Oct. 19, 1926. 1,603,604

D. H. HUNTER

PUMPING MECHANISM

Filed July 3, 1923 2 Sheets-Sheet 1

Fig. 1.

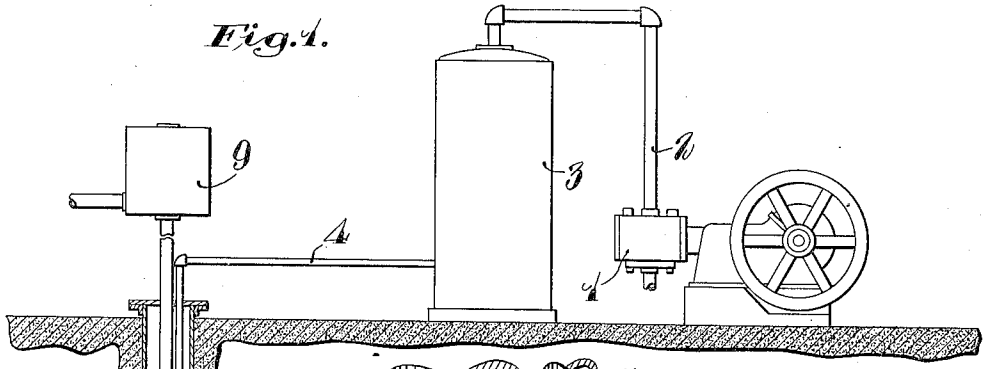


Fig. 2.

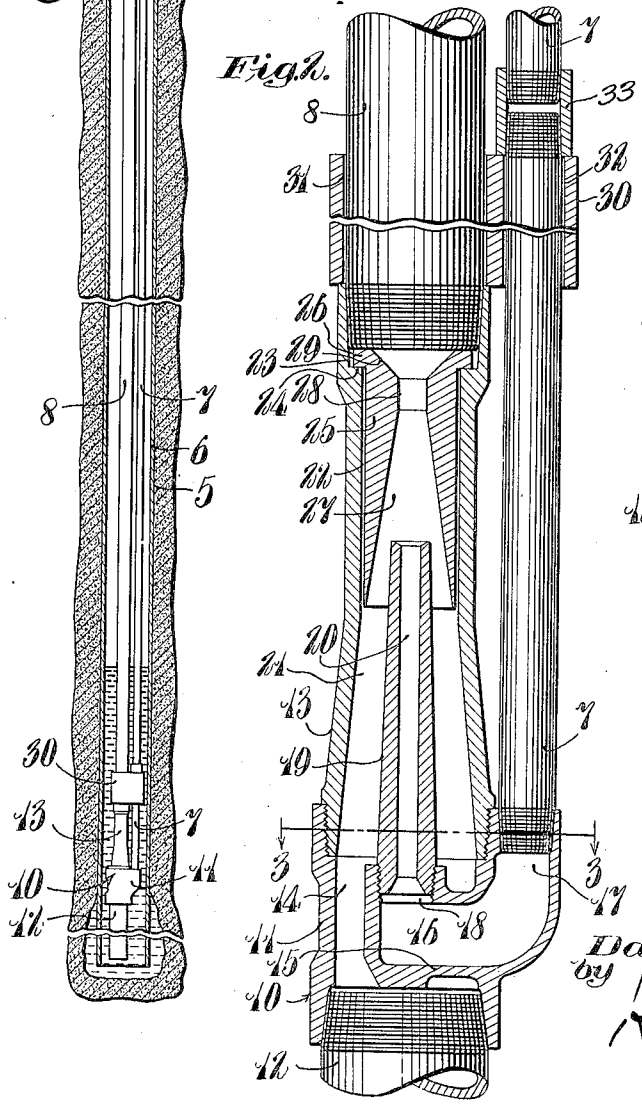
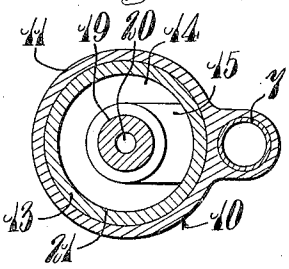


Fig. 3.



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Fig. 4.

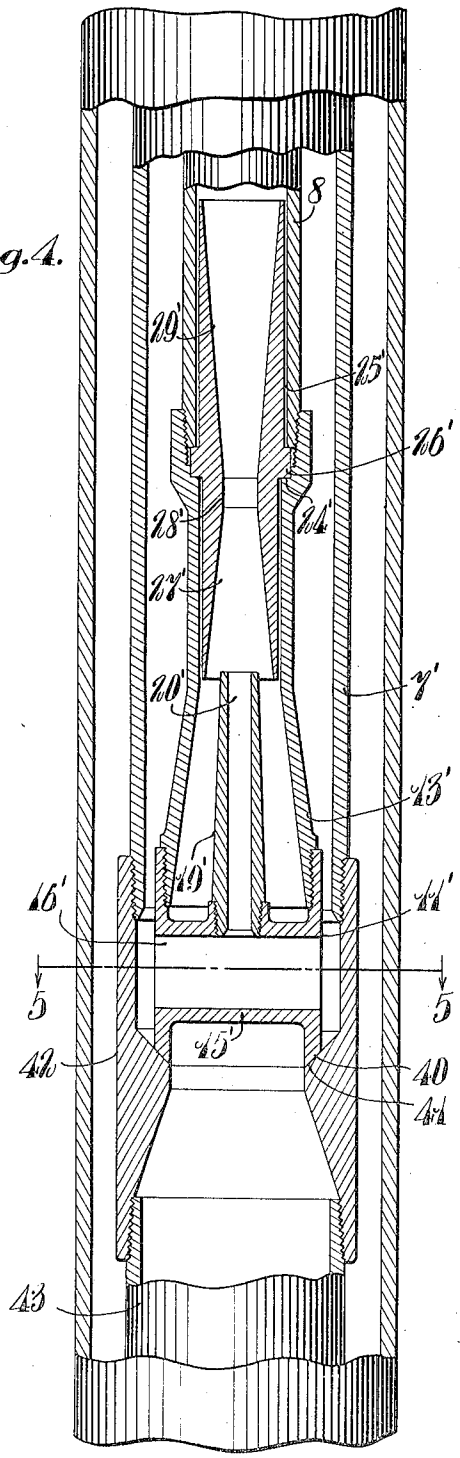
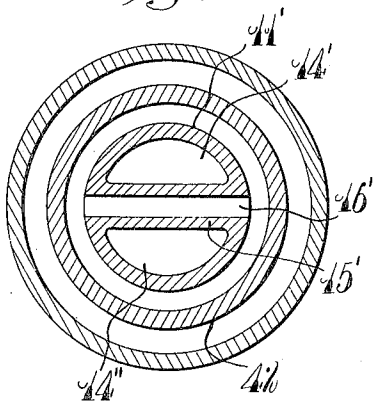


Fig. 5.



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Patented Oct. 19, 1926. 1,603,604

UNITED STATES PATENT OFFICE.

DAVID H. HUNTER, OF DALLAS, TEXAS, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, A CORPORATION OF MASSACHUSETTS.

PUMPING MECHANISM.

Application filed July 3, 1923. Serial No. 649,358.

My invention relates to pumping mechanisms, and more particularly to pumping mechanisms for raising a column of liquid by the action of air.

An object of my invention is to provide an improved liquid raising apparatus. Another object of my invention is to provide an improved liquid pumping apparatus which partakes in its nature both of an injector and of an air lift pumping mechanism. A further object of my invention is to provide an improved foot piece for use in mechanisms of the character referred to. With regard to the objects of my invention it may be stated that the ordinary air lift pumping mechanism cannot be used without having the foot piece very substantially submerged. This results in the necessity for quite deep wells and renders it impossible to pump relatively shallow wells in which the normal standing level of the liquid is a relatively small fraction of the total depth of the well. Accordingly, the object of this invention is particularly to provide a pumping mechanism which is especially adapted to the raising of liquids from relatively shallow wells in which, while the quantity of liquid available may be quite substantial, it is not at sufficient head to permit the satisfactory use of the ordinary air lift pump. A further object is to provide a pumping mechanism which may be used in relatively deep wells also where the degree of submergence is low.

In the accompanying drawings I have shown for purposes of illustration two forms which my invention may assume in practice.

In these drawings,—

Fig. 1 is a diagrammatic view showing a system in which one illustrative form of my invention is incorporated.

Fig. 2 is a central vertical section through the foot piece mechanism constituting a part of one species of my invention shown herein for purposes of illustration.

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

Fig. 4 is a view similar to Fig. 2 on an enlarged scale, showing a further construction which is especially adapted for use with deeper wells.

Fig. 5 is a transverse section on the line 5—5 of Fig. 4.

In the form of my invention shown in Figs. 1 to 3 a compressor 1 will be observed to be discharging air by way of a pipe 2 to a receiver 3 from which air under pressure is led by a pipe 4 to a well 5. The well is shown provided with a casing 6 within which a down pipe 7 is disposed and also a riser pipe 8 which leads to a booster or tank 9 at the top of the well. The particular connections used for suspending the down pipe 7 and riser pipe 8 from the top of the well are not shown as they may be any one of a number of different forms.

Now referring particularly to Figs. 2 and 3 for details of construction, it will be noted that a foot piece 10 of novel construction is arranged at the bottom of the well. This foot piece comprises a casting 11 which forms a junction member adapted to connect a tail pipe 12 with a fluid conducting pipe 13. The member 11 is hollow and has a liquid conducting bore 14 therein into which there projects a portion 15 which is hollow as indicated at 16 and serves to connect a chamber 17 into which the down pipe 7 opens with a central opening 18 in which a nozzle member 19 is arranged. The nozzle 19 has a slight external taper and is provided with a central vertically arranged bore 20 through which a jet, of substantial diameter, of fluid under a pressure considerably in excess of that necessary to discharge against the hydrostatic head due to the level of the liquid surrounding the riser pipe is adapted to discharge. The member 13 is provided with an initially tapering bore 21 which terminates at its upper end in a cylindrical bore 22 and at the top of the cylindrical bore is an enlargement 23 which is screw threaded for connection to the riser pipe and which at its bottom terminates in a shoulder 24. Mounted within the cylindrical portion 22 is a throat piece 25 which has at its upper end a collar 26 adapted to seat upon the shoulder 24 and to be clamped between the bottom of the riser pipe 8 and the shoulder 24. The member 25 has, as herein illustrated, a tapering bore 27 which at its upper end is connected by a small cylindrical passageway 28 with a rapidly flaring bore 29. It will be understood that the flare may be varied in practice to suit conditions. A guiding member 30, having bores 31 and 32 respectively adapted to loosely fit the pipes 8 and 7, is mounted at the top of the member 13 and rests thereon when the mechanism is arranged in the well. A coupling 33 is arranged in the pipe 7 so as to be sup-

ported on the member 30 and so prevents the weight of the air line having to be supported on the member 11.

The operation of this mechanism so far described will be readily understood. In view of the fact that the device is used in a well where the submergence of the foot piece is relatively low, it is necessary not only to aerate the rising column of liquid, but to impart a sufficient velocity to the same to cause it to be raised to the top of the well. In order that this may be done, the discharge of air through the nozzle 20 is at a much higher rate than would be the case in an ordinary air lift foot piece where the air discharges through the orifices with little excess pressure. By reason of the velocity of the air in the present case and the fact that the column is lightened, it is possible to raise a mixed column of liquid and air to a considerably greater height than would be possible with a purely air lift mode of operation. The tail piece 12 prevents back blowing.

In the second form of foot piece shown for purposes of illustration, which is especially adapted to raise a liquid from a deep well, the down pipe and the riser pipe are made coaxial, that is, the air supply pipe surrounds the riser pipe. In this construction the member 11′ is cylindrical in outline and is provided with a conical seating portion 40 at its bottom adapted to seat upon a shoulder 41 formed in a member 42 which connects the tail pipe 43 with the down pipe 7′. The upper end of the member 11′ is internally threaded as in the case of the form first shown and a member 13′ substantially identical in construction with the member 13 of my first form is threaded thereinto. The throat member 25′ is of a different construction from the throat member 25, being substantially longer and having the flange 26′ about midway of its length. The tapering portion 27′ and the cylindrical portion 28′ of the bore and the throat member are quite closely similar to the corresponding parts in the first construction, but the expanding portion 29′ is much longer and of a more gradually expanding shape than in the first described form of my invention. It will be understood, however, that this may also be varied in practice. The flange or collar 26′ is clamped as in the previous construction between the bottom of the riser pipe 8 and a shoulder 24′ on the member 13′. It should be noted, however, that the flanges 26 or 26′ may have threaded engagement with the top of the members 13 and 13′ respectively in such manner as to permit adjustment longitudinally. The member 11′ is provided with a diametrically extending hollow bridge-like element 15′ upon which the nozzle 19′ is mounted with its bore 20′ in communication with a transversely extending passage 16′ which receives air through the space between the riser pipe 8 and the down pipe 7′. It will be observed that the passageway corresponding to passageway 14 is divided into two parts, 14′, 14″, each communicating with tail piece 43 in this form of my invention.

By reason of the construction of this mechanism shown it will be apparent that the entire riser pipe and foot piece may be readily drawn through the top of the well without disturbing any part of the casing or of the down pipe 7′. The general mode of operation is the same as in the form first disclosed, the only difference being that the air is supplied through the space between the pipes 7′ and 8 and from both sides through the passage 16′ instead of as in the previous construction. It should be understood that the throat members and also the nozzle members are exchangeable and that, depending upon the height to which the liquid must be raised, the submergence obtainable, the viscosity of the liquid and other factors, the proportioning of the jet and the throat piece will be varied.

While I have in this application specifically described two forms which my invention may assume in practice, it will be understood that these forms of the same are shown for purposes of illustration and that the invention may be modified and embodied in other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In an air lift pump, a supply pipe, a member forming a liquid passage and having a radially extending portion therein forming a pumping fluid supply passage, an upwardly tapering liquid pumping member secured to said first mentioned member with its bore in communication with said liquid passage, a jet forming means mounted on said radially extending portion and having communication with a pumping fluid supply passage, said jet discharging centrally of said liquid passage, a riser pipe, a connection between said liquid conducting member and riser pipe, and means for effecting a supporting relation between said liquid passage forming member and supply pipe adjacent said member.

2. In an air lift pump, a supply pipe, a member forming a liquid passage and having a radially extending portion therein forming a pumping fluid supply passage, an upwardly tapering liquid pumping member secured to said first mentioned member with its bore in communication with said liquid passage, a jet forming means mounted on said radially extending portion and having communication with a pumping fluid supply passage, said jet discharging centrally of

said liquid passage, a riser pipe, a connection between said liquid conducting member and riser pipe, and means for effecting a supporting relation between said liquid passage forming member and supply pipe adjacent said member, said supporting means including members having cooperating tapered surfaces.

3. In an air lift pump, a supply pipe, a member forming a liquid passage and having a radially extending portion therein forming a pumping fluid supply passage, an upwardly tapering liquid pumping member secured to said first mentioned member with its bore in communication with said liquid passage, a jet forming means mounted on said radially extending portion and having communication with a pumping fluid supply passage, said jet discharging centrally of said liquid passage, a riser pipe, a connection between said liquid conducting member and riser pipe, and means for effecting a supporting relation between said liquid passage forming member and supply pipe adjacent said member, and means whereby said latter supporting relation is effected by gravity.

4. In an air lift pump, a supply pipe, a member forming a liquid passage and having a radially extending portion therein forming a pumping fluid supply passage, an upwardly tapering liquid pumping member secured to said first mentioned member with its bore in communication with said liquid passage, a jet forming means mounted on said radially extending portion and having communication with a pumping fluid supply passage, said jet discharging centrally of said liquid passage, a riser pipe, a connection between said liquid conducting member and riser pipe, and means for effecting a supporting relation between said liquid passage forming member and supply pipe adjacent said member, and means whereby said latter supporting relation is effected by gravity, and said member is centered in said supply pipe automatically when inserted therein.

5. In an air lift pump, a member forming a liquid passage and having radially extending therein a portion forming a pumping fluid supply passage open at each end thereof, an upwardly tapering liquid conducting member secured to said first mentioned member with its bore in communication with said liquid passage, a jet forming means mounted on said radially extending portion intermediate said open ends and having communication with the pumping fluid supply passage, a riser pipe connected to said liquid conducting member, a throat member arranged within said liquid conducting member, and means whereby said throat member is removably secured by said riser pipe and liquid conducting member.

6. In an air lift pump, a foot piece comprising a member forming a liquid passage and having radially extending therein a portion forming a pumping fluid supply passage, a supply pipe therefor, a nozzle member supported by said portion and having a bore communicating with the pumping fluid supply passage in said portion, a tapering liquid conducting member mounted on said first mentioned member and surrounding said nozzle member and having at its upper end a bore to receive a riser pipe, said bore terminating in a shoulder, and a throat member having a flange adapted to seat on said shoulder and to be clamped thereover on connection of said foot piece to a riser pipe, said riser and supply pipes forming a unitary structure and so arranged that said foot piece carries substantially only an axial load.

7. In an air lift pump, a member forming a liquid passage and having a portion forming a radially extending pumping fluid supply passage having open ends, a nozzle member supported by said portion intermediate said openings and having a bore communicating with the pumping fluid supply passage in said portion, a liquid conducting member mounted on said first mentioned member and having an initially tapering bore terminating in a cylindrical bore, a throat member having oppositely tapering communicating bores therein and an external flange, said throat member being supported by its flange in a position projecting into said cylindrical bore, and a pipe connected to the bottom of said first mentioned member.

In testimony whereof I affix my signature.

DAVID H. HUNTER.