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J. M. McDANIEL

2,429,940

PUMPING APPARATUS

Filed Dec. 12, 1945

2 Sheets-Sheet 1

Fig. 1.

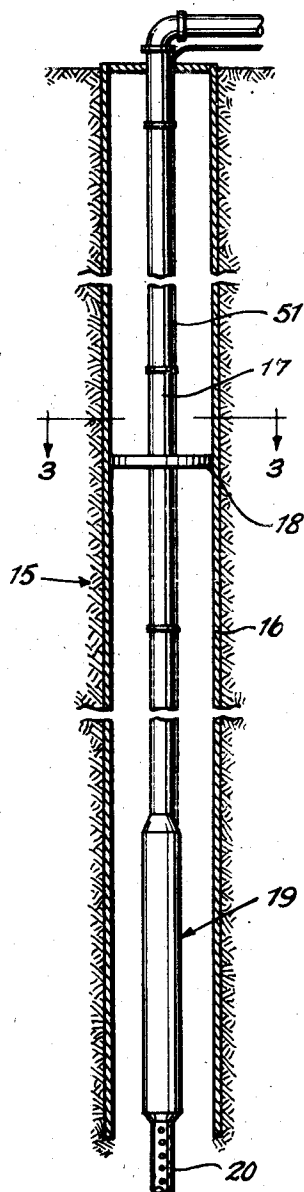


Fig. 2.

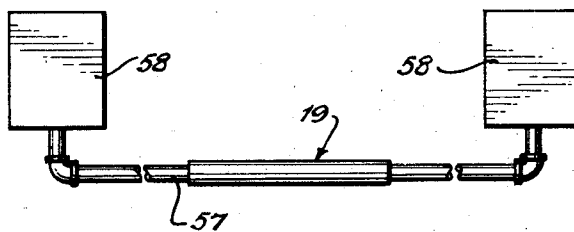


Fig. 3.

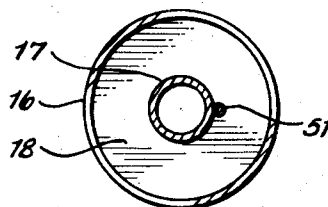
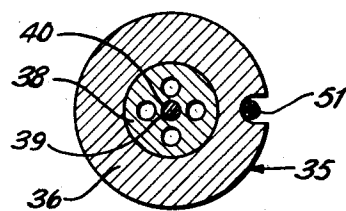


Fig. 8.



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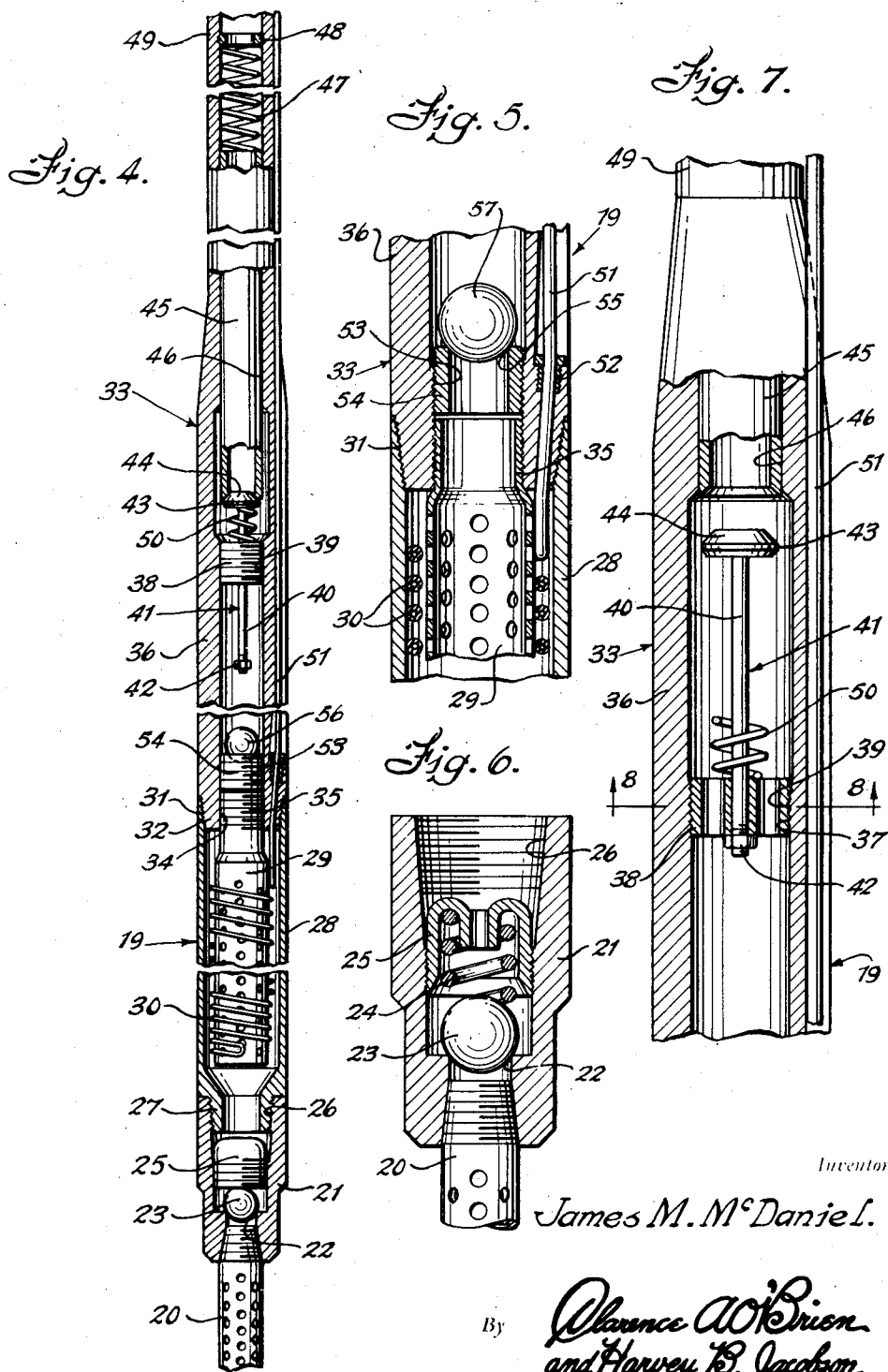
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2 Sheets-Sheet 2



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PUMPING APPARATUS

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3 Claims. (Cl. 103—234)

1

This invention relates to a pumping apparatus and more particularly to the pumping of petroleum products.

In the ordinary practice of pumping petroleum products, particularly in the pumping of such products out of deep wells, it is necessary to lift the liquid many thousands of feet, in fact it is not infrequent that such wells will reach as far as fifteen thousand (15,000') into the earth and consequently highly efficient pumping apparatus involving a tremendous investment in labor and materials has heretofore been necessary in order to maintain an adequate supply of the petroleum products from such wells. Also in the transportation of petroleum products by pipe line it is necessary to install at frequent intervals throughout the length of the line pumping apparatus to insure the proper flow of the liquid through the pipe line. It can therefore be seen that in the pumping of wells and the transportation of the products thereof for long distances through pipe lines a tremendous capital investment is involved in the pumping apparatus alone.

The primary object of the present invention is economically and efficiently to pump petroleum products from deep wells and through long pipe lines.

Another object is to effect great savings in labor by reducing to a minimum the amount of maintenance necessary to preserve the pumping apparatus in operative condition.

The above and other objects may be attained by employing this invention which embodies among its features pumping liquid by admitting it into a closed chamber, vaporizing at a portion of the liquid so admitted, when the vapor pressure in the chamber attains a predetermined value discharging the content of the chamber and directing the discharge material along a predetermined course.

Other features include the automatic discharge of the chamber by the building of the vapor pressure up to or beyond a predetermined point.

Still other features include a pumping system having a chamber with an intake port and a discharge port, a liquid admitting check valve through which the liquid is admitted to the chamber through the intake port and movable in the chamber in axial alignment with the discharge port a pressure relief valve which includes a valve member and a movable sleeve having an axial discharge passage which is normally closed by the valve member, which sleeve and valve member are arranged to move in unison when the

2

pressure in the chamber exceeds a predetermined point, means to arrest the movement of the valve member while permitting the sleeve to move under the initial inertia imparted to it so as to open the discharge passage and permit the discharge of the content of the chamber into the discharge passage from whence it may be directed according to the desires of the user.

Still further features include electrical heating means by which the liquid within the chamber may be heated so as to increase its vapor pressure and cause its discharge through the discharge valve automatically.

In the drawings:

Figure 1 is a diagrammatic view of a well showing this improved pumping apparatus in place therein,

Figure 2 is a diagrammatic view showing the pumping apparatus as it would appear when employed in a pipe line,

Figure 3 is a transverse sectional view taken substantially on the line 3—3 of Figure 1 on a somewhat enlarged scale,

Figure 4 is an enlarged longitudinal sectional view through the pumping unit,

Figure 5 is an enlarged fragmentary sectional view through the lever end of the pumping unit,

Figure 6 is an enlarged detail sectional view through the foot valves,

Figure 7 is an enlarged fragmentary sectional view through the upper end of the pumping unit showing the discharge valve in open position, and

Figure 8 is a transverse sectional view taken on the line 8—8 of Figure 7.

Referring to the drawings in detail a well designated generally 15 is lined with the customary well casing 16 and leading upwardly from the bottom of the well to the surface is the usual pipe of conduit 17 through which the liquid from the well flows to the surface. Surrounding the conduit intermediate its upper and lower ends is the usual sealing plug 18 of conventional form which forms a seal between the conduit and the casing so as to confine any vapors below the seal all in the conventional manner.

Attached to the lower end of the conduit 17 in the conventional manner is my improved well pumping apparatus designated generally 19 which is provided at its lower end with the usual anchor 20 which comprises a perforated pipe of any suitable length which is normally embedded in the oil and gas bearing sands found at the bottom of the well. Threaded or otherwise attached to

3

the upper end of the anchor 20 is a fitting 21 carrying adjacent its lower end a valve seat 22 upon which a ball valve 23 is adapted to rest. A spring 24 bears on the ball valve 23 to hold it against the seat 22 and the upper end of this spring bears on a cage 25 held in the fitting 21 in any suitable manner so as to provide a check valve for admission of the liquid into the chamber to be more fully hereinafter described.

The upper end of the fitting 21 is provided with an internally screw threaded socket 26 into which the externally screw threaded tubular boss 27 formed at the lower end of a hollow cylindrical body 28 forming the heating chamber of the pump is received. The heating chamber is of any suitable length and contains a perforated axially extending tubular member 29 serving as a support for electrical resistance coils 30 which are contained within the heating chamber as will be readily understood upon reference to Figure 4. The upper end of the body 28 is provided with an internally screw threaded socket 31 into which an externally screw threaded boss 32 of a discharge valve unit designated generally 33 is adapted to be received. The interior of the boss 32 is internally screw threaded as at 34 to receive the externally screw threaded end 35 of the tubular member 29 in order to hold the parts in proper position.

The discharge valve 33 comprises a hollow cylindrical body 36 provided intermediate its ends with an internally screw threaded shoulder 37 by means of which a perforated stop or cage 38 is supported therein. This cage is provided with a longitudinal opening 39 arranged in axial alignment with the longitudinal axis of the body 36 and slidably mounted in the opening 39 is the valve stem 40 of a poppet valve designated generally 41. The lower end of the stem 40 is threaded to receive a stop nut 42 which is adapted to engage the bottom side of the cage 39 to limit the upward movement of the valve as will be more fully hereinafter described. Carried at the end of the valve stem 40 opposite that carrying the nut 42 is a valve head 43 provided with an upwardly tapered seat 44 upon which a sleeve 45 is seated as will be understood upon reference to Figure 4. This sleeve 45 is mounted for longitudinal sliding movement in a bore 46 which communicates with the interior of the body 36 and is normally urged against the tapered end 44 of the head 43 of the valve 41 by means of a compression coil spring 47 which bears on the end of the sleeve 45 opposite that which engages the seat 44, while the opposite end of the spring bears on a suitable stop member 48 carried by a tubular extension 49 formed at the end of the body opposite the boss 32 and which is connected to the discharge pipe 17. A cushioning spring 50 rests on the cage 39 so that when the valve 41 settles back on the cage 38 the shock thereof will be absorbed.

The heating coil 30 is connected by means of a cable 51 to any suitable source of power supply, which cable extends upwardly through a suitable packing gland 52 in the body 36 to the upper end of the well and thence to the source of power (not shown). It will be understood of course that the cable 51 contains the customary conductors for conveying electrical power from the power source to the heating coil all in the conventional manner.

Supported in any suitable manner as by internal screw threads 53 in spaced relation to the valve cage 38 is an externally screw threaded sleeve 54, on the upper end of which a ball check

4

valve 55 is adapted to rest. In actual practice this ball check valve is located about 10 to 12 inches below the lower end of the valve 41 when the latter is in the position shown in Figure 4 and cooperates therewith during the discharge of the device in preventing pressure created in the system above the discharge valve 33 from entering the heating chamber.

The operation of the device is as follows, assuming that the pumping unit 19 has been lowered into the bottom of a well and is connected to the discharge pipe 17 in the conventional manner it will be evident that the fluid in the well will flow into the chamber in the interior of the cylindrical body 28 through the check valve formed by the ball 23 and seat 22 so as to fill or partially fill the chamber. This flow of oil into the chamber is aided by the vapor pressure built up below the packing 18 within the well casing and once the chamber has been filled or partially filled the heating coils 30 will raise the temperature of the surrounding liquid tending to vaporize the latter with the result that the vapor pressure within the chamber will be increased to a point where acting against the head 43 of the valve 41 it will lift the valve 41 and sleeve 45 against the spring 47 with considerable force. Upon the driving upward of the valve 41 and the sleeve 45 the stop nut 42 will encounter the cage 38 so as to limit further upward movement of the valve 41; but due to the movement imparted to the sleeve 45 and its inertia it is obvious that it will unseat from the valve seat 44 as illustrated in Figure 7 thus allowing the contents of the heating chamber to discharge through the discharge passage or bore of the sleeve 45 and pass upwardly into the pipe 17. Due to the friction of the flowing materials against the sleeve 45 it will be held upwardly against the compression of the spring 47 for a sufficient period of time to permit the escape of the contents of the heating chamber and when the pressure has sufficiently subsided the sleeve will fall back upon the seat 44 of the valve 41 and return it to the position illustrated in Figure 5 ready for a repeat operation. By thus lowering the pressure in the heating chamber the surrounding oil again flows into the chamber through the valve connected to the anchor 20 and when a sufficient amount of oil has been received within the chamber and is heated to a point sufficient to raise the vapor pressure therein again to a predetermined point the cycle of operation will be repeated.

Obviously the device may be employed in a pipe line 57 between reservoirs 58 and as many such units may be interposed in the line as may be required to pump the oil from one to the other.

From the foregoing it is obvious that a simple automatically functioning pumping unit is provided and it is evident that as many such units as may be necessary may be introduced into a well as well as in a pipe line in order to maintain the well production at capacity.

While in the foregoing there has been shown and described the preferred embodiment of this invention it is to be understood that minor changes in the details of construction, combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as claimed.

What I claim is:

1. In a pumping system a chamber having an intake port and a discharge port; a liquid admitting check valve associated with the intake port; movable in the chamber in axial align-

5

ment with the discharge port a valve, and movable axially through the discharge port and seated on the valve a sleeve having an axial discharge passage which is normally closed by the valve; means to increase the vapor pressure of the liquid in the chamber to drive the valve and sleeve in unison toward the outlet end of the discharge port; and means to arrest such movement of the valve and allow the sleeve to move to unseated position on the valve whereby the discharge passage through the sleeve will be cleared for the discharge of the contents of the chamber.

2. In a pumping system a chamber having an intake port and a discharge port; a liquid admitting check valve associated with the intake port; movable in the chamber in axial alignment with the discharge port a valve, and movable axially through the discharge port and seated on the valve a sleeve having an axial discharge passage which is normally closed by the valve; means yieldingly to hold the sleeve seated on the valve; means to increase the vapor pressure of the liquid in the chamber to drive the valve and sleeve in unison toward the outlet end of the discharge port; and means to arrest such movement of the valve and allow the sleeve to move to unseated position on the valve whereby the passage through the sleeve will be cleared for the discharge of the contents of the chamber.

3. In a pumping system a chamber having an

6

intake port and a discharge port; a liquid admitting check valve associated with the intake port; movable in the chamber in axial alignment with the discharge port a valve, and movable axially through the discharge port and seated on the valve a sleeve having an axial discharge passage which is normally closed by the valve; means yieldingly to hold the sleeve seated on the valve; heating means in the chamber for elevating the temperature of the liquid therein and thereby increasing the vapor pressure thereof to drive the valve and sleeve in unison toward the outlet end of the discharge port; and means to arrest such movement of the valve and allow the sleeve to move to unseated position on the valve whereby the passage through the sleeve will be cleared for the discharge of the contents of the chamber.

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