April 11, 1939. W. L. FOSTER 2,153,883

OIL WELL JAR

Filed July 6, 1936 2 Sheets-Sheet 1

Fig. 1.

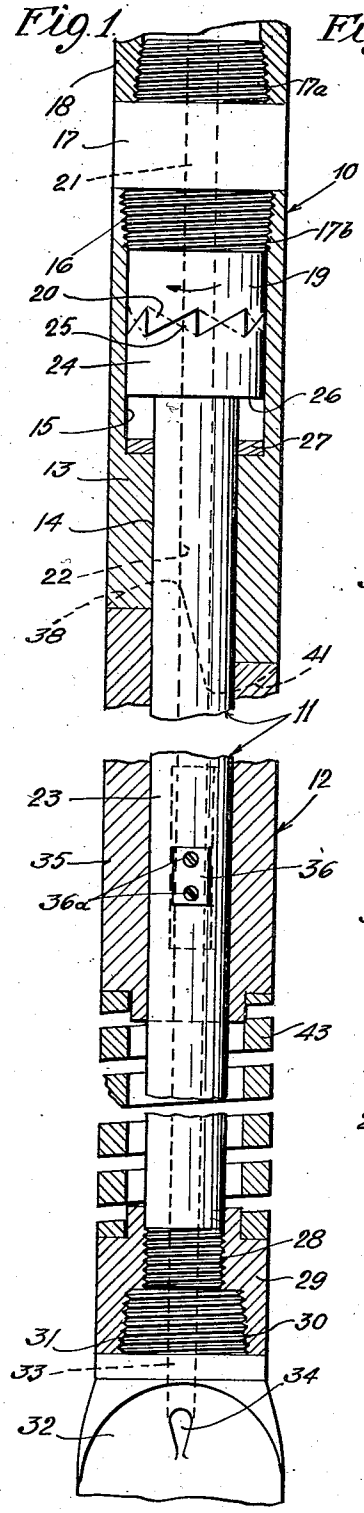


Fig. 2.

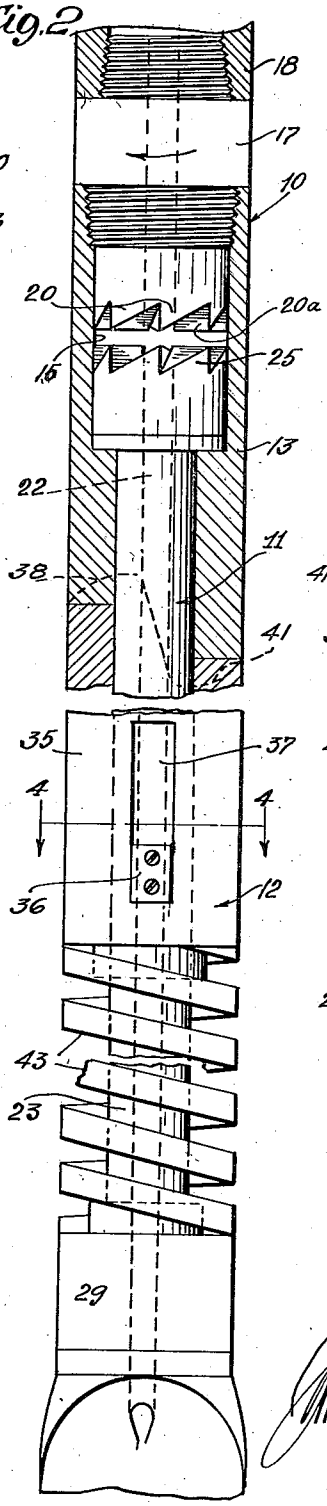


Fig. 3.

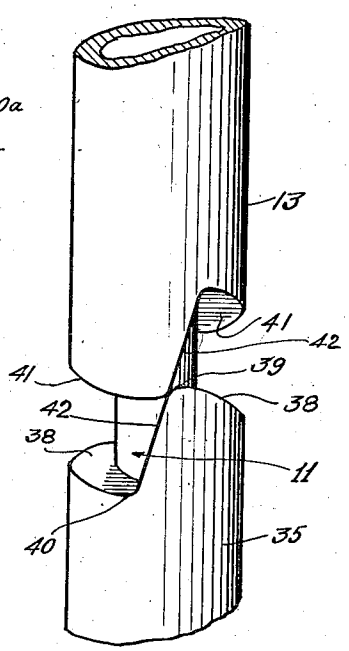
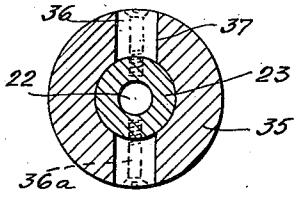


Fig. 4.



Inventor
Walter L. Foster.

Attorney.

April 11, 1939. W. L. FOSTER 2,153,883

OIL WELL JAR

Filed July 6, 1936 2 Sheets-Sheet 2

Fig. 5.

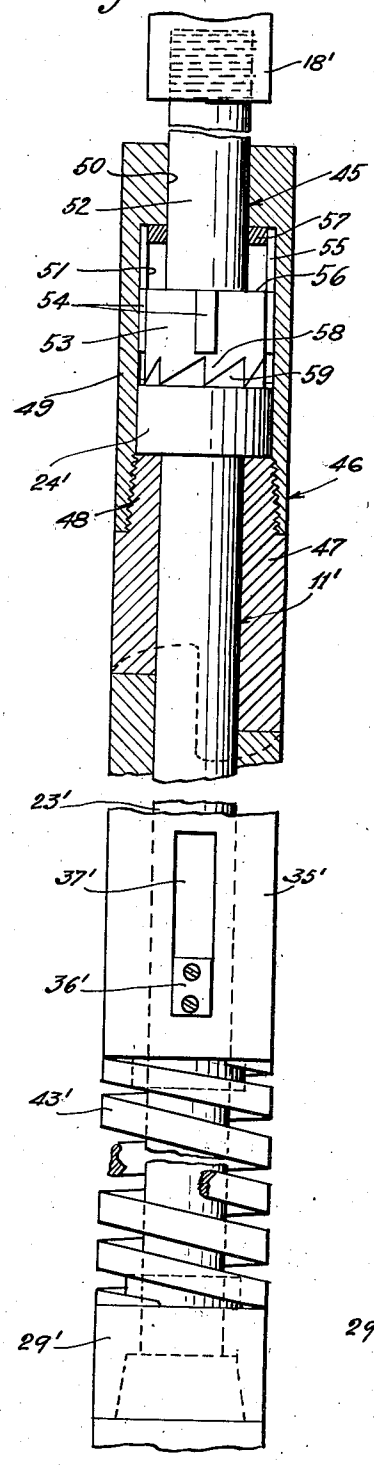


Fig. 6

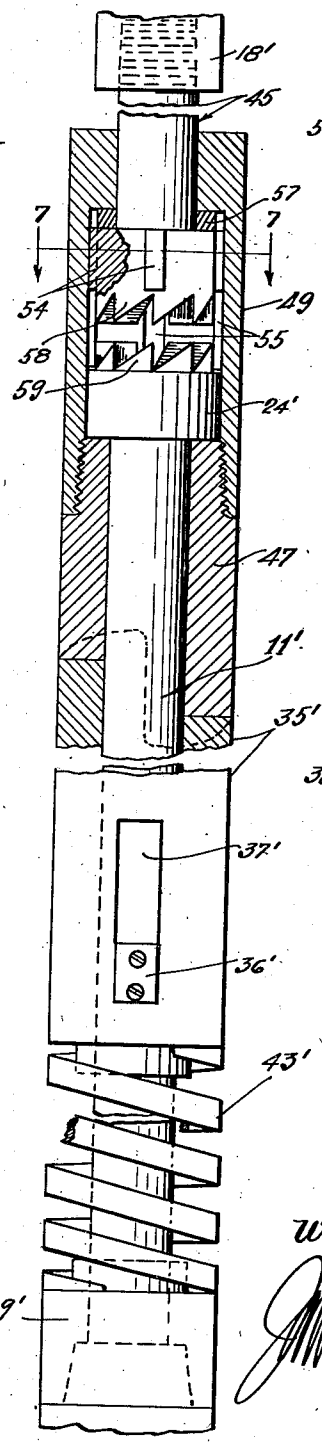


Fig. 7

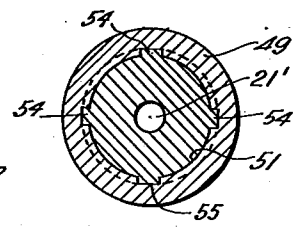
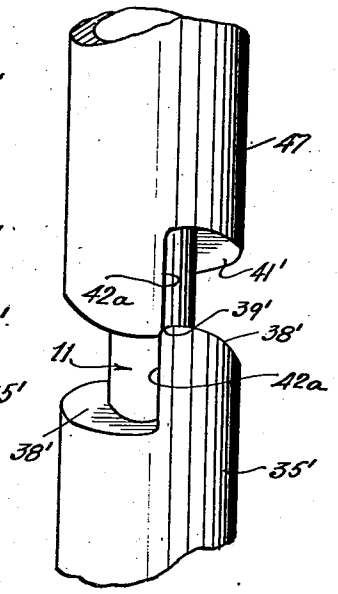


Fig. 8.



Inventor.
Walter L. Foster
James Markelew
Attorney.

Patented Apr. 11, 1939 2,153,883

UNITED STATES PATENT OFFICE

2,153,883

OIL WELL JAR

Walter L. Foster, Whittier, Calif., assignor to John Grant, Los Angeles, Calif.

Application July 6, 1936, Serial No. 88,917

5 Claims. (Cl. 255—27)

This invention has to do with improvements in jarring apparatus for removing lodged objects such as drill pipe, bits or other tools, from wells, and deals particularly with a type of jar operating to deliver a succession of upwardly directed blows while a continuous and uninterrupted pull is applied to the lodged object by way of the drill pipe.

The customary practice in operating rotary jars is to attach to the lodged object a fishing tool carried on the drill pipe below the jar, to then place the drill pipe under longitudinal strain, and to suddenly release, by the exertion of a predetermined pull on the drill pipe, the relatively movable parts of the jar which impact and produce a blow that is transmitted to the lodged object. In such jars the stretch of the pipe is utilized as the means of producing the blow, since, when a long drill pipe placed under great longitudinal strain is released at its lower end, the pipe in contracting develops a tremendous dynamic inertia and force.

After the jar parts have become released, they move relatively and freely a substantial distance in order that a blow of the desired magnitude may be generated, and during this time the connection, via the jar, between the drill pipe and unlodged object, is necessarily slackened. It is evident therefore that the drill pipe is effective as a means of exerting a pull on the lodged object, only prior to, and possibly after the jar release, and that during the interval between the points of release and impact, the pull on the object will be temporarily and completely interrupted. Likewise, in the usual type of jar, the relatively movable impacting parts can only be reset for a subsequent jarring operation by lowering the drill pipe, so that by no possibility can a continued pull be exerted on the object between successive blows. Ordinarily, therefore, it has not been possible to obtain the benefit of uninterrupted pull and concurrent jarring impact or a series of such impacts.

Now it is believed that the last named condition, i. e., uninterrupted pull and concurrent impact, is the ideal one for most effectively dislodging an object, because by virtue of a sustained pull on the object, the latter is prevented from settling back to the position from which it is moved by the jarring blow, and thus the full benefit of each blow will be retained, until the object is finally loosened. Furthermore, by maintaining a sustained pull on the object, the latter can be loosened by much lighter blows than where impact alone is relied upon. Accordingly, this invention has been made with these objects in view. Briefly, the present type jar is one in which delivery of the jarring impact and resetting are independent of longitudinal movement of the drill or strain pipe, so that a sustained pull may be exerted on the object at the same time one or a series of blows are delivered, and throughout the intervals between successive blows.

Another object of the invention is to provide a jar in which the striking element is actuated by a spring, the latter being compressed and the striking element released for operation under the influence of the spring, by virtue of rotation of the drill pipe. In the preferred form of the invention, the striking element comprises a vertically movable sleeve placed about the body of the jar. The body of the jar includes a pair of relatively rotatable parts whose connections with the drill string and fishing tool below, remain at all times the same distance apart. By virtue of relative rotation between the body parts, the striking sleeve is forced downwardly to compress the spring and is then released for upward jarring travel, while, during a complete operation or any successive number of operations, a continuous and uninterrupted pull is communicated through the jar to the lodged object.

The various features and objects of the invention to which I have referred in the foregoing, as well as additional objects and the details of a typical and preferred form of the invention, will be more fully understood from the description to follow. Throughout the description reference is made to the accompanying drawings, in which:

Fig. 1 is a longitudinal section showing one form of jar embodying the invention, with the parts in drilling position;

Fig. 2 is a view similar to Fig. 1, with certain parts disengaged for jarring operations;

Fig. 3 is a fragmentary perspective illustrating the cam surfaces on the body and striking sleeve;

Fig. 4 is a section on line 4—4 of Fig. 2;

Figs. 5 and 6 are sectional views similar, respectively, to Figs. 1 and 2, and showing a variant form of the invention;

Fig. 7 is a cross section on line 7—7 of Fig. 6; and

Fig. 8 is a perspective similar to Fig. 3 showing a modified form of cam between the body and striking sleeve.

Referring first to Figs. 1 and 2, the jar may be described generally as comprising a pair of relatively rotatable and longitudinally movable parts, indicated at 10 and 11, and hereinafter termed the body and mandrel, respectively, and a strik-

ing member 12 movable longitudinally of the mandrel into impacting engagement with the body, by virtue of relative rotational movement of the body and mandrel. The body 10 comprises a tubular section 13 having a reduced diameter bore 14 and a counterbore 15 into the upper end of which is threaded at 16 a coupling 17, the upper pin end 17a of which connects with the drill pipe 18. Coupling 17 has a lower end extension 19 below the threads 17b, on which is formed a series of clutch teeth 20, the vertical surfaces 20a of which face in the direction of drill pipe rotation as indicated by the arrow. The coupling bore 21 conducts circulating fluid from the drill pipe downwardly to the upper end of the mandrel bore 22, and from the lower end of which the fluid is discharged to the work.

The mandrel portion 11 of the jar comprises an elongated tube 23 of substantially the diameter of body bore 14, having on its upper end a cylindric enlargement 24 whose diameter corresponds substantially to the diameter of body bore 15. The mandrel enlargement 24 has a plurality of clutch teeth 25 corresponding to the body teeth 20 and adapted to interengage therewith to hold the body and mandrel against relative rotation when the jar parts are in the drilling position of Fig. 1. As illustrated in Fig. 2, the body 10 is movable upwardly relative to the mandrel 11 a distance sufficient to disengage the clutch teeth 20 and 25, this distance corresponding to the spacing in Fig. 1 between shoulder 26 and the surface of thrust washer 27. It is only necessary that the body and mandrel be capable of sufficient relative longitudinal movement to disengage the clutch teeth, although for clarity in illustration, I have shown the parts to be capable of relative movement somewhat in excess of that distance.

The lower end of the mandrel is threaded at 28 into coupling 29 connecting at 30 with the work, which may be a length of pipe or any of the usual tools carried by the drill string and in conjunction with which jars customarily are used. Typically, the coupling 29 is shown to connect with the pin end 31 of a drill bit 32. Circulating fluid passing downwardly through the mandrel bore 22 is discharged through bore 33 within the bit and out through the usual circulation openings 34 in opposite sides thereof. A continuous flow of circulating fluid to the work may be maintained at all times, during both drilling and jarring operations.

The striking member 12 comprises an elongated sleeve 35 slidable longitudinally on the mandrel tube 23 and held against rotational movement relative to the mandrel by guide blocks 36 secured by screws 36a to opposite sides of the mandrel and extending within vertical guide slots 37 in the sleeve. The upper end of the striking sleeve is shaped to provide a cam surface 38, which is also a striking surface, in the form of a substantially 360° spiral, the high point of which is indicated at 39, and the low point at 40, the latter being offset somewhat from the high point in the form shown in Fig. 3. A correspondingly shaped cam and striking surface 41 is formed on the lower end of the body portion 13, and in the normal position of the jar parts, see Fig. 1, cam surfaces 38 and 41 fit in full engagement, as indicated by the dotted lines. As shown in Fig. 3, the slip-off shoudlers 42 between the high and low points of the spiral cam surfaces, may extend at a slight angle with the vertical, or, as illustrated in Fig. 8, the slip-off shoulders 42a may be vertical. It may be mentioned that the purpose of forming the cam surfaces as 360° spirals and with a single pair of slip-off shoulders that release upon 360° body rotation relative to the mandrel, is to provide for the maximum possible length of travel of the sleeve in its striking movement. For the same reason, cam surfaces 38 and 41 are formed at a steep angle so that at the point of release, substantially as shown in Fig. 3, the cam surfaces, which now become striking shoulders, are spaced apart a maximum distance consistent with proper cam action.

Downward movement of the striking sleeve relative to the body is resisted by a heavy coil spring 43 supported on coupling 29 and bearing against the lower end of the sleeve, the spring being strongly resistant to compression and therefore capable, after compression, of expanding with great force to project the sleeve upwardly into jarring impact with the body. For the purpose of predetermining the magnitude of the jar blow, the sleeve 35 and mandrel tube 23 may be of any desired length to give the necessary weight to the sleeve, and a spring 43 may be used that will be capable of projecting the sleeve with very great force.

During normal drilling operations the body is lowered relative to the mandrel to bring clutch teeth 20 and 25 into engagement, thereby providing a rotational driving connection between the drill pipe and work via the body and mandrel. In the described form of the invention, spring 43 is compressed in the drilling positions of the parts to an extent corresponding to the distance between mandrel shoulder 26 and the thrust washer 27. In performing the jarring operation, the body is raised to release the clutch teeth, as shown in Fig. 2, in which position the spring 43 preferably is in substantially fully expanded condition while maintaining the sleeve and body cam surfaces 38 and 41 in engagement.

The drill pipe 18 is placed under longitudinal tension by exerting an upward pull that is communicated to the work 32 by the engagement of the body carried thrust washer 27 with mandrel shoulder 26. While under tension, the drill pipe is rotated in the direction indicated by the arrow, to produce relative rotation between the body 10 and mandrel 11, as a result of which the striking sleeve 35, being splined to the mandrel and consequently held against rotation, is cammed downwardly by the action of cam surfaces 38 and 41. At the end of each succeeding 360° rotation of the body relative to the sleeve, the cam surfaces reach the slip-off position shown in Fig. 3, at which point the striking sleeve is released and impacted against the body under the expansive force of spring 43 to communicate to the work, via the mandrel, an upwardly directed blow. It will be understood that the drill string may be continuously rotated, while it is kept under tension, to repeatedly actuate the jar, and that the frequency with which the jarring blows are delivered may be controlled by regulating the rate of rotation of the drill pipe. During a single jarring operation, or succession of operations, a sustained and continuous upward pull is maintained on the work since no relative longitudinal movement occurs between the jar parts directly connecting the drill pipe with the work.

In Figs. 5 and 6, I show a variational embodiment of the invention that is generally similar to the first described form, but differs in that it eliminates any necessity for having to maintain

the sleeve actuating spring under compression during drilling operations, or under greater compression than that existing in the spring with the clutch parts released and the sleeve in its uppermost position relative to the body. Except as to the parts specifically referred to in the following description, all other parts similar to the corresponding parts in the first described form of the invention, are given the same reference characters with primes added.

The jar illustrated in Figs. 5 to 8 may be described as comprising an upper mandrel section 45 movable longitudinally and rotatably relative to the lower mandrel section 11', and movable longitudinally within the body section 46. The body includes a lower tubular portion 47 with an upper pin end 48 threaded into an upper portion 49 having a reduced diameter bore 50 and a counterbore 51, whose diameters correspond respectively to the diameters of portions 52 and 53 of the upper mandrel section 45. Relative rotation between the upper mandrel section and the body is prevented by splines 54 on the enlarged portion 53, extending within vertical ways 55 formed in the wall of the body. In the jarring positions of the parts, the upward pull on the drill pipe is transmitted to the body by the engagement of the upper mandrel shoulder 56 with thrust washer 57 seated in the upper end of bore 51. Clutch teeth 58 and 59 provide a releasable driving connection between the upper and lower mandrel sections.

In the drilling positions of the parts shown in Fig. 5, the upper mandrel section 45 is lowered to engage the clutch teeth 58 and 59, with splines 54 engaging within ways 55, so that the body and both mandrel sections rotate together. Here it will be noted that since the clutch is engaged by relative longitudinal movement of the mandrel sections, instead of corresponding relative movement between the mandrel and body, as in the first described form, the condition of spring 43' is independent of the positions of the clutch parts. To perform the jarring operation, the clutch is released as shown in Fig. 6, and the drill pipe rotated to cause the body 46 to rotate relative to the lower mandrel section 11' (splines 54 providing the driving connection between the upper mandrel section 45 and the body) whereupon the striking sleeve 35 is actuated to deliver the jarring blows by impact against the lower end of body section 47, all in the manner previously described.

It is to be understood that the drawings are to be regarded merely as typical and illustrative of the invention in certain of its preferred forms, and that various changes and modifications may be made without departure from the invention in its intended spirit and scope.

I claim:

1. In a well jar for connecting the drill pipe with the work, a body attached to the lower end of the drill pipe, a relatively rotatable mandrel depending below said body and attached to the work, a vertically movable sleeve on the mandrel openly exposed within the well and adapted to impact upwardly against the body, and means for bringing said sleeve into impacting engagement with the body by virtue of relative rotation between the body and mandrel.

2. In a well jar for connecting the drill pipe with the work, a body attached to the lower end of the drill pipe, a relatively rotatable mandrel depending below said body and attached to the work, a vertically movable sleeve on the mandrel openly exposed within the well and adapted to impact upwardly against the body, a spring placed about the mandrel and resisting downward movement of the sleeve thereon, and means for operating said sleeve to compress the spring and then impact against the body, by virtue of relative rotation between the body and mandrel.

3. In a well jar for connecting the drill pipe with the work, a body attached to the lower end of the drill pipe, a relatively rotatable mandrel depending below said body and attached to the work, a vertically movable sleeve on the mandrel openly exposed within the well and adapted to impact upwardly against the body, means holding the sleeve against rotation on the mandrel, a spring placed about the mandrel and resisting downward movement of the sleeve thereon, and engaging cam surfaces on the upper end of the sleeve and lower end of the body whereby the sleeve is caused to repeatedly compress the spring and then impact against the body, by virtue of relative rotation between the body and mandrel.

4. In a well jar for connecting the drill pipe with the work, a body attached to the lower end of the drill pipe, a relatively rotatable and longitudinally movable mandrel depending below said body and attached to the work, a vertically movable sleeve on the mandrel openly exposed within the well and adapted to impact upwardly against the body, means for bringing said sleeve into impacting engagement with the body by virtue of relative rotation between the body and mandrel, and disengageable means for holding said body and mandrel against relative rotation.

5. In a well jar for connecting the drill pipe with the work, a body attached to the lower end of the drill pipe, a relatively rotatable and longitudinally movable mandrel depending below said body and attached to the work, a vertically movable sleeve on the mandrel openly exposed within the well and adapted to impact upwardly against the body, means holding the sleeve against rotation on the mandrel, a spring placed about the mandrel and resisting downward movement of the sleeve thereon, engaging cam surfaces on the upper end of the sleeve and lower end of the body whereby the sleeve is caused to repeatedly compress the spring and then impact against the body, by virtue of relative rotation between the body and mandrel, and disengageable means for holding said body and mandrel against relative rotation.

WALTER L. FOSTER.