Nov. 5, 1940. A. G. H. STRAATMAN 2,220,554

DEVICE FOR RECOVERING CORES FROM BOREHOLES

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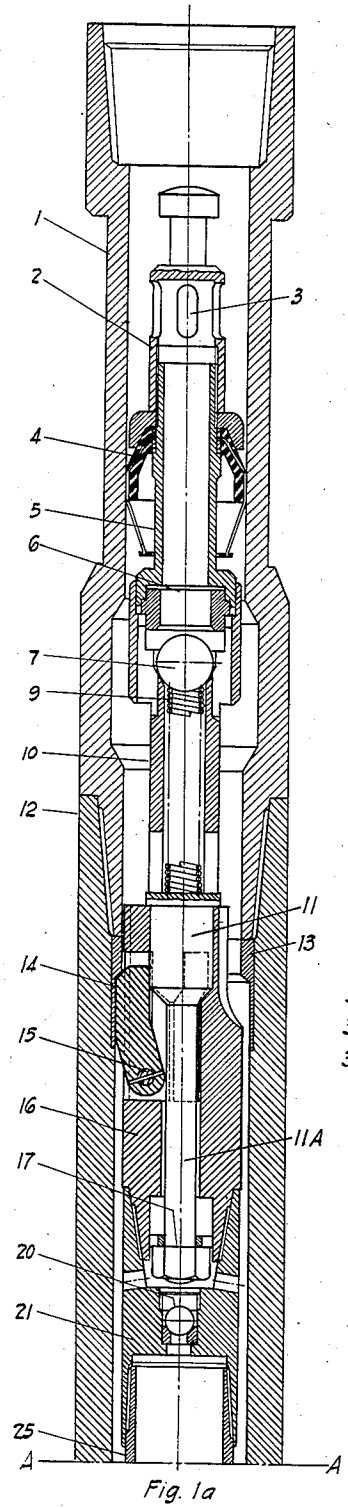

Fig. 1a

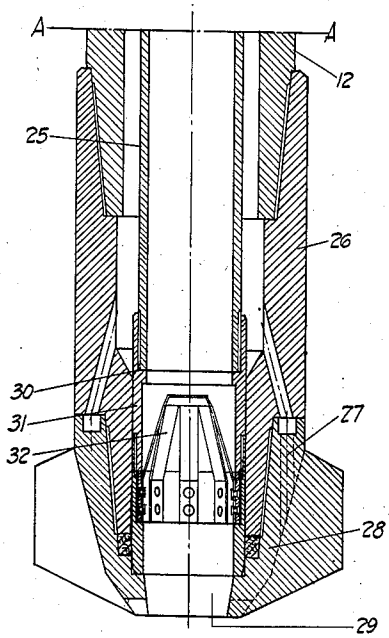

Fig. 1b.

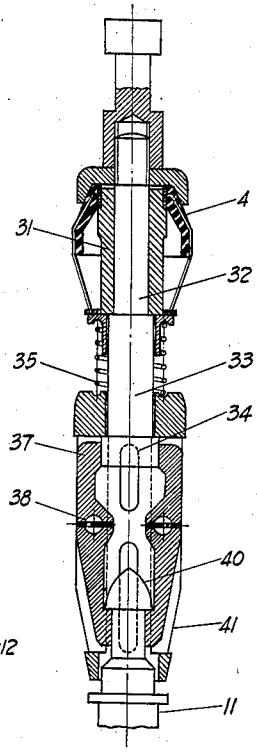

Fig. 2

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DEVICE FOR RECOVERING CORES FROM BOREHOLES

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5 Claims. (Cl. 255—72)

The present invention pertains to the drilling of wells, and relates more particularly to an apparatus whereby representative formation samples or cores may be lifted from a well without the necessity of removing or raising the drilling equipment from the borehole.

There has been described in the U. S. Letters Patent No. 2,073,263 to Hohmann and De Wilde, a device comprising a core barrel fitting inside a drill bit and surrounded by a valved annular passage, by means of which device cores can be lifted to the surface by the pressure of the drilling fluid. For this purpose, the circulation of the drilling fluid, which is normally pumped down through the drill pipe, is reversed by pumping said fluid down outside the drill pipe, whereby the valved annular passage is automatically closed, and the pressure of the drilling fluid, applied to the bottom face of the core, operates to raise the core and the core barrel to the surface through the drill pipe.

It has been, however, found that apparatus of this construction gives rise in operation to various difficulties due to the scoring and clogging of the automatic valve located in the relatively constricted annular passage between the core drill and the core barrel and subjected to the pressure of the drilling fluid.

It is the object of the present invention to remedy these difficulties by providing a core lifting apparatus arranged so that the surface subjected to the pressure of the reversed drilling fluid is formed by a packer or piston located above the core barrel.

It is another object of this invention to provide a core lifting apparatus either entirely dispensing with a valve controlling the directional flow of the drilling fluid or having a valve attached to the core barrel instead of the drill pipe or bit, whereby said valve is lifted to the surface during each core-taking operation and may be easily repaired if damaged, or cleaned if clogged.

Other objects and features of the invention will appear more clearly from the following description taken in connection with the attached drawing, wherein:

Figs. 1*a* and 1*b* give a cross-sectional elevation view of a preferred embodiment of the present invention in which the surface subjected to the pressure of the drilling fluid is formed by a piston permanently attached to the core barrel.

Fig. 2 gives a cross-sectional elevation view of a part of another preferred embodiment of the present invention in which said piston forms part of a separate hoisting device lowered into the well and temporarily coupled to the core barrel when the latter is to be lifted from the well.

Referring to Fig. 1, a drill pipe comprising coupled sections 1, 12 and 26 is shown carrying at its lower end a drill bit 28, provided with suitable passages 27 for the circulation of the drilling fluid. The drill bit has a circular opening 29 at its lower end to receive the core. A bushing 31, carrying suitable core-catching members 32, is inserted in this opening and screwed to the drill bit. The bushing 31 is provided with a shoulder 30. The lower end of a core barrel 25 fits slidingly against said shoulder. The core barrel 25 is closed at the top by a barrel head 21, provided with a vent valve 20. A hollow mandrel 16 is screwed to the head 21 and carries a plurality of pawls 14 (of which one is shown in the cross sectional drawing), rotatable about shafts 15. The pawls 14 abut with their upper ends against the sloped inside shoulder of a collar 13 attached to the drill pipe. When in the position shown in the drawing, these pawls prevent an upper movement of the core barrel. They are forced into said position by the thickened portion 11 of a rod 11A which fits slidingly in the axial bore of the mandrel 16 and carries at its lower end a stop nut 17. Above its thickened portion 11, the rod 11A extends as a tube 10, which forms in its upper part a housing for a ball valve 7. The ball is pressed upwards by a spring 9 against a seat 6 which is fitted in a tubular part 5 screwed into the tube 10. The tubular part 5 carries externally a packer or piston 4 made of rubber, canvas or other suitable elastic material, and adapted to fit tightly against the walls of the drill pipe 1. The tubular part 5 is closed at the top by a head 2 provided with lateral openings 3.

In operation, the following procedure may be followed:

When the core is being drilled, the position of the parts is as shown on the drawing. The drilling fluid is pumped down inside the drill pipe 1 and passes through the lateral openings 3 in the head 2, inside the tubular part 5, past valve 7, which is forced down against the action of spring 9, around tube 10 and mandrel 16 to the annular space between drill pipe section 12 and core barrel 25, being finally discharged to the outside of the drill pipe through passages 27 in the drill bit.

When the circulation is reversed, and the drill-

ing fluid is pumped down outside the drill pipe, it enters the latter through the passages 27, and passes up through the annular space between the inside walls of the drill pipe and the core barrel and the mandrel 16. The ball valve 7 is now, however, pressed against the seat 6 by the action of spring 9, thus preventing further escape of the fluid. The pressure of the fluid, acting on the underside of piston 4 causes the latter to move upwards, carrying with it the tube 10 and the rod 11—11A, until said motion is stopped by the nut 17. The upward displacement of the thickened rod 11 permits the pawls 14 to move inwards by pressure against the slanting shoulder 13, whereby the whole core barrel assembly is released from engagement with the drill pipe and lifted to the surface by the continued fluid pressure against the piston 4 and/or the bottom of the core.

If the piston 4 is to be effective in raising the core barrel assembly to the surface, it is desirable that it should remain in continuous contact with the walls of the drill pipe throughout the whole length of the string. Tool joints free of internal constructions, that is, tool joints of the externally upset type should, therefore, be preferably used to connect drill pipe sections when using the apparatus of this invention.

It is, however, possible to use the present core-lifting device in drill pipe strings equipped with the usual internally upset tool joints and having, therefore, passages of reduced diameter at the couplings, provided the length of the core barrel assembly (from piston 4 to the lower end of the core barrel 25) is somewhat greater than the distance between two tool joints, so that at least one of two successive constricted passages is at all times closed either by the piston 4 or by the core barrel itself.

Fig. 2 shows a somewhat different embodiment of the present device, in which the piston or packer 4 forms a part of a separate hoisting device to be lowered into the drill pipe string.

This hoisting device comprises a member 41 carrying jaws 37 hinged on shafts 38. A rod 33 having a lower thickened portion 34, and an upper reduced portion 32 passes through an axial opening in the upper part of the member 41, the thickened rod portion 34 being located below said opening. A tube 31 surrounds the upper reduced rod portion 32 and carries externally the packer or piston 4. A spring 35 is provided around rod 33 and urges it upwards with regard to the member 41, forcing the thickened portion 34 between the upper ends of the jaws 37 and keeping thereby the lower ends of said jaws closed.

The arrangement of all parts of the core barrel assembly proper is identical to that shown in Fig. 1 below the thickened rod portion 11 (which is partially shown in Fig. 2). A knob-shaped fishing head 40 instead of the tube 10 is, however, attached to the top of the thickened rod 11, and is adapted to be engaged by the jaws 37.

In operation, the following procedure may be followed when using the device shown in Fig. 2.

When the core has been drilled out, the hoisting device is pumped down the drill pipe string. The closed jaws come to rest on the knob 40, while momentum and the downward pressure of the fluid forces the piston 4, tube 31, and rod 32—33—34 further down against the action of the spring 35. When the thickened rod 34 is depressed beyond the lower ends of jaws 37, the lower ends of these jaws open and slide down past the knob 40.

When the circulation of the drilling fluid is reversed, the upward pressure of the fluid raises the piston 4, tube 31, and rod 32—33—34. The thickened rod 34 is again forced between the upper ends of the jaws, and the lower ends of these jaws are locked in gripping engagement with the knob head 40, the barrel assembly and the hoisting device being then raised to the surface by the fluid pressure against the piston 4 as described above.

I claim as my invention:

1. In an apparatus for lifting cores through a drill pipe by fluid pressure, a core barrel within the drill pipe, means releasably locking the core barrel with the drill pipe, a piston above the core barrel in sliding internal engagement with the drill pipe, rigid means connecting the piston to the core barrel, said means being capable of a limited axial stroke with regard to the core barrel, and being adapted on reaching the end of their upper stroke to release the means locking the core barrel with the drill pipe and to cause the core barrel to follow the piston when the latter is moved upwards by the flow of the fluid in the drill pipe.

2. In an apparatus for lifting cores through a drill pipe by fluid pressure, a core barrel within the drill pipe, means releasably locking the core barrel with the drill pipe, a piston above the core barrel in sliding internal engagement with the drill pipe, valve means surrounded by said piston to permit a downward flow and to prevent an upward flow of the fluid in the drill pipe past said piston, rigid means connecting the piston and the core barrel, said means being capable of a limited axial stroke with regard to the core barrel, and being adapted on reaching the end of their upward stroke to release the means locking the core barrel with the drill pipe and to cause the core barrel to follow the piston when the latter is moved upwards by the fluid flow in the drill pipe.

3. In an apparatus for lifting cores through a drill pipe by fluid pressure, a core barrel within the drill pipe, means releasably locking the core barrel in engagement with the drill pipe, a piston adapted to be pumped down into the drill pipe by a downward fluid flow, gripping means carried by said piston, means actuated by a downward fluid flow in the drill pipe to cause said gripping means to engage the means locking the core barrel with the drill pipe, and means actuated by an upward fluid flow in the drill pipe, and comprising said gripping means, adapted to release the means locking the core barrel from engagement with the drill pipe, and to cause the core barrel to follow the piston when the latter is moved upwards by the fluid flow in the drill pipe.

4. In an apparatus for lifting cores through a drill pipe by fluid pressure, a core barrel within the drill pipe, means releasably locking the core barrel to the drill pipe, a fluid passage around the core barrel in communication with the inside of the drill pipe, means to pass a downward fluid flow through the drill pipe and said passage, means to reverse the direction of said flow, means within the drill pipe above the core barrel closing said drill pipe to an upward fluid flow, said means being actuated by a reversal of fluid flow to release the means locking the core barrel to the drill pipe.

5. In an apparatus for lifting cores through a drill pipe by fluid pressure, a core barrel within the drill pipe, means releasably locking the core barrel with the drill pipe, a fluid passage between the core barrel and the drill pipe, a valved piston above the core barrel, the valve of said piston being adapted to remain open during a downward flow of the fluid through said passage and to close when the direction of said flow is reversed, the closing of said valve automatically causing the piston to release the means locking the core barrel to the drill pipe.

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