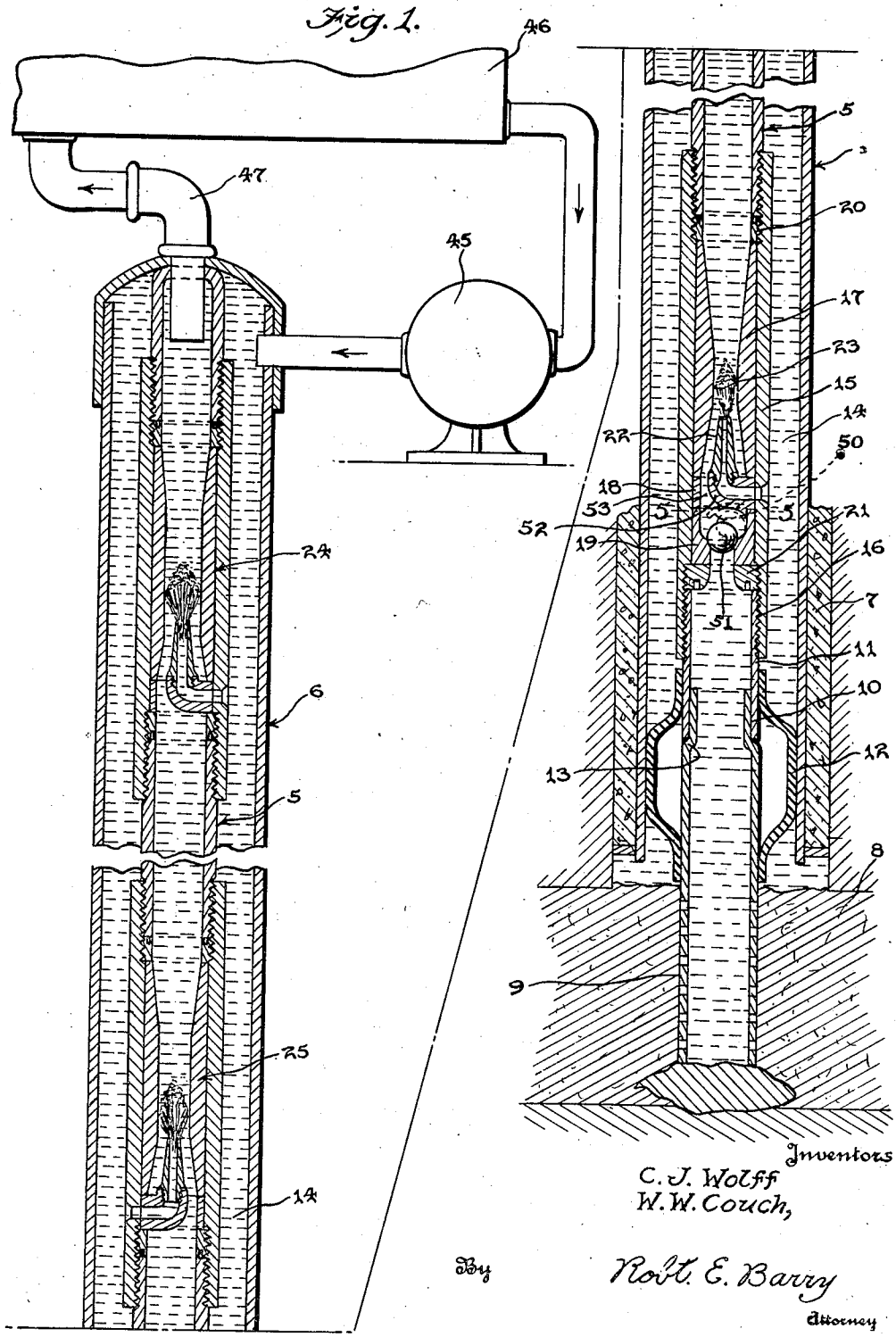
July 26, 1932. C. J. WOLFF ET AL 1,868,621

IMPACT EJECTOR PUMP

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Fig. 1.



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Fig. 2.

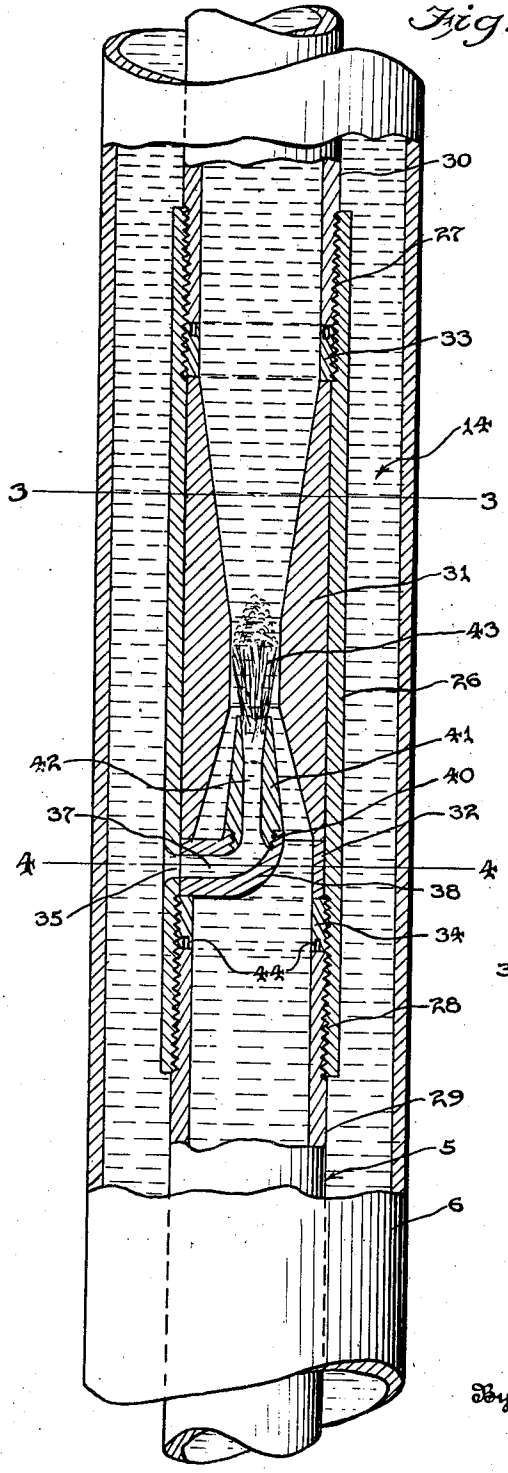


Fig. 3.

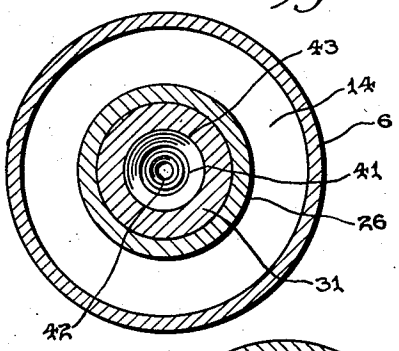


Fig. 5.

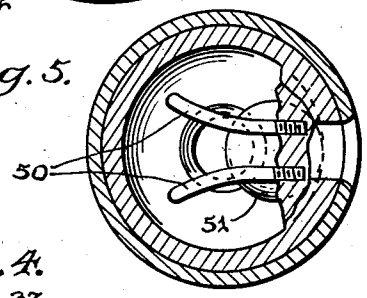
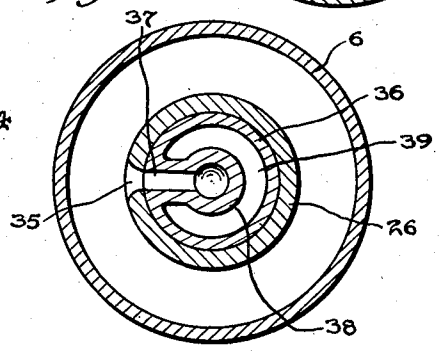


Fig. 4.



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UNITED STATES PATENT OFFICE

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IMPACT EJECTOR PUMP

Application filed December 4, 1931. Serial No. 579,073.

This invention relates to improvements in impact ejector pumps, and more particularly to a novel pump of this type to be employed in the pumping of oil wells or the like.

Heretofore it has been proposed to arrange in the tubing string of a well, nozzles and Venturi tubes through which a pressure fluid is forced from the exterior of the tubing to drive the pumped fluid up the tubing. Such apparatus has required weakening of the tubing string and enlargement of the tubing where the nozzles and Venturi tubes are located. It is the primary object of the present invention to eliminate such disadvantages.

In accordance with our invention, the nozzle and Venturi tube are arranged within an ordinary tubing coupling section, and these elements are firmly secured within such section by threaded members which engage the conventional threads of the coupling section.

Another object of the invention is to provide a deep well liquid pump in which the pumped liquid is employed as the pressure fluid, so that it is unnecessary to make any separation at the top of the well between the pumped liquid and the pressure medium.

With the foregoing objects outlined and with other objects in view which will appear as the description proceeds, the invention consists in the novel features hereinafter described in detail, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

In the drawings,

Fig. 1 is a vertical sectional view partly in elevation and partly broken away, of a pump in accordance with our invention, the pump being shown in the well, and the left hand portion of the figure showing the upper portion of the well and pump, and the right hand portion showing the lower parts of the same.

Fig. 2 is an enlarged vertical sectional view partly in elevation of a detail.

Fig. 3 is a horizontal sectional view on the line 3—3 of Fig. 2.

Fig. 4 is a horizontal sectional view of a detail on the line 4—4 of Fig. 2.

Fig. 5 is a horizontal sectional view of a detail taken on the line 5—5 of Fig. 1.

Referring to the drawings, 5 designates the well tubing and 6 the casing. The casing is of conventional construction and is cemented in the well at its lower end as shown at 7, and such end terminates above the oil sand 8.

A conventional strainer or intake 9 for the tubing, is arranged at its lower end, and is joined by a telescopic joint 10 to a lower section 11 of the tubing. This section and the strainer are connected by a packer 12 which, when the section 11 is resting on a shoulder 13 of the strainer, acts to expand into contact with the casing so as to seal the annular passageway 14 between the tubing and casing, from the oil sand.

In accordance with our invention, an ordinary tubing coupling section 15 of uniform external diameter from end to end, has the threads at its lower end screwed on to the tubing section 11 as shown at 16; and removably arranged in such coupling section are a Venturi tube 17, a nozzle element 18, a valve member 19, and a pair of threaded collars 20 and 21. It will be noted that the valve member rests on the threaded collar 21, and that the latter engages the conventional threads of the coupling section. Furthermore, the nozzle member rests on the valve member, and the Venturi tube rests on the nozzle member and is securely locked in position by the upper threaded collar 20 which screws into the upper threads of the coupling section. The nozzle proper 22 of this pumping ensemble terminates in close proximity to the throat 23 of the Venturi tube.

As many of these ensembles as are necessary for a particular well may be interposed in the tubing string at proper elevations, but if desired, the valve member 19 may be employed in the lowermost section only. As shown in Fig. 1, a plurality of the pumping ensembles 24 and 25 are interposed in the tubing string, and each of these may be constructed as shown in Figs. 2 to 4 inclusive.

As shown in these figures, a coupling section 26 has internal upper and lower threads 27 and 28, the latter engaging the external threads of a tubing section 29, and the former engaging the lower threads of a tubing section 30. Within the coupling section, we removably arrange a Venturi tube 31 and a nozzle member 32, and we anchor these elements in position by the use of threaded collars 33 and 34 which screw respectively into the threaded ends 27 and 28 of the coupling section.

In order that the coupling section may not be weakened to any material extent, we provide the same with a single inlet hole 35 only; and the nozzle member includes a ring 36 having a passageway 37 communicating with this hole. The passageway extends through an elbow 38, and between this elbow and the ring there is a single substantially C-shaped passageway 39 to permit the well fluid to flow up the tubing. In each instance, the elbow terminates in internal threads 40 to receive the external threads of the nozzle proper 41, and the latter is provided with a Venturi-shaped bore 42 through which the pressure fluid travels into the throat 43 of the Venturi tube.

Each of the threaded collars is preferably provided with spanner wrench holes 44 to facilitate removal of the elements within the coupling section.

In practice, pumping ensembles of the types described may be sold to the owner of the well and he can insert the same at any desired point in the tubing string in substitution for some of the ordinary coupling sections, and this may be done without increasing the diameter of the tubing or materially weakening the latter.

As a further feature of our invention, we arrange at the top of the well a pump 45 which acts to draw liquid from a reservoir 46 and to force the same into the annular space 14, from which it travels through the nozzle members into the tubing string. This pressure medium and the liquid pumped from the well are returned by a pipe 47 to the reservoir or tank 46. Obviously, as we use the pumped liquid as the pressure medium, it is unnecessary to make any separation of the same in the reservoir 46.

In actual practice, the Venturi tubes and nozzles will be increased in diameter from bottom to top of the tubing string to take care of the extra pump fluid that enters the nozzles, in addition to the well fluids, without retarding or choking the flow.

As best shown in Fig. 5, we have arranged two guide spurs 50 on the lowermost nozzle 18 to guide the ball 51 up beneath the elbow 52 and to keep it out of the crescent shaped port 53 so that when it is in raised position, it will not obstruct the flow of the liquid through said port. These spurs may be screwed into a lug cast on the bottom of the elbow, as shown.

In operation, the pump 45 will force oil or the like from the reservoir 46 down the annular space 14, and it will enter the nozzle elements and be discharged into the throats of the Venturi tubes where it will impact against the liquid entering the tubing through the strainer 9 and will act to drive the well liquid up the tubing and through the pipe 47 into the reservoir 46. Obviously, some of the pumped liquid returned to the well and the nozzle by means of the pump 45, and the upper ones of the pumping ensembles 24 and 25, will act to boost the liquid which has been forced upwardly by the lower ensemble or ensembles.

From the foregoing it is believed that the construction, operation and advantages of the invention may be readily understood, and we are aware that changes may be made in the details disclosed, without departing from the spirit of the invention, as expressed in the claims.

What we claim and desire to secure by Letters Patent is:

1. A well pumping apparatus including a tubing string, a coupling section forming part of said string and of substantially the same diameter as the latter, a Venturi tube arranged in said section, a nozzle member arranged in the section and having an upwardly directed nozzle terminating near the throat of the Venturi tube, a port in said section for admitting a pressure fluid into the nozzle member, and securing elements for the Venturi tube and nozzle member arranged above and below the latter and anchored to said section.

2. A well pumping apparatus including a tubing string, a coupling section forming part of said string and of substantially the same diameter as the latter, a Venturi tube arranged in said section, a nozzle member arranged in the section and having an upwardly directed nozzle terminating near the throat of the Venturi tube, a port in said section for admitting a pressure fluid into the nozzle member, and securing elements for the Venturi tube and nozzle member arranged above and below the latter and anchored to said section, one end portion of the section being threaded and one of the securing elements having threads engaging the threads of the section.

3. A well pumping apparatus including a tubing string, a coupling section forming part of said string and of substantially the same diameter as the latter, a Venturi tube arranged in said section, a nozzle member arranged in the section and having an upwardly directed nozzle terminating near the throat of the Venturi tube, a port in said section for admitting a pressure fluid into the nozzle member, and securing elements for

the Venturi tube and nozzle member arranged above and below the latter and anchored to said section, the end portions of the tubing section being provided with internal threads, and the securing elements comprising threaded collars engaging the threads of the tubing section.

4. A well pumping apparatus including a tubing string, a coupling section forming part of said string and of substantially the same diameter as the latter, a Venturi tube arranged in said section, a nozzle member arranged in the section and having an upwardly directed nozzle terminating near the throat of the Venturi tube, a port in said section for admitting a pressure fluid into the nozzle member, securing elements for the Venturi tube and nozzle member arranged above and below the latter and anchored to said section, the nozzle member comprising a ring engaging the inner surface of the section at the elevation where the port is located, an elbow united with the ring and having a passageway therethrough, and a substantially C-shaped passageway positioned between the elbow and the ring.

5. A well pumping apparatus including a tubing string, a coupling section forming part of said string and of substantially the same diameter as the latter, a Venturi tube arranged in said section, a nozzle member arranged in the section and having an upwardly directed nozzle terminating near the throat of the Venturi tube, a port in said section for admitting a pressure fluid into the nozzle member, and securing elements for the Venturi tube and nozzle member arranged above and below the latter and anchored to said section, said section being of uniform diameter throughout its length.

6. A well pumping apparatus including a tubing string, a coupling section forming part of said string and of substantially the same diameter as the latter, a Venturi tube arranged in said section, a nozzle member arranged in the section and having an upwardly directed nozzle terminating near the throat of the Venturi tube, a port in said section for admitting a pressure fluid into the nozzle member, securing elements for the Venturi tube and nozzle member arranged above and below the latter and anchored to said section, and a valve member positioned in the section below the nozzle member.

7. A well pumping apparatus including a tubing string, a coupling section forming part of said string and of substantially the same diameter as the latter, a Venturi tube arranged in said section, a nozzle member arranged in the section and having an upwardly directed nozzle terminating near the throat of the Venturi tube, a port in said section for admitting a pressure fluid into the nozzle member, and securing elements for the Venturi tube and nozzle member arranged above and below the latter and anchored to said section, said Venturi tube and nozzle member being removable from the coupling section through either end of the same.

8. A well pumping apparatus including a tubing string, a coupling section forming part of said string and of substantially the same diameter as the latter, a Venturi tube arranged in said section, a nozzle member arranged in the section and having an upwardly directed nozzle terminating near the throat of the Venturi tube, a port in said section for admitting a pressure fluid into the nozzle member, securing elements for the Venturi tube and nozzle member arranged above and below the latter and anchored to said section, and a valve member positioned in the section below the nozzle member, said Venturi tube, nozzle member and valve member being removable from the coupling section through either end of the same.

9. A well pumping apparatus including a tubing string, a series of Venturi tubes arranged in the tubing string between the top and bottom of the latter, the bores of the Venturi tubes increasing in diameter from the bottom toward the top of the tubing string, a nozzle associated with each Venturi tube and having an upper end terminating near the throat of the Venturi tube, the bores of the nozzles increasing in diameter from the lowermost nozzle to the uppermost nozzle, ports in the tubing string for admitting a pressure fluid into said nozzles, and means for furnishing a pressure fluid to said ports.

10. A well pumping apparatus including a tubing string, a Venturi tube arranged in the string, a nozzle member arranged in the string and comprising a collar and an elbow shaped nozzle, the nozzle having an upwardly directed outlet terminating near the throat of the Venturi tube, a port in the collar for admitting a pressure fluid into the passageway of the nozzle, said nozzle member having a substantially C-shaped passageway between the nozzle and collar, a valve seat arranged in the tubing string below the nozzle member, a ball valve cooperating therewith, and guiding means within the string for causing the ball in rising to occupy a position beneath the nozzle to prevent the ball from obstructing said substantially C-shaped port.

In testimony whereof, we hereto affix our signatures.

CHARLES J. WOLFF.
WILLIAM W. COUCH.