

Sept. 30, 1930.

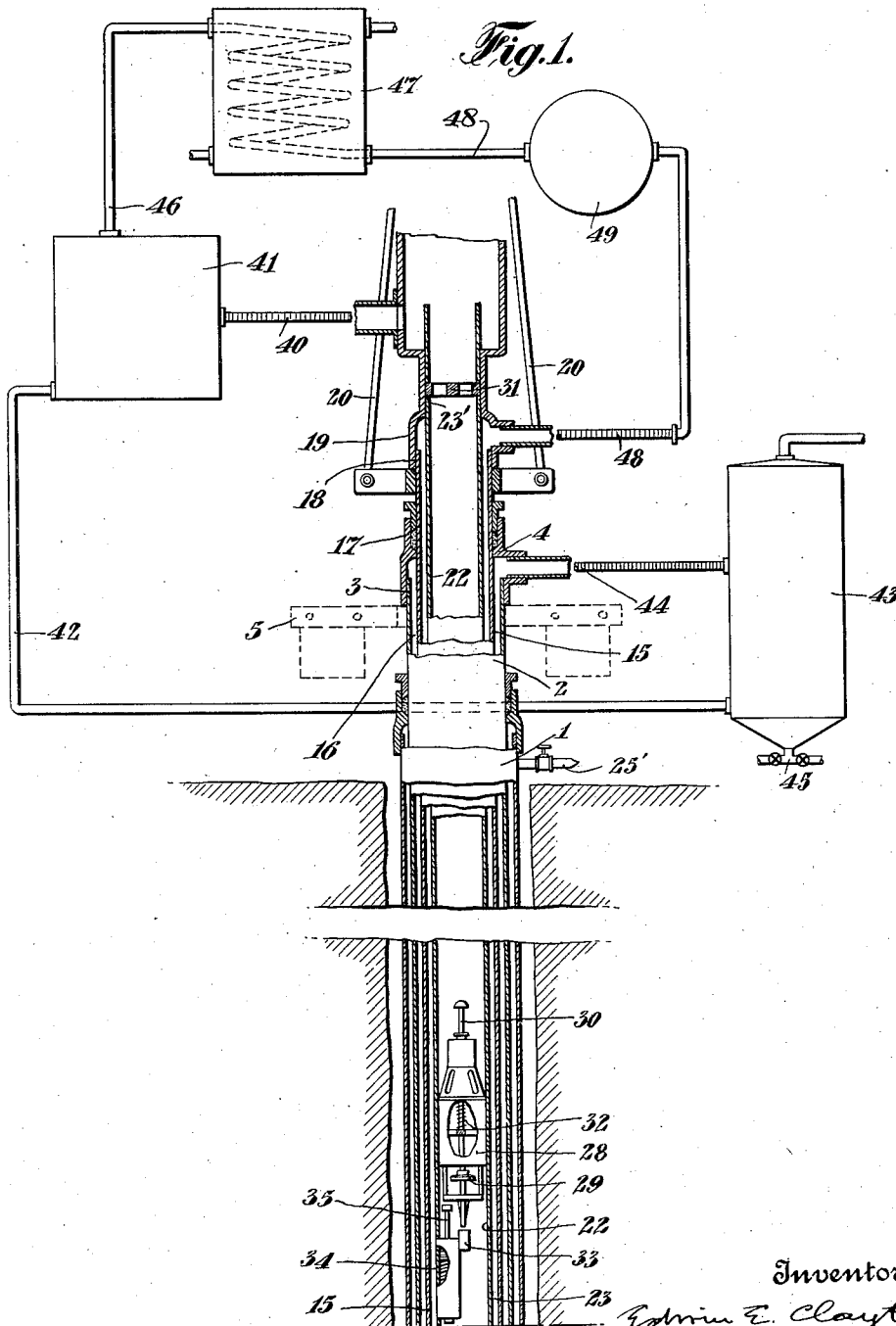
E. E. CLAYTOR

1,776,889

MINING APPARATUS

Filed April 18, 1925

3 Sheets-Sheet 1



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Fig. 1A.

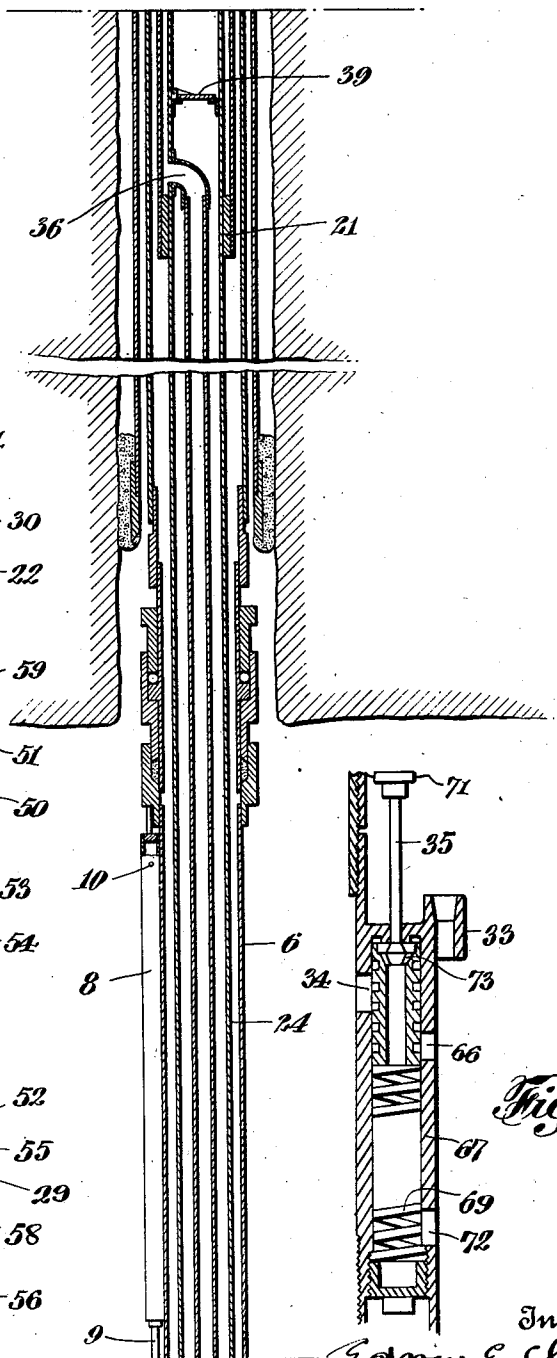


Fig. 2.

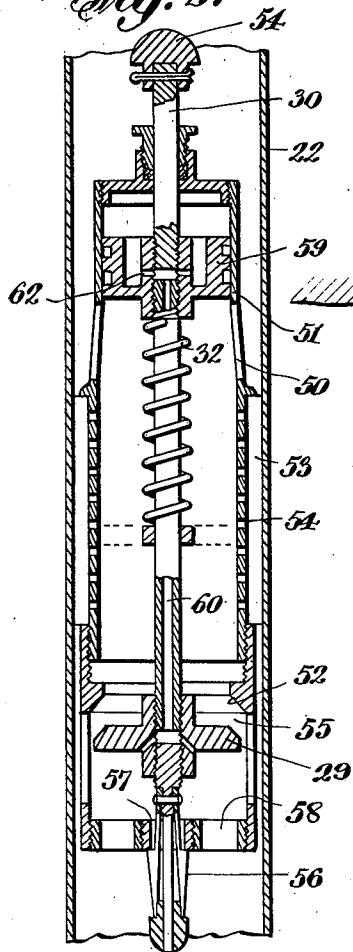
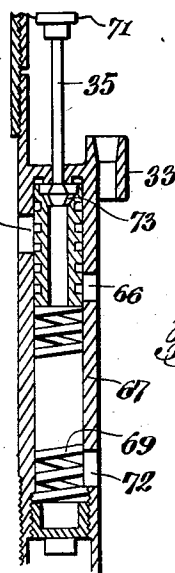


Fig. 3.



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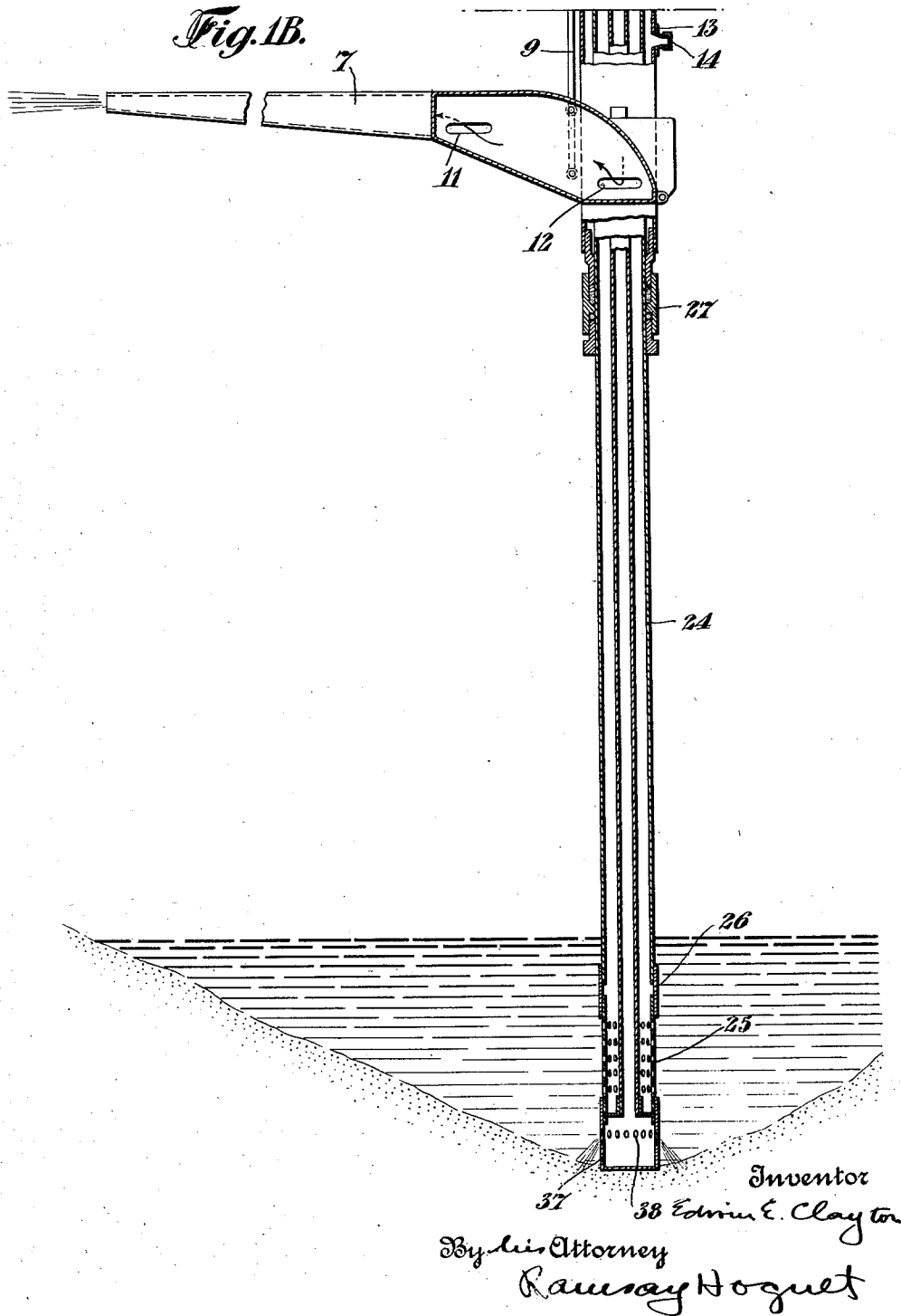
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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

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MINING APPARATUS

Application filed April 18, 1925. Serial No. 24,030.

This invention relates to apparatus for freeing materials which are capable of assuming a fluid state from materials which are incapable of assuming such a state, and for lifting the same, and is in the nature of an improvement on the apparatus described in my copending application Serial No. 13,011.

For the convenience of description I have illustrated and will describe my invention as adapted for use for the freeing of oil from oil-bearing sands in a well, and the elevation of the oil in the well, but it is to be understood that the invention is not limited to this use as it is adapted for use in many other connections.

In the drawings:

Figures 1, 1A and 1B constitute sectional views of the complete device, parts thereof, however, being shown diagrammatically. Figures 2 and 3 show details of the swab and pressure inlet valve.

The embodiment of the invention illustrated in the drawings includes a well casing 1, which is adapted to be lowered into a well, and sealed therein in the usual manner. A tube 2 is secured at 3 to a packing head 4, and is adapted to removably extend into the casing 1 and into the well and be supported normally during operation in a fixed position by a support such as, for instance, that shown at 5. Rotatably mounted on the lower end of this tube 2 is a relatively smaller tube 6, which carries a pivoted nozzle 7 which is adapted to assume vertical and horizontal positions, the nozzle being controlled by a spring within a casing 8 which actuates a rod 9 attached to the nozzle and the operation of which spring is controlled by a manually removable pin 10. Thus, when the pin is removed, the nozzle will be elevated to a substantially horizontal position, while at other times it will be maintained in its downwardly extending or vertical position.

The nozzle 7 is similar to that described in my Patent No. 1,607,586, dated November 16, 1926 above identified, and is provided with a head 11, which head is divided into two chambers, one of which lies on each side of the tube 6. These chambers are provided with openings 12, which, when the nozzle is

elevated, will register with complementary openings in the tube 6, but which registration will be destroyed when the nozzle is in its lowered or inoperative position.

In addition to this nozzle the tube 6 is provided with a stationary nozzle 13, which carries a removable cap 14. This nozzle 13 extends from the tube 6 eccentric with its axis, that is to say, the longitudinal axis of the nozzle is tangential to a circle having for its center the axis of the tube. This arrangement of the nozzle is for the purpose of producing a reactive force when the solution is ejected from the nozzle which will cause the rotation of the tube 6 and consequently of the nozzle 7. This arrangement and action is similar to that described in my Patent No. 1,607,586, dated November 16, 1926.

A second tube 15 is mounted longitudinally within the tube 2, and is relatively smaller than the same leaving a space 16 between the tubes. The tube 15 extends upwardly through the packing head 4 and is adapted to slide therethrough, leakage from the space 16 being prevented by a packing 17. This tube 15 is secured at 18 to a tubing head at 19, which latter is adapted to be elevated by the links 20, so that the tube 15 will be raised and lowered within the tube 2 and independently thereof. The lower end of this tube 15 is secured to a casting 21. An additional tube 22 is secured to the tubing head 19 at 23, and extends downwardly through the tube 15. This tube 22 is stationary with respect to the tube 15, but, being movable therewith because of its attachment to the tubing head, is movable with relation to the tube 2. The lower end of this tube 22 is likewise secured to the casting 21. A space 23 is provided between the tubes 15 and 22 and terminates at the casting 21. Communicating with the tube 22 and carried by the casting 21 is a tube extension 24 which carries at its lower end a perforated section 25 removably secured by a joint 26. This tube extension 24 is stationary with relation to the tube 6 and the latter revolves about it as an axis.

To prevent leakage from the space 16 a packing 27 is disposed between the lower end of the tube 6 and the tube extension 24.

A swab 28 is mounted in and adapted to operate in the tube 22. This swab is provided with a valve 29 having an operating rod 30 which when it engages the spider 31 at the upper end of the movement of the swab opens the valve, the valve being normally urged into closed position by a spring 32 which is released as the swab reaches the lower end of its movement by an abutment 33. This swab includes a mandrel 51 which carries a packing 53 to seal the joint between the swab and the tube in the usual manner, that is to say, by the pressure of the liquid exerted on the packing 53 through the perforations 54 in the mandrel. The lower end of the mandrel is provided with an opening 55, while at the upper end there is a series of openings 50. The provision of openings 55 and 50 permits the liquid to flow through the swab. However, the opening at the lower end of the mandrel is adapted to be closed by a valve 29 which cooperates with a valve seat 52. This valve 29 is mounted on a valve rod 30, the upper end of which protrudes beyond the mandrel and is provided with a buffer 54. The valve is normally urged into its closed position, that is to say, on to the seat 52, by means such as a spring 32, but is at times held in its open position by the engagement of releasable means 56. This means in the form illustrated in the drawings includes flat springs which are adapted to be compressed to permit their passage through an opening 57 in a spider 58, which guides the lower end of the valve rod, or to be expanded to engage the lower surface of this spider to retain the valve in its open position.

In order that this valve may be balanced so that it will be subject to operation by the action of the spring 32, I have secured to the valve rod 30 a piston 49 which operates in the upper end of the mandrel as a cylinder. A port 60, having outlets 61 below the valve 29, extends through the valve rod and communicates at 62 with the cylinder above the piston 59. The area of the upper surface of the piston 59 and the area of the lower surface of the valve 29 are equal, substantially, to produce a balancing effect.

Thus, when the valve 29 is moved downwardly by impact with the buffer 54, it will be locked in its open position by the locking means 56, and the fluid permitted to flow through the openings 55 and 50 at the same time the fluid will pass through the port 60 so as to exert pressure on the piston 59. When the locking means 56 is released the spring 32 will automatically close the valve 29 against the seat 52, and the flow of liquid through the mandrel stopped, and the liquid which is located above the swab will be maintained in such position.

In order that the valve 29 may be closed when the swab reaches the lowermost extent

of its downward travel, I have provided a trip 33 into which the lower end of the valve rod 30 descends. The wall of the trip 33 is of inverted frusto-conical shape, so that as the valve rod descends into the trip the springs 56 will be compressed to an extent sufficient to permit them to move upwardly through the opening 57 in the spider 58, and thus permit the operation of the spring 32.

In order that the valve 29 may be opened when the swab reaches the uppermost extent of its travel, I have provided an abutment 64 within the tubing head, which abutment is engaged by the buffer 54 at the upper end of the valve rod 30. The result of this engagement is the opening of the valve 29 and the movement of the valve rod, and the locking springs 56 through the spider 58, to an extent sufficient to permit said locking springs to come into operation, that is to say, to engage the lower surface of the spider 58.

In order that the swab may be automatically moved upwardly after the swab has been submerged, or, in other words, after a quantity of the liquid has been accumulated above the swab and the valve in the swab closed, and in order that it may be permitted to move downwardly after the liquid has been ejected from the tube 22, I have provided the following means: Communication is established between the tube 24, which conducts the pressure medium from the source of supply, and the tube 22, in which the liquid is elevated, by means of ports 34 and 66, the former leading into a cylinder 67 from the tube 24 and the latter leading from the cylinder into the tube 22. In this cylinder 67 a valve 68 is adapted to reciprocate to assume positions to destroy communication between the ports 34 and 66, or to permit the establishment of communication between the two. This valve is normally urged into a position to destroy communication between the ports by automatic means, such as spring 69, and is provided with a valve stem 35, which extends upwardly through the head of the cylinder 67 and is provided with a buffer 71. This buffer 71 is disposed in the path of movement of the swab, and is adapted to be engaged by the lower end of the same in the downward movement of the swab which engagement moves the valve downwardly against the action of the spring 69 and permits the establishment of communication between the ports 34 and 66.

In order that the pressure on both sides of the valve 68 may be equal, and the valve therefore balanced, and in order that the cylinder may at the same time be kept clear of any foreign material which would impede the operation of the valve, or of the spring 69, I have provided the cylinder 67 with an orifice 72 which admits liquid into the cylinder below the valve. The face of the valve adjacent the orifice 72 is substantially

equal in area to the face of the valve remote from said orifice and the valve is provided with ducts 73, which permit the liquid to pass from the cylinder 67 through the valve so that the liquid exerts its pressure against both faces of the valve to an equal extent. Thus the spring 69 will be relieved of the necessity of working against an unbalanced valve, as will also the swab. Furthermore, in the movement of the valve 68 within the cylinder, the liquid is drawn into and expelled from the cylinder so that the cylinder is effectively scoured or freed from any foreign material which might otherwise impede the action of the valve or of the spring. Communication is established between the tube 22 and the tube 15 so as to permit the inflow of air from the space 23 through a valve-controlled port 34, which port is automatically opened by the actuation of the valve rod 35 through the medium of the swab when the latter reaches its lowermost position, and is automatically closed when the action of the swab is relieved.

A conduit 36 is secured to the tube 22 and communicated with the space 23 between the tubes 15 and 22. This conduit extends downwardly through the tube 24 and is at its lower end provided with a distributing nozzle 37 having a series of downwardly directed perforations 38 therein. This distributing nozzle is located below the perforated end of the tube 24. A flap or check valve 39 is mounted within the tube 22 so as to permit the upward flow of fluid through the tube 22 but prevent the downward flow there-through at certain times.

The upper end of the tubing head 19 is connected by a flexible pipe 40 with a receiving tank 41 which is connected by a fluid conduit 42 to a settling tank 43 which tank is connected by a flexible pipe 44 with the tube 2, and is provided with a Spitzkasten 45 at its lower end. The receiving tank 41 is also provided with a pipe 46 which communicates with, and is adapted to convey air to, a cooler 47. A pipe 48 connects this pipe 46 with the tube 15, there being interpolated in the pipe 48 an air compressor 49 and the pipe being flexible to permit the movement of the tubing head.

In operation, after the preliminary excavation of the well has taken place, and the nozzle 7 has assumed its horizontal position, the tube 2 is supplied with a mining agent from the settling tank 43, and this mining agent is fed downwardly through the tube 2 to the nozzles 7 and 13, being under the head of the liquid, and, if desired, under additional gas pressure through the settling tank 43. A small stream of the mining agent will be ejected from the nozzle 13 through an opening in the cap 14, and will cause the nozzle 7 to revolve in a horizontal path. The mining solution ejected from the nozzle 7 will bring down

the oil and inert material to the bottom of the well in which the lower end of the tube 24 is located. Air under pressure is admitted to the tube 15 through the pipe 48 being supplied from a compressor 49 in a heated state, the heat being produced by the last phase of compression and by the absence of cooling after this last phase compression, in case a multiple phase compressor is used. This air under pressure is conducted through the tube 15 to the port 34. Air is injected into the tube 22 below the swab. This air closes the flap valve 39 and elevates the swab.

It is here pointed out that the valve 29 of the swab being open during the descent of the swab in the tube 22, the oil and other liquid which is forced upwardly through the tube 22 in a manner which is later described will accumulate above the swab or, in other words, the swab will be submerged. When, however, the swab reaches its lowermost position the valve will be automatically closed and it is at this time, because of the engagement of the swab with the valve rod 35, that the port 34 is opened and causes the upward movement of the swab and of the liquid which is above the same. During this upward movement the air within the tube 22 and below the swab maintains the flap valve 39 closed. When the air pressure within the tubes 15 and 22 is equalized, the valve rod 35 automatically closes the port 34.

The upward movement of the swab ejects the liquid and air through the pipe 40 and into the receiving tank 41, the air passing through the pipe 46 to the cooler 47 and then to the air compressor 49 and the liquid passing through the pipe 42 to the settling tank 43, where the constituents of the liquid arrange themselves according to their specific gravities and are thus drawn off, the mining solution passing through the pipe 44 for further use.

This mining solution obtains its proper amount of heat by the exchange of the heat from the compressed air as they pass downwardly respectively in the tubes 2 and 15.

A portion of the compressed air passes from the tube 15 through the pipe 36 and is ejected downwardly through the openings 38 of the nozzle 37, thus agitating the accumulation of liquid and inert materials. Furthermore this compressed air maintains a back pressure in the cavity which pressure forces the liquid into the tube 24 through the perforations in the lower end 25 thereof and upwardly through the tube 22 to and above the swab, for lifting by the latter. This back pressure in the cavity may be maintained slightly lower than the pressure of the air for elevating the swab which will result in the continuous agitation of the sand by means of a valve 25'. However, on the other hand, the pressure may be maintained the same in the cavity as in the tube 15 or behind the swab in which

event the agitation of the sand in the well will be periodic.

I claim:

1. An apparatus for lifting fluid from a well including a tube having perforations therein, a fluid actuated swab in said tube, means for conducting fluid under pressure to the well, means for conducting fluid under pressure to the tube behind the swab, and means for preventing the pressure fluid behind the swab from communicating with the fluid within the well.

2. An apparatus of the class described including a tube, a fluid operated swab in said tube, said tube having perforations at the lower end, a valve located in the tube between the swab and the perforations, and means for conducting fluid under pressure between the swab and the valve and into the well.

3. An apparatus of the class described including a tube for conducting liquid from the well, and having perforations in its lower end, a pressure operated swab in said tube, means operated by the swab for admitting fluid under pressure intermittently behind the swab, and means for conducting fluid under pressure to the well.

4. In an apparatus for lifting fluid from a well, the combination with a tube of a swab operable therein, said tube extending beyond the end of the travel of the swab in one direction and having a perforated end, a fluid supply tube surrounding the first mentioned tube and adapted to supply pressure behind the swab, a tube extending from the fluid supply tube and having an open discharge end to supply pressure into the well.

5. In an apparatus for lifting fluid from a well, the combination with a tube of a swab operable therein, said tube extending beyond the end of the travel of the swab in one direction and having a perforated end, a fluid supply tube surrounding the first mentioned tube and adapted to supply pressure behind the swab, a tube extending from the fluid supply tube and having an open discharge end to supply pressure into the well, said last mentioned tube having perforations therein isolated from the perforations in the first mentioned tube.

6. In an apparatus of the class described the combination with a tube of a swab operable therein, said tube having a plurality of inlet perforations at the lower end thereof, means for supplying fluid under pressure to said tube at one side of said swab, and means connected with said supply means to convey fluid under pressure to the lower end of said tube and permit it to escape therefrom below said perforations.

7. In an apparatus for lifting fluid from a well, the combination of a tube with a swab operable therein, means for conducting fluid under pressure to said tube constructed and arranged to discharge said fluid at two points,

one behind the swab and the other into the well at the lower end of the tube.

8. In an apparatus for lifting fluid from a well, the combination with a tube of a swab operable therein, a fluid supply tube connected with the first mentioned tube at one side of the swab and a second fluid supply tube connected with the first mentioned supply tube and adapted to discharge into the well from the end of the first mentioned tube, and common means for supplying fluid under pressure to the supply tubes.

9. In an apparatus for lifting fluid from a well, the combination with a tube of a swab operable therein, a fluid supply tube connected with the first mentioned tube at one side of the swab and adapted to supply fluid intermittently thereto, and a second fluid supply tube connected with the first mentioned supply tube and adapted to discharge into the well from the end of the first mentioned tube, and common means for supplying fluid under pressure to the supply tubes.

In testimony whereof, I have signed my name to this specification this 26th day of March, 1925.

EDWIN E. CLAYTOR.