Jan. 24, 1939. G. M. BOULTER 2,144,869

ROTARY JAR

Filed March 20, 1936

Fig. 1.

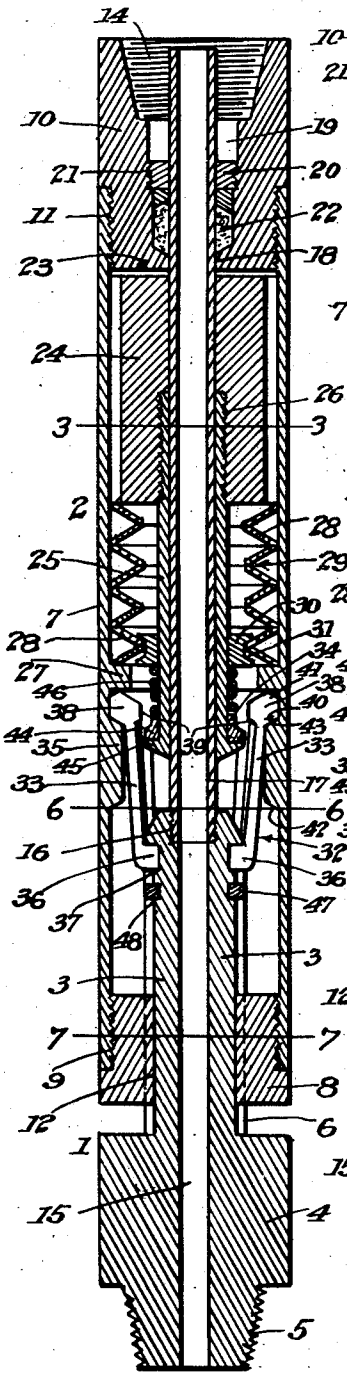


Fig. 2.

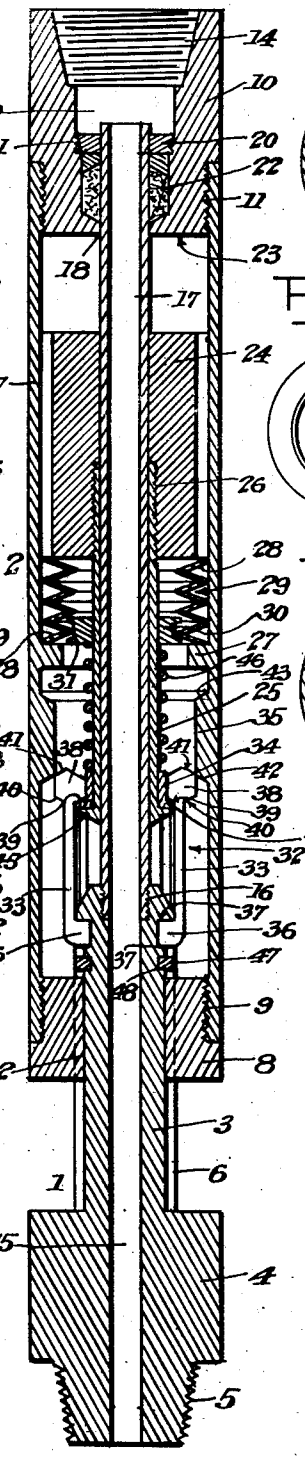


Fig. 3.

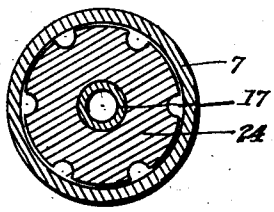


Fig. 4.

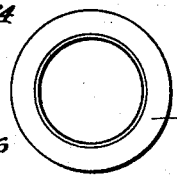


Fig. 5.

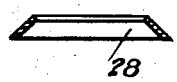


Fig. 6.

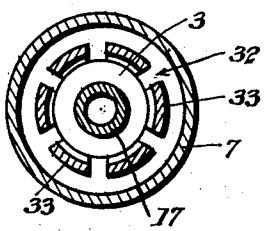
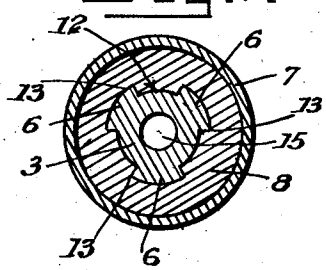


Fig. 7.



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ROTARY JAR

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9 Claims. (Cl. 255—27)

The present invention relates to rotary jars and pertains particularly to the rotary system of drilling oil or other deep wells.

In the drilling or reconditioning of oil and gas wells it often happens that tools or pipe become stuck within the well bore. In the event that the driller cannot pull loose such tools or pipe, which are called "fish", it then becomes necessary to employ a rotary jar. By the use of rotary jar a series of severe blows are delivered upon the "fish" until it is cleared from the well hole.

In the reconditioning of oil or gas wells it may also be an advantage to remove a certain amount of pipe or casing that may have been cemented into the well at a previous time. To do this it is necessary that the casing be cut at the desired depth and then a set of rotary jars are employed to jar the severed piece from the well bore.

The general object of the invention is to provide a rotary jar that is less expensive, hits a harder jarring blow and is generally more effective and more efficient than jars now in use.

Another object is to provide an adjustable rotary jar that is capable of delivering a jarring blow in an upward direction, while the strain necessary to develop such blow is maintained on the "fish" throughout the jarring action.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawing forming a part thereof, in which,

Fig. 1 is a longitudinal section of my jar shown in its retracted position.

Fig. 2 is a longitudinal section of my jar shown in its expanded position.

Fig. 3 is a horizontal cross section of my jar taken on line 3—3 of Fig. 1.

Fig. 4 is a plan view of one of the conical spring members for actuating the plunger hammer to strike the anvil to deliver a jarring blow.

Fig. 5 is a diametrical section of the ring member shown in Fig. 4.

Fig. 6 is a horizontal cross section of my jar taken on line 6—6 of Fig. 1.

Fig. 7 is a horizontal section of my jar taken on line 7—7 of Fig. 1.

Referring more particularly to the drawing in which corresponding parts are designated by the same reference characters in all the figures, 1 designates the lower member and 2 the upper member of my jar. The lower member 1 comprises a shank 3 and a head 4 on the lower end of said shank, which head is formed with a depending threaded pin 5 for engaging a threaded box in the "fish" (not shown) for connecting said lower member 1 to said "fish" for jarring the same, in the manner hereinafter more fully described. The shank 3 is formed with a plurality of undercut splines 6. The upper member 2 of the jar comprises a tubular casing 7, a lower bushing 8 screw seated at 9 in the lower end of said casing and an upper bushing 10 screw seated at 11 in the upper end of said casing. The lower bushing 4 is provided with a central axial opening 12 and a plurality of undercut axial grooves 13 extending from said opening 12, through which opening and grooves slidably extend the shank 3 and splines 6 respectively of the lower member 1 of the jar, the engagement of said splines with said grooves preventing relative rotary movement of the lower member 1 and the upper member 2 of the jar. The upper bushing 10 is formed in its upper end with a threaded box 14 for engagement with a threaded pin (not shown) on the lower end of a fishing string. The lower member 1 is provided with a central axial bore 15 extending therethrough and in the upper end of the shank 3 is screw seated at 16 the lower end of a tube 17 in communication with the upper end of said bore 15. The tube 17 extends upwardly in the upper member 2 of the jar and into the upper bushing 10 of said member through an opening 18 in the lower end of said bushing, said bushing being also formed with a bore 19 extending downwardly from the box 14 in said bushing to a point near the lower end of said bushing, there being a nut 20 screw seated in said bore at 21 between the lower and upper ends of said bore, forming a packing box 22 around the tube 17 which slidably extends through said nut 22.

The lower inner end of the upper bushing 10 of the upper jar member 2 forms an anvil 23 to be struck by the upper end of a plunger hammer 24 which is slidably fitted on the pipe 17 and is constructed with a sleeve shank 25 also slidably fitted on said pipe, said shank being screw seated at its upper end at 26 in the lower end of said hammer 24 and extending downwardly from said hammer. The casing 7 is formed with an internal annular flange 27 upon which rests the lowermost of a plurality of superimposed conical flat spring rings 28, which conical rings are alternately inverted and rest, one upon the other, alternately, at their inner and outer edges in bellows formation, the lower end of the hammer 24 resting upon the uppermost of said rings. Said rings being resilient form a spring 29 between the supporting flange 27 and the hammer 24, which spring may be expanded

and contracted in the manner and for the purpose hereinafter described. On the sleeve shank 25 of the hammer 24 is slidably fitted a stop ring 30 provided with an annular peripheral groove 31 to receive the inner meeting edges of the two lowermost conical spring rings 28.

Means such as a clutch 32 is provided for connecting the lower end of the hammer shank 25 and the upper end of the shank 3 of the lower member 1 of the jar, for contracting the spring 29 when the upper member 2 of the jar is pulled upwardly by the fishing string, while the lower member 1 of the jar is connected to a "fish" in an oil well hole. Said clutch 32 comprises a plurality of clutch dogs 33, a grip ring 34 and a cam 35. The lower end of the clutch dogs 33 are formed with inturned lugs 36 which are turnably fitted in an annular groove 37 in the upper end portion of the shank 3 of the lower jar member 1, whereby said clutch dogs are pivotally connected at their lower ends to the upper end of said shank, so that the upper ends of said dogs may swing inwardly and outwardly for the purpose to be described. The upper ends of the clutch dogs 33 are formed with engaging heads 38 which are formed with lower cam faces 39 and 40, and an upper cam face 41. The cam 35 is formed on the inside of the casing 7 extending around the same, and said cam is formed with a cam face 43 at its upper end. The grip ring 34 is slidably fitted on the hammer shank 25 and is formed at its lower end with an external annular shoulder 44. The lower end of the hammer shank 25 is formed with an annular external shoulder 45 against which the lower end of the grip ring 34 abuts under the influence of a coil spring 46 surrounding the hammer shank 25, which spring engages at its lower end the upper end of the grip ring 34 at its upper end the lower side of the stop ring 30.

A stop ring 47 is secured in a peripheral groove 48 in the upper portion of the shank 3 of the lower jar member 1 immediately below the lower ends of the clutch dogs 33 for engaging the upper end of the lower bushing 8 and limiting the extension of the jar members 1 and 2 with relation to each other.

The operation, uses and advantages of my invention are as follows:

The lower jar member 1 being connected by its threaded pin 5 to a "fish" in an oil well, and the upper jar member 2 being connected by its threaded box 14 to the lower end of a fishing string, the parts of the jar, under the influence of the spring 29, first assume their initial position, as shown in Fig. 1 of the drawing, in which position the upper jar member 2 is lowered on the lower jar member 1 and the dogs 33 of the clutch 32 are swung outwardly so that their cam faces 39 are out of engagement with the grip ring shoulder 44, while their cam faces 40 engage the upper cam face 43 of the cam 35.

To jar the "fish" loose in the well, the upper jar member 2 is pulled upwardly with relation to the lower jar member 1 by the fishing string, which moves the cam 35 upwardly with relation to the clutch dogs 33, while the upper ends and heads 38 of said dogs are swung inwardly by the engagement of the cam faces 43 and 40 of said cam and dogs respectively, until the dog cam faces 39 engage the grip ring shoulder 44, in which position the dogs are held by the engagement of the inner surface of the cam 35 with the outer surfaces of the dog-engaging heads 38, whereby the hammer 24 is held against upward movement and the spring 29 is compressed between the lower end of said hammer and the upwardly-moving seat flange 27 of the upper jar member 2, as shown in Fig. 2 of the drawing, until the lower end of the cam 35 moves upwardly past the dog heads 38 and the upper ends and heads 38 of the dogs 33 swing outwardly under the lower end of the cam 35, so that the upper cam faces 41 of said dog heads engage the lower cam face 42 of the cam 35 and the cam faces 39 of said dog heads escape the grip ring shoulder 44, whereupon the hammer 24 is projected upwardly with great force under the influence of the expansion of the spring rings 28 of spring 29, until the upper end of said hammer strikes the anvil 23 with a powerful upward jarring blow, the impact of which is transmitted through the upper jarring member 2 and the lower jarring member 1 to the "fish", and the "fish" is thereby jarred upwardly, and if not jarred loose with the first jar applied thereto, as above described, the upper jar member 2 is again lowered until the parts of the jar are again brought to their initial position, as shown in Fig. 1 of the drawing, and the above-described operations of the jar are repeated until the "fish" is jarred loose in the well hole, so that it may then be lifted out of the well hole by the fishing string and jar.

By turning the grip ring sleeve 25, the engagement of the upper threaded end 26 of said sleeve with the hammer 24 moves said sleeve downwardly or upwardly with relation to said hammer, which determines the length of upward movement of the upper jar member 2 before the dog shoulders 39 engage the grip ring shoulder 44 and cause the spring 29 to be compressed between the hammer 24 and the flange 27, thus determining the degree of compression of said spring before the dogs 33 escape the grip ring 34 to allow said spring to act to cause the hammer to strike the anvil an upward jarring blow, and thus providing a means for adjusting the force of the upward jarring blow of the jar.

My jar is applicable to rotary drilling apparatus for drilling oil wells or other wells.

My jar delivers its jarring blow while the pulling strain on the jar members necessary to develop the force of the blow is maintained on the "fish" throughout the jarring action, thus adding said jarring strain to the jarring blow and increasing the effectiveness of the jarring action and blow.

I do not limit my invention to the exact construction herein disclosed, since various changes may be made therein without departing from the spirit of the invention.

I claim as my invention:

1. In a jar, a pair of jar members, means for connecting one of said jar members to a "fish" in a well, means for connecting said other jar member to a fishing string, an anvil mounted in one of said jar members, a plunger hammer slidably mounted in said jar member in which said anvil is mounted, spring means engaging said plunger hammer, said plunger hammer including a shank, a shoulder on said shank, a cam on one of said jar members, a plurality of dogs connected to said other jar member for engaging said cam and said shank shoulder, for drawing said plunger hammer against said spring means and compressing said spring means, when an upward force is applied, through said fishing string, to the jar member connected to said string, and a stop on one of said jar members for engaging the other

jar member and holding said members against relative longitudinal movement, when sufficient upward force is applied, through the fishing string, to the jar member connected to said string, to cause said dogs to escape said shank shoulder and said cam and allow said compressed spring means to force said plunger hammer upwardly to strike said anvil with an upward blow.

2. In a jar, a lower jar member and an upper jar member mounted to telescope one within the other, means for connecting said lower jar member to a "fish" in a well, means for connecting said upper jar member to a fishing string, an anvil mounted in the upper end of said upper jar member, a plunger hammer mounted in said upper jar member, a shank depending from said plunger hammer, a dog shoulder on the lower end of said hammer shank, a cam on said upper jar member, a ring-supporting shoulder in said upper jar member, a plurality of conical spring rings interposed between said ring-supporting shoulder and the lower end of said plunger hammer, said conical spring rings being alternately inverted, a plurality of dogs connected to said lower jar member, for normally extending upwardly between said dog shoulder and said cam and engaging the upper end of said cam for holding said jar members in their retracted positions, and a stop on said lower jar member for engaging the lower end of said upper jar member to limit the expanding relative movement of said jar member, under the influence of sufficient upward force, applied, through said fishing string, to said upper jarring member, to cause said dogs, acted upon by said cam, to engage said dog shoulder and draw said plunger downwardly to compress said conical spring rings, and to escape said cam to release said dog shoulder to enable said spring rings to expand and cause said plunger hammer to strike said anvil an upward jarring blow.

3. In a jar, a lower jar member, an upper jar member, said upper jar member comprising a tubular body and bushings respectively secured in the lower end and the upper end of said tubular body, means for connecting said lower jar member to a "fish" in a well, said lower jar member being formed with a splined mandrel extending upwardly through and slidably fitted in said bushing in the lower end of the tubular body of said upper jar member, to permit relative longitudinal movement of said jar members but to prevent relative turning movement of said jar members, means for connecting the bushing, in the upper end of the tubular body of said upper jar member, to a fishing string, the lower end of said bushing forming an anvil, a plunger hammer slidably mounted in said tubular body of said upper jar member, spring means for urging said plunger hammer upwardly toward said anvil, said plunger hammer including a depending shank, a dog shoulder on said shank, a cam on the inside of the body of said upper jar member, a plurality of dogs, connected to said mandrel of said lower jar member, for engaging said cam and said dog shoulder on said hammer shank and drawing said plunger hammer downwardly against said spring means, when said upper jar member is pulled upwardly by said fishing string, and a stop ring fitted in said mandrel of said lower jar member, for engaging said bushing in the lower end of said upper jar member and preventing further relative longitudinal expansion of said jar members, when said dogs escape the lower end of said cam and said dog shoulder, under the influence of the upward pulling movement of said upper jar member by said fishing string, to release said plunger hammer, so that said spring means will cause said plunger hammer to strike said anvil an upward blow.

4. In a jar, a lower jar member and an upper jar member mounted to telescope one within the other, means for connecting said lower jar member to a "fish" in a well, means for connecting said upper jar member to a fishing string, an anvil mounted in the upper end of said upper jar member, a plunger hammer mounted in said upper jar member, a shank depending from said plunger hammer, a dog shoulder on the lower end of said hammer shank, a cam on said upper jar member, a ring-supporting shoulder in said upper jar member, spring ring means for urging said plunger hammer upwardly toward said anvil, a plurality of dogs connected to said lower jar member, for normally extending upwardly between said dog shoulder and said cam and engaging the upper end of said cam for holding said jar members in their retracted position, and a stop on said lower jar member for engaging the lower end of said upper jar member to limit the expanding relative movement of said jar members, under the influence of sufficient upward force, applied, through said fishing string, to said upper jarring member, to cause said dogs, acted upon by said cam, to engage said dog shoulder and draw said plunger downwardly to compress said conical spring rings, and to escape said cam to release said dog shoulder to enable said spring rings to expand and cause said plunger hammer to strike said anvil an upward jarring blow, said lower jar member being formed with a longitudinal circulation duct extending therethrough, a circulation tube connected at its lower end to the upper end of said lower jar member and communicating with said circulation duct, and said circulation tube extending upwardly through and slidably fitted in said plunger hammer and its shank and the upper end of said upper jar member.

5. In a rotary jar, a pair of jar members slackly linked together with limited relative movement longitudinally and maintained against relative rotation, a hammer and an anvil mounted in one of said jar members, compressible and expansible means mounted in said latter jar member and engaged by said hammer, means for causing said hammer to compress said expansible and compressible means when said jar members are extended longitudinally with relation to each other, means for adjusting the compression of said compressible and expansible means, and means for releasing said hammer, when the jar members are extended relatively longitudinally a predetermined distance, to enable said compressible and expansible means to cause said hammer to strike said anvil a jarring blow.

6. In a jar, an anvil, a hammer, a spring, means actuated by upward strain exerted thereon for deforming the spring so that upon release of the deforming stress the spring operates the hammer to strike the anvil a jarring blow, means for holding against release of said deforming stress, and means engaging the holding means for preventing release thereof, the engaging means being movable relative to the holding means by upward strain exerted on the engaging means, said relative movement of the engaging means disengaging it from the holding means

to permit release of the holding means for operation of the hammer.

7. In a jar, an anvil, a hammer, a spring, means actuated by upward strain exerted thereon for deforming the spring so that upon release of the deforming stress the spring operates the hammer to strike the anvil a jarring blow, means for holding against release of said deforming stress, and means engaging the holding means for preventing release thereof, the engaging means being movable relative to the holding means by upward strain exerted on the engaging means, said relative movement of the engaging means disengaging it from the holding means to permit release of the holding means for operation of the hammer.

8. In a jar, an anvil, a hammer, a spring, means actuated by upward strain exerted thereon for deforming the spring so that upon release of the deforming stress the spring operates the hammer to strike the anvil a jarring blow, means for holding against release of said deforming stress, said means being releasable by radial displacement thereof, and means for positively confining the holding means against radial displacement, the confining means being movable relative to the holding means by upward strain exerted on the confining means, said relative movement of the confining means disengaging it from the holding means to permit radial displacement and release of the holding means for operation of the hammer.

9. In a jar adapted for incorporation in a well string, an anvil, a hammer, a spring, means actuated by upward strain exerted thereon for deforming the spring so that upon release of the deforming stress the spring operates the hammer to strike the anvil a jarring blow, means for holding against release of said deforming stress, and means engaging the holding means for preventing release thereof, the engaging means being movable relative to the holding means by longitudinal strain exerted on the well string, said relative movement of the engaging means disengaging it from the holding means for release of the holding means and operation of the hammer.

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