

[54] **CHAIN JACK WITH MECHANICALLY AND HYDRAULICALLY OPERATED PAWLS**

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[58] Field of Search 254/105, 108, 109, 110, 254/111, 93 R

[56] **References Cited**

UNITED STATES PATENTS

2,951,679	9/1960	De Witt	254/111
2,973,566	3/1961	Elsner	254/93 R
3,499,629	3/1970	Horton	254/93 R

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[57] **ABSTRACT**

A chain jack has a pair of pawls, one attached to a hydraulic cylinder as a base and the other attached to the head of a ram which is attached to a piston in the ram actuating hydraulic cylinder. Alternate extension and retraction of the ram, with the pawls spring biased to successively engage the links of the chain, causes movement of the chain with respect to the ram actuating cylinder in one direction. Cams attached to the ram head and to the ram actuating cylinder engage catches which are hydraulically controlled to cause selective engagement of the pawls with links of the chain to cause movement of the chain with respect to the ram actuating cylinder in the other direction, also with alternate extension and retraction of the ram.

4 Claims, 4 Drawing Figures

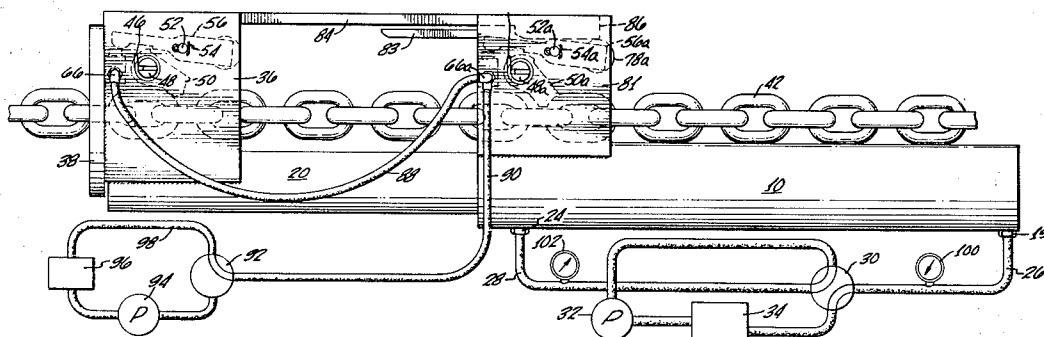
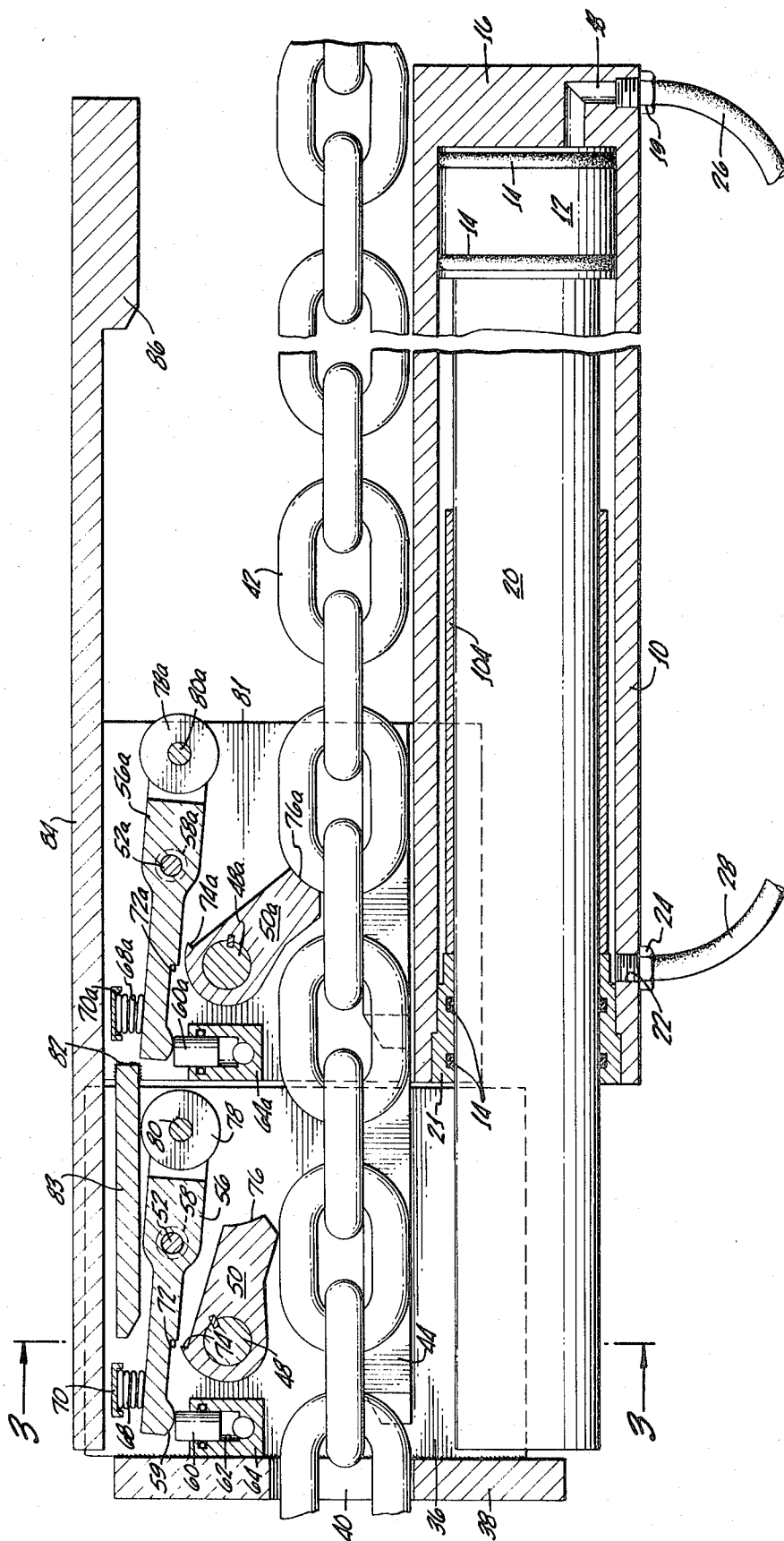


FIG. 2.



CHAIN JACK WITH MECHANICALLY AND HYDRAULICALLY OPERATED PAWLS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a chain jack having mechanically and hydraulically operated pawls.

2. The Prior Art

Link chain or roller chain lifting or jacking mechanisms have been proposed and used in the prior art. These have often been lever operated and suitable for light work. Heavy duty chain jacks are generally hydraulically operated with hydraulically operated latches for holding chain links during lifting and lowering operation of the jack ram, such as, for example, described and claimed in my copending patent application Ser. No. 312,024 filed Dec. 4, 1972. For applications in the medium range, not requiring the extremely heavy hydraulically operated construction of the heavy duty type, hydraulic operation of the jack itself is desirable but the expensive and massive latches with wholly hydraulic operation are not necessary.

This invention provides a hydraulically operated chain jack employing simple mechanically and hydraulically operated pawls to engage and disengage the links of the chain as the jack ram is sequentially extended and retracted.

BRIEF SUMMARY OF THE INVENTION

Summarized briefly this invention comprises a chain jack having a base and a hydraulically operated ram, a chain passing through the base and alongside the ram, and pawls attached to the base and to the ram head. The pawls are spring biased to engage the ends of links of the chain to prevent relative movement of the chain in one direction while riding over links of the chain when the chain is relatively moved in the other direction. For operation in one direction, for example the "lift" mode, the ram head pawl engages the chain and moves the jack along the chain as the ram extends while the base pawl drags over the chain links. When the ram reaches the end of its extension stroke and retracts, the base latch automatically engages a link to hold the jack while the ram retracts to engage the chain again for another "lift" stroke. For reverse or "lower" mode of operation, a cam operated lock holds the base pawl away from the chain while the upper pawl is engaged with a chain link during the lowering or retraction stroke of the ram. At the end of the lowering or retracting ram stroke the cam lock releases the base pawl to engage and hold the chain while the ram head pawl is held by a cam operated lock away from the chain during extension of the ram. At the end of the ram extension stroke the ram head pawl is again actuated to engage the chain while the base pawl is held away from the chain and the cycle is repeated successively to lower the jack by increments along the chain.

BRIEF DESCRIPTION OF THE DRAWINGS

Construction and operation of this invention will be more readily understood by reference to the detailed description thereof and to the accompanying drawings in which:

FIG. 1 shows an end view of a chain jack embodying features of this invention.

FIG. 2 shows a central vertical section of the chain jack of FIG. 1 taken along the line 2—2.

FIG. 3 shows a vertical cross section of the chain jack taken along the line 3—3 of FIG. 2.

FIG. 4 shows a general side view of the chain jack of FIG. 1 with the ram extended along the chain.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now particularly to FIGS. 1 to 4, the chain jack comprises a hydraulic operating cylinder 10 having a piston 12 sealed to the walls of cylinder 10 by spaced apart seals 14. One end of cylinder 10 is closed as at 16 through which is led a channel 18 for application of oil under pressure to one side of piston 12, this oil being transferred to channel 18 through fitting 19 by which it is connected to an external hydraulic system. The other end of cylinder 10 is attached to outer ram bearing 21 fitted also with spaced-apart seals 14 which seal its interior surface at this end to the outer surface of ram 20 which is attached at its inner end to piston 12 which acts also as an inner bearing for ram 20. Channel 22 is arranged through the wall of cylinder 10 as shown to provide a flow of oil introduced through fitting 24 to the back or other side of piston 12. Fittings 19 and 24 are connected by oil lines 26 and 28 respectively to four way valve 30 through which oil is supplied under pressure by pump 32 from a suitable reservoir 34, as seen in FIG. 4. By selective positioning of valve 30, oil under pressure may be caused to flow alternately to one side and then the other of piston 12 to cause repetitive retraction and extension of ram 20.

Attached to ram 20 at about its mid lines (considered vertically as viewed in FIG. 2) are side plates 36 to which are attached, as by welding at their outer edges, an orifice plate 38 having a central hole 40 through which passes chain 42. The links of chain 42 are maintained in horizontal alignment as they enter the hole 42 by guides 44 which are suitably attached to the inner surfaces of side plates 36.

Passing through side plates 36 and biased by end springs 46 is shaft 48 on which is fixedly mounted ram head pawl 50. Springs 46 are arranged to bias the lower part of pawl 50 against the surfaces of the links of chain 42 as shown.

Also passing through side plates 36 is shaft 52 maintained in place by cotter pins 54 and on which is rotatably mounted catch 56 which is maintained centrally between side plates 36 by spacers 58. Catch 56 is provided at one end with a surface as at 59 adapted to contact the top of a piston 60 which is set in hydraulic cylinder 62 in a block 64 suitably attached to an inner surface at one of side plates 36 and which may be supplied with oil under pressure through fitting 66 (see FIG. 4). Catch 56 is biased downwardly toward pawl 50 by spring 68 held conveniently in a mount 70 attached also to an inner face of a side plate 36. In the area that catch 56 would contact pawl 50 under urging by spring 68, and when it is not urged upwards by piston 60, it is provided with a shoulder 72 which, when pawl 50 is raised as by passing over a vertical link of chain 42, can engage a mating shoulder 74 on pawl 50 to lock pawl 50 in raised position as shown and to prevent engagement of curvate end 76 of pawl 50 with an end of a link of chain 42. The other end of catch 56 is provided with a rotatable wheel 78 maintained by shaft 80 in a fork in its end.

Attached to cylinder 10 are a second set of side plates 81 which are somewhat shorter (in height) than side plates 36 and which together with cylinder 10 can be considered to constitute a base. Side plates 81 are fitted with base pawl 50a biased by spring 46a on shaft 48a, and with catch 56a rotatably mounted on shaft 52a, and with hydraulic piston 60a, and with biasing spring 68a and wheel 78a all as described in detail for similar elements shown and described with respect to those associated with side plates 36. In FIG. 2 the pawl 50a between side plates 81 is shown in lower position with its curvate end 76a locked against an end of a link of chain 42. Also attached to one of side plates 81 as at 82 is an elongated cam 83 which is positioned to engage and force down the wheeled end of catch 56 between side plates 36 thus rotating catch 56 and maintaining shoulder 72 on catch 56, and shoulder 74 on pawl 50, out of engagement under conditions to be described hereinafter. Fixedly attached to the tops of side plates 36 is a top member 84 which extends over chain 42 and cylinder 10 and which terminates in elongated cam 86 which can engage wheel 78a attached to catch 56a between side plates 81 to maintain shoulder 72a on catch 56a, and catch 74a on pawl 50a, out of engagement as will be referred to again hereinafter.

The hydraulic system actuating pistons 60 and 60a is shown in FIG. 4. Flexible hydraulic tubing 88 connects fittings 66 and 66a which communicate respectively with cylinders actuating pistons 60 and 60a. The connection to fitting 66a also leads through tube 90 to valve 92 which can be turned to admit oil under pressure provided by pump 94 from reservoir 96 to extend pistons 66 and 66a, or can be turned to release oil in this circuit back to reservoir 96 through oil line 98 thus allowing pistons 66 and 66a to be retracted.

Pressure gauges 100 and 102 are inserted in oil lines 26 and 28 respectively to indicate the ends of each stroke of ram 20 and to facilitate control of the ram motion particularly in the lowering mode.

A feature of the chain jack of this invention is provision for compensating for the eccentric load caused by the off-center position of the chain 42 (which lies longitudinally alongside hydraulic cylinder 10) with respect to the central axis of ram 20. The outer bearing 21 and the piston 12 acting as an inner bearing maintain ram 20 aligned in cylinder 10. When the ram 20 is retracted (as shown in FIG. 2) by fluid input through oil line 28, the outer ram bearing 21 and the inner ram bearing, that is piston 12, are spaced well apart, as will be obvious, and this spacing will enable the ram and cylinder assembly to readily bear the offset or eccentric load of the chain. When the ram 20 is extended by fluid input through oil line 26, however, the spacing between ram bearings that is outer bearing 21 and piston 12 is decreased, and to maintain the ram bearings always spaced apart at least a minimum distance a tubular spacer 104 is provided surrounding ram 20 inside cylinder 10. The length of tubular spacer 104 is such that even when ram 20 is in fully extended position the ram bearings will still be spaced apart a sufficient distance so that they will properly bear the eccentric load of the chain, this load being offset by a side load-supporting couple in the spaced apart ram bearings.

The chain jack of this invention, as will be obvious, may be operated as are other types of jacks, and the chain and basic assembly (hydraulic cylinder 10 and side plates 81) may move with respect to each other in

one direction or the other, to left or right or up or down, to move or to raise or lower a load which may be conventionally or suitably attached to either. Since the drawings show the jack and chain in horizontal position, operation will be described for purposes of example with the ram hydraulic cylinder stationary to move a load, assumed to be attached to the left hand end of the chain, from left to right referring particularly to FIG. 4. If the jack is arranged vertically, as by rotating 90° from the position shown in FIG. 4 this may correspond to a "lift" mode to raise an assumed load on the chain.

In operation of the chain jack for left to right chain movement or "lift" mode of operation valve 92 is rotated to connect oil line 90 with oil under pressure from pump 94 thus raising pistons 60 and 60a which in turn raise the left hand ends (as illustrated) of catches 56 and 56a. This prevents the shoulders 72 and 72a from locking with shoulders 74 and 74a on pawls 50 and 50a and these pawls are then continuously biased against the surfaces of the links of chain 42 by springs 46 and 46a. Valve 30 is then rotated to cause connection of oil under pressure from pump 32 repetitively and successively to oil lines 26 and 28 to supply pressurized oil alternately to the sides of piston 12 and causing ram 20 to be repetitively extended and retracted with respect to cylinder 10. At each extension of ram 20 the cylinder 10 will be held in place by pawl 50a engaging a link of chain 42 as illustrated in FIG. 2, while pawl 50 will drag over the surfaces of the links until ram 20 reaches the end of its stroke as seen in FIG. 4. Then on the reverse stroke of the ram, pawl 50 will engage a link of chain 42 and pull the jack up or along the chain while pawl 50a drags over the surface over the chain links. On reversal of the stroke of ram 20 the cycle is repeated. Thus the pawls are alternately lifted and opened by the chain links passing in one direction but their shape and spring biasing prevent the chain from passing through in the opposite direction.

To reverse the direction of travel or to lower the load, valve 92 is first rotated to depressurize pistons 60 and 60a thus allowing catches 72 and 72a to engage and catch ram head pawl 50 and base pawl 50a as required. The length of the stroke of ram 20 is established to allow some over travel beyond the pitch distance of the links over which it travels at each stroke. To begin reverse direction chain movement or lowering, the load is supported by pawl 50 engaging one of the links of chain 42. Oil is directed by valve 30 to cause full retraction of ram 20. During the final short distance of travel base pawl 50a is lifted by passing over an upright chain link and it is captured there by interlocking of shoulder 72a on 56a with shoulder 74a on pawl 50a. Now the extension stroke of ram 20 is initiated by the operator by manipulation of valve 30. As ram 20 extends pawl 50a will drag lightly over chain 42 but will not engage a link because it is being held open, and it will pass over the chain until pawl catch 56a is released by cam surface 86 acting on wheel 78a to depress that end of catch 56a and to release shoulder 72a from 74a. Base pawl 50a then engages the chain at the next upright link halting travel of the mechanism associated with plates 81. The mechanism associated with plates 30 now begins to travel a short distance until ram head pawl 50 is forced outward and is captured by catch 56 by interlocking of shoulders 72 and 74, the ram at this stage being fully extended. Now the ram retraction stroke is initiated by

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the operator by manipulation of valve 30. Ram head pawl 50 will drag lightly over the links of chain 42 but will not engage once it is locked open until released by contact of cam 83 with wheel 80 which releases shoulder 72 from shoulder 74 and allows ram head pawl 50 to engage chain 42 at the next upright link. The load is now held or supported by ram head pawl 50 and full ram retraction is accomplished as before and the cycle repeated.

The operator merely positions the handles on valve 92 for left or right direction at "lift" or "lower" as right or left chain travel and then operates valve 30 for alternate retraction and extension of ram 20. The end of each ram stroke is indicated by a pressure spike on gauges 100 and 102. Pawl position indicators are not necessary since pawl actuations is an automatic function of the jack operating mode (lifting and lowering or right or left chain travel) and of the extended or retracted ram position. The operator operates the valve controls and the chain or the jack with its load responsively inches its way up or down the chain as selected. Small amounts of ram pretravel and overtravel permit locking and unlocking the pawl catch mechanisms. The sequence or mode can be stopped or reversed at any point in the cycle and the load will be safely held.

I claim:

1. A chain jack having a chain, a ram attached to a piston in a hydraulic cylinder for actuation thereof, a pawl attached to the head of said ram, and a pawl attached to said hydraulic cylinder, said pawls engaging links of said chain successively and repetitively as the piston in said hydraulic cylinder extends and retracts said ram; in which the improvement comprises:

- a. springs biasing said pawls toward links of said chain;
- b. catches selectively locking said pawls out of en-

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gagement with links of said chain and releasing said pawls for engagement with links of said chain;

c. hydraulic cylinders for maintaining said catches released from said pawls during operation in a mode to move the chain and the ram actuating cylinder in one direction with respect to each other; and

d. a cam attached to said ram actuating hydraulic cylinder and a cam attached to said ram head to selectively engage each of said catches to cause selective engagement of and release of said pawls from the links of said chain during operation in a mode to move the chain and the ram actuating cylinder in the other direction with respect to each other.

2. A chain jack according to claim 1 in which one of said pawls has a shoulder adapted to be engaged by a corresponding shoulder on a catch attached to the cylinder of said ram actuating hydraulic cylinder and the other of said pawls has a shoulder adapted to be engaged by a corresponding shoulder on a catch attached to said ram head, when said catches are engaged by said cams.

3. A chain jack according to claim 1 in which the ram actuating hydraulic cylinder consists of a single cylinder and a piston with the ram attached thereto, and having the said chain lying longitudinally alongside said hydraulic means, the eccentric load of the chain with respect to the central axis of said ram being born by ram bearings spaced apart an extended distance within said hydraulic cylinder.

4. A chain jack according to claim 3 in which an extended tubular spacer surrounds said ram within said cylinder to maintain said ram bearings at least a distance apart sufficient to bear the eccentric load of said chain with respect to the central axis of said ram.

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