Dec. 15, 1931. N. H. RICKER 1,836,875

FLUID PRESSURE OPERATED SWAB

Filed May 9, 1930

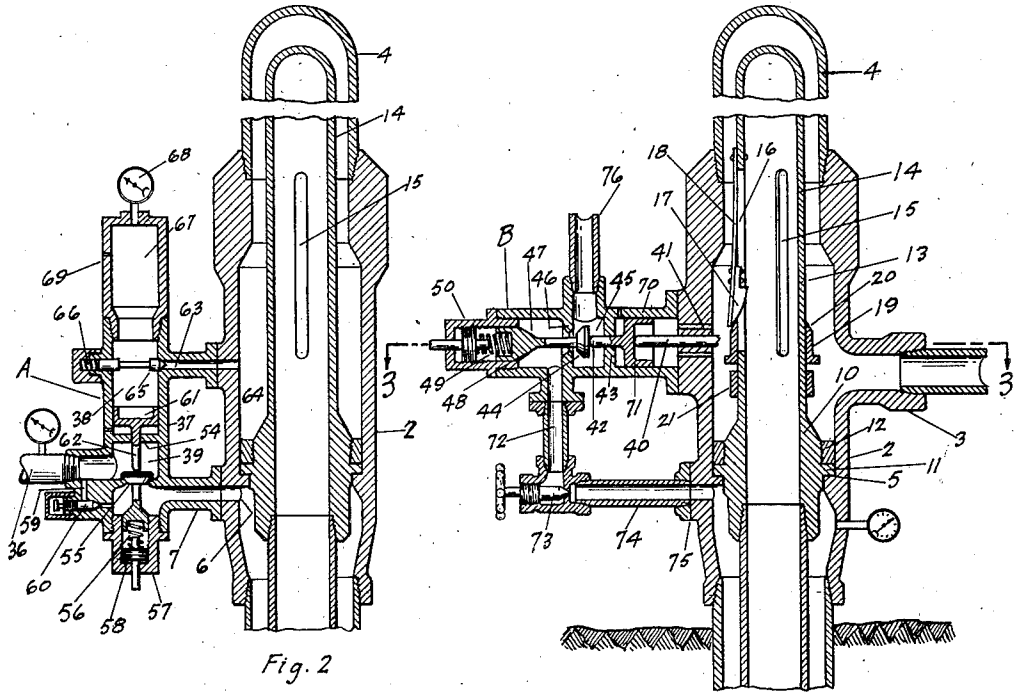


Fig. 2

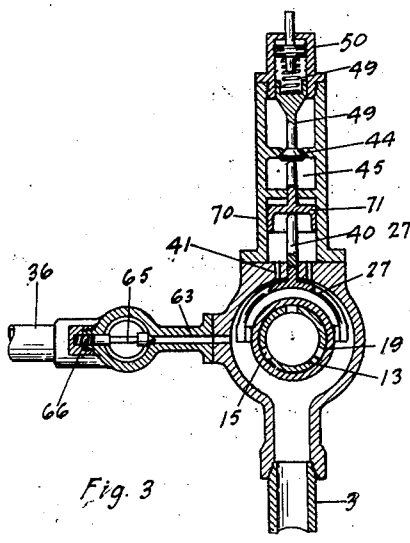


Fig. 3

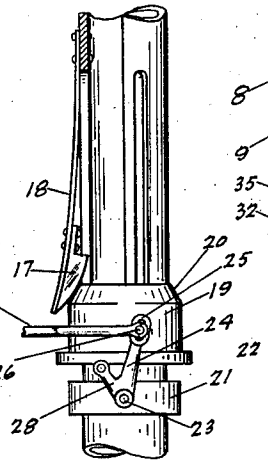


Fig. 4

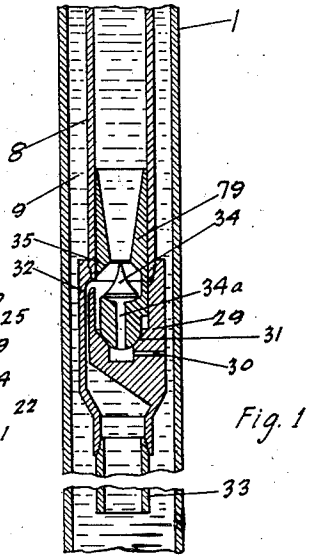


Fig. 1

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Patented Dec. 15, 1931 1,836,875

UNITED STATES PATENT OFFICE

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FLUID PRESSURE OPERATED SWAB

Application filed May 9, 1930. Serial No. 450,971.

My invention relates to the lifting of liquid from deep wells by means of the pressure of gaseous fluid. It pertains particularly to devices of this character in which a swab is employed.

It is an object of the invention to provide an apparatus whereby the liquid may be raised from the well by a single eduction tube and a well casing outside thereof, thus doing away with the use of a separate pipe to conduct the air to the lower end of the eduction tube.

I have as a further object to provide attachments for the casing head, whereby the plunger may be automatically caught at the upper end of its stroke and again automatically released through the accumulation of fluid pressure in the well.

I desire that the inlet of gaseous fluid pressure from the main line may be automatically controlled to enter the well and to raise the plunger when the desired head of liquid has accumulated above the plunger.

In the drawings herewith Fig. 1 is a central vertical section through an apparatus embodying my invention.

Fig. 2 is a similar section through the upper end of said apparatus, taken on a plane at right angles to that of Fig. 1.

Fig. 3 is a transverse section taken on the plane 3—3 of Fig. 2.

Fig. 4 is a broken side elevation of the upper end of the eduction tube.

The device here disclosed is an improvement upon the apparatus disclosed in the application for patent of H. W. Fletcher, Serial No. 326,234, filed December 15, 1928, and is a modification of the invention disclosed in my copending application No. 448,832 filed May 1, 1930. The device is similar but with the same modified to include means to automatically hold the plunger while the liquid is rising and to provide means for eliminating the use of two tubes within the casing.

The casing is shown at 1. It has a casing head 2 at its upper end. Said casing head has a lateral outlet 3 for liquid from the well, and its upper end is closed by an elongated cap 4. The interior of the casing head has an inwardly extending flange providing a shoulder 5 to support the eduction tube.

The gaseous fluid enters the casing head through a lateral inlet 6 connecting with a pipe 7 leading to an automatic pressure fluid regulator A.

The eduction tube 8 is of smaller diameter than the casing below the inlet 6 to provide an inlet passage 9 for the pressure fluid. Within the casing head, the eduction tube connects with a head 10 upon which is a flange 11 to engage upon the shoulder 5 to support the tube in the casing. Above the flange 11 is a sleeve 12 screwed upon the head 10 and adapted to form a seal within the casing head.

Above the head 10, the eduction tube extends upwardly into the outer cap 4, the upper end of the tube being closed as shown at 13. The sides of the extension are slotted at 15 to allow for the pressure fluid and the liquid from the well. A slot 16 is also formed to receive a latching dog 17 suspended upon a leaf spring 18 which holds said dog normally in position to engage the swab 79.

Below the dog 17 is a slidable collar 19, the upper end of which is beveled at 20, see Fig. 4, to engage beneath the dog 17 and move it out of swab engaging position. Below the collar 19 is a ring 21 secured to the tube extension 14 by welding or the like, and serving as a support for a bell crank lever 22. Said lever is pivoted at 23 to the ring and has an upwardly extending lever arm 24, the end of which is slotted at 25 to receive the pin 26 upon an operating yoke 27. There is a short arm 28 on the lever, which engages beneath the collar 19 to move said collar when the well is operated.

The lower end of the tube 8 is connected with the inlet coupling 29 which forms a seat for the swab and has an inlet port 30 below the swab seat 31 for the gaseous pressure fluid, and an inlet port 32 for the liquid past the swab to the space above. At the lower end of the coupling is a nipple 33 projecting into the liquid.

The swab 79 fits within the eduction tube. Its lower end is rounded to fit the seat 31. A valve 34 has a stem 34—*a* slidable in the lower

end of the swab, and the said valve is normally retained out of its seat by gravity and by fluid pressure below the seat 35. Below the seat are lateral openings in the swab through which liquid or other fluid may pass into and through the swab.

My pressure fluid may be air, gas, or similar fluid forced under pressure through pipe 36 to the pipe 7 by way of the pressure fluid regulator A.

Said regulator includes a housing 37, one end of which is secured to the head 2 by the pipe 7. A cylinder 38 in the housing is separated from the valve chamber 39 by a partition 54.

The valve chamber 39 has a seat at its lower side to receive the valve 55, which normally closes the passage from the pressure fluid pipe 36 to the inlet pipe 7. The valve 55 is normally under pressure of a spring 56 pressing against the stem of the valve from below. Said spring is housed within a chamber 57 and adjusted as to pressure by a nut 58 therein.

There is a by-pass 59 from the chamber 29 to the pipe 7, said by-pass being controlled as to size by a needle valve 60.

The cylinder 38 houses a piston 61, the stem 62 on which projects through the partition 54 to engage the valve 55. There is a port 63 in the side wall of the cylinder connecting with a passage 64 which leads to the interior of the casing head 2. The port 63 is normally closed by a needle valve 65, said valve being held resiliently in port closing position by a spring 66 bearing against the stem of said valve.

Above the valve 65, the cylinder is connected with a compression chamber 67 upon which is mounted a pressure gage 68. A leak from said chamber is provided at 69. The valve 55 will be closed by the piston 61 under pressure in the casing head 2. Pressure fluid from the line 36 will leak past the valve through the by-pass 59 until the pressure in the well plus the pressure of spring 56 opens the valve to allow full line pressure to enter the well.

Secured to the casing head in a position at approximately right angles to the pressure regulator is the swab control device "B". Said control device includes a cylinder 70 secured in a radial position upon the casing head. Said cylinder has a piston 71 therein adapted to bear against the rod 40 which projects through the wall of the casing head where it is connected with the yoke 27 for operation of the sleeve 19. A plurality of openings 41 about the rod 40 allow the passage of fluid from the casing head to said cylinder.

A stem 42 on the piston is slidable through a partition 43 at the head of the cylinder and may engage a valve 44 at one side of a chamber 45. Said valve closes an opening in a wall 46 separating the chamber 45 from an adjacent chamber 47 with which the pipe 72 is connected. The valve 44 has a stem connected with a head 48 recessed to receive a spring 49 adjustably mounted in a cap 50 on the outer end of chamber 47. The pipe 72 connects by way of a manually operated valve 73 with a pipe 74 leading to an inlet opening 75 in the casing head 2. The pressure fluid enters chamber 45 from the pipe 76 which may be connected with the same source of pressure fluid as is pipe 36, it only being necessary that the pressure of fluid in this pipe be comparatively uniform.

In the operation of the device; beginning with the parts positioned as shown in Fig. 1, the plunger has just reached its seat and is ready for the valve to be closed to start upwardly. The pressure fluid entering below the swab closes the valve, and the plunger with its load of liquid is forced upwardly to the surface. The liquid discharges through the outlets 15 and 3, and the plunger moves past the openings, and the back pressure of the fluid entrapped in the cap 13 forces the valve open. The plunger, however, is engaged by the dog 17 and is retained there temporarily.

Some of the fluid under pressure in the upper end of the eduction tube passes through openings 41 to the cylinder and moves the piston 39 to close the valve 44. This shuts off the full line pressure from the pipe 76 to the pipe 72. The air behind the plunger exhausts through the outlet at the upper end of the eduction tube, and the liquid from the well immediately moves up into the eduction tube above the seat 31.

The fluid pressure in the casing head, as the load of liquid is discharged, forces fluid through the opening 64 and the pipe 63 past the valve 65 to the cylinder 38, thus forcing the piston 61 downwardly. This forces the valve 55 to closed position, shutting off the full line pressure from the pipe 36 to the well. This allows the liquid to enter freely, filling the eduction tube to the desired level. As the liquid is thus flowing into the eduction tube, the air is entering slowly through the by-pass 59 to the well and bubbling upwardly through the liquid. It enters through the inlet 30 and past the valve stem 34—*a* and valve 34 and thus to the eduction tube. As the head of liquid in the eduction tube increases, it exerts back pressure on the air or gaseous fluid employed, thus gradually building up the pressure in the casing until this pressure plus the force of the spring 56 unseats the valve 55 and allows full line pressure to enter the well.

The pressure fluid forces the valve 34 in the swab to closed position, and the swab and its load is then moved upwardly on the next stroke of the plunger. It is to be understood that as the fluid pressure builds up in the well, the valve 44 in the swab control device will be operated for movement to open position

before the valve 55 in the pressure regulator is opened. This is due to the greater force of the spring 49 behind the valve 44. The pressure in the well will enter the chamber 47 past valve 73 to act with the pressure of spring 49 to move the valve 44 open and to thereby move the piston 71 and rod 40, thus unlatching the swab and allowing it to drop. The liquid will have risen by this time well above the seat 31, so that said liquid will cushion the fall of the plunger. When the valve 44 is opened, the line pressure cannot enter the well suddenly, due to the choking action of the valve 73, which allows the pressure fluid to pass but slowly.

The operation of the swab releasing mechanism must preferably be timed to release the swab plunger so that the swab may reach its seat with the load of liquid above it before the pressure fluid regulator is operated to admit the full force of the line pressure to the well. This is done by the comparative areas of the valves upon which the pressure fluid may act, and mainly by the comparative forces of the springs 49 and 56.

The advantage of my device lies in the fact that the swab is controlled automatically in its travel without the use of a special pressure fluid inlet pipe. The swab is retained from falling until the liquid has risen above the swab seat 31, thus assuring that said swab will not fall to a dry seat, thereby avoiding the shock, which would necessarily result if no liquid had accumulated above the seat.

What I claim as new is:

1. A well casing, a casing head thereon, an eduction tube in said casing having discharge openings to said casing head, a swab plunger movable in said tube from one end to the other thereof, means to control the entrance of fluid pressure to the lower end of said tube, means to latch said swab to said tube at the upper end of said tube, and means to release said latch before said control means is operated.

2. In combination, a well casing, a single eduction tube therein, a pressure fluid conducting pipe connected with said casing to introduce pressure fluid to the lower end of said tube, a swab in said tube, a seat therefor adjacent the lower end of said tube, a latch to engage said swab adjacent the upper end of said tube, means actuated by fluid pressure in said casing to release said latch, and a regulator in said pressure fluid conducting pipe and separate from said means to admit the full pressure therefrom to said casing responsive to a predetermined pressure in said casing.

3. In combination, a well casing, a single eduction tube therein, a pressure fluid conducting pipe connected with said casing to introduce pressure fluid to the lower end of said tube, a swab in said tube, a seat therefor adjacent the lower end of said tube, a latch to engage said swab adjacent the upper end of said tube, means actuated by fluid pressure in said casing to release said latch, and a regulator in said pressure fluid conducting pipe to admit the full pressure therefrom to said casing responsive to a predetermined pressure in said casing, said swab-releasing means being arranged to operate before said regulator is operated to admit full line pressure to the casing.

4. In combination, a well casing, a single eduction tube therein, a pressure fluid conducting pipe connected with said casing to introduce pressure fluid to the lower end of said tube, a swab in said tube, a seat therefor adjacent the lower end of said tube, means to engage and hold said swab at the upper end of said tube, means to release said swab, and means to thereafter admit full pressure of fluid from said pipe to said tube to raise said swab.

5. In combination, a well casing, a single eduction tube therein, a pressure fluid conducting pipe connected with said casing to introduce pressure fluid to the lower end of said tube, a swab in said tube, a seat therefor adjacent the lower end of said tube, means to engage and hold said swab at the upper end of said tube, means to release said swab, and means to thereafter admit full pressure of fluid from said pipe to said tube to raise said swab, said releasing means and said fluid admitting means each being responsive to a predetermined fluid pressure in said casing.

6. In combination, a well casing, a casing head thereon, a single eduction tube suspended in said casing head, a swab in said eduction tube, a stop seat for said swab adjacent the lower end of said tube, means to latch said swab at the upper end of said tube, means to deliver pressure fluid below said swab, means to release said latch, and means operable after release of said latch to allow an increased flow of pressure fluid to raise said plunger.

7. In combination, a well casing, a casing head thereon, a single eduction tube suspended in said casing head, a swab in said eduction tube, a stop seat for said swab adjacent the lower end of said tube, means responsive to fluid pressure in said casing to latch said swab at the upper end of said tube, means to deliver pressure fluid below said swab, means to release said latch, and means operable after release of said latch to allow an increased flow of pressure fluid to raise said plunger.

8. In combination, a well casing, a casing head thereon, a single eduction tube suspended in said casing head, a swab in said eduction tube, a stop seat for said swab adjacent the lower end of said tube, means to engage and hold said swab at the upper end of said tube, said means being releasable in

response to fluid pressure in said casing, and separate means to control the entrance of fluid pressure to the well, operating to raise said swab when a full load of liquid rises above said swab.

In testimony whereof, I hereunto affix my signature, this the 30th day of April, A. D., 1930.

NORMAN H. RICKER.