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O. S. PROCTOR

1,973,541

DEEP OIL WELL PUMP

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Fig. 1

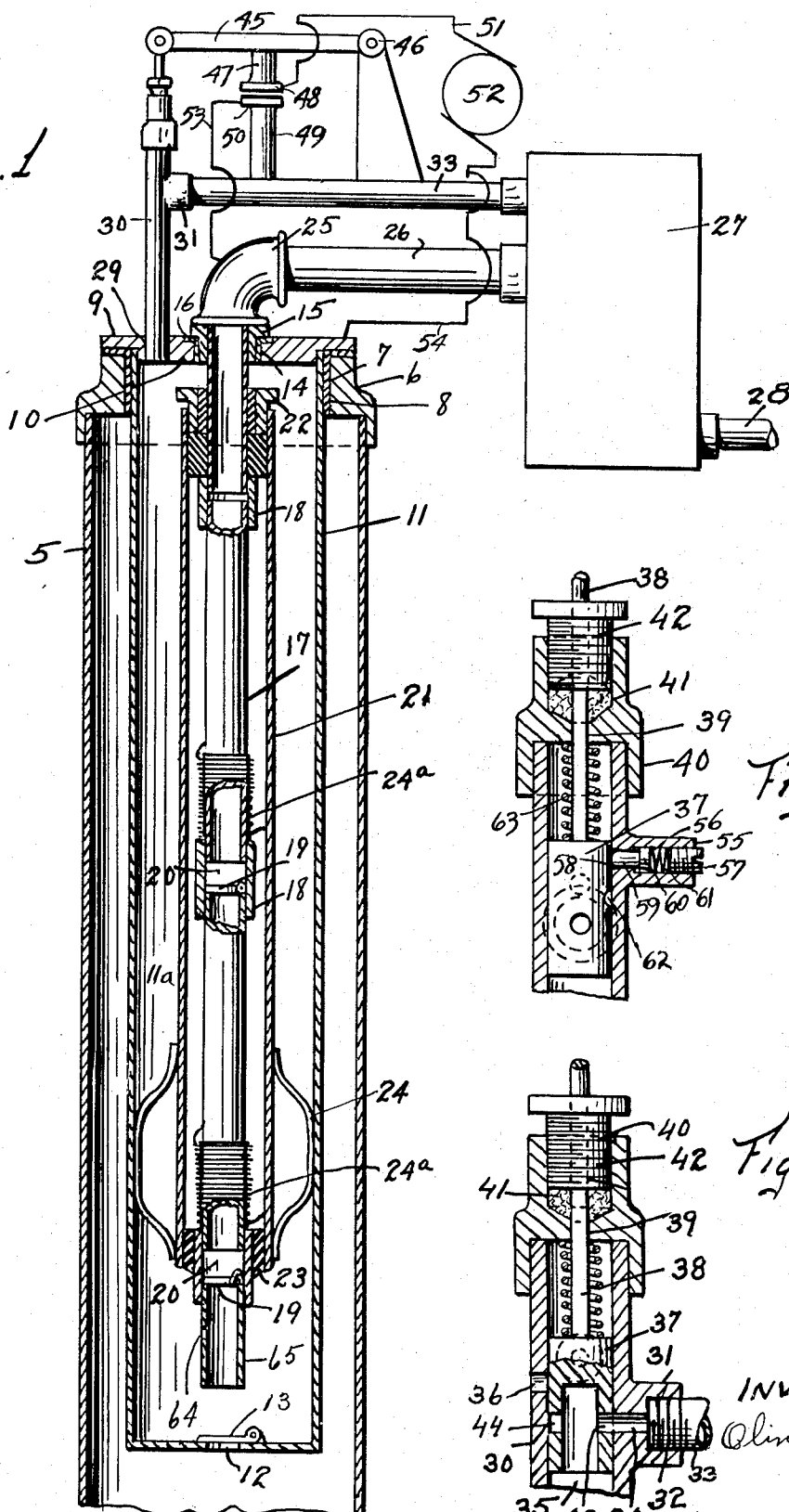


Fig. 2.

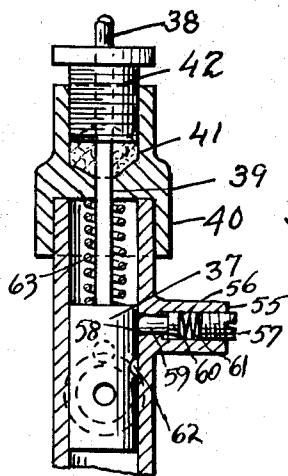
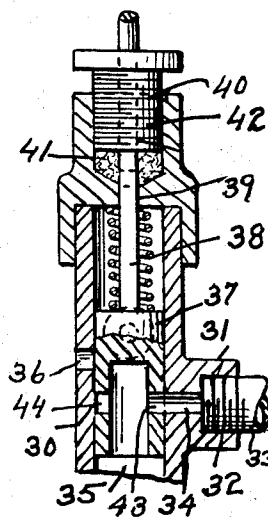


Fig. 3.



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DEEP OIL WELL PUMP

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9 Claims. (Cl. 103—1)

My invention relates primarily to improvements in pumps or fluid handling devices, and more particularly to those devices adapted to deep oil well work, and it has for its prime object the provision of economical means for raising fluid from great depths.

Another object is to provide means of the above character for increasing the velocity of the flow of fluid by converting a portion of the liquid to gas and thus increasing the volume and reducing the specific gravity.

Another object is to provide positive means to control or induce the flow of liquid into the pump for conversion into gas by heat.

Another object is to provide means of supplying heat intermittently, whereby the liquid is caused to flow into the pump, when the heat is cut off, by the cooling and contracting of gas in the compression chamber, and caused to flow out of the compression chamber and to the surface by the expansion and generation of gas, when the heat is on, by suitably arranged check valves, electric heating apparatus and current control.

Another object is to provide in mechanism of the above character means whereby the excess pressure from the well may be exhausted to atmosphere or may be used to assist in inducing the flow of fluid into the pump to be heated.

In the operation of mechanical pumps at great depth, many difficulties are encountered, such as maintaining tight joints around the moving parts. The transmission of power through a pump rod is cumbersome, expensive, and impractical in crooked holes. The passing of oil and water through small openings, such as the pump valves, under great pressure or velocity is difficult and very inefficient.

It is the purpose of this invention to overcome these difficulties by employing a pump or compression chamber, of suitable capacity, to which heat, preferably electric, is applied intermittently so as to reduce the specific gravity and hydraulic pressure and at the same time increase the velocity and flow. On reaching the surface, the fluid is trapped out and the gases therein condensed or conducted down into the well to be used in assisting the flow of the liquid upwardly or conduct it to atmosphere if desired or found necessary.

Other objects and advantages will appear hereinafter, and while I have shown and will describe the preferred form of my invention, it will be understood that I do not limit myself to such preferred form, but that various changes

and adaptations may be made therein without departing from the spirit of my invention.

In the drawing accompanying and forming a part hereof:

Fig. 1 is a side elevation of my device installed in a well.

Figs. 2 and 3 are enlarged fragmentary details of portions of my device.

Referring to the drawing, 5 indicates the usual well casing in the upper end of which I provide an annular ring 6, provided with a concentric opening 7 therein. Supported on the upper end of the ring 6, but insulated therefrom by insulation 8, is a cap 9, provided with a downwardly depending central portion 10, and secured to this central portion to depend downwardly therefrom is a tubing 11, the lower end of which is closed, except at the center where it is provided with an inlet opening 12. Normally of cap 9 is an opening 14, and mounted in this opening is a sleeve 15, suitable insulation 16 being provided by the said cap and sleeve to prevent electrical contact therebetween.

Mounted in the sleeve 15 is the flow pipe 17 which depends downwardly therefrom. The flow pipe 17 is made up of a plurality of sections, the abutting ends of which are connected by suitable couplings 18, and provided within these couplings in the upper end of each of the sections are upwardly opening check valves 19. Each of these sections with its check valve acts as a station or stage 20 for the fluid during its upward flow, as hereafter explained.

Suspended within the tubing 11, to surround the flow pipe 17, is a tube 21, the upper end of which is closed by a fitting 22, and the lower end of which is closed by a spacer 23.

Provided on the outer periphery of tube 21, at the lower end thereof, are a plurality of contact fingers 24, the object of which is to provide electrical contact between the housing tube 21 and tube 11.

Wound around each of the sections of the flow pipe 17 at the lower end thereof are heating coils 24a of suitable resistance wire or the like.

Connected to the upper end of the flow pipe 17, resting upon and supported by the sleeve 15, is an elbow 25, the other or outlet end of which is connected by an insulation pipe 26, to a tank 27. Tank 27 is connected by a pipe 28 to a suitable storage means (not shown).

Provided in the cap 9, near the inner face of the tube 11, is an aperture 29, and mounted at its lower end in this aperture is a cylindrical housing 30. As best shown in Figs. 2 and 3, this cy-

lindrical housing 30 is provided near its upper end with an outwardly extending projection 31 in which is provided an interiorly screw threaded recess 32 adapted for connection to the outer end of a pipe 33, the other end of which pipe is connected to the tank 27, near the upper end thereof.

The inner end of the recess 32 is connected by a port 34 to the piston chamber 35 of the housing 30. Extending through the wall of housing 30, in the opposite wall thereof, and above the port 34, is an outlet 36 which connects the interior of housing 30 to atmosphere as hereafter explained. Slidably mounted in the chamber 35 is a piston 37 provided with an upwardly projecting stem 38 which stem projects through an aperture 39 in a closure cap 40, positioned on the upper end of housing 30, suitable packing 41 and packing gland 42 being provided to provide an air-tight joint around stem 38.

The piston 37 is substantially hollow and is open at the bottom, and extending through the side wall of said piston, in opposite relation, are openings 43 and 44, opening 43 being adapted to register with the port 34, and opening 44 being adapted to register with passage 36 during the operation of my device, as will hereafter be more fully explained.

Pivotally connected to the upper end of the stem 38 is one end of a link 45. The other end of the link 45 is pivotally mounted in a bearing 46 extending upwardly from pipe 33. Depending downwardly from link 45, about centrally of its length, is a boss 47, and mounted upon the lower face of this boss, but insulated therefrom, is a contact plate 48. Extending upwardly from pipe 33, in vertical alignment with the boss 47 is a boss 49, upon the upper end of which is mounted, but insulated therefrom, a contact plate 50, these plates 48 and 50 being so positioned and spaced as to be brought into contact or separated during the vertical movement of the link 45. The contact plate 48 is connected by wire 51 to one side of a generator or other source of electrical energy 52. Contact plate 50 is connected by a wire 53 to an elbow 25. The other side of generator 52 is connected by a wire 54 to the cap 9.

Extending outwardly from housing 30, near the upper end thereof, is a boss 55, and in this boss 55 is provided a recess 56, the outer end of which is interiorly screw threaded, and in this screw threaded end is mounted an adjusting screw 57. Extending from the inner end of the recess 56, to the interior of housing 30 is an aperture 58 and in this aperture is slidably mounted a plunger 59. Plunger 59 is provided with a head 60, which head is slidably positioned within the inner end of the recess 56. Mounted within recess 56, between head 60 and the inner end of screw 57, is a coil spring 61 which acts to normally project plunger 59 inwardly.

A recess 62 is provided in the side wall of piston 37 and is adapted for the reception of the projecting end of the plunger 59, whereby the downward movement of piston 37 will be retarded. A coil spring 63 is mounted within chamber 35, between the upper end of piston 37 and the closure cap 40.

In the operation of my device, the piston will be initially in the position shown in Figs. 2 and 3, permitting the link 45 to descend and make contact between contact plates 48 and 50. The current will then flow from the generator through wire 51 and the contacts 48 and 50, wire 53 into the elbow 25, thence down the flow pipe 17 energizing the heating coils 24a, thence across the contact fingers 24 and into the tubing 11, thence through cap 9, wire 54 to the ground side of the generator 52.

When the current is on, all of the heating elements being mounted in parallel will be heated simultaneously and part of the liquid at each station and in the compression chamber will be heated and converted to gas, thus increasing the pressure at all stations, and due to the check valves 19, this expansion must take place upwardly, thereby causing an upward movement of the fluid.

The stations next below the surface will blow through upwardly first, due to the fact that there is no resistance thereabove, then the next lower ones will blow in successively until the gas in the compression chamber blows through into the flow pipe carrying liquid with it. As the pressure increases, due to the heating, part of the gas will flow upwardly through the housing 30 and force piston 37 upwardly breaking the connection between apertures 43 and passage 34, and making connection between aperture 44 and aperture 36, permitting the excess pressure to escape to atmosphere and at the same time elevating link 45, thus breaking contact between plates 48 and 50, when the flow of current to the heating coils is cut off.

As the piston 37 is elevated, the plunger 59 will be projected into the recess 62, in the side of piston 37 and hold said piston in its elevated position until the pressure in the compression chamber is sufficiently lowered to permit the spring 63 to overcome the combined resistance of said pressure and the spring 56 when said spring will force piston 37 downwardly, forcing the plunger 59 out of the recess 62, until aperture 43 again registers with passage 34.

When the flow ceases, there is still some liquid and gas in each station and the cooling and contracting of this gas draws gas up from each succeeding lower station, excepting at the bottom station where liquid flows in instead.

As the piston 37 returns to its initial lower or starting point, contact is made between plates 48 and 50 and the heating coils are again energized, thus repeating the performance just explained and at the same time the gas in tank 27 which has previously been drawn from the well, will pass through pipe 33, aperture 34 and opening 43 into the housing 30 and down into the compression-expansion chamber 11a, thus assisting in creating a pressure upon the fluid in said compression-expansion chamber 11a, assisting in forcing the same into the flow pipe.

Obviously adjustment of the springs 56 and 63 provides means to control operation under a wide range of conditions. The opening 64 in pipe 65 provides for mixing gas with liquid, so that when once started, the operation may be continuous, as a blower.

Having described my invention, what I claim is:

1. In a deep well oil pump comprising a flow pipe projecting down into the well casing and formed of a series of separable sections connected together by coupling sleeves, an upwardly opening check valve at the inner section of each of said sections, a connection from the upper end of said flow pipe to a storage tank, an impervious insulating tube surrounding said flow pipe, an expansion chamber surrounding said insulation tube, an upwardly opening check valve in the bottom wall of said expansion chamber.

- ber, a closure for the upper end of said expansion tube, a connection from the upper end of said tank to the upper end of said expansion chamber, a piston in said last connection adapted to connect the expansion chamber to atmosphere, a pair of contact plates, means operable by said piston for moving said contact towards or away from each other, an electric circuit, a connection from one side of said electric circuit to one of said contact plates, a connection from the other of said contact plates to the upper end of said flow pipe, a connection from said closure to the other side of said electric circuit, heating coils surrounding a portion of said flow pipe at the lower ends of the sections thereof, and connections from said heating coils to said insulating tube to said expansion chamber walls.
2. A deep well pump comprising in combination a well casing, an annulus surrounding the upper end of said casing, a closure supported upon the upper end of said annulus, but insulated therefrom, an expansion chamber mounted within said well casing, concentric therewith, but spaced therefrom, a flow pipe projecting down into said expansion chamber, concentric therewith, but spaced therefrom, and terminating at a distance from the bottom wall thereof and formed of a plurality of sections connected together by coupling sleeves, an upwardly opening check valve at the upper end of each of said sections, an insulated tube surrounding said flow pipe, insulated therefrom, but concentric therewith, a heating coil surrounding each of said flow pipe sections at the lower ends thereof, insulated therefrom, a connection from one end of each of said coils to said flow pipe, a connection from the other end of each of said coils to said insulating tube, connections from said insulating tube to the wall of said expansion chamber, a connection from said flow pipe to a storage receptacle, a connection from the upper end of said expansion chamber to the upper end of said storage tank, a piston valve mounted in said last connection adapted to control the passage of fluid therethrough adapted to connect the upper end of said expansion chamber to said tank or to atmosphere, a source of electrical energy, a connection from one side of said source of energy to said flow pipe, a switch controlling said last connection, means operable by said piston for opening and closing said last connection and a connection from said closure to the other side of said source of energy.
3. In a deep well pump including a casing, a flow pipe projecting down into the well casing concentric therewith and arranged to form a series of superposed stations, means to confine fluid flowing through said flow pipe to a path of upward movement only, a connection from the upper end of said flow pipe to a storage tank, insulated therefrom, an expansion chamber surrounding said flow pipe, an upwardly opening check valve in the bottom wall of said expansion chamber, a connection from the upper end of said tank to the upper end of said expansion chamber, a source of electric energy, a plurality of heating coils coiled around said flow pipe, there being one coil at each of said stations, a connection from said source of energy to one side of said coils, a connection from the other side of said coils to the other side of said source of energy, and means operated by fluid pressure in said expansion chamber for intermittently opening and closing said electric circuit, substantially as described.
4. In a deep well oil pump comprising a flow pipe projecting down into the well casing and formed of a series of separable sections connected together by coupling sleeves at predetermined locations, valves at the inner section of said sections, a connection from the upper end of said flow pipe to a storage tank, an impervious insulating tube surrounding said flow pipe, an expansion chamber surrounding said insulation tube, an upwardly opening check valve in the bottom wall of said expansion chamber, a closure for the upper end of said expansion tube, a connection from the upper end of said tank to the upper end of said expansion chamber, a piston in said last connection adapted to connect the expansion chamber to atmosphere, a pair of contact plates, means operable by said piston for moving said contact towards or away from each other, an electric circuit, a connection from one side of said electric circuit to one of said contact plates, a connection from the other of said contact plates to the upper end of said flow pipe, a connection from said closure to the other side of said electric circuit, heating coils surrounding a portion of said flow pipe at the lower ends of the sections thereof, and connections from said heating coils to said insulating tube to said expansion chamber walls.
5. A deep well pump comprising in combination a well casing, an annulus surrounding the upper end of said casing, a closure supported upon the upper end of said annulus, but insulated therefrom, an expansion chamber mounted within said well casing, concentric therewith, but spaced therefrom, a flow pipe projecting down into said expansion chamber, concentric therewith, but spaced therefrom, and terminating at a distance from the bottom wall thereof and formed of a plurality of sections connected together by coupling sleeves, and upwardly opening check valves at the upper end of each of said sections, a tube housing surrounding said flow pipe, insulated therefrom, a heating coil surrounding each of said flow pipe sections at the lower ends thereof, insulated therefrom, a connection from one end of each of said coils to said flow pipe, a connection from the other end of each of said coils to said tube housing, connections from said tube housing to the wall of said expansion chamber, a connection from said flow pipe to a storage receptacle, a connection from the upper end of said expansion chamber to the upper end of said storage tank, a piston valve mounted in said last connection adapted to control the passage of fluid therethrough adapted to connect the upper end of said expansion chamber to said tank or to atmosphere, a source of electrical energy, a connection from one side of said source of energy to said flow pipe, a switch controlling said last connection, means operable by said piston for opening and closing said last connection and a connection from said closure to the other side of said source of energy.
6. A deep well pump comprising a flow pipe projecting down into the well casing and forming a series of superposed booster stations, the valves in said stations limiting the flow of fluid therethrough to an upward direction only, an insulated connection from the upper end of said flow pipe to a storage tank, an impervious tube surrounding said flow pipe, insulated therefrom, an expansion chamber surrounding said insulating tube, an upwardly opening check valve in the bottom wall of said expansion chamber, a closure for the upper end of said expansion chamber, a connection from the upper end of said tank to the upper end

- of said expansion chamber, heating coils surrounding said flow pipe at the booster stations therein, connections from one side of said heating coils to ground, a connection from the other side of said heating coils to a source of electric energy, a circuit breaker in last connection and means operable by the fluid pressure in said expansion chamber for alternately opening and closing said circuit breakers.
7. A deep well pump comprising in combination a well casing, an annulus surrounding the upper end of said casing, a closure supported on the upper end of said annulus, but insulated therefrom, a flow pipe projecting into said well casing, an insulating tube surrounding said flow pipe, an expansion chamber surrounding said last tube and said flow pipe and insulated therefrom, a plurality of stations formed in said flow pipe, means in said stations to limit the flow of fluid therethrough to an upward direction, heating coils wound around said flow pipe at each of said booster stations, a source of electric energy, connections from one side of said source of energy to one side of said coils, a circuit breaker in said connection, a connection from the other side of said coils to ground and means operable by the pressure in said expansion chamber for alternately opening and closing said circuit breaker, substantially as described.
8. In a well pump comprising a well casing, a flow pipe mounted in said casing, an electrical conductor attached to said flow pipe so that electrical current may be caused to flow through said flow pipe, electrical resistance winding connected to said flow pipe wound around said flow pipe with insulation between the winding and the flow pipe, a ground connection to the outer covering whereby the circuit is completed, a check valve in said flow pipe permitting fluid flow upward and a suitable source of electrical current.
9. In a well pump comprising a well casing, a flow pipe mounted in said well casing, an electrical conductor attached to said flow pipe so that electrical current may be caused to flow through said flow pipe, electrical resistance winding connected to said flow pipe wound around said flow pipe with insulation between the winding and the flow pipe, a ground connection to the outer covering whereby the circuit is completed, a check valve in said flow pipe permitting fluid flow upward, a compression chamber surrounding said flow pipe provided with inlet check valve and a suitable source of electrical current.
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