May 13, 1941. C. A. RASMUSSEN 2,241,477

JAR

Filed Aug. 14, 1940

Fig. 2.

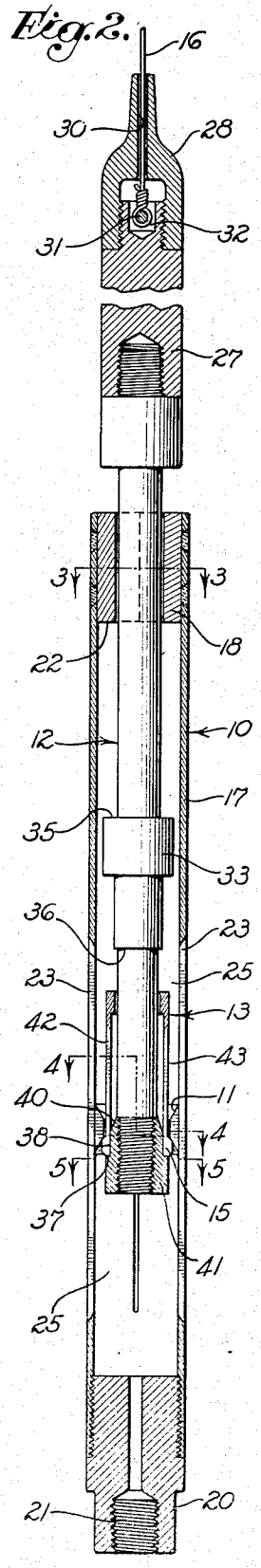


Fig. 3.

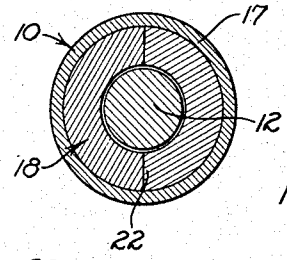


Fig. 1.

Fig. 7.

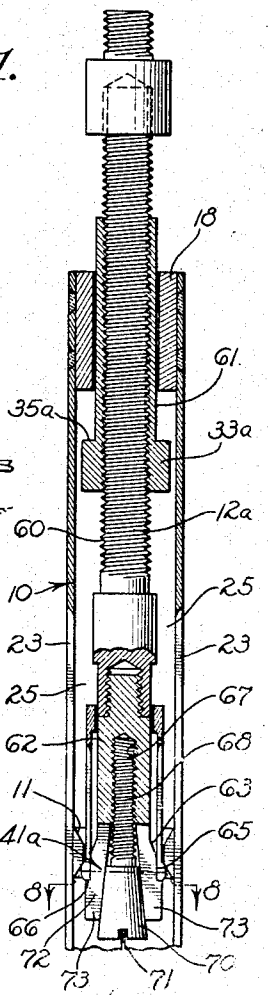


Fig. 6.

Fig. 4.

Fig. 5.

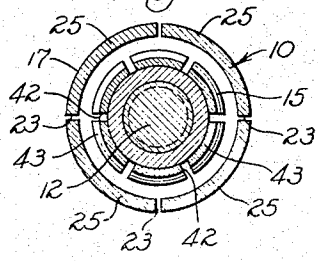
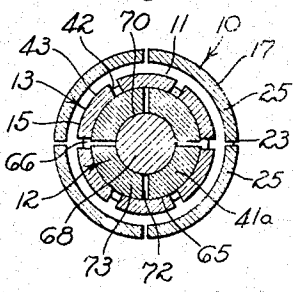


Fig. 8.



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2,241,477

JAR

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Application August 14, 1940, Serial No. 352,555

9 Claims. (Cl. 255—27)

My invention relates to jars employed to dislodge devices and tools in oil wells.

While the principles of my invention are applicable either to rotary jars or to straight-pull jars, I elect for the purpose of this disclosure to limit my description to a straight-pull jar. Those skilled in the art will find sufficient guidance herein for embodying the invention in other types of jars.

The general object of my invention is to provide an efficient and reliable jar that is relatively simple in structure and is inexpensive to manufacture.

A jar of the type elected for disclosure comprises two slidingly telescoped members on a supporting line and is caused to operate by placing the supporting line under tension, the stroke of the jar being caused by the telescoped members being suddenly released for relative longitudinal movement of limited extent. It is desirable to provide for variable lengths of stroke. because various magnitudes of jarring energy are required and because the stretch of a supporting line, which must be commensurate with the stroke, varies both with the elasticity of the supporting line and with the effective length of the supporting line. It is an object of my invention to provide a jar that is adjustable with respect to the degree of stress at which the jar operates and/or is adjustable with respect to the length of the stroke of the jar.

Present day jars are almost all, if not all, relatively heavy in construction and while suitable for use in drill strings are entirely unsuited for light tasks. A further object of my invention is to provide a relatively light jar of relatively small dimensions that may be lowered into a well on a wire or light cable when only moderate jarring forces are required. In this aspect of the invention it is my further object to provide a jar that may be reset with relatively little longitudinal force.

The above and other objects of my invention will be apparent from the following description considered with the accompanying drawing.

In the drawing, which is to be taken as illustrative only—

Fig. 1 is a diagrammatic view of an oil well showing my jar disposed for operation therein;

Fig. 2 is a longitudinal sectional view of one form of my jar;

Fig. 3 is a transverse section taken on the line 3—3 of Fig. 2;

Fig. 4 is a transverse section taken on the broken line 4—4 of Fig. 2;

Fig. 5 is a transverse section taken on the broken line 5—5 of Fig. 2;

Fig. 6 is a fragmentary section of the device of Fig. 2 showing parts of the jar in released disposition;

Fig. 7 is a fragmentary view similar to Fig. 2 showing an adjustable form of my jar; and

Fig. 8 is a transverse section taken as indicated by the broken line 8—8 of Fig. 7.

The principal parts of the first form of my invention shown in Figs. 2 to 6 are: an outer tubular member generally designated 10 having an inwardly directed annular slip shoulder 11; a mandrel generally designated 12 telescoped into the outer tubular member 10; and a radially yieldable member 13 slidingly mounted between the outer tubular member and the mandrel, the member 13 having an outwardly directed annular slip shoulder 15 to cooperate with the slip shoulder 11. The outer tubular member 10 and the mandrel 12 provide, or are unitary with, opposite ends of the jar and either the tubular member or the mandrel may be uppermost. In the present construction the mandrel 12 is uppermost and is attached to the end of a supporting wire 16, and the tubular member 10 is adapted for connection with a tool or other device at its lower end.

The outer tubular member 10 comprises a cylinder 17, a bushing 18 at the upper end of the cylinder, and a nipple 20 at the lower end of the cylinder having threads 21 for connecting the jar to various devices. The bushing 18 may be made in two sections for convenience in assembling the jar and is adapted to limit the upward movement of the mandrel relative to the outer tubular member 10, the lower end of the bushing forming a stop shoulder 22.

The annular slip shoulder 11 of the outer tubular member 10 is preferably tapered in both axial directions and may be formed conveniently by welding a ring of the desired configuration inside the cylinder 17. In the preferred form of my invention, both the cylinder 17 and the slip shoulder 11 are cut by a series of longitudinal slots 23 which locally divide the cylinder 17 into relatively flexible longitudinal strips 25, each of the strips carrying a segment of the annular slip shoulder 11.

The upper end portion of the mandrel 12 is reduced in diameter and threaded for engagement with a weight or "sinker" 27, and the upper end of the weight 27 is in turn adapted to receive a removable bonnet 28. The previously mentioned wire 16 extends through a bore

30 in the bonnet 28 and is secured to a cross-pin 31 in a recess 32 in the upper end of the weight 27.

Inside the outer tubular member 10 the mandrel 12 is formed with an impact collar 33 that presents an impact shoulder 35 to strike against the previously mentioned shoulder 22 of the bushing 18. At a point spaced below the impact collar 33 the mandrel is reduced in diamter to form what may be termed an annular resetting shoulder 36 that faces downward to meet the upper end of the previously mentioned member 13. For cooperation with the member 13 the lower end of the mandrel is provided with an annular stop shoulder 37 to limit the downward movement of the member 13, a circular portion 38 to prevent radial contraction of the member 13, and a conical portion 40 to guide the member 13 into a position embracing the circular portion 38. In the particular construction shown in the drawing the stop shoulder 37, the circular portion 38, and the conical portion 40 are all provided by a stop collar 41 that is threaded onto the lower end of the mandrel 12.

The slidable member 13 is tubular in general configuration and preferably the annular slip shoulder 15 formed thereon tapers in both axial directions. The member 13 is radially yieldable at the slip shoulder 15 by virtue of the fact that a series of slots 42 are cut upward from the lower end of the member to form a series of downwardly extending flexible fingers 43, each of which fingers carries a portion of the annular slip shoulder 15.

When the jar is in "set" position ready for a jarring stroke, the various parts are in the position indicated by Fig. 2. It wil be noted that the slide member 13 is at its lowermost position with respect to the mandrel 12 and is supported by the annular stop shoulder 37 of the mandrel with the slip shoulder 15 below the slip shoulder 11 of the outer tubular member 10. Since the various flexible fingers 43 of the member 13 embrace the circular portion 38 at the lower end of the mandrel it is apparent that at such time the annular slip shoulder 15 is not free to yield by radial contraction. When the jar is in the described set disposition, whatever load is carried by the outer tubular member 10 is transmitted through the slip shoulder 11 and the slip shoulder 15 to the mandrel 12 and is transmitted through the mandrel to the wire 16. When the tension in the wire 16 rises to a predetermined value, the outer slip shoulder 11 yields radially by outward flexure of the longitudinal strip 25 and the slip shoulder 15 escapes upward to permit the stroke action of the jar, the stroke terminating abruptly when the impact shoulder 35 of the impact collar 33 strikes the shoulder 22 of the bushing 18.

Resetting of the jar for a repetition of the stroke is acomplished by moving the mandrel 12 downward relative to the outer tubular member 10. Early in the downward movement of the mandrel, the lower end of the mandrel passes without resistance the annular slip shoulder 11. Downward progress of the member 13, however, is interrupted by contact of the annular slip shoulder 15 with the annular slip shoulder 11, as shown in Fig. 6, and the member 13 remains stationary relative to the outer tubular member 10 until the resetting shoulder 36 of the downwardly moving mandrel makes contact with the upper end of the member 13 and forces the slip shoulder 15 downward past the slip shoulder 11. It will readily be understood from Fig. 6 that the interruption in the downward movement of the member 13 causes disengagement of the enlarged lower end of the mandrel from the flexible fingers 43 so that the fingers are free to flex inward sufficiently to permit the annular slip shoulder 15 to pass the annular slip shoulder 11 of the outer tubular member 10. There is some reaction on the part of the annular slip shoulder 11 of the outer tubular member, but it is contemplated that the yielding action will be primarily on the part of the annular slip shoulder 15 and that the fingers 43 will be highly flexible to minimize resistance to the resetting of the jar. As soon as the annular slip shoulder 15 is forced past the annular slip shoulder 11, the tubular member 13 drops of its own weight into the normal set position indicated in Fig. 2.

Fig. 1 illustrates by way of example an arrangement for employing my jar in an oil well. The above described jar generally designated 45 in Fig. 1 is suspended on the end of a wire 16 and is connected to a tool 46 which may be, for example, a valve-operating tool described in my copending application, Serial No. 208,106, entitled "Producing apparatus for oil wells." Fig. 1 shows the jar lowered into a string of tubing 47 surrounded by a casing 48. At the top of the well is a Christmas tree assembly generally designated 50 that includes an upwardly extending length of pipe 51 coaxial with the tubing 47 to house the jar when the jar is not in use. The wire 16 extending upward from the upper end of the pipe 51 passes over a suitable sheave 52 and hence passes downward through a tension indicator generally designated 53 and finally is wound onto a drum 55. The drum 55 is driven by an engine 56 through a belt 57 and a suitable clutch that is not shown in the drawing.

After the valve operating tool 46 engages a subterranean valve in the well (not shown) and operates the valve, it is necessary to subject the tool 46 to a jarring action to sever a shear pin in the tool thereby to cause the tool to release the subterranean valve. To produce the jarring action, the operator at the surface of the well manipulates the above-mentioned clutch to increase the tension of the wire 16. The operator observes a pointer 58 on the tension indicator 53 and throws out the clutch to relax the cable as soon as the indicator shows the sudden drop in tension that characterizes a stroke of the jar. If it is found that the jarring action has not caused disengagement of the valve operating tool 46, the operator makes sure that the wire is relaxed sufficiently to permit the jar to be reset and then repeats the jarring procedure.

The jar shown in Figs. 7 and 8 is similar in large part to the first embodiment of my invention, corresponding numbers being employed to indicate corresponding parts. The differences involve the substitution of a modified form of mandrel 12*a* for the mandrel 12, the substitution of an adjustable impact collar 33*a* for the previously described impact collar 33, and the substitution of an adjustable stop member generally designated 41*a* for the stop collar 41.

The mandrel 12*a* is formed with a long peripheral thread 60 that is engaged by a threaded tube 61, the threaded tube being integral with the stop collar 33*a* and extending upward through the bushing 18 at the top of the outer tubular member 10. An impact shoulder 35*a* is provided by the upper end of the impact collar 33*a* to strike against the stop shoulder 22 of the

bushing 18 to limit the upward movement of the mandrel. Rotation of the threaded tube 61 varies the longitudinal position of the impact collar 33a on the mandrel 12a, and since the tubing is exposed at its upper end, adjustment of the stroke may be accomplished from the exterior of the jar.

The stop member 41a which is threaded into the lower end of the mandrel 12a has an upper cylindrical portion 62 of the same diameter as the mandrel to serve as an extension of the mandrel. Below the cylindrical portion 62 the stop member 41a expands to form a conical portion 63 that leads to an enlarged cylindrical portion 65, the cylindrical portion 65 terminating at an upwardly presented stop shoulder 66. The portions 63, 65, and the stop shoulder 66 of the stop member 41a will be recognized as corresponding to similar parts of the previously described stop collar 41.

The stop member 41a has a threaded axial bore 67 into which adjustably extends a threaded plug 68 that has a conical head 70, the conical head having a transverse slot 71 to receive an adjustment tool. The lower end of the stop member 41a has a series of longitudinal slots 72 that divides it into longitudinal segments 73. The material of the stop member is such that the segments 73 have substantial flexibility so that adjustment of the threaded plug 68 inward and outward causes the enlarged cylindrical portion 65 of the stop member to expand and contract in diameter. It will be readily understood that expansion of the stop member 41a increases the effective diameter of the annular slip shoulder 15 on the member 13 and thereby raises the point of tension at which the jar is released. Access to the plug 68 for adjustment may be had simply by removing the nipple 20 at the lower end of the outer tubular member 10.

This second embodiment of the invention is operated in the same manner as the first form of the invention and is removed from the well for adjustment whenever necessary. It is a relatively light device that may be lowered into a well on wire as light as 16 gauge to perform delicate jarring operations. The jarring action is under close control and may be easily predetermined.

The preferred forms of my invention described herein may be widely varied by those skilled in the art without departing from my underlying concept, and I reserve the right to all such modifications that come within the scope of my appended claims.

I claim as my invention:

1. A jar of the character described, comprising: a tubular body having an inwardly presented slip shoulder; a radially yieldable member mounted in said body for relative movement longitudinally thereof, said yieldable member having an outwardly presented slip shoulder for cooperation with said inwardly presented slip shoulder; and a mandrel slidingly mounted in said body with said yieldable member between the body and mandrel, said mandrel having a shoulder to cooperate with said tubular body for jarring impact, an enlarged portion to prevent radial contraction of said yieldable member when the jar is set, a stop shoulder to limit longitudinal movement of said yieldable member relative to the mandrel when the jar is set, and a reduced portion to permit radial contraction of said member when the jar is released, thereby to permit resetting of the jar.

2. A jar constructed as set forth in claim 1 in which said tubular body is slit longitudinally into resilient strips at said inwardly presented slip shoulder.

3. A jar constructed as set forth in claim 1 in which said enlarged portion of the mandrel is expansile and in which adjustable means is provided to expand said enlarged portion to increase the radial extent of said yieldable member when the jar is set.

4. A jar of the character described, comprising: a tubular body having an inwardly presented slip shoulder; a radially yieldable member mounted in said body for relative movement longitudinally thereof, said yieldable member having an outwardly presented slip shoulder for cooperation with said inwardly presented slip shoulder; a mandrel slidingly mounted in said body with said yieldable member between the body and the mandrel, said mandrel having an enlarged expansile portion to prevent radial contraction of said yieldable member when the jar is set, a stop shoulder to limit longitudinal movement of said yieldable member relative to the mandrel when the jar is set, and a reduced portion to permit radial contraction of said member when the jar is released, thereby to permit resetting of the jar; adjustable means to vary the effective diameter of said expansile portion of the mandrel; and means movably mounted on said mandrel to cooperate with said tubular body for jarring impact, said movably mounted means being adjustable longitudinally of the mandrel to vary the length of the stroke of the jar.

5. A jar as set forth in claim 4 in which said movably mounted means on the jar has an extension to the exterior of said tubular body whereby the movably mounted means may be adjusted from the exterior of the jar.

6. A jar of the character described, comprising: a tubular body having an inwardly presented slip shoulder; a radially yieldable annular member mounted in said body for relative movement longitudinally thereof, said yieldable member having an outwardly presented slip shoulder for cooperation with said inwardly presented slip shoulder; and a mandrel surrounded by both said body and said yieldable member and movable longitudinally relative to both said body and said member, said mandrel having a shoulder to cooperate with said tubular body for jarring impact, an enlarged portion to engage said yieldable member to hold the member in expanded disposition when the jar is set, a shoulder to prevent relative movement of said member away from said enlarged portion when the jar is set, and a shoulder to force said member to contract and to pass said inwardly presented slip shoulder for resetting of the jar.

7. A jar constructed as set forth in claim 4 in which said enlarged portion of the mandrel is split for radial expansion and in which an adjustable wedge is provided to expand said enlarged portion.

8. A jar as set forth in claim 4 in which said enlarged portion of the mandrel has a substantially cylindrical surface for contact with said contractile member when the jar is set and has a conical surface to guide the contractile member to said conical surface in the setting of the jar.

9. A jar of the character described, comprising: a tubular body unitary with the lower end of the jar, said tubular member having an inwardly presented slip shoulder; a mandrel uni-

tary with the upper end of the jar and slidingly telescoped into said body, said mandrel having an enlarged portion and a downwardly presented shoulder; and a radially contractile annular member around said mandrel with sufficient clearance to permit the contractile member to gravitate to said enlarged portion of the mandrel to be held thereby against contraction, said contractile member having an outwardly presented slip shoulder to cooperate with said inwardly presented slip shoulder, said downwardly presented shoulder of the mandrel being disposed to force said contractile member downward to carry said slip shoulder of the member past said slip shoulder of the tubular body when the mandrel is moved downward relative to the tubular member to set the jar.

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