Aug. 8, 1967 P. E. H. CATU 3,334,865

HYDRAULIC WINCH WITH SELF-CLAMPING JAWS

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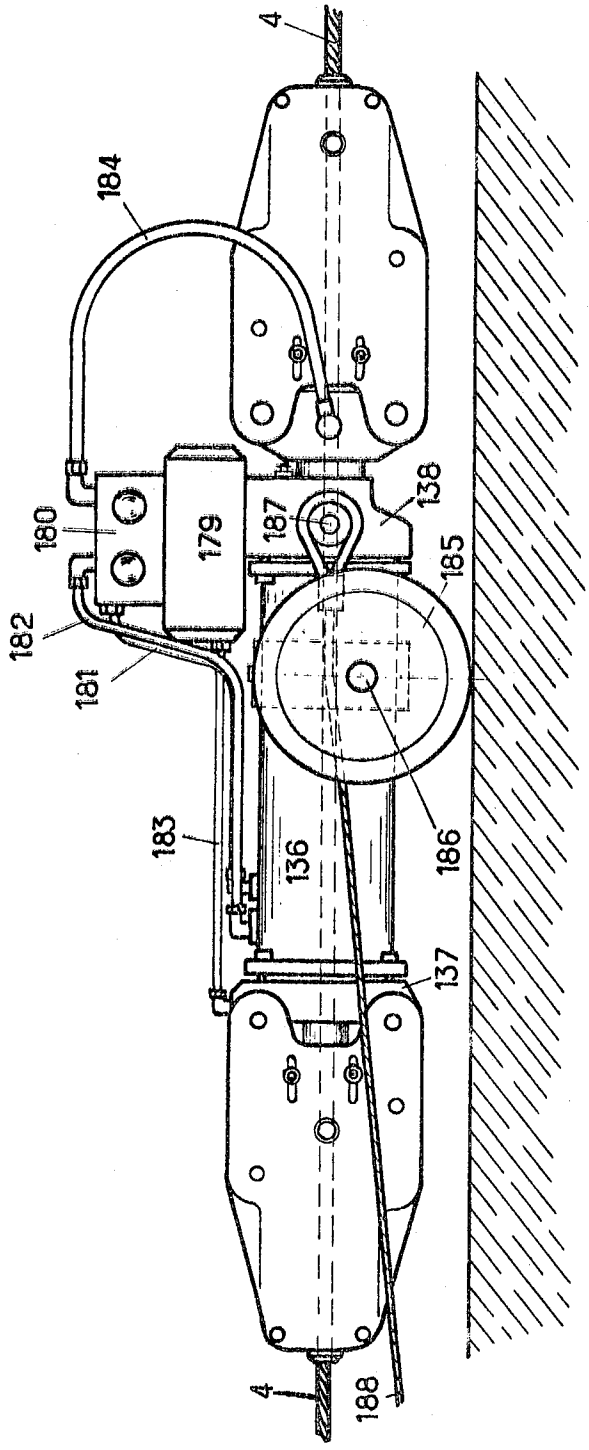


Fig 1

HYDRAULIC WINCH WITH SELF-CLAMPING JAWS

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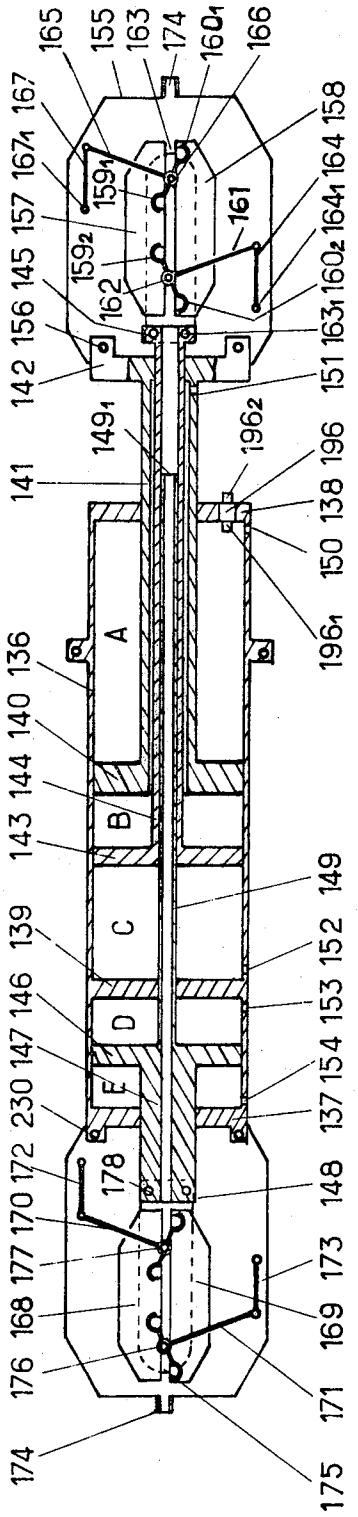


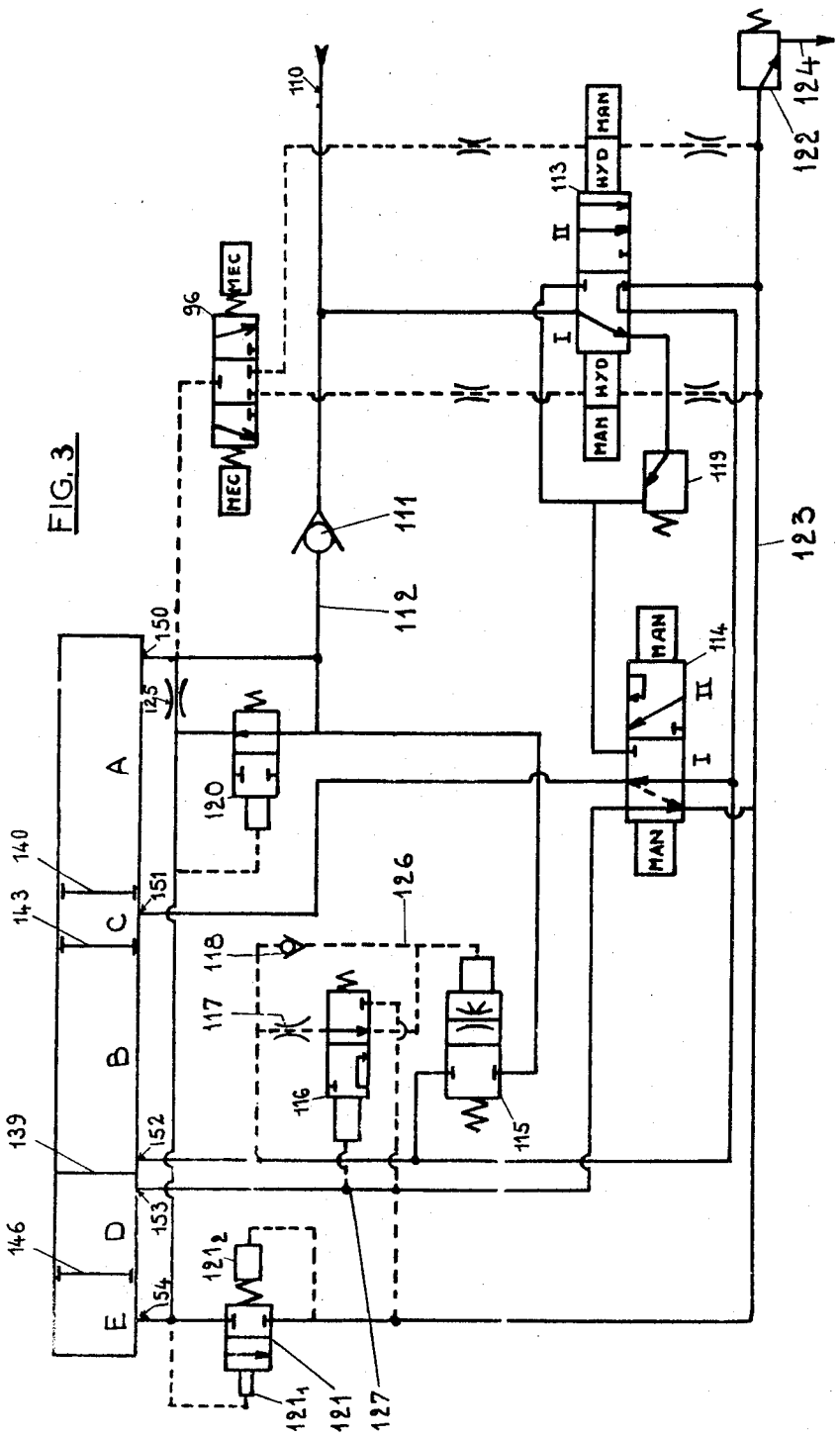
Fig 2

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HYDRAULIC WINCH WITH SELF-CLAMPING JAWS

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FIG. 3



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HYDRAULIC WINCH WITH SELF-CLAMPING JAWS

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One of the objects of the invention is to produce a hydraulic winch which is strong, of compact construction, unfailing to operate and easy to handle, while being entirely automatic.

Another object of the invention is to produce a hydraulic winch which comprises auto-clamping jaws provided with clamps, moving symmetrically in relation to the axis of the winch.

Another object of the invention is to produce a winch which, while being entirely automatic is also independent.

Another object of the invention is to produce a winch automatically establishing the releasing, gripping or pre-gripping of the clamps, and enabling either hauling movements, or backward movements to be effected at a controlled speed.

Other objects and advantages of the invention will be revealed by the description and claims hereafter as well as the attached drawings, in which:

FIGURE 1 is an overall external view of a winch according to the invention.

FIGURE 2 is a diagrammatical view in longitudinal section of the jack assembly, fitted with its two clamp blocks.

FIGURE 3 shows the diagram of the circuit layout for controlling the winch.

The hydraulic cable winch, according to the invention, comprises (see FIGURE 1) a cylinder **136** provided with two head elements **137, 138.**

This cylinder is divided into two parts by a partition **139** (see FIGURE 2) placed at a shorter distance from the head **137** than the head **138.**

Between the head **138** and the partition **139,** the cylinder accommodates a mobile assembly comprising a main piston **140** and an auxiliary piston **143.**

The tubular rod **141** of this piston **140** can slide in a seal-tight manner through the head **138** for externally receiving a rocking bar **142.**

The auxiliary piston **143** is placed between the piston **140** and the partition **139,** and the tubular rod **144** of this piston traverses, without any clearance, the rod **141** of the main piston, and without play, the rocking bar **142** in which it can slide in a seal-tight manner, receiving a flange **145,** where it comes out.

Between the partition **139** and the head **137,** the cylinder **136** receives a second auxiliary piston **146.** This auxiliary piston **146** comprises a hollow rod **147** which can slide in a seal-tight manner through the head **137.** This rod has a flange **148** at its end.

The piston **146** and its rod **147** are integral with a central tube **149** able to slide in a seal-tight manner, on the one hand, through the partition **139,** and on the other, through the hollow rod **144** of the auxiliary piston **143.**

The end 149_1 of this central tube **149** is located inside the rod **144.**

The cylinder **136** of the jack is thus divided into 5 independent chambers A, B, C, D, and E.

The chamber A, for generating the hauling movement of the mobile jaw, is supplied through an orifice **150** made in the end of the cylinder **136** close to the head **138.**

The chamber B, for controlling the opening of the mobile jaw, is supplied through an orifice **151** made in

the free end of the rod **141** of the main piston. This orifice **151** emerges inside the rod **141** in the annular space comprised between this rod **141** and the rod **144.**

The chamber C, for controlling the exit movement of the mobile assembly comprises the pistons **140–143** and the mobile jaw.

The chamber D controls the opening of the fixed jaw.

The chambers C and D are supplied through the orifices **152** and **153,** placed close to and at each end of the partition **139.**

The chamber E controls the closing and pre-gripping of the fixed jaw. This chamber is supplied through an orifice **154,** made in the end of the cylinder **136,** close to the head **137.**

The free end of the rod **141** of the main piston **140** has two lateral external side plates **155,** removably fixed on the rocking lever **142** by means of two pins **156,** and between which are two gripping jaws with plain bearings, **157** and **158.** On each of its two lateral faces, the grip **157** carries, at an equal distance from its ends, two cylindrical semi-journals 159_1 and 159_2, whereas the grip **158** carries on its two lateral faces, two cylindrical semi-journals 160_1 and 160_2, placed equidistant from its ends, while being farther apart from each other than the semi-journals 159_1 and 159_2.

A grip multiplying lever **161,** comprising two arms enclosing the grips **157** and **158,** seizes the two semi-journals 159_2 and 160_2, in corresponding cavities, and comprises a lateral journal **162** centred on the middle of the segment joining the centers of the semi-journals 159_2 and 160_2.

This journal **162** can revolve freely in one of the two lateral plates **163,** removably fixed to the end of the flange **145** by means of pins 163_1, while being axially guided in the two external side plates **155.** The main arm of the lever **161** is directed downwards and is articulated at its lower end, on to the end of a connecting rod **164,** whose other end accommodates an articulation spindle 164_1 fixed at its ends in the two side plates **155.**

In a similar way, a second lever **165,** provided with two arms enclosing the grip **157,** comprises a journal **166** and is placed symmetrically in relation to the lever **161.**

This lever **165** takes the two semi-journals 159_1 and 160_1 and is directed upwards and articulates at its upper end on a connecting rod **167** whose second end takes an articulation spindle 167_1 fixed at its ends in the two side plates **155.**

The journal **166** of the lever **165** engages in one of the coupling plates **163** placed between the gripping lever and the external side plates **155.** At the entry to the jaw unit, a cable guide **174** is fixed between two side plates **155** in the axis of the jaw unit.

A fixed jaw unit, placed at the other end of the jack, is removably attached to the head **137,** by means of pins **230.**

This unit is composed of the same elements as the mobile jaw unit, but differs from it, however, owing to the fact that, as compared with the external side plates, the gripping clamps **168** and **169** are switched over, the same as the levers **170, 171, 172** and **173,** everything else, however, remaining the same from the assembling standpoint.

A cable guide **174** is also placed at the exit from this fixed jaw unit. The coupling plates **175** of the journals **176** and **177** of the gripping levers **170** and **171,** are removably attached to the flange **148** of the rod **147** by means of pins **178.**

On the upper part of the head **138** of the cylinder **136** a control unit **179, 180** (see FIGURE 1) is fixed, whose exits are connected by external piping **181, 182, 183** to the supply orifices **152, 153** and **154,** and by a flexible pipe **184** to the orifice **151** of the rod **141,** for supplying the chamber B.

The orifice **150** of chamber A directly communicates with the corresponding exit from the unit **179**.

The cylinder **136** is articulated on a pair of wheels **185**, whose spindle **186**, situated slightly below the axis of the jack, is as near as possible to the center of gravity of the winch.

On each of its sides, the head **138** has a journal for attaching the end of a cable **188** for securing the winch to a fixed point.

When passing above the spindle **186** of the wheels **185**, the cable **188** is kept at the height of the axis of the jack, so as to be able then to swing it round at will around this point.

The hydraulic circuit of the winch control comprises (see FIGURE 3), a supply duct **110** with non-return valve **111**, delivering into a circuit **112** supplying the chamber A, a two-position distributor **113** for reversing the movement of the mobile jaw, a two-position distributor **114** for reversing the movement of the cable holding the load, a braking valve **115**, a pilot valve **116**, controlling the opening and closing of the valve **115**, a throttle valve **117** for limiting the delivery of the valve **116**, a non-return valve **118**, a pressure reducing valve **119** for generating a steady pressure drop between chambers A and B when the driving rod of the mobile jaw enters, the load being propulsive, a pressure compensating valve **120** connecting chamber E with the supply circuit **112** below a certain pressure prevailing in this chamber B, a valve **121** opening by differential pilotings for balancing the thrusts on both faces of the auxiliary piston **146** with a slight constant overpressure on the piston **146** of chamber E towards chamber D, a pressure limiting valve **122** for creating a slight counter-pressure between the delivery circuit **123** and the return duct to the tank **124**, a throttle valve **125** ensuring a permanent supply with a very slight output from chamber E by the high pressure circuit **112**, and lastly, a three-position valve **96** for automatically controlling the valve **113**.

The two valves **115**, **116**, the throttle **117** and the non-return valve **118** form the device for hydraulically braking the load.

The valve **115** has a variable opening. When this valve is full open, it connects, without braking, chamber A to chamber B; on the other hand, it completely isolates these two chambers when it is closed; for intermediate positions, the valve **115** produces a throttling of the fluid which slows down its flow from A to B. When not operating, this valve is closed.

The piloting valve **116** with three ways and two positions, connects, when at rest, the control circuit **126** for opening the valve **115** to chamber B through the throttle **117**. In its second position, the valve **116** connects the opening circuit **126** to the delivery circuit **123**. The non-return valve **118** ensures the rapid emptying of the opening circuit **126** towards chamber B when the pressure at B drops below a certain value.

The passage of the valve **116** from its rest position to its working position takes place by hydraulic piloting supplied by chamber D. The valve **115** only begins to open for a pressure at **126** exceeding that of the counter-pressure circuit **123**. The pressure of chamber D required for piloting at **127** of the valve **116** is slightly greater than the pressure at the end of opening for the circuit **126** of the valve **115**. The balancing valve **121** comprises a small section pilotage 121_1 connected to chamber E and a large section pilotage 121_2 connected to the counter-pressure circuit **123**. The valve **121** closed at rest opens for connecting chamber E to the circuit **123** for a certain pressure at E that it maintains.

The compensation valve **120** which is open when at rest, ensuring the link of the circuit **112** with chamber E, cuts this link slightly before the valve **121** opens.

The distributors **113** and **114** being on the first position (positions shown) chamber A is supplied by the circuit **112**, chamber B is connected to the counter-pressure circuit **123** through the distributor **113** and chamber C through the distributor **114**. These connections generate the entry of the rod driving the mobile jaw, the pre-clamping of this jaw by counter-pressure at B and C on the unequal sections of the piston **143** and a pre-clamping of the fixed jaw by the piston **146**. The load is carried. The distributor **114** being on its first position and the distributor **113** on its second position (position shown waiting in FIGURE 3), chamber B is connected to the supply circuit **110** through the distributor **113** and to chamber C through the distributor **114**. These connections generate the putting under pressure of chambers B and C entailing the opening of the valve **115** by the control circuit **126** and hence the evacuation of the fluid from chamber A to chamber B and the rapid exit of the rod whereas the cable **4** is held by the fixed jaw. During the self-clamping of the fixed jaw, the piston **146** creates a depression at E which causes the opening of the compensation valve **120**.

The distributor **114** being put on its second position, and the distributor **113** on its first, chamber B is connected to chamber D through the distributor **114** and the counter-pressure circuit **123** through the distributor **113**, whereas chamber C is connected to the high pressure circuit **110** through the distributor **114**, the pressure reducing valve **119** and the distributor **113**. These connections generate a pressure in chamber C which tends to release the grips of the mobile jaw if the latter holds the load. Owing to the pressure drop generated by the valve **119** between chamber A and chamber B the piston **140** and its rod begin to enter taking along the mobile jaw **155** which slides on the cable, before said jaw has been able completely to open, the cable then being held by the fixed jaw.

The distributors **113** and **114** being placed on their second position, chamber B is connected to chamber D through the distributor **114** and to the supply circuit **110** through the distributor **113**, whereas chamber C is connected to the counter-pressure circuit **123** through the distributor **114** and the distributor **113**. The fixed jaw holding the load, the putting under pressure of chambers B and D causes the opening of the braking valve **115** without this bringing about the displacement of the main piston **140**, then the hydraulic control of the valve **115**, which cuts out the control pressure of the valve **115**, which closes, then, the opening of the fixed jaw whereas the mobile jaw progressively takes up the load. For a certain pressure value at D, before the complete releasing of the fixed jaw, the valve **116** resumes its rest position, the valve **115** opens and the fluid from chamber A flows to chamber B whereas the withdrawal speed of the load increases up to the moment when the delivery of the circuit **110** becomes just sufficient for supplying chamber B under pressure. The valve **115** then stops opening and the speed of the load remains constant.

In this method of embodiment, the distributor **113** can be hydraulically controlled in both directions by the piloting valve **96** mechanically controlled at the end of the stroke and manually at any point of the stroke of the jack rod.

Of course, the invention is not restricted to the examples of embodiment described and shown above, from which other methods and forms of embodiment can be provided without going outside of the scope of the invention for that purpose.

What I claim is:

1. Hydraulic winch comprising a hydraulic cylinder, a fixed self-clamping jaw secured to one end of the cylinder, a mobile self-clamping jaw at the opposite end of the cylinder, each jaw including a body containing a pair of movable grips and clamping levers articulated on the body for moving the grips toward each other to clamp the jaw when the grips are moved lengthwise in one direction relative to the body, a plurality of pistons in said cylinder provided with central openings, hollow piston rods secured to the pistons around said openings, said

rods being slidably disposed in one another and forming a central telescoping tube extending through the cylinder for the passage of a haulage cable therethrough, one of the hollow rods being connected with the grips of the fixed jaw to move them lengthwise of the fixed jaw body, another hollow rod being connected with the body of the mobile jaw, another hollow rod being connected with the grips of the mobile jaw to move them lengthwise of the mobile jaw body, and means for introducing fluid under pressure into said cylinder at predetermined points for moving the pistons in predetermined directions to move the mobile jaw toward and away from the cylinder and to clamp that jaw when it is moving in one direction and to clamp the other jaw when the mobile jaw is moving in the other direction.

2. Hydraulic winch according to claim **1**, including a partition in said cylinder provided with a central opening therethrough, the hollow rod that is connected with the grips of the fixed jaw extending through said partition opening in sliding engagement with the partition, the piston that is secured to that hollow rod being disposed between said partition and the fixed jaw, and the piston connected to the hollow rods connected with the body and grips of the mobile jaw being disposed at the side of said partition opposite to said first-mentioned piston.

3. Hydraulic winch according to claim **2**, in which the inlets to the cylinder for said fluid under pressure are located between the ends of the cylinder and the nearest pistons and between said partition and the nearest pistons and in the exposed end of the hollow rod connected with the mobile jaw, the hollow rods connected with the mobile jaw and the grips thereof being in sliding engagement at their outer ends but spaced apart inwardly thereof to form a passage for fluid entering said inlet in said exposed end.

4. Hydraulic winch according to claim **1**, in which said fluid pressure introducing means includes a hydraulic circuit provided with a distributor for producing the reversing movement of the grips and mobile jaw, and valves controlled by the pressure of the liquid in the circuit for

setting up counter-pressure on the pistons connected with the grips of the jaws and for producing their pre-gripping.

5. Hydraulic winch according to claim **1**, in which said fluid pressure introducing means includes a hydraulic circuit provided with a distributor for producing the reversing movement of the grips and mobile jaw, and a hydraulic braking valve for limiting the speed of the load on the haulage cable when it is propulsive.

6. Hydraulic winch according to claim **5**, in which a piloting valve subjects said braking valve to the unclamping pressure of the fixed jaw for keeping the fixed jaw slightly clamped on the cable during braking of said load.

7. Hydraulic winch according to claim **6**, including a pressure reducing valve in the hydraulic circuit to prevent complete unclamping of the mobile jaw when, the load being propulsive, the mobile jaw returns toward the cylinder empty.

8. Hydraulic winch comprising a fixed self-clamping jaw and a mobile self-clamping jaw, each of said jaws having a body containing a pair of vertically spaced movable grips and two pairs of clamping levers, the levers of each pair being pivoted together at their inner ends with the outer ends of one lever pivoted to the adjoining jaw body and the outer end of the other lever articulated on the grips, one pair of levers in each jaw being above the grips therein and the other pair being below those grips, and means for moving each pair of grps horizontally, relative to the body containing them, in directions toward and away from the other pair of grips to actuate said levers for opening and closing said grips.

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