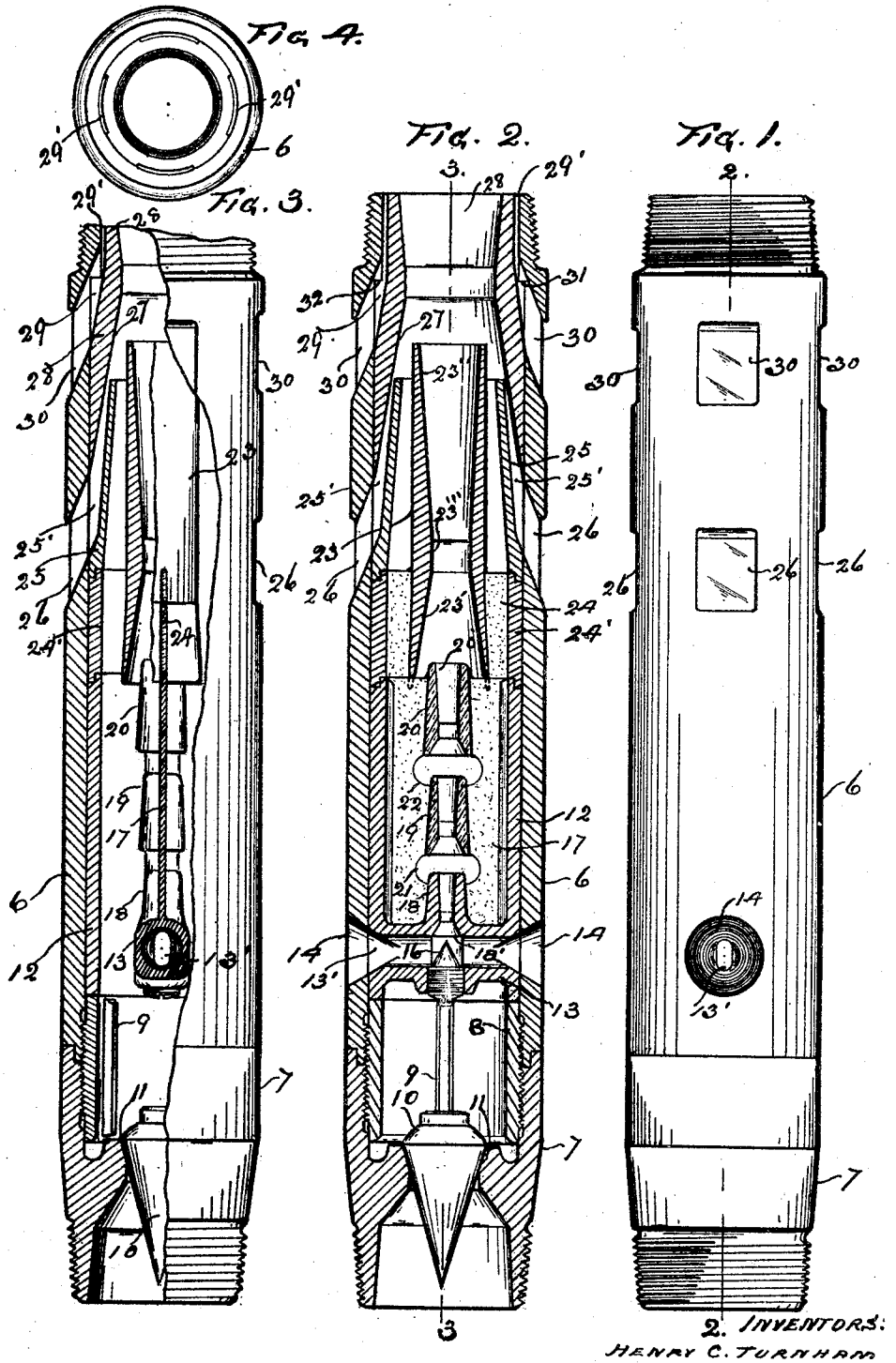
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INJECTOR PUMP

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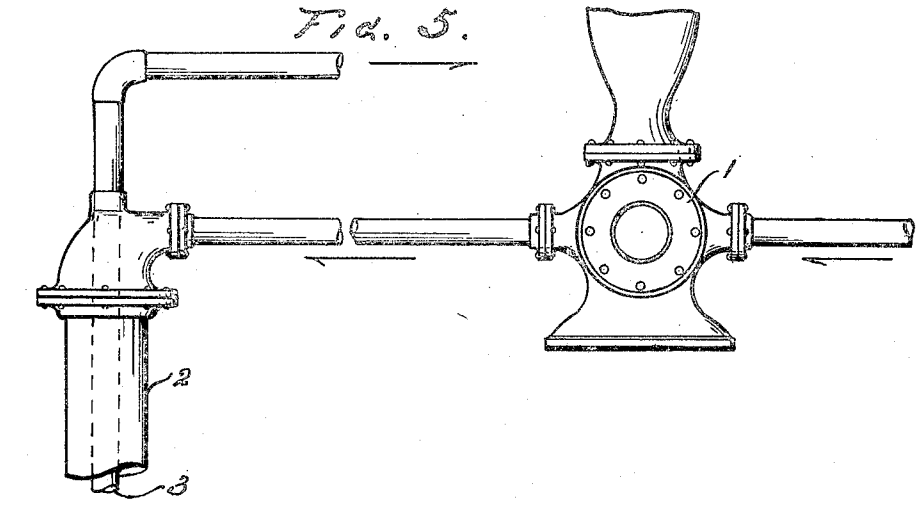
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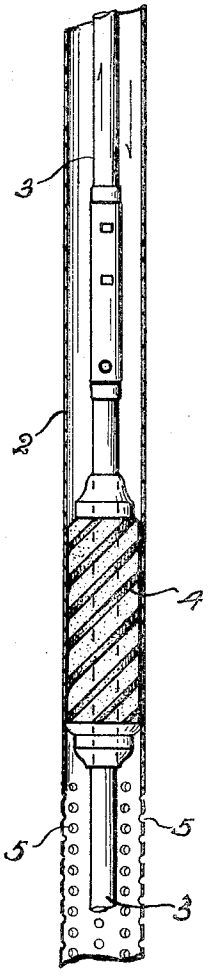
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Fig. 5.





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UNITED STATES PATENT OFFICE

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INJECTOR PUMP

Application filed August 17, 1926. Serial No. 129,807.

This invention relates to a means for elevating liquids from deep wells and it has particular reference to the recovery of oil by hydrodynamic means, and to a device for imparting velocity to a moving body of fluid and utilizing the velocity in entraining and carrying fluids from a well.

The prime object of the invention is to provide a simple and efficient device for carrying fluids from great depths, a device which is entirely free from any active parts which are dependent entirely upon constant movement or operation; to provide a simple means for removing from deep wells the fluids contained therein by the action of a similar or dissimilar fluid in controllable motion, and to provide an economical means which may be controlled in point of efficiency of production from the ground surface so that a maximum or controllable quantity of fluid may be caused to be removed from a well.

A further object of the invention is to provide a device which may be operable by fluid pressure to entrain and carry upwardly a body of oil, wherein and whereby the fluid used in the generation of pressure and consequent velocity may and will support the casing and, regardless of the exhaustion of oil from the oil sands, prevent any collapse of the casing.

A further object of our invention is to provide a means for entraining and carrying oil out of wells which may be out of plumb and which for this reason impair greatly the efficiency of standard pumps now in general use.

A further object of our invention is to provide a device of this character in which a steady, continuous and even flow of oil may be effected through the discharge pipe, as distinguished from the usual intermittent flow produced by the reciprocating action of the present pumps, and thereby maintaining open the pores of the oil sand.

Another object of our invention is to provide a fluid lifting means which will not be affected by the detrital or sandy portions contained in the oil.

Another object of our invention is to provide a means for entraining fluids from deep wells, that will satisfactorily cope with the water problem in oil wells, especially where the water is in excessive quantities, and prevent the occurrence of water strata in the oil string whereby the oil does not have to travel through the water.

The invention consists broadly of means arranged for disposal in the oil string and constructed to divide a fluid column under exterior pressure into a plurality of velocity jets which are upwardly directed, whereby the standing or gravity valve commonly used is relieved of any superimposed pressure, and the jetted oil or fluid is caused to move upwardly and away from the valve. By this upward movement of a fluid column under the varying velocities imparted by the jetting of the pressure column, and the relief of any gravitational pressure upon the valve, the oil rising from the oil sands is enabled to lift without much power force, the standing valve from its seat and to pass freely in a steady flow into the zone of the velocity jets, by which the production oil is entrained and immediately carried upwardly and continuously with the rising column.

The invention is shown in one of its preferred forms in the accompanying drawing which is exemplary only and may be modified in many respects without deviating from the nature of the invention. In the drawing

Fig. 1 is an elevation of a device embodying our invention.

Fig. 2 is a sectional view on line 2—2—Fig. 1.

Fig. 3 is an elevation, partly in section, the section taken on line 3—3—Fig. 2.

Fig. 4 is a top plan view, and

Fig. 5 is an elevation showing our invention as installed for operation.

Our invention relates generally to the entrainment of oil from a well by a fluid under pressure, and for this purpose is shown to include a pump 1 for forcing oil or other fluid into a well casing 2, in which is disposed the oil string 3. In operation, the oil string 3, is provided with a packing 4 immediately above the perforations 5 in the casing 2 to necessitate the travel of oil from the sands through the oil string 3 instead of between the oil

string 3 and the casing 2. The packing is provided primarily for the purpose of preventing the flow into the oil sands of any of the pressure fluid used and also preventing any of the oil from the oil sands from passing upwardly into the casing. The fluid forced into the casing 2 by the pump 1 is compelled to pass upwardly into and through the oil string 3. In order to obtain from said fluid under pressure the maximum velocity and the resultant maximum entraining force for the production oil, we have devised our present invention, which is designed to jet the pressure column which, owing to the velocity increase of the column ascending in the oil string, entrains and carries with it the oil rising from the oil sands. This device is arranged to compose a part of the oil string and comprises the parts and structures now detailed.

Referring with particularity to the embodiment of the invention shown in the drawings, 6 and 7 respectively designate sections which compose the essential parts of the cylinder or shell, these two parts being conjoined by an interior hollow cylindrical coupling 8, which associates the sections 6 and 7 by threaded engagement, and which is provided with guideways 9 for a gravity valve 10, that is arranged to fit upon an annular seat 11 in the section 7 and to be moved by the passage of oil from the oil sand therethrough. This valve 10 also prevents the backflow of any oil into the oil sands. The sections 6 and 7 respectively are threaded for coupling or connection with the oil string above the packing 4. Within said section 6 of the cylinder and immediately above said coupling 8 is tightly fitted an open ended cylindrical chamber 12, provided at or near the bottom thereof with a horizontal rib 13, having a passageway 13′ extending longitudinally therethrough. The respective inlet ends of said passageway taper inwardly and are arranged in register with inwardly tapering ports 14 provided in the shell or cylinder 6. A cone 16 is provided centrally in said passageway and is secured in any desirable manner in said rib 13, this cone functioning as a deflector for the fluid streams inflowing through the ports 14 and passageway 13′. The said cylindrical chamber 12 is provided with a transverse web 17 which supports a plurality of superposed, vertically alined converging and diverging tubes 18, 19 and 20, the tubes being relatively spaced and the divergent portions of the tubes communicating with openings 21 and 22 provided in the web 17 of said cylindrical chamber. Each of the tubes 18, 19 and 20 has the shape common to Venturi tubes, that is, they comprise two truncated cones joined in their smallest diameter by a throat. Each of the superimposed tubes varies in size from the bottom tube 18 to the top tube 20. As seen in Fig. 2, the convergent portion 18′ of the lower tube 18 communicates directly with the passageway 13′ in the rib 13 and is disposed immediately above the cones 16, which diverts the fluid inflowing through the ports 14 into said divergent portions 18′, the fluid then continuing to travel upwardly from tube to tube with cumulated velocity, and eventually escaping from the divergent portion 20′ of the upper tube 20, entraining with it the increment of oil or fluid rising from the oil sands under the normal well pressure augmented by the suctional force engendered by the jetting action initiated by the tubes. This discharge of the fluid from the upper tube 20 occurs in the convergent portion 23′ of a Venturi tube 23, which is disposed centrally of the shell 6, and which is connected by a membrane 24 with the cylindrical body 24′, that is tightly fitted within the shell 6. The tube 23 is provided with opposed slots into which the web 17 is arranged to fit, as shown in Fig. 2, thereby to prevent rotative movement of said tube. It is formed with a divergent portion 23″ which is conjoined in the narrowest diameter with a short throat 23‴, and is supported freely and centrally of the shell 6, by the membrane 24 as explained. The tube 23 is surrounded by an upwardly tapering nozzle 25 diametrically larger than the tube 23 and terminating short of the end thereof. Said taper nozzle 25 is provided on the outside thereof with a plurality of wide, but shallow longitudinal grooves 25′ tapering in depths upwardly, and the lower portions of said grooves registering with ports 26 provided in the shell 6. The tube 23, the nozzle 25 and grooves 25′ in the nozzle are in direct communication with the convergent portion 27 of a tube 28 which is fitted within the shell 6 and also over the end of the nozzle 25, thus co-operating with the upper ends of the grooves 25′ to form equally spaced outlets through which the pressure or operating oil or fluid enters into the convergent portion 27 of the tube 28. Said tube 28 is provided on the outside thereof with a plurality of equally spaced grooves 29, the lower ends of which are in communication with ports 30 provided in the shell 6, and through which ports the operating fluid is caused to travel upwardly through the grooves 29. This tube 28 is provided with a shoulder 31 for engagement with a shoulder 32 provided in the shell or cylinder 6. The upper part of the shell 6, which surrounds the tube 28, co-operates with the grooves 29 to form enclosed ports or outlets as seen at 29′ in the plan view Fig. 4.

The purpose of this invention is to entrain oil flowing upwardly from the oil sands by means of a fluid of similar or dissimilar nature, and for the operation of this device it is necessary to employ a column of fluid which is under pressure and which is divided into a plurality of jets or velocity streams whereby an increment of oil is entrained and car-

ried upwardly with the pressure oil used. For this purpose, as has been pointed out, oil is forced downwardly into the casing 2, which is provided at a suitable point above the perforations in the casing with a packing 4, which prevents the pressure or operating oil passing into the oil sands. The oil free from sand and grit is introduced into the casing under pressure and is relieved and escapes through the device disclosed, dividing the oil into a number of jets of increasing velocities. When the casing is fully supplied with oil, the injector device and the oil string are also filled with the fluid. Now, as pressure is exerted upon the operating fluid entraining column, the fluid, which is preferably oil or a fluid similar to the one which it is desired to entrain, is set in motion in an upward direction, the initial upward movement being directed by the cone 16, in the passageway 13′, into which the pressure fluid enters through the ports 14 in the casing 6. The fluid directed upwardly by the cone 16 enters into the reduced portion of the gradually expanding frustrum of the cone 18, and discharges at the larger end as much fluid as is received at the smaller end but with increased velocity. The discharge of the fluid from the tube 18 occurs in a space 21, in the web 17, and in direct line with another tube 19, from which again the fluid discharges at increased velocity and from the last named tube 19 the fluid passes upwardly into the space 22 in the web 17 and into another tube 20 which is disposed in direct line with the discharge end of the tube 19. Since the upward discharge of fluid from each of the superposed tubes 18, 19 and 20 is attended by increasing velocities, dependent in intensity upon the pressure exerted by the operating column, the fluid within and filling the cylinder 12 is also carried upwardly by the velocity jets issuing from the tubes 18, 19 and 20, thereby continuously removing the fluid from the stand valve 10 and permitting the oil from the oil sands to pass up freely into the injector pump. The upward movement of the oil column under pressure and under the velocity initiated by tubes 18, 19 and 20, produces a suctional force which inducts and assists in lifting the oil from the oil sand, and causes it to be entrained with the velocity oil. The velocity oil, or fluid, which we term the introduced oil or fluid, after leaving the cylindrical chamber 12 and the upper tube 20, passes into the enlarged vertically disposed tube 23 by which again the upward moving oil is so to speak "boosted" by the velocity engendered in passing through the Venturi tube 23. Part of the oil or fluid which is in the nozzle 25 is entrained or drawn into said tube by the oil passing therethrough, but the major portion is caused to move upwardly by the oil escaping from the tube and by that oil which enters into the tube 28, through the grooves 25′ in the outside of said nozzle 25 and ports 26 in the shell 6. From the tube 23 the oil or fluid discharges into the enlarged Venturi tube 28, and from there, under increased velocity into the oil string 3, being assisted and augmented in the velocity of its travel by the plurality of jets which are caused to pass through the ports 30 in the casing, and through the grooves 29 and outlets 29′ provided on the outside of said tube 28. Thus is provided a plurality of nozzles of varying diameters, capacities and sizes for jetting the pressure fluid and thereby causing an increment of oil from the oil sands to be entrained and carried upwardly, in a continuous and uninterrupted stream.

What we claim, is:

1. A device for elevating liquids from wells comprising, in combination with a casing, a hollow body formed at the respective ends thereof with means for attachment to a pipe string and provided interiorly thereof with a plurality of superposed Venturi tubes of progressively increasing diameters, said body having ports leading into said Venturi tubes and ports communicating with the inside of said body and outside the upper Venturi tube, means to supply a fluid under pressure to within said casing and outside said body to cause the fluid to enter the respective ports and travel upwardly through said Venturi tubes, means to seal the pressure fluid within said casing, and a valve in said body to permit the upward flow of fluid from a well with the pressure fluid, and prevent the downward flow of the pressure fluid.

2. A device of the character described comprising a hollow body formed at the respective ends thereof with means for attachment to an oil string, a chamber within said body and provided with a plurality of superposed Venturi tubes, said body having ports near the bottom thereof and said chamber having a passageway communicating with said tubes and ports, a plurality of diametrically larger tubes above said first named Venturi tubes, and a nozzle within said body and surrounding one of said larger tubes, said body having ports through which fluid is conveyed on the outside of said nozzle to within said larger tubes.

3. In a device of the character described, the combination with a hollow body arranged for connection with an oil string, provided near the respective ends thereof with ports, and with a seat near one end of said body, a valve on said seat, a chamber in said body provided with a plurality of centrally supported, vertically alined Venturi tubes of varying diameters, and having a transverse passageway above said valve and in communication with the ports near the lower end of said body, said passageway also in communication with the bottom Venturi tubes, a diametrically larger tube in the upper

part of said body, a nozzle surrounding said larger tube and provided with exterior grooves communicating with ports in the upper part of the body, and a tube diametrically larger than said last named tube fitted within said body, said tube having a plurality of longitudinal grooves which communicate at the bottom with other ports provided in the upper part of the body.

4. A device of the character described comprising a cylindrical body formed for connection with an oil string, and provided in the bottom thereof with a valve seat, a valve on said seat, said body having ports near the bottom and top thereof, a plurality of centrally disposed diametrically increasing Venturi tubes within said body, the lower of which communicates with the ports near the bottom of said body, and a nozzle within the upper part of said body surrounding one of said Venturi tubes, and provided with longitudinal grooves, which communicate at the bottom thereof with ports in the upper part of said body.

5. A device of the character described comprising a hollow cylindrical body having tapering ports near the bottom thereof and upwardly inclining ports near the top thereof, an open ended chamber fitting within said body and formed with a horizontal passageway which communicates with said tapering ports, a plurality of superposed, vertically alined Venturi tubes centrally supported within said chamber, the bottom tube being in open communication with said horizontal passageway, a centrally supported Venturi tube within said body and in line with the top of said superposed tubes, a nozzle surrounding and spaced from said Venturi tube and provided with longitudinal grooves which communicate at the bottom with certain of said upwardly inclining ports in said body and a Venturi tube fitting over said nozzle.

6. A device for elevating liquids comprising in combination with a casing for receiving a pressure fluid, a hollow body having a plurality of ports near the bottom thereof to receive a portion of the pressure fluid, a plurality of superposed Venturi tubes of progressively increasing diameter centrally supported within said body, the bottom Venturi tube communicating with the ports near the bottom of said body, a seat formed in said body, a valve on said seat to permit the upward flow of fluid from a well and prevent the downward flow of the pressure fluid, and a nozzle within said body and surrounding the upper Venturi tube, said body having ports for leading about said nozzle the pressure fluid.

7. A device for removing fluids from wells comprising a cylindrical body having a seat near the bottom end thereof, a valve on said seat to prevent the flow downward of any fluid within said body, said body having ports near the top and bottom thereof, a chamber within said body, a plurality of diametrically increasing Venturi tubes carried by said chamber, said chamber having a passageway communicating with the smallest Venturi tube and with the ports near the bottom of said body, and a means within said body and above said Venturi tubes to produce a plurality of pressures upon and outside of the main fluid body to assist the upward movement of the fluid.

In testimony whereof we have set our hands.

FRANK NEWNHAM.
HENRY C. TURNHAM.