Aug. 14, 1945. E. N. WASHBURN 2,382,685

ROTARY JET GUN

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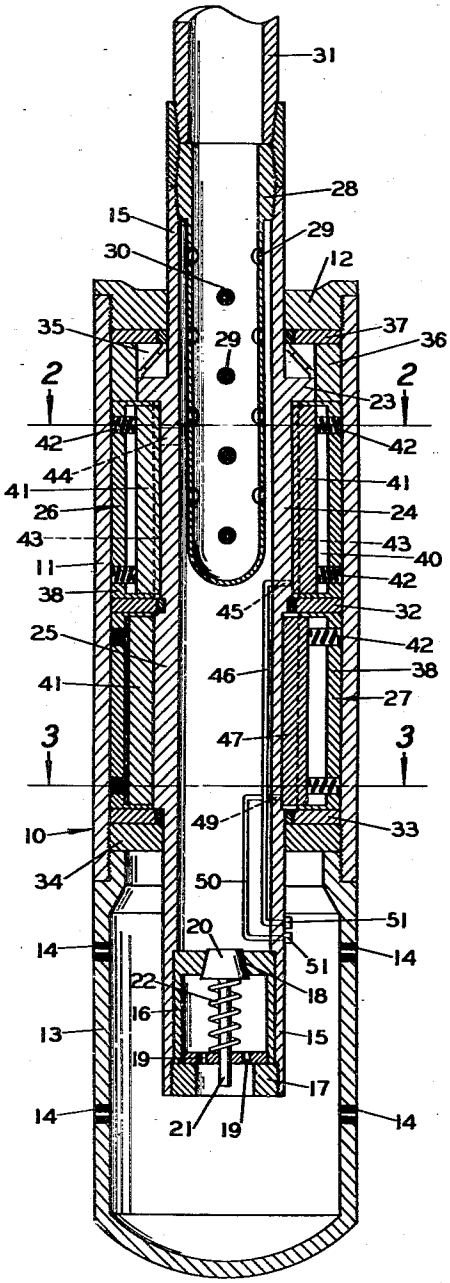


FIG. 1

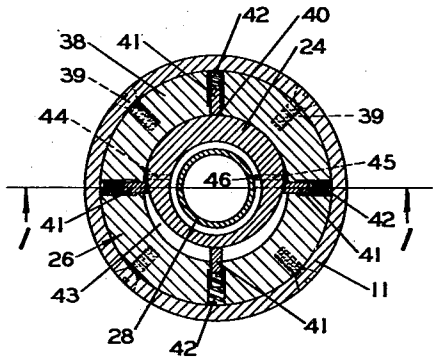


FIG. 2

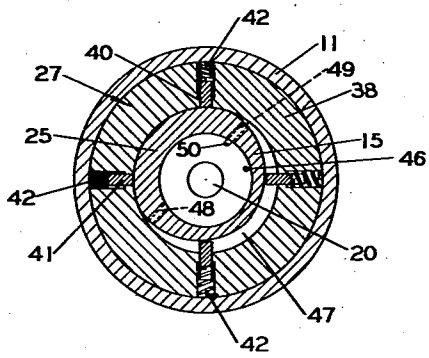


FIG. 3

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4 Claims. (Cl. 166—20)

This invention relates to the treatment of underground formations, and more particularly to an apparatus for treating well bores.

In order to facilitate the recovery of hydrocarbon fluids from oil and gas wells, the formations containing the hydrocarbon fluids are often treated with acids or other chemicals. It is common practice in acidizing oil and gas wells to inject a quantity of acid solution into the formation surrounding the well bore, where the acid solution reacts with the formation increasing the size of the pores of the formation, and after the acid has reacted to retrieve the solution of "spent" acid and dissolved chemicals from the formation. Under certain operating conditions it is expedient to impinge the acid solution against the wall of the well bore with great force in order to thoroughly cleanse or break down the formation adjacent to the well bore.

By the practice of my invention I am able to overcome a number of disadvantages which are inherent with present-day types of jetting devices or "jet guns" that are adapted for acidizing well bores. Present-day jetting devices are commonly lowered into a well bore on a string of oil well tubing from the surface of the ground. These devices are usually provided with a plurality of jets through which fluid under very high pressure is impinged against the wall of the well bore. As it is a dangerous operation to rotate the tubing string when it is filled with a high pressure fluid, the fluid which is discharged from the jets acts upon only those portions of well bore wall as lie directly in the path of the jets. As I employ a rotating type of jetting device, I am able to jet fluid on the entire surface of a well bore with the employment of a lesser number of jets than has been heretofore possible. This increases the effectiveness of the jetted fluid. Further, the rotation of my jetting device is effected without the loss to the jets of any fluids.

The primary object of my invention is to provide an apparatus for treating well bores.

Another object is to provide a rotatable jetting apparatus for discharging a high velocity fluid against the surface of the well bore.

These and additional objects and advantages will be apparent to persons skilled in the art by reference to the following description and annexed drawing, which pertain to a preferred embodiment of my invention; wherein,

Figure 1 is a central cross-sectional view in elevation showing one half of my invention;

Figure 2 is a view in cross-section taken along line 2—2 of Figure 1; and

Figure 3 is a view in cross-section taken along line 3—3 of Figure 1.

Referring to the drawing and more particularly to Figure 1 for a detailed description of my invention, it will be noted that reference numeral 10 generally refers to a cylindrical housing which includes an upper hollow cylinder 11, which is preferably internally threaded at the top to connect with a threaded cap 12 and a lower closed hollow cylindrical member 13, which is provided with a plurality of removal jets 14, connected by threads to a cylinder 11. A tubular member 15 is contained within housing 10 in a manner which will be described later along in the specification. Member 15 extends downwardly into the lower portion of the housing. The bottom end of member 15 is adapted to receive a valve housing 16 which is positioned by a threaded ring 17. The valve housing has a valve seat 18 in the top and a plurality of ports 19 in the bottom. A valve head 20, which is connected to a slidable valve stem 21, is normally maintained in a closed position by a compression spring 22. Member 15 is also provided with a flange 23 and with a pair of circular bosses 24 and 25; the cross-section of the bosses is best illustrated in Figures 2 and 3. Bosses 24 and 25 form a part of the nonrotating shaft of a pair of fluid motors 26 and 27, respectively, which will be described in detail later along in this specification. The top of member 15 is preferably internally threaded to receive a filter 28, having a plurality of openings 29 which are covered with filtering elements 30. The upper end of the filter is also threaded to receive a string of oil well tubing 31. It is to be noted that fluid motor 26 is separated from fluid motor 27 by a sealing ring 32. A second sealing ring 33 is provided at the base of motor 27. A bearing 34, which is threadedly positioned in the lower end of cylinder 11, supports ring 33 and the fluid motors. The inner surface of the bearing journals on member 15 and aligns the housing with the lower portion of member 15. A suitable bearing 35 is positioned on flange 23 between the external surface of member 15 and the upper inner surface of a positioning ring 36, which is placed between the internal wall of cylinder 11 and the periphery of flange 23, maintaining member 15 in a central position. It will be noted that bearing 35 is covered with a sealing ring 37, which is positioned on the upper surface of ring 36 and between the internal wall of cylinder 11 and the external surface of member 15. Sealing ring 37 is held in place by cap 12. Thus, flange 23, positioning ring 36, sealing ring 37 and member 15 provide a race for bearing 35. It will be noted that cap 12 and bearing 34 cooperate to position fluid motors 26 and 27 within housing 11 and to place the downward thrust of housing 10 on bearing 35. From the above description of structure, it is apparent that the motors are mounted in an upper chamber separated from the lower chamber by bearing 34 and valve 20.

Referring also to Figures 2 and 3 for a description of the fluid motors, it will be noted that each

motor is provided with a hollow cylindrical element 38, which rotates about the circular bosses of member 15. Elements 38 are attached to housing 10 by a plurality of set screws 39, which insure the rotation of the housing when elements 38 rotate about member 15. Elements 38 are provided with a plurality of radial slots 40, each of which contains a slidable vane 41. The vanes are provided with suitable springs 42 which urge the vanes inwardly to make contact with member 15. It is to be noted that parts of the fluid motors are in sufficiently close contact to effectively prevent the leakage of fluid. As shown in the drawing, the inner surface of element 38 contacts that portion of member 15 which contains the circular bosses. A space 43 is formed between the inner surface of element 38 and the external surface of member 15, where those two surfaces are not in close contact. A suitable inlet 44, which is provided at one side of boss 24 near the upper end of fluid motor 26, allows communication between the interior of member 15 and space 43. A suitable outlet 45, which is provided at the other side of boss 24 allows communication between space 43 and a conduit 46 which in turn communicates with the interior of closed cylinder 13. A space 47, identical to space 43, is formed in fluid motor 27, which, like motor 26, has a suitable inlet 48 and an outlet 49 which communicates with a conduit 50. This conduit allows communication between space 47 and the interior of closed cylinder 13. Conduits 46 and 50 are provided with check valves 51 which prevent fluid from entering the conduits from closed cylinder 13. It is to be further noted that motors 26 and 27 may be identical in size and shape and under certain operating conditions, only one of the motors, such as motor 26, may be used to rotate housing 10. If only one motor is used, the inertia of my apparatus will be utilized to rotate the housing when one of the vanes covers the inlet. In order to insure a positive rotation of housing 10, I recommend the use of a plurality of fluid motors, which are so arranged and positioned with respect to each other that one of the inlets is always open. I prefer to arrange the bosses so that inlet 44 is forty-five degrees clockwise from inlet 48 with respect to the vertical axis of member 15. It is to be noted that my arrangement of parts insures a counterclockwise rotation of the fluid motors.

In operation, let us assume that my apparatus has been assembled, as shown in the drawing. My apparatus is filled with a fluid, such as an inhibited acid, paraffin solvent, water, or other desired fluid, and is supported by tubing 31 which conducts fluid thereto. Fluid flows from tubing 31 to filter 28 where entrained solids are removed by filtering elements 30. Fluid leaves the filter by means of openings 29 and passes into member 15. As valve head 20 is urged against valve seat 18 by a compression spring 22, the fluid in member 15 must be at a higher pressure than that of the closed container in order to move the valve head off its seat, allowing the fluid in member 15 to flow through the valve, ports 19, and into closed cylinder 13. Part of the fluid in member 15 flows through inlets 44 and 48 of fluid motors 26 and 27, respectively, where the fluid fills spaces 43 and 47 of the motors and acts upon vanes 41 to cause rotation of housing 10 in a counterclockwise direction. During the rotation of the housing and elements 38, the vanes are urged against the external surface of member 15 by springs 42. As the vanes move along the surfaces of the bosses, they recede fully into slots 40. As the vanes approach the outlets of the fluid motors, the fluid which is carried in front of the vanes flows through outlets 45 and 49, and is conveyed by conduits 46 and 50, respectively, to closed cylinder 13. Thus, the pressure of the fluid discharged from the fluid motors will be substantially that of the fluid in the closed cylinder. The differential pressure between the fluid in member 15 and in the closed cylinder may be small. The differential pressure is controlled by spring 22 which regulates the movement of valve head 20 with respect to the valve seat. The pressure in the closed cylinder, however, may be very high. Due to the high pressure, the fluid emitted from the closed cylinder through jets 14 will have a high velocity and will be capable of producing a high jetting action. When my apparatus is employed in a well bore, it is possible to jet a high velocity fluid along the circumference of the well without rotating tubing 31. By employing several jets and by raising or lowering my apparatus in a well bore, I can jet the entire surface of a well bore with a high velocity fluid.

From the foregoing, it is believed that the operation and advantages of the apparatus for practicing my instant invention will be readily comprehended by persons skilled in the art. It is to be clearly understood, however, that various changes in the apparatus shown and described may be resorted to without departing from the spirit of the invention, as defined by the appended claims.

I claim:

1. A well tool of the character described comprising a housing, means dividing said housing into an upper chamber and a lower chamber, fluid conducting means for introducing fluid under pressure into both chambers, a fluid motor in the upper chamber operated by the fluid under pressure therein for rotating said housing, a discharge conduit from said motor opening into the lower chamber, and discharge means in the wall of the part of the housing forming the lower chamber to discharge the fluid therefrom.

2. In the combination of claim 1, said conducting means including a spring loaded valve for maintaining a predetermined pressure in the lower chamber.

3. In the combination of claim 1, said conducting means including a spring loaded valve for maintaining a predetermined pressure in the lower chamber and a check valve at the discharge end of said conduit to prevent fluid flow from the lower chamber into said conduit.

4. A well tool of the character described comprising fluid conducting means having a port at its end, a spring loaded valve for normally closing said port, a housing rotatably mounted on said conducting means, a sealing partition in said housing dividing it into an upper chamber and a lower chamber, a fluid motor in said upper chamber, said conducting means containing a passage for supplying fluid to said motor, a conduit from said motor discharging into said lower chamber into which said spring loaded valve also discharges, and jet means in the wall of the portion of the housing forming the lower chamber, said spring loaded valve maintaining a predetermined pressure in the lower chamber during discharge of fluid from said jets.

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