May 21, 1929. J. McAFEE 1,713,848

DEEP WELL JET PUMP

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Fig. 1

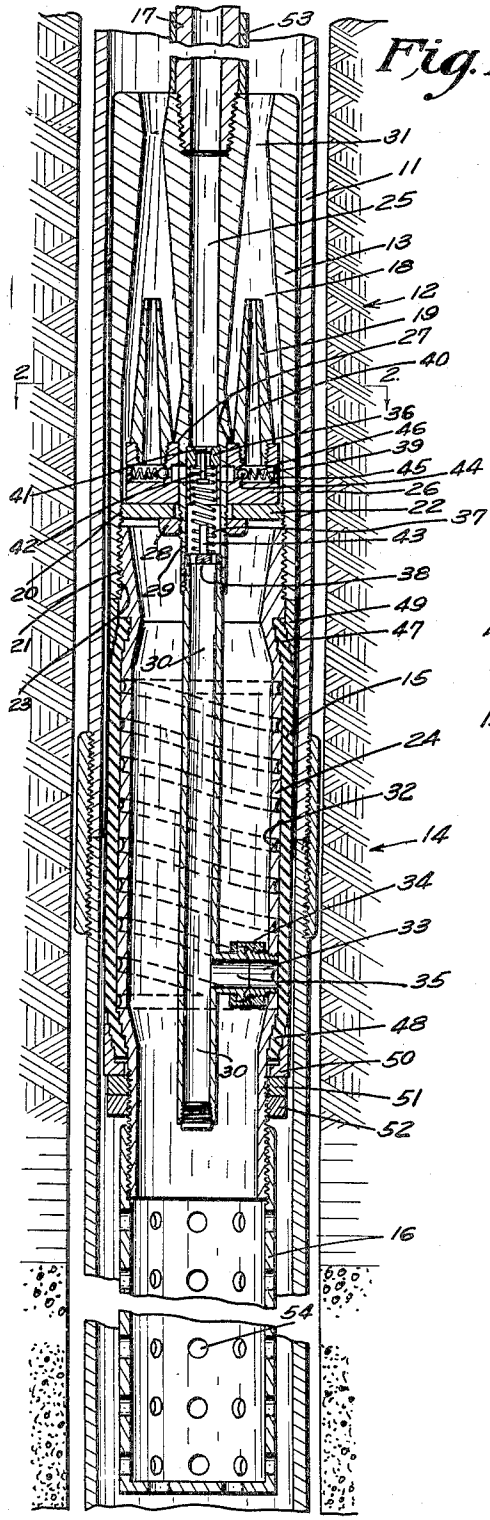


Fig. 2

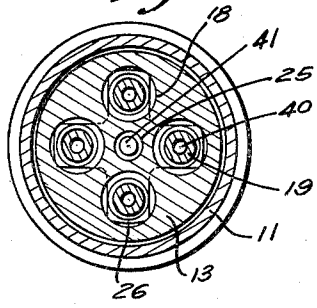
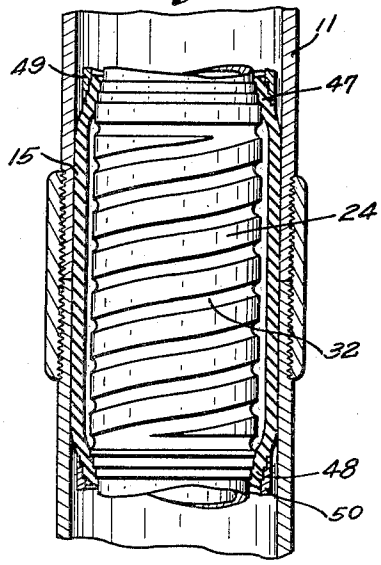


Fig. 3



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Fig. 4

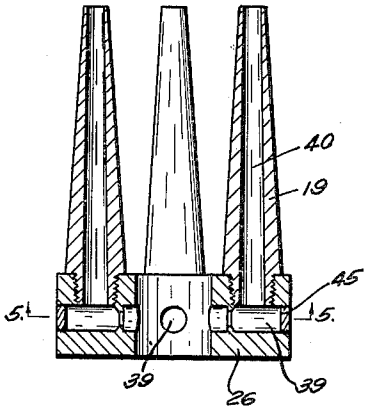


Fig. 5

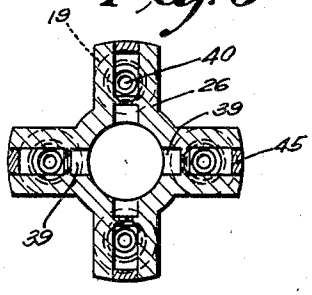
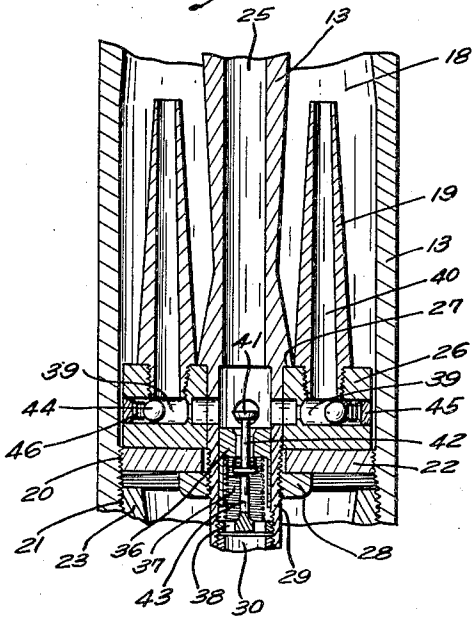


Fig. 6.



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UNITED STATES PATENT OFFICE.

JOSEPH McAFEE, OF AVALON, CALIFORNIA.

DEEP-WELL JET PUMP.

Application filed June 28, 1926. Serial No. 119,022.

My present invention relates to means, of the character commonly referred to as an "air lift" or "gas lift", for the elevation of a liquid from a deep well,—such as a water or oil well, or the like.

It is an object of my invention to produce a deep well blower having special structural features adapting the same to operate at a high efficiency and at any desired level; and an important feature of my invention is the provision of means whereby air or gas pressure may be employed to lock the blowing organization within a string of delivery tubing, at any desired level.

It is an object of my invention to provide, for the purposes referred to, a blower (preferably including a plurality of nozzles symmetrically disposed within a main casting comprising pressure chambers and combining tubes having Venturi constrictions) with expansible means adapted not only to secure the same within a delivery string but also to prevent return flow of the upwardly delivered oil or other liquid,—the mentioned expansible member thus serving as a means for relieving the formation through which liquid enters the well from the pressure of the oil column above the blower.

Other objects of my invention, which may be regarded as broadly including an upper or liquid delivering section or member provided with nozzles, a lower or intermediate section provided with an expanding member, and optionally a third or inlet section provided with a perforated or other tail pipe (all these parts being movable together by means such as a central pipe for the downward delivery of air, gas or the like) and in which a piston valve and/or other valves and passages may be disposed and employed in the unique manner hereinafter described, may be best appreciated from the following description of an illustrative embodiment of my invention, taken in connection with the appended claims and the accompanying drawings, in which

Fig. 1 may be regarded as a median vertical section through the lower portion of a deep well in which an embodiment of my invention is installed, parts being broken away.

Fig. 2 is a transverse section, taken substantially as indicated by the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary view, comparable with the central portion of Fig. 1, but with an expansible member shown as inflated,—parts interior thereto not being sectioned.

Fig. 4 is a vertical sectional view, showing, on a slightly larger scale than Fig. 1, certain optional details of blower construction.

Fig. 5 is a horizontal section, taken substantially as indicated by the line 5—5 of Fig. 4.

Fig. 6 is a vertical section corresponding to a portion of Fig. 1, but enlarged, and showing certain valves as open.

Referring to the details of that specific embodiment of my invention chosen for purposes of illustration, 11 may be referred to as a delivery string of usual or special pipe (as, "extra, extra heavy") adapted to cooperate with parts expansible therein in the retention of my blower unit at a predetermined level.

Every embodiment of my jet pump may be regarded as comprising an upper or liquid-delivering section 12 (including a main or Venturi casting 13) and a lower or intermediate section 14, comprising a laterally expansible member 15 (adapted to take a brake-like grip within the delivery tubing) and optionally also a third or inlet section in the form of an oil feed or tail pipe 16.

As best shown in Fig. 1, the air or gas supply pipe 17 may be threaded into the upper end of the main or Venturi casting 13; and the latter may be provided not only with combining passages 18, for the reception of nozzles 19, but with interior threads, as at 20 and 21, identical or respectively suitable for engagement by an apertured nozzle-retaining plate 22 and by male threads, as at 23, upon the upper end of a carrier casting 24 for the mentioned expansible member 15, or its equivalent.

In such embodiments of my invention as are provided with four nozzles 19, for the upward delivery of air or gas forced downward through the pipe 17 and through a central or other passage 25 in the main casting 13, both the plate 22 and the manifold block 26, into which the nozzles 19 are shown as separately threaded, may be practically cruciform in outline, substantially as illustrated in Fig. 5; and the manifold block 26 may be locked in place in any suitable way, as by an engagement between an annular and downwardly facing shoulder 27, shown as concentric with the passage 25, and a nut or

nuts 28, shown as engaging an exterior thread upon an integral and central extension 29,—projecting downwardly from the main casting 13 and shown as carrying a central conduit 30, for a purpose hereinafter described.

The position and diameter of Venturi constrictions such as are indicated at 31 may naturally depend upon the viscosity of the liquid to be elevated and the pressures involved and the intended rate of upward delivery; and it will be appreciated that the described features of construction of the upper member 11 render the same suitable for a wide variety of uses, irrespective of the nature of the associated parts; but I consider it especially advantageous to provide, in conjunction therewith, means whereby oil or water or another liquid to be pumped is prevented from rising within the passage 25, or its equivalent, and means whereby pressure of the gas or air downwardly delivered through the passage 25, or its equivalent, may be advantageously used in expanding the member 15, or its equivalent.

For example, providing the carrier casting 24 or its equivalent, with circumferential or other communicating channels, such as spiral passages 32, I may conduct air or gas thereto by means such as a nipple 33, shown as connected by a coupling 34 with a coupling stud 35, extending laterally from the conduit 30; and I may control the admission of gas or air to the nozzles 19 and beneath the expansible member 15 by a valve construction of the general character best illustrated in Figs. 1 and 6.

That is to say, I may provide, in a valve chamber at the lower end of the casting 13, a piston valve 36; and I may normally hold the same in a closed position by means such as a compression spring 37,—this spring being in turn retained by means such as an apertured adjustable stop 38 within or above the upper end of the conduit 30, or its equivalent. The manifold block 26, or its equivalent, may be provided with radially-extending passages 39, leading to the respective interiors 40 of the nozzles 19; and the piston valve 36, or its equivalent, may be not only capable of downward movement, under gas pressure, to such a level as to permit delivery of air or gas through the nozzles 19, but also with a central subsidiary valve 41, so constructed and positioned as to be unseated by or subsequently to such downward movement of the piston valve 36.

For the purpose last referred to, I show the stem 42 of the valve 41 as engageable by a pin 43, which may be integral with the adjustable stop plate 38, the mentioned parts being preferably so proportioned, as best indicated in Fig. 6, that any interior pressure which is sufficient to operate the described blower, under given conditions, is incidentally effective to inflate and to hold the expansible member 15, or its equivalent, in engagement with the tubing 11, or its equivalent,—so that, although the inner pipe 17 may be used in bringing the entire blowing organization to a desired level, all strains incidental to the lifting effects of the introduced air or gas may be transmitted to and carried by the tubing 11.

If desired, in order to make sure that the gripping action of the expansible member 15 shall precede the upward delivery of air or gas in the nozzles 19, each of said nozzles may be additionally provided with a separate valve of any preferred type, as suggested at 44,—the pressure thereof being optionally adjusable by means such as threaded plugs 45, shown as engaging compression springs 46.

Although the expansible member 15, or its equivalent may be of any preferred material, such as a rubber composition, and of any preferred design, I show the same as provided with stepped ends 47 and 48, engageable by similarly stepped retaining rings 49, 50,—the latter being in turn advanced and retained by means such as nuts 51 and/or lock nuts 52.

In the operation of a blowing organization of the general character described, assuming the entire organization to be lowered to a desired level by means such as the inner or gas feed pipe 17 (which may be surrounded, at its lower end, with a projecting steel sleeve 53, or the like) the effects of an admission of air or gas into the passage 25 (from which liquid is at all times excluded, so that the nozzles 19 may operate with a "running start" as soon as pressure is turned on and the described valves opened) may be a simultaneous or sequential (1) gripping of the tubing 11, or its equivalent, by the expansible member 15, or its equivalent, and (2) an upward advance of the liquid from the well (whether or not the same enters through suitable apertures 54, in the tail or feed pipe 16) through the Venturi constrictions 31, in the casting 11, or its equivalent; and it will be appreciated that the gripping engagement of the expansible member, in the indicated manner, serves not only to provide for the support of the described blowing organization but also to prevent return flow of oil or other liquid externally past the same; and it is a a matter of primary importance that, by the described means, the strata or formation from which oil or another liquid may be flowing into the well, above or below the level at which my blower is installed in the tubing 11, is incidentally relieved of the downward pressure produced by the upwardly advancing column of oil, above the expansible member 15. Thus a rapid inflow of oil, under low interior pressure, is encouraged incidentally to the action of the introduced gas or air for a lifting effect.

Obviously the use of the expansible member or its equivalent, tends to obviate such

vibration as might otherwise result in early deterioration of parts, or loosening of connections; and a release of gas pressure, applied through the pipe 17, or its equivalent, is immediately effective to permit a collapse of said expansible member, so that the level of the same may be changed at will.

Although I have herein described a single complete embodiment of my invention, it should be understood not only that various features thereof may be independently used but also that numerous modifications might be made by those skilled in the art to which this case relates, without the slightest departure from the spirit and scope of this invention, as the same is indicated above and in the following claims.

I claim as my invention:

1. A liquid lifting organization comprising a Venturi section having nozzle receiving Venturi passages therethrough radially disposed about a central longitudinal gas admitting passage; a nozzle section mounted in said Venturi section comprising a nozzle supporting base provided with channels adapted to reverse the direction of flow of the gas admitted through said longitudinal passage, and nozzles mounted on said base in coaxial alignment with said Venturi passages, said channels being provided with valves adapted to control the flow of gas into said nozzles.

2. A liquid lifting organization comprising a Venturi section having nozzle receiving Venturi passages therethrough radially disposed about a central longitudinal gas admitting passage; a nozzle section mounted in said Venturi section comprising a nozzle supporting base provided with channels adapted to reverse the direction of flow of the gas admitted through said longitudinal passage, nozzles mounted on said base in coaxial alignment with said Venturi passages; valves mounted in said channels for controlling the admission of said gas to each of said nozzles and a valve mounted in said central passage for controlling the admission of gas to said channels.

3. A liquid lifting organization comprising a Venturi section having nozzle receiving Venturi passages therethrough radially disposed about a central longitudinal gas admitting passage; a nozzle section mounted in said Venturi section comprising a nozzle supporting base channeled to reverse the direction of flow of the gas admitted through said longitudinal passage and nozzles mounted on said base in coaxial alignment with said Venturi passages; and cooperatively operating valves for controlling the admission of said gas to said nozzle section,—said valves comprising a resiliently closed piston valve operating in said longitudinal passage and resiliently closed ball valves operating at right angles to said piston valve.

4. A liquid lifting organization comprising a Venturi section having nozzle receiving Venturi passages radially disposed about a central gas admitting passage; an apertured nozzle retaining plate mounted in said Venturi section; a nozzle base mounted on said plate, said base having a central passage communicating with said longitudinal Venturi section passage, and radial passages disposed at right angles to, and communicating with said central passage; nozzles, mounted on said base in substantially coaxial alignment with said Venturi passages and communicating with said radial passages; a resiliently closed piston valve operating in said central nozzle base passage and resiliently closed ball valves operating in said radial nozzle base passages.

5. A liquid lifting organization comprising: a Venturi section carrying nozzles; a section carrying an expansible member; and a piston valve provided with an additional valve for controlling the admission of air or gas to said sections and said expansible member, the opening of said additional valve being contingent upon the movement of said piston valve.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 9th day of June, 1926.

JOSEPH McAFEE.