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(54) STRAP TENSIONING APPARATUS

(71) I, GERALD LEE SCHNURMÄCHER, a citizen of the United States of America, of 319 Bonita Avenue, Piedmont, State of California, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to strap-tensioning apparatus.

Heretofore, straps have been utilized for securing objects tightly together as well as for tying them down as, for example, on the bed of a truck, on the deck of a ship, on the roof of a car, or in the baggage compartment of an aircraft. When two or more articles are to be secured together, a strap having a buckle affixed to one end thereof is generally passed around the articles, and the free end of the strap attached to the buckle. Certain buckles can then be used to draw the ends of the strap together to secure the strap in a tightened condition. When articles are to be secured to a base, two straps are generally utilized. One end of each strap is attached to the base by suitable fasteners, such as hooks, and the other end of one strap is permanently affixed to a buckle. When the straps have been passed over the article to be secured, the free end of the second strap is attached to the buckle, and the buckle is utilized to draw the ends of the straps together and then to secure them.

The invention provides in combination an elongate strap and a buckle for tightening and securing the strap, said buckle comprising a transversely extending cross arm at one end of the buckle, the strap having a free end portion to be looped around the cross arm, a pair of lever arms extending from the ends of the cross arm, transverse arms extending from the lever arms in a direction generally parallel to the cross arm, another end portion of the strap being formed with a closed loop fixed around the transverse arms, an operating portion extending from the ends of the transverse arms, said operating portion being longer than the lever arms to

provide a mechanical advantage for tightening the strap when the buckle is pivoted about the axis of the cross arm from a position overlying that end of the strap looped about the transverse arms towards a second position overlying the end portion of the strap looped about the cross arm, and said operating portion extending diagonally across said strap and including means for engaging from beneath the end portion of the strap looped about the cross arm when in the second position to cause said means to increasingly grip the edge of said end portion in response to increased tension in the strap.

The invention further provides a buckle comprising a resilient rod, a transversely extending cross arm at one end of the buckle about which a free end portion of the strap can be looped, a pair of lever arms extending from the ends of the cross arm, transverse arms about which a second end portion of the strap can be looped and secured, said transverse arms being spaced from said cross arm and extending from the short lever arms in a direction generally parallel to the cross arm, a pair of elongate operating arms extending diagonally from opposite ends of the transverse arms toward that end of the buckle remote from the cross arm and crossing each other intermediate the ends of the buckle, said operating arms being longer than the lever arms and means carried by each of the elongate operating arms for engaging the free end portion of the strap looped about the cross arm from beneath to retain the buckle in position adjacent the first end portion and thereby secure the strap in its tightened condition.

Two embodiments of a buckle and strap according to the invention will now be described with reference to the accompanying drawings, in which:—

Figures 1 and 2 show perspective views of a prior art strap and buckle assembly,

Figure 3 shows a perspective view of one embodiment of a strap and buckle assembly according to the invention.

Figures 4A—4C show fragmentary views,

illustrating the operation of the buckle and strap assembly of Figure 3, and

Figure 5 shows a fragmentary sectional view of another embodiment of a strap and buckle assembly according to the invention.

One type of buckle heretofore provided for tightening and securing a strap is illustrated in Figures 1 and 2. This buckle is formed of a resilient rod or wire stock and has a transverse cross arm 11 formed at one end and about which the free end 12 of a strap is looped. The buckle also has a pair of transverse arms 13 and 14 about which the other end 16 of the strap is looped and permanently secured, as by stitching. Substantially parallel side arms 18, 19 extend from opposite ends of the transverse arms. Hooks 21, 22 at the free ends of arms 18, 19, respectively serve to retain the buckle flat to the strap. The buckle is pivoted back and forth about cross arm 11, as indicated by arrow 20, to tighten the strap, and then the buckle is secured in the position illustrated, i.e., with the buckle adjacent to free end 12 of the strap and with hooks 21 and 22 engaging the two thicknesses of the strap at this end. The buckle can be released from its secured position by spreading the free ends of arms 18 and 19 laterally apart to disengage hooks 21, 22 from the strap.

It has been observed that the foregoing buckle tends to uncontrollably release itself from its clamped position under certain circumstances. Thus, the pull of strap end 16 on transverse arms 13 and 14 tends to draw the "free" ends of these transverse arms 13, 14 backwardly as illustrated by arrows 23 and 24 thereby drawing hooks 21 and 22 laterally apart, as indicated by arrows 26 and 27.

It will be readily evident that if the tension in the strap increases suddenly, as it can, for example, if a truck on which the strap is utilized hits a bump or has to stop abruptly, the hooks can separate sufficiently whereby they can lose their grasp on the strap, in which case the buckle springs loose and rotates clockwise (as shown in Figure 1) 180° about cross arm 11, releasing the strap. Similarly, the tendency of the hooks to be drawn apart by increased tension limits the extent to which the strap can be tightened and its ultimate utility.

The embodiment illustrated in Figure 3 includes an elongate strap 31 and a buckle 32. Strap 31 is fabricated of a suitable material such as cotton or nylon belting, and is preferably woven. Strap 31 has a fixed end portion 33 and a free and adjustable end portion 34 attached to buckle 32 in a manner described hereinafter in detail. Strap 31 can consist of either a single section or a plurality of sections. With a single section, end portions 33 and 34 will be at the opposite ends of the same section, while with more

than one section they will be the confronting ends of different sections.

Buckle 32 is formed of a semi-rigid, resilient rod or wire stock, such as oil tempered spring steel. As illustrated, the rod has a circular cross section, although it can have a rectangular or other suitable cross section.

A transversely extending cross arm 36 is provided at one end of the buckle, and short lever arms 37 and 38 extend from the ends of cross arm 36. Transverse arms 41, 42 extend from the short lever arms in a direction generally parallel to cross arm 36. Elongate operating arms 43, 44 extend diagonally from opposite ends of transverse arms 41 and 42 and cross each other intermediate the ends of buckle 32. As discussed more fully hereinafter, the strap is tightened by grasping arms 43, 44 and pivoting the buckle back and forth about cross arm 36 between positions adjacent to strap ends 33 and 34, respectively. The amount of tightening provided by each pivoting movement of the buckle is determined by the effective length of lever arms 37 and 38, i.e., the distance between cross arm 36 and transverse arms 41, 42. The length of arms 43, 44 provides a sufficient mechanical advantage for tightening the strap.

Inwardly opening confronting jaws 46 and 47 are formed at the free ends of arms 43, 44, respectively. These jaws include upper loops 46a, 47a and lower retaining arms 46b, 47b. The loops and arms of jaws 46, 47 are spaced apart by a distance somewhat greater than two thicknesses of strap 31, and smooth protective tips 48 are carried on the confronting ends of arms 46b, 47b.

The fixed end portion 33 of strap 31 is permanently affixed to the buckle by passing the end portion of belt 31 around both transverse arms 41, 42 and then stitching or otherwise securing it to itself to form a closed loop 49 encircling arms 41, 42. The stub end 33a is preferably disposed on the underside of the loop to maximize the frictional force between adjacent layers of the strap when the strap is tightened in the manner described below.

Operation and use of the assembly of Figure 3 can be described with reference to Figures 4A-4C. Strap 31 is placed around the articles to be secured, and free end portion 34 threaded through the opening between cross arm 36 and transverse arms 41 and 42, then folded back to overlie itself to form an open loop 51. The strap is tightened by grasping and exerting tension on free end 34a of open loop 51 with one hand and, while maintaining tension on free end 34a, pivoting the buckle in the direction of arrow 52 about cross arm 36 from a position adjacent to the fixed strap end to a position adjacent to the free end. This rock-

ing or pivoting movement draws loops 49 and 51 past each other (Figure 4B), tightening the strap to an extent determined by the effective length of the short lever arms 37, 38. As buckle 32 is rocked toward the free end of strap 31, the outer run of loop 51 is clamped against the inner run to prevent

page of the free end (Figure 4B).

If further tightening of the strap is desired, the buckle is rocked back toward the fixed end of the strap, as indicated by arrow 53. During the return movement, slack produced by the preceding tightening movement is taken up simply by pulling free end 34a of loop 51 in the direction indicated by arrow 54. The buckle is then rocked back toward the free end of the strap, drawing the strap yet more tightly about the articles. The process is repeated until the desired degree of tightening has been effected. Note the advance of arm 36 relative to line A in Figure 4A through 4C.

Once the strap has been tightened to the extent desired, the buckle is secured in position adjacent to the free end of the strap by placing arms 46b and 47b under the two runs of loop 51, with loops 46a and 47a on top of the two runs. With the jaws so positioned, the free end of the belt is securely constrained between loops 46a and 47a and hook arms 46b and 47b.

As in the prior art, the tension in the strap tends to pull the ends of transverse arms 41 and 42 away from hooks 46, 47 as illustrated by arrows 61 and 62. However, unlike the prior art, this pull tends to draw jaws 46, 47 more tightly together, as indicated by arrows 63, 64.

The confronting end portions of loops 46a and 47a and lower retaining arms 46b and 47b are disposed to abut against each other to limit the inward movement.

Thus, buckle 32 serves to enhance its gripping characteristic under increased tension in the strap so as to preclude release of the grip of buckle 32 on strap 31 under the adverse circumstances which, in the past, tended to dislodge the grip of the buckle in Figure 1.

Yet, buckle 31 can be released simply by drawing the free ends of arms 43, 44 in an outward direction to disengage the jaws from the strap, then allowing the end of the buckle with the hooks to pivot away from strap end portion 34. With the buckle so positioned, the free end of strap 31 is readily withdrawn from buckle 32.

Figure 5 illustrates another embodiment which is similar to that described above, except that the buckle is formed of a rod having a generally square cross section. This square cross section has been found to provide a better grip on the strap in some applications. Primed reference numerals are used in Figure 5 to designate elements which

correspond to similar elements in Figures 3 and 4.

From the foregoing description it will be readily evident that an improved strap and buckle assembly has been provided. The advantage of the figure 3 embodiment of the invention is that the ability of the buckle to hold the strap is positively maintained notwithstanding substantial increased tension in the strap, since the buckle is fabricated of a resilient rod, such as spring steel, and provided with crossed arms which draw retaining hooks together as tension in the strap is increased.

WHAT I CLAIM IS:—

1. In combination an elongate strap and a buckle for tightening and securing the strap, said buckle comprising a transversely extending cross arm at one end of the buckle, the strap having a free end portion to be looped around the cross arm, a pair of lever arms extending from the ends of the cross arm, transverse arms extending from the lever arms in a direction generally parallel to the cross arm, another end portion of the strap being formed with a closed loop fixed around the transverse arms, an operating portion extending from the ends of the transverse arms, said operating portion being longer than the lever arms to provide a mechanical advantage for tightening the strap when the buckle is pivoted about the axis of the cross arm from a position overlying that end of the strap looped about the transverse arms towards a second position overlying the end portion of the strap looped about the cross arm, and said operating portion extending diagonally across said strap and including means for engaging from beneath the end portion of the strap looped about the cross arm when in the second position to cause said means to increasingly grip the edge of said end portion in response to increased tension in the strap.
2. An elongate strap and a buckle as claimed in claim 1 wherein the buckle has two transverse arms and the operating portion comprises a pair of elongate operating arms extending diagonally from opposite ends of the transverse arms toward that end of the buckle remote from the cross arm and crossing each other intermediate the ends of the buckle, the engaging means comprising a portion of each of the elongate operating arms which portions extend across at least a part of the width of said strap from beneath.
3. An elongate strap and a buckle as claimed in claim 1 or claim 2 wherein the buckle is formed of a rod of resilient material.
4. A buckle comprising a resilient rod, a transversely extending cross arm at one end of the buckle about which a free end portion of the strap can be looped, a pair of lever arms extending from the ends of the

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ing or pivoting movement draws loops 49 and 51 past each other (Figure 4B), tightening the strap to an extent determined by the effective length of the short lever arms 37, 38.

5 As buckle 32 is rocked toward the free end of strap 31, the outer run of loop 51 is clamped against the inner run to prevent slippage of the free end (Figure 4B).

10 If further tightening of the strap is desired, the buckle is rocked back toward the fixed end of the strap, as indicated by arrow 53. During the return movement, slack produced by the preceding tightening movement is taken up simply by pulling free end 34a of loop 51 in the direction indicated by arrow 54. The buckle is then rocked back toward the free end of the strap, drawing the strap yet more tightly about the articles. The process is repeated until the desired degree of tightening has been effected. Note the advance of arm 36 relative to line A in Figure 4A through 4C.

15 Once the strap has been tightened to the extent desired, the buckle is secured in position adjacent to the free end of the strap by placing arms 46b and 47b under the two runs of loop 51, with loops 46a and 47a on top of the two runs. With the jaws so positioned, the free end of the belt is securely constrained between loops 46a and 47a and hook arms 46b and 47b.

20 As in the prior art, the tension in the strap tends to pull the ends of transverse arms 41 and 42 away from hooks 46, 47 as illustrated by arrows 61 and 62. However, unlike the prior art, this pull tends to draw jaws 46, 47 more tightly together, as indicated by arrows 63, 64.

25 The confronting end portions of loops 46a and 47a and lower retaining arms 46b and 47b are disposed to abut against each other to limit the inward movement.

30 Thus, buckle 32 serves to enhance its gripping characteristic under increased tension in the strap so as to preclude release of the grip of buckle 32 on strap 31 under the adverse circumstances which, in the past, tended to dislodge the grip of the buckle in Figure 1.

35 Yet, buckle 31 can be released simply by drawing the free ends of arms 43, 44 in an outward direction to disengage the jaws from the strap, then allowing the end of the buckle with the hooks to pivot away from strap end portion 34. With the buckle so positioned, the free end of strap 31 is readily withdrawn from buckle 32.

40 Figure 5 illustrates another embodiment which is similar to that described above, except that the buckle is formed of a rod having a generally square cross section. This square cross section has been found to provide a better grip on the strap in some applications. Primed reference numerals are used in Figure 5 to designate elements which

correspond to similar elements in Figures 3 and 4.

From the foregoing description it will be readily evident that an improved strap and buckle assembly has been provided. The advantage of the figure 3 embodiment of the invention is that the ability of the buckle to hold the strap is positively maintained notwithstanding substantial increased tension in the strap, since the buckle is fabricated of a resilient rod, such as spring steel, and provided with crossed arms which draw retaining hooks together as tension in the strap is increased.

WHAT I CLAIM IS:—

1. In combination an elongate strap and a buckle for tightening and securing the strap, said buckle comprising a transversely extending cross arm at one end of the buckle, the strap having a free end portion to be looped around the cross arm, a pair of lever arms extending from the ends of the cross arm, transverse arms extending from the lever arms in a direction generally parallel to the cross arm, another end portion of the strap being formed with a closed loop fixed around the transverse arms, an operating portion extending from the ends of the transverse arms, said operating portion being longer than the lever arms to provide a mechanical advantage for tightening the strap when the buckle is pivoted about the axis of the cross arm from a position overlying that end of the strap looped about the transverse arms towards a second position overlying the end portion of the strap looped about the cross arm, and said operating portion extending diagonally across said strap and including means for engaging from beneath the end portion of the strap looped about the cross arm when in the second position to cause said means to increasingly grip the edge of said end portion in response to increased tension in the strap.

2. An elongate strap and a buckle as claimed in claim 1 wherein the buckle has two transverse arms and the operating portion comprises a pair of elongate operating arms extending diagonally from opposite ends of the transverse arms toward that end of the buckle remote from the cross arm and crossing each other intermediate the ends of the buckle, the engaging means comprising a portion of each of the elongate operating arms which portions extend across at least a part of the width of said strap from beneath.

3. An elongate strap and a buckle as claimed in claim 1 or claim 2 wherein the buckle is formed of a rod of resilient material.

4. A buckle comprising a resilient rod, a transversely extending cross arm at one end of the buckle about which a free end portion of the strap can be looped, a pair of lever arms extending from the ends of the



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cross arm, transverse arms about which a second end portion of the strap can be looped and secured, said transverse arms being spaced from said cross arm and
5 extending from the short lever arms in a direction generally parallel to the cross arm, a pair of elongate operating arms extending diagonally from opposite ends of the transverse arms toward that end of the buckle
10 remote from the cross arm and crossing each other intermediate the ends of the buckle, said operating arms being longer than the lever arms and means carried by each of the elongate operating arms for engaging the free
15 end portion of the strap looped about the

cross arm from beneath to retain the buckle in position adjacent the first end portion and thereby secure the strap in its tightened condition.

5. A strap and buckle assembly substantially as hereinbefore described with reference to and as shown in Figures 3 and 4, or Figure 5 of the accompanying drawings. 20

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