

Jan. 21, 1930.

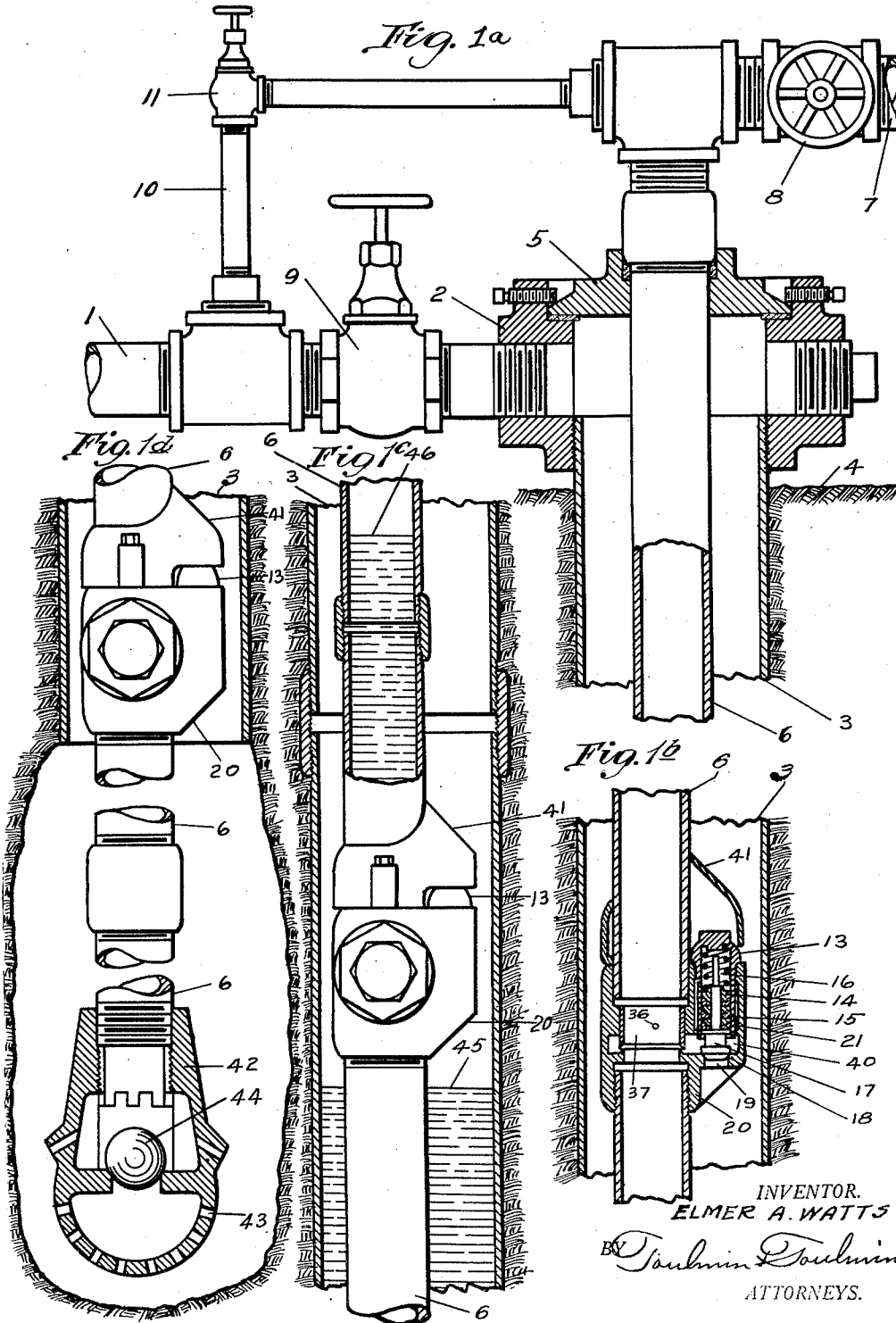
E. A. WATTS

1,744,087

PUMPING APPARATUS

Filed Jan. 17, 1927

4 Sheets-Sheet 1



Jan. 21, 1930.

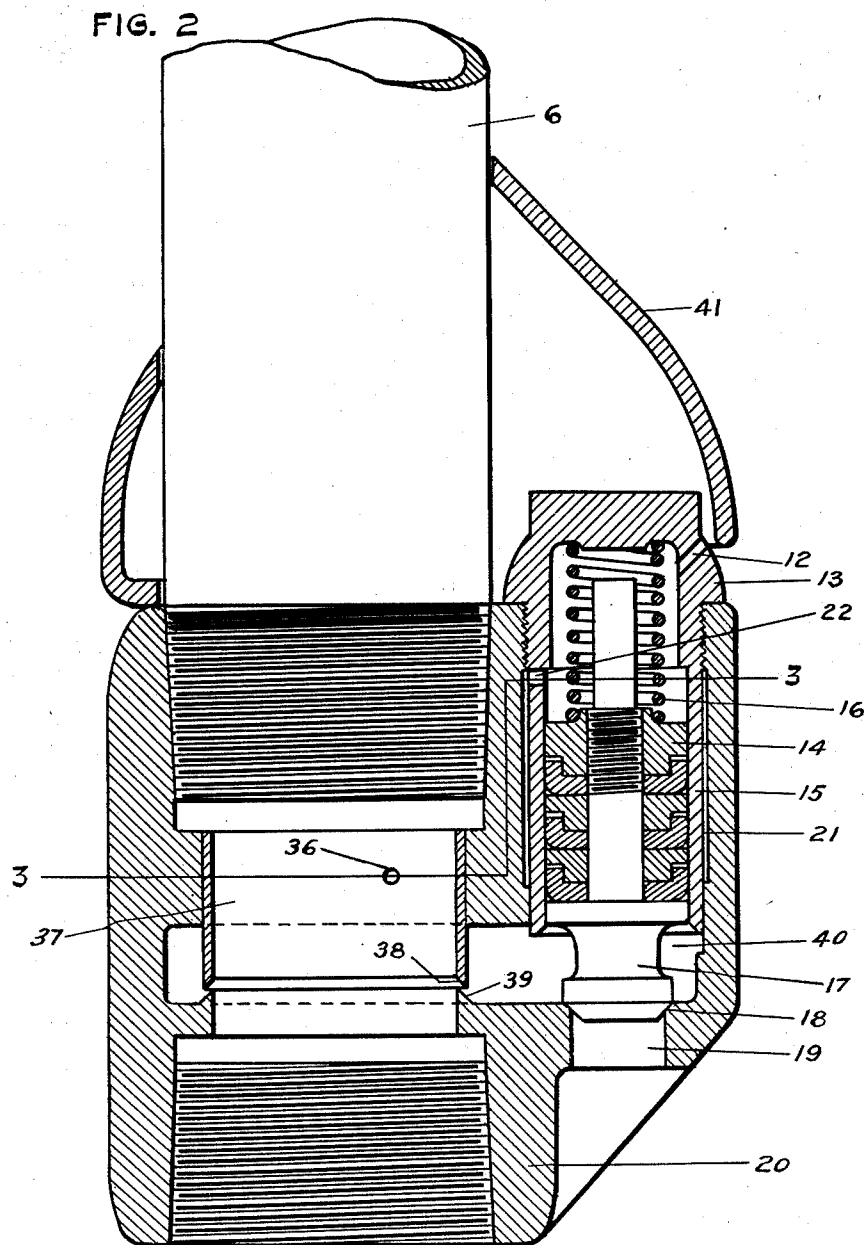
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PUMPING APPARATUS

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4 Sheets-Sheet 2



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Jan. 21, 1930.

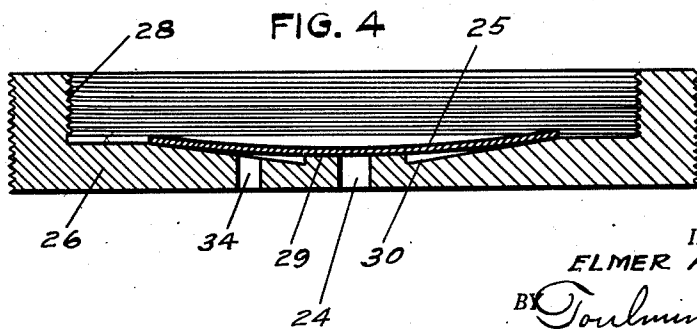
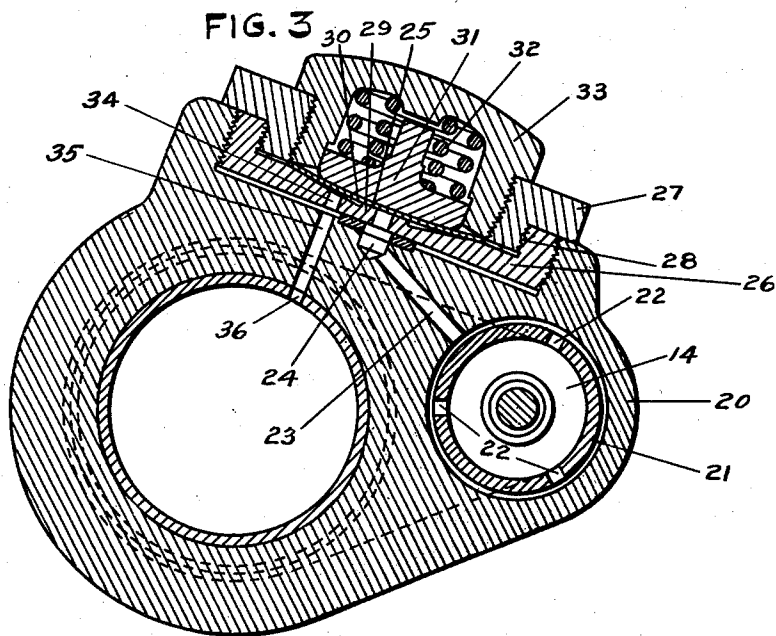
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PUMPING APPARATUS

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4 Sheets-Sheet 3



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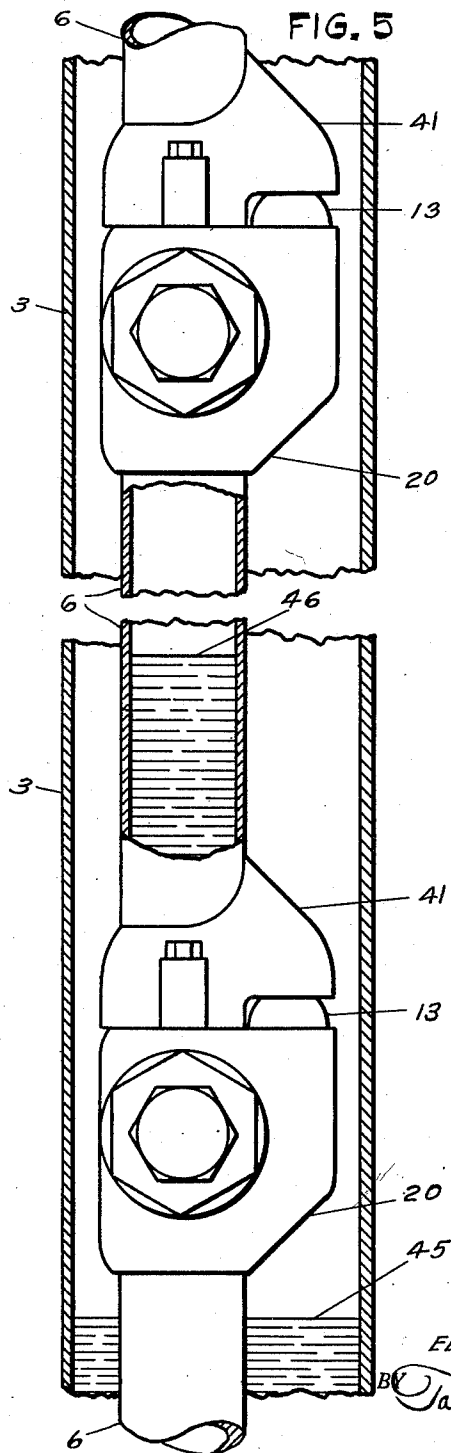
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PUMPING APPARATUS

Filed Jan. 17, 1927

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

ELMER A. WATTS, OF SPRINGFIELD, OHIO

PUMPING APPARATUS

Application filed January 17, 1927. Serial No. 161,517.

My invention relates to pumping apparatus for oil wells.

In particular, it is my object to provide means for automatically pumping the well by gaseous pressure.

It is a further object to provide means for automatically pumping the well by stages by gaseous pressure, the application of the pressure stage by stage being controlled by the height of the oil so that wells, particularly very deep wells, can be pumped automatically by the simple expedient of turning into the well a predetermined pressure.

In the accompanying drawings:

Figure 1^a is a section through the well with the pumping apparatus partially in section;

Figure 1^b is a continuation of the tubing shown in Figure 1^a, showing the means for the introduction of air pressure into the tubing.

Figure 1^c is a continuation of Figure 1^b, showing a further view of the casing and well partially in section, and Figure 1^d is a continuation of Figure 1^c showing the mechanisms attached to the extreme end of the tubing 6.

Figure 2 is an enlarged section through an individual automatic stage control unit;

Figure 3 is a section on the line 3—3 of Figure 2;

Figure 4 is an enlarged detail view of the diaphragm and its seat shown in Figure 3.

Figure 5 is an enlarged view of a portion of the structures shown in Figures 1^c, and 1^d, these portions being shown in operative position.

Referring to the drawings in detail, 1 is an air intake pipe, which communicates with a head 2 threaded upon the well casing 3 located in the ground 4. This head 2 is provided with a detachable cap 5, which carries the tubing 6 through which the oil flows into the discharge line 7. This discharge line is controlled by a valve 8. The air intake is controlled by the valve 9.

It will be understood that, when I refer to air, I refer to any gaseous medium, which may be available for this purpose. The air pipe 1 and the oil discharge pipe 7 are connected by a by-pass line 10, which is con-

trolled by a valve 11, the purpose of which line and valve will be explained hereinafter.

The well tubing 6 is provided at suitable intervals with mechanism for automatically controlling the application of the air pressure to the oil in the tubing 6. The air pressure is delivered to the space between the casing 3 and the tubing 6.

This air pressure is adapted to enter the one-thirty-second-of-an-inch opening 12 in the threaded cap member 13 and engage the rear surface of the piston 14 working within the cylinder 15 in cooperation with the resistance of the spring 16. The air pressure entering through the opening 12 cooperates with the spring 16 in maintaining the valve member 17 carried by the piston 14 in engagement with the seat 18 closing the passageway 19 in the body of the fitting 20 which forms the support for the cylinder 15 and other mechanism utilized for the purpose of controlling the application of the air pressure to the oil for discharging it from the well.

This fitting 20 is connected to the ends of the sections of the piping 6 which are held in spaced relationship thereby so that a continuous pipe is formed.

The cylinder 15 is spaced from the fitting 20 by the passageways 21 with which the air passing through the opening 12 communicates through the openings 22.

This air passes through the passageway 23 in the passageway 24 behind the diaphragm 25 which is held between the diaphragm supporting plate 26 threaded externally into internal threads of the fitting 20 and the collar 27 threaded within a shoulder 28 of the plate 26. The plate 26 is provided with a diaphragm seat 29 on its cup face 30 in order to form a perfect seal of the opening 24 by the diaphragm 25. The diaphragm is normally in sealed position by reason of the pressure thereon of the plunger 31 which is imparted to seating position by the spring 32 contained within the retaining and guiding cup 33, which guides the plunger 31, retains its body and limits its movement, and contains the spring 32. This cup is threaded in the collar 27.

When the diaphragm lifts, the air may pass

from the passageway 24 beneath the diaphragm through the passageway 34, the passageway 35 into the interior of the pipe 6 through the vent hole 36.

Between the ends of the pipe 6 and within the fitting is a depending annular collar 37 in which is located the vent hole 36. This collar has a lower internally beveled edge 38 spaced above a beveled edge 39 of the fitting 20, such edges being located in the passageway 40 in the casing communicating with the passageway 19 when the valve member 17 is lifted from its seat 18.

In order to protect this equipment, a guard 41 is mounted on the pipe 6 as illustrated.

The bottom of the pipe 6 is provided with any suitable form of head, such as the head 42, having the inlet openings 43 and an interiorly located ball check 44 which may be utilized in some conditions. The lower end of the pipe with its head extends below the casing into the oil pool.

Method of operation

For the purpose of illustration as to the method of operation of this equipment, if the head of oil is 200 feet, that is, the distance from the top of the oil at 45 in the casing to the top of the oil at 46 in the tubing is 200 feet, which constitutes substantially the distance above in one stage between the automatic air controlling apparatus, and if the pressure of the oil is 100 pounds and the pressure of the air is 125 pounds, then the spring 32 behind the diaphragm 25 is adjusted so that the diaphragm will open the passageway 24 just under 100 pounds to let in air to the oil in the tube 6 to lift it.

This apparatus under such conditions acts as follows. The air enters the passageway 12 and with the spring 16 maintains the valve member 17 seated. As soon as the oil in the casing which is also under pressure of the air on the outside of the casing 6 enters the vent hole 36 and adds its pressure against the diaphragm, the air in the passageways 23 and 24 can pass under the lifted diaphragm through the passageway 35 into the casing 6 to lift the oil through the discharge line, but the main air for this purpose enters through the passageway 19 due to the fact that the pressure behind the piston 14 has been thus relieved and the greater pressure operating on the valve head 17 lifts the valve and permits the air to enter through the passageway 19, passageway 40, between the beveled surfaces 38 and 39 which distribute the air and thence against the oil lifting it through the discharge.

This continues so long as there is pressure in the vent hole 36, but, upon the cessation of the pressure therein, the pressure behind the piston being on a larger area overcomes the differential pressure on the similar area on

the valve head 17 with the assistance of the spring 16 closing the passageway 19.

Briefly, each stage apparatus described admits air to elevate the oil in the tubing 6 when the oil surface 45 descends allowing the air to pass into the passageway 19 and when the oil in the casing 6 enters the vent hole 36 permitting the opening of the diaphragm and the unbalancing of the pressure on the differential valve member 17 permitting it to open to allow the air in the casing 3 to enter to lift the oil in the tubing 6.

Reversal of air for cleansing

In the event it is desired to cleanse the stage apparatus of any accumulation of soot or sand, the valve 8 can be closed and the valve 9 closed allowing the air to pass through the by-pass passageway 10 into the pipe 6, thence out of the stage apparatus in the reverse direction into the casing 3.

It will be understood that I desire to comprehend within my invention such modifications as may be necessary to adapt it to varying conditions and uses. When I mention "air", I include any gas.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The combination with a well of means to deliver air pressure to the well, means comprising a tubing to deliver oil from the well, means in the tubing to admit the air pressure from the well to the means carrying the oil to eject the oil when the pressure in the oil-carrying means achieves a predetermined pressure at the point of air admission by first releasing the pressure on one part of the means in the tubing.

2. In combination, a casing, means to admit air pressure thereto, tubing in said casing adapted to receive oil subjected to pressure in the casing and forced thereby to a higher level in the tubing, means in said tubing for admitting air in the casing to the tubing to eject the oil therefrom, and means to open said means for controlling the admission of air when the pressure on the interior of the tubing adjacent the point of air entrance reaches a predetermined amount.

3. In combination in an automatic oil pumping apparatus, a casing, spaced tubing therein open at the bottom to the oil and open at the top for the discharge of oil, spaced apparatus in said tubing for admitting air under pressure in the casing to the oil in the tubing, consisting of an air admission valve, a pressure controlling means for controlling the opening of the valve depending upon the pressure in the casing.

4. In combination in an automatic oil pumping apparatus, a casing, spaced tubing therein open at the bottom to the oil and open at the top for the discharge of oil, spaced apparatus in said tubing for admitting air

under pressure in the casing to the oil in the tubing, consisting of an air admission valve, a pressure controlling means for controlling the opening of the valve depending upon the pressure in the casing, means to apply a portion of the air from within the casing to maintain the valve in seated condition, and yielding means to maintain said valve in seated condition, said pressure controlling means effecting the exhausting of the air behind the valve when the pressure in the casing achieves a predetermined amount, allowing the pressure in the casing on the valve head to counter-balance the yielding means.

5. In combination in an automatic oil pumping apparatus, a casing, spaced tubing therein open at the bottom to the oil and open at the top for the discharge of oil, spaced apparatus in said tubing for admitting air under pressure in the casing to the oil in the tubing, consisting of an air admission valve, a pressure controlling means for controlling the opening of the valve depending upon the pressure in the casing, means to apply a portion of the air from within the casing to maintain the valve in seated condition, yielding means to maintain said valve in seated condition, said pressure controlling means effecting the exhausting of the air behind the valve when the pressure in the casing achieves a predetermined amount, allowing the pressure in the casing on the valve head to counter-balance the yielding means, and means to distribute the air admitted by the valve so as to provide the maximum effect upon the oil in the tubing to elevate it.

6. In combination in an automatic well pumping apparatus of a casing containing air under pressure and oil subjected to the air pressure, tubing in said casing adapted to contain said oil under pressure, said air being at a greater pressure than the oil, spaced means in said tubing for admitting said air under pressure to the interior of the tubing to lift the oil stage by stage automatically, said admission means being open upon the accomplishment of a predetermined pressure in the casing adjacent to the admission means, and controlling means controlled by said pressure for allowing the opening of the air admission means when the pressure in the casing reaches a predetermined amount.

7. In combination in an automatic well pumping apparatus of a casing containing air under pressure and oil subjected to the air pressure, tubing in said casing adapted to contain said oil under pressure, said air being at a greater pressure than the oil, spaced means in said tubing for admitting said air under pressure to the interior of the tubing to lift the oil stage by stage automatically, said admission means being open upon the accomplishment of a predetermined pressure in the casing adjacent to the admission means, and controlling means controlled by said pres-

sure for allowing the opening of the air admission means when the pressure in the casing reaches a predetermined amount, said air admission means consisting of a differential piston and valve member engaged on either end by the air pressure in the casing, said pressure means in the tubing being adapted to exhaust the air on one side of said differential valve member and piston to allow the pressure in the casing to open it and enter the tubing.

8. In combination in an automatic well pumping apparatus of a casing containing air under pressure and oil subjected to the air pressure, tubing in said casing adapted to contain said oil under pressure, said air being at a greater pressure than the oil, spaced means in said tubing for admitting said air under pressure to the interior of the tubing to lift the oil stage by stage automatically, said admission means being open upon the accomplishment of a predetermined pressure in the casing adjacent to the admission means, and controlling means controlled by said pressure for allowing the opening of the air admission means when the pressure in the casing reaches a predetermined amount, said air admission means consisting of a differential piston and valve member engaged on either end by the air pressure in the casing, said pressure means in the tubing being adapted to exhaust the air on one side of said differential valve member and piston to allow the pressure in the casing to open it and enter the tubing, and yielding means for cooperating with the air pressure on one side for maintaining said valve member seated.

9. In combination, a fitting having an air inlet passageway, tubing carried by said fitting communicating with said passageway, a valve member closing said passageway, means for yieldingly maintaining said valve member closed, means for admitting air pressure to cooperate in maintaining said valve member closed, means to exhaust said air pressure behind the valve into the tubing and pressure operated means connected with the tubing for permitting such exhaust, whereupon the pressure of the air on the valve member will relieve it.

10. In combination, a fitting carrying tubing and having an air entrance passageway for introducing air into the tubing, a differential valve member closing said passageway having a head and piston, yielding means for seating the valve member, a casing with a restricted opening for admitting air pressure behind the valve member, means for conveying such pressure to said tubing, means for interrupting such pressure conveyed from behind the valve member to the tubing operated by the back pressure from the tubing.

11. In combination, a fitting carrying tubing and having an air entrance passageway

for introducing air into the tubing, a differential valve member closing said passageway having a head and piston, yielding means for seating the valve member, a casing with a restricted opening for admitting air pressure behind the valve member, means for conveying such pressure to said tubing, means for interrupting such pressure conveyed from behind the valve member to the tubing operated by the back pressure from the tubing, and yielding means for maintaining said interrupting means normally seated.

12. In combination, a fitting having an air inlet passageway, tubing carried by said fitting, a differential valve member closing said passageway, a piston on said valve member, a cylinder for said piston carried in said fitting, yielding means for seating said piston and valve member, a casing having an opening for admitting pressure behind said piston, said cylinder having passageways for exhausting said pressure through said fitting into the interior thereof, a diaphragm seat forming a part of said passageway, a diaphragm adapted to close said passageway, yielding means to maintain said diaphragm in closed position.

13. In combination, a fitting having an air inlet passageway, tubing carried by said fitting, a differential valve member closing said passageway, a piston on said valve member, a cylinder for said piston carried in said fitting, yielding means for seating said piston and valve member, a casing having an opening for admitting pressure behind said piston, said cylinder having passageways for exhausting said pressure through said fitting into the interior thereof, a diaphragm seat forming a part of said passageway, a diaphragm adapted to close said passageway, yielding means to maintain said diaphragm in closed position, and air suspension means carried in said fitting in said passageway.

14. In combination, a fitting having an inlet air passageway to admit exterior air under pressure, tubing carried by said fitting, the fitting having a cylinder, a valve member and piston operating in said cylinder for closing said passageway, yielding means for maintaining said piston and valve member in seated position, said fitting having means for admitting air behind said piston, said piston being larger than the head of said valve member, means for conveying air from behind said piston to the interior of the fitting, a diaphragm support and a diaphragm adapted to interrupt said means, a plunger behind said diaphragm, yielding means engaging said plunger for normally keeping said diaphragm in position to close the means for exhausting the air into the fitting from behind the piston.

15. In a method of automatically pumping oil from a well, subjecting oil in the well to air pressure, forcing the oil into an exit

line to form a predetermined head, and applying the oil pressure from said predetermined head in the exit line to open, in cooperation with said air pressure, lines for admitting air pressure in the well to the oil in the exit line to eject it.

16. In a method of automatically ejecting oil from a well, applying air pressure to the oil in the well, forcing the oil to form a predetermined head in an exit line, restricting the area of the exit line, applying the oil pressure from the predetermined head to relieve an air pressure so that the first named air pressure can open lines to admit the air pressure into the exit line, and applying the air pressure so admitted for moving the oil towards the exit of the exit line.

In testimony whereof, I affix my signature.
ELMER A. WATTS.