DEVICE FOR RELEASABLY GRIPPING
AN ELONGATE FLEXIBLE MEMBER

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ABSTRACT
A device for releasably gripping an elongate flexible member, such as a webbing strap extending therethrough, and wherein gripping surfaces of the device are resiliently urged by a loading spring into pressure engagement with the strap, manually operable camming means being provided for releasably varying the pressure engagement resulting from the loading spring, so as to permit relative restrained movements between the gripping surfaces of the device and the webbing strap under load stressing forces applied between the webbing strap and the device.

11 Claims, 7 Drawing Figures
DEVICE FOR RELEASABLY GRIPPING AN ELONGATE FLEXIBLE MEMBER

BACKGROUND OF THE INVENTION

The present invention relates generally to strap and cable clamping devices. Heretofore, it has been generally known to provide a variety of devices and schemes for manually releasably controlling the paying out of flexible members such as ropes, straps, cables, and the like, while being subjected to load tensioning forces. For example, in mountain climbing, it is common practice in repelling for the climber to pass a rope around his body, and through rings in such a manner as to place portions of the rope in a bite which can controllably be released to permit lowering of the body along the rope. In some cases, it has been the custom to pass the rope through staggered slots in such a way as to provide releasable control.

Presently, there is need for a cable or strap gripping device which can be effectively and simply used in a safe manner for the controlled lowering of suspended loads attached to the device, or to the associated flexible member. Such a device finds a particular beneficial use, for example, as means for debarking and lowering loads from a hovering helicopter, in rescue work, and many other situations.

Recently, a cable clamping device has become generally known in U.S. letters Pat. No. 3,528,139, which issued on Sept. 15, 1970. Briefly, the device of this patent comprises a clamping unit designed with a view to producing a self-clamping action due to the traction exerted by the cable supporting the load, the gripping force increasing with the cable tension. Spring means constantly urge, by means of linkages, the jaws in clamping direction, and manually operable levers are provided for releasing the jaws.

A study of this patent, however, indicates that devices such as the patented device are not adaptable for use in the particular fields, and under the conditions, in which the device of the present invention is particularly beneficial. The patented device lacks the required nicety of regulation which permits the clamping holding force to be reduced in such a way as to permit a restrained movement of the device with respect to the gripped flexible member. Moreover, while the patented device shows the utilization of springs for creating a pre-clamping force, these springs do not operate in the same manner as in applicant's invention, nor is the urging force of these springs varied to obtain the advantageous results which are obtained in the device of the present invention. In the device of the present invention, the inherent disadvantages of the device disclosed in the above patent have been eliminated by providing an elongate pivoted structure wherein a leaf-spring is pre-stressed to urge a roller gripping member against the flexible member, in this case a webbing strap, a camming lever being provided which permits flexing of the spring so as to controllably reduce the gripping pressure against the webbing strap and permit restrained controlled movements between the device and the strap under applied load stressing forces.

SUMMARY OF THE INVENTION

The present invention relates generally to a device for clamping engagement with a flexible member, such as a webbing strap, and is more particularly concerned with such a device wherein the clamping forces can be releasably controlled to permit restrained movements between the device and flexible member under a condition of applied load stressing forces.

One object of the invention is to provide a device of the herein described character for clamping or gripping a flexible member, which is so arranged that the device may be anchored and utilized to feedingly control movement of a load stressed strap therethrough, or conversely permit the strap to be anchored and manually control the movement of the device thereof, together with an attached load.

A further object is to provide a clamping device of the above type having unique means for applying an adjustable pre-determined gripping force to an associated flexible member, together with manually actuable means for variably relieving the gripping force in a manner to control relative movements under load stressing forces applied between the flexible member and the device.

Another object is to provide an improved device for releasably gripping an elongate flexible member, and which utilizes a pressure or gripping member that is spring loaded against the flexible member, and including manually operable means for variably relieving the spring loading.

It is also an object to provide a device of the above noted character, wherein a unique camming lever is operable to adjustably and controllably relieve a predetermined spring pressure applied to a gripping member, the lever being foldable to an out-of-the-way position when not in use.

Additional objects and features relate to the provision of the following:

a. The utilization of a serrated rotatable gripping sleeve member having a toothed outer surface, the sleeve member being mounted on a replaceable oil-filled bronze bushing.

b. A cooperable gripping surface, opposite the gripping sleeve member, which is impregnated with a wear-resisting material such as tungsten carbide.

c. A unique mounting for the gripping sleeve member and associated loading spring, wherein floating movement enables proper and effective seating of the gripping sleeve member.

d. The utilization of a side opening channel permitting lateral positioning of the associated flexible webbing strap therein, and wherein the associated structure including the loading spring is provided with retaining means for holding the webbing in the channel.

e. The provision of a safety locking pin for the spring latching and tensioning means.

Further objects and advantages of the invention will be brought out in the following part of the specification, wherein detailed description is for the purpose of fully disclosing a preferred embodiment of the invention without placing limitations thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the accompanying drawings which are for illustrative purposes only:
FIG. 1 is a side elevational view of a device embodying the features of the herein described invention, the parts being shown in opened position for receiving a flexible member with which it is to be associated; FIG. 2 is a similar view showing the parts in closed clamped position with the inserted flexible member; FIG. 3 is an elevational front view of the device, when applied as shown in FIG. 2; FIG. 4 is a transverse section, taken substantially on line 4—4 of FIG. 3, and showing details of the mounting of the rotary gripping means; FIG. 5 is a transverse section, taken substantially on line 5—5 of FIG. 3, showing certain details of the mounting for the release control means; FIG. 6 is a transverse sectional view, taken substantially on line 6—6 of FIG. 3, showing details of the spring latching and tensioning means; and FIG. 7 is a longitudinal section taken substantially on line 7—7 of FIG. 3, and illustrating the cooperative relationship of the components of the clamping device with the elongate flexible member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more specifically to the drawings, for purposes of illustration, the present invention is shown in FIG. 1 as comprising generally a body structure B which carries a pivotally mounted gripping means G and associated spring means S which are adapted to be latched into an operating position by means of a latching and tensioning means L, wherein the gripping means will be resiliently urged against an associated webbing strap W. A release control mechanism R is manually operable to release the loading pressure of the spring S and permit controlled relative restrained movements between the gripping means and the webbing strap under load stressing forces applied between the webbing strap and the device.

More specifically, the body structure comprises an elongate substantially rectangular back plate 10 of high strength steel or other suitable material. At the opposite ends, the back plate 10 is provided with rigid connector loops 11, 11.

On the opposite side of the back plate 10 from the connector loops 11, transversely extending finger plate members 12a, 12b and 12c are supported in spaced relation to the back plate by spacers 13a, 13b and 13c, respectively, these finger plates being secured to edge projections of the back plate as by securing bolts 14 in each case. It will be noted that the finger plate 12a is at one end of the back plate, and that the finger plate 12c is at the opposite end, while the finger plate 12b is intermediate the ends of the back plate. As thus located, the finger plates cooperate with the adjacent surface of the back plate to provide in effect channel means having an opening at the side for laterally receiving edgewise thereinto the webbing strap W. Insertion of the strap may be facilitated by angularly deflecting the outer ends of the finger plates, and providing deflected cooperating spaced finger projections, as indicated at 15a and 15b, on the back plate in underlying relation to the adjacent finger plate deflected portion.

Normally, the inserted webbing strap W is freely movable lengthwise in the body structure. It is a feature, however, of the present invention to provide unique means for restraining free movement of the webbing strap by providing spring loaded gripping means as will now be described. For this purpose, there is provided a bracket structure, as generally indicated at 16, which is formed with spaced leg portions 17 and 18 (FIG. 3) adapted to straddle a rib 19 formed on the finger plate 12a and to which it is pivotally floatingly supported for swinging movement by means of pivot bolt 20. As shown in FIG. 7, the pivot bolt 20 is mounted in a loose fit relation in an opening 21 of the rib 19 so that this bracket may accommodate the gripping means with respect to the associated webbing strap. Rotative movement of the bracket structure 16 is limited in a clockwise direction, as seen in FIG. 7, by an angular abutment surface 22 on the underside of each of the leg portions 17 and 18.

On the opposite side of the pivot bolt 20, the bracket structure 16 is provided with extended side flanges 23 and 24 which serve as mounting members for the strap gripping elements. As will be seen, a cylindrical oil filled bronze bushing 25 is fixedly but removably mounted between the flanges by means of supporting screws 26 and 27 which have their innermost ends threaded engaged in the ends of the bushing. A washer 28 is preferably placed under the head of each mounting screw, and a washer 29 interposed between each end of the bushing 25 and the adjacent side flange. The bushing 25 rotatably supports a cylindrical sleeve 30, the outer surface of this sleeve being serrated to provide a toothed surface 31 for non-slipping engagement with the associated webbing strap W during operation of the devise. As will be seen in FIG. 8, the side flanges 23 and 24 in the strap engaging position of the gripping means, extend past the back plate and serve to retain the webbing strap W within the strap receiving channel.

The bracket 16 also carries a loading spring which comprises an elongate generally rectangular leaf spring element 32 which is formed at one end with spaced end projections 33 and 34 providing leg attachments secured to the leg portions 17 and 18, respectively, of the bracket structure 16 by means of mounting bolts 35, 35. As thus mounted, the leaf spring 32 extends axially along the back plate 10, and the outermost end of this spring will be positioned adjacent the opposite end of the back plate where it is operatively associated with the latching and tensioning means L which will be subsequently described in detail.

As best shown in FIG. 7, means are provided for adjustably varying the normal position of the leaf spring 32 with respect to the bracket structure 16 on which it is supported. For such purpose, the leg portions 17 and 18 are each provided with an adjustable abutment screw 36 which underlies and is engageable with the adjacent end of the leaf spring element inwardly of the mounting bolts 35, 35. It will thus be evident that with the mounting bolts 35, 35 in loosened condition, the abutment screws 36, 36 may be raised and lowered so that when the mounting bolts 35, 35 are again tightened, the position of these abutment screws will determine the angular relationship of the leaf spring and the supporting bracket 16. This will determine the amount of loading spring force which will be applied to the gripping means G.
The latching and tensioning means \( L \) are supported upon the finger plate \( 12c \) as shown in FIG. 6. The finger plate \( 12c \) is fabricated with a lug \( 37 \) to which one end of a link member \( 38 \) is pivotally connected by a pivot pin \( 39 \). A latching lever \( 40 \) is constructed with a grip portion, and at one end is formed with a portion \( 41 \) having spaced end flanges \( 42 \) and \( 43 \) (FIG. 6) adapted to straddle the other end of link \( 38 \) to which it is connected by a pivot pin \( 44 \). The latching lever and link \( 38 \) as thus connected form an articulated linkage for clampingly retaining and anchoring the outer end of the leaf spring element \( 32 \) in a tensioned anchored position with respect to the finger plate \( 12c \). At this end of the spring, an end slot \( 45 \) permits the spring end to move from a position as shown in FIG. 1 to a latched position as shown in FIG. 7 wherein the lug \( 37 \) and associated link \( 38 \) will be straddled and permit actuation of the latching lever \( 40 \) into a latched position as shown in FIG. 7. The end flanges \( 42 \) and \( 43 \) have outer edge camming surfaces \( 46, 47 \) respectively, which will operate to force the spring into a deflected tensioned position as the latching lever reaches a fully latched position, at which point straight-edge portions \( 47, 48 \) respectively, on the flanges \( 42 \) and \( 43 \) will produce over center dwell points which will operate to retain the latching lever in latched position. As a safety feature, a latch pin \( 48 \), which is connected with the latching lever \( 40 \) by means of a flexible cable \( 49 \), may be inserted in aligned openings \( 50, 50 \), provided in the end flanges \( 42 \) and \( 43 \) to retain the lever against movement to an unlatched position. The operative position of the latch pin \( 48 \) to hold the latching lever is clearly shown in FIG. 3.

Retention of the webbing strap within the receiving channel of the device by the side flanges \( 23 \) and \( 24 \) as previously explained, is augmented at the latching end of the spring by means of a projecting lug \( 51 \) which is riveted or otherwise secured by conventional means at the outer end of the leaf spring element \( 32 \). This lug is adapted to be carried endwise into a slot or opening \( 52 \) at the free end of the finger plate \( 12c \), as shown in FIG. 6. In the latched position, the lug \( 51 \) projects past the back plate \( 10 \), in which position it opposes outward movement of the webbing strap from the body channel.

The mechanism as thus far described provides a device which may be clampingly gripped to a webbing strap \( W \), and in the clamped position the spring \( 32 \) will be stressed so as to preload the gripping surface \( 31 \) against the underlying webbing strap \( W \). It will be appreciated that the preloading force applied to the strap will depend upon the use which is to be made of the device, and the load forces which are to be applied between the strap and the device. The tension of the spring \( 32 \) will, of course, be adjusted accordingly by means of the screws \( 36, 36 \), in the manner previously described.

The release control mechanism \( R \) as utilized for controlling release of the loading force applied by the leaf spring \( 32 \) is associated with the finger plate \( 12b \) located between the ends of the back plate \( 10 \), and will now be described in detail. As shown in FIG. 5, the finger plate \( 12b \) is provided with a lug \( 53 \) upon which an angle link \( 54 \) is swingably mounted. The link \( 54 \) is longitudinally formed with a groove \( 55 \) which provides spaced apart side flanges \( 56 \) and \( 57 \) which are bridged at least in part by a connecting wall portion \( 58 \) (FIG. 7). The link \( 54 \) is pivotally connected at one end with the side flanges \( 56 \) and \( 57 \) straddling the lug \( 53 \), by means of pivot pin \( 59 \). The opposite end of the angle link \( 54 \) is connected through a pivot pin \( 60 \) with one end of a manually operable lever \( 61 \) which is constructed with an end projection \( 62 \), as best shown in FIG. 1, which is adapted in an extended position of the lever to abut an adjacent portion of the connecting wall \( 58 \) to limit counter-clockwise swinging movement of the lever to a position extending generally at an angle to the back plate \( 10 \), as shown in FIG. 7. However, the lever is freely swingable to an out-of-the-way position as shown in phantom lines in FIG. 2. The angle link \( 54 \) carries a spring engaging pin \( 63 \) which is anchored by means of a set screw \( 64 \) in a position in which the pin ends will respectively project outwardly beyond the side flanges \( 56 \) and \( 57 \) (FIG. 5). Referring to FIG. 7, the inner ends of the side flanges \( 56 \) and \( 57 \) are provided with similarly arranged end edges \( 65 \), which converge to a point as indicated at \( 67 \), these edges forming abutment stops for limiting the swinging movement in opposite directions of the link \( 54 \) on its pivot. The spring \( 32 \) is provided with a longitudinally extending slot \( 67' \) of sufficient width to permit the lever \( 61 \) and side flanges of the angle link \( 54 \) to project therethrough so as to permit movement of the spring loading means \( S \) to a released position as shown in FIG. 1 and a tensioned position as shown in FIG. 7. It will be seen that in the tensioned position of the spring \( 32 \), as shown in FIG. 7, the edge \( 66 \) provides an abutment stop which will oppose clockwise movement of the angle link \( 54 \) about its pivot when the tensioned spring \( 32 \) is in engagement with the spring engaging pin \( 63 \). Likewise, in the position shown in FIG. 1, the edge \( 65 \) forms a stop abutment which limits counterclockwise swinging movement of the angle link \( 54 \).

From the foregoing description it will be apparent that with a spring loading force applied to the gripping means, the serrated surface \( 31 \) will retain the device and webbing \( W \) against relative movement until the loading force is exceeded. However, until this point is reached, the loading pressure of the spring \( 32 \) may be controllably released with a high degree of nicety simply by pulling the lever \( 61 \) in a counter-clockwise direction, this action tending to bow the spring \( 32 \) in a direction to relieve the spring pressure acting on the serrated surface \( 31 \).

Due to the relatively high spring loading pressure which will be applied between the serrated surface \( 31 \) and the webbing strap \( W \), relative movement of the strap will subject the contact point immediately below the rotatable sleeve \( 30 \) to increased wear. It is therefore desirable to provide a surface in this area which may be extremely adverse to wear conditions and this may be done by impregnating the surface of the back plate at this location with a suitable material, as indicated by numeral \( 68 \), such as tungsten-carbide, which can be done by known methods.

From the foregoing description and drawings, it will be clearly evident that the delineated objects and features of the invention will be accomplished.

Various modifications may suggest themselves to those skilled in the art without departing from the spirit of my invention, and, hence, I do not wish to be
restricted to the specific forms shown or uses mentioned.

I claim:

1. A device of the character described for manually varying and controlling a gripping force applied to a connected flexible member to permit relative restrained movements between the device and the flexible member under a stressing loading force, comprising:
   a. a body structure for receiving an elongate flexible member for axial movements therein;
   b. means carried by said body including gripping surfaces supported for movement into and out of engagement with said flexible member;
   c. means including a leaf spring for resiliently urging said gripping surfaces into pressure engagement against said flexible member; and
   d. manually operable means carried by said body for releasably varying said pressure engagement so as to enable relative restrained movements between the gripping surfaces and said flexible member under applied stressing forces, including a swingably mounted camming lever for relieving the urging force of said resilient means with respect to said gripping surfaces.

2. A device according to claim 1, wherein the camming lever is articulated and includes a foldable handle portion.

3. A device according to claim 1, wherein the camming lever includes a camming link portion pivoted on said body structure for swinging movement, said link portion having a part engageable with said leaf spring, whereby movement of said camming link portion in one direction opposes the urging force of said spring.

4. A device according to claim 3, whereby the camming link portion has abutting surfaces for limiting the extent of movement of said camming link portion in opposite directions of its pivotal movement.

5. A device according to claim 3, wherein the camming lever includes an extension handle portion pivoted on said camming link portion for movement from a normal operative position to a folded out-of-the-way position.

6. A device of the character described for manually varying and controlling a gripping force applied to a connected webbing strap to permit relative restraint movements between the device and the webbing strap under a stressing loading force, comprising:
   a. a body structure including a guiding channel through which the webbing strap is axially movable;
   b. means carried by said body including a first gripping surface for engaging one side of the webbing strap and a second gripping surface carried on a rotatable member supported for translatory movement into and out of engagement with an opposite side of the webbing strap positioned in said channel, the support for said rotatable member comprising a bracket mounted for floating and swinging movement about a pivotal axis, whereby to enable its gripping surface to automatically accommodate to the engaged webbing strap surface;
   c. prestressed spring means for applying a loading force for urging said second gripping surface into pressure engagement against said webbing strap and to force it against the first gripping surface; and
   d. manually operable means carried by said body for changing the spring stress and consequent pressure engagement so as to enable relative restrained movements between the gripping surfaces and said webbing strap.

7. A device of the character described for manually varying and controlling a gripping force applied to a connected webbing strap to permit relative restrained movements between the device and the webbing strap under a stressing loading force, comprising:
   a. a body structure including a guiding channel through which the webbing strap is axially movable;
   b. means carried by said body including a first gripping surface for engaging one side of the webbing strap and a second gripping surface supported for movement into and out of engagement with an opposite side of said webbing strap, and being carried by a bracket mounted on said body structure for swinging about a pivotal axis extending transversely of said body structure;
   c. prestressed spring means for applying a loading force for urging said second gripping surface into pressure engagement against said webbing strap and to force it against the first gripping surface, said spring means comprising an elongate leaf spring connected at one end with said bracket for swinging movement therewith and having an outer end positionable in engagement with said body structure at a location longitudinally spaced from the pivotal axis of said bracket;
   d. means for releasably securing said spring outer end in a clamped engaged position with respect to said body structure; and
   e. manually operable means carried by said body for changing the spring stress and consequent pressure engagement so as to enable relative restrained movements between the gripping surfaces and said webbing strap.

8. A device according to claim 6, wherein said guiding channel has a side opening for receiving the webbing strap sidewise into said guiding channel and retaining means operably movable with said spring and bracket for extending across said side opening in the secured position of the outer end of said leaf spring.

9. A device according to claim 6, wherein the means for releasably securing said outer end includes a manually operable lever having a camming surface engaged with said spring.

10. A device according to claim 9, wherein said camming lever has a dwell surface operable at said clamped engaged position of said spring.

11. A device according to claim 10, including means for releasably latching said camming lever at said clamped engaged position of said spring.