Dec. 8, 1931. C. H. HARDIES ET AL 1,835,392

ROTARY DRILLING JAR

Filed June 11, 1930 2 Sheets-Sheet 1

Fig. 1.

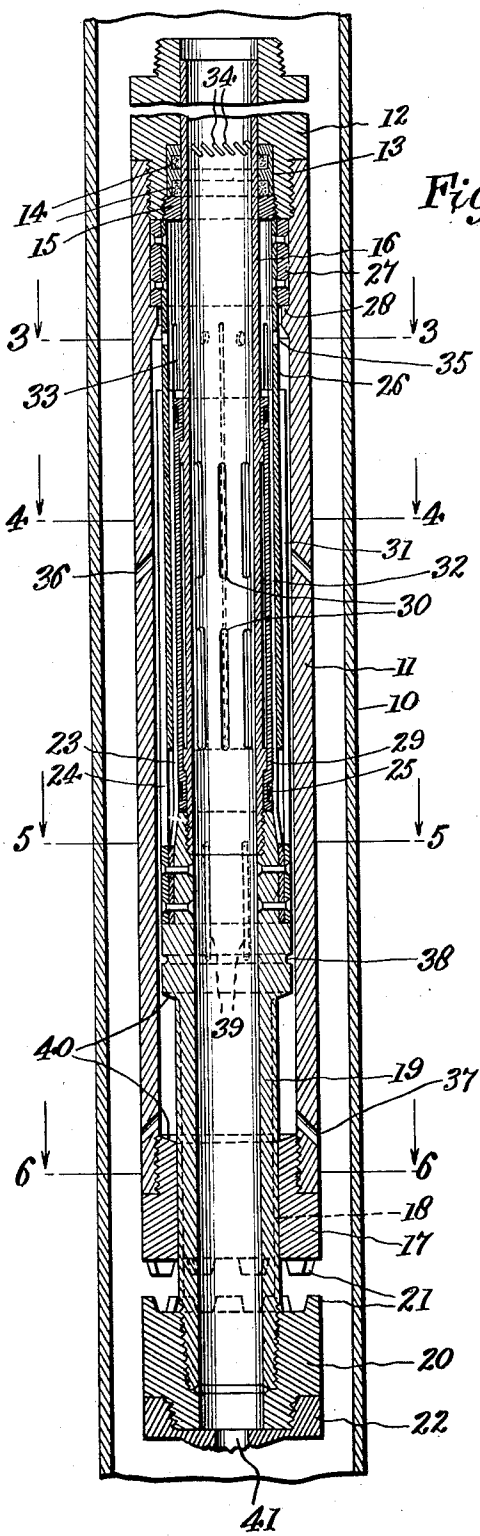


Fig. 3.

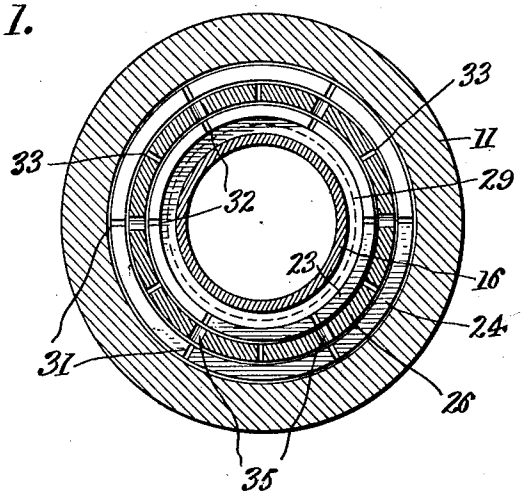
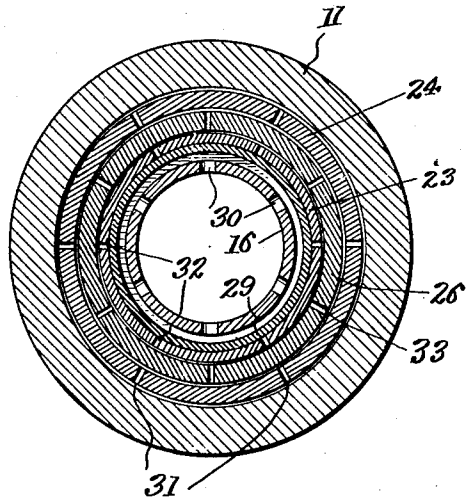


Fig. 4.



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Fig. 2.

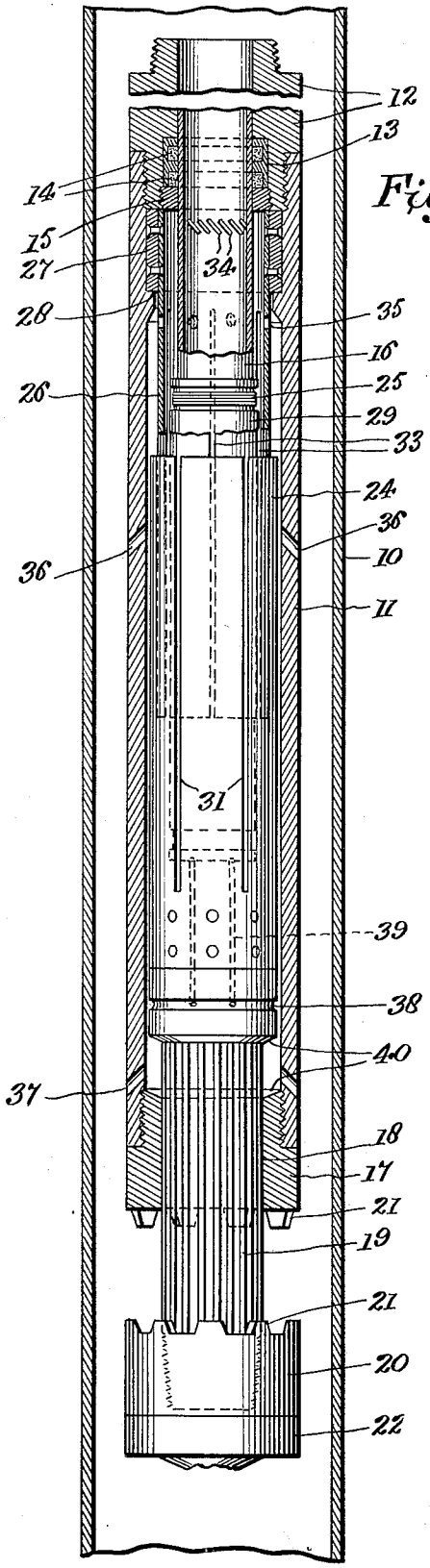


Fig. 5.

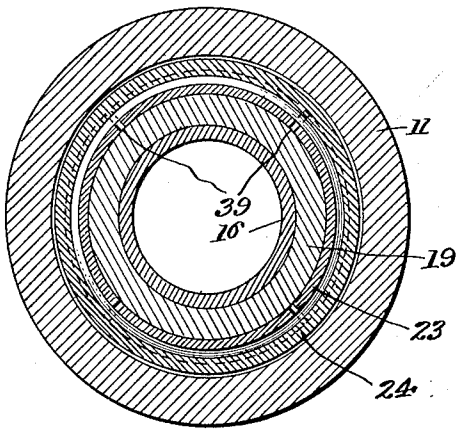
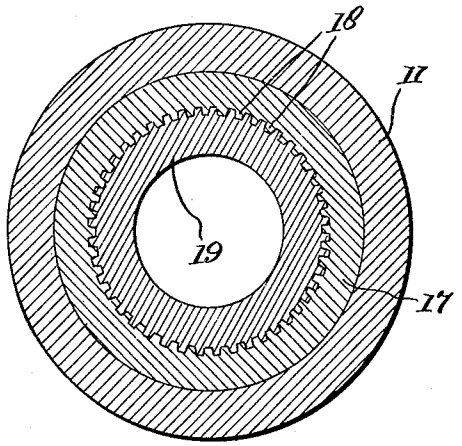


Fig. 6.



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UNITED STATES PATENT OFFICE

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ROTARY DRILLING JAR

Application filed June 11, 1930. Serial No. 460,453.

The present invention relates to improvements in rotary drilling jars, and has for an object to provide an improved rotary drilling jar, in which there will be no delicate mechanism to get out of order, or become broken.

Another object of the invention is to provide an improved rotary drilling jar, in which a minimum number of parts are employed in a compact and strong structure whereby it becomes feasible from a practical standpoint to incorporate the jar in the drilling string and have same always available.

Heretofore, where the jar was not incorporated with the string, if the bit became stuck, it was necessary to unhook or disconnect the string from the bit, pull the string out, apply the jar, run the string in again with the jar attached, and reconnect this string with the tool. Not until then could the jar be actuated to set the tool free. This operation involves a loss of time, during which mud, sand or formation are allowed to settle about the fish, and render it vastly more difficult to free.

It is an object of the invention to overcome all of these difficulties by incorporating the jar directly in the string by a novel arrangement of the parts whereby the jar will always be in a potential condition ready to actively dislodge a fish.

A still further object of the invention is to provide an improved device of the above nature which will be free of such complications as spirals, latches, pawls, knobs, springs, tumblers, etc.; and at the same time to offer a tool capable of delivering a blow of any magnitude without previous adjustment.

A still further object of the invention is to provide a tool of maximum circulation area which will be free of all obstructions, and which will be ready for use at all times.

With the foregoing and other objects in view, the invention will be more fully described hereinafter, and will be more particularly pointed out in the claims appended hereto.

In the drawings, wherein like symbols refer to like or corresponding parts throughout the several views,

Figure 1 is a longitudinal sectional view taken through a well casing, and drilling string, with the improved jar incorporated therein and shown in one position.

Figure 2 is a similar view with the parts advanced to a subsequent position.

Figure 3 is a cross section taken on the line 3—3 in Figure 1.

Figure 4 is a similar view taken on the line 4—4 in Figure 1.

Figure 5 is also a cross section taken on the line 5—5 likewise in Figure 1, and

Figure 6 is a further transverse section taken on the line 6—6 in Figure 1.

Referring more particularly to the drawings, the well casing is designated generally at 10, and 11 designates the outer barrel of the jar assembly, which is incorporated in the drilling string. The upper end of the barrel 11 is connected to the drilling string through a coupling member 12 provided at its lower inner portion with a recess 13 to receive a packing 14 held in place by the nut 15, which is screwed into the lower end of the coupling member 12. This packing gland 14 encircles the wash pipe 16.

The lower end of the barrel 11 is attached by means of threads, or otherwise, to a clutch member 17, the bore of which is serrated or provided with teeth, as indicated at 18 in Figure 6. This clutch member 17 is slidably fitted to corresponding teeth or serrations in the outer portion of a plunger 19. On the lower end of the plunger 19 is a cooperating clutch member 20 engageable with the first mentioned clutch member 17, there being cooperating teeth 21 between the clutch members 17 and 20. The drilling bit or tool is indicated at 22, the same being carried by the clutch member 20. By locking the clutch member 20 to the plunger 19 as by welding, or other means, the clutch jaws 21 are at all times in line; and when the jar is in the lower position, which is the drilling position, the clutch jaws 21 will be engaged and will transmit the torque of the barrel 11 to the bit or tool 22 below. If the bit 22 should lower away from the drilling string, the serrations or gear teeth 18 will also transmit the torque.

The upper end of the plunger 19 is adapted

to be attached to leaves or blades 23 and 24 of circular or other form, the faces of which serve as frictional clutch surfaces. To the upper end of the plunger 19 is connected, as by screw threads or otherwise, the lower end of the wash pipe 16. Around the wash pipe is placed an elastic tube 29, the same being fastened at each end as by binding, indicated at 25, to prevent creeping.

The elastic tube 29 is adapted to seal off the fluid from the spaces between the leaves 23, thereby preventing fluid from entering between the leaves 23 and 24, and also between the leaves 26. The leaves 26 are attached at their upper ends to a ring 27 which is free to rotate inside the upper portion of the barrel 11, being held in place by a shoulder 28 at the lower end, and by the coupling member 12 at the upper end. The wash pipe 16 is provided with slots 30 for circulating fluid to the interior of the elastic tube 29. As shown in Figure 4, the leaves 23, 24 and 26 are provided with longitudinally extending slots 31, 32 and 33, respectively, which slots divide the leaves from one another and permit of flexibility and elasticity therein. These various slots are arranged to break joint. Near the upper end of the wash pipe are openings 34, which are adapted to be normally masked within the packing gland 14, but which may move below the packing gland, as shown in Figure 2, permitting the fluid to get into the space about the wash pipe and within the slots 31, 32 and 33 of the leaves, thus equalizing the pressure within and without, and thus releasing the leaves. While the liquid on the exterior of the wash pipe may have access to the slots in the innermost leaves 23, such liquid will pass out through the openings 35 in the intermediate sleeve 26 to the space about the intermediate sleeve 26, whereby this fluid will be enabled to get into the slots between the outermost leaves 24. This fluid will be enabled to escape through the scavenger ports 36 and 37.

The ports 37 are adapted to register with the circular channel 38 in the upper position of the barrel 11 whereby to receive fluid from said channel 38, which fluid is brought to the channel through longitudinal ports 39 communicating at their rear ends with the annular channel 38, and at their forward ends with the space occupied by the leaves or slots therebetween. At 40 are indicated the hammer or anvil faces which strike together to jar the bit or fish 22 loose.

In operation, in the rotary drilling of wells, there is used a fluid, commonly a mixture of clay and water, forming a mud, which picks up the drillings and carries them out to the top of the well. This mud is circulated by means of a powerful pump located at the top of the well, the mud being forced downwards through the drilling string and through the orifice 41 of the tool 22. Such orifice 41, being of lesser diameter than that of the string, will create back pressure, or, in other words, a greater pressure within the drilling string than in the casing outside. When the pump is not supplying fluid under pressure, the two columns of fluid, that within and that without the drilling string, equalize in pressure. When the pump pressure is applied, the pressure within the drilling string becomes greater than that without, due to the lesser orifice diameter through the bit, which restricts the flow at this point.

In drilling, the drilling string is lowered until the bit rests upon bottom, and the pump pressure is applied to start circulation.

The bit is thereupon caused to rotate. When the pressure is applied by the pumps, the clutch jaws 21 having engaged, the pressure is transmitted to the elastic tube 29 through the orifices 30, and is in turn transmitted by the tube to the leaves or blades 23, 24 and 26, in a radial direction, forcing the surfaces of these elastic leaves or blades into firm contact. Due to the gripping of the leaves surfaces under radial pressure, the jar is locked in the inner telescoped position.

Now assume that the bit or tool 22 becomes stuck and resists rotation or upward pull, and it is desired to loosen it by a blow above it. A strain is set up by an upward pull at the top of the well of an amount in excess of the known weight of the drilling string, the pump pressure being maintained constantly until the strain upward has been applied. The pressure is then suddenly released, for instance, by stopping the pumps, by-passing the fluid, or slowing down the pumps.

When the pressure is released, or reduced sufficiently, the two columns of fluid, that within and that without the drilling string, become equalized, or nearly so. This equalization releases the pressure upon the leaves or blades and permits them to slide upon one another. The barrel 11 is now free and may move upward in response to the upward strain above referred to. Being permitted to move upward, the barrel 11 does so with a velocity induced by the tension on the drilling pipe.

Full release of the leaves 23, 24 and 26 comes when the slots 34 move below the packing 14, as shown in Figure 2; as, in this position, the fluid pressure is permitted to enter into and between the leaves. As the barrel 11 snaps upward, the hammer or anvil surfaces 40 of the parts 17 and 19 come into contact, thus transmitting a blow through the part 19 to the bit 22 below.

The scavenger ports 37 are placed slightly above the lower hammer face 40 on the part 17, so that a small quantity of fluid will be trapped between the faces, and transmit the blow equally around and upon the two surfaces 40. Another object of the ports 37 is

to permit free exit of the fluid when the hammer member 17 moves upward.

The scavenger ports 36 are so placed that free circulation will take place when the two hammer faces are together, and the barrel is in upward position. The scavenger ports 38 and 39 are to provide exit of all fluid below ports 36. If one blow fails of its object, the blow may be repeated indefinitely. The blow is regulated by pump pressure to suit the driller.

Any number of the jars may be included in the string.

Without relief ports, a cushioning effect would obtain, destroying the magnitude of the blow. Other jars have this defect.

It will be obvious that many changes in the construction, combination and arrangement of parts could be made, which could be used without departing from the spirit of our invention, and we do not mean to limit the invention to such details, except as particularly pointed out in the claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent of the United States is:—

1. In a drilling jar, a pipe string, a jar device included in said string, and having means for operating the jar upon fall in fluid pressure in the string.

2. In a drilling jar, a pipe string, a jar device included in said pipe string and including hammer faces, means for maintaining said faces normally apart, and means subject to fall in pressure in the string and upward tension on the pipe string to bring the faces forcibly together.

3. In a drilling jar, a pipe string, a bit or tool at the lower end of the pipe string having a reduced opening therethrough to create back pressure in the string, a jar device included in the string and including a clutch member moved to clutched condition by the pressure within the string, and hammer faces kept apart by the clutch and adapted to be moved together on fall of pressure within the pipe string.

4. In a drilling jar, a barrel, opposed hammer faces within said barrel and a hydraulically releasable clutch for holding the hammer faces apart.

5. In a rotary drilling jar, a barrel, means for supporting the barrel from the well string, a bit or tool below the barrel, a wash pipe and plunger within the barrel, an expansible clutch carried by the barrel and plunger, and hammer faces also on or between said barrel and plunger.

6. In a rotary drilling jar, a barrel suspended from the pipe string and having a hammer face, a plunger movably mounted in said barrel and having an opposing hammer face, a wash pipe attached to said plunger with clutch members between said wash pipe and barrel, and means operable upon predetermined pressure in the string for binding the clutch members together.

7. In a rotary drilling jar, a barrel, having scavenger ports and a hammer face, a wash pipe and plunger movably mounted in the barrel, means whereby the barrel may be carried upon the pipe string, flexible clutch leaves carried between said barrel and wash pipe, and expansible resilient tube carried by said wash pipe concentrically within the clutch leaves, said wash pipe having openings within the tube, hammer faces carried by said barrel and plunger, and a bit or tool connected with the plunger and having a reduced opening therethrough.

8. In a rotary drilling jar, a barrel having scavenger ports therein and a hammer face, a wash pipe movably mounted within said barrel and having release ports, packing for normally masking said release ports, flexible clutch leaves carried between said barrel and wash pipe, a resilient tube carried about said wash pipe and within said leaves, said wash pipe having openings within the flexible tube, a hammer face carried with said wash pipe, one or more of said scavenger ports communicating with the space between the hammer faces, the other scavenger port communicating with the space about the clutch leaves.

9. A jar whose hammer faces are held apart through the action of internal radial pressure upon a series of leaves forming a friction clutch.

10. In a rotary drilling jar, a barrel having scavenger ports and a hammer face, a wash pipe and plunger movably mounted in the barrel, means whereby the barrel may be carried upon the pipe string, flexible clutch leaves carried between said barrel and wash pipe, an expansible resilient tube carried by said wash pipe concentrically within the clutch leaves, said wash pipe having openings within the tube and hammer faces carried by said barrel and plunger, said plunger having a reduced opening therethrough.

11. In a rotary drilling jar, a barrel having a hammer face, a wash pipe and plunger movably mounted in the barrel, means whereby the barrel may be carried upon the pipe string, flexible clutch leaves carried between said barrel and wash pipe, an expansible resilient tube carried by said wash pipe concentrically within the clutch leaves, said wash pipe having openings within the tube and hammer faces carried by said barrel and plunger, said plunger having a reduced opening therethrough.

12. A jar whose hammer faces are held apart through the action of internal radial pressure hydraulically applied to the leaves forming a friction clutch.

13. In a drilling jar, a barrel suspended from the pipe string and having a hammer face, a wash pipe movably mounted in the barrel and carrying a valve, a plunger hav-

ing an opposing hammer face movably mounted in the barrel, and flexible clutch leaves carried between said barrel and wash pipe, the internal wash pipe pressure becoming equalized with the fluid about and between said leaves when the valve is opened upon upward tension on the pipe string when the hammer faces are brought forcibly together.

14. In a drilling jar, a barrel suspended from the pipe string and having a hammer face, a wash pipe movably mounted in the barrel and carrying a valve, a plunger having an opposing hammer face movably mounted in the barrel, and flexible clutch leaves carried between said barrel and wash pipe, the internal wash pipe pressure becoming equalized with the fluid about and between said leaves when the valve is opened upon upward tension on the pipe string when the hammer faces are brought forcibly together, said upward tension on the pipe string sliding the leaves against the resisting friction and moving the wash pipe a short distance.

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