodiments, it is to be understood that such embodiments are by way of example and are not limiting. As is evident from the foregoing description, certain aspects of the present invention are not limited by the particular details of the invention illustrated in the drawings. Other modifications and applications, or equivalents, will occur to those skilled in the art. The terms "having", "comprising" and "including" and similar terms as used in the foregoing specification are used in the sense of "optional" or "may include" and not as "required". Many changes, modifications, variations and other uses and applications of the present construction will, however, become apparent to those skilled in the art after considering the specification and attached drawings. All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention which is limited only by the claims that follow. The scope of the disclosure is not intended to be limited to the embodiments shown herein, but is to be accorded the full scope consistent with the claims, wherein reference to an element in the singular is not intended to mean "one and only one" unless specifically so stated, but rather one or more.

CLAIMS

1. A ladder safety tie-down system comprising:
 - a) a reel assembly comprising a housing having an upper section;
 - b) an end plate, the housing attached to the end plate, supporting a shaft, a bearing at the shaft end, a reel, and a tether;
 - c) the tether attachable at one end to the reel and at its second end to the anchor tether attachment point(s);

The whole ladder safety tie-down system located inside any of the lower rungs of the ladder.
2. The ladder safety tie-down system of claim 1 wherein the reel is a rotatable member rotatable around the shaft.
3. The ladder safety tie-down system of claim 1 wherein the end plate is configured to accommodate a recessed bearing supporting the shaft and encompasses the width of a retracting spring mechanism.
4. The ladder safety tie-down system of claim 1 wherein the end plate is configured to accommodate a recoil safety brake and a locking mechanism.
5. The ladder safety tie-down system of claim 1 wherein the tether is coupled at one end to the reel and at the other end to the anchor member including an arched blade (adze) at a right angle to a shaft and opposite a striking surface, a bedding hook and at least one tether attachment point.
6. The ladder safety tie-down system of claim 1 with a retracting mechanism that is operatively coupled to the reel and attached to the shaft of the retracting mechanism.
7. A ladder safety tie-down system comprising:
 - a) a reel assembly comprising a housing having an upper section;

b) two end plates, the housing attached to the end plates, supporting a shaft, a bearing at the shaft ends, a reel, and a tether;

c) the tether attachable at one end to the reel and at its second end to the anchor tether attachment point(s);

The whole ladder tie-down safety system located inside any of the lower rungs of the ladder.

8. The ladder safety tie-down system of claim 7 wherein the reel is a rotatable member rotatable around the shaft.

9. The ladder safety tie-down system of claim 7 wherein the end plates are configured to accommodate recessed bearings supporting the shaft and one of the end plates encompasses the width of a retracting spring mechanism.

10. The ladder safety tie-down system of claim 7 wherein one of the end plates is configured to accommodate a recoil safety brake and a locking mechanism.

11. The ladder safety tie-down system of claim 7 wherein the tether is coupled at one end to the reel and at the other end to the anchor member including an arched blade (adze) at a right angle to a shaft and opposite a striking surface, a bedding hook and at least one tether attachment point.

12. The ladder safety tie-down system of claim 7 with a retracting mechanism that is operatively coupled to the reel and attached to the shaft of the retracting mechanism.

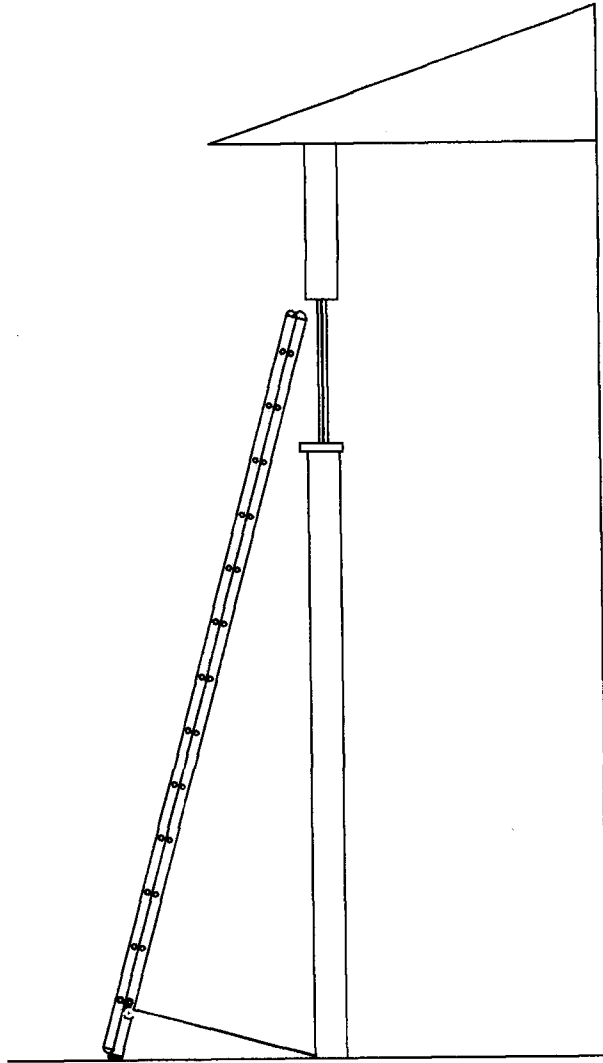


FIG. 1/22

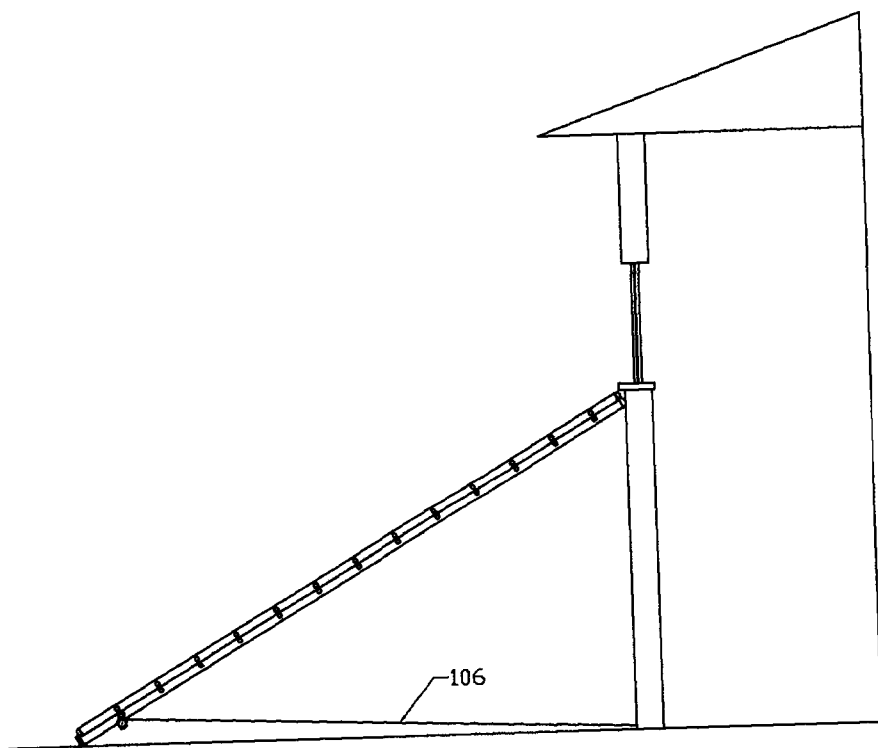


FIG. 2/22

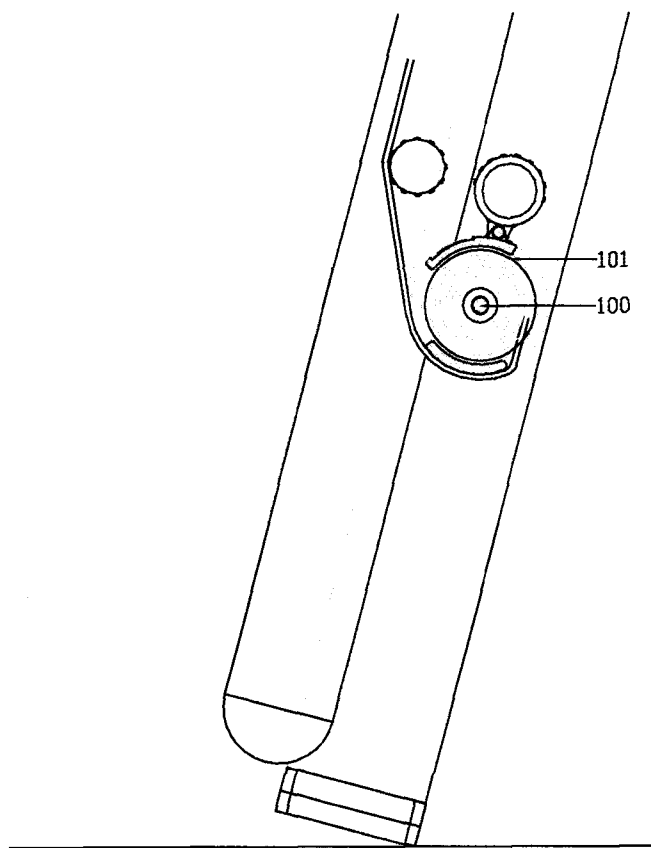


FIG. 3/22

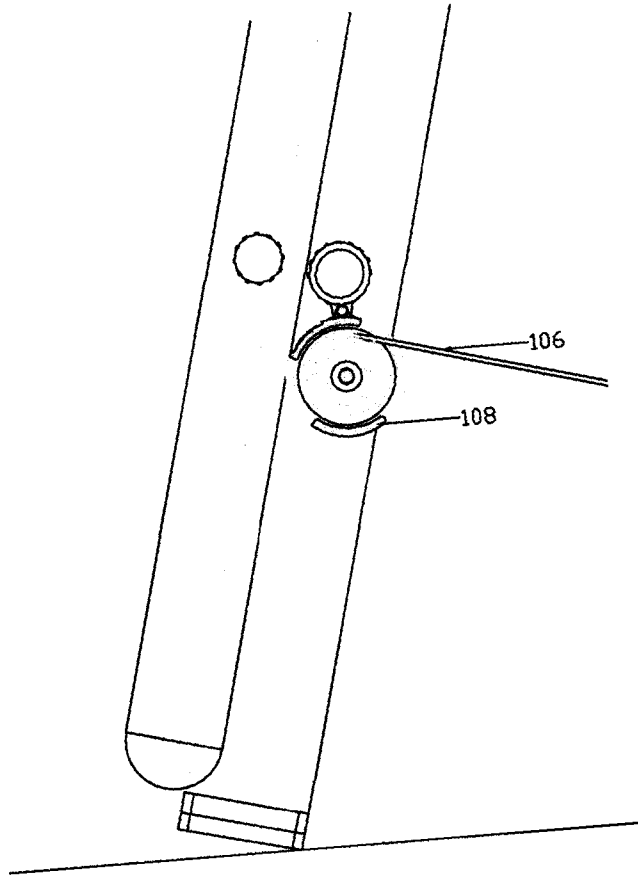


FIG. 4/22

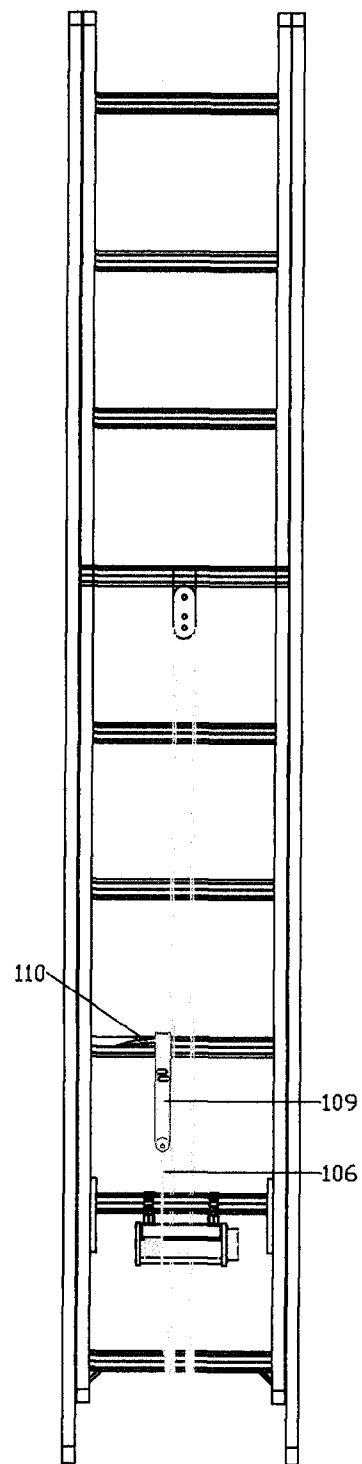


FIG. 5/22

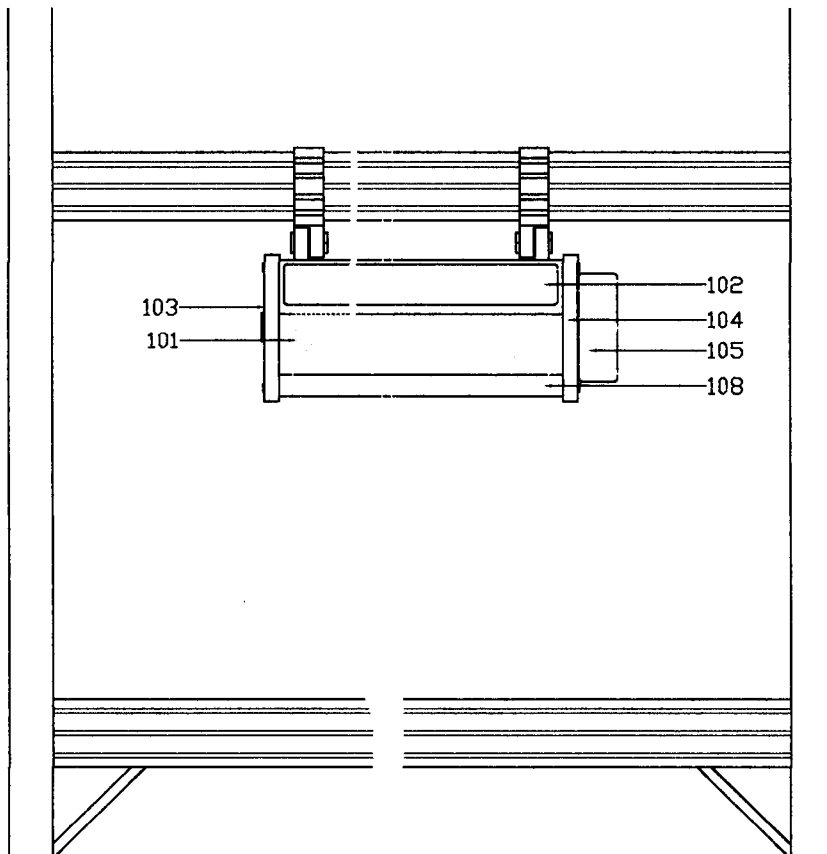


FIG. 6/22

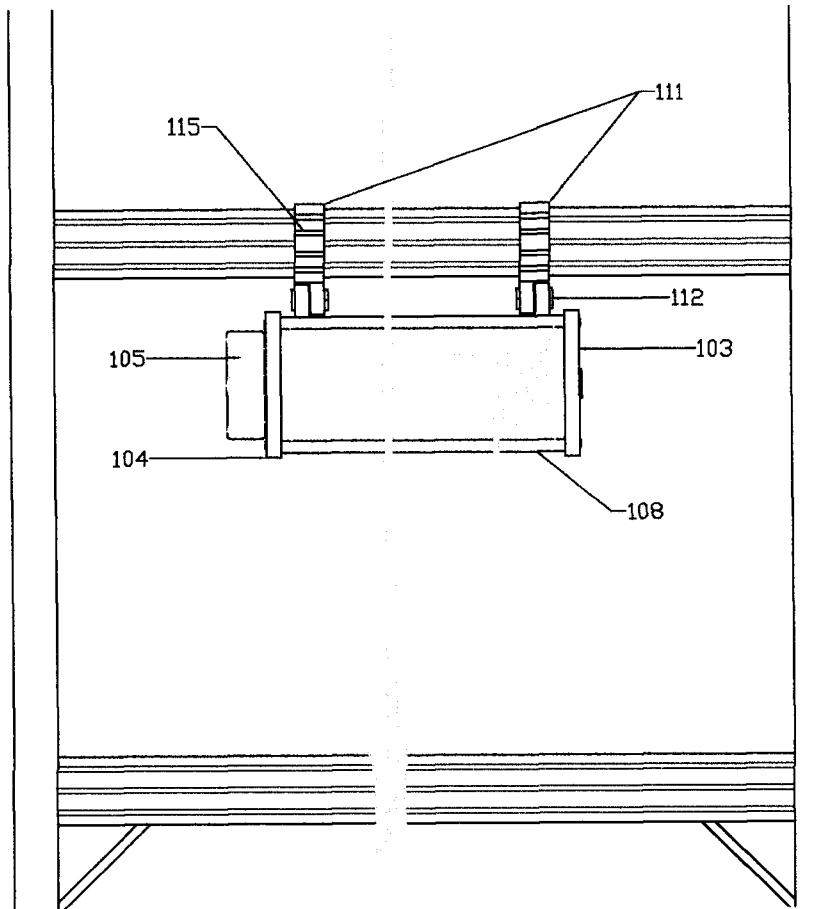


FIG. 7/22

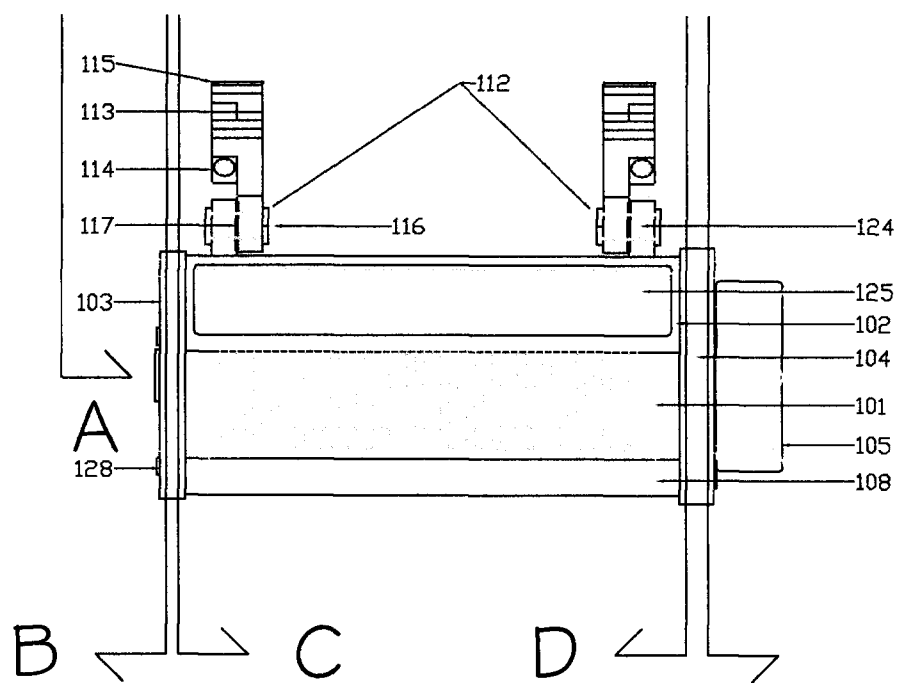


FIG. 8/22

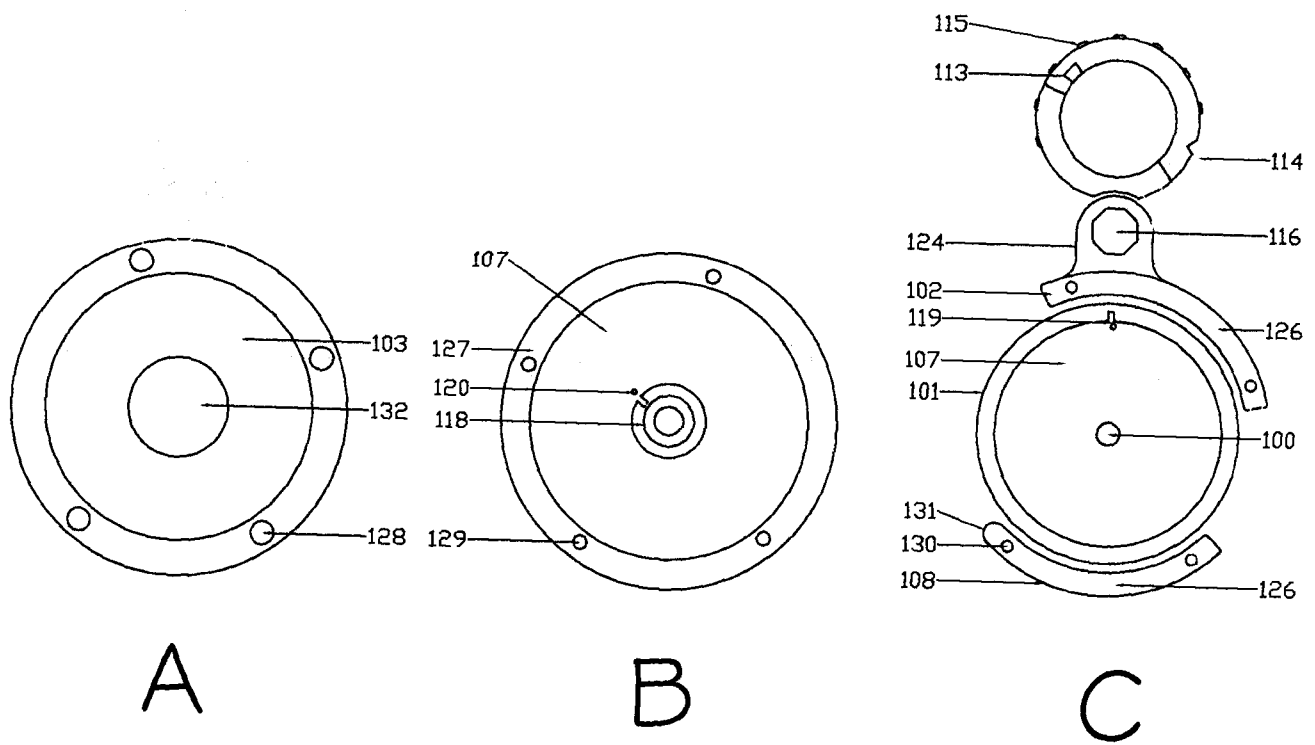


FIG. 9/22

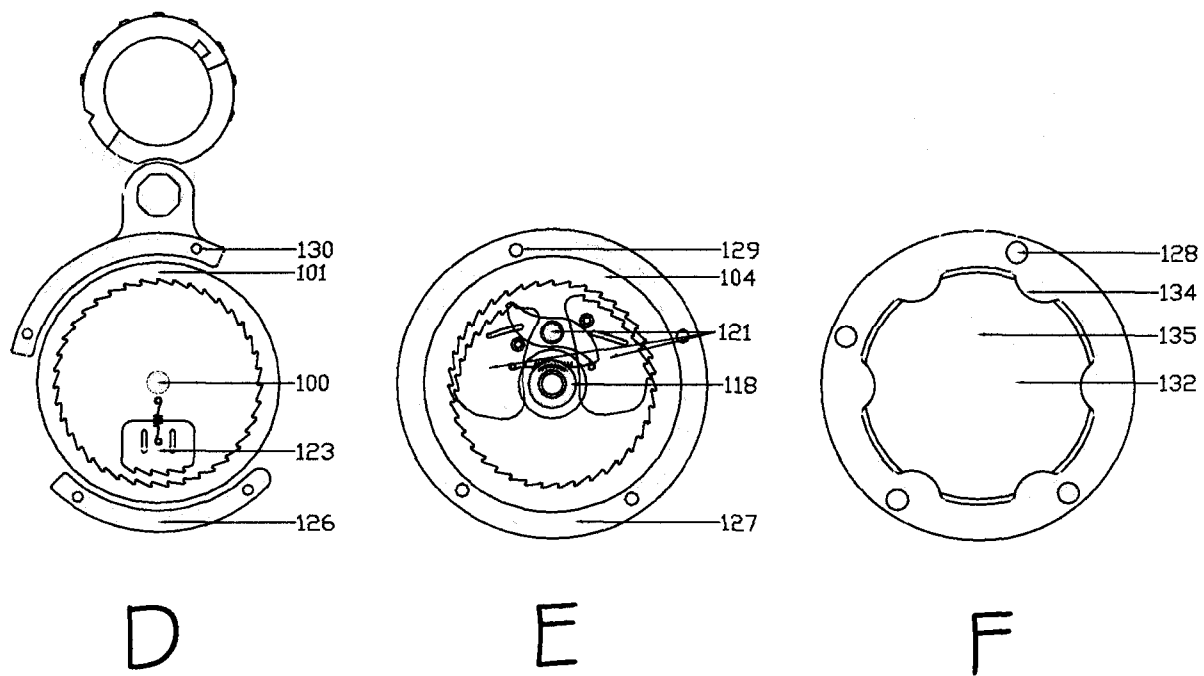
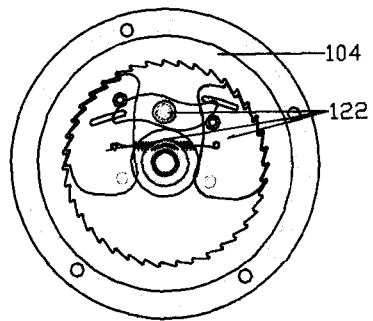


FIG. 10/22



E

FIG. 11/22

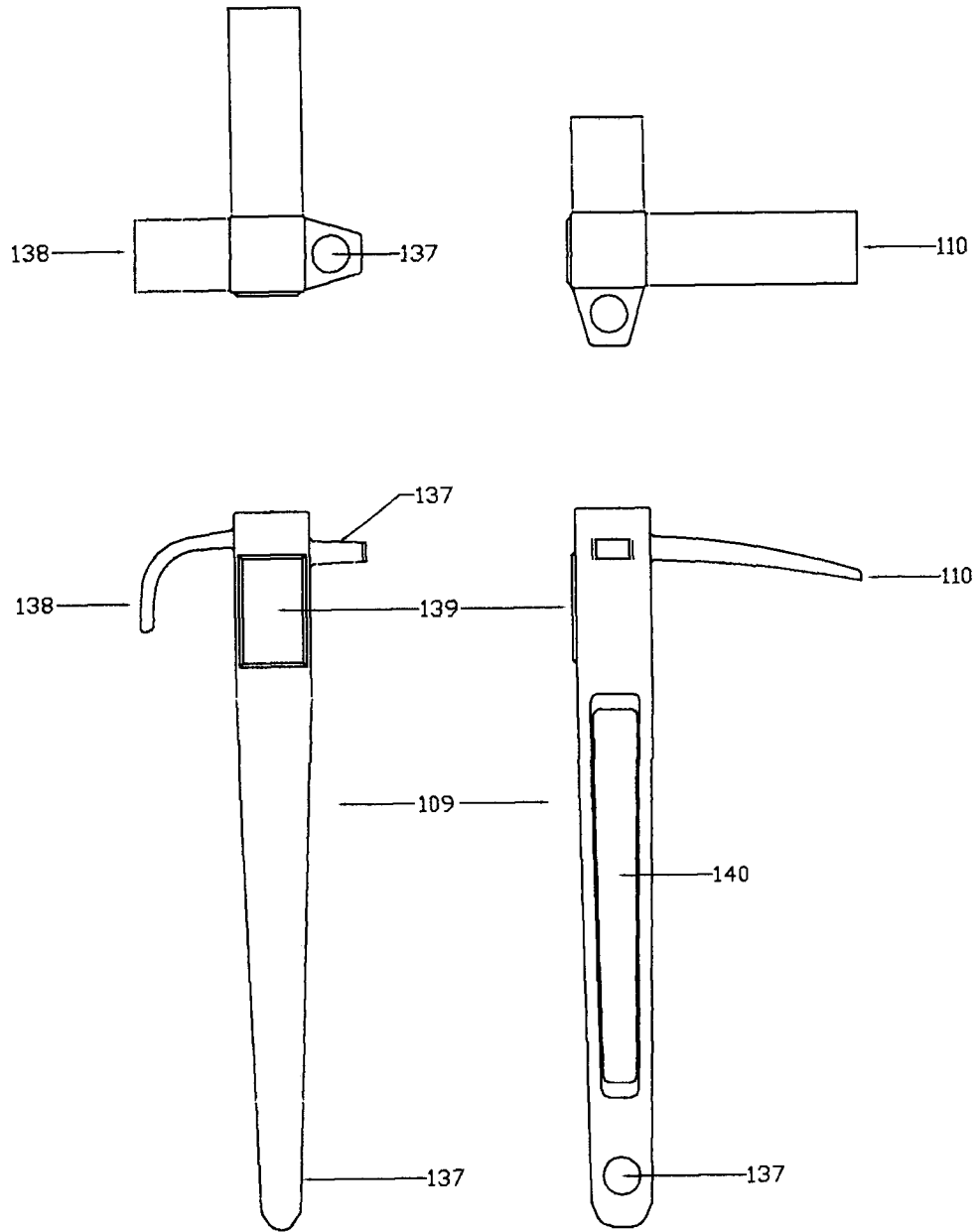


FIG. 12/22

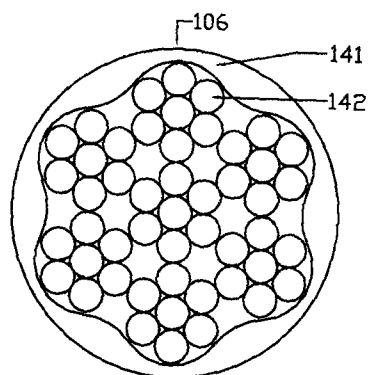


FIG. 13/22

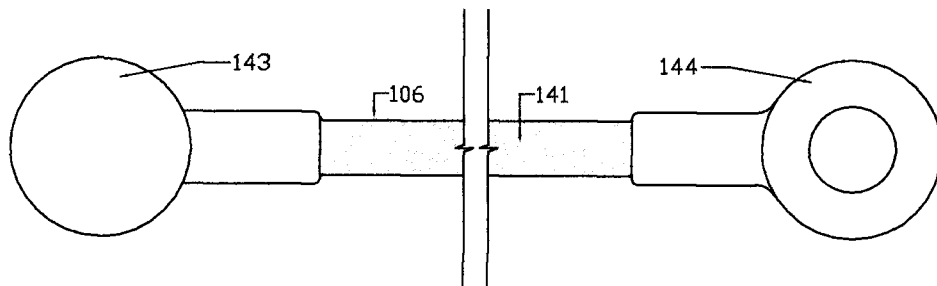


FIG. 14/22

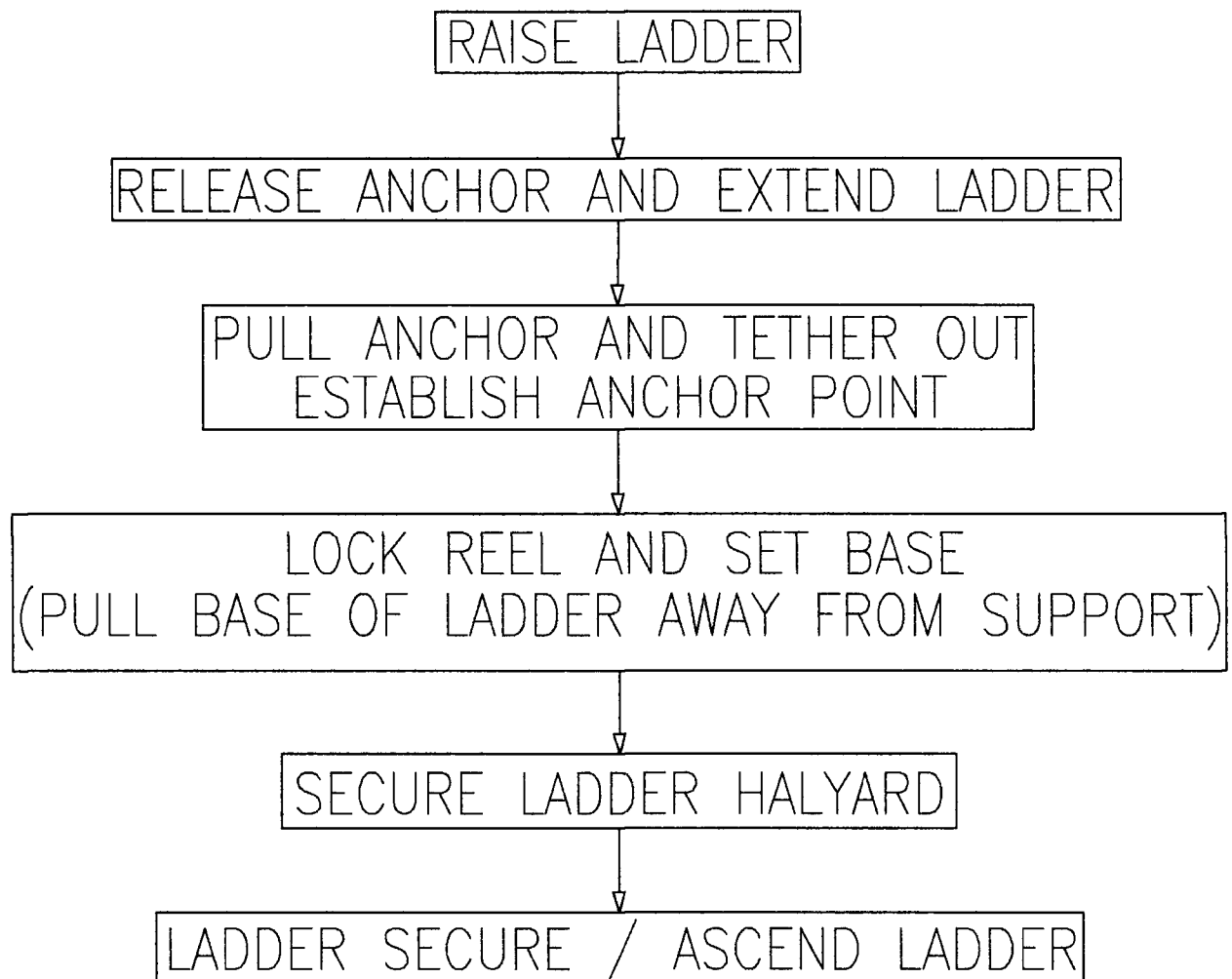


FIG. 15/22

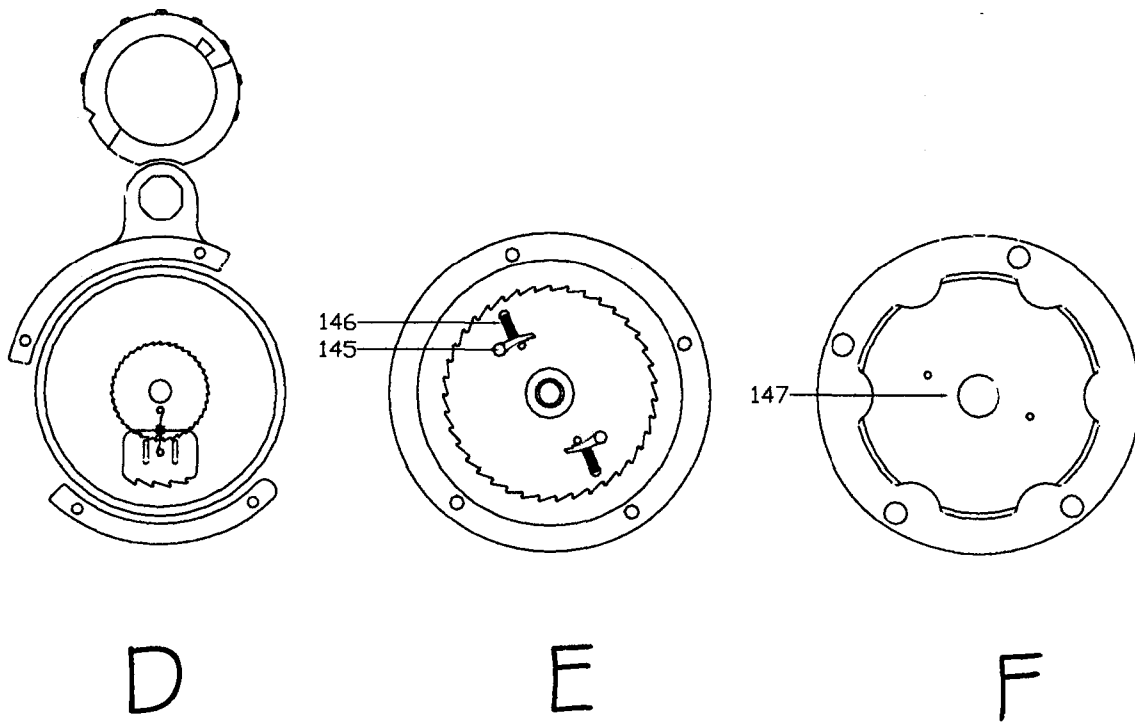


FIG. 16/22

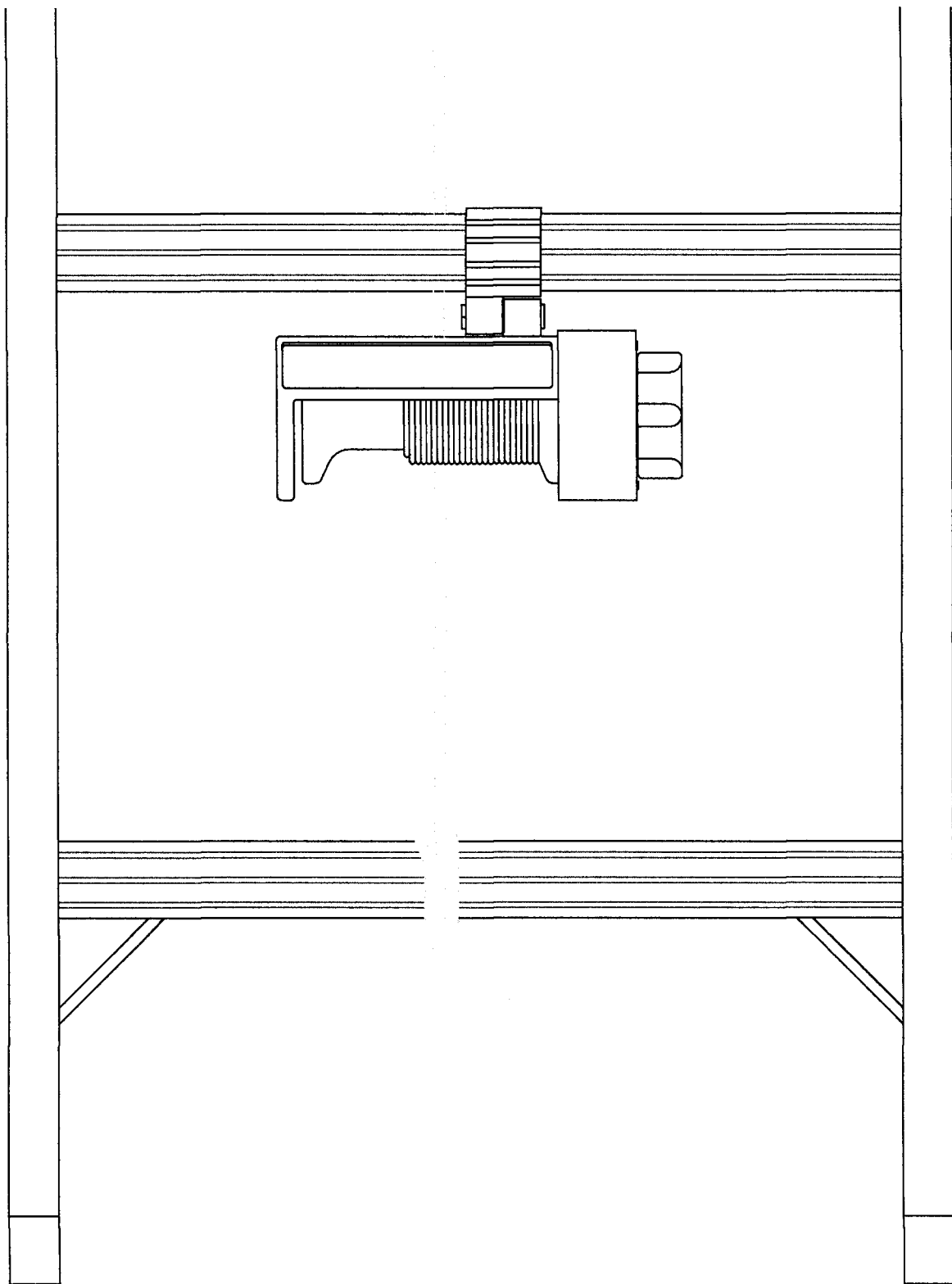


FIG. 17/22

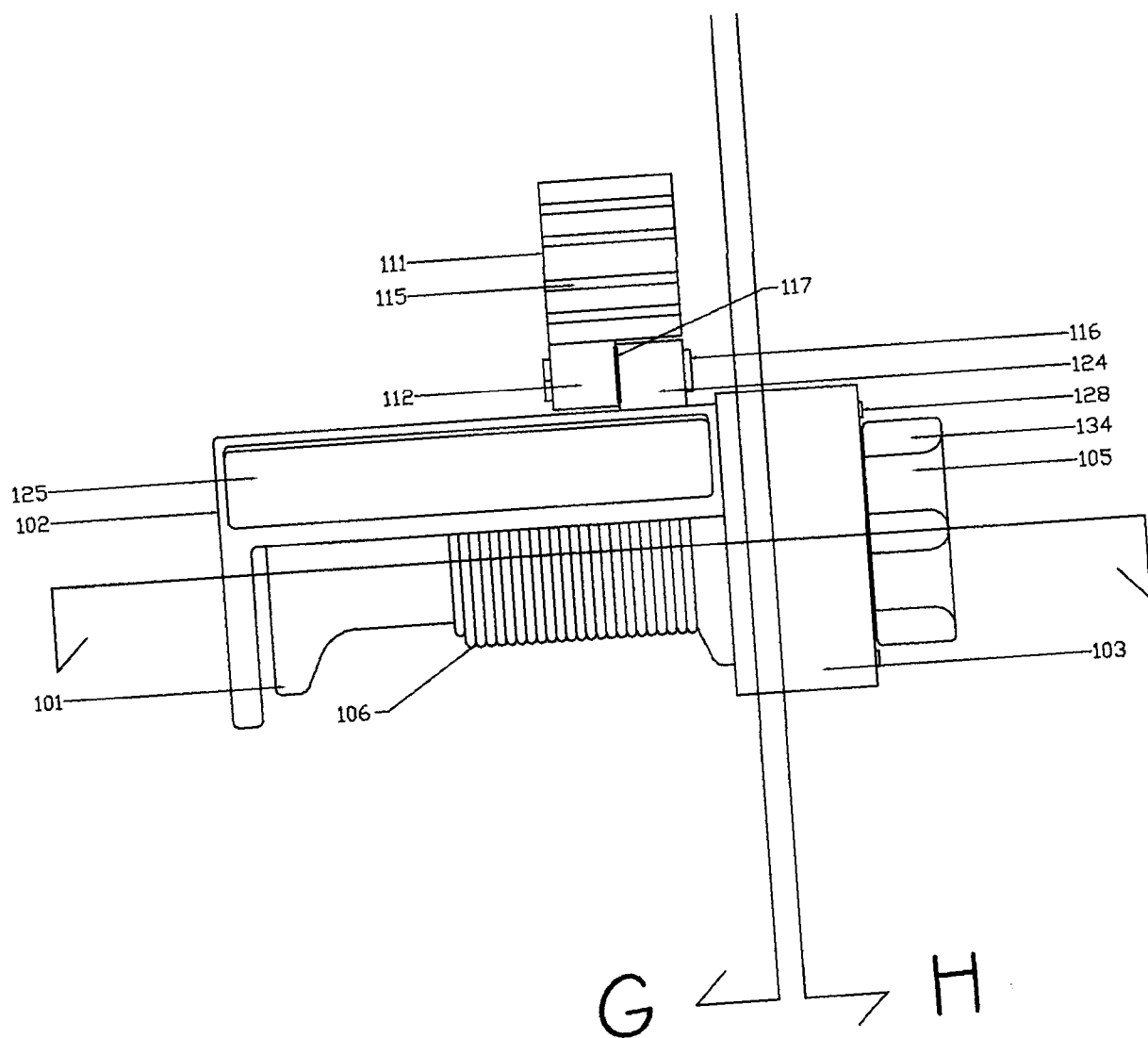
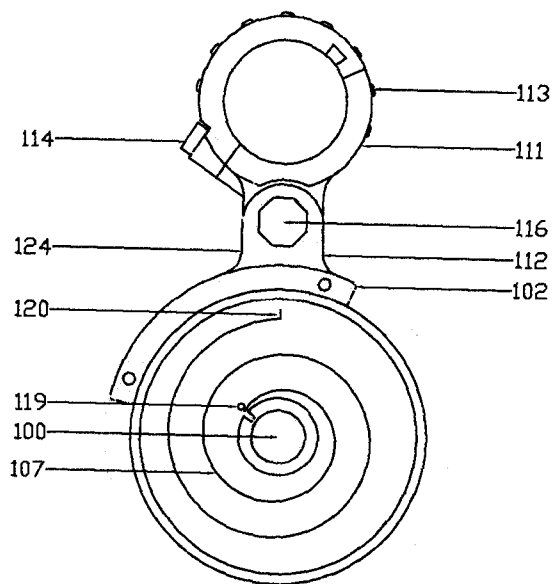
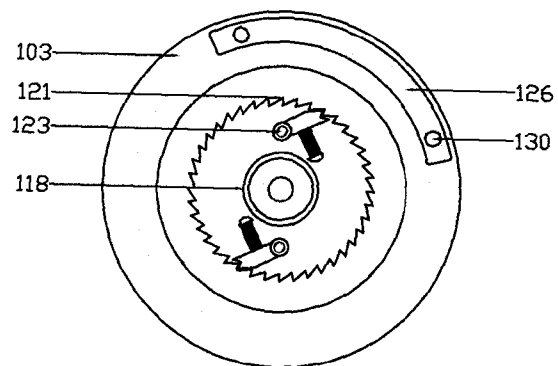


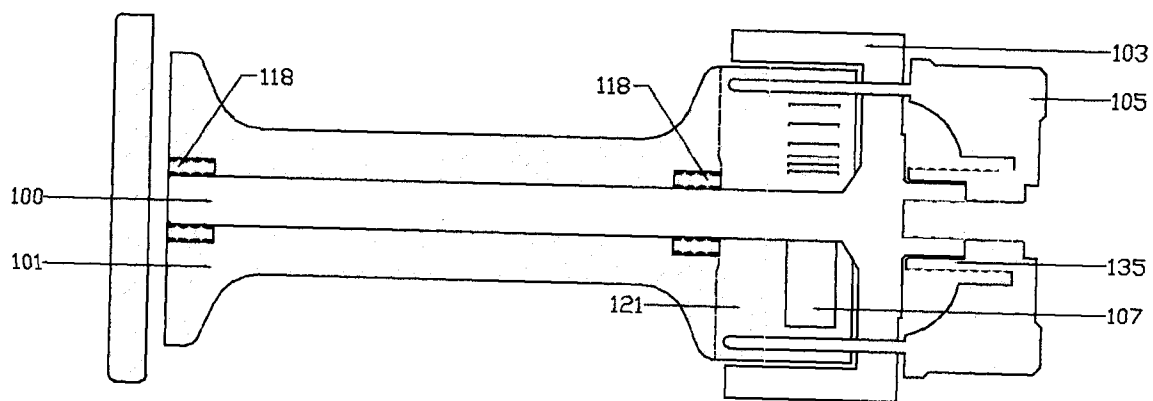
FIG. 18/22



G



H



I

FIG. 19/22

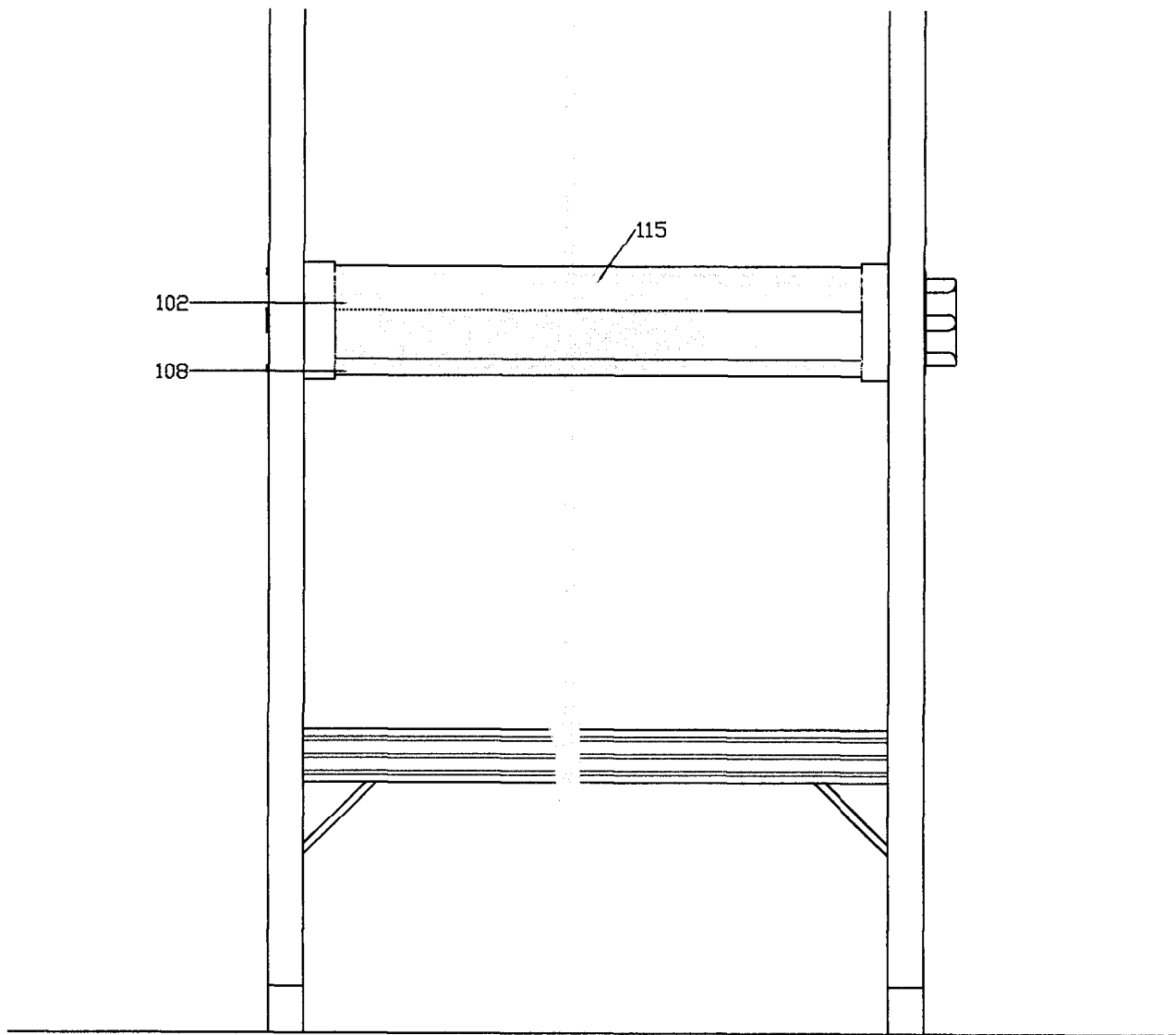


FIG. 20/22

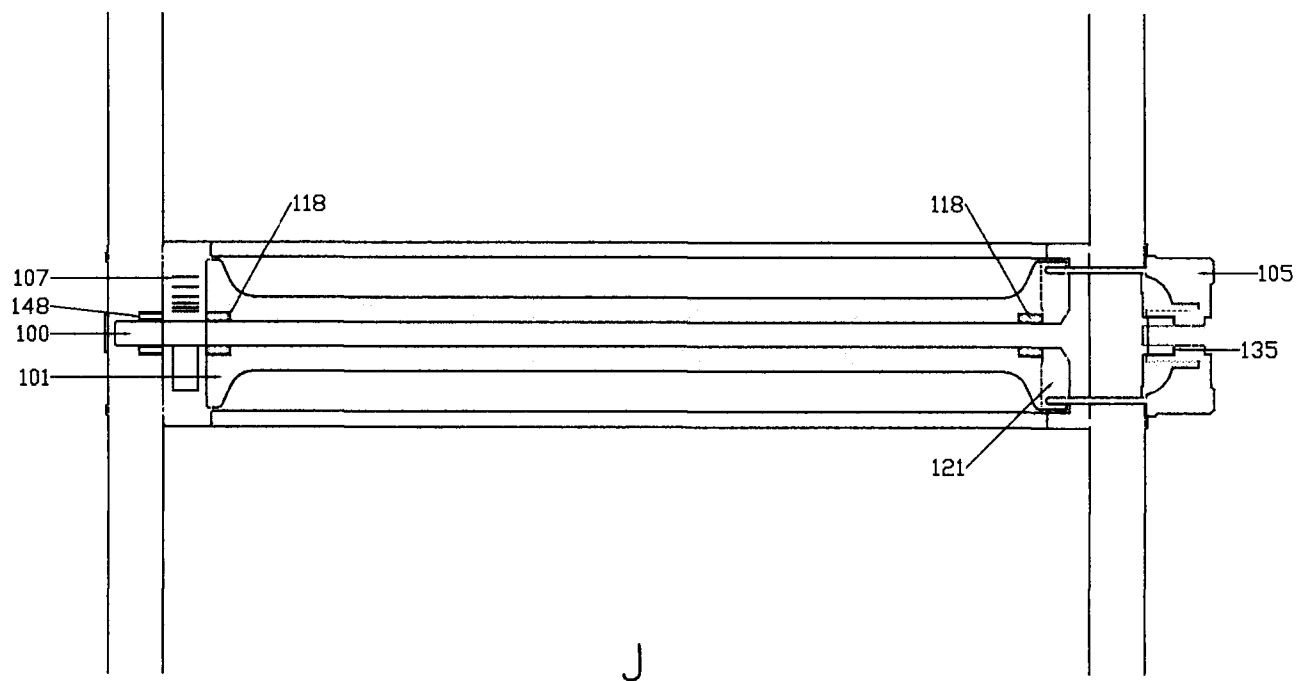
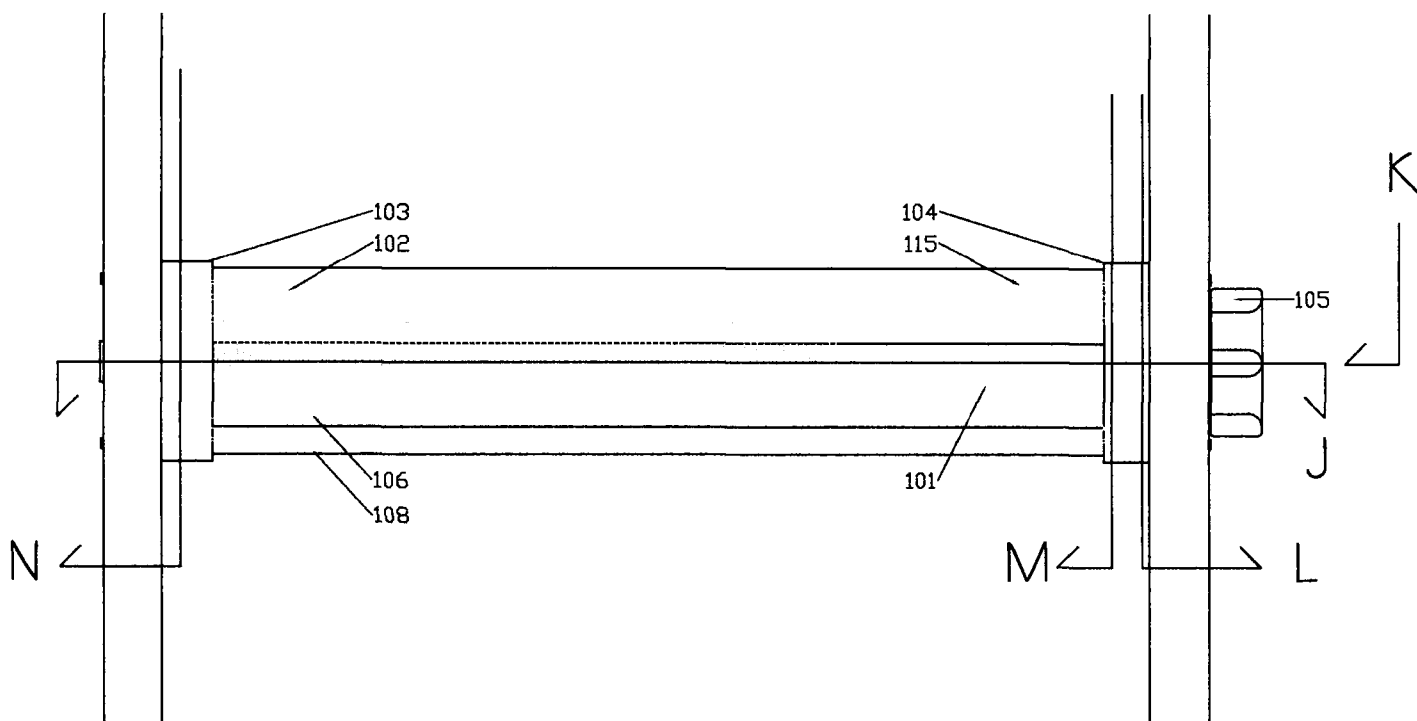
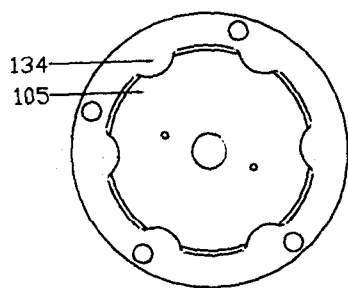
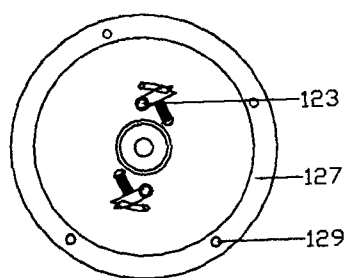


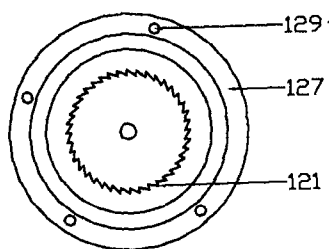
FIG. 21/22



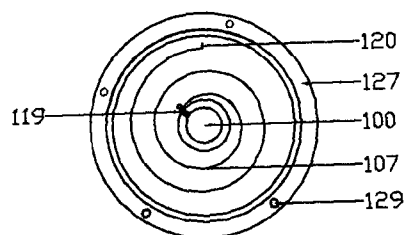
K



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M



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