United States Patent [19]

Cain et al.

[11] **3,724,816**

[45] **Apr. 3, 1973**

[54] ECONOMY HOIST

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[21] Appl. No.: **122,756**

[52] **U.S. Cl.** **254/164**

[51] **Int. Cl.** **A63b 61/04**

[58] **Field of Search** 254/146, 163, 164

[56] **References Cited**

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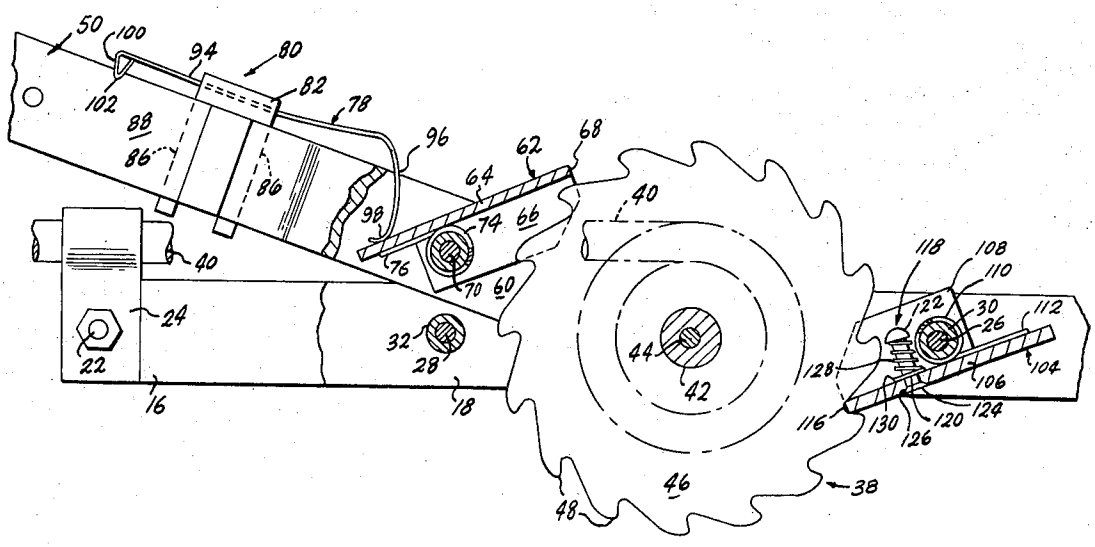
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Assistant Examiner—W. Scott Carson
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[57] **ABSTRACT**

A hoist or power unit characterized by its economy of construction utilizing a symmetrically formed frame including spaced elements at the central region thereof between which a rotatable ratchet drum is mounted having a tension member wound thereon. The lever arm upon which the ratchet catch is mounted, the catch, drum ratchet pawl and frame are all constructed of sheet metal, and the configuration of the components is such as to produce high strength with a minimum of material and a substantially uniform distribution of forces within the hoist during tensioning of the tension member. Catch and pawl operating components are of a simplified nature, the catch release being linearally shifted in the release direction and including a leaf spring whose influence is overcome during release of the drum by an abutment mounted upon the pawl.

4 Claims, 6 Drawing Figures



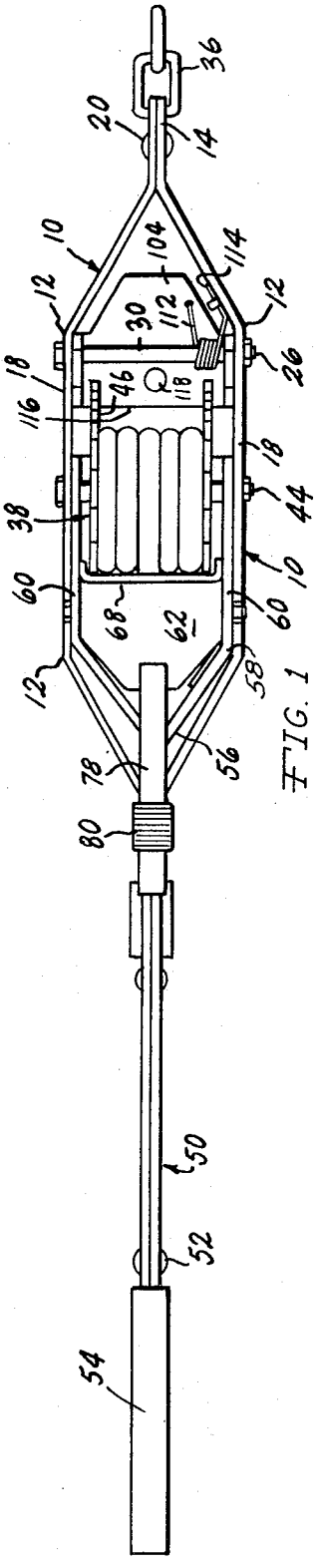


FIG. 1

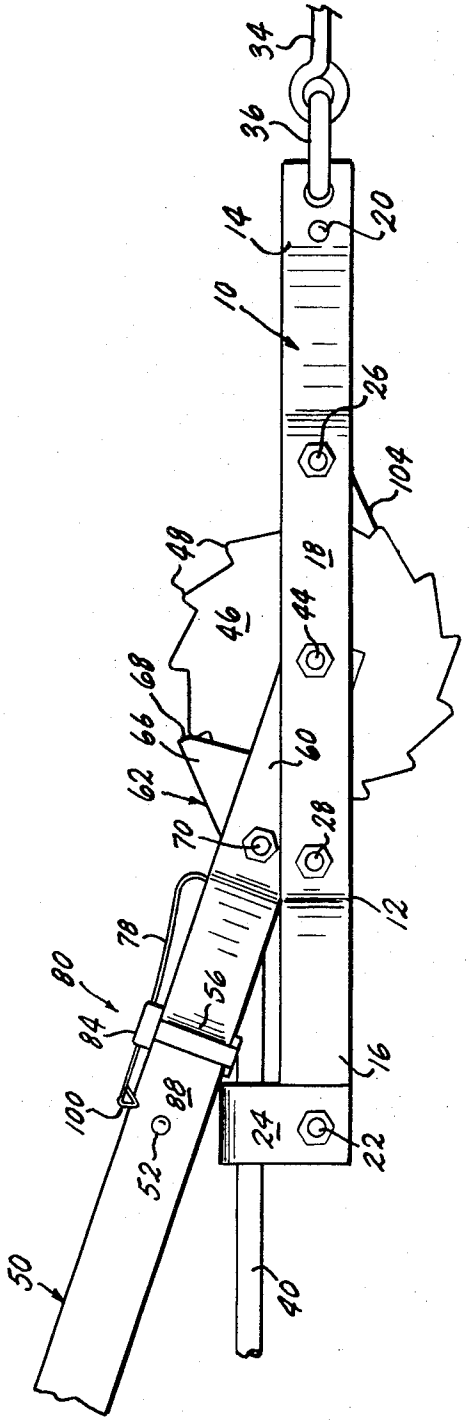


FIG. 2

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FIG. 3

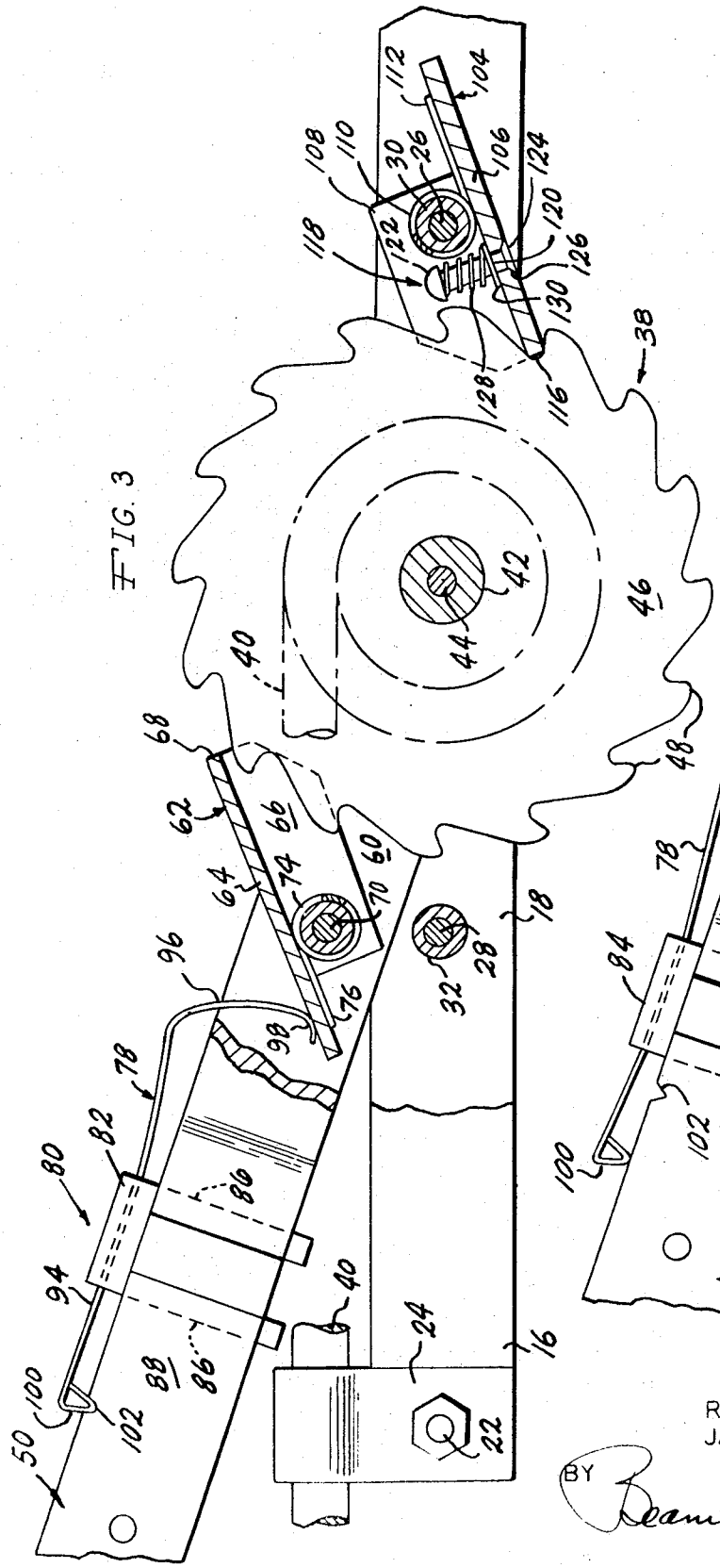
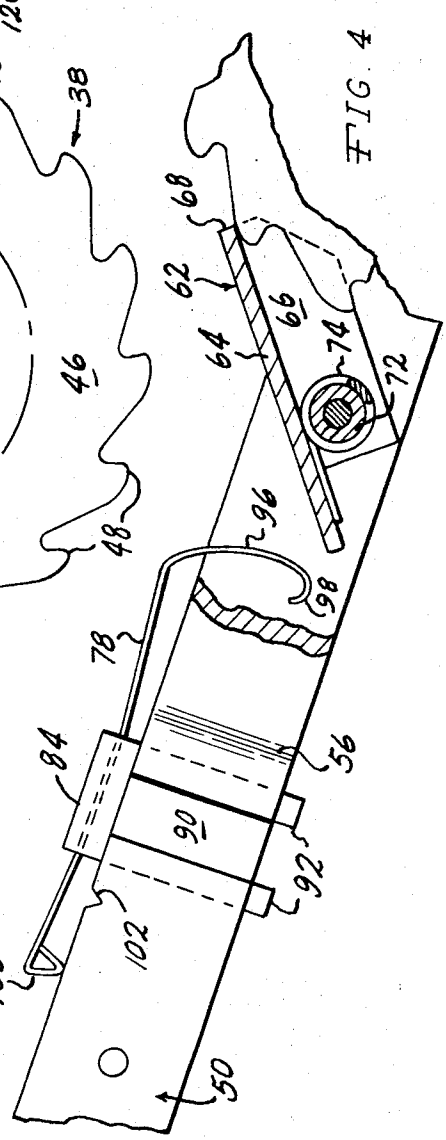


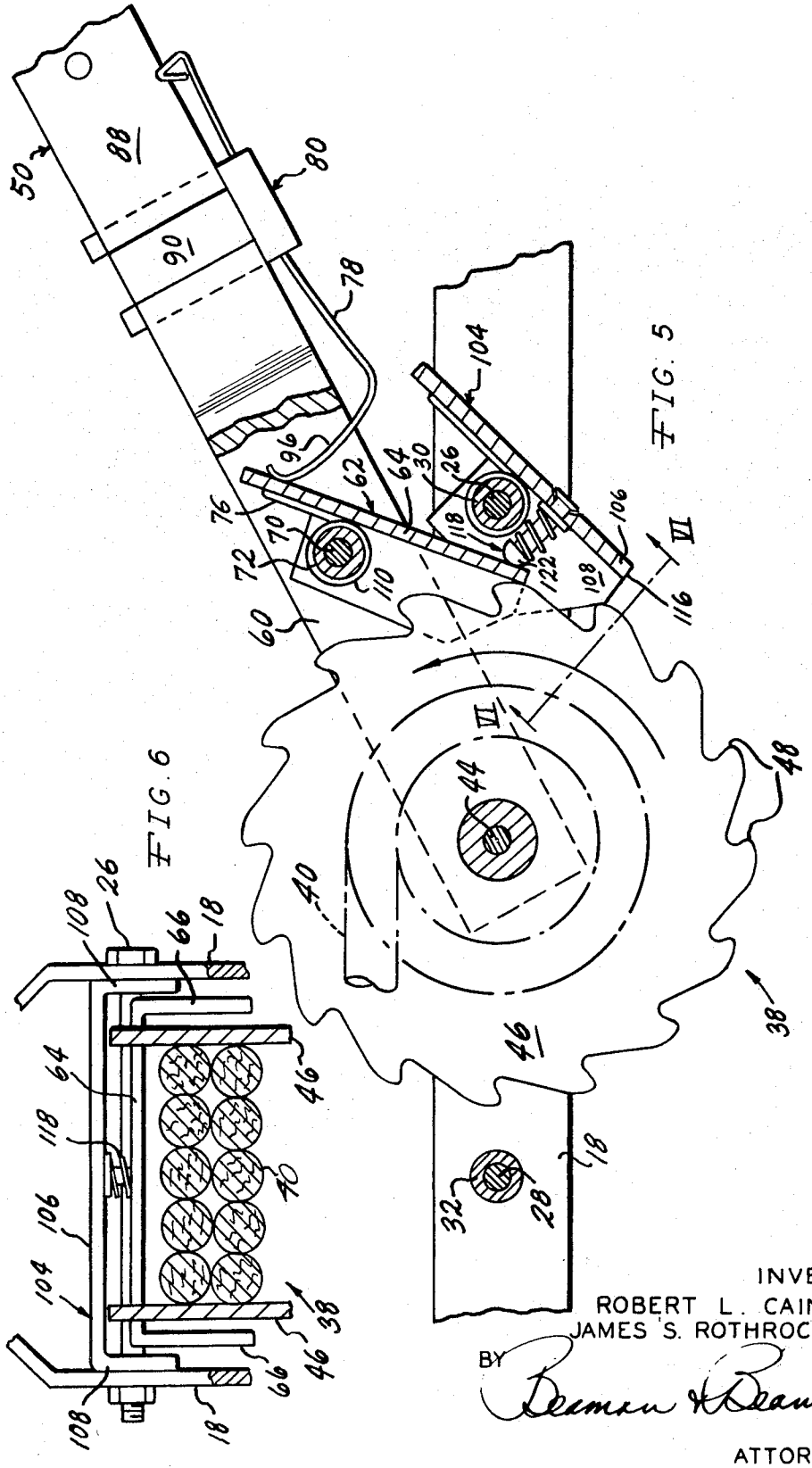
FIG. 4



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ECONOMY HOIST

BACKGROUND OF THE INVENTION

The invention pertains to a power unit hoist or tensioning device capable of winding a flexible tension member upon a reel or drum by means of a ratchet mechanism.

Manually operated power units or hoists of the ratchet type have found use in applications where a force is required for lifting or tensioning purposes. For instance, power unit hoists of the type shown in U.S. Pat. No. 2,501,253 may be utilized in either the lifting of heavy objects, stretching fence, tightening guy wires, pulling stumps, tying down cargo, or other applications wherein a high tension force is required.

Such manually operated units utilize a rotating ratchet mechanism wherein the tension member, such as a rope, chain or cable, is wound upon a drum having ratchet teeth formed concentrically thereon. Winding of the drum is produced by a manually operated lever arm having a ratchet catch formed thereon for cooperation with the drum teeth to rotate the drum in a tensioning direction. Unreeling of the drum is prevented by a pawl mechanism, and release means are associated with the catch and pawl for operation when it is desired to release the tension or lower the load.

The many uses for this type of power unit have created a wide market, and in particular, a large market exists for a ratchet type power unit capable of producing a tension of 1000 pounds or less which is of such an economical construction as to be readily purchasable by the nonprofessional user as to constitute an available tool in the workshop of small business, garages, mechanics and domestic users. Prior hoists of this type are usually constructed in such a manner that the cost of purchase is greater than that which the casual or nonprofessional user is willing to expend. Prior devices usually incorporated forged or cast components which are of relatively expensive manufacture and while these components contribute to the strength and safety of the device, the strength and safety factors existing are often much greater than necessary in a power unit which is required to produce tensioning of less than one half ton.

In view of the considerable tension created in the tensioning member of a ratchet type power unit hoist, and as such hoists are often utilized in the lifting and raising of objects to considerable heights, safety requirements are most important and significantly increase the cost of manufacture. Accordingly, the manufacturing techniques of prior art devices of this type have not resulted in a power unit which is both safe to use and economical to manufacture.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an economical power unit hoist capable of producing a substantial tension within a flexible tension member by the use of a ratchet mechanism without compromising safety factors.

Additionally, a purpose of the invention is to provide a power unit of low cost construction which is easily assembled, may be operated by unskilled personnel, and is relatively light in weight.

In the practice of the invention economies of manufacture are obtained by forming the majority of components from sheet or strap steel preferably of approximately one-eighth inch in thickness. Many of the components may be manufactured from conventionally available stock, and stamping and bending fabrication techniques are used in the construction of those sheet metal components not available in stock form.

The frame of the power unit is formed from strap steel and includes end regions and a central region defined by two strap elements separated in spaced parallel relationship. Intermediate the frame elements a ratchet reel or drum is rotatably mounted, and the drum includes sheet metal end plates having ratchet teeth defined therein by a stamping process. A pawl formed of sheet metal into a channel configuration is pivotally mounted upon the frame adjacent the drum and intermediate the frame elements.

Rotation of the power unit drum is accomplished by a manually operated lever arm pivotally mounted to the frame about the drum axis. The lever arm is formed of a pair of conventional metal straps contiguously interconnected at their outer ends to form a handle, and spaced apart at their inner ends to be disposed on opposite sides of the drum. A catch formed of sheet metal into a channel configuration is pivotally mounted upon the lever arm and is biased toward engagement with the drum ratchet teeth by a torsion spring. Catch positioning means in the form of a leaf spring is mounted upon the lever arm positionable between catch operative and release positions permitting selective operation of the catch.

As both end plates of the drum have ratchet teeth defined therein, and as the width of the catch and the pawl is such as to simultaneously engage the ratchet teeth of both drum end plates, and as the lever arm, catch and pawl are all symmetrically related to the longitudinal axis of the frame, the forces created within the power unit during tensioning, and the maintaining of tension, are substantially symmetrically related to the frame longitudinal axis insuring maximum usage of the metal of the components with respect to resistance to deformation wherein relatively high tension forces can be produced with a minimum of material. The symmetry of forces within the power unit also helps in maintaining the longitudinal axis of the unit in alignment with the direction of tension, which aids in ease of operation.

Positioning of the catch between the ratchet tooth engaging position used during tensioning, and the pawl bypass or release position used during tension release is achieved through a leaf spring element slidably mounted upon the lever arm for movement in a direction parallel to the lever arm length, and toward and away from the catch and drum. The leaf spring is deformable, and may be overcome at the maximum travel of the lever arm when engaged by an abutment on the pawl when it is desired to release the tension. The use of the leaf spring considerably simplifies the construction and arrangement of components while at the same time permits the desired sequence of operation and resists abuse and mishandling.

As the components of the power unit are readily visible to the operator, the position of catch operation may be immediately determined, and the replacement of the tension member, and maintenance of the unit, are readily accomplished.

BRIEF DESCRIPTION OF THE DRAWINGS

The aforementioned objects and advantages of the invention will be appreciated from the following description and accompanying drawings wherein:

FIG. 1 is a top plan view of an economy power unit hoist constructed in accord with the invention,

FIG. 2 is a side, enlarged detail, elevational view of the hoist taken from the bottom of FIG. 1, the lever arm being illustrated in the maximum counter-clockwise position,

FIG. 3 is an enlarged, detail, partially sectioned, elevational view of the drum and associated components illustrating the catch positioning means in the release position maintaining the catch out of engagement with the drum ratchet teeth and illustrating the pawl in engagement with the drum teeth,

FIG. 4 is an enlarged, detail, elevational, partly sectioned view of the lever arm and catch positioning means in the position for rotating the ratchet drum, the catch being illustrated as initially aligning with a ratchet tooth,

FIG. 5 is an enlarged, detail, elevational view similar to FIG. 3 illustrating the lever arm catch in the release position and subsequent to disengaging the pawl from the drum ratchet teeth and prior to engagement of the teeth with the catch to permit tension release, and

FIG. 6 is an enlarged, detail, sectional view taken along Section VI—VI of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The frame of the economy power unit hoist constructed in accord with the invention is best illustrated in FIGS. 1 and 2. Basically, the frame consists of a pair of steel strap members 10 of a thickness of approximately one-eighth inch and a width of approximately 1 inch. The frame members are each bent at locations 12 wherein the frame members may be assembled to define contiguous end regions 14 and 16 and central regions portions 18. The end region 14 is maintained in assembly by a rivet 20, and the ends of the members 10 defining the end region 16 are maintained in contiguous relationship by a bolt 22 extending through the guide 24, as will be later described. The frame member portions 18 defining the central region of the frame are maintained in spaced parallel relation to each other by bolts 26 and 28 having spacer sleeves 30 and 32, respectively, mounted thereon and interposed between the central member portions.

Anchor means in the form of a hook or eye 34 is affixed to the frame end 14 by means of ring 36 received within a hole. At the other end of the frame the tension member guide 24 is attached by means of the bolt 22, and the guide 24 comprises a U-shaped strap between which the tension member passes as it extends to the left of the frame, FIG. 2.

The reel or drum 38 for the tension member 40 is mounted on the frame intermediate the central region portions 18. The drum 38 includes a hub 42 rotatably mounted upon the axis bolt 44 extending through portions 18, and the drum width is defined by a pair of identical end plates 46 radially extending from the hub 42.

The end plates 46 are formed of flat stamped sheet metal one-eighth inch in thickness and the periphery of each drum is provided with a plurality of ratchet teeth 48 concentrically related to the drum axis bolt 44. The teeth 48 of each end plate are equal in number, and are similarly angularly related to the drum hub to insure that a tooth of each end plate is simultaneously engaged by the catch and pawl as will be later described.

The tension member 40 illustrated comprises a nylon rope wound upon the drum hub between the end plates 46. The drum end of the rope 40 is attached to the drum by any conventional means, such as a U bolt attached to an end plate, not shown, and the other rope end extends through the guide 24 and usually includes a hook, not shown, which is affixed to the load, in the known manner. Of course, the tension member may comprise a chain or wire cable, or other flexible member capable of being wound on the drum 38 and having the desired tension load capacity.

Rotation of the drum 38 is accomplished through the manually rotated lever arm 50. The lever arm 50 is preferably formed of a pair of members of the same strap stock used to form the frame members 10, and the outer region of the members forming the lever arm are maintained in contiguous relationship by rivets 52. A handgrip sleeve 54 of a rubber or plastic material is preferably slipped over the outermost end of the lever arm to facilitate manual gripping. The straps constituting the lever arm are outwardly deformed with respect to each other at 56 to form a bifurcation, FIG. 2, and again bent at 58 wherein the innermost end regions 60 are parallel to each other and are spaced apart a distance slightly less than the spacing of the frame portions 18 as to be closely received therebetween, as will be apparent in FIG. 1. The lever arm regions 60 are pivotally mounted upon the drum axle bolt 44, and in this manner the lever arm is pivotally mounted on the frame for concentric movement about the drum 38.

A ratchet catch 62 is pivotally mounted upon the lever arm 50 for selective engagement with the drum ratchet teeth 48 for producing rotation of the drum in a tensioning direction, and the catch is also utilized in the release sequence of operation for reversing the drum rotation to release tension in the tension member 40.

In accord with the inventive concepts and principles the catch 62 is formed of sheet metal approximately one-eighth inch in thickness, and is formed into a channel configuration including a flat base portion 64, and leg portion 66 depending at right angles from the base portion. The base portion 64 includes a straight end edge 68 which is disposed parallel to the catch pivot bolt 70, and this edge constitutes the surface for engagement between the drum ratchet teeth 48 and the catch. The pivot bolt 70 extends across the lever arm regions 60 and a sleeve 72 is interposed on the bolt between the regions 60 extending through holes in catch leg portions 66. A torsion spring 74 is wrapped about sleeve 72 and includes an end 76 engaging the catch base portion 64, and the other end of the spring, not shown, is attached to a lever arm end 60 whereby a biasing force is continually maintained upon the catch endeavoring to rotate the catch in a clockwise direction about bolt 70 and sleeve 72, FIG. 3, toward engagement with the drum ratchet teeth 48. It will be noted that the spring end 76 engages the base portion 64 to the left of the pivot bolt 70, FIG. 3.

Although the torsion spring **74** continuously biases the catch **62** in the direction which would produce engagement between the catch edge **68** and the drum ratchet teeth **48**, catch release positioning means are mounted upon the lever arm **50** in order to control the position of the catch and thereby selectively determine whether the operation of the lever arm is to produce a tension in the tension member **40** wound on the drum, or remove the tension by unwinding the drum. In the disclosed embodiment such catch positioning means takes the form of a leaf spring **78**, mounted upon a slide **80**.

The slide **80** is preferably formed of a bright colored synthetic plastic material and includes a base portion **82** having an upper surface **84** which may be knurled or ribbed to increase frictional engagement with the operator's thumb finger. Three legs extend from the slide base portion **82**, two legs **86** being disposed along one side of the contiguous strap lever arm handle portion **88**, while a single leg **90** extends alongside the opposite side of the handle portion **88**. The free end of each of the legs **86** is provided with an inwardly turned flange **92** which is located under the handle portion **88**, FIG. **3**, and the clearance and fit of the slide legs and flanges with the lever arm handle portion are such that the slide **80** is capable of freely moving upon the lever arm in the longitudinal direction thereof.

The leaf spring **78** includes a portion **94** molded into the base portion of the slide **80** as to be firmly affixed thereto. That portion of the leaf spring extending toward the catch **62** is arcuately formed at **96**, and terminates in a convex end portion **98**, adapted to engage the catch base portion **64**, as shown in FIG. **3**, at the release position of the slide.

The portion of the leaf spring **78** which extends toward the handgrip sleeve **54** is formed with a downwardly disposed detent **100** capable of being selectively received within a detent notch **102** defined in the edge of the lever arm handle portion **88**, FIG. **3**. Thus, it will be appreciated that by operation of the slide **80** the slide and leaf spring **78** may be positioned at its closest or release position to the catch **62** as shown in FIG. **3**, or, by exerting sufficient force on the slide toward the sleeve **54**, the detent **100** will ride out the notch **102** and the leaf spring end **98** will be moved out of engagement with the catch **62** to the position shown in FIG. **4**. Limiting of the slide movement away from the catch is produced by engagement of the spring end **98** with the bifurcation of the lever arm end regions **60**, and movement of the slide **80** toward the catch **62** is limited by engagement of the adjacent slide leg **86** with the other surface of the lever arm deformations **56** at the bifurcation.

Rotation of the drum **38** in the counterclockwise direction, FIGS. **2**, **3** and **4**, which is the "unreeling" or "untensioning"direction, is prevented by a ratchet pawl **104** pivotally mounted upon the central region portions **18** of the frame. The pawl **104** is pivotally mounted on pivot bolt **26** and sleeve **30** extending between the portions **18** and the pawl is formed of sheet metal approximately one-eighth inch in thickness in a channel transverse cross section including a flat base portion **106** and leg portions **108** extending at right angles to the base portion, as will be apparent from FIG. **6**. The pivot bolt and sleeve **30** extend through holes defined in the leg portions **108** in a manner similar to that means of support used with the catch **62**. A torsion spring **110** circumscribes the sleeve **30** having an end **112** bearing upon the pawl base portion **106**, and an end **114** connected to a frame member **10**, FIG. **1**. The torsion spring **110** biases the pawl **104** in a clockwise direction, FIG. **3**, which tends to engage the pawl base portion edge **116** with the drum end plate ratchet teeth **48** of both end plates. During normal operation the pawl **104** will be in the condition shown in FIG. **3**, and prevent a counterclockwise direction of rotation of the reel or drum **38**.

The pawl **104** includes a release abutment or actuator **118** for engagement with the catch **62** when the catch is moved its full extent toward the pawl, as shown in FIG. **5**, to release the pawl from the drum ratchet teeth and permit the drum to be indexed in the counterclockwise direction which removes the tension from the tension member **40**.

The abutment **118** preferably takes the form of an axially movable stud **120** having a head **122**, and an enlarged swaged end **124** received within a hole **126** defined in the pawl base portion **106**. A compression spring **128** is interposed between the head **122** and a washer **130** whereby the force of the spring biases the head toward the ratchet teeth **48** and maintains the abutment in the relationship shown in FIG. **3**.

When the lever arm **50** is pivoted to approximately the extent of its movement as in FIG. **5**, the catch base portion **64** engages the abutment head **122** adjacent the edge **68** and tends to compress the spring **128** as resistance to rotation of the pawl **104** in the counterclockwise direction is produced by the engagement of the pawl edge **116** with the ratchet teeth **48**. Further clockwise movement of the lever arm **50**, FIG. **5**, increases the force imposed upon the abutment **118** to the point where the pawl **104** is caused to rotate in a counterclockwise direction clearing the edge **116** from the ratchet teeth. At such time the reaction force produced on the catch base portion **64** by the abutment **118** causes the counterclockwise biasing force imposed upon the catch **62** by the leaf spring **78** to be overcome and rotates the catch in a clockwise direction aligning the catch edge **68** with the ratchet teeth **48**. Thus, as the pawl is released from the teeth **48**, the catch edge **68** will be aligned with the ratchet teeth and "catch" the teeth as soon as the pawl is freed therefrom. The lever arm **50** is now rotated counterclockwise and this produces an indexing rotation of the drum for an angular movement substantially corresponding to the distance between ratchet teeth and the tension on the tension member will be reduced. Rapid and short angular oscillation of the lever arm about bolt **44** will alternately engage and disengage the pawl **104** with the ratchet teeth, as well as alternately engage and disengage the catch from the ratchet teeth and permit the drum to rotate in a counterclockwise direction, FIG. **5**, in a stepwise or indexing fashion. The biasing force imposed on the catch **62** by the leaf spring **78** will free the catch edge **68** from the ratchet teeth once the catch and the abutment **118** are disengaged as the drum rotates in the counterclockwise direction, and as soon as the abutment **118** and the catch are disengaged the pawl **104** will pivot in a clockwise direction to engage the next set of ratchet teeth and restrain the drum against indexing beyond a single tooth.

The tension member **40** is wound upon the drum **38** in the manner illustrated wherein the tension member extends through the guide **24** as previously described. Normally, the lever arm **50** will not be angularly positioned about the pivot axis bolt **44** to the extreme counterclockwise position shown in FIG. **3**, and the tension member **40** passes under the catch **62** and the pivot bolt **70** in the event that the lever arm is pivoted to this condition. During normal operation, the degree of angular movement of the lever arm is such that the tension member, as it is deployed from the drum **38**, will be of a linear configuration from the drum through the guide **24**.

Rotation of the drum **38** in the clockwise direction, FIG. **3**, to tension the tension member **40** occurs when the slide **80** and leaf spring **78** are positioned as shown in FIG. **4** where the slide is moved toward sleeve **72** and detent **100** is removed from notch **102**. Under this condition the biasing force imposed on the catch **62** is solely that produced by the torsion spring **74** which will keep the catch edge **68** in constant engagement with the ratchet teeth **48** of the drum end plates. Thus, clockwise rotation of the lever arm **50**, FIG. **4**, causes the catch **62** to engage the ratchet teeth and rotate the drum **38** in the clockwise direction for winding the tension member upon the drum. Rotating of the drum in the counterclockwise direction is prevented by the pawl **104**, and as the lever arm is moved in the return stroke, counterclockwise, direction the catch will ride over the ratchet teeth in the well known manner.

When the slide **80** is positioned as shown in FIG. **3**, such that the detent **100** is received in the notch **102**, the biasing force imposed upon the catch **62** by the leaf spring **78** is sufficient to overcome the biasing force produced by the torsion spring **74**, and will pivot the catch to the release position shown in FIG. **3** wherein the edge **68** is radially moved out of alignment with the ratchet teeth **48**. This condition is used when it is desired to "back off" or "lower" the load, and the lever arm is moved to the extreme clockwise direction as shown in FIG. **5**, and the operation for permitting the drum to index in the counterclockwise direction in a tooth-by-tooth manner is as set forth above. As will be noted in FIG. **6**, the width of pawl **104** is greater than the width of the catch **62** which permits the catch to be received "within" the pawl leg portions **108** during releasing of the pawl. Thus, the strength afforded by the channel configuration of the pawl and catch does not interfere with the close cooperation between these components during release of the drum.

It will be appreciated that by locating ratchet teeth **48** on both of the end plates of the drum, and by using both catch and pawl members of a width great enough to simultaneously engage the ratchet teeth of both end plates, and also by centrally mounting the catch and pawl intermediate the frame portions **18**, the forces produced in the hoist during tensioning of the tension member are symmetrically related to the longitudinal axis of the frame and thus primary shear forces, rather than bending forces, are imposed upon the pivot axes of the drum, catch and pawl. Additionally, due to the symmetry of force distribution within the hoist, and due to the use of the channel configuration of the catch and pawl, sheet metal may be used for these components, as well as to form the frame and lever arm, while providing a strong and rugged power unit hoist.

The use of the leaf spring **78** permits an economical release positioning means for the catch to be employed which is also capable of accommodating the pawl release mechanism for indexing of the drum in the tension removing direction. The abutment **118** is centrally between the leg portions **108** of the pawl, and thus the force produced upon the pawl due to engagement with the catch is likewise symmetrically disposed to the frame axis. Fabrication of a hoist in accord with the invention may be accomplished with conventional tooling and use by the unskilled is facilitated by the use of the slide **80** and detent **100**, which permits the operation to immediately ascertain the condition of the catch release mechanism.

It will be appreciated that the disclosed embodiment of the invention fulfills the objects desired, and it is appreciated that various modifications to the inventive concept may be apparent to those skilled in the art without departing from the spirit and scope of the invention.

We claim:

1. A power unit hoist characterized by its economy of manufacture and symmetry of force distribution comprising, in combination, an elongated frame having a longitudinal axis, end regions and a central region defined by spaced frame portions, anchor means mounted on said frame adjacent one of said end regions, a ratchet drum mounted on said frame central region intermediate said frame portions rotatable about an axis substantially perpendicular to said frame axis, said drum including a pair of spaced, radial extending end plates each having ratchet teeth defined upon the periphery thereof concentrically disposed about said drum axis, a flexible tension member wound upon said drum, a manually pivotable lever arm mounted on said frame central region for pivotal movement about said drum axis, a catch pivotally mounted on said arm having a width at least equal to the spacing between said drum end plates for selective simultaneous engagement with said ratchet teeth of both end plates, resilient means biasing said catch toward said ratchet teeth, catch positioning means mounted on said lever arm selectively positioning said catch relative to said ratchet teeth comprising a resilient leaf spring supported on said lever arm for movement thereon toward and away from said catch, said leaf spring including a deformable portion selectively engaging said catch for pivoting said catch about its pivotal axis, a slide member slidably mounted on said lever arm adjacent said catch for movement toward and away from said catch, said leaf spring being mounted on said slide, detent means interposed between said slide and said lever arm, a pawl pivotally mounted in said frame central region having a width at least equal to the spacing between said drum end plates for simultaneous engagement with the ratchet teeth of both end plates, and resilient means biasing said pawl toward said ratchet teeth for engagement therewith.

2. In a power unit hoist as in claim **1** wherein said detent means includes a notch defined in said lever arm, and a detent defined on said leaf spring selectively engaging said notch.

3. In a power unit hoist as in claim **1** wherein both said catch and said pawl are formed of sheet metal of a channel cross-sectional configuration each including a

base portion having an edge and leg portions, the pivot axes of said catch and pawl being parallel to the associated base portion and said ratchet teeth selectively engaging said edge of said catch and pawl, said catch being moved toward said pawl during tensioning, and catch engaging and operating means mounted on said pawl base portion engaging said catch base portion at the maximum movement of travel of said lever arm in a tensioning direction to move said catch edge into engagement with said ratchet teeth and remove said pawl therefrom.

4. In a power unit hoist as in claim 3 wherein the spacing between said leg portions of said pawl is greater than the spacing between the leg portions of said catch whereby said catch is received intermediate said pawl leg portions during lever arm movement in a tensioning direction.

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