Feb. 19, 1929. 1,702,838

J. OLIPHANT

COMBINED MECHANICAL AND AIR LIFT PUMPING SYSTEM

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Fig. 1.

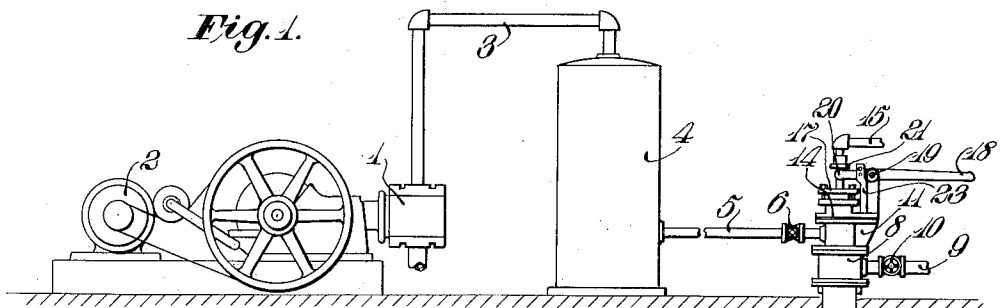


Fig. 4.

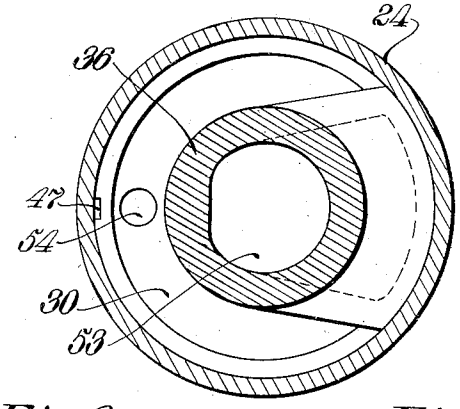


Fig. 8.

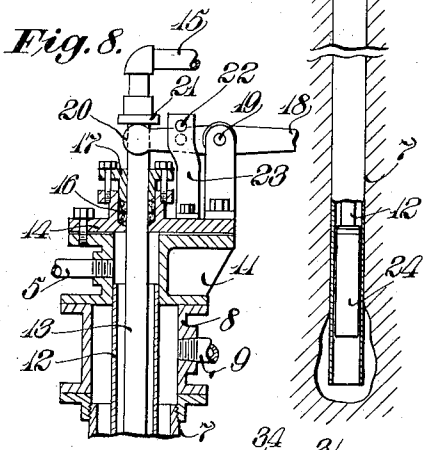


Fig. 6.

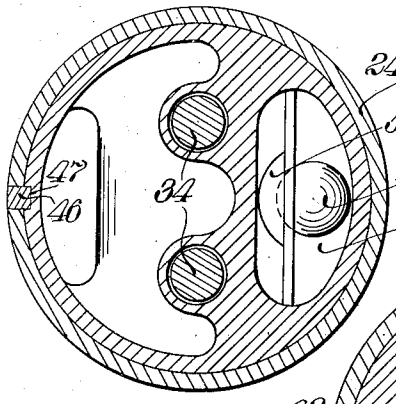


Fig. 5.

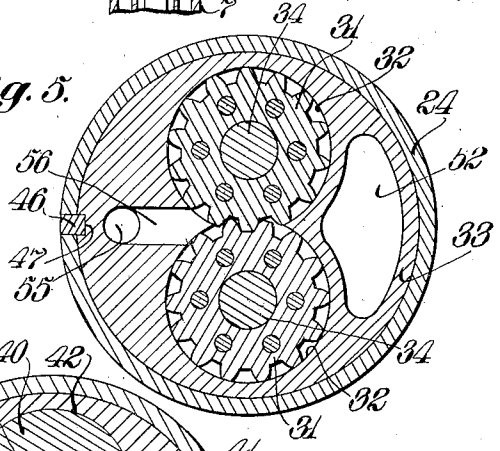
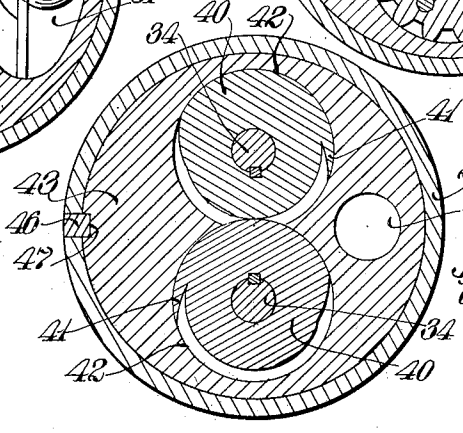


Fig. 7.



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COMBINED MECHANICAL AND AIR LIFT PUMPING SYSTEM

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Fig. 2.

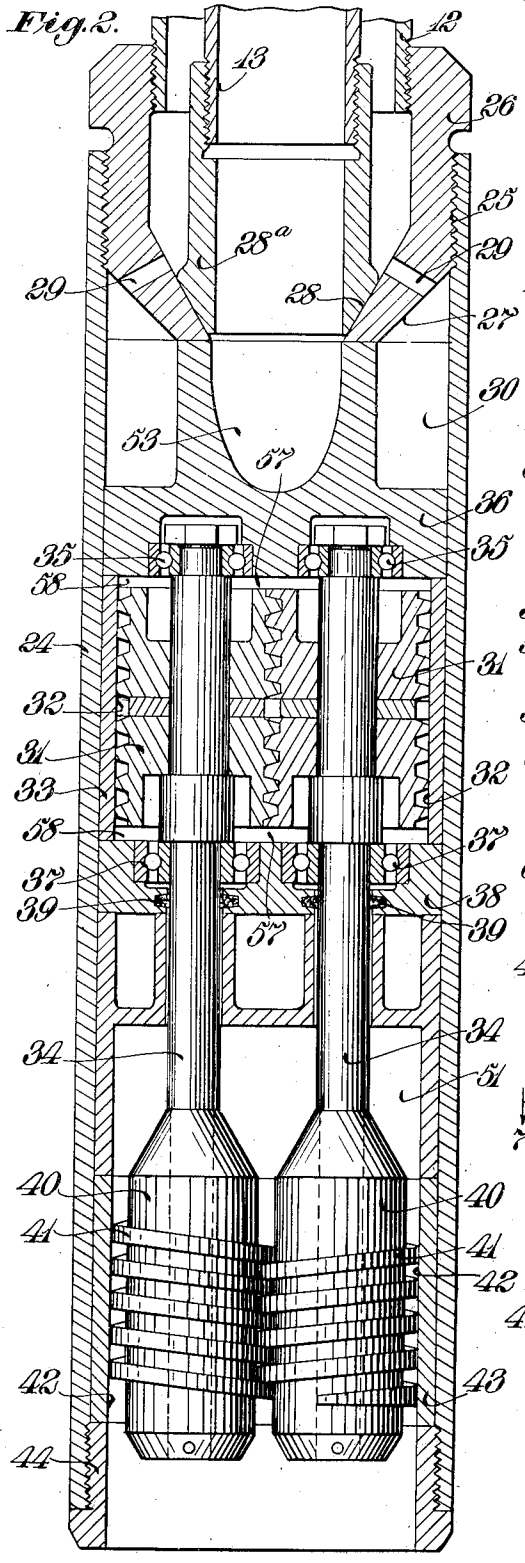
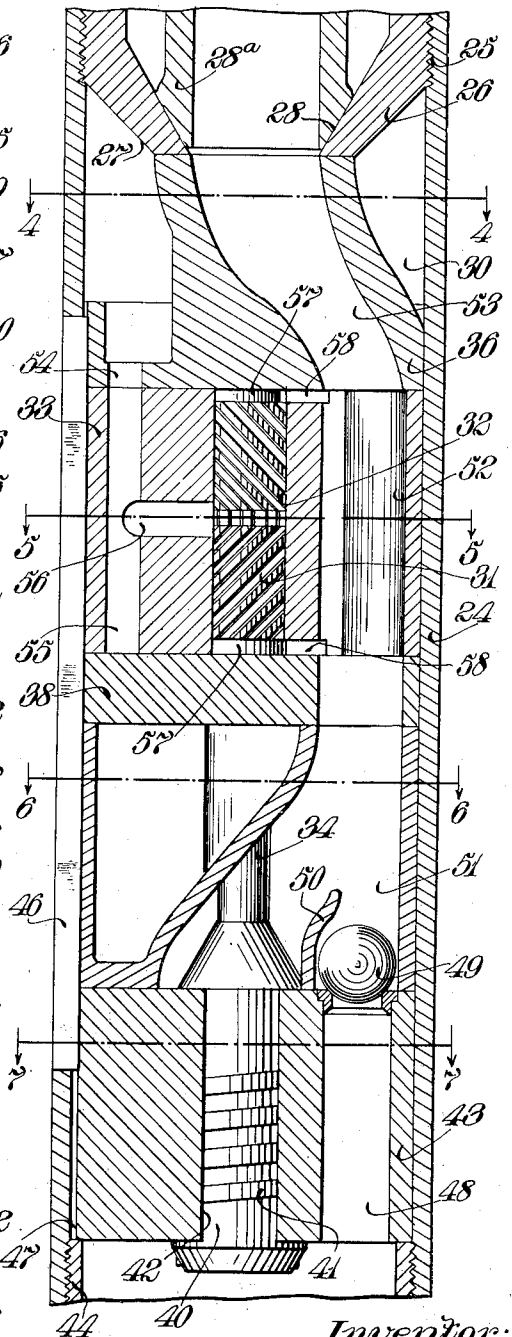


Fig. 3.



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Patented Feb. 19, 1929. 1,702,838

UNITED STATES PATENT OFFICE.

JOHN OLIPHANT, OF CHICAGO, ILLINOIS, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS.

COMBINED MECHANICAL AND AIR-LIFT PUMPING SYSTEM.

Application filed December 30, 1927. Serial No. 243,620.

The invention relates to a combined mechanical and air lift pumping system.

In air lift pumping it is well known that there must be a certain head or submergence at the bottom of the well for efficient operation. A large number of oil wells are now being pumped by air and in many cases the well will not maintain the necessary head continuously and accordingly there is a great need for a simple and dependable mechanical pumping unit which can be installed in the bottom of a well for building up a head of oil so that it can be blown off successfully by the direct action of the actuating fluid.

This invention has for an object to provide an improved pumping system, which will be useful in pumping liquid from wells. A further object of the invention is to provide improved means for creating the needed head on the liquid to be pumped and effecting the final pumping action by means of the usual air lift action. Still another object of the invention is to provide an improved mechanical pump and pressure fluid motor with means for exhausting the motor into the liquid discharged from the pump. A still further object of the invention is to install a fluid motor actuated pumping unit in the bottom of a well and to conduct exhaust fluid from this unit into the eduction pipe for assisting in the pumping action. Still another object is to provide an improved combined air lift and mechanical pumping system employing a mechanical pump with means for operating the system as a straight air lift when desired. Other objects and advantages of my invention will hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one specific form which the invention may assume in practice.

In these drawings,—

Fig. 1 represents a diagrammatic view of the essential elements of a pumping system, having my invention embodied therein.

Fig. 2 is a central vertical section through the mechanical pump unit and footpiece at the bottom of the well.

Fig. 3 is another section through the pump and footpiece taken at right angles to the section shown in Fig. 2.

Fig. 4 is a transverse section taken on line 4—4 of Fig. 3.

Fig. 5 is a section through the motor taken on line 5—5 of Fig. 3.

Fig. 6 is another transverse section on line 6—6 of Fig. 3.

Fig. 7 is a section through the pump unit on line 7—7 of Fig. 3.

Fig. 8 is a detail view in section illustrating the apparatus at the top of the well.

In this illustrative arrangement there is shown in Fig. 1 a compressor 1 driven by a motor 2 which discharges compressed fluid through a pipe 3 to a receiver tank 4 from which actuating fluid is supplied to the pumping system through a pipe 5 controlled by valve 6. The outer well casing is indicated at 7 and has a coupling 8 at its upper end from which fluid may be discharged through a pipe 9 controlled by a valve 10. A combined coupling and supporting member 11 is mounted above the coupling 8 and in this latter member the outer pipe 12 is secured, through which motive fluid is conducted to the bottom of the well from pipe 5. Liquid is discharged from the well through an inner pipe 13 which is slidably mounted in a head 14 and adapted to conduct liquid to some suitable tank through pipe 15. The head 14 is provided with a packing 16 and gland 17 for preventing leakage of air between the head and liquid discharge pipe. Some suitable mechanism is employed for lifting pipe 13 a small amount, which in this instance comprises a hand lever 18 pivoted at 19 and having a cam surface 20 cooperating with a collar 21 on the liquid discharge pipe. This lever may be held in raised position by means of a pin 22 placed in holes formed in a bracket member 23.

Referring now to Figs. 2 and 3, the combined footpiece and mechanical pumping unit comprises an outer casing 24 which is of slightly smaller diameter than the interior of the well casing 7 so that the unit may be removed and inserted into the well when desired. Casing 24 is secured by a screw joint 25 to a coupling member 26, which is in turn fixed to the pipe 12. The coupling member 26 has a beveled portion 27 having a ground conical valve seat 28 and a series of fluid conducting apertures 29 for supplying air from pipe 12 to a chamber 30. A valve element 28^a is fixed to pipe 13 and operable by means of lever 18 and has a conical surface cooperating with the valve seat 28. The driving motor is herein shown as being of the rotary type employing a pair of intermeshing spiral toothed rotors 31 mounted in a pair of com-

municating cylindrical bores 32 in a casing 33. These rotors are keyed to shafts 34 which are mounted in a pair of bearings 35 in the head member 36 and at the other end in a pair of bearings 37 in an intermediate member 38. Some suitable packing such as indicated at 39 may be provided for preventing the entrance of foreign material to the motor casing. The pump herein shown is of a well known intermeshing screw type. This pump comprises a pair of screws 40 mounted on the shafts 34 and having oppositely directed threads 41 on their outer surfaces. These screws revolve in a pair of cylindrical bores 42 formed in a casing 43. The parts of the motor and pump casings as well as the intermediate and head members are held in position in the outer casing 24 by means of a retaining collar 44 threaded in casing 24 and bearing against the pump casing 43. The motor and pump casing are held from rotation in the outer casing 24 by means of a longitudinally extending key 46, which may be secured in casing 24 by any suitable method, such as welding. A keyway 47 formed in the pump and motor casings and intermediate members cooperates with the key 46 to lock the parts against relative rotation. The pump casing 43 has a longitudinally extending passage 48 for allowing liquid to flow to the discharge pipe independently of the pump and this passage is preferably provided with a ball check valve 49 to permit flow of liquid upwardly but preventing the possibility of compressed air flowing back through the passage 48 and putting pressure on the well. Some suitable guard, such as indicated at 50, may be arranged to hold the valve 49 in place. Liquid may be discharged into a chamber 51 from either the pump or passage 48 and from this chamber flows upwardly through a passage 52 in the motor casing and passage 53 in the member 36 to the liquid discharge pipe 13.

In operation, compressed air or other gas flows downwardly between pipes 12 and 13 through openings 29 into chamber 30 and through a port 54 to a passage 55 extending longitudinally through the motor casing from which motive fluid is supplied from a transverse passage 56 to the central portion of the intermeshing rotors. Fluid is exhausted from these rotors at either end into chambers 57, which communicate by ports 58 with the liquid passage 52 in the motor casing. To protect the motor from injury, ports 58 may be and preferably are modified and provided with suitable check valves permitting exhaust but preventing reverse flow. The exhaust fluid is discharged, while still at a fairly high pressure, into the eduction pipe after having part of its energy expended in going through the motor. Shafts 34 are rotated by the motor rotors at high speed in opposite directions and thus the two screws 40 of the pump are rotated in opposite directions and liquid is forced along the grooves of the screw threads into chamber 51 and upwardly into the eduction pipe. The pressure fluid exhausting from the motor will mix with the rising liquid and assist in the pumping action on the familiar principle of the air lift pump.

If it is desired to blow off the head of the liquid in the eduction pipe or if it is found desirable to discontinue operation of the mechanical pump due to the fact that there is already a sufficient head of liquid in the well, the eduction pipe carrying the valve element 28^a may be lifted by means of the hand lever 18 and allow compressed fluid to flow directly into the eduction pipe and operate the system as an ordinary air lift pump. When the level of liquid has been lowered a sufficient amount so that there is not enough head to flow against the fluid pressure in the eduction pipe, check valve 49 will automatically close and prevent a backflow and the application of pressure to the well. After the head has been blown off, valve 28^a may be again moved to closed position, when the mechanical pump will begin operating in the manner heretofore described.

As a result of my invention it will be evident that a very simple and effective means has been provided for creating the needed head for efficient air lift pump operation, which consists of a single compact unit of a mechanical pump and direct connected motor. Also that simple and effective means have been provided for utilizing the exhaust fluid from a motor driving a liquid pump to further assist in the pumping action on the air lift principle. With the apparatus disclosed a well may be pumped on the ordinary air lift principle as long as it maintains sufficient head and when the head drops the mechanical pump may be put into operation to build up the required head for successful pumping and the actuating fluid is always utilized in the most efficient manner.

While I have in this application specifically described one form which my invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a liquid pumping system, an eduction pipe, a mechanical liquid pump for discharging liquid into said pipe, means for admitting expansible fluid into said eduction pipe for blowing off a head of liquid therein and simultaneously rendering said mechanical pump ineffective, and means for admitting liquid to said eduction pipe when said mechanical pump is ineffective.

2. In a liquid pumping system, an eduction pipe, a mechanical liquid pump for discharging liquid into said pipe, a pressure fluid motor for driving said pump, means for conducting exhaust fluid from said motor to said pipe to assist in the pumping action, means for selectively admitting other live pressure fluid to said eduction pipe for operation as an air lift pump, and means for admitting liquid to said eduction pipe during air lift operation.

3. In a liquid pumping system, an eduction pipe, a mechanical liquid pump arranged to discharge into said eduction pipe, a pressure fluid motor for driving said pump, fluid conducting means for supplying motive fluid to said motor, valve-controlled means for admitting motive fluid directly from said conducting means to said eduction pipe, and means for admitting liquid to said eduction pipe when motive fluid is supplied directly to said eduction pipe.

4. In a system for pumping liquid from wells, a fluid motor actuated mechanical pumping unit installed in the well, motive fluid conducting means extending into the well for supplying actuating fluid to said unit, an eduction pipe, valve means controllable from the surface of the ground for controlling direct communication between said eduction pipe and said motive fluid conducting means, and means for admitting liquid to said eduction pipe when motive fluid is supplied directly to the same.

5. In a liquid pumping system, an eduction pipe, a mechanical liquid pump arranged to discharge into said pipe, a pressure fluid motor for driving said pump, means for conducting exhaust fluid from said motor into the liquid discharged by said pump for assisting in the pumping action, valve controlled means for admitting motive fluid directly to said eduction pipe, and means for permitting liquid to flow into said eduction pipe independently of said mechanical pump.

6. In a liquid pumping system, an eduction pipe, a mechanical liquid pump arranged to discharge into said pipe, a pressure fluid motor for driving said pump, means for conducting exhaust fluid from said motor into the liquid discharged by said pump for assisting in the pumping action, valve controlled means for admitting motive fluid directly to said eduction pipe, means for permitting liquid to flow into said eduction pipe independently of said mechanical pump, and a check valve for controlling said latter means.

7. In a pumping system, a screw pump comprising a casing having a plurality of communicating cylindrical bores, a pair of interengaging oppositely threaded screws rotatable in said bores, a motor for driving said pump including a pair of intermeshing rotors each disposed in alinement with one or said screws and directly connected thereto.

8. In a liquid pumping system, a pressure fluid line adapted to be placed in a well, a fluid pressure driven pumping unit for connection to said line, said unit including an outer casing, a motor casing, and a pump casing, said motor and pump casings slidably and nonrotatively mounted in said outer casing.

9. In a liquid pumping system, a liquid pump having a pair of intermeshing revolving screws, a motor for driving said pump having intermeshing rotors directly connected to said screws, a casing in which said motor and pump are mounted to form a single removable unit, and means for conducting the fluid exhausted from said motor to the liquid discharged from said pump.

10. In a liquid pumping system, a liquid pump having a pair of intermeshing revolving screws, a motor for driving said pump having intermeshing rotors directly connected to said screws, a casing in which said motor and pump are mounted to form a single removable unit, means for conducting the fluid exhausted from said motor to the liquid discharged from said pump, and means for permitting the system to operate as an air lift pump until the head of liquid in the well has been lowered.

In testimony whereof I affix my signature.

JOHN OLIPHANT.