March 30, 1965 E. PRETE, JR 3,175,806

RATCHET BUCKLE

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Fig. 1

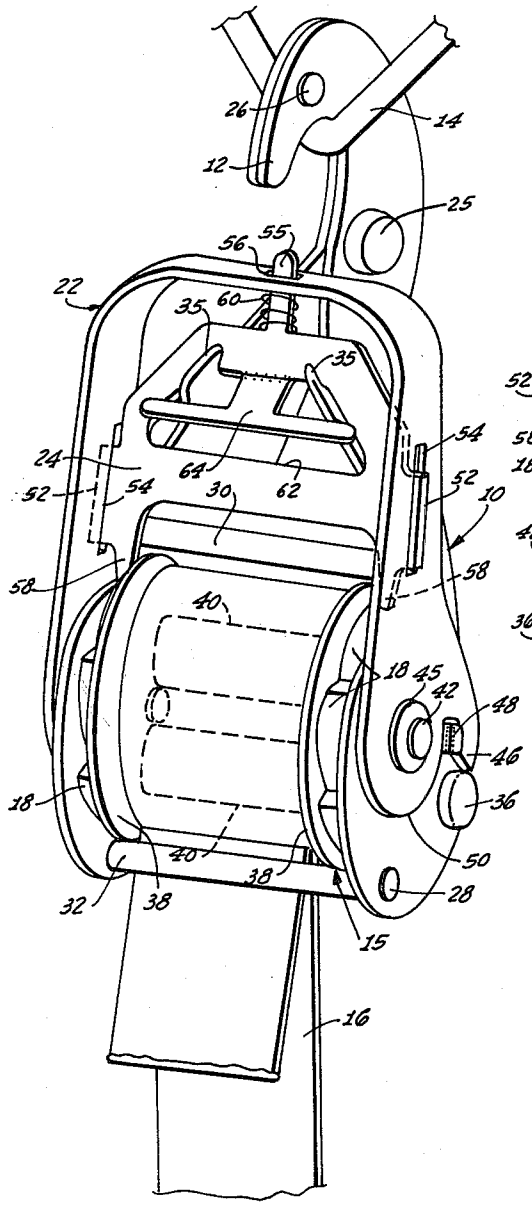
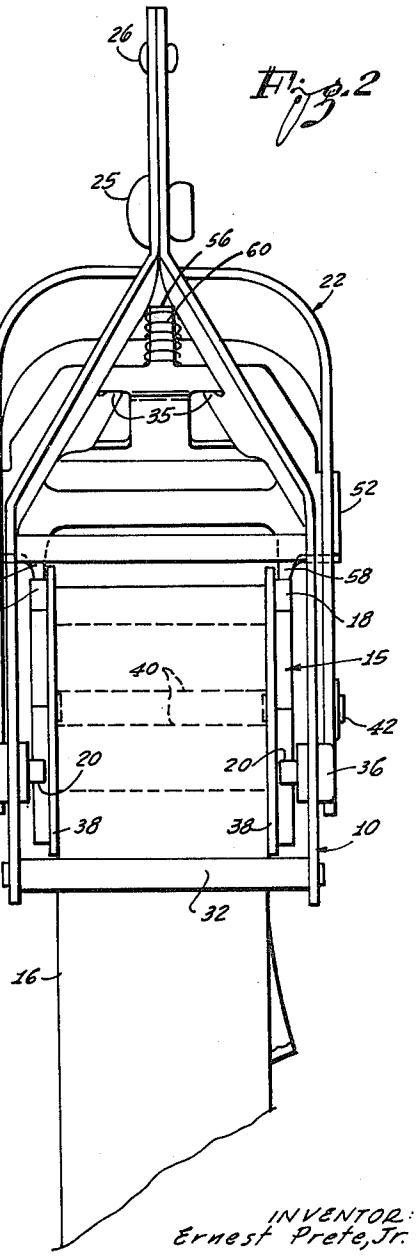


Fig. 2



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RATCHET BUCKLE

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Fig. 3

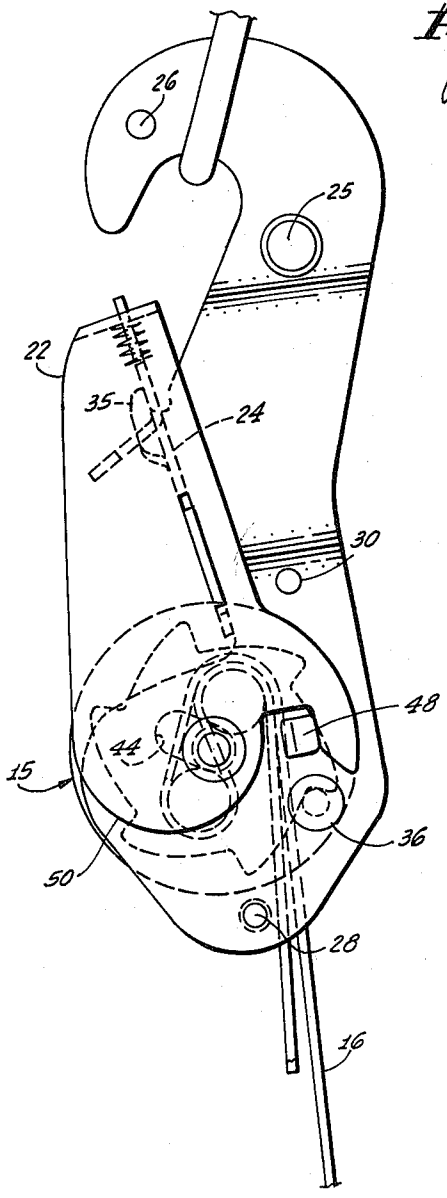
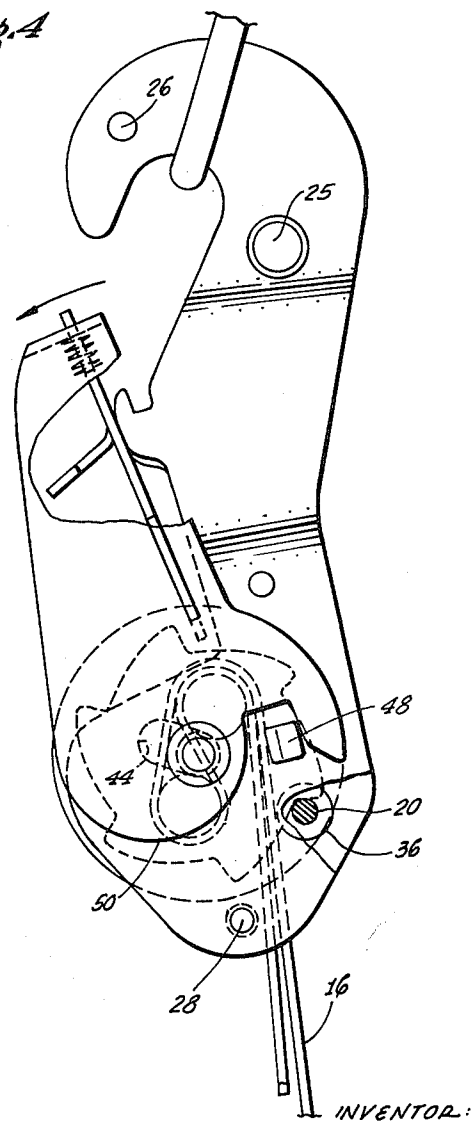


Fig. 4



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RATCHET BUCKLE

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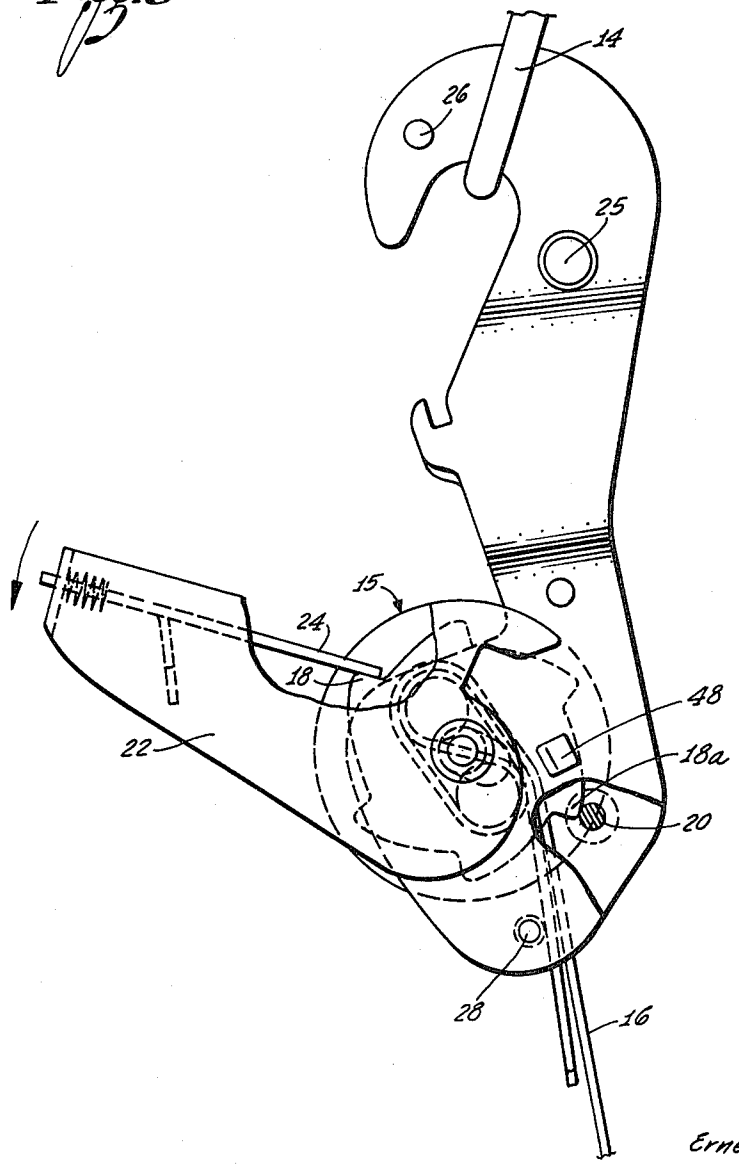
Fig. 5



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RATCHET BUCKLE

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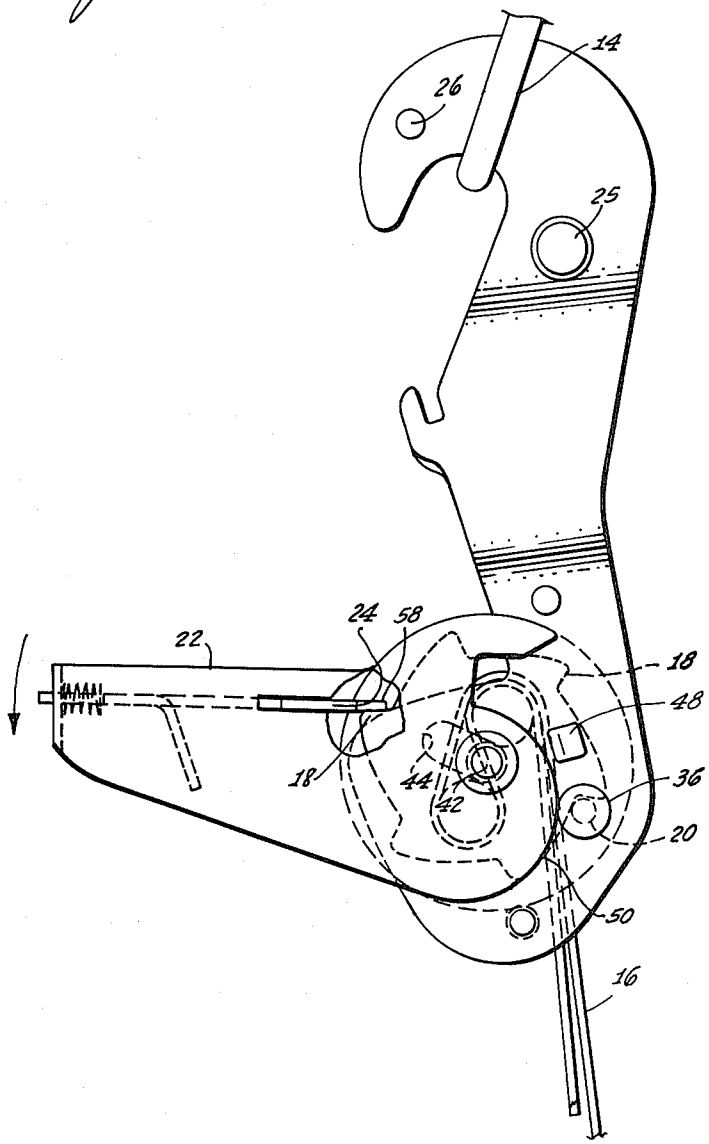
Fig. 6



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RATCHET BUCKLE

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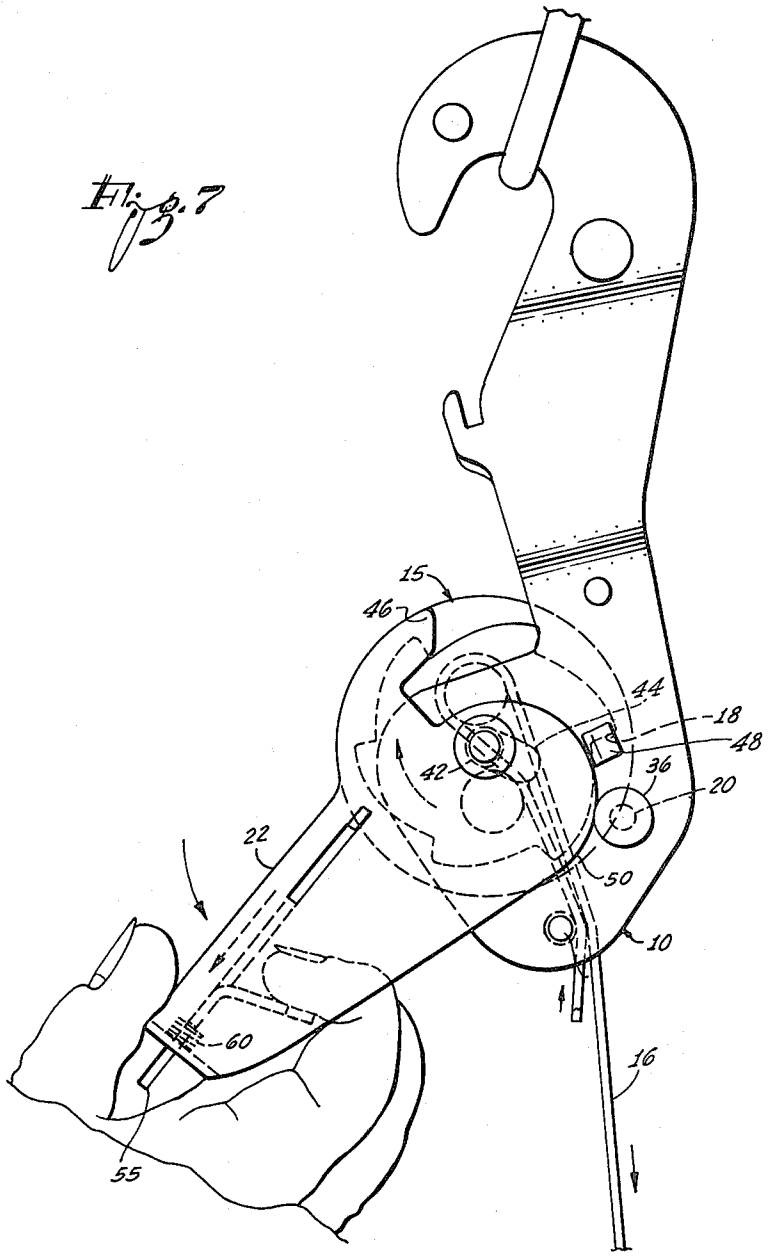
Fig. 7



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United States Patent Office

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Patented Mar. 30, 1965

3,175,806

RATCHET BUCKLE

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Filed Nov. 4, 1963, Ser. No. 321,065
11 Claims. (Cl. 254—164)

This invention relates to a ratchet type buckle for tensioning an elongated flexible member such as a strap, rope or cable.

While the invention is widely applicable for its purpose, it has been initially embodied in a buckle for tensioning a strap to tie down cargo in an aircraft. This particular embodiment of the invention is disclosed herein and will provide adequate guidance for those skilled in the art who may have occasion to apply the invention to other specific purposes.

A buckle for tying down a cargo strap is typically formed with a hook to engage, for example, a shackle on the floor space or to engage a loop on the end of a strap. One end of the strap that is to be tensioned by the buckle is connected to a spool on the buckle to be wound thereon and the other end of the strap typically carries a hook member for engagement with a second on the floor. With the buckle connected with one shackle and the strap hook engaging the other shackle, a pawl and ratchet mechanism that is incorporated into the construction of the buckle is manually operated to wind in the strap and thereby place the strap under effective tension.

Such a ratchet mechanism conventionally includes ratchet teeth carried by the spool and a spring-pressed holding pawl to prevent reverse rotation of the spool together with a spring-pressed driving pawl to rotate the spool in the winding direction. As heretofore constructed, such a tie-down strap buckle is a complicated device having numerous working parts including a plurality of springs. Obviously the more complicated the mechanism the higher the cost and the greater the possibility of malfunction or failure. The broad object of the present invention is to provide a simpler tie-down buckle of fewer working parts for higher reliability as well as lower cost.

Simplicity is achieved in a number of different ways. For example, the usual spring-pressed holding pawl is eliminated entirely by using a fixed lug means to serve the function of a holding pawl and by mounting the spool in a floating manner, the arrangement being such that the tension of the strap urges the spool into engagement with the fixed holding lug. Thus the strap itself provides the yielding force that is usually provided by a special spring. Both reliability and simplicity are served by eliminating the spring and obviously a fixed stud means to serve the function of a holding pawl is more reliable than a pivotally mounted and spring-pressed pawl.

Another example of achieving simplicity is in providing dual functions for the usual spring-pressed driving pawl means. In addition to serving its usual purpose, the spring-pressed driving pawl means also has the function of serving as a latch means for locking the ratchet mechanism against inadvertent release operation while the buckle is in service.

Still another example is found in the multiple functions of an operating handle which is oscillated to operate the ratchet mechanism. One of the added functions of the operating handle is to serve at its normal retracted position as means to prevent the spool from shifting out of its position of engagement with the fixed holding stud means. Another of its added functions is to serve, when desired, to provide cam action to shift the spool out of engagement with the fixed holding stud means thereby to release the spool for rotation in the unwinding direction.

Reduction in weight is of special importance in an aircraft. The invention minimizes weight and at the same time keeps down cost by providing a design which is constructed primarily of sheet metal parts that can be fabricated by punch press operations. The remaining parts are made of tubing stock and rod stock.

The features and advantages of the invention may be understood from the following detailed description and the accompanying drawing.

In the drawing, which is to be regarded as merely illustrative:

FIG. 1 is a perspective view of the presently preferred embodiment of the invention as seen from above;

FIG. 2 is a bottom plan view of the device;

FIG. 3 is a side elevational view of the device in its normal position holding a strap under tension to tie down cargo;

FIG. 4 is a similar view of the device with the operating handle unlatched in preparation for manual manipulation to tighten the strap;

FIG. 5 is a similar view showing the operating handle at an intermediate point in its actuating stroke to tighten the strap;

FIG. 6 is a similar view showing the operation handle at the end of its actuating stroke; and

FIG. 7 shows how the operating handle may be shifted beyond the range of its actuating stroke for the purpose of releasing the spool for unwinding rotation to loosen the strap.

Referring first to FIGS. 1, 2 and 3, the principal parts of the ratchet buckle include: a buckle body, generally designated 10, which forms a hook 12 that may, for example, engage a fixed shackle 14 in the floor of an aircraft; a spool generally designated 15 for winding up one end of a strap 16, the spool being provided with ratchet teeth 18 at its opposite ends; two fixed holding lugs 20 carried by the buckle body to engage the ratchet teeth to prevent reverse rotation of the spool; an operating handle 22 for reciprocation to drive the spool in the winding direction; and a retractable driving pawl member 24 carried by the operating handle for engagement with the ratchet teeth.

In this particular embodiment of the invention, the buckle body 10 is made of two heavy sheet metal stampings which form the two sides of the body and which converge together to form the hook 12. In the region of the hook 12 the two stampings are held together by rivets 25 and 26 and the two spaced portions of the stampings that form the opposite sides of the body are interconnected by two cross rods 28 and 30. The cross rod 28 carries a spacer sleeve 32, and is connected to the two stampings by extending through bores in the two stampings respectively with the outer ends of the cross rods peened or staked. As best shown in FIGS. 1 and 4, the converging portions of the two stampings are shaped to form a pair of latch hooks 35 for cooperation with the driving pawl 24 to releasably hold the operating handle 22 in its normal retracted position shown in FIGS. 1–3.

As may be seen in FIG. 2, each of the two holding lugs 20 is the reduced inner end of a fitting mounted in the corresponding sheet metal stamping. The outer enlarged ends of the fitting form external lugs 36 on the opposite outer sides of the buckle body, which lugs may be termed camming lugs since they cooperate with the handle 22 in a camming operation, as will be explained.

The spool 15 may be of the construction shown wherein two opposite disks 38 form the flanges of the spool and are rigidly interconnected by a pair of transverse rods 40. The rods 40 have reduced ends which extend through the two disks 38 and are staked at their outer ends. Two outer ratchet disks forming the ratchet teeth 18 are mounted on the opposite ends of the spool and are se-

cured by staking the ends of the two rods that are concealed in the two tubes 40. The spool 15 is rotatably mounted on the buckle body by two trunnions 42 that extend through corresponding slots 44 (FIG. 3) in the two opposite sides of the buckle body, the outer ends of the two trunnions being secured to the operating handle 22. In the construction shown, the two trunnions 42 extend through corresponding bores in the handle 22 and through washers 45 on the outer faces of the handle, the ends of the trunnions being peened or staked for retention by the washers.

As indicated in FIG. 3, the two slots 44 in the opposite sides of the buckle body are in approximate alignment with the two previously mentioned inner holding lugs 20 and external camming lugs 36. When the strap 16 is wound onto the spool 15 in the manner shown in FIG. 3 and the strap is under tension, the two slots 44 are oriented at an acute angle relative to the general direction of the tensioned strap with the consequence that the tension of the strap urges the trunnions 42 to the ends of the two slots that are closest to the holding lugs 20 and the camming lugs 36. Thus the tension in the strap 16 provides a yielding force that is equivalent to spring force to urge the ratchet teeth 18 of the spool into holding engagement with the two holding lugs 20 as may be seen in FIG. 4.

As may be seen in FIG. 1, the handle 22 is a U-shaped piece of heavy sheet metal with its two lugs connected respectively to the two trunnions 42 for pivotal movement of the handle about the axis of the spool. When the handle 22 is in its normal latched position shown in FIGS. 1 and 3, two arcuate locking fingers 46 formed on the opposite sides of the handle engage corresponding locking lugs 48 on the buckle body to lock the spool 15 in its position of holding engagement with the two holding lugs 20. The locking lugs 48 may be provided as shown by simply lancing and offsetting the sheet metal of the buckle body.

The operating handle 22 is further formed with two arcuate cam edges on its opposite sides that are eccentric relative to the two trunnions 42 and are adapted for camming action against the corresponding camming lugs 36 to shift the spool out of holding engagement with the two holding lugs 20. The cam action occurs when the handle 22 is swung counterclockwise from the position shown in FIG. 6 to the extreme position shown in FIG. 7.

The driving pawl 24 may be in the form of a flat piece of heavy sheet metal having two opposite guide ears 52 that slidingly extend into corresponding guide slots 54 in the opposite sides of the operating handle 22. The outer end of the driving pawl 24 is formed with a longitudinal guide finger 55 that slidingly extends through a guide slot 56 in the end of the operating handle.

The inner end of the driving pawl 24 is formed with two pawl fingers 58 that straddle the spool 15 for the purpose of engaging the ratchet teeth 18 to drive the spool in the direction to wind in the strap 16. The driving pawl 24 may be biased into engagement with the spool teeth 18 by means of a compression spring 60 that surrounds the guide finger 55 under compression between the driving pawl and the operating handle 22.

To make it convenient to retract the driving pawl 24 manually, the sheet metal of the driving pawl may be formed with a large aperture 62 which defines a T-shaped handle 64 that is bent outward from the plane of the driving pawl as shown. The edges formed by the aperture 62 provide two spaced latching shoulders 65 for releasable engagement with the previously mentioned latch hooks 35 of the buckle body. It is to be noted that the spring 60 biases the driving pawl 24 for releasable engagement with the latch hooks 35 as well as for releasable engagement with the ratchet teeth 18 of the spool.

Operation

FIGS. 1, 2 and 3 show the ratchet buckle in service holding the strap 16 under tension for the purpose of tying down a load. The fact that the arcuate locking fingers 46 engage the locking lugs 48 at the normal retracted position of the operating handle 22 and the fact that the operating handle is held in its locking position by engagement of the driving pawl 24 with the two latch hooks 35 provide positive assurance that the spool 15 will not shift out of engagement with the holding lugs 20.

In preparation for employing the operating handle 22 to place the strap 16 under tension, the driving pawl 24 is manually retracted out of engagement with the latch hooks 35 against the opposition of the spring 60 and then with the handle lifted slightly the driving pawl is released to return to its normal position as shown in FIG. 4. In FIG. 4, the driving pawl 24 rests on the two latch hooks 35 so that the two latch hooks serve as a stop to limit clockwise rotation of the operating handle 22.

The spool 15 is rotated in the direction to wind in the strap 16 by swinging the operating handle 22 counterclockwise from the position shown in FIG. 4 to the position shown in FIG. 6. Early in this strap-tensioning stroke of the operating handle 22, the driving pawl 24 engages ratchet teeth 18 of the spool 15 to rotate the spool counterclockwise with the consequence that a pair of ratchet teeth 18*a* in FIG. 5 cam against the two holding lugs 20 to shift the spool along the two inclined slots 44 in opposition to the tension of the strap 16. When the operating handle 22 is swung counterclockwise beyond the position shown in FIG. 5 to bring the two teeth 18*a* past the two holding lugs 20, the spool drops back in the two parallel slots 44 to the position shown in FIG. 6 with the abrupt shoulders of the two teeth 18*a* in holding engagement with the two holding lugs 20. Thus the counterclockwise movement of the operating handle 22 from the position shown in FIG. 4 to the position shown in FIG. 6 advances the rotation of the spool by at least one ratchet tooth in the strap-tightening direction. The reciprocation of the handle 22 is repeated until the strap is under sufficient tension to hold down the cargo, the driving pawl 24 is manually retracted to permit the handle to be swung back to its normal position and then the driving pawl is released for engagement with the two latch hooks 35 as shown in FIGS. 1 and 3.

When it is desired to release the spool 15 for reverse rotation to loosen the tensioned strap 16, the operating handle 22 is released from the two latch hooks 35 by manual retraction of the driving pawl 24 and the driving pawl is held in its retracted position to prevent engagement with the ratchet teeth 18 while the operating handle is swung counterclockwise from the position shown in FIG. 4 to the extreme release position shown in FIG. 7. The release position is beyond the strap-tensioning stroke of the handle as may be seen by comparing FIG. 7 with FIG. 6. When the operating handle 22 in its counterclockwise movement reaches the position shown in FIG. 6, the two arcuate cam edges 50 of the operating handle come into operating contact with the two corresponding cam lugs 36 and the further counterclockwise movement of the operating handle from the position shown in FIG. 6 to the position shown in FIG. 7 causes the two cam edges to cooperate with the two cam lugs 36 to shift the handle and thereby shift the spool 15 along the two parallel slots 44 until the ratchet teeth 18*a* in FIG. 6 escape from the holding lugs 20 to free the spool for reverse rotation.

My description in specific detail of the selected embodiment of the invention will suggest various changes, substitutions and other departures from my disclosure within the spirit and scope of the appended claims.

I claim:

1. In a device of the character described for winding in a flexible member, the combination of:

a body;

a spool for attachment to the flexible member and

adapted to wind in the flexible member in a given general direction, the spool having ratchet teeth;

means to rotate the spool in its winding direction;

blocking means fixedly mounted on the body to block unwinding rotation of the spool,

the spool being both rotatably and floatingly mounted on the body for rotation relative thereto and for translation relative thereto along a given path into and out of engagement with the blocking means, said given path being oriented at less than 90° from the given general direction to cause the spool to be biased into engagement with the blocking means by resistance of the flexible means to the winding operation of the spool; and

means to shift the spool along said path away from the blocking means to release the spool for unwinding rotation.

2. In a ratchet-type buckle of the character described for tensioning an elongated flexible member, the combination of:

a buckle body adapted for suitable anchorage, the body including two interconnected opposite side members;

a spool adapted for connection with one end of the flexible member to wind in the flexible member in a given general direction relative to the spool thereby to tension the flexible member, the spool having ratchet teeth;

manually operable means to rotate the spool in the winding direction;

blocking means fixedly mounted on the body to engage the ratchet teeth to block unwinding rotation of the spool;

means rotatably mounting the spool on the body with freedom for translation of the spool along a given path, the path being oriented relative to said general direction and the blocking means being positioned relative to the path and relative to the general direction to cause the tension in the flexible member to urge the journaling means along the path toward the blocking means to a blocking position at which the blocking means engages the ratchet teeth to prevent unwinding rotation of the spool; and

manually operable means to shift the spool along said path away from the blocking means to release the spool for unwinding rotation.

3. A combination as set forth in claim 2, in which the means to rotate the spool comprises:

ratchet means and a manually operable handle for the ratchet means, the handle being movable from a normal retracted position to an advanced position; and

means responsive to movement of the handle to its normal position to lock the spool against translation at the position of the spool at which the spool engages said blocking means.

4. In a ratchet-type buckle of the character described for tensioning an elongated flexible member, the combination of:

a buckle body adapted for suitable anchorage, the body including two interconnected opposite side members;

a spool adapted for connection with one end of the flexible member to wind in the flexible member in a given general direction relative to the spool thereby to tension the flexible member, the spool having ratchet teeth;

manual means swingable about the axis of the spool between a normal position and an advanced position;

pawl means movably mounted on the manual means and biased to engage the teeth of the spool to rotate the spool in the winding direction in response to movement of the manual means towards its advanced position;

blocking means fixedly mounted on the body to engage the ratchet teeth to block unwinding rotation of the spool;

means rotatably mounting the spool on the body with freedom for translation of the spool along a given path, the path being oriented relative to said general direction and the blocking means being positioned relative to the path and relative to the general direction to cause the tension in the flexible member to urge the journaling means along the path towards the blocking means to a blocking position at which the blocking means engages the ratchet teeth to prevent unwinding rotation of the spool; and

manually operable means to shift the spool along said path away from the blocking means to release the spool for unwinding rotation.

5. A combination as set forth in claim 4 which includes means to releasably latch the manual means at its normal position.

6. A combination as set forth in claim 5 which includes fixed means on the body engageable by the manual means at its normal latched position to lock the journaling means in its blocking position.

7. A combination as set forth in claim 4, in which the manually operable means to shift the spool along the path away from the blocking means comprises fixed means on the body together with cam means carried by the manual means and cooperative with the fixed means to shift the journaling means.

8. In a ratchet-type buckle of the character described for tensioning an elongated flexible member, the combination of:

a buckle body adapted for suitable anchorage, the body including two interconnected opposite side members;

a spool adapted for connection with one end of the flexible member to wind in the flexible member in a given general direction relative to the spool thereby to tension the flexible member, the spool having ratchet teeth;

blocking means fixedly mounted on the body to engage the ratchet teeth to block unwinding rotation of the spool;

two parallel slots in the two side members respectively;

axial means carried by the spool and extending therefrom in opposite axial directions through said two slots respectively to journal the spool for rotation relative to the body and the permit bodily shift of the spool along the two slots relative to the blocking means,

the two slots and the blocking means being oriented relative to the general direction to cause the tension in the flexible means to urge the spool towards engagement with the blocking means;

manual means mounted on said axial means to swing about the axis thereof between a normal retracted position and an advanced position;

pawl means movably mounted on said manual means and biased to engage the teeth of the spool to rotate the spool in the winding direction in response to movement of the manual means towards its advanced position;

means to releasably latch the manual means at its normal position; and

means to shift the axial means along the two slots away from the blocking means to release the spool for unwinding rotation.

9. A combination as set forth in claim 8, which includes means to releasably latch the axial means against shifting of the spool out of engagement with the blocking means.

10. In a ratchet-type buckle of the character described for tensioning an elongated flexible member, the combination of:

a buckle body adapted for anchorage, the body including two interconnected opposite side members;

a spool adapted for connection with one end of the

flexible member to wind in the flexible member in a given general direction relative to the spool thereby to tension the flexible member, the spool having ratchet teeth;

blocking means fixedly mounted on the body to engage the ratchet teeth to block unwinding rotation of the spool;

two parallel slots in the two side members respectively;

axial means carried by the spool and extending therefrom in opposite axial directions through said two slots respectively to journal the spool for rotation relative to the body and to permit bodily shift of the spool along the two slots relative to the blocking means for releasable engagement of the teeth of the spool with the blocking means,

the two slots and the blocking means being oriented relative to the general direction to cause the tension in the flexible means to urge the spool towards engagement with the blocking means;

manual means mounted on the axial means to swing about the axis thereof from a normal retracted position to a first advanced position and beyond the first advanced position to a second advanced position;

pawl means movably mounted on the manual means and biased to engage the teeth of the spool to rotate the spool in a winding direction in response to the movement of the manual means from its normal retracted position to its first advanced position;

latch means fixedly mounted on the body adjacent the normal retracted position of the manual means for engagement by the pawl means to latch the manual means at its normal retracted position, the pawl means being retractable to move past the latch means;

first fixed means on the body;

cam means united with the manual means for movement therewith, the cam means being eccentric relative to the axial means to act against the first fixed means to shift the spool along the two slots out of engagement with the blocking means, the cam means being located to be effective in response to movement of the manual means from its first advanced position to its second advanced position whereby the spool may be released for reverse rotation by retracting the pawl means and moving the manual means to its second advanced position;

second fixed means on the body; and

latch means on the manual means to engage the second fixed means at the normal retracted position of the manual means to prevent the axial means from moving along the two slots thereby to prevent release of the spool from the blocking means as long as the manual means is in its normal retracted position.

11. In a ratchet-type buckle of the character described

for tensioning an elongated flexible member, the combination of:

a buckle body adapted for anchorage, the body including two interconnected opposite side members having slots therein;

a spool adapted for connection with one end of the flexible member to wind in the flexible member in a given general direction relative to the spool thereby to tension the flexible member, the spool having ratchet teeth;

blocking means fixedly mounted on the buckle body to engage the ratchet teeth to block unwinding rotation of the spool;

axial means carried by the spool and extending therefrom in opposite axial directions through the two slots respectively to journal the spool for rotation relative to the body and to permit bodily shift of the spool along the two slots relative to the blocking means for releasable engagement of the teeth of the spool with the blocking means,

the two slots and the blocking means being oriented relative to the general direction to cause the tension in the flexible means to urge the spool towards engagement with the blocking means;

manual means mounted on the axial means to swing about the axis thereof from a normal retracted position to a first advanced position and beyond the first advanced position to a second advanced position;

pawl means movably mounted on the manual means and biased to engage the teeth of the spool to rotate the spool in the winding direction in response to movement of the manual means from its normal position to its first advanced position;

cooperative means on the manual means and the buckle body respectively to lock the spool in engagement with the blocking means when the manual means is in its normal position;

cooperative means on the manual means and the buckle body respectively to latch the manual means at its normal position; and

cooperative means on the manual means and the buckle body respectively to move the spool out of engagement with the blocking means in response to movement of the manual means from its first advanced position to its second advanced position.

References Cited by the Examiner

UNITED STATES PATENTS

2,658,722	11/53	Coffing	254—167
2,719,696	10/55	Palka	254—146
2,874,431	2/59	Elsner	24—71.2
2,993,680	7/61	Davis.	

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