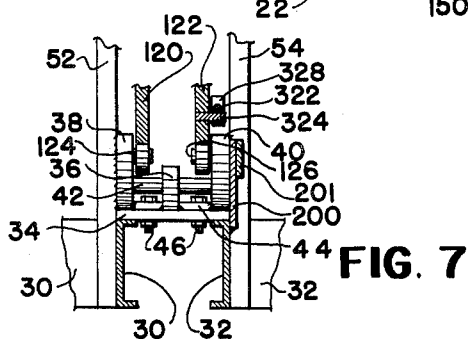
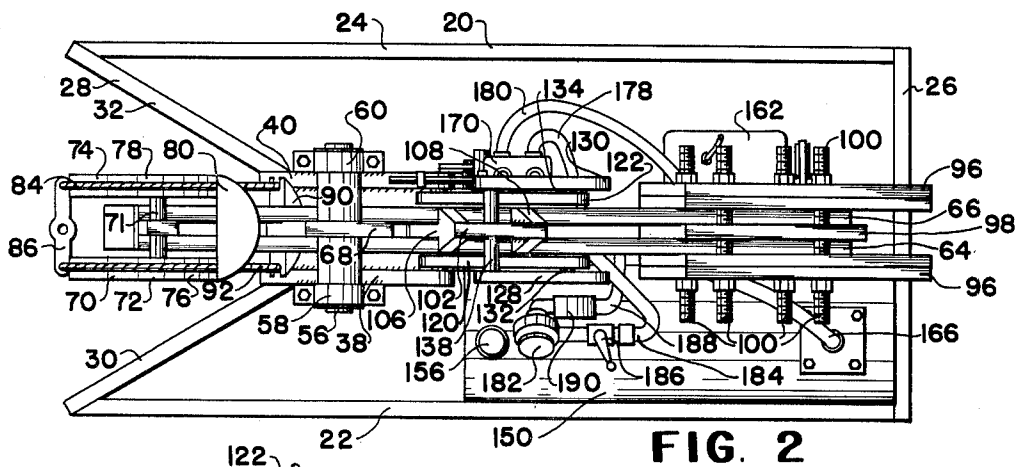
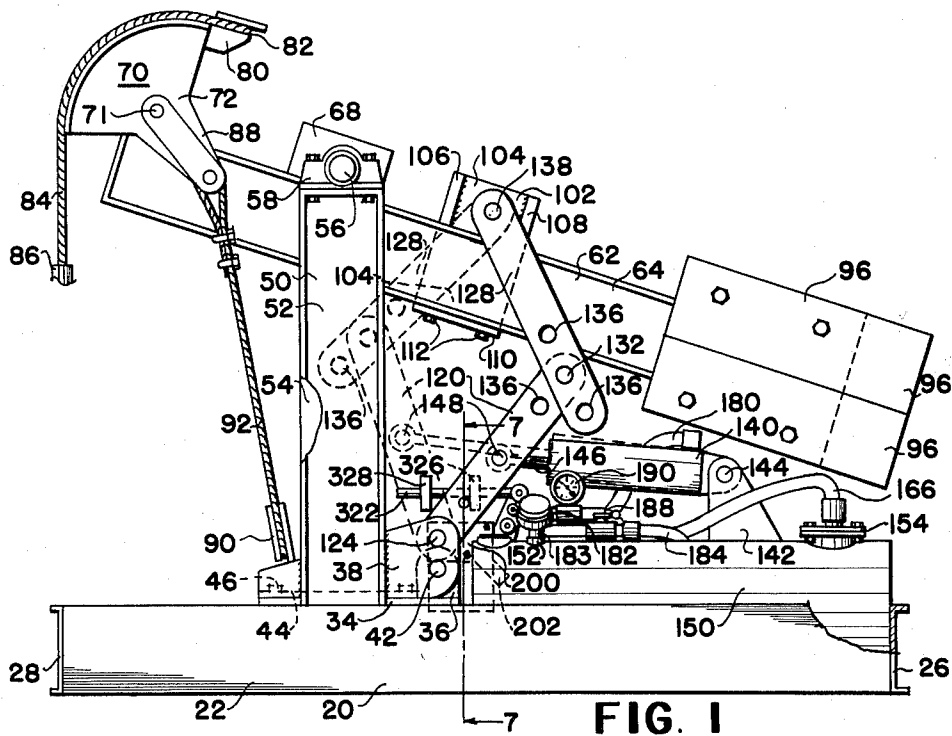


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WELL PUMPING APPARATUS

3 Sheets-Sheet 1



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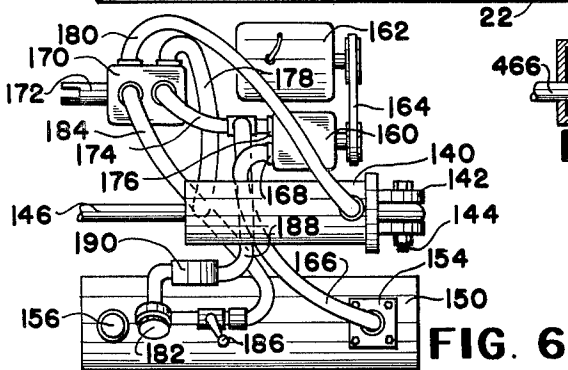
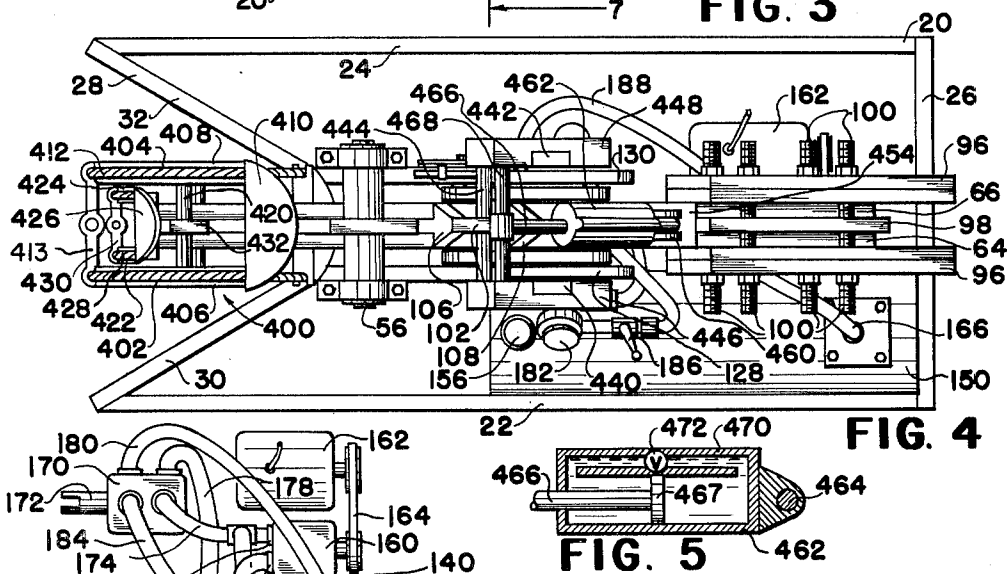
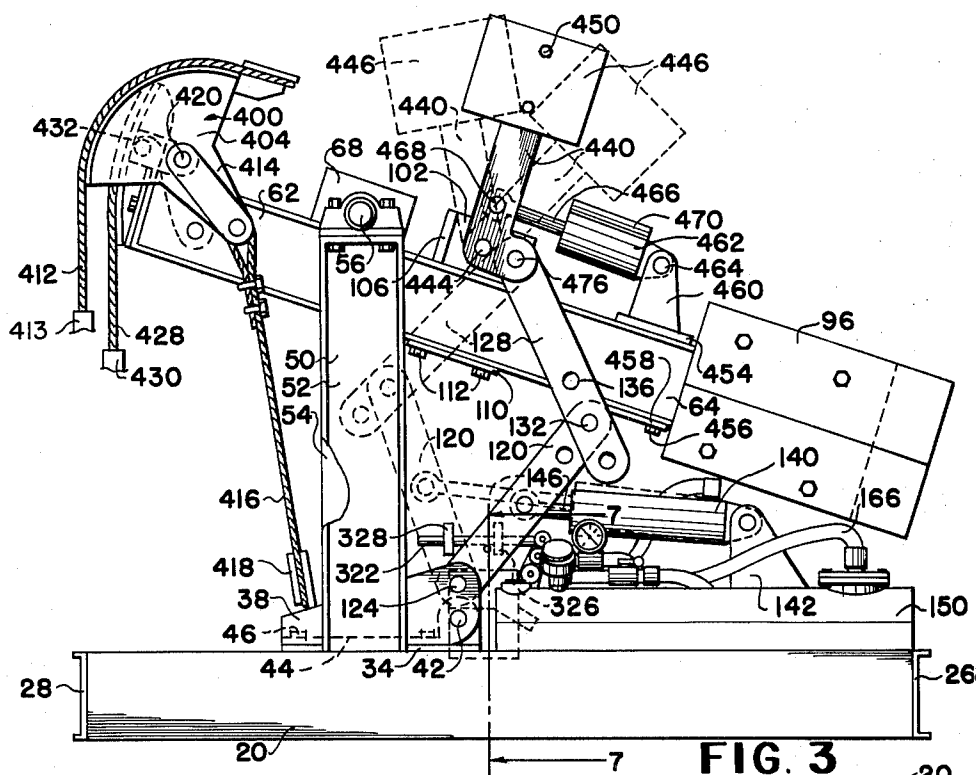
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3,221,568

WELL PUMPING APPARATUS

Filed May 14, 1962

3 Sheets-Sheet 2



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3,221,568

WELL PUMPING APPARATUS

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8 Claims. (Cl. 74-106)

This invention relates to well pump means and in a more specific aspect to well pumping apparatus. More particularly, the invention relates to well pumping means having means constructed so that the well pumping apparatus and horsehead are moved through a complete cycle of operation during each half cycle of operation of the powering means therefor. In a still more specific aspect, the invention relates to well pumping means having means therewith whereby hydraulic powering means are used to drive the apparatus so that a complete cycle of operation of the apparatus for lifting oil, water or the like from a well is accomplished during a half cycle of operation of the hydraulic powering means and means are provided to automatically reverse the powering means at the completion of each cycle of pumping operation. In a still further specific aspect, the invention relates to scissor like connecting means for moving a walking beam or the like upon operation of a power or drive means. In a still further specific aspect the invention relates to well pumping apparatus having a counterbalance weight means therewith for balancing the apparatus for the weight of the fluid in the well during well pumping operations.

Various types of well pump means are known to the prior art. These include the usual and common pumping apparatus whereby a walking beam is oscillated about its mounting in operation and is moved through a cycle of operation during each cycle of operation of the powering means. The well pumping apparatus of the prior art are relatively inefficient and do not provide for mechanical multiplying means whereby the work load of the pumping apparatus for a given powering means is substantially increased as a result of the construction of the parts of the well pumping apparatus. In addition, balancing means are not provided with the prior art devices so that both the weight of the fluid in the well and the weight of the well pumping apparatus are balanced. Furthermore, hydraulic power means as known to the art have not included suitable means whereby the apparatus for reversing movement of the hydraulic drive means is cocked and fired at the proper time so that the piston rod of the servo-motor or the like being used is instantaneously reversed in direction of movement at the proper time.

In accordance with the present invention well pumping means are provided which include a Samson post having means pivotally mounted thereon defining a walking beam. Means on one end portion of the walking beam receives and holds a rope or the like during movement of the walking beam. Drive means are provided and connecting means are operatively connected to the drive means and to the walking beam. The connecting means are constructed of upper and lower portions pivotally connected together and movable from a position substantially in line with each other to positions on opposite sides thereof during operation so that the walking beam moves through an entire cycle of operation as the drive means moves through a half cycle of operation.

Accordingly, it is an object of the invention to provide new well pump means.

Another object of the invention is to provide new well pump means having means therewith whereby the walking beam is moved through a complete cycle of operation as the powering means is moved through a half cycle of operation.

Another object of the invention is to provide new well pumping means constructed to compound the movement of the powering means.

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Another object of the invention is to provide new well pumping means having hydraulically operated powering means therewith and having means to reverse the movement of the piston rod of the power means when the apparatus has reached the extreme positions of its movement.

Another object of the invention is to provide new well pumping means having counterbalance means therewith to balance the apparatus for the weight of the fluid being pumped from the well hole.

A still further object of the invention is to provide a new well pumping apparatus having means to compound the movement of the powering means and also having counterbalancing means therewith for balancing the apparatus for the weight of the fluid in the well hole and for the weight of the rods in the well hole.

Another object of the invention is to provide new well pumping means having hydraulic power means therewith whereby the fluid operating the hydraulic power means is instantaneously switched during movement of the piston rod of the power means when the piston rod has reached its extreme positions of movement.

Various other objects, advantages, and features of the invention will become apparent to those skilled in the art from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a side elevation view, partially cut away, illustrating a preferred specific embodiment of the well pumping apparatus of the invention.

FIG. 2 is a top plan view of the apparatus shown in FIG. 1.

FIG. 3 is a side elevational view, partially broken away, illustrating another preferred specific embodiment of the well pumping apparatus of the invention.

FIG. 4 is a top plan view of the embodiment of the invention shown in FIG. 3 of the drawings.

FIG. 5 is a partial cross sectional view of a portion of the apparatus of FIGS. 3 and 4 showing a preferred construction of the hydraulic cylinder.

FIG. 6 is a diagrammatic plan view of the hydraulic cylinder or motor and fluid system therefor used in connection with the well pumping means of the invention.

FIG. 7 is a partial cross section view taken along the line 7-7 of FIGS. 1 and 3.

FIG. 8 is a partial side elevation view showing a preferred specific embodiment of the switching means for reversing movement of the hydraulic cylinder with the parts in position to commence movement in the direction shown by the arrows.

FIG. 9 is a cross section view taken along the line 9-9 of FIG. 8.

FIG. 10 is a partial side elevation view of the means shown in FIG. 8 with the switching means in position after firing.

FIG. 11 is a partial side elevation view diagrammatically illustrating a portion of the well pumping apparatus in the tilted position for access to the well.

The following is a discussion and description of preferred specific embodiments of the new well pumping apparatus of the invention, such being made with reference to the drawings whereon the same reference numerals are used to indicate the same or similar parts and/or structure. It is to be understood that such discussion and description is not to unduly limit the scope of the invention.

A preferred specific embodiment of the well pump means of the invention is illustrated in FIGS. 1 and 2 of the drawings and includes base or foundation means shown generally at 20 and which desirably includes spaced and generally parallel side members 22 and 24 joined at the end portions thereof to end members 26 and 28. The end member 28 is preferably formed of two channel

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shaped members 30 and 32 which have a portion thereof positioned at an angle to each other as best illustrated in FIG. 2 and which have end portions positioned between the side members 20 and 22 in generally parallel relation as illustrated in FIG. 7.

A base plate 34 is preferably provided and secured to the portions 30 and 32 of the end member 28 of the base 20 and is positioned in a generally horizontal plane. A support 36 is secured to the upper surface of the base plate 34 and desirably positioned at one end thereof and extends upwardly therefrom at substantially right angles thereto.

Two spaced and generally parallel mounting members 38 and 40 are positioned on opposite sides of the support 36 in planes which are generally parallel to each other and perpendicular to the base plate 34 and each of the mounting members 38 and 40 desirably has a longitudinal edge at the bottom thereof which is flat and in normal use engages the base plate 34 as illustrated in FIGS. 1 and 7. A pivot or shaft 42 passes through the support 36 and one end portion of each of the mounting members 38 and 40 to thereby pivotally connect the mounting members to the support.

A mounting plate 44 extends between and is rigidly secured to the other end portions of the mounting members 38 and 40 and is desirably normally in abutting relation with the upper surface of the base plate 34 and in operation the mounting plate 44 is secured to the base plate 34 by suitable mounting bolts 46.

A Samson post 50 is provided and is suitably supported by the base 20. Preferably, the Samson post 50 is constructed of two spaced and generally parallel channel shaped members 52 and 54 which are desirably rigidly secured in the lower end portion to an intermediate portion of the mounting members 38 and 40, respectively, in any suitable manner, such as by welding. The Samson post 50 is normally positioned in a generally vertical position as illustrated in FIG. 1 and preferably has a shaft 56 mounted on the upper end portion thereof by pillow bearings or the like 58 and 60.

An elongated walking beam is provided and is shown generally at 62 and is preferably constructed of two spaced and generally parallel channel shaped members 64 and 66 which are secured to a plate 68 which is positioned between the members 64 and 66 and is rigidly secured thereto in any suitable manner. One end portion of the plate 68 desirably projects above the walking beam 62 as is best illustrated in FIG. 1 and is mounted on an intermediate portion of the shaft 56 to thereby pivotally mount the walking beam on the Samson post.

A horsehead is provided and is generally shown at 70 and is preferably of the type shown in Patent No. 3,006,201 titled Well Pump Means. The horsehead 70 desirably includes two spaced and generally parallel members 72 and 74 which have arcuate outer edges 76 and 78, respectively. A connecting member 80 is provided with the horsehead and has an arcuate surface 82 which terminates at the arcuate edges 76 and 78 and cooperates therewith to receive and hold the intermediate portion of a rope or the like 84 which has its end portions connected to a connecting member or the like 86 which in turn can be connected to pumping apparatus in the well hole. The horsehead 70 preferably has spaced and rearwardly projecting arm portions such as shown at 88 in FIG. 1 and are positioned on opposite sides of the walking beam 62. An anchor member 90 is fixedly mounted relative to the base 20 and receives the intermediate portion of a rope, cable or the like 92 which is secured in its end portions to the arm portions 88 of the horsehead 70. In operation as the horsehead 70 is raised and lowered with the walking beam the stroke obtained is increased as a result of the movement of the horsehead 70 about its pivotal mounting 71.

Means are preferably provided to balance the well pumping apparatus to compensate for the weight of the

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rods and other pumping apparatus in the well hole. This is preferably provided by mounting a plurality of counterbalance weights 96 on the end portion of the walking beam 62 opposite from the horsehead 70. The weights 96 can be secured directly to the portions 64 and 66 of the walking beam 62 if desired. Preferably a plate 98 is positioned between and rigidly secured to the members 64 and 66 of the walking beam 62 and projects above and below the walking beam and mounting bolts 100 pass through the weights 96 and the projecting or extending portions of the plate 98 to fixedly attach the weights to the walking beam.

A mounting member 102 is preferably provided and has a flat portion positioned between the channel shaped members 64 and 66 of the walking beam 62 as shown at 104, FIG. 1, and is located between the Samson post 50 and the counterbalance weights 96. A portion of the mounting member 102 projects above the walking beam 62 and desirably has spaced flange portions 106 and 108 which are positioned at the edges of the flat center portion and extend transversely to and have the lower edge portion thereof engaging the upper surface of the channel shaped members 64 and 66 of the walking beam 62. A plate 110 is positioned against the lower surface of the channel shaped members 64 and 66 and bolt means 112 pass through the plate 110 and into the mounting member 102 to attach the plate 110 thereto. The mounting member 102 can be adjustably positioned along the walking beam 62 by loosening the bolt means 112 and moving the mounting member 102 to the desired location and subsequently tightening the bolt means 112.

Connecting means are preferably provided and operatively connected to the walking beam 62 to cooperate with the drive or power means to raise and lower the horsehead 70 by moving the walking beam. Preferably the connecting means includes two spaced and generally parallel arm members 120 and 122 which are pivotally connected in a lower end portion to the mounting members 38 and 40 by pivots 124 and 126, respectively. Two other spaced and generally parallel arm members 128 and 130 are pivotally connected in one end portion to the other end portions of the arms 120 and 122 by pivots 132 and 134. The arm members 120, 122, 128 and 130 of the connecting means are preferably provided with a plurality of holes or openings 136, FIG. 1, so that the arm members can be adjustably mounted relative to each other to vary the stroke of the walking beam in operation. Also, by the use of the additional holes 136 the arm members can be fixedly positioned relative to each other when tilting the well pumping apparatus as described hereinafter in connection with FIG. 11. The arm members 128 and 130 are connected in the other end portion to the projecting portion of the mounting member 102 by a pivot or the like 138.

Drive means are provided and operatively connected to the connecting means to move same in operation. The drive means preferably used with the apparatus of the invention is illustrated in the drawings and includes a double acting servo-motor or hydraulic cylinder 140 which is preferably mounted in one end portion on a support 142 by a pivot 144 and has the common piston rod 146 projecting from the other end portion thereof. The end portion of the piston rod 146 is pivotally connected to the arm members 120 and 122 by a pivot 148 so that extension and retraction of the piston rod 146 causes movement of the connecting means.

Fluid circulating means are provided to provide fluid to the motor or hydraulic cylinder 140 for operation thereof. The fluid circulating means includes a fluid storage tank 150 for hydraulic fluid or the like and tank 150 has a fluid inlet 152 and a fluid outlet 154. A cap 156 can be provided for filling the tank 150.

A pump 160 is driven by suitable power means, such as an electric motor 162, internal combustion engine or the like and is connected to the pump 160 by belt means

164 or by a direct drive. A hose or conduit 166 is connected in its end portions to the outlet 154 of tank 150 and to the inlet 168 of the pump 160. A valve 170 is provided and preferably has a valve operator 172 projecting therefrom which is operable upon extension and retraction to change fluid flow through the valve. A hose or conduit 174 is operatively connected in one end portion to the outlet 176 of the pump 160 and connected in the other end portion to the valve member 170 to provide hydraulic fluid to the valve upon operation of the motor 160. Another hose or conduit 178 is connected in its end portions to one of the outlets of the valve 170 and to one end portion of the hydraulic cylinder 140 and another hose or conduit 180 is connected to another outlet of the valve 170 and to the other end portion of the hydraulic cylinder 140.

A pressure regulator control 182 is connected to a pipe 183 on the inlet 152 of the tank 150 and in operation is set and opens to pass fluid therethrough upon the pre-set pressure being exerted on the control. A conduit 184 is connected in its end portions to the other outlet of the valve 170 and is connected in the other end portion to the pipe 183 at the inlet 152 of the tank 150 to return hydraulic fluid pumped by the pump 160 through valve 170 and hydraulic cylinder 140 to the tank. A hand operated control valve 186 is positioned in the conduit 184 and is operable to open and close conduit 184 to the passage of fluids therethrough and thus control operation of the hydraulic cylinder 140. Another conduit 188 is connected to the outlet 176 of the pump 160 and to the pressure regulator control 182 and desirably has a pressure gauge 190 therein for visual reading of the pressure in the conduit.

During normal operation of the hydraulic cylinder 140 the hand operated valve 186 is open and the pressure regulator control 182 is set at a pressure such that the normal operating pressure of the fluid will not open the control and permit fluid flow through conduit 188 to the inlet of the tank 150. Upon operation of the electric motor 162, pump 160 is operated to provide fluid from tank 150 to the valve 170 and from there to one end portion or the other end portion of the hydraulic cylinder 140 to cause extension and retraction of the piston rod 146 with direction of movement of the piston rod 146 being reversed by movement of the valve operator 172 from an extended to a retracted position as a result of the switching means described hereinafter. When it is desired to stop the hydraulic cylinder 140 the hand operated valve member 186 is moved to close conduit 184 to the passage of hydraulic fluid therethrough and since the fluid from the pump 160 can no longer pass through valve 170, hydraulic cylinder 140 and be returned to tank 150 through conduit 184, then the pressure in conduit 188 builds up or is increased as a result of continued operation of the pump and pressure control 182 opens at the pre-set or predetermined pressure to permit passage of hydraulic fluid from pump 160 through conduit 188 back to the tank 150 and thus recirculates the fluid from tank 150 through the pump 160 back to the tank.

The hydraulic apparatus described hereinbefore is a substantial improvement over the usual hydraulic system particularly in that the control for the passage of fluid through the apparatus is positioned at the exhaust of the apparatus instead of at the input and by controlling the exhaust, further operation of the pump tends to compress the fluid which does not have a harmful effect. Where the inlet is normally controlled further operation of the pump normally causes a vacuum to be created in the hydraulic apparatus which is undesirable and can lead to premature failure of the pumping apparatus.

Suitable switching means or the like are desirably provided to extend and retract the valve operator 172 as the connecting members moving the walking beam reach the extreme positions of their movement as illustrated in the solid and dashed lines in FIG. 1. Desirably the valve

operator 172 is moved quickly and positively at the same time the connecting means reach their extreme positions of movement and not continuously during the entire movement of the connecting means so that positive switching results and immediate and accurately controlled reversal of movement of the hydraulic cylinder 140 is obtained. A preferred specific embodiment of the switching means is illustrated in the drawings and includes a bracket 200 which is secured to the base 20 in any suitable manner, such as by mounting plate 201 on the base portion 32 or directly on the mounting member 40. The bracket 200 has an integral arm portion 202 projecting therefrom which has a pin 204 secured to the outer end portion thereof and which projects therefrom.

A support arm 206 is provided and has a base portion 208 and two spaced end portions 210 and 212 which project from the base portion 208 at an angle to each other. A spacer member 214 is positioned between the base portion 208 of the support arm 206 and the bracket 200 and the arm 206, the spacer member 214 and the bracket 200 are secured in assembled relation by welding or other suitable means.

The end portion 212 of the support arm 206 has a flat portion 220 at substantially a right angle to the main portion of the support arm and an opening 222 therein is positioned to receive the valve operator 172 of the valve 170 as illustrated in FIGS. 8-10 of the drawings.

An ear or support 224 is secured to the portion 220 of the end portion 212 of the support arm 206 and projects therefrom at substantially a right angle thereto and is positioned in a plane substantially parallel to the support arm 206. A pin 226 is secured to the ear 224 and projects therefrom and is positioned adjacent the end portion of the valve operator 172.

A bar 228 is mounted in an intermediate portion by a pivot 230 onto the end portion of valve operator 172 and is desirably positioned in the slot 173 of the valve operator. The end portions of the bar 228 are preferably bifurcated or provided with slots 232 and 234 with the slot 232 receiving the pin 226.

A lever arm 240 is pivotally mounted in an intermediate portion on the support arm 206 at the juncture of the base portion 208 and the end portions 210 and 212 thereof and the lever arm 240 is preferably positioned at the side of the arm 206 opposite from the portion 220 projecting to the side thereof and through which the valve operator 172 projects. Preferably, a spacer member 242 is positioned between the lever arm 240 and the support arm 206 and a pivot or mounting member 244 passes through the lever arm 240 and the spacer member 242 to mount same on the support arm.

A first sprocket 250 having teeth 252 is mounted on the support arm 206 at the juncture of the end portions and base portions thereof and is preferably rotatably mounted by the pivot or bolt means 244 which also functions to connect the lever arm 240 to the support arm 206. A pin 254 is secured to the sprocket 250 and projects therefrom toward the lever arm 240 and the end of the pin is positioned in spaced relation to the lever arm.

Two additional sprockets 256 and 258 having teeth 260 and 262, respectively, are both mounted on the lower end portion of the lever arm 240 in spaced relation to mounting member 244 and are positioned in spaced relation to each other. The lever arm 240 can be enlarged at the lower end portion thereof to accommodate the sprockets if desired. A spacer member such as shown at 264 in FIG. 9 is desirably used in connection with the mounting means or pivot 266 to secure the sprockets 256 and 258 in position. A chain or the like 268 is preferably provided and the intermediate portions thereof are positioned on the sprockets 256 and 258 and on the pin 254 projecting from the sprocket 250. A helical spring 270 is connected in its end portions to one end portion of the chain 268 and to the pin 204 on the integral arm 202 of the bracket 200 and another helical spring 272

is connected in its end portions to the other end portion of the chain 268 and to the pin 204. Since the sprockets 256 and 258 are moved with the lever arm 240 and since pin 254 on sprocket 250 remains stationary during the initial movement of the lever arm 240, one of the springs 270 and 272 is tightened by initial movement of the lever arm while the other spring is relaxed and due to the spring pressure acting through chain 268 on pin 254 the first sprocket 250 is urged into rotation.

Another sprocket 276 is rotatably mounted on an intermediate portion of the upper end portion of the end portion 210 of the support arm 206 by a mounting bolt of the like 280 and the sprocket 276 has teeth 278 which are in meshing engagement with the teeth 252 on the sprocket 250. A generally circular member 282 is in abutting relation and fixedly secured to the sprocket 276 by the bolt 280 and is desirably on the side of the end portion 210 of the support arm 206 opposite from the lever arm 240. The holding member 282 has two pins 284 and 286 secured thereto and such are desirably at diametrically opposite portions of the holding member. The notch or bifurcated portion 234 of the bar 228 receives the pin 284 and rotation of the holding member 282 causes the bar 228 to be moved about the pin 226 to retract and extend the valve operator 172. The holding member 282 preferably has two spaced concave edge surfaces 288 and 290 which are positioned between the pins 284 and 286.

A generally circular trigger member 292 having a concave surface 294 on the outer edge thereof is mounted on the outer end portion of the end portion of the support arm 206 by a bolt or the like 296. A pin 298 is secured to the trigger member and positioned thereon substantially diametrically opposite from the concave surface 294 and preferably projects away from the lever arm 240. A helical spring 300 is secured in its end portions to the pin 298 on the trigger member 292 and to the pin 286 on the holding member 282.

Two rollers 302 and 304 are mounted on the trigger member 292 and positioned adjacent the ends of the concave surface 294 thereon and in use are engageable with the concave surfaces 288 and 290 on the holding member 282. Two rods 306 and 308 are secured to the trigger member 292 adjacent the pin 298 thereon and have end portions 310 and 312 respectively on opposite sides of the trigger member which project toward the lever arm 240 as best illustrated in FIG. 9.

A generally circular trigger actuator 314 is fixedly secured to the upper portion of the lever arm 240 and is positioned to engage in its upper portions the end portions 310 and 312 of the rods 306 and 308 on the trigger member 292 as the lever arm 240 moves. As the lever arm 240 moves the trigger actuator 314 engages the end portions of the rods and the trigger member 292 is rotated and causes the spring 300 to be tightened and subsequently causes disengagement of one of the rollers 302 and 304 from the concave surfaces 288 and 290 of the holding member 282 to permit rotation thereof. Rotation of holding member 282 results from the tension exerted by the springs 270 and 272 connected to the chain 268 which are urging rotation of the first-named sprocket 250 during movement of the lever arm 240. Movement of sprocket 250 causes movement of sprocket 276 and holding member 282 attached thereto. Disengagement of the rollers from the concave surfaces of the holding member 282 permits rotation of this member to cause pin 284 thereon to be moved which in turn moves the bar 228 to move the valve operator 172.

A rod 320 is secured in one end portion to the upper end portion of the lever arm 240 and projects therefrom at substantially a right angle thereto as best illustrated in FIG. 9. A stop rod 322 is secured to the other end portion of the rod 320 and projects therefrom at substantially a right angle thereto and is positioned adjacent the arm 122 of the connecting means as shown in FIG. 7.

A pin 324 is secured to the arm 122 of the connecting means and projects to the side thereof and the rod 322 desirably slides thereon. Two stop members or plates 326 and 328 are adjustably mounted on the stop rod 322 and are positioned in spaced relation to each other and are located on opposite sides of the pin 324 on the arm 122 and are engageable by the pin 324 during movement of the connecting means to urge the stop rod 322, rod 320 and lever arm 240 into movement about the pin 244 which mounts the lever arm 240 on the support arm 206. The stop plates 326 and 328 are adjusted on the rod 322 so that the lever arm 240 is moved to cause the trigger member 292 to be released from engagement from the holding member 282 as the connecting means reaches the extreme positions of its movement to thereby permit movement of the sprocket 250 and cause retraction and extension of the valve operator 172 of the valve 170.

Assuming the well pumping apparatus to be in the position shown in the solid lines in FIGS. 1 and 2 with the piston rod of the hydraulic cylinder 140 and the valve operator 172 retracted and the arm members 120 and 122 of the connecting means inclined or at an angle relative to the upper arm members 128 and 130 of the connecting means, then flow of hydraulic fluid through conduit 180 causes the piston rod 146 to be extended which moves the connecting means from the position shown by the solid lines in FIG. 1 through a substantially longitudinally aligned position to the position shown in the dashed lines in FIG. 1 and such movement causes the walking beam 62 to be moved through an entire cycle of operation, that is, from the position shown in FIG. 1 with the horsehead elevated and the weights 96 lowered to the opposite position and again returned to the position illustrated in FIG. 1. This movement is accomplished during a half cycle of operation of the power means or hydraulic cylinder 140. As the connecting means reaches the position illustrated on the dashed lines in FIG. 1 the stop member 328 is engaged by the pin 324 on the arm 122 of the connecting means which causes pivotal movement of the lever arm in the direction of the arrows in FIG. 8 and from the position shown in FIG. 8 to the position shown in FIG. 10. As lever arm 240 is moved trigger actuator 314 engages the end portion 310 of rod 306 on the trigger 292 to start rotation thereof and the spring 300 is thus tightened and spring 270 is also tightened as a result of movement of lever arm 240 which cocks the valve switching mechanism. When the lever arm 240 is moved to its furthestmost position the roller 304 is disengaged from the arcuate surface 288 of the holding member 282 to permit rotation of the holding member 282. Member 282 is rotated in the direction of the arrow in FIG. 8 by the spring 270 acting on the pin 254 on the sprocket 250 which also rotates in the direction of the arrow in FIG. 8 to cause rotation of the sprocket 276 which is fixed to and rotates the holding member 282 from the position shown in FIG. 8 to the position shown in FIG. 10 to move bar 228 and extend the valve operator 172. The arcuate surface 294 of the trigger member 292 is positioned during movement of the holding member to permit the portion thereof adjacent to the pin 286 to pass therealong and not interfere with the movement of the trigger member. During movement of the trigger member the spring 300 tightens and as it moves past the center of the pin 296 mounting the trigger member 292 it causes the trigger member to be rotated and roller 302 is moved into engagement with the arcuate surface of the holding member or into the position illustrated in FIG. 10.

When the connecting means is moved from the position shown on the dashed lines to the position shown on the solid lines in FIG. 1 the opposite movement of the lever arm 240 occurs and the trigger actuator 314 engages the end portion 312 of rod 308 to disengage roller 302 from the arcuate surface 290 of the holding member 282 to permit movement of the holding member 282, sprocket

276, sprocket 250 and associated structure to thereby retract the valve operator 172 and return the apparatus to the position illustrated in FIG. 8. This, of course, occurs as a result of pin 324 moving the stop plate 326 during movement of the arm 122. During movement of the walking beam 62 the horsehead 70 operates to compound the stroke of the apparatus in the manner described in the before mentioned patent and results in greater movement of the rods and pumping apparatus located in the well.

As will be apparent from the foregoing, the amount of fluid lifted from the well during a complete cycle of the hydraulic cylinder 140 is substantially multiplied as a result of the mechanical construction and action of the connecting means which effectively multiplies the movement of the piston rod 146 of the hydraulic cylinder 140 and also as a result of the preferred horsehead used with the combination. Substantial improvement in the apparatus and doubling of movement of the walking beam is obtained by the construction and operation of the connecting means even when used with other types of horseheads.

The use of the preferred means for operating the valve operator 172 is quite desirable since the valve operator is positively and immediately moved as the connecting means reach the extreme positions of its movement and there is no continuous movement of the valve operator which is not effective and causes interruption of the operation of the hydraulic cylinder 140 if the valve operator 172 is continuously moved with the connecting means without the desirable cocking and releasing structure as described hereinbefore.

FIGS. 3-5 illustrate another preferred specific embodiment of the invention which is quite similar in many respects to the previously described embodiment and which additionally includes a modified horsehead construction and means for balancing the apparatus to compensate for the weight of the fluid being pumped from the well hole. The base 20 is of the same or similar construction as that illustrated and described previously as is the Samson post 50, walking beam 62 and mounting thereof on the Samson post by use of the plate 68 or the like. The counterbalance weights 96 are also the same or similar in construction and are secured to the end of the walking beam 62 in any suitable manner, such as in the manner shown and described hereinbefore. The same reference numerals have been used to designate parts or structures which are the same or similar to that previously described.

In the embodiment shown in FIGS. 3-5 a modified horsehead construction is provided and is shown generally at 400 and includes two spaced and generally parallel members 402 and 404 each having an arcuate outer edge 406 and 408, respectively, and a connecting member 410 is positioned between the member 402 and 404 and has an arcuate surface thereon which terminates at the edges 406 and 408 and forms a continuation thereof and in use receives and holds a rope, cable or the like 412 which has its end portions connected to a connecting member 413 to raise and lower apparatus in the well hole. Rearwardly projecting arm portions as shown at 414 in FIG. 3 are provided and are positioned on opposite sides of the walking beam 62 and a rope, cable or the like 416 connects the ends of the arm portions 414 to an anchor member 418. The horsehead 400 is suitably mounted on the walking beam, such as by a pivot 420.

Two separate spaced and generally parallel members 422 and 424 are positioned between members 402 and 404 and have a connecting member 426 secured thereto at the upper edge portion thereof. The connecting member 426 has an arcuate surface terminating at the edges of the members 422 and 424 and holds a rope or the like 428 which is secured to a connecting member 430 which in turn is connected to well pumping apparatus in the well hole. The members 422 and 424 are con-

nected to a support plate 432 which is also pivotally mounted on the shaft or pivot 420 and the back surface of the members 424 and 422 can rest on the forward edge of the walking beam 62. By using the horsehead 400 two separate wells can be simultaneously pumped, one of the connecting members 413 being secured to the well pumping apparatus in one well hole and the other connecting member 430 being secured to well pumping apparatus in another well hole, the well holes being either closely or remotely spaced and connected to the members 413 and 430 by cables or the like.

Two generally L-shaped arms 440 and 442 are provided and are pivotally mounted in mirror image relation on the center portion of the projecting portion of the mounting member 102 at the juncture of the longer and shorter portions of the arm members by a pivot 444. As illustrated in FIG. 3 the longer portions of the arms are located in a generally vertical position and the shorter portions are disposed in a generally horizontal position. Counter-balance weight 446 and 448 are secured to the longer portions of 440 and 442, respectively, and are desirably mounted at the outer end portions thereof by mounting bolts or the like 450.

A cylinder support member 454 is desirably provided and is connected to the walking beam 62 in any suitable manner, such as by having a portion of the support 454 projecting between the beams 64 and 66 and with bolt means 456 projecting upwardly through a plate 458 into the member 454 to fixedly and adjustably attach the support member to the walking beam. The cylinder support member 454 has an upwardly projecting mounting portion or flange 460 which is located between the counter balance weight 96 and the mounting member 102.

A hydraulic cylinder 462 is provided and is pivotally mounted in one end portion of the flange 460 by a pivot 464. The hydraulic cylinder 462 has a piston rod 466 projecting from one end portion thereof and is secured in its end portion to a pivot or connecting member 468 and the connecting member is secured in its end portions to intermediate portions of the longer portions of the L-shaped arms 440 and 442. A bypass conduit 470 is provided and can be within the housing of the cylinder 462 if desired. The end portions of the conduit 470 open into the cylinder 462 at the end portions of the cylinder as best illustrated in FIG. 5. As the piston rod 466 is moved the piston 467 within the cylinder 462 is moved from one end portion thereof to the other end portion thereof and forces fluid from the cylinder 462 through the conduit 470 back into the cylinder. A pressure operated valve shown diagrammatically at 472 in FIG. 5 is positioned within the conduit 470 and is operable to restrict or impede the flow of fluid through the conduit 470 and thus restricts or slows down movement of the piston 467 and piston rod 466. The cylinder 462, bypass conduit 470 and valve 472 function to restrict or slow movement of the arms 440 and 442 to result in slow and even movement of the arms during well pumping operations.

The connecting means including the upper and lower arm members are the same or similar in construction to that previously described in connection with FIGS. 1 and 2 and in this embodiment the upper end portion of the arms 128 and 130 are pivotally connected to the outer end portions of the shorter portions of the L-shaped arms 440 and 442 such as by the use of pivot pins 476, FIG. 3. The connecting means are thus operatively connected to the walking beam 62 through the L-shaped arms 440 and 442 and the mounting member 102.

In operation the hydraulic cylinder 140 has fluid provided thereto in the manner described hereinbefore and as a result the piston rod 146 thereof is extended and retracted to drive the connecting means. In this embodiment the force directed against the arm members 128 and 130 causes movement of the L-shaped arms 440 and 442 about the pivot 444 and also moves the L-shaped arms

from the positions shown in solid lines to the positions shown in the dashed lines in FIG. 3. Movement of the arms 440 and 442 and counter-balance weights 446 and 448 is impeded or restricted by the hydraulic cylinder 462, bypass conduit 470 and valve 472 therein so that the weights 446 and 448 reach the position at the left as illustrated at the dashed lines at FIG. 3 when the walking beam has reached the position with the horsehead 400 at the lowermost position and with the portions of the connecting means being in substantially longitudinally aligned position. As the connecting means moves to the position illustrated in the dashed lines of FIG. 3 the horsehead is again raised and the counterbalance weights 446 and 448 are moved rearwardly to the position shown in the dashed lines at the right side of FIG. 3. Thus, the counterbalance weights 446 and 448 are, in effect, located on the horsehead 400 during downward movement thereof and are moved rearwardly to in effect add to the counterbalance weights 96 as the horsehead is elevated and thus balances the apparatus for the weight of the fluid being lifted from the well hole in operation. The counterbalance weights 96 function in the usual manner to balance the well pumping apparatus for the weight of the rods in the well. By adjusting the cylinder mounting member 454 rearwardly or forwardly and/or raising or lowering weights 446 and 448 on the arms and/or by adjusting the mounting member 102 the apparatus can be adjusted for substantially all pumping conditions encountered. Also, by moving the pivot 132 to other of the holes 136 in the connecting means the movement of the walking beam and horsehead can be varied.

In both of the preferred specific embodiments described the Samson post 50 is desirably mounted on the base 20 in the manner described so that the Samson post, walking beam 62 and horsehead mounted thereon can be moved out of the position illustrated in FIGS. 1-4 and moved away from the well hole so that necessary operations to be performed in the well hole other than pumping can be easily accomplished without interference of the apparatus. Thus, referring to FIG. 11 the apparatus can be moved into the tilted position as shown there by first moving the piston rod 146 of the hydraulic cylinder 140 so that the arm members of the connecting means are substantially longitudinally aligned and then a pin or connecting rod 480 is passed through aligned ones of the holes 136 in the connecting means and the rod 480 together with the pivot or rod 132 makes the upper and lower portions of the connecting means rigid relative to each other.

Mounting bolts 46 are then loosened or removed so that the mounting plate 44 is separable from the plate 34 and the piston rod 146 of the hydraulic motor 140 is then retracted to pull rearwardly on the connecting means which pivots the mounting members 38 and 40 and the Samson post 50 about the pivot 42 to move the well pump apparatus to the position illustrated in FIG. 11. Also, if desired, the horsehead 400 can be pivoted about the shaft 420 to locate same on the walking beam as illustrated in FIG. 11. By reversing movement of the piston rod 146 of hydraulic cylinder 140 the apparatus is returned to its normal position and the bolts 46 can be replaced or tightened to rigidly secure the Samson post 50 in fixed relation relative to the frame 20.

While the invention has been described in connection with preferred specific embodiments thereof, it will be understood by those skilled in the art that this description is intended to illustrate and not to limit the scope of the invention which is defined by the claims.

What is claimed is:

1. Well pumping apparatus comprising, in combination, a base having a base plate secured thereon and positioned in a generally horizontal plane, a support attached to said base plate at one end portion thereof, spaced and generally parallel mounting members positioned on opposite sides of said support, a pivot passing through said support and one end portion of said mounting members to pivotally

connect said mounting members to said support, means removably connecting the other end portion of said mounting members to said base plate, a Samson post secured in one end portion to an intermediate portion of said mounting members and projecting upwardly therefrom, a walking beam pivotally mounted in an intermediate portion on the other end portion of said Samson post, a horsehead secured to one end portion of said walking beam and being constructed to receive and hold a rope or the like during well pumping operations, counterbalance weight means secured to the other end portion of said walking beam, a mounting member connected to said walking beam and positioned between said Samson post and said counterbalance weight means thereon, a generally L-shaped arm having the longer portion thereof disposed in a generally vertical position and having the shorter portion thereof disposed in a generally horizontal position, said arm being pivotally connected to said last-named mounting member at the juncture of said portions of said arm, counterbalance weight means secured to said longer portion of said L-shaped arm, a cylinder support member connected to said walking beam between said last-named mounting member and said counterbalance weight means on said walking beam, a hydraulic cylinder connected in one end portion to said cylinder support member and having a piston rod projecting from the other end portion thereof with said piston rod being pivotally connected to an intermediate portion of said longer portion of said L-shaped arm, a conduit connected in its end portions to the end portions of said cylinder, a pressure operated valve in said conduit operable to impede flow of fluids there-through upon movement of said piston rod, connecting means including two spaced and generally parallel arm members each pivotally connected in a lower end portion to said first-named mounting members and movable relative thereto, said connecting means having two additional spaced and generally parallel arm members each pivotally connected in one end portion to the other end portion of said first-named arm members of said connecting means and pivotally connected in the other end portion to said shorter portion of said L-shaped arm, drive means including a double acting hydraulic cylinder supported by said base and having the outer end portion of the piston rod thereof connected to said connecting means to move said arm members of said connecting means from a generally longitudinally aligned position to positions on both sides thereof, pump means, valve means having a valve operator, conduit means connecting said valve means to said pump means and said last-named hydraulic cylinder to selectively direct hydraulic fluid to one end portion and the other end portion of said last-named hydraulic cylinder upon operation of said valve operator, switching means operatively connected to said arm members of said connecting means and to said valve operator operable to move said valve operator to change direction of flow of hydraulic fluid from said pump means through said last-named hydraulic cylinder when said connecting means reaches the extreme positions of its movement, said well pumping apparatus being constructed and adapted so that operation of said last-named hydraulic cylinder drives said connecting means to move said walking beam through one complete cycle of operation as said last-named hydraulic cylinder completes a half cycle of operation with said switching means moving said valve operator to reverse movement of said last-named hydraulic cylinder at the end of each cycle of said walking beam and with said counterbalance weights on said L-shaped arm being moved toward said horsehead when said horsehead is lowered and moved away from said horsehead when said horsehead is raised to balance said apparatus for the weight of the fluid in the well.

2. Well pumping apparatus comprising, in combination, a base, a Samson post mounted on said base, a walking beam pivotally connected to said Samson post, a horsehead mounted on one end portion of said walking beam,

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counterbalance weight means carried by the other end portion of said walking beam, a generally L-shaped arm, means pivotally mounting said arm on an intermediate portion of said walking beam between said Samson post and said counterbalance weight means with one portion of said arm positionable in a generally vertical position and with another portion of said arm positionable in a generally horizontal position, a hydraulic cylinder carried by said walking beam and having a rod therein connected in an end portion to said one portion of said L-shaped arm and operable to oppose movement of said arm, counterbalance weight means carried by said one portion of said arm and movable with said arm in operation to balance said well pumping apparatus for the weight of the fluid in a well, hydraulic power means, connecting means secured in one end portion to said another portion of said L-shaped arm in spaced relation to said counterbalance weight means and operatively connected in the other end portion to said hydraulic power means, said connecting means being operable to move said walking beam and being operable to move said counterbalance weight means on said L-shaped arm toward said horsehead when said horsehead is being lowered, and switching means operatively connected to said connecting means and said hydraulic power means and being operable to reverse movement of said power means to cause oscillation of said walking beam about said Samson post, said well pumping apparatus being constructed and adapted so that said power means moves said walking beam and said L-shaped arm in operation to move said horsehead and with said counterbalance weight means on said L-shaped arm balancing said apparatus for the weight of the fluid in a well.

3. Well pump means comprising, in combination, a Samson post, walking beam means pivotally connected to said Samson post, means with one end portion of said walking beam to receive and hold a rope or the like during well pumping operations, counterbalance weight means operatively connected to said walking beam means, pivotally mounted arm means carried by said walking beam means and having a portion normally located in a generally vertical position, said portion of said arm means having means operatively connected thereto and to said walking beam means operable to impede movement of said arm means, weight means on said portion of said arm means, connecting means operatively connected in one end portion to said arm means to in operation control movement of said arm means, and power means connected to said connecting means operable to drive same and move said walking beam means and said arm means, said well pump means being constructed and adapted to provide a balanced well pumping unit having means to compensate for the weight of the fluid in the well and for the weight of the rods in the well.

4. Well pump means, comprising, in combination, a Samson post, means pivotally mounted on said Samson post defining a walking beam, means on one end portion of said walking beam to receive and hold a rope or the like during movement of said walking beam, arm means operatively connected to said walking beam and having end portions positioned at an angles relative to each other with one of said end portions being located in a generally vertical position, weight means carried by said one of said end portions of said arm means, drive means, connecting means operatively connected to said drive means and to the other of said end portions of said arm means, said connecting means being constructed of upper and lower portions pivotally connected together and movable from a position substantially in line with each other to positions on opposite sides thereof during operation with said walking beam being moved through an entire cycle of operation as said drive means moves through a half cycle of operation and with said weight means counterbalancing said pump means for the weight of the fluid in a well or the like.

5. Well pumping apparatus comprising, in combination,

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a base, a mounting plate on said base, a Samson post secured in one end portion to said base, a shaft carried by the other end portion of said Samson post, an elongated walking beam pivotally connected in an intermediate portion to said shaft on said Samson post, a horsehead pivotally mounted on one end portion of said walking beam and having a portion constructed to hold a rope or the like during well pumping operations, a plurality of counterbalance weights secured to the other end portion of said walking beam, connecting means including two spaced and generally parallel elongated arm members pivotally connected in a lower end portion to said mounting plate, a pin mounted on an intermediate portion of said arm members and projecting to one side thereof, said connecting means including two other spaced and generally parallel arm members each pivotally connected in one end portion to the other end portion of said first-named arm members and operatively connected in the other end portion to an intermediate portion of said walking beam, drive means with said arm members operable to move said walking beam relative to said Samson post, said drive means including a double acting hydraulic cylinder mounted on said base and having the piston rod connected to said arm members, fluid supply means operatively connected to said cylinder, a valve member in said fluid supply means and having the valve operator thereof projecting therefrom, said valve operator being operable so that when said valve operator is in the extended position hydraulic fluid will be provided to said hydraulic cylinder to retract said piston rod therein and when said valve operator is in the retracted position said fluid will be provided to said hydraulic cylinder to extend said rod, a bracket connected to said base and having an arm portion projecting therefrom, a support arm having a base portion connected to said bracket and having end portions projecting from said base portion, one of said end portions of said support arm having a portion thereof in close proximity to said valve operator, a bar pivotally connected in an intermediate portion to said projecting end portion of said valve operator and operatively connected to said one of said end portions of said support arm, a lever arm pivotally mounted in an intermediate portion on said support arm, a first sprocket mounted on said support arm, pin means mounted on said sprocket, a second and third sprocket each mounted on said lever arm and positioned in spaced relation to each other and to said first sprocket, a chain positioned on said second and said third sprockets and said pin means on said first sprocket, spring means connecting the end portions of said chain to said arm of said bracket, a fourth sprocket rotatably mounted on said other end portion of said support arm and in meshing engagement with said first sprocket, a holding member secured to said fourth sprocket and having two pins secured thereto in spaced relation with one of said last-named pins being moveably connected to the other end portion of said bar to cause movement of said bar and said valve operator upon movement of said fourth sprocket and said holding member, said holding member having two spaced concave edge surfaces positioned between said last-named pins, a trigger member having a concave surface and mounted on said other end portion of said support arm, a pin mounted on said trigger member and positioned substantially diametrically opposite from said concave surface, other spring means connected to said last-named pin and the other of said pins on said holding member, two roller members mounted on said trigger member and positioned adjacent the ends of said concave surface thereon and engagable with said concave surfaces on said holding member and preventing movement of said holding member while in engagement therewith, rod means projecting from said trigger member adjacent said pin thereon and having end portions projecting toward said lever arm, trigger actuator means with said lever arm engagable with said end portions of said rod means as said

lever arm is moved relative to said other end portion of said support arm to turn said trigger member to disengage one of said rollers thereon from engagement with said concave surfaces of said holding member to permit rotation thereof as a result of tension exerted by said first-named spring means acting through said chain to urge movement of said first sprocket, connecting means secured to said other end portion of said lever arm and having stop means connected thereto, said stop means being engagable by said pin on said arm of said connecting means to move said lever arm upon movement of said connecting means.

6. Well pumping means comprising, in combination, support means, walking beam means movably mounted on said support means and having means on an end portion thereof to receive and hold a rope or the like, a pair of toggle links having one end connected to said walking beam means and the opposite end connected to said support means, and drive means including a fluid operated cylinder having rod means operatively connected to said pair of toggle links to bend same to positions on both sides of the center extended position, fluid supply means for said cylinder including valve means having a valve operator with said valve means being operatively connected to said cylinder and with movement of said valve operator being operable to reverse movement of said rod means of said cylinder, and linking means having a first portion operatively connected to said pair of toggle links and movable therewith, said linking means having a second portion operatively connected to said valve operator so that movement of said second portion of said linking means causes movement of said valve operator, and actuating means including a trigger means, said actuating means operatively connecting said first and second portions of said linking means and being connected and constructed so that movement of said first portion of said linking means to the extreme position of movement thereof actuates said trigger means to cause movement of said second portion of said linking means to thereby quickly move said valve operator with said second portion of said linking means and with said valve operator being substantially stationary during initial movement of said first portion of said linking means, said well pumping means being constructed and adapted so that operation of said cylinder drives said toggle links to move said walking beam means with said first portion of said linking means being moved by said toggle links to actuate said trigger means and cause movement of said second portion of said linking means to thereby cause movement of said valve operator when said toggle links and said first portion of said linking means reach extreme positions of movement.

7. Well pumping apparatus comprising, a base, a mounting plate on said base, a Samson post on said base, a shaft carried on the top portion of said Samson post, an elongated walking beam, means pivotally connecting said walking beam to said shaft, a horse head mounted on one end portion of said walking beam, a plurality of counter balance weights secured to the other end portion of said walking beam, connecting means including two spaced and generally parallel articulated members pivotally connected in lower end portions to said mounting plate and pivotally joined at the upper end portions to an intermediate

portion of said walking beam, drive means for said articulated members operable to move said walking beam relative to said Samson post, said drive means including a double acting hydraulic motor on said base and having a piston rod, means pivotally connecting the end of said piston rod to intermediate portions of said articulated members, said hydraulic motor positioned relative to said articulated members to enable same to bend said members to relative positions from an acute to an obtuse angle, fluid supply means operatively connected to said hydraulic motor, a valve member in said fluid supply means, a valve operator means for said valve member positioned generally transverse of said articulated members when in extended position, and having spaced abutment means, a trip element mounted on one of said articulated members adapted in operation to alternately engage said abutment means, said well pump apparatus in operation adapted to produce two complete oscillations of the walking beam with a single oscillation of said hydraulic motor.

8. Well pump means comprising, in combination, a base, a Samson post mounted in one end portion on said base, a walking beam, means pivotally mounting said walking beam on the other end of said Samson post, a horse head secured to one end portion of said walking beam, counter balance weight means connected to the other end portion of said walking beam, a pair of actuating toggle links connected at one end to an intermediate portion of said walking beam and at the other end to said base, a drive means operatively connected to said pair of toggle links, said drive means comprising, a double acting hydraulic cylinder having a piston rod, said piston rod connected to one of said toggle links, said cylinder mounted relative to said pair of toggle links to flex same to alternately acute and obtuse angles, fluid pump means, conduit means operatively connecting said hydraulic cylinder and said fluid pump means, a valve in said conduit means to control the flow of fluid pumped by said fluid pump means to said hydraulic cylinder to oscillate the piston rod, a valve operator means operably connected for actuation to said pair of toggle links, said well pump means in operation adapted to produce two complete oscillations of said walking beam to a single oscillation of said hydraulic cylinder.

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