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WELL PUMPING APPARATUS

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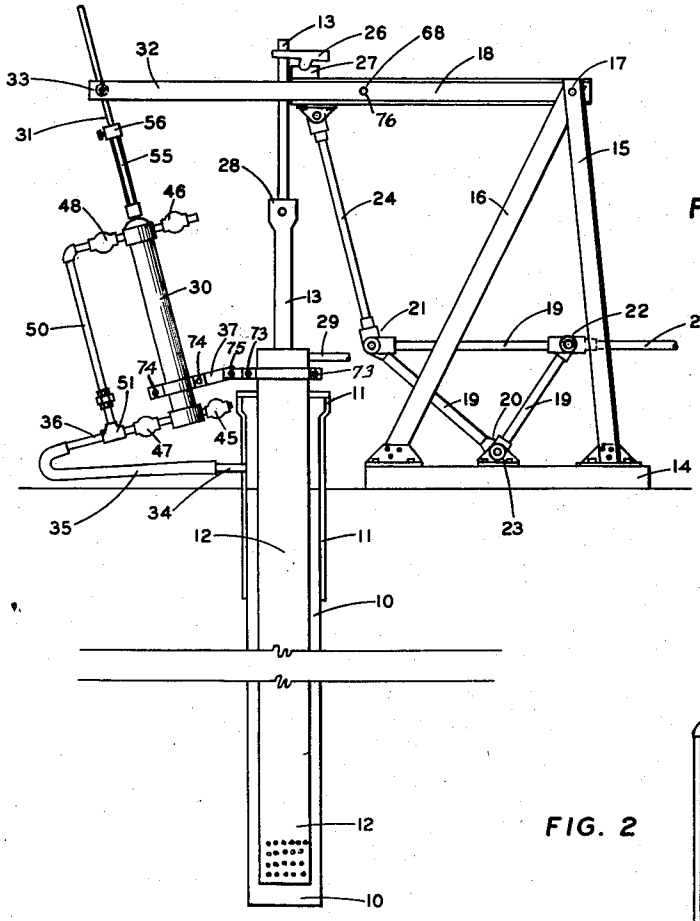


FIG. 1

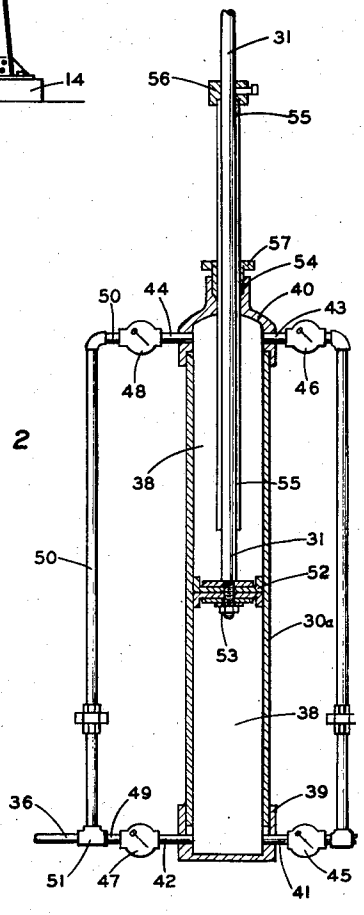


FIG. 2

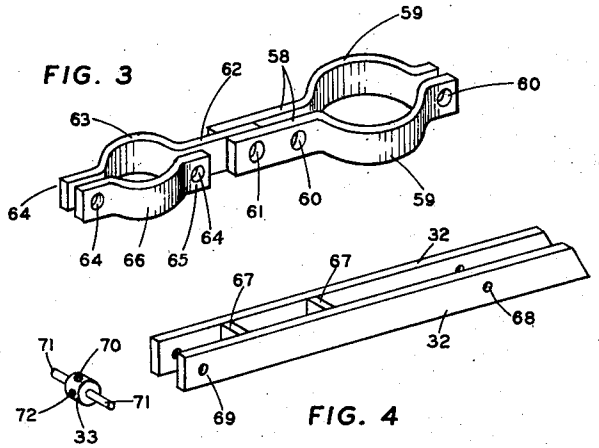


FIG. 3

FIG. 4

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WELL PUMPING APPARATUS

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1 Claim. (Cl. 103—6)

This invention relates to an improvement in well pumping apparatus which will affect increases in the production of wells in areas where the reservoir pressure is low.

In old oil fields, where the reservoir pressure is low or has been completely exhausted, well production is low because oil does not flow into the bore hole as rapidly as the well pump can remove it.

It is, therefore, the principal object of this invention to provide an improvement in well pumping apparatus whereby the well output may be increased by applying a vacuum to the producing face of the well bore hole.

It is a further object of this invention to provide an improvement as described, the cost of manufacture and operation of which is appreciably less than the value of the increase in well production which it affects.

It is a further object of this invention to provide a vacuum pump for use in combination with a conventional well pump in such a manner that both pumps may be driven by the same source of power.

It is a further object of this invention to provide means for mounting a vacuum pump which will enable the vacuum pump to be operated by a moving member which describes the arc of a circle.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then comprises the features hereinafter fully described and particularly pointed out in the claim, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

Fig. 1 is a side elevational view partially in section of my invention applied to a conventional well pump;

Fig. 2 is a cross-sectional view in side elevation of my invention;

Fig. 3 is a perspective view of the clamp by which my invention is held to the stationary part of the well pump; and

Fig. 4 is a perspective view of the beam extension and securing means by which the piston rod of my invention is held to the pivoted driving beam of the well pump.

Broadly stated, my invention comprises the combination with a well pump having a pivotally supported beam, a power cable secured to said beam whereby application of tension causes said beam to rotate in a first direction about its fulcrum, a sucker rod adapted to be reciprocated axially by said beam and connected to said beam so that the weight of the sucker rod urges said beam for rotation in a second direction about its fulcrum counter to said first direction, of a vacuum pump comprising relatively movable piston and cylinder elements, one of said elements connected to said beam for actuation thereby and the other of said elements connected to a substantially fixed support, said conduit means for connecting said vacuum pump with the space in the well bore in which said sucker rod operates.

With reference now to Fig. 1, 10 designates a well bore hole, the top portion of which is enclosed by a casing 11. Suspended in the bore hole 10 is a pipe string 12 which comprises the outer shell of a conventional well pumping unit. The pipe string 12 extends above the top of the casing 11 and is sealed thereto. Protruding from the top of the pipe string 12 is a sucker rod 13 which is connected at its lower end to the piston of the well pumping unit. On the surface of the earth adjacent to the casing 11 is a cement foundation 14 on which are mounted two pairs of steel beams only one of which is shown in Fig. 1. Each pair comprises a beam 15 and a beam 16. A shaft 17 is provided extending between the two pairs of beams and securing the beams 15 and 16 of each pair together. Pivotally secured to the shaft 17 intermediate of the pairs of beams 15 and 16 is an H beam 18. A triangular rocker 19 is provided, having the three corners 20, 21 and 22, and a shaft through the corner 20 of the rocker 19 is mounted in a journal 23 which is secured to the foundation 14. A shaft 24 is pivotally secured at one end to the corner 21 of the rocker 19 and pivotally secured at its other end to the under side of the beam 18. A cable 25 is secured to the corner 22 of the rocker 19. The sucker rod 13 extends above and adjacent to the end of the beam 18 and is supported above the beam 18 by a clamp 26 which rests in a circular groove in a support 27 on the top of the beam 18. A joint 28 is provided in the sucker rod 13 between the beam 18 and the top of the pipe string 12 to permit the lower part of the sucker rod 13 to remain vertical while the upper part follows the circular arc path through which the end of the beam 18 moves. Leading from the pipe string 12 above the top of the casing 18 is a conduit 29.

The well pumping apparatus is operated by a remote power source which periodically pulls on the cables 25 from a number of wells. When the cable 25 is pulled, the rocker 19 pivots about the shaft 23 and pushes the shaft 24 upwards. As the shaft 24 rises, it forces the beam 18 to pivot upwardly about the shaft 17, and in doing so lifts the sucker rod 13. As the sucker rod 13 rises, the piston connected to its lower end lifts the column of fluid above it until some of the fluids flow out of the pipe string 12 through the conduit 29. When the remote power source relaxes its pull on the cable 25, the weight of the sucker rod 13 pulls the beam 18 downward, and the descending beam 18 pushes the shaft 24 downward. The shaft 24 pivots the rocker 19 about the shaft 23, and the cycle is repeated.

The apparatus described above is a conventional well pumping apparatus. My improvement in this apparatus comprises a vacuum pump 30 which is operated by

a piston rod 31, a beam extension 32, a pivotal securing means 33, as illustrated more clearly in Fig. 4, a conduit 34 through the wall of the well casing 11, a flexible conduit 35 connecting the intake conduit 36 of the vacuum pump 30 to the conduit 34, and a pivoted double clamp 37 which is more clearly illustrated in Fig. 3.

With reference now to Fig. 2, the vacuum pump, indicated generally at 30 in Fig. 1, comprises the wall 30*a*, which encloses a cylindrical chamber 38, a cap 39 sealing the bottom of the chamber 38, and a head 40 sealing the top of the chamber 38. Leading through the cap 39 are two conduits 41 and 42, and leading through the head 40 are two conduits 43 and 44. The conduits 41 and 43 are connected respectively to outwardly opening check valves 45 and 46, and the conduits 42 and 44 are connected respectively to inwardly opening check valves 47 and 48. Conduits 49 and 50 lead respectively from the check valves 47 and 48 and are joined together at a T 51. The conduit 36 described above leads from the T 51. A piston 52 is reciprocable in the cylindrical chamber 38 and is connected to the piston rod 31 by a bolt 53. The piston rod 31 extends through a port 54 in the head 40 and is partially covered by a piston rod liner 55. The top of the piston rod liner 55 is secured to the piston rod 31 by a clamp 56. A sleeve 57 is screwed into the port 54 in the head 40 sealing the space between the lead 40 and the piston rod liner 55. A body of lubricant is maintained in that part of the port 54 not occupied by the sleeve 57, the piston rod liner 55, or the piston rod 31.

With reference now to Fig. 3 wherein is shown the pivoted double clamp 37 described above, 58 designates two identical pieces of scrap iron. Each piece 58 is bent so that a part 59 of it conforms to a circular arc and a hole 60 is drilled through the piece 58 on either side of the part 59. The part 59 is not centrally located along the length of the piece 58, and a hole 61 is drilled through the piece 58 near its end which is more remote from the center of the part 59. The two pieces 58 are placed opposite each other with the parts 59 thereof encircling the part of the pipe string 12 which is above the top of the well casing 11. The top pieces 58 are then clamped around pipe string 12 by bolts 73 extending through the corresponding holes 60 in them. A piece 62 of strap iron is then inserted between the ends of the pieces 58 so that a hole in the piece 62 lies between the holes 61 in the pieces 58. A pin is inserted through the holes 61 pivotally securing the piece 62 to the pieces 58. The piece 62 is bent so that a part 63 of it conforms to a circular arc, and two holes 64 are drilled through it on either side of the part 63. A piece 65 of strap iron is provided opposite the piece 62 and a part 66 of it is bent into the shape of a circular arc. Two holes 64 are drilled in the piece 65 on either side of the part 65 thereof and opposite the holes 64 in the piece 62. The pieces 62 and 63 are held around the wall 30 of the vacuum pump by two bolts 74 which extend through corresponding holes 64 in the pieces 62 and 63. This pivoted double clamp secures the vacuum pump 30 to the pipe string 12 but permits the vacuum pump 30 to pivot around the pin 75 in the hole 61.

With reference now to Fig. 4 wherein is shown the beam extension 32 and the pivotal securing means 33 referred to above, 32 designates two parallel pieces of strap irons which are secured together by two braces 67. The pieces 32 slide into the sides of the H beam 18 and are secured thereto by set screws 76 in the holes 68 in the pieces 32. A hole 69 is provided in each of the pieces 32 near its end. The pivotal securing means 33 comprises a cylindrical center section 33 containing a radial hole 70 therethrough and two pins 71 extending axially from the part 33. A set screw 72 is provided in the part 33 perpendicular to the hole 70. The pins 71 of the securing means 33 extend through the holes 69 in the beam extension 32, and the piston rod 31 is held in the hole 70 by the set screw 72.

When the well pump described in connection with Fig. 1 is operated the moving beam 18 raises and lowers the beam extension 32. As the beam extension 32 descends, it pushes down the piston rod 31 which in turn pushes down the piston 52. As the piston 52 descends the check valves 46 and 47 are closed, and the check valves 45 and 48 are open so that air is driven from the lower part of the chamber 38 through the conduit 41 and drawn into the upper part of the chamber 38 from the conduit 36. When the beam 18 finishes its down stroke and starts its up stroke, the check valves 45 and 48 close and the check valves 46 and 47 open so that the air in the cylinder above the piston 52 is subsequently driven from the upper part of the chamber 38 through the conduit 43 and air is drawn into the lower part of the chamber 38 through the conduit 36. When the beam 18 finishes its up stroke and starts its down stroke, the check valves 46 and 47 close; the check valves 45 and 48 open, and the cycle is repeated.

Therefore, while the well pump is drawing fluids up the inside of the pipe string 12, the vacuum pump is drawing air through the conduits 36 and 34 from the inside of the well casing 11. As the vacuum pump draws air from the inside of the casing 11 the air pressure in the lower part of the well decreases so that a partial vacuum is applied to the walls of the well bore hole. This partial vacuum near the walls of the well bore hole causes the underground fluids to flow into the bore hole from the surrounding formations more rapidly.

My invention has been used on several wells constantly for a week. The following figures show how the use of my invention affected the production of two of these wells:

Well	Output during a week without the vacuum pump, Bbl.	Output during a week with the vacuum pump, Bbl.	Total increase, Bbl.	Percent increase
A	102.82	120.21	17.39	16.9
B	54.70	91.91	37.21	68.0

The practice of my invention provides valuable increases in the output of wells as indicated by the results of actual practice. My invention is particularly advantageous because of its low cost of manufacture and because it can be operated at almost no additional cost over the cost of operating the well on which it is used. My invention may be used in many situations where other pumps of its type could not be used because, since my invention can be operated at almost no additional cost, it can be used on many wells where the value derived from its use would not justify the use of a pump requiring its own independent power source.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in the following claim or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

An improved pumping system for use with a well comprising a casing enclosing the top portion of the well, a pipe string within and extending above said casing forming the outer shell of a well pumping unit, a pivotally supported beam, means for supporting said beam, a power cable secured to said beam whereby application of tension causes said beam to rotate in a first direction about its fulcrum, a sucker rod attached to be reciprocated axially by said beam and connected to said beam so that the weight of the sucker rod urges said beam for rotation in a second direction about its fulcrum counter to said first direction, a piston within said pipe string connected to the lower end of said sucker rod and adapted

to travel freely within said pipe string, a vacuum pump comprising relatively movable piston and cylinder elements wherein said piston element is connected to said beam for actuation thereby and the cylinder is pivotally connected to said pipe string extending above said casing, said pivotal connection including a first clamping member having jaw portions at each end thereof shaped to engage said pipe string extending above said casing and a second clamping member pivotally connected to said first clamping member, said second clamping member having jaw portions at each end thereof and shaped to

engage said cylinder element and conduit means for connecting said vacuum pump with the space in the well bore.

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