May 12, 1931. B. SCHWEIGER 1,805,377

DEVICE FOR RAISING FLUIDS FROM BOREHOLES

Filed Dec. 8, 1928 2 Sheets-Sheet 1

Fig. 1.

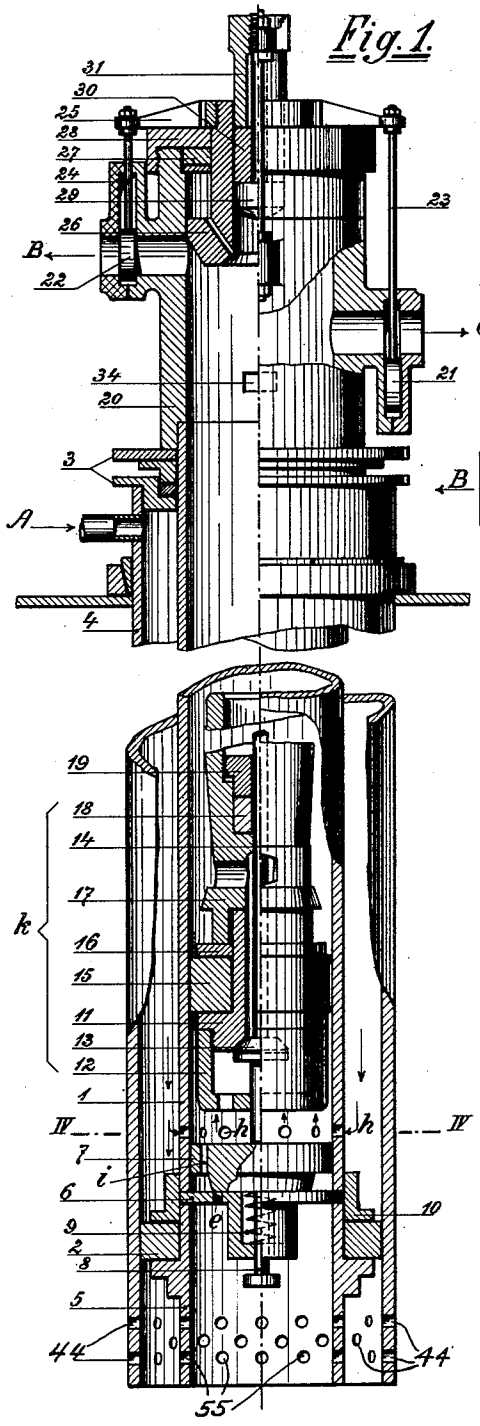


Fig. 3.

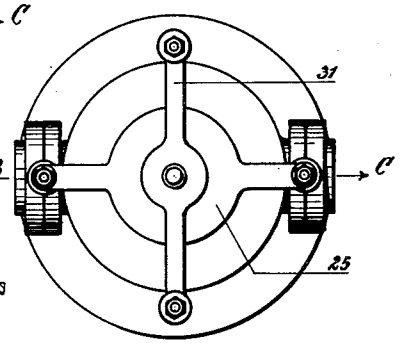
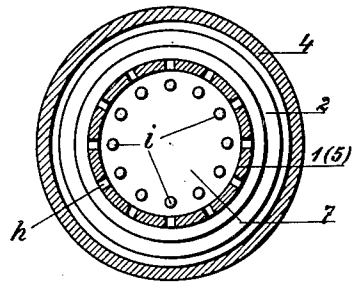


Fig. 4.



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DEVICE FOR RAISING FLUIDS FROM BOREHOLES

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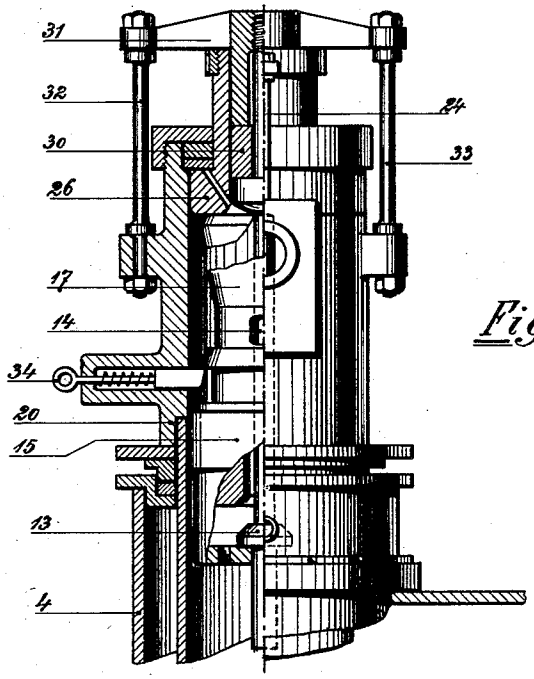
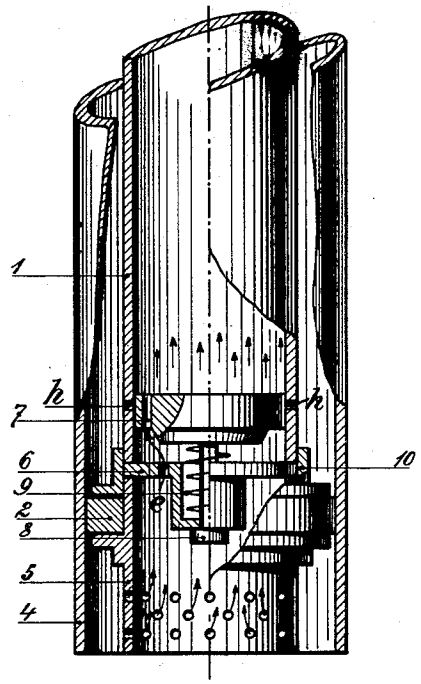


Fig. 2.



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UNITED STATES PATENT OFFICE

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DEVICE FOR RAISING FLUIDS FROM BOREHOLES

Application filed December 8, 1928, Serial No. 324,602, and in Germany June 2, 1926.

The present invention relates to a device for raising fluids, particularly mineral oil, from deep and narrow boreholes by means of a piston driven upwards by compressed air, gas or steam from the bottom of the borehole through the tubing up to the surface, the fluid above the piston being thereby carried forward.

It is a well-known fact that mineral oil is drawn up from deep boreholes, which do not possess sufficient gas to force out the oil, either by pumping it to the surface by deep-well pumps driven by means of sucker rods or compressed air, or by raising it with bailers, or finally with swabs. The latter method of raising oil is chiefly used in such places where, owing to the depth and small diameter of the borehole, it does not pay to raise the oil by means of bailers and it is a matter of impossibility to draw up oil with the aid of deep-well pumps on account of the paraffin content of the oil readily solidifying when the temperature falls.

The method of raising the oil with the use of compressed air by means of pumps termed "Mammut pumps" can only be employed with borings of limited depth, because it is essential that the level of the fluid rise as high as possible in the borehole for the well-known reason that only about one third of the height of the fluid can be raised.

Raising oil by means of the swabbing method, by which the swab raising piston is elevated from the bottom of the borehole up to the surface, has gained entrance in various oil territories as the sole method of raising oil. The piston was hitherto let down and hauled up exclusively by means of a winding rope. The drawback of that method of raising the oil is the excessive wear and tear to which the rope is subjected, and the wear on the tubes owing to the rope grinding on the inner walls, particularly with bent tubing. Moreover, the gases rising with the oil alongside the rope through the borehole cover are lost. Further, owing to the dead load of the rope, this method of raising oil calls for a comparatively large winder with an uneconomically high power consumption.

With my improved swabbing method, the winding rope and consequently the dead load of the rope are dispensed with, the weight required to be raised being reduced, by way of example, by about 1900 to 2000 kilos in the case of a borehole 1500 m. deep. The saving in power effected compared with a rope swabbing equipment of equal capacity is up to 70%. The raising piston is moved upwards by means of compressed air or gas or steam the whole long lifting height, the piston descending to the bottom of the borehole by gravity, whereby in case of a too great acceleration of the fall, the air entering above the piston through the piston valve is throttled, the piston valve closing to a corresponding extent by reason of the increase of pressure of the air under the piston.

The new swabbing device comprising the invention is shown in the accompanying drawing by way of example, in which:—

Fig. 1 is partly a section, partly an elevation, of the swabbing device,

Fig. 2 shows the device with the valve piston removed,

Fig. 3 is a plan of Fig. 1 and

Fig. 4 is a section on the line IV—IV of Fig. 1.

The raising device consists of the raising tube 1, the joint at the bottom being made tight by the packing ring 2 and at the surface by the stuffing-box 3 in the casing 4, said casing 4 having oil inlet perforations 44 at its bottom. Between the bottom end of the tube 1 with the flange 10 and the tube 5 is arranged the valve seat 6, upon which latter the bottom valve 7 fits with a tight joint. The tube 5 is formed with perforations 55 and the piston 7 is provided with aperture *i* (see Fig. 4) and with a stop bolt 8, and is lifted from the seat 6 by the spring 9. The swab (raising piston), consists of the valve-seat tube-piece 11 with its hood 12 in which the valve 13 of the raising piston with its rod 14 is guided, the rubber ring 15, the washer 16 and the stop clamping bush 17. In this clamping bush is arranged the rubber ring 18 which can be caused to grip the valve rod 14 by tightening the nut 19. At the surface the tube head 20 is secured to the tubing 1, said tube head being provided with an outlet C for oil

and an outlet B (see Fig. 1) for compressed air. The outlets can be so adjusted by the slide valves 21 and 22, which are connected to the head 25 by the rods 23 and 24, that the air outlet must be closed and vice versa when the oil outlet is open. The head 25 is screwed to the buffer piece 26 and can be lifted up to the rubber ring 27. The rubber ring 27 is secured to the tube head by the hood 28. The buffer bolt 29 is fitted into the bore of the buffer piece 26, said buffer bolt being provided with a rubber ring 30 acting as a cushion and screwed into the head 31. The latter head is securely anchored to the tube head 20 by the bolts 32 and 33. The reference numeral 34 denotes a locking pawl for holding the raising piston in its extreme position at the surface.

The operation is as follows:

When the piston *k* drops down or strikes against the fluid in the borehole, the rubber ring 18, which is pressed around the rod 14, prevents the valve 13 from being closed. This closing of the valve does not occur until the rod 14 strikes the bottom valve 7, whereby said piston is pressed downwards at the same time and the inside of the raising tube is closed against the oil level. When the bottom valve 7 descends, it uncovers the openings *h* in the tubing 1, thus admitting compressed air or gas or steam (Fig. 1). The compressed air admitted at A into tube 4 drives the raising piston *k* upwards together with the oil column resting on it, the oil having entered through the perforations 44 and 55. At the surface the oil flows off through the opening C. As soon as all the oil is forced out of the tubing, and the raising piston reaches the top, the stop bush 17 first strikes against the buffer piece 26, and then lifts it until it reaches the rubber ring 27, the oil opening C being closed by reason of the slide valves 21 and 22 being simultaneously carried upward, while the air outlet B is, on the other hand, uncovered. Shortly before the stop bush 17 strikes against the rubber ring 27, the valve rod 14 strikes against the stop bolt 29, causing the valve 13 to open so that the compressed air under the swab passes to the top of the piston, whence it can escape through the outlet B. When the compressed air blows off at B, the entrance of more compressed air through inlet A (Fig. 1) is shut off by hand. As soon as the compressed air has flowed out of the raising tube at the top through the outlet B, the bottom valve 7 will be lifted up by means of the pressure of spring 9 whereby the air entry openings *h* in the tube 1 will be closed and the entry of oil will take place through the opening *e* in the seat 6. The swab can be held in its highest position by the locking pawl device 34. The pawl is released by hand. The length of time the raising piston is held depends upon how long the supply of oil lasts. If there is a plentiful supply, the raising piston need only be held long enough to allow the compressed air to escape. The swab then drops again after striking against and opening its valve, closes the bottom valve 7, and the sequence of operations starts afresh. When the swab drops from the top position, the slide valves 21 and 22 at the same time move downwards by gravity so that the opening B is closed and C is uncovered.

What I claim is:—

1. Apparatus for raising fluids from deep and narrow boreholes with low fluid levels, comprising tubing having inlets at its bottom for the fluid to be raised, and also having an inlet and an outlet for compressed air and an outlet for the fluid; a valved raising piston within the tubing moved from the bottom of the borehole for the full height of its lifting stroke by the compressed air and then falling back upon the bottom by gravity; and a bottom valve below the raising piston for controlling the admission of fluid and air between it and said raising piston; the valve of the raising piston being closed by the increasing pressure of the air under it when the raising piston falls at too great an acceleration so as to throttle the air escaping above the raising piston, said raising piston having means for controlling the movement of the bottom valve.

2. Apparatus for raising fluids from deep and narrow boreholes with low fluid levels, comprising tubing having inlets at its bottom for the fluid to be raised, and also having an inlet and an outlet for compressed air and an outlet for the fluid; a raising piston within the tubing moved from the bottom of the borehole for the full height of its lifting stroke by the compressed air and then falling back upon the bottom by gravity; a valve rod movable with the raising piston; a valve attached to said rod and a bottom valve below the raising piston for controlling the admission of fluid and air in alternation between it and the raising piston; said bottom valve being closed by the valve rod of the raising piston when the latter moves downward, and thereby closing the fluid admission while opening the air admission to effect upward movement of the raising piston.

3. Apparatus for raising fluids from deep and narrow boreholes with low fluid levels, comprising tubing having inlets at its bottom for the fluid to be raised, and also having an inlet and an outlet for compressed air and an outlet for the fluid; a valved raising piston within the tubing moved from the bottom of the borehole for the full height of its lifting stroke by the compressed air and then falling back upon the bottom by gravity; a bottom valve below the raising piston to control the admission of fluid and air between it and the raising piston; and means

operated by said raising piston during its descent for closing the bottom valve, thereby closing the fluid admission while opening the air admission to effect upward movement of the raising piston, the fluid passing to the upper surface of the raising piston through the valve therein as it descends into the fluid and until the bottom is reached and its valve closed.

4. Apparatus for raising fluids from deep and narrow boreholes with low fluid levels, comprising tubing having inlets at its bottom for the fluid to be raised, and also having an inlet and an outlet for compressed air and an outlet for the fluid; a valved raising piston within the tubing moved from the bottom of the borehole for the full height of its lifting stroke by the compressed air and then falling back upon the bottom by gravity; a pair of oppositely-acting valves for opening and closing the air and fluid outlets in alternation; and means operated by the raising piston at the end of its lifting stroke for actuating said controlling valves, the fluid passing to the upper surface of the raising piston through the valve therein as it descends into the fluid and until the bottom is reached and its valve closed.

5. Apparatus according to claim 4, in which the oppositely-acting valves are attached to the ends of a cross-piece which is provided with a central depending buffer adapted to be struck and thereby raised by the raising piston.

6. Apparatus for raising fluids from deep and narrow boreholes with low fluid levels, comprising tubing having inlets at its bottom for the fluid to be raised, and also having an inlet and an outlet for compressed air and an outlet for the fluid; a raising piston within the tubing moved from the bottom of the borehole for the full height of its lifting stroke by the compressed air and then falling back upon the bottom by gravity; a valve rod movable with said piston; a valve attached to said rod; a pair of oppositely-acting valves for opening and closing the air and fluid outlets in alternation; a cross-piece on top of the apparatus and from the ends of which the valves are suspended; a central depending buffer on said cross-piece adapted to be struck by the upper end of the valve rod and thereby raised; and a bottom valve below the raising piston for controlling the admission of fluid and air in alternation between it and the raising piston; said bottom valve being closed by the valve rod of the raising piston when the latter moves downward, and thereby closing the fluid admission while opening the air admission to effect upward movement of the raising piston.

In testimony whereof I affix my signature.

BRUNO SCHWEIGER.