

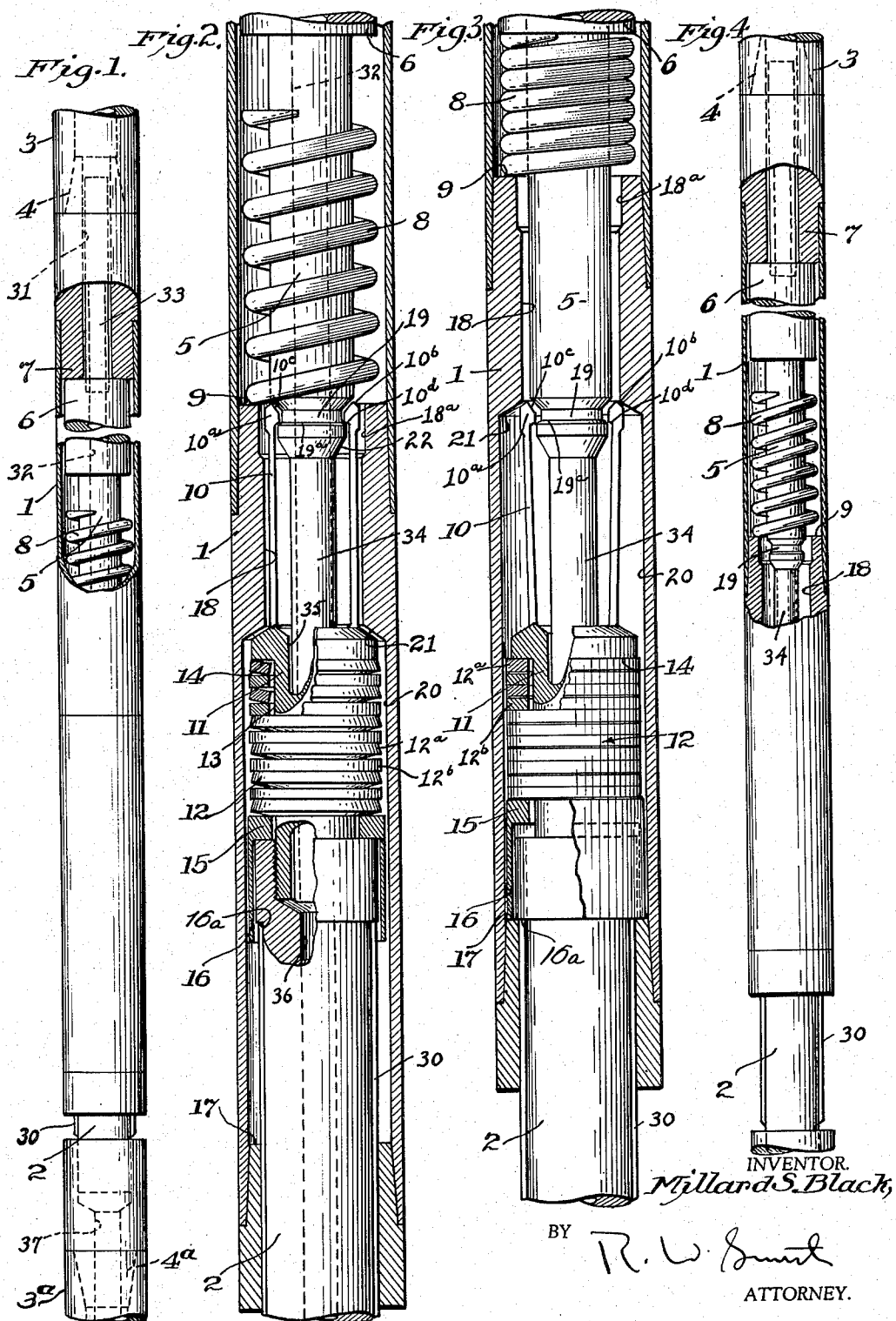
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JAR

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JAR

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This invention is a jar for releasing an element which has become stuck in a well bore; and has for its object to provide a spring actuated hammer for delivering a jarring blow.

5 It is a further object of the invention to compress the spring while the hammer is held inoperative, and to then release the hammer for operation by the compressed spring so as to deliver a jarring blow for releasing a stuck element.

10 It is a still further object of the invention to provide means whereby after actuation of the jar the hammer may be again held inoperative and the spring compressed and the hammer then released, thereby adapting the jar for delivering successive jarring blows until the stuck element has been released.

15 It is a still further object of the invention to deliver a jarring blow while the stuck element is subjected to upward tensile strain.

20 More particularly it is the object of the invention to provide a jar comprising telescopic elements adapted for incorporation in a drill string, with one of said elements forming an anvil which is adapted to be struck by a hammer which is slidable relative to the telescopic elements and which has an actuating spring, with relative expansion of the telescopic elements, when the lower portion of the drill string is stuck in a well, 30 subjecting the drill string to upward tensile strain and at the same time compressing the actuating spring while the hammer is held inoperative, and with said relative expansion of the telescopic elements finally releasing the hammer whereby 35 its compressed spring causes it to deliver a jarring blow against the anvil, and with tensile strain on the drill string maintained while the jarring blow is being struck.

40 Further objects of the invention will be readily understood from the following description of the accompanying drawing, in which:

Fig. 1 is a side elevation of the jar, partly in axial section, and incorporated in a drill string ready for the jar to be actuated in the event of 45 the lower portion of the drill string being stuck in a well bore.

Fig. 2 is an enlarged axial section through the jar, ready for actuation.

Fig. 3 is an enlarged axial section through the 50 jar, showing the actuating spring compressed and the hammer at the instant of release for operation.

Fig. 4 is a side elevation of the jar, partly in axial section, showing the hammer delivering its 55 jarring blow.

The jar comprises relatively telescopic elements 1-2 adapted for incorporation in a well string such as a string of drill pipe, the upper element 1 being shown suspended from the upper portion 3 of a drill string by a pin 4, and the lower 5 portion 3a of the drill string being shown suspended from the element 2 by a pin 4a. The telescopic elements may be fixed against relative rotation, as for example by splines 30. A mandrel 5 is slidable in the telescopic elements and terminates in a hammer 6 which is adapted to strike 10 an anvil 7 which is a fixed part of element 1. A spring 8 is positioned between the hammer 6 and an internal shoulder 9 of the element 1; and latches 10 which project upwardly from a sleeve 11 which is fixed to the element 2, are adapted to releasably engage the mandrel 5 for holding the hammer 6 inoperative.

A second spring 12 is mounted in an annular recess 13 of sleeve 11, between a shoulder 14 of the recess and a support 15 which is slidable in the recess and which has a depending extension 16, and when the elements 1-2 are relatively telescopically contracted as shown at Fig. 2, the 25 spring 12 seats the support 15 on the upper end of the element 2 with the extension 16 depending below a shoulder 16a on said element, and with a shoulder 17 of the element 1, which is adapted to engage the extension 16 and the shoulder 16a, spaced therebelow. 30

The latches 10 are spring fingers which are received in a restricted bore 18 of element 1 when the latter is telescopically contracted relative to element 2 as shown at Fig. 2, and the spring fingers normally radially contract so that their heads 35 10a seat in an annular groove 19 which is formed in the mandrel 5, for holding the hammer 6 inoperative.

The restricted bore 18 terminates in an enlarged bore 20, adapted to transversely aline with the 40 latch heads 10a when the telescopic element 1 has been expanded relative to element 2 as shown at Fig. 3, and the lower side of groove 19 preferably tapers as shown at 19a and cooperates with corresponding tapering ends 10d of the latch 45 heads 10a, so that when the latch heads transversely aline with bore 20, the force of spring 8 tending to elevate the mandrel as hereinafter described, causes the latch heads to ride outwardly on tapering surface 19a and thereby dis- 50 engage the groove 19 for releasing the hammer 6 for operative movement to strike the anvil 7. As the element 1 is subsequently telescopically contracted relative to element 2 for resetting the jar, the mandrel 5 is depressed through impingement 55

of anvil 7 against the hammer 6 until groove 19 is again transversely aligned with latch heads 10a, and at the same time the latch fingers 10 slide through the restricted bore 18 for ultimate reengagement of the latch heads with the groove 19.

A tapering shoulder 21 preferably connects the bores 18—20 and cooperates with tapering ends 10b of the latch heads for guiding the latches into the restricted bore 18 as the telescopic elements 1—2 are relatively contracted for resetting the jar; and a tapering shoulder 22 is preferably formed on the mandrel 5 just below the groove 19, and cooperates with tapering ends 10c of the latch heads, for guiding the latter into locking engagement with the groove 19 as the jar is reset.

The spring 8 is preferably a coil spring, which when telescopic elements 1—2 are relatively expanded is compressed between the shoulder 9 and the hammer 6 as shown at Fig. 3, the hammer being held against movement, as a result of the latch heads 10a engaging the groove 19; and when the bore 18 finally disengages the latch heads so that they release the mandrel 5, the compressed spring 8 drives the hammer upwardly so that it strikes a sharp jarring blow against the anvil 7 as shown at Fig. 4.

The entire well string is maintained under peak tensile strain during delivery of the jarring blow, with the spring 12 insuring stretch of the well string being taken up and the entire string being subjected to the desired tensile strain before the bore 18 disengages the latch heads 10a, and in order to provide a spring of the desired tension within the limited space which is available, the spring 12 preferably comprises a plurality of dished resilient annuli 12a, spaced from one another by flat annuli 12b. When the telescopic elements 1—2 are relatively expanded the shoulder 17 engages the extension 16 of the spring support 15 for elevating the support 15 from the element 2 and thereby compressing the spring 12 by flattening out the dished resilient annuli 12a as shown at Fig. 3, and the tension of the compressed spring arrests relative telescopic expansion of the elements 1—2, with the latch heads 10a adjacent the lower end of the bore 18 but still engaged by said bore so that the hammer 6 is still held against delivering its jarring blow, and with the shoulder 17 just about to engage but still clear of the shoulder 16a. The entire well string may thus be subjected to desired tensile strain by upward pull upon the upper portion 3 of the well string. When desired tensile strain has been obtained, the spring 12 yields slightly, permitting the bore 18 to disengage the latch heads 10a for releasing the mandrel 5 and at the same time engaging the shoulder 16a by the shoulder 17, so that the entire well string is maintained under peak tensile strain during delivery of the jarring blow by the hammer 6.

Usual circulation may be maintained through the jar and the drill string in which it is incorporated, and for this purpose the anvil 7 and pin 4 are shown provided with a bore 31 communicating with the usual circulation bore of the drill string 3, and mandrel 5 and hammer 6 have a bore 32, preferably terminating at its upper end in a wash pipe 33 which is slidable in bore 31, and preferably terminating at its lower end in a wash pipe 34 which is slidable in the bore 35 of sleeve 11. The telescopic element 2 has a bore 36 communicating with the bore 35, and at its lower end

the bore 36 opens into the bore 37 of pin 4a, which in turn communicates with the usual circulation bore of the lower portion 3a of the drill string.

In operation, assuming the jar incorporated in a drill string as shown at Figs. 1 and 2, with hammer 6 spaced from anvil 7 and held against movement relative to element 1 by means of the latches 10; and assuming that the lower portion of the drill string is stuck in the well bore.

The upper portion 3 of the drill string is elevated, thereby expanding telescopic elements 1—2 so that the shoulder 17 engages the extension 16 and elevates the support 15 for compressing the spring 12, whereupon continued upward pull on the well string tensions the entire length of the string. When the entire string has been subjected to the desired tensile strain, the spring 12 yields sufficiently to disengage the bore 18 from the latch heads 10a and at the same time engage the shoulder 16a by the shoulder 17 as shown at Fig. 3, and the latch heads 10a being thus disengaged from the groove 19 as a result of their transverse alignment with the enlarged bore 20, the compressed spring 8 drives the released mandrel 5 upwardly so that the hammer 6 strikes a jarring blow against the anvil 7 as shown at Fig. 4, with the jarring blow transmitted to the lower portion 3a of the well string through the elements 1—2, and the engagement of the shoulder 17 with the shoulder 16 maintaining the entire well string under peak tensile strain during delivery of this jarring blow.

If the stuck element is not released by the first jarring blow, the string 3 is lowered so as to return the parts to the position shown at Figs. 1 and 2, the mandrel 5 and the latches 10 being thus relatively telescoped while the latches slide through the bore 18, until the latch heads 10a ride outwardly on tapering surface 22, as is permitted by a counterbore 18a at the end of bore 18, and the latch heads then reset in groove 19 for locking the mandrel against sliding movement. The jar may then be again actuated, and the operation may be repeated until the stuck element has been jarred loose.

I claim:

1. In a jar which is adapted to have tensile strain exerted thereon, an anvil, a hammer spaced from the anvil, means for releasably holding the hammer against movement toward the anvil, a spring adapted for compression while the hammer is so held, the compressed spring being adapted to drive the released hammer against the anvil for delivering a jarring blow, a spring yieldable responsive to tensile strain on the jar for releasing the holding means, and means for maintaining the jar under tensile strain during delivery of the jarring blow.

2. 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, a second spring, means actuated by the aforementioned upward strain for maintaining deforming stress on the second spring, the second spring being yieldable responsive to the aforementioned upward strain for releasing the deforming stress on the first spring, and means for maintaining the jar under tensile strain during delivery of the jarring blow.

3. In a jar, an anvil, a hammer, a spring, means actuated by longitudinal stress exerted thereon for deforming the spring, a second spring, the second spring being yieldable responsive to said aforementioned longitudinal stress for releasing

the deforming stress on the first spring so that said first spring operates the hammer to strike the anvil a jarring blow, and means for maintaining the jar under tensile strain during delivery of the jarring blow.

4. 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, a second spring yieldable under tensile strain exerted on the jar for releasing the holding means to permit striking movement of the hammer, and means for maintaining the jar under tensile strain during delivery of the jarring blow.

5. 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, a second spring, means actuated by tensile strain exerted on the jar, for maintaining deforming stress on the second spring, the second spring being yieldable responsive to said tensile strain for releasing the holding means to permit striking movement of the hammer, and means for maintaining the jar under said tensile strain during delivery of the jarring blow.

6. In a jar adapted for incorporation in a well string, a sectional body, 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, a second spring between the sections of the body, means actuated by upward strain exerted on the well string for exerting deforming stress on the second spring, the second spring being yieldable responsive to said upward strain for releasing the holding means to permit striking movement of the hammer, and means for maintaining the sectional body under tensile strain during delivery of the jarring blow.

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, a second spring, means actuated by upward strain on the jar for exerting deforming stress on the second spring, the second spring being yieldable responsive to said deforming stress for releasing the holding means, and means for maintaining the jar under tensile strain during delivery of the jarring blow.

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