April 28, 1953 S. C. CARTER 2,636,391

PUMP DRIVE MECHANISM

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Fig. 1

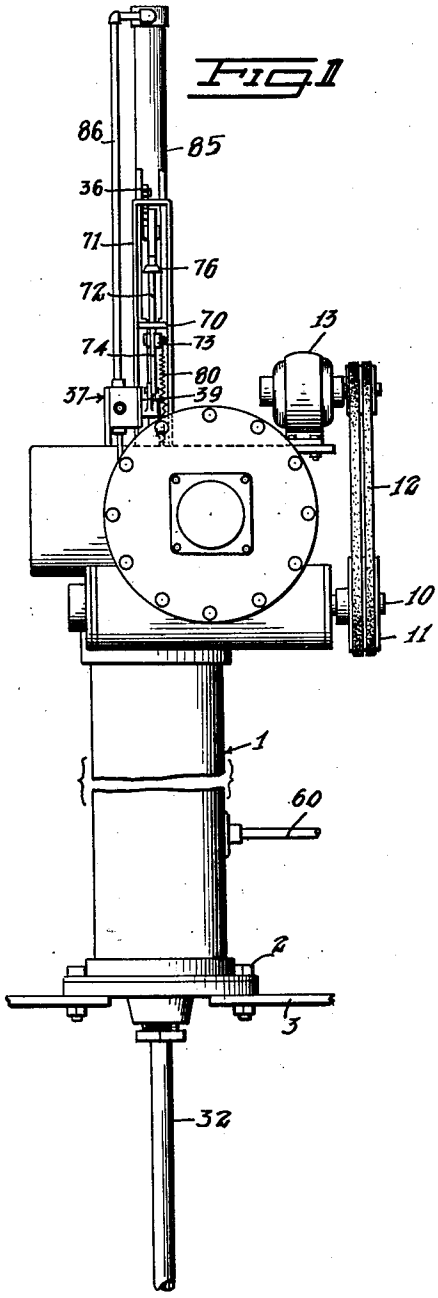
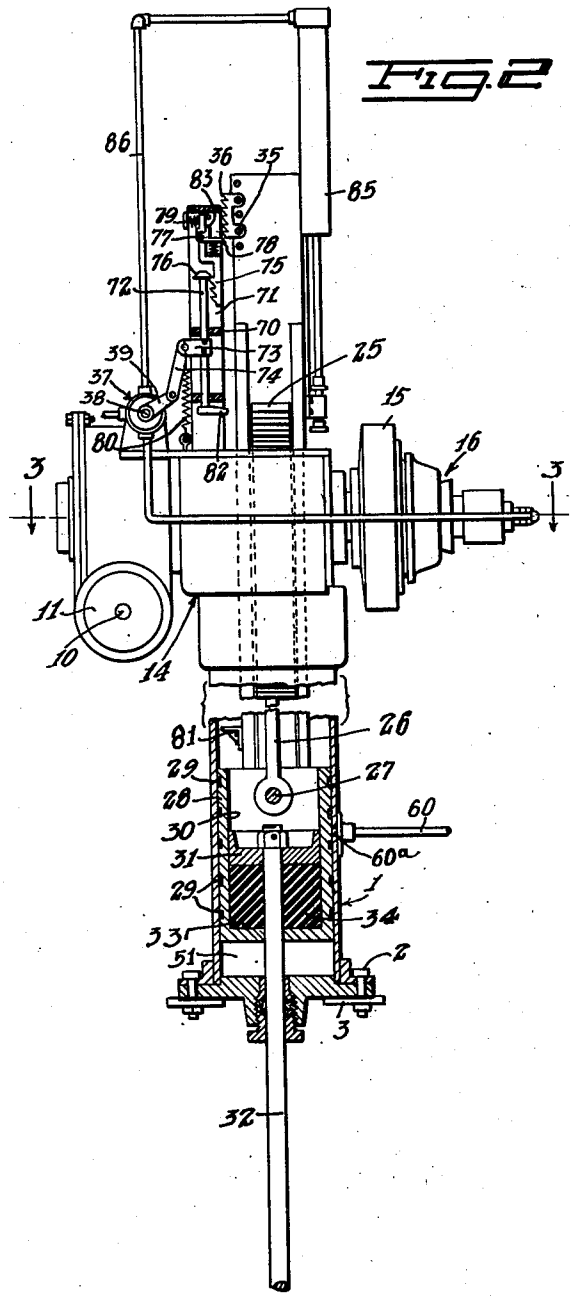


Fig. 2



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FIG 3

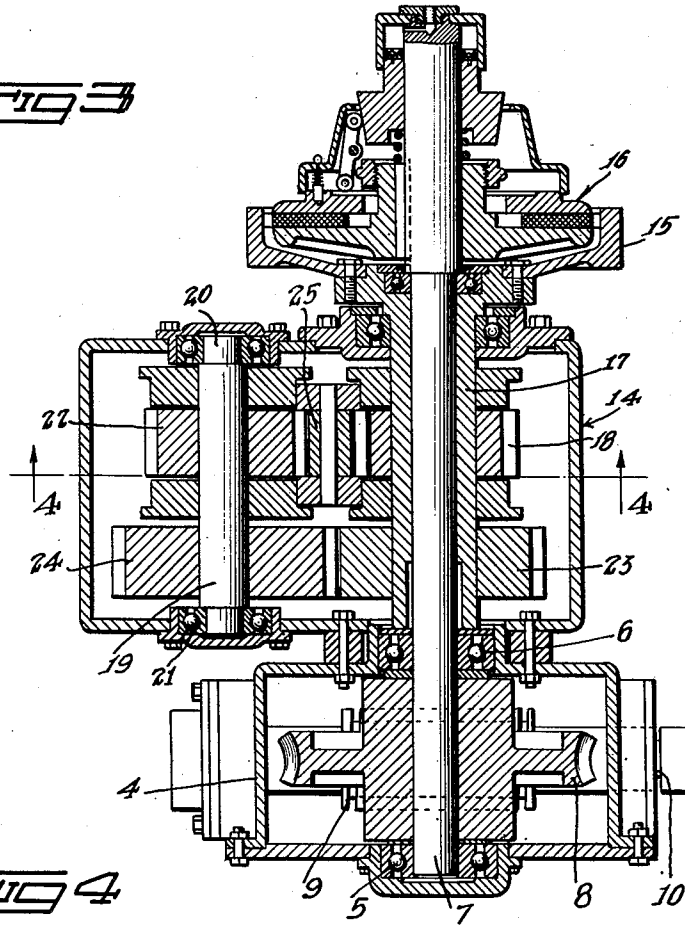


FIG 4

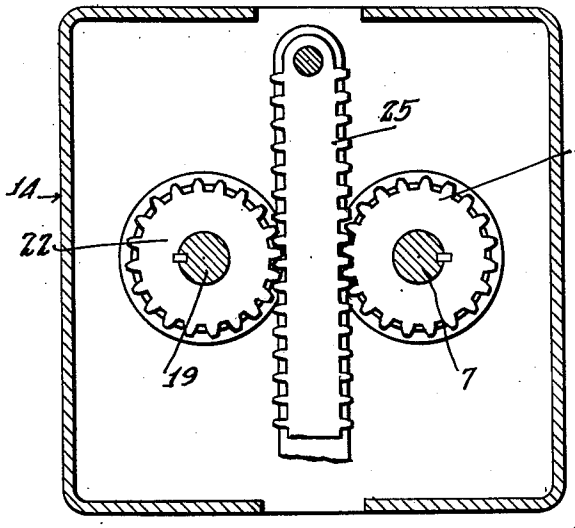
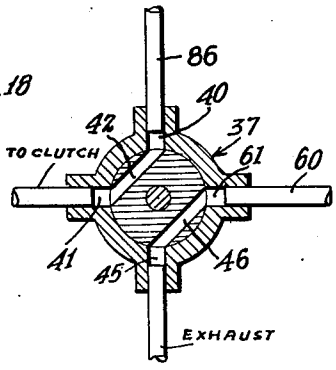


FIG 5



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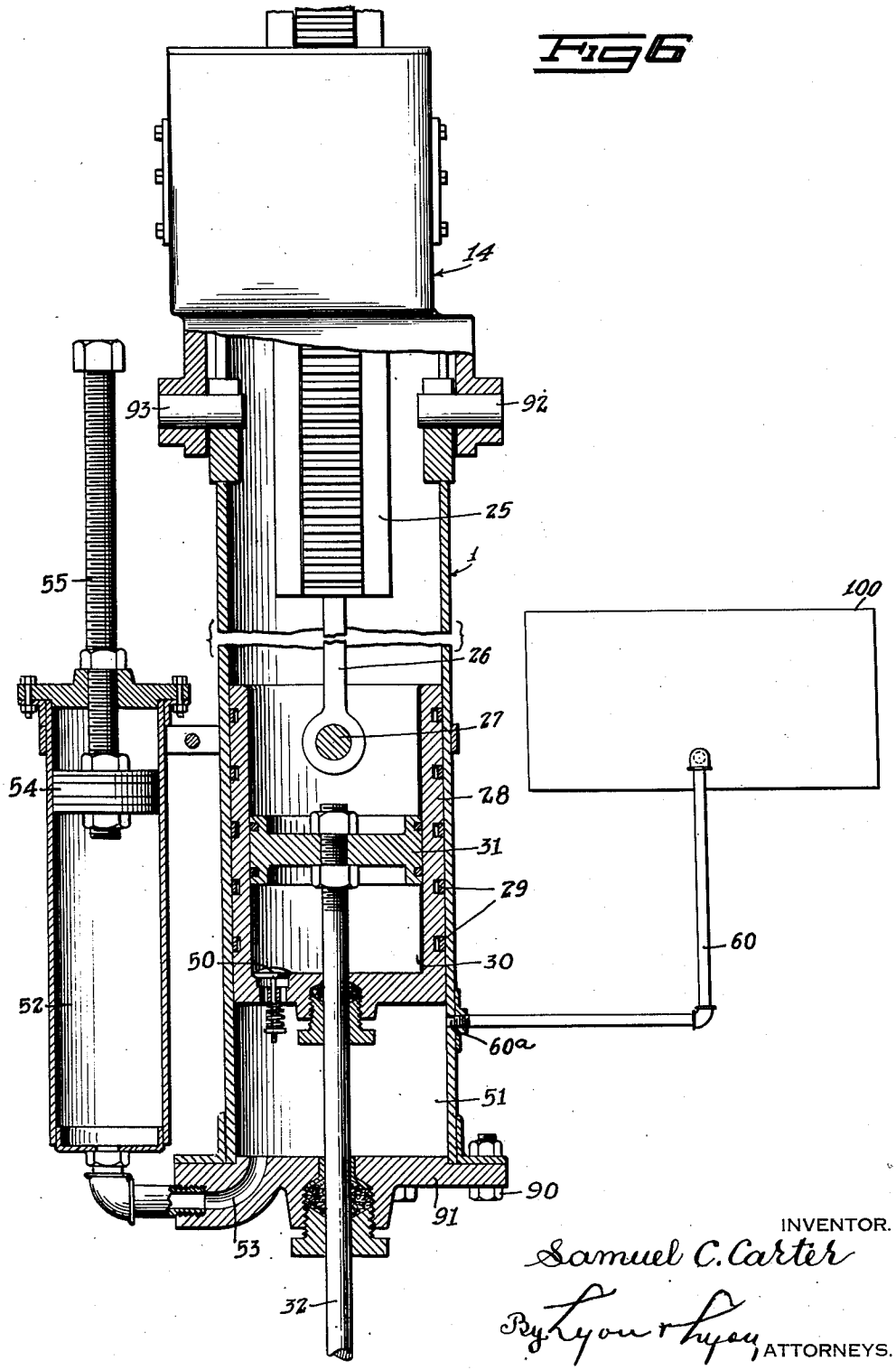
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FIG 6



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UNITED STATES PATENT OFFICE

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PUMP DRIVE MECHANISM

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13 Claims. (Cl. 74—34)

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My invention comprises a pumping mechanism and more specifically, a device for connecting a power unit, such as an electric motor or other prime mover, to the sucker rods of an oil well to actuate the same.

In general, my invention comprises a combination of a rack member supported by two rack gears which are positively driven by a prime mover through a clutch to lift the rack member which is attached to some form of dash pot and from that dash pot to the sucker rods.

In the upward stroke the rack member is positively driven by the rack gears. At the top of the stroke the clutch is declutched, allowing the rack member to fall of its own weight and that of the sucker rods until it comes near the bottom of its stroke, wherein the dash pot absorbs that stroke and gives a slight rebound which energizes a mechanism which reengages the clutch so that at the top of the bounce the rack member will be in positive engagement with the prime mover and continue the movement upward. By the use of this construction, normal shock at the bottom of the stroke is absorbed and made to act for useful purposes, thus lengthening the life of the entire apparatus and cutting down on the amount of power necessary to drive the same.

It is desirable to control the rate of speed of the descent of the pumping mechanism and this speed should be substantially the maximum permissible so as to get as many upward strokes per period of time as possible. However, this speed cannot exceed certain limits and to control this speed a cylinder is positioned at the lower end of my pumping mechanism with a piston therein connected to the sucker rods. This cylinder is ported intermediate the stroke of the piston to a large container of compressed air and by controlling the pressure in this container the rate of fall of the piston in the cylinder is controlled. When however the piston passes the port the cylinder then becomes the dash pot above set forth.

Other objects and advantages of my invention will be apparent from the preferred embodiments thereof.

In the drawings:

Figure 1 is a front elevational view of my pumping mechanism.

Figure 2 is a side elevational view, partially sectioned.

Figure 3 is a sectional view taken on the line 3—3 of Figure 2.

Figure 4 is a sectional view taken on the line 4—4 of Figure 3.

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Figure 5 is a sectional view of a detail.

Figure 6 is an elevational view, partially in section, of a modification of my invention.

A pumping mechanism constructed in accordance with my invention comprises a barrel 1 which is bolted at 2 to the top of the tubing head 3. Upon the upper end of the barrel 1 is attached a casing 4 carrying bearings 5 and 6 (see Figure 3), for rotatively positioning a shaft 7. Upon the shaft 7 is a gear 8 driven by a worm gear 9 on a shaft 10. The shaft 10 has a pulley 11 to which is connected by means of belting 12 a prime mover 13. The prime mover 13 thus transmits power to rotate the shaft 7.

Upon the top of the casing 4 is mounted a rack gear housing 14 and upon the top of that a housing 15 having a clutch member generally indicated at 16.

A sleeve 17 mounted to rotate upon the shaft 7 is adapted to be directly driven by the shaft 7 when the clutching mechanism indicated at 16 is engaged. Any type of clutching mechanism can be used and is not part of my invention other than that some type of clutching mechanism to engage or disengage the sleeve 17 from the shaft 7 is necessary.

Upon the sleeve 17 are mounted the rack gears 18. A secondary shaft 19, journaled in the bearings 20 and 21, is carried by the housing 14 and carries thereon a rack gear 22. The sleeve 17 carries a pinion gear 23 which engages a similar gear 24 on the secondary shaft 19 to rotate the same and drive the rack gear 22 in the opposite direction from the rack gear 18.

Mounted between the rack gears 18 and 22 is a rack 25 which carries a rod 26 at its lower end. Attached to the rod 26 by means of the pin 27 is a piston 28 slidable in the barrel 1. The piston 28 has a series of piston rings 29 to insure sealing the barrel 1. The piston 28 has its interior formed as a cylinder 30 in which is slidably mounted a sucker rod piston 31, to which a sucker rod 32 is attached. Between the end 33 of the cylinder 30 and the sucker rod piston 31 is positioned a rubber cushion 34.

On the upper end of the rack 25 is bolted a hanger 35 upon which is adjustably mounted a ratchet 36. A valve 37 is mounted on a housing 14 and has attached to the valve shaft 38 a crank arm 39.

Guides 70 are carried by a bracket 71 to slidably mount a push rod 72. The push rod 72 has an arm 73 connected by a link 74 with the crank arm 39. Rotatively attached to the bracket 71 is a ratchet 75 adapted to engage the enlarged

cap 76 on the end of the push rod 72. Rotatively mounted upon the pivot pin 77 is a spring-loaded pawl 78 adapted to engage the ratchet 36. A spring 79 tends to move the ratchet 75 into engagement with the cap 76. A spring 80 tends to draw the push rod 72 downwardly.

The clutch 16 can be operated by compressed air. To actuate this clutch 16, the valve 37 has a port 40 connected by an air line 86 to a source of compressed air, such as the air pump 85, actuated by movement of the rack 25. The port 41 is connected to the clutch actuating means and when the valve passage 42 is aligned between the ports 40 and 41 positive pressure engages the clutch, allowing the prime mover 13 to raise the rack 25.

Near the top of the upstroke of the rack 25 a shoe 81 engages a projection 82 on the bottom of the push rod 72, lifting the same and by the motion of the link 74 and crank arm 39 rotates the valve shaft 38 aligning the exhaust port 45 with the port 41, allowing the compressed air to exhaust through the valve passage 46 and exhaust port 45.

At the top of the upward stroke the cap 76 engages the ratchet 75 and is held in this position as the down stroke is made. At the bottom of the down stroke the ratchet 36 engages the pawl 78 and when a rebound of the mechanism results the ratchet 36 rotates the pawl 78, causing a projection 83 thereon to rotate the ratchet 75 and disengage the cap 76, permitting the spring 80 to lower the push rod and to rotate the valve arm 38, realigning the ports 40, 41 and the valve passage 42 to reengage the clutch 16.

A feature of my invention is that the upward stroke is by positive drive but the downward stroke is by gravity controlled by the air pressure in a cylinder or main air supply container 100 of suitable size to prevent any substantial rise in pressure in the chamber 51. At the lower limits of the stroke the shock will be partially absorbed by the rubber cushion 34 acting between the piston 31 and the bottom of the piston 28. The remainder of the shock will be absorbed by the compressed air in the barrel 1. The barrel 1 is pressurized by means of the pressure line 60 connected to a source of compressed air. When the bottom of the piston 28 passes the port 60a it will further compress the air in the barrel 1 until the entire weight of the mechanism and the sucker rods will be supported thereby.

A recoil, however, will result and the sucker rods and rack will bounce upwardly until the ratchet 36 engages the pawl 78, rotating it and releasing the push rod 72 and rotating the valve 37, thus engaging the clutch and causing the prime mover to again lift the rack 25 and sucker rod 32.

In the modification of my invention shown in Figure 6 the rubber cushion 34 is dispensed with and merely an air cushion formed in the cylinder 30 is used to absorb the shock at the bottom of the stroke. However, to aid the air cushion to absorb the shock a valve 50, which is normally closed during the downward movement of the piston 31, will be open during the descending of the piston 28 in the barrel 1 as the air in the chamber 51 will force the valve 50 open, permitting a surge of air into the cylinder 30. When the piston 28 descends to the lowermost position, the piston 31 will start to descend in the cylinder 30, forcing the valve 50 shut and the air compressed in the cylinder 30 will act as a cushioning member.

To adjust the amount of recoil to engage the ratchet 36 with its pawl 39, an accumulator 52 is connected by a passage 53 with the interior of the barrel 1 beneath the piston 28. In the accumulator 52 is positioned a piston 54 which is raised and lowered by an adjusting screw 55. Thus the amount of pressure in the chamber 51 and in the cylinder 30 can be adjusted by raising and lowering the piston 54 by means of the adjusting screw 55. This position of the piston 54 also will regulate the length and rate of drop after the closing of the port 60a.

Another modification of my invention comprises connecting a line 60 to the chamber 51. The line 60 is connected to the port 61 in the chamber 51. On the up stroke the port 61 is connected to the exhaust port 45 by the valve passage 46 and thus any back pressure on the piston 28 is relieved. Upon the down stroke the line 60 is connected by means of the ports 61 and 40 and valve passage 42 to the container 100 to build up pressure in the chamber 51 and in the cylinders 30 and 52.

As the barrel 1 forms the main mounting for my entire pumping mechanism, it is bolted as shown at 90 to the top of the casing head 91 in an airtight manner. I have found it desirable that the gears, gears' motor and clutches be connected thereto in a pivotal manner. Therefore, the barrel 1 is connected to the housing 14 by means of the pins 92 and 93 respectively.

While I have described the preferred embodiments of my invention, I am not limited to any of the details herein described except as set forth in the following claims.

I claim:

1. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch controlling means, ratchet means connected to said rack to actuate said clutch controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft.

2. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, a barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, and shock-absorbing means in said last mentioned piston.

3. In a pumping mechanism, a shaft driven

by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, a barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, and a rubber cushion in said cylinder to absorb shock.

4. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, an airtight barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, a valve between said barrel and said cylinder adapted to open when the pressure in said barrel is greater than in said cylinder.

5. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, an airtight barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, a valve between said barrel and said cylinder adapted to open when the pressure in said barrel is greater than in said cylinder, and an adjustable secondary cylinder to control the pressure in said barrel.

6. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve,

a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, an airtight barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, a valve between said barrel and said cylinder adapted to open when the pressure in said barrel is greater than in said cylinder, and a secondary pumping mechanism attached to said rack to deliver air pressure to said barrel.

7. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch controlling means, ratchet means connected to said rack to actuate said clutch controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, and an air controlled shock absorbing means to stop and rebound said rack.

8. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, a barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, and shock-absorbing means in said piston, said cylinder containing air under pressure to stop the fall of said piston.

9. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-con-

trolling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, a barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, shock-absorbing means in said piston, said cylinder containing air under pressure to stop the fall of said piston, and an adjustable accumulator connected to said cylinder to determine the rate of drop of said cylinder and to limit its downward stroke.

10. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, a barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, and shock-absorbing means in said piston, said clutch mechanism being pivotally mounted upon said barrel.

11. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, a barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, and shock-absorbing means in said piston, said cylinder containing air under pressure to stop the fall of said piston, said clutch mechanism being pivotally mounted upon said barrel.

12. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch-controlling means, ratchet means connected to said rack to actuate said clutch-controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, a piston connected to said rack, a barrel in which said piston is adapted to slide, said piston having a cylinder formed therein, a piston adapted to move in said cylinder and connected to a reciprocating rod, shock-absorbing means in said piston, said cylinder containing air under pressure to stop the fall of said piston, and an adjustable accumulator connected to said cylinder to determine the rate of drop of said cylinder and to limit its downward stroke, said clutch mechanism being pivotally mounted upon said barrel.

13. In a pumping mechanism, a shaft driven by a prime mover, a sleeve rotatably mounted upon said shaft, a clutch mechanism adapted to connect said shaft and said sleeve to rotatably drive said sleeve, rack gears driven by said sleeve, a vertically mounted rack adapted to be moved by said rack gears, a clutch controlling means, ratchet means connected to said rack to actuate said clutch controlling means at substantially the upper limits of the movement of said rack to declutch said sleeve and said shaft whereby said rack will fall to its lowest position, means connected to said rack to actuate said clutch-controlling mechanism when said rack rebounds at the bottom of its stroke to engage said clutch and to connect said sleeve and said shaft, said rack being connected to a piston, an airtight cylinder in which said piston reciprocates, said piston being connected to a reciprocating rod, and an air container containing air under pressure connected to said cylinder by a port intermediate the stroke of said piston.

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