Aug. 29, 1950 A. E. WILSHUSEN ET AL 2,520,187

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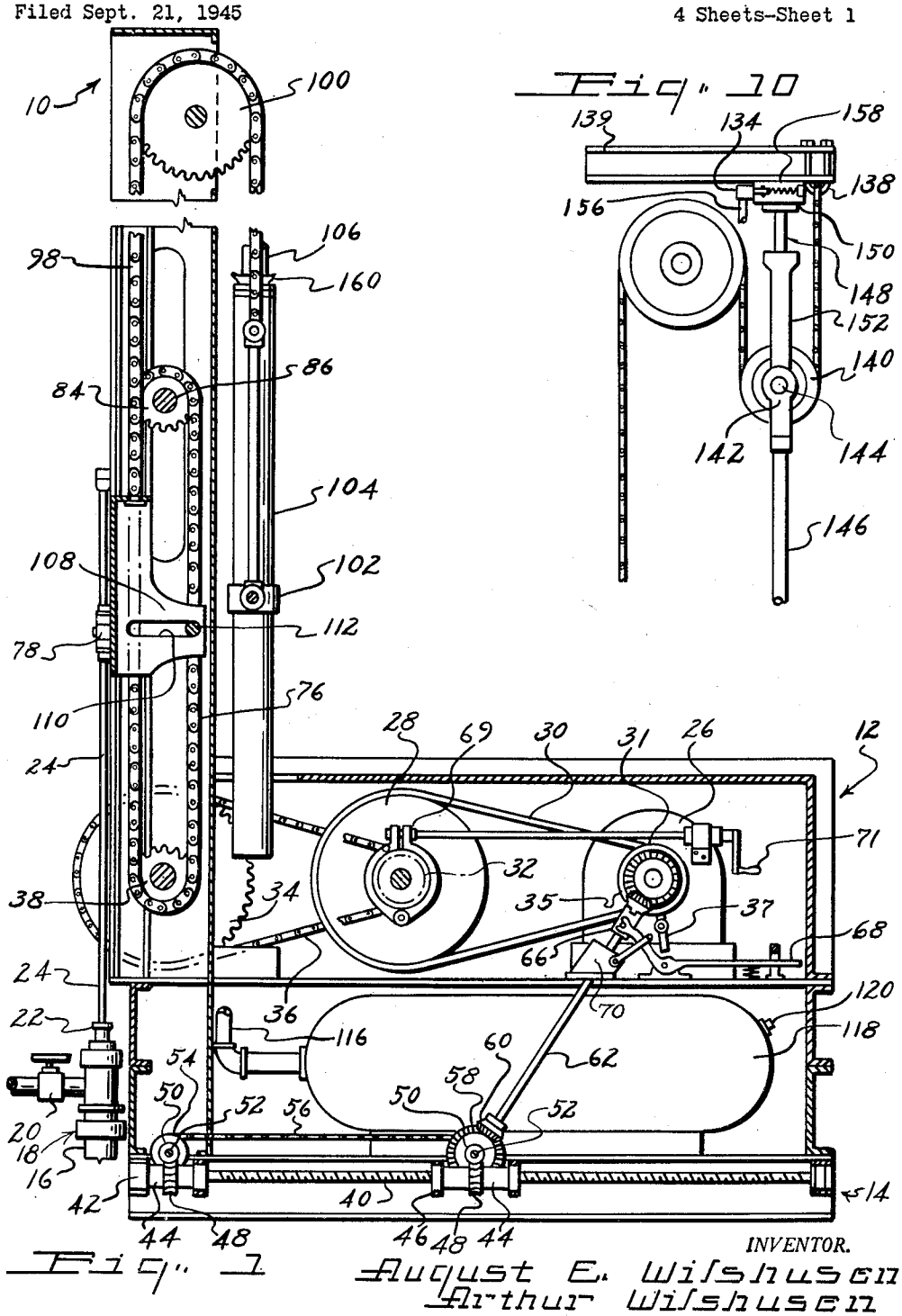


Fig. 1

Fig. 10

INVENTOR.

August E. Wilshusen

Arthur Wilshusen

Inom Graham

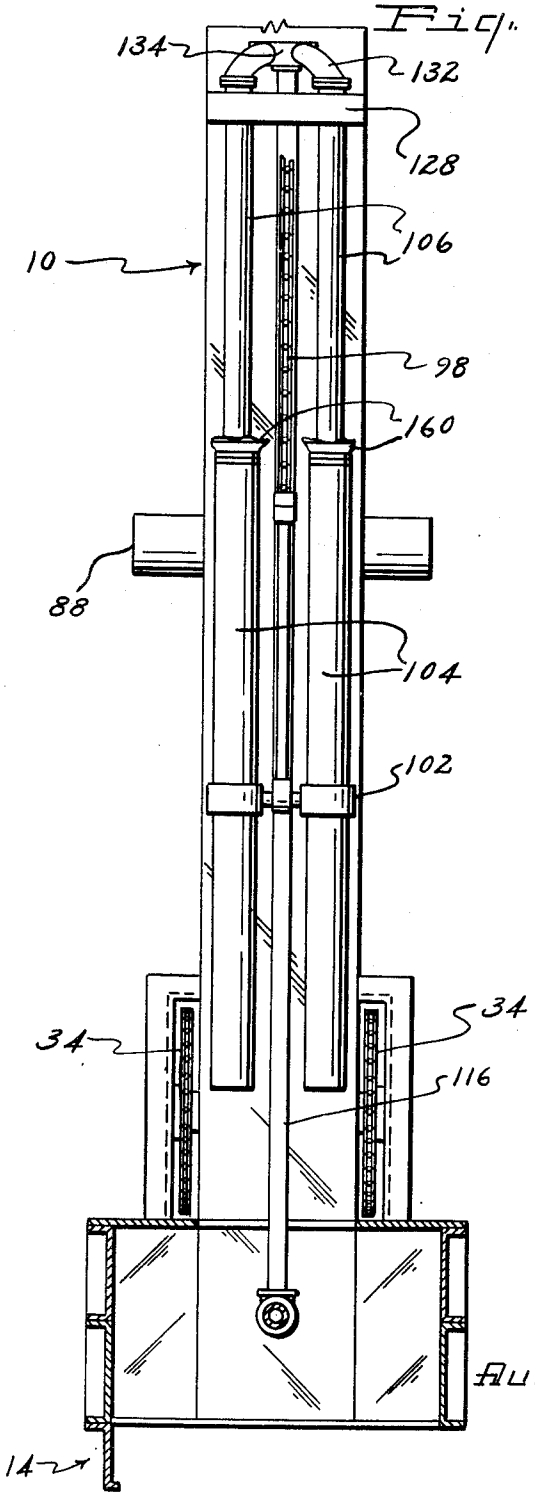
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Fig. 2



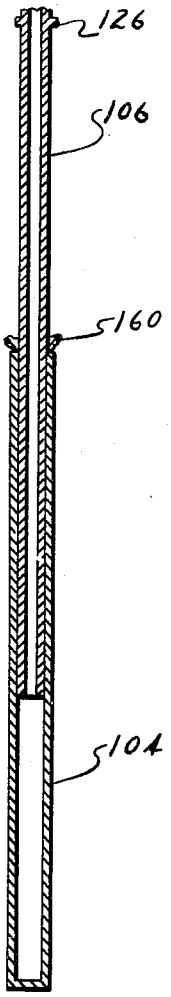


Fig. 6

INVENTOR.
August E. Wilshusen
Arthur Wilshusen
Mann Graham
Attys

Aug. 29, 1950 A. E. WILSHUSEN ET AL 2,520,187

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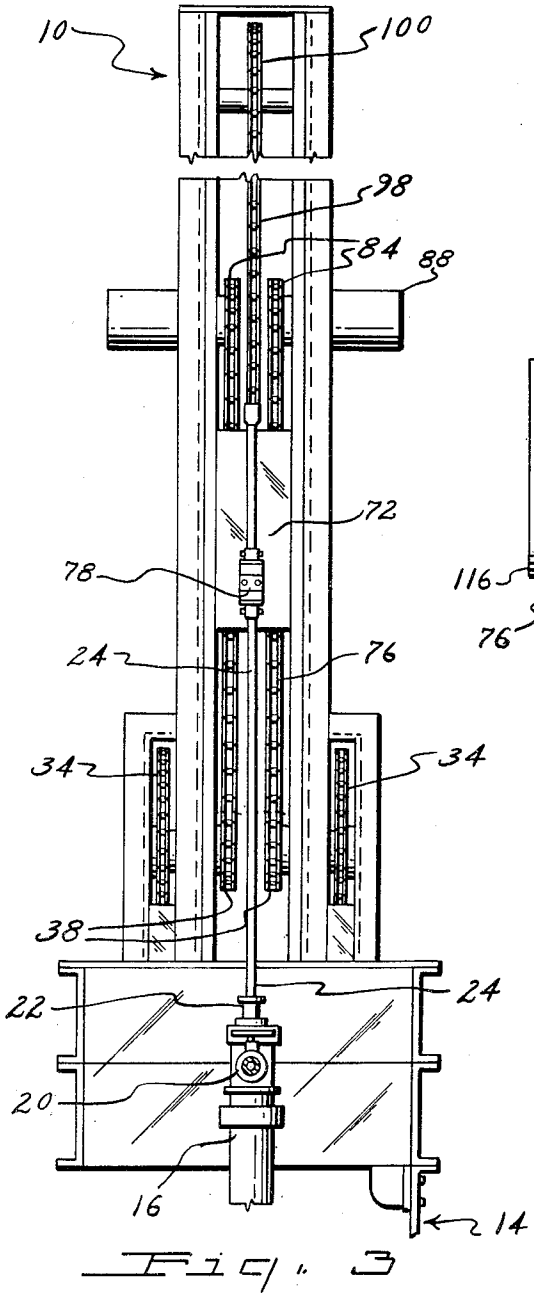


Fig. 3

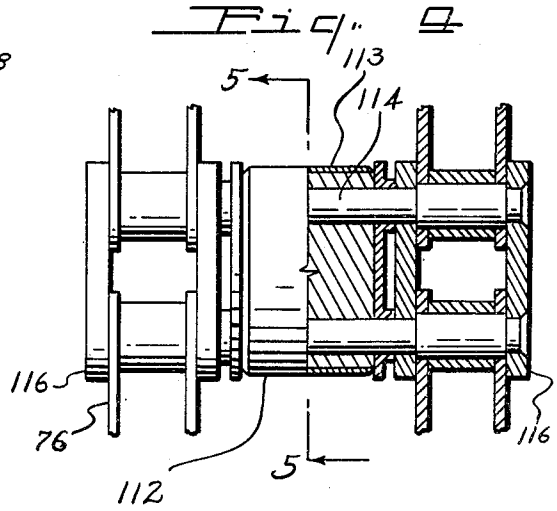


Fig. 4

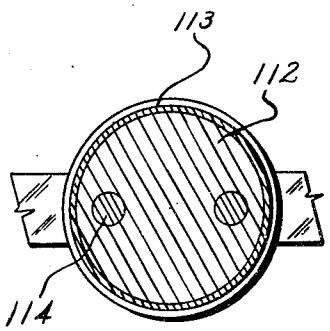


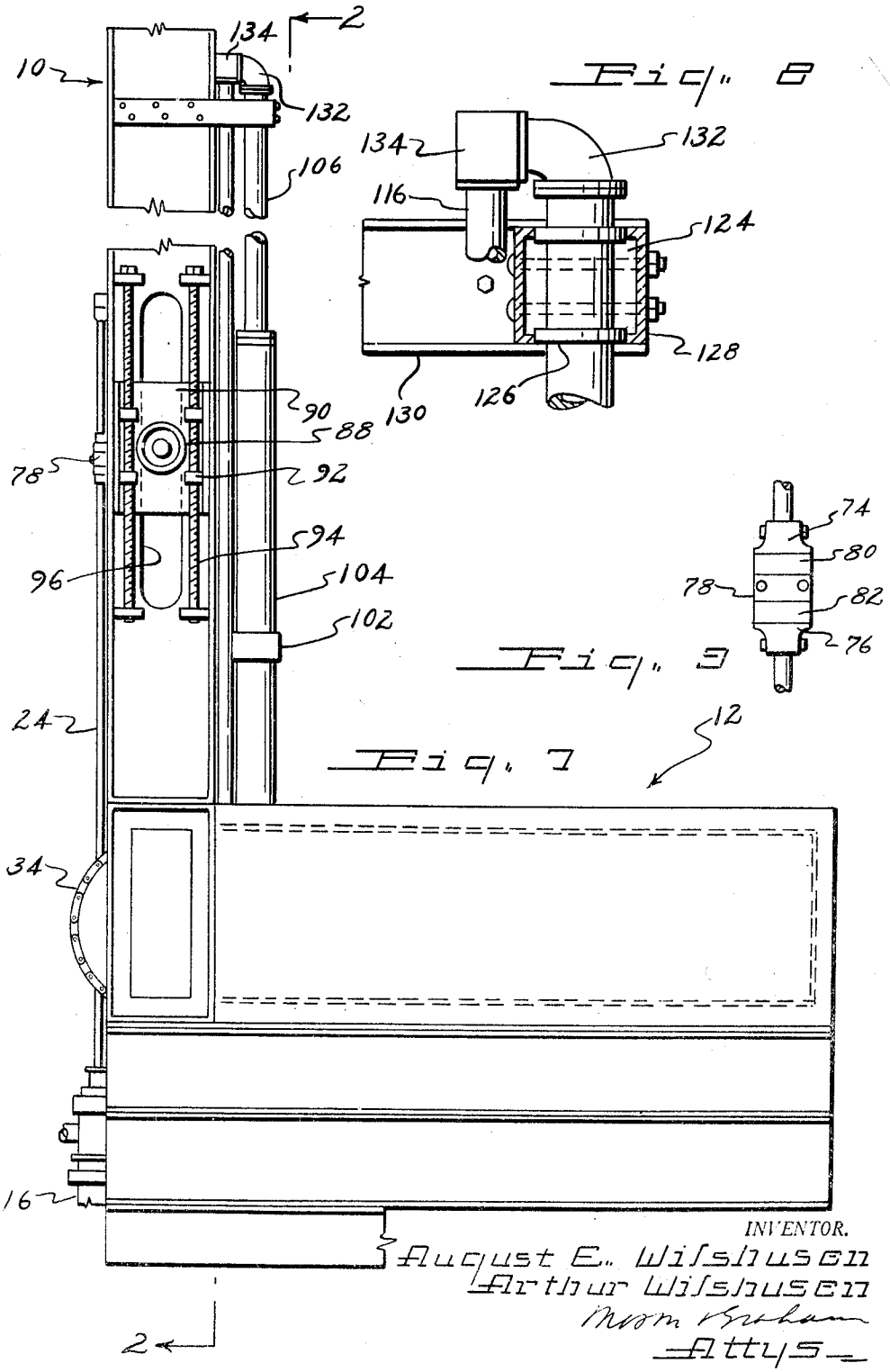
Fig. 5

INVENTOR.
August E. Wilshusen
Arthur Wilshusen
Mason Graham
Attys

Aug. 29, 1950 A. E. WILSHUSEN ET AL 2,520,187

PUMP JACK

Filed Sept. 21, 1945 4 Sheets-Sheet 4



INVENTOR.
August E. Wilshusen
Arthur Wilshusen
Thom Graham
Attys

Patented Aug. 29, 1950 2,520,187

UNITED STATES PATENT OFFICE

2,520,187

PUMP JACK

August E. Wilshusen, Inglewood, and Arthur Wilshusen, Torrance, Calif.

Application September 21, 1945, Serial No. 617,792

4 Claims. (Cl. 74—37)

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This invention relates to pump jacks or machines for operating pumps, and particularly for operating pumps used in the oil well industry.

Such machines are often required to operate pumps bringing oil from considerable depths, and the weight of the pump rod and liquid often amounts to thousands of pounds. The type of pump jack generally in use is fitted with a "walking beam" which is a heavy beam oscillated in a vertical plane about a pivot by means of a crank driven from a prime mover, the oil well pump rod commonly being attached to a cable passing over an arcuate head at the end of the beam in order to secure a straight pull on the pump rod. This type of equipment necessitates the use of a prime mover of considerable power to handle the wide fluctuations in load imposed on it and also is very wasteful of space. It has been proposed to counterbalance the load due to the pump rods which, of course, is constant, and part of the weight of the column of liquid being raised, by using air under pressure contained in a tank and introduced between a cylinder and piston, one of which members is attached to a pivot on the "walking beam" and the other to a pivot on the pump platform.

Our invention is particularly designed to provide improved pump actuating mechanism having a straight line motion of all load carrying parts, and to utilize compressed air and cylinder and piston means to reduce the fluctuations in load on the prime mover, the cylinder and piston means also having only a straight line movement to secure a very advantageous arrangement of pumping power.

An object of the invention is to provide a pump jack having a straight line pull on the pump rods which may be readily adapted to strokes of various length.

It is a further object of the invention to provide a pump jack of simple yet sturdy construction occupying a relatively small area.

It is a still further object of the invention to provide a pump jack of the type described fitted with compressed air counterbalancing means including piston and cylinder means having a straight line movement only.

A still further feature of the invention is to provide a pump jack which may be readily moved out of position above the well in order to enable the pump rods or well casing to be drawn out of the well.

A further object of the invention is to provide a pump jack construction in which all working parts run continuously in a bath of lubricant.

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Further objects and features of the invention will appear in the following description taken in conjunction with the accompanying drawings.

The invention is hereinafter described and illustrated in a preferred form, but it is to be understood that the scope of the invention is not in any way limited by this illustrative showing but only as indicated by the scope of the appended claims.

In the accompanying drawings:

Fig. 1 is a side elevation of the pump jack shown partly in section;

Fig. 2 is a section taken on line 2—2 of Fig. 7;

Fig. 3 is a front elevation;

Fig. 4 is a detail view, partly in section and to an enlarged scale, of the element transmitting power from the prime mover to a part connected to the pump rod;

Fig. 5 is a section taken on line 5—5 of Fig. 4;

Fig. 6 is a fragmentary vertical sectional view through one of the counterbalance cylinders and its associated piston;

Fig. 7 is a side elevation of the pump jack structure, the view being broken away to shorten its length;

Fig. 8 is a fragmentary section to an enlarged scale showing the method of mounting the upper ends of stationary piston rods of the compressed air counterbalancing means;

Fig. 9 is a fragmentary detail showing a means of clamping the pump rod to the reciprocating crosshead of the pump jack in a manner enabling readings of the power exerted by the pump jack to be made; and

Fig. 10 is a fragmentary detail showing an alternative method of connecting the compressed air counterbalancing means to the pump jack, which is particularly advantageous when using an exceptionally long pumping stroke, and also showing a method of mounting a make-up cylinder connected to the compressed air system.

Referring now to Fig. 1, the pump jack comprises a vertical column 10 built of channel beams and supported on a base structure 12 arranged for sliding movement on a platform formed by beams 14. The top of the oil well casing is indicated at 16, a cap 18 being shown fitted with the usual arrangement of outlet valve 20 and pump rod packing gland 22. The pump rod is indicated by the numeral 24.

The base structure 12 encloses a suitable prime mover, such as an electric motor 26. While any suitable reduction gearing may be provided between the prime mover and the pump, we have shown a simple double driving pulley 28 pro-

vided with a grooved periphery driven by belts 30 from the motor driven belt pulley 31 and carrying a chain sprocket 32 which drives the driving sprocket 34 of the pump by means of a driving chain 36. A clutch 35 of any suitable kind is arranged between the motor shaft and motor driven pulley 31, a lever 37 being shown by which the clutch may be operated to connect or disconnect the belt pulley 31 from the engine shaft.

From Fig. 3 it will be seen that a driving sprocket 34 is arranged in each side of the vertical column. The sprockets 34 are mounted on shafts carrying sprockets 38.

The arrangement given by way of example for sliding the pump jack structure on the platform beams 14 comprises a threaded rod 40 carried in brackets 42 mounted on the inner sides of the beams 14. Threaded sleeves 44 are mounted on the stem and arranged to revolve thereon between brackets 46 carried by the base 12. The sleeves may be rotated by a worm gear 48 surrounding the sleeves and worms 50 mounted on shafts 52. Two of the worm driven sleeves are shown, one being at the forward end of the base and one about midway of the length thereof, the construction being duplicated at each side of the base.

The worm shafts may be rotated in unison by means of sprockets 54 mounted on the worm shafts 52 and connected by a chain 56. One of the shafts 52 may be driven from the prime mover by means of bevel gears 58 on the shaft 52 engaged by a bevel gear 60 in a shaft 62 driven by bevel gears from the motor shaft.

A muff coupling 66 is arranged at the upper end of the driving shaft 62 and this coupling may be engaged and disengaged by means of a lever 68 pivoted on the floor of the jack base. When the coupling is engaged the shafts 52 will be rotated in unison, causing rotation of the sleeves 44 which will screw forwardly or backwardly on the threaded stems 40 and thereby shift the pump structure along the base beam 14. In order to secure drive either toward or away from the well, a gear box 70 is provided.

The clutch lever 37 is preferably operated by movement of lever 68 to disconnect the motor from the pump mechanism when moving the vertical column.

The usual brake for holding the pumping mechanism in raised position is indicated at 69, and the operating crank for the brake rod is indicated at 71.

The pump rod 24 is vertically reciprocated by means of a cross head 72 to which the pump rod is secured, preferably as shown in Fig. 9, by means of collars 74 and 76 clamped to the pump rod above and below a bracket 78 projecting from the cross head. Pads of resilient material 80 and 82 are interposed between the clamps and bracket.

The slight relative movement between the pump rod and the bracket 78 may be caused to operate a pressure indicator not shown, provided with a record tape in any convenient manner in order that a record of the work done by the pump through the day may be secured.

The cross head 72 is reciprocated by means of the driving chains 76 which pass around the driving sprockets 34 previously mentioned and around sprockets 84 carried on shafts 86 mounted in vertically adjustable bearing sleeves 88.

By reference to Fig. 7 it will be seen that the sleeves 88 are rigidly mounted on sliding plates 90 provided with threaded lugs 92 which mesh with threaded stems 94. By rotation of these stems the plates may be displaced upwardly or downwardly, thereby adjusting the shafts 86 in vertical position as may be required by the length of stroke desired, or take up slack due to wear in the chain. Elongated slots 96 are provided in the vertical columns 10 to permit this vertical adjustment.

The cross head is provided with a rearwardly extending arm 108 which is provided with a slot 110 in which is mounted a sliding member 112 to which the driving chains are secured and which acts to transmit both upward and downward movement to the cross head. Member 112 evidently will occupy a position at the rear end of the slot during the downward movement of the cross head and will travel from that point to the forward end of the slot as its point of attachment to the chain passes over the driving sprocket at the commencement of the up stroke of the cross head and return to the rear end of the slot when the cross head reaches the end of its upstroke as its point of attachment passes over the upper chain sprocket.

The construction of the sliding member 112 is shown in detail in Figs. 4 and 5. It will be noted that member 112 is connected to adjacent links of chain by pins 114 which extend through the chain and through the body of the member 112, a specially heavy outer link 116 being used to connect the outer ends of the pins. The member 112 being cylindrical in shape enables the chain to follow the contour of the sprocket wheels while the two pins provide a strong connection between the chain and the member 112, as is necessary since the whole of the power of the prime mover is transmitted to the cross head through this member. Preferably the member 112 is provided with a tire or sleeve 113 of hard steel.

A third chain 98 is attached to the cross head between the two driving chains and connects the cross head to the compressed air counterbalancing means. Chain 98 passes around a chain sprocket 100 carried vertically above the cross head and is secured to a yoke 102 fastened to cylinders 104 working on pistons 106.

Cylinders 104 and pistons 106 form a closed system together with the air conduit 116 and compressed air tank 118. Preferably the compressed air counterbalancing means is arranged to counterbalance about 64% of the combined weight of the reciprocated parts of the pump and pump jack as well as of the fluid load lifted by the pump.

In order to enable the compressed air tank to be initially charged to a pressure depending on the load to be counterbalanced, a charging valve 120 is provided through which the air may be forced by an air compressor of any suitable type. Any desired arrangement of make-up pump to supply air lost by leakage may be provided.

The arrangement of the abutment for the upper end of the pistons is shown in Fig. 8 and comprises bored and split blocks 124 which may be bolted around the upper end of the pistons between flanges 126 welded thereon. The blocks are clamped between I-beams 128 which in turn are supported between I-beams 130 projecting from the vertical column of the pump. An elbow 132 connects the upper ends of the pistons with a manifold 134 to which the upper end of the air pipe 116 from the compressed air tank is bolted.

It is sometimes necessary to provide for a long stroke in pumps of the type with which the pump

jack is used. In such cases it may be economical to use cylinder and pistons of the sizes used for shorter stroke pumps and to secure the necessarily greater travel of the chain connecting the compressed air cylinders with the cross head by attaching the end of the chain to an abutment projecting from the vertical column. A construction of this type is shown in detail in Fig. 10, in which it will be seen that the end of the chain is connected to a U-bolt 138 carried by a beam 139 projecting from the head of the column 10. An idler sprocket 140 is arranged in the loop of the chain and a stirrup 142 is provided journalled on a shaft 144 passing through the hub of the sprocket. A rod 146 is secured to the stirrup and to the yoke 102 connecting the compressed air cylinder. The described construction will result in a length of travel of the rod 146 only half the travel of the cross head. The construction also provides an advantageous means of arranging the make-up pump which, as shown in Fig. 10, consists of a stationary piston 148 provided with a bore for the passage of air and mounted on a base 150 secured to the I-beam 139. The piston works in a cylinder 152 carried on a second stirrup also mounted on the shaft 144. The air pipe 156 leads air from the piston to any suitable point in the counterbalancing system such as, for instance, to the manifold 134.

A relief valve 158 is provided to enable air above the desired pressure to be released from the make-up pump. If the pressure in the counterbalancing system falls below the desired value, however, the pump will bring the pressure back to that desired.

It will be noted that all moving parts concerned with the pumping operation or with the counterbalancing of the forces against which the prime mover works are provided with a straight line motion, thereby not only applying the effort of the prime mover in the most advantageous manner, but also eliminating wear due to angularly applied forces and wear on packing glands caused thereby. One of the many advantages secured by this arrangement is that sufficient lubrication between the cylinder and piston walls of the compressed air counterbalancing means may be provided by means of a bell or flare 160 formed at the top of the cylinders, as shown in Fig. 6, which may be packed with oily waste or similar lubricating material and will serve to maintain efficient lubrication of the running surfaces.

We claim:

1. A pump jack for a pump operated by a pump rod including: a frame; a vertical column carried by said frame and adapted to be positioned above a well; a cross-head having a main body and having a slotted arm extending rearwardly therefrom at right angles thereto, the main body of said cross-head being mounted for straight line vertical reciprocation in said column; means connecting the pump rod to said cross-head at the side thereof opposite to said arm; a driving member mounted for movement in the slot in said arm; sprockets arranged above and below the range of travel of said cross-head; an endless chain drive mounted on said sprockets and connected to the driving member mounted in the slotted arm; and a prime mover acting to continuously rotate said chain sprockets.

2. A pump jack as defined in claim 1 in which the pump rod is connected to the cross-head at a point spaced laterally of the chain drive.

3. A pump jack for a well pump actuated by a rod, comprising a frame, a vertical column carried by the frame and disposed above the well, a cross-head reciprocally mounted in the column for vertical movement, means operatively connecting the cross-head to the rod, means for reciprocating the cross-head, comprising driven sprockets rotatably carried by the column, an endless chain carried by the sprockets to be moved thereby, means connecting the cross-head and chain for moving the cross-head in response to movement of the chain, and counterbalance means including an air cylinder member, a piston member in the cylinder, one of said members being dependently mounted on said frame and the other extending below the mounted member, an idler wheel mounted at the upper end of said column, a second idler wheel mounted on the lowermost of said members, and an elongated flexible element attached to said cross-head at one end and to said frame at the other, said flexible element passing over said idler wheels between its ends whereby downward movement of said cross head causes said members to be telescoped.

4. A reciprocating mechanism of the type described comprising a frame including a vertical column having a pair of horizontally spaced vertical guide tracks, a cross-head including a main body adapted to be reciprocated in the vertical column guided by said guide tracks, said main body being elongated vertically with respect to the width thereof, an arm extending from one side of said main body presenting a slot for the reception of a drive element, means on the side of said main body opposite to said arm for supporting a pump rod, vertically spaced sprockets mounted on said column, drive chains over said sprockets, and a driving element slidably receivable in the slot of said arm connected to said chains.

AUGUST E. WILSHUSEN.
ARTHUR WILSHUSEN.

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