SELF-CLAMPING GRIPS FOR FREE CABLE WINCHES

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References Cited
UNITED STATES PATENTS
1,143,713 6/1915 Kirstin 254/76
1,449,945 3/1923 Jacobsen 24/134 L
3,142,879 8/1964 Faure 24/134 N
3,410,526 11/1968 Tannan 24/134 N X
3,528,139 9/1970 Desplats 254/76 X

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ABSTRACT
A self-clamping gripping apparatus for selectively clamping and pulling a cable. The apparatus includes two jaws which are connected on their ends by respective straps. Rocking pieces raise the inner jaw through the agency of their tailed-in beads. A spring ensures the self-clamping action.

10 Claims, 6 Drawing Figures
FIG. 5
SELF-CLAMPING GRIPS FOR FREE CABLE WINCHES

The present invention relates to improvements in self-clamping grips of the kind used in a so-called “free cable” winch.

BACKGROUND OF THE INVENTION

As is known, there are two main types of cable winches. The first one is the drum winch wherein driving means rotatably drive the drum onto which the cable winds itself. In contradistinction, a free cable winch is provided with two grips which pull in turn the cable to hoist same, so that the cable moves ahead through the winch, beyond which the end of said cable remains free.

The principle of such a free cable winch is disclosed, for instance, in French Pat. No. 687,232.

Substantial improvements have been brought to the design of the grips, for instance, by French Pat. No. 1,451,230 which teaches forming each grip from an outer U-shaped jaw disposed around an inner jaw, the clamping between the two jaws being obtained by cams which bear directly on the outer U-shaped jaw in order to press the inner jaw. This allows clamping the cable between the two jaws when the latter have to support the load.

In all the known embodiments, the cams have a double function, that is:

1. They bring about between the two jaws a clamping action sufficient to draw the cable;
2. After the clamping is effected, they bear the whole stress of the drawing of the cable by the grip concerned.

As the friction coefficient of a cable clamped by the jaws is about 20%, the cam pressing force required for clamping the jaws onto the cable is at least six times the pulling force proper for drawing the cable. This proportionality automatism between the clamping force of the jaws and the pulling force, according to a ratio of about 6:1, is obtained in a simple way in the known winches, by using two separate pairs of levers having no interconnection, except that each pair is keyed, on the one hand, to the ends of the cam profiles, and, on the other hand, to the linking and driving axes for the mechanism. It is found that said lateral levers are necessarily thin, and transmit enormous clamping stresses through bearings having comparatively small surfaces. Thus, the two pairs of levers constitute deformable parallelograms, which tend to warp under the stresses, which brings about parasitic frictions between the various members of the winch. This results in deformations of parts and undue wear. Finally, these known systems can only be used for winches of comparatively low powers.

On the other hand, the known systems cannot be fitted to high power winches adapted, for instance, to exert a stress of 5 tons or more on a cable.

The object of the present invention is to avoid such drawbacks by providing a self-clamping grip arrangement adapted to be used on a high power free cable winch.

SUMMARY OF THE INVENTION

The present invention provides a gripping apparatus for a free cable winch including a first jaw member, and a second jaw member disposed adjacent the first jaw member to form with the first jaw member a passageway through which a cable may selectively be pulled and clamped. The apparatus also includes rockable means bearing against the first jaw member. First strap means is disposed adjacent one end of the first and second jaw members, and second strap means is disposed adjacent the other end of the first and second jaw members. The gripping apparatus also includes link means. First pivot means is disposed on one side of the cable pivotally interconnecting the first and second strap means, the second jaw member, and the rockable means bearing against the first jaw member. Second pivot means is disposed on the other side of the cable pivotally interconnecting the link means and the first and second strap means. The gripping apparatus also includes resilient means connected between the second jaw member and the first strap means urging the jaw members to clamp together against the cable under the action of the rockable means.

A grip for a free cable winch according to the invention includes a movable inner jaw adapted to move within a U-shaped outer jaw by which it is surrounded, these two jaws defining together a passageway receiving a cable. Said grip is characterized in that the pair of jaws is opened at one end by a first strap, and at the other end by a second strap, each of said straps having a transverse back, the inner surface of which is provided with a rocking piece which bears on the back of the inner jaw, while each strap pivots about a transverse axis which is likewise located behind the back of the inner jaw, the free ends of the arms of one of the straps beyond the outer jaw being connected, on the one hand, to a stop on the outer jaw by a spring tending to rock the lever in the direction in which the jaws are clamped, and, on the other hand, to the free ends of the arms of the other strap by at least one pivot link.

In the same way as in a free cable winch, at least one of the two straps is provided with means ensuring the driving thereof positively, through swinging about the axis thereof.

According to another feature of the invention, each rocking piece is connected to the back of the inner jaw through a bi-directional connection. This connection is constituted, for instance, by a cylindrical bead on the rocking piece, which bead is pivoted in a housing in the back of said jaw, which housing surrounds the bead over more than 180°. Such a connection is obtained in practice by securing a small block to the back of the inner jaw, after mounting the bead of each rocking piece into a semi-cylindrical recess defining an angle lower than or equal to 180° in said back of the inner jaw. Said block having one curved bearing surface which closes on the head and makes the recess cylindrical. According to a preferred embodiment, the back of the inner jaw is provided with a transverse dovetailed slot near each semi-cylindrical housing, with which slot a tenon on the base of the respective small block engages. With this arrangement, it is possible to fix the small block merely by means of a screw which passes through and engages in a hole tapped in the jaw, since the main operation stresses are received by the tenon and slot assembly.

According to an additional feature of the invention, each rocking piece is provided at its top with a projection or boss, which is nested into a corresponding opening in the back of the strap before the welding of the assembly, so as to obtain a highly rigid structure.
A further feature of the invention consists in providing on the back of the positively driven strap a small arm having a hole to receive the pivot pin of a connecting rod or a control lever.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 illustrates a free cable winch equipped according to the invention.

FIG. 2 is a longitudinal section thereof.

FIG. 3 is an exploded view showing the whole of the component parts of a pair of clamping jaws in a free cable winch according to the invention.

FIG. 4 is a side view showing the upper jaw fitted with its rocking pieces, the latter being shown before their fixing onto the backs of the straps.

FIG. 5 is a side view, partly in section, showing the jaws in their positions of operation or rest, with self-clamping.

FIG. 6 is a similar view showing the jaws in their released position.

**DETAILED DESCRIPTION OF THE INVENTION**

A free cable winch according to the invention is illustrated in FIGS. 1 and 2. This winch includes:

- an outer casing 1;
- a hoisting control lever 2, adapted to swing alternately in the directions of arrows 3 and 4;
- a release lever 5;
- a handle 6;
- a fixing hook 7.

It is known that a winch of the above type is used by securing the hook 7 to a fixed point, and then swinging the lever 2 in the directions of the arrows 3 and 4. A cable 9, which tows a load not shown, is thus made to move forward in the direction of the arrow 8. This cable 9 passes through the winch over the whole length of the casing 1. Forward of the winch, the end 10 of the cable 9 remains free.

The motion of the cable 9 is obtained by means of two pairs of jaws, 11 and 12, housed inside the casing 1. Said jaws are connected, through a connecting-rod arrangement (not shown) known per se, with the end 13 of the lever 2, the latter swinging about a pin 14. Thus, the pairs of jaws 11 and 12 are alternatively given a motion which brings them near each other (arrows 15 and 16) or away from each other. During said motions, one of the pairs of jaws, for example, 12, is clamped on the cable 9, while the other, for example, 11, is open, and vice versa.

This principle of operation for a free cable winch is known per se. The present invention relates to a particularly advantageous embodiment of the pairs of jaws 11 and 12. Since these two pairs of jaws are of similar construction, only one of them will now be described in more detail, such as, for instance, the pair 11.

Said pair includes a first jaw member of upper jaw 17 and a second jaw member or lower jaw 18. The jaw 18 has an U-shaped transverse section, and embraces the jaw 17, while it rises on either side of the latter. The jaw 18 is provided at the top of its lateral surfaces with two pairs of holes 19 and 20 intended for receiving first pivot means, such as pins 21 and 22.

The assembly constituted by the two jaws 17 and 18 is embraced by first and second strap means, such as two straps 23 and 24, which, according to the invention, may be identical, that is, produced from the same machinery. The two limbs of the strap 23 extend on either side of the outer jaw 18, below which their ends are provided with holes 25, which lie opposite each other to receive a transverse pin 26 forming part of second pivot means. The strap 23 includes two stop shoulders 27 located below the holes 25, and a small plate 28 provided with a central finger 29 bears against said shoulders. The finger 29 is adapted to receive resilient means, such as the bearing coil 30 of a compression spring 31 which centers itself thereon. Said coil 30 ends in a hook 32 which engages, after assembling, round the pin 26 (FIGS. 5 and 6).

The spring 31 is provided at its opposite end with a bearing coil 33 which centers itself on a finger 34 integral with a rod 35 which forms part of the jaw 18.

The strap 23 is provided near its top with two holes 36 disposed in opposite relation and adapted to receive the transverse pin 21. The latter is located above the back of the upper jaw 17.

The top of the strap 23 is provided with a transverse bottom 37, in which an opening 38 is preferably provided, which is, for instance, square or rectangular. This opening is intended for receiving the centering projection 39 having the same profile and provided on the back of rockable means, such as a rocking piece 40. Said rocking piece is a solid part, the front of which is provided with a cylindrical pushing bead 41 connected to the end of a lever arm 42. The transverse section of the bead 41 is in the shape of an arc of a circle extending over at least 260°. The rear portion of the rocking piece 41 is provided with a stop heel 43. A cylindrical housing 44 is provided between the lever arm 42 and the heel 43, according to a diameter enabling the transverse pin 21 to be inserted. The cylindrical housing 44 may open laterally to the outside, in the area indicated by the arrow 45.

During the manufacture, the projection 39 is nested into the opening 38 in the bottom 37 of the strap 23, and the assembly is finally welded (FIG. 6). The assembly thus obtained is highly rigid, and adapted to transmit substantial forces at the level of the pushing bead 41, when the strap 23 swings about its pin 21. A hollow 46 with a substantially semi-cylindrical profile is provided in the back of the upper jaw 17, said hollow being adapted to receive the pushing bead 41. A transverse slot 47 with a dovetail profile is provided in front of the hollow 46, and is adapted to receive the dovetail tenon 48 of a small block 49. The latter is fixed by means of a screw 50 passing therethrough and engaging inside a tapped hole 51 (FIG. 3) in the bottom of the slot 47.

The small block 49 is provided rearwardly with a concave bearing surface 52, which forms a portion of cylindrical surface having the same radius as the hollow 46.

After the assembly (FIGS. 5 and 6) the hollow 46 and the concave surface 52 together define a cylindrical surface portion extending over about 260°. Said concave cylindrical portion constitutes the female part of a housing inside which the bead 41 rests, because hollow 46 and bearing surface 52 extend over an angle greater than 180°, the bead remains trapped and cannot clear itself from the jaw 17. The latter is also subjected to a truly desmodromic drive, as will be seen further below.

The upper part of the rear portion of the jaw 17 defines an oblique bearing face 53, which is adapted to receive the stop heel 43 so as to limit the swinging am-
plitude of the strap 23 when the latter is in a position where the jaws are released (FIG. 6).

The front strap 24 is designed in the same way as the strap 23, except that its top is provided with a welded arm 54 provided with a hole 55. Said hole is used for mounting the linkage ensuring the connection with the end 13 of the control lever 2.

Apart from this difference, the strap 24 is, like the strap 23, provided with:
- two transverse holes 125 to receive a pin 126 forming part of the second pivot means; an upper bottom 137 below which a rocking piece 140 is welded;
- two transverse holes 136 to receive the pin 22, the latter passing also through the opening 144 in the rocking piece 140 forming part of the rockable means.

The rocking piece 140 is likewise provided with a head 141 which fits into a hollow 146 in the back of the jaw 17. Said hollow 146 is completed by the concave bearing face 152 of a retaining small block 49, the latter being assembled with the jaw 17 by means of a dovetail tenon 148.

Rearwards of the hollow 146, the back of the jaw 17 is provided with an oblique stop surface 153.

Lastly, the pins 26 and 126 at the free ends of the straps 23 and 24 are interconnected by two pivoted lateral links 56.

Upon the mounting, the cable 9 is engaged between the bottom of the U-shaped jaw 18 and the base of the upper jaw 17.

Lastly, the ends of the pins 21 and 22 carry runners which move within guiding slides 57 (FIG. 1) provided in a known way in the sides of the casing 1.

The operation is as follows:

When the operator actuates the lever 2, and transmits to the pin in the hole 55 an effort directed according to the arrow 58 (FIG. 5), the strap 24 tends to swing in the same direction about its axis pin 22. The connection through links 56 causes the strap 23 to swing about its axis pin 21 in the same direction. Consequently, the offset heads 41 and 141 of the two rocking pieces 40 and 140 bear upon the back of the upper jaw 17 (arrow 59), which causes the cable 9 to be strongly clamped on the bottom of the U-shaped jaw 18. It will be noted that said clamping takes place by the two jaws 17 and 18 after reduction. As a result, the assembly has very great rigidity which allows exerting on the cable 9 much stronger pulls than with the free cable winches of known types.

On the other hand, when the operation of the swinging lever 2 subjects the pin in the hole 55 to the effort directed according to the arrow 60 (FIG. 6), the strap 24 tends to swing in the same direction about its axis pin 22. The connection links 56 cause the strap 23 to rock in the same direction about its axis pin 21. Thus, the head 41 or 141 of each rocking piece 40 or 140 rises, as indicated by the arrow 61. Owing to the bidirectional connection of each head 41 or 141 with the upper jaw 17, the latter is also raised in the direction of the arrow 61, while remaining parallel to the bottom of the jaw 18. The cable 9 is thus freed, which enables the pair of jaws 11 to move lengthwise with respect to said cable, while the other pair of jaws 12 remains clamped.

The function of the spring 31 is to cause automatically the straps 23 and 24 to rock in the direction of the arrow 58 (FIG. 5), that is, in the direction in which the jaws 17 and 18 are clamped when the winch is at rest, or during an intermediate stage of inversion of the direction of motion. The springs 31 have thus a starting action which ensures a safe utilization of the winch.

The main advantages of the arrangement according to the invention are as follows:

1. The machining of the rocking pieces 40 and 140, straps 23 and 24 (hot or cold extrusion), and jaws 17 and 18 (forming, bending) includes only drilling operations and cut of cylindrical surfaces; in particular, no machining is required according to a more complete profile.

2. The assembly is particularly rigid, which allows exerting substantial clamping efforts on the cable 9, and increasing therefore the towing power of the winch.

3. As no intermediate members are required for transmitting the overall effort between the jaws 17 and 18, it is possible to make the pairs of jaws as assemblies taking up very little space; it becomes possible, in particular, to increase the length of the jaws 17 and 18 substantially, that is, to increase their contact areas on the cable 9; this, in fact, makes it possible to increase the overall clamping effort on the cable, while locally reducing the specific pressures exerted on the periphery of said cable by the jaws 17 and 18; the wear of the cable is thus reduced, as compared with that in a conventional winch, in spite of the increase of the useful pull.

4. Mounting the springs 31 which start the self-clamping of the jaws is particularly simple inasmuch as no coupling or connection with the casing 1 of the winch is required any longer.

5. The pivot pins 21 and 22 do not bear any torsional stress; the comparatively high stresses they have to bear in all cases are only shearing stresses, which the assembly according to the invention makes it possible to distribute in four planes (corresponding to the four bearing ends of the pins 21 and 22); such division of the shearing stresses improves the working conditions for the pins 21 and 22 and enables the pulling power of the winch to be increased.

I claim:

1. A gripping apparatus for a free cable winch, comprising, in combination:
   a first jaw member;
   a second jaw member disposed adjacent said first jaw member to form with said first jaw member a cable passageway through which a cable may selectively be pulled and clamped; rockable means including, at one end, a substantially cylindrical head which bears against and is received by said first jaw member;
   first strap means disposed adjacent one end of said first and second jaw members and pivotally coupled to said second jaw member;
   second strap means disposed adjacent the other end of said first and second jaw members and pivotally coupled to said second jaw member;
   first pivot means disposed on one side of said cable passageway, said first pivot means extending
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through apertures having completely closed peripheries in said strap means and in said second jaw member and through a partially opened cylindrical housing, disposed between a lever arm and a stop heel which are provided on said rockable means.

said first pivot means pivotally interconnecting said first and second strap means, respectively, and said rockable means with said second jaw member; link means;

second pivot means disposed on the other side of said cable passageway pivotally interconnecting said link means and said first and second strap means; resilient means connected between said second jaw member and said first strap means urging said jaw members to clamp together against said cable under the action of said rockable means; and wherein each of said strap means has a transverse bottom, the inner surface of which is provided with an aperture adapted to receive one of said rockable means.

2. A gripping apparatus characterized substantially in accordance with claim 1, wherein:
said first jaw member comprises an inner jaw;
said second jaw member comprises a U-shaped outer jaw;
said inner jaw is adapted to move within said U-shaped outer jaw by which said inner jaw is surrounded;
said jaws together defining said passageway for receiving said cable;
said first strap means comprises a first strap;
said second strap means comprises a second strap;
said jaws are capped at one end by said first strap, and at the other end by said second strap;
said rockable means comprises a rocking piece bearing on the bottom of said inner jaw;
each of said straps has a transverse bottom, the inner surface of which is provided with one of said rocking pieces which bears on the back of the inner jaw, while each strap pivots about a transverse axis which is likewise located behind the bottom of said inner jaw at a location which is set over with respect to said rocking pieces;
said link means includes at least one pivoted link;
said resilient means comprises a spring; and
the free ends of the arms of one of said straps beyond said outer jaw being connected, on the one hand, to a stop on said outer jaw by said spring tending to rock the lever in the direction in which said jaws are clamped under the action of the set over rocking pieces, and, on the other hand, to the free ends of the arms of the other strap by at least one pivoted link.

3. A gripping apparatus characterized in accordance with claim 2, wherein at least one of said straps is provided with means ensuring the positive driving thereof through swinging about the axis pin thereof.

4. A gripping apparatus substantially in accordance with claim 3, characterized in that the positive driving means includes an arm provided with a hole and welded to the bottom of the corresponding strap, which arm is intended for receiving the pivot pin for a connecting rod or a control lever.

5. A gripping apparatus substantially in accordance with claim 2, characterized in that each rocking piece is connected to the bottom of said inner jaw through a bi-directional connection which ensures a desmodromic or positive control of said jaws, both for driving them away from each other and bringing them toward each other.

6. A gripping apparatus characterized in accordance with claim 5, wherein the connection between a rocking piece and the back of said inner jaw comprises a cylindrical bead provided on said rocking piece outside the pivoting axis of the latter, said bead bearing in a female housing in the back of said inner jaw which housing surrounds said bead for more than 180°.

7. A gripping apparatus characterized in accordance with claim 6, wherein, after mounting said bead of each rocking piece in a semicylindrical surface defining an angle equal to or less than 180° on the back of the jaw, a small block is fixed to the back of said inner jaw, and said block has a bearing in the shape of an arc of a circle which closes behind said bead and completes the semicylindrical surface.

8. A gripping apparatus according to claim 6, wherein the back of said inner jaw is provided with a transverse dovetailed slot near each semi-cylindrical surface, and a tenon provided on the base of said small block engages transversely in said slot.

9. A gripping apparatus characterized in accordance with claim 8, including a screw which passes through said small block and is fixed in a tapped hole in the jaw so that the main operation stresses are not borne by said screw but by the tenon and slot assembly.

10. A gripping apparatus characterized in accordance with claim 2, wherein:
each rocking piece is provided with a projection nested into a corresponding opening in the bottom of said first and second straps so as to obtain a particularly rigid structure;
each rocking piece is provided with a rear heel adapted to abut a bearing face on said inner jaw to limit the rocking amplitude of the corresponding strap in the direction in which said jaws are loosened;
said spring, which causes the self-clamping of said jaws, bears at one end against a centering finger on a shaft integral with said U-shaped jaw, while the other end of said spring bears against a shoulder of the corresponding strap.

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