Aug. 24, 1937. R. L. ARTERBURY 2,091,023

WELL BORING APPARATUS

Filed April 14, 1937

Fig. 1.

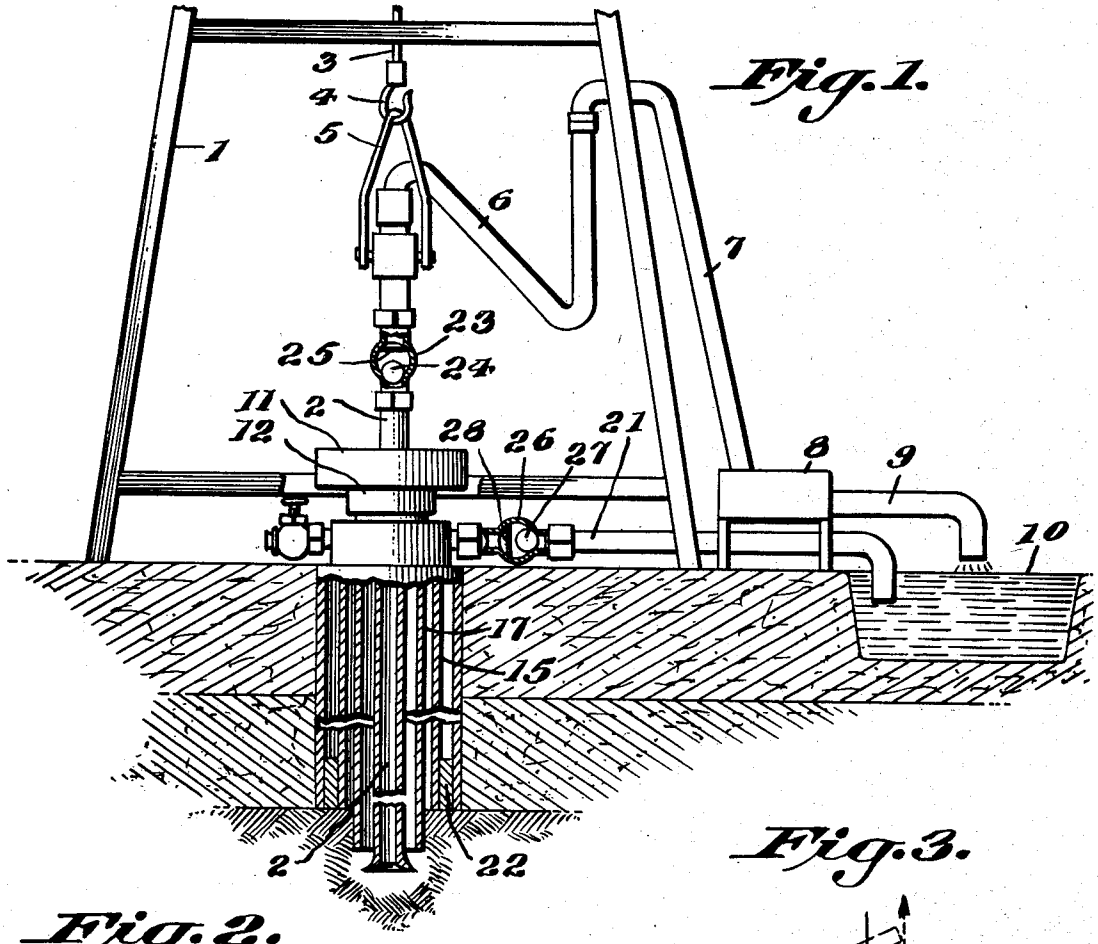


Fig. 3.

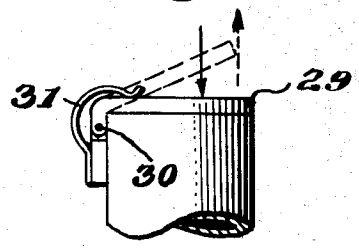


Fig. 2.

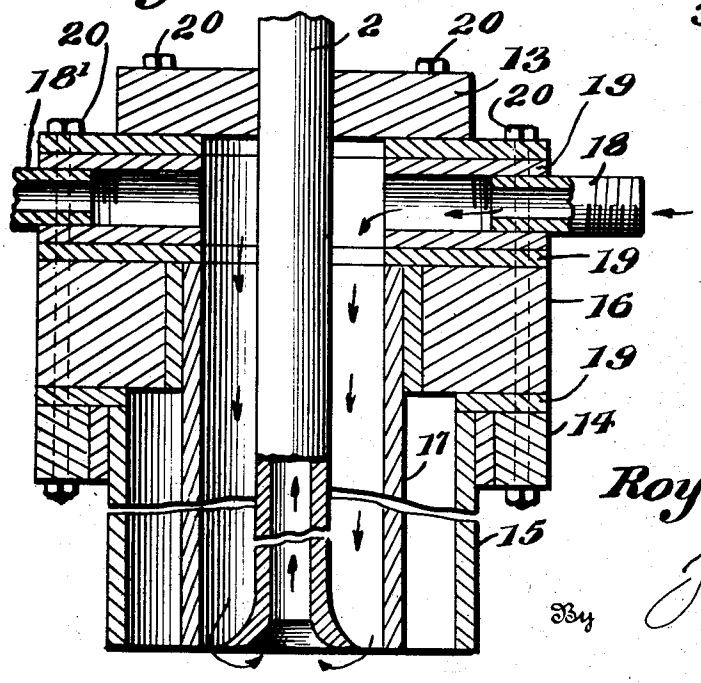
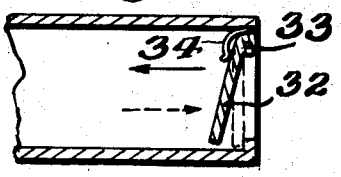


Fig. 4.



Inventor

Roy L. Arterbury,

By James M. Earnest.

Attorney

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WELL BORING APPARATUS

Roy L. Arterbury, Houston, Tex.

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5 Claims. (Cl. 255—24)

This invention relates to an apparatus for use in boring wells, but more particularly to a novel means associated with a boring tool for providing a fluid circulation to and from the working end of such tools for removing the borings.

The main object of the invention is to provide a means which is operative to produce a continuous one directional circulation of a fluid mass through certain pipes used in boring a well.

Another object is to dispense with the use of the mud-pump and related apparatus now in common use by modifying the drill pipe and related apparatus in a manner to permit the drill pipe itself to function in the manner of a fluid pump.

A further object is to provide, in a boring tool, a fluid circulatory means which is simple, practical and economical, and which may be readily installed and operated.

According to this invention, a one-way fluid outlet or exhaust valve is provided within a drill pipe and the upper end of the pipe is connected by a conduit, flexible all or in part, which is arranged to discharge into a sump or reservoir. A return conduit is arranged to draw fluid from this reservoir and deliver this fluid to the space provided between the drill pipe and the bore-casing pipe. This return conduit is provided with a one-way intake valve which is effective to prevent flow of fluid from the bore hole towards the reservoir. When it is desired to circulate the fluid, the drill pipe is reciprocated up and down. During the upward travel of the drill pipe, a vacuum tends to form between the drill pipe and bore-casing pipe, which vacuum is effective to simultaneously cause or permit removal of a quantity of liquid from the bore hole and a replacement of an equal quantity of fluid which is drawn into the bore hole from the reservoir or supply tank. During the downward travel of the drill pipe, a corresponding or equal quantity of liquid is ejected or forced from the bore hole upwardly past the exhaust valve in the drill pipe.

For a detailed description of the apparatus set forth and operation thereof, reference is made to the specification which follows and accompanying drawing, wherein—

Figure 1 is a side elevational view, partly in section, of a preferred form of the invention;

Fig. 2 is an enlarged detail view of a unitary stuffing box and fluid inlet;

Fig. 3 shows a modified form of outlet valve; and

Fig. 4 shows a modified form of inlet valve.

Referring to the drawing for details, a conventional well rig 1 is shown in position to support a drill pipe 2 by means of a rod 3, a hook 4 and clevis 5. The upper end of pipe 2 is shown as connected through a flexible conduit 6 to a rigid conduit 7 which feeds into a sediment or mud trap 8. The liquid, after being freed of excess sediment or borings, passes through a pipe 9 into a reservoir or basin 10.

Any well known means is provided to raise and lower the rod 3 and drill pipe 2. Numeral 11 indicates a common form of rotary table which is operative to rotate the drill. An essential and important feature of this invention comprises a unitary stuffing box and inlet head 12 shown in detail in Fig. 2. The stuffing box proper is shown at 13 as surrounding the drill. A metal threaded ring 14 is arranged to support the outside bore casing 15 and a second metal threaded ring 16 is arranged to support the inner bore casing 17. One or more fluid inlet pipes 18, 18' are provided to supply fluid to the space between drill 2 and casing 17. Gaskets 19 are provided to effectively seal the chambers between drill 2 and casings 15, 17 against leaks of fluid or air therefrom to the outside space except in and out of conduits arranged for normal flow. A series of bolts 20 are provided to secure the parts described in close engagement. The inlet pipes 18 are connected by a conduit 21 to the reservoir 10. A cement plug 22 is set at the bottom of bore casing 15 to prevent interference from surface elements. If desired, the pipe 18' properly valved may serve as a gas exhaust from the bore hole.

A ball check or one-way valve 23 is provided within drill pipe 2. The ball 24 is adapted to seat by gravity in its lower position to close the drill pipe. This ball is free to move upwardly against a cross-bar 25 when the drill pipe is lowered to permit liquid to flow upwardly.

A similar ball check or non-return valve 26 is provided in conduit 21. The valve ball 27 is arranged to seat at its extreme right hand position to close the conduit 21 and prevent fluid from flowing back to reservoir 10 when the drill is being lowered. The ball 27 may move to its left in Fig. 1 against cross-bar 28 to permit liquid to be drawn from the reservoir when the drill pipe is being elevated.

Fig. 3 shows a modified form of exhaust valve 29 particularly adapted to handle larger sizes of borings or debris. The valve 29 is pivoted at 30 and a spring 31 is arranged to bias the valve to its closed position. A modified form of inlet

valve 32 is shown in Fig. 4. The valve 32 is pivoted at 33 and a spring 34 is provided to bias this valve to its closed position. When a valve such as 29 is used, it will be placed at the outlet end of conduit 7.

In the operation of the apparatus described, when it is desired to remove accumulated debris or borings from around the drill tip, the rod 3 is caused to reciprocate up and down a desired amount. Any well known means may be used to produce such motion such as a simple first class lever or walking beam connected at one end to rod 3 and at its free end to an operating link driven from the machine that operates the rotary 11. When pipe 2 is moving up, ball 23 is seated. Due to a vacuum forming within casing pipe 17 and drill pipe 2, fluid will be retained within pipe 2 below ball 24 and a quantity of fluid will be drawn in from conduits 18 and 21 equal in amount to that lifted by pipe 2. When the drill pipe 2 is moved downwardly, no fluid will be permitted to pass back to reservoir 10 because valve 26 will close with the result that fluid in pipe 2 will be forced up along and above the valve 23 in a manner to discharge through conduits 6 and 7 to reservoir 10. The amount of fluid taken in and discharged during each up and down stroke will equal the displacement volume of the drill in the fluid. As long as drill pipe 2 is reciprocated, a one-way circulation of fluid will be maintained from reservoir 10 by way of pipes 21, 18 and 17, up through drill pipe 2, and conduits 6, 7 back to reservoir 10.

In prior art devices such as shown in Patent No. 260,483, issued to C. H. Leach, a check valve is positioned at the lower end of the drill. In such position, the valve operation is not satisfactory due, in part, to presence of heavy boring particles and lack of sufficient velocity of fluid. According to British Patent No. 1,450 of 1858, it is proposed to arrange a piston on and around the drill pipe and position check valves therein. Such a piston is not readily accessible and is costly to install and maintain in view of excessive wear thereon not to mention loss of efficiency due to fluid leakage around the piston. A piston of this type is subject also to excessive wear due to rotation of the drill pipe during boring. According to the present invention, the disadvantages of such prior art devices are entirely eliminated.

I claim:

1. In a device for drilling in combination, a tubular drill pipe, a fluid discharge conduit connected to the upper end of said pipe, an exhaust check valve positioned to intercept fluid flow through said pipe and conduit and directed to permit fluid flow upwardly only through said pipe, a bore casing surrounding said pipe, means for providing a fluid tight seal between the upper end of said casing and drill, a source of fluid supply, a conduit connecting said fluid supply to the space within said casing, a check valve associated with said last-named conduit and being formed and directed to permit fluid flow from said source to said space but not in a reverse direction, said valves being respectively arranged to alternately close and open upon reciprocation of said drill pipe.

2. In a device as set forth in claim 1, wherein the exhaust check valve is positioned within the drill pipe a substantial distance above the lower end thereof.

3. In a device as set forth in claim 1, wherein the exhaust check valve is positioned adjacent the free end of the fluid discharge conduit.

4. In a device for drilling a vertical bore hole, a tubular drill pipe, a bore casing surrounding and spaced from said pipe, means providing a liquid seal between the upper end of said casing and said pipe, a conduit for supplying fluid to the space within said casing, an inlet check valve operatively associated with said conduit, an exhaust check valve associated with said drill pipe and being positioned above the lower end thereof for controlling fluid flow therethrough, said inlet valve being arranged to open to pass liquid to said space under suction due to displacement of the drill in an upward direction, said exhaust check valve being arranged to be closed during upward movement of the drill.

5. In a device for drilling a vertical bore hole, a tubular drill pipe, a bore casing surrounding and spaced from said pipe, means providing a liquid seal between the upper end of said casing and pipe, an exhaust check valve associated with said drill pipe and being positioned above the liquid seal to intercept fluid flow through said pipe, a fluid reservoir, a fluid supply conduit for connecting said reservoir to the space within said casing, an inlet check valve for controlling fluid flow through said conduit and being directed to pass fluid only towards said space, said drill upon being moved upwardly tending to produce a vacuum within said space, said vacuum being effective to open the inlet valve and draw in fluid through said conduit, said exhaust valve simultaneously therewith being held in closed position by said vacuum and fluid head in said pipe, said exhaust and inlet valves respectively being moved to open and closed positions during return movement of the drill pipe to its lowered position whereby a quantity of fluid in said space is displaced to a position above said exhaust valve.

ROY L. ARTERBURY.